Addendum No. 1
Assessment of Corrective Measures
Landfill and Surface Impoundment

Lansing Generating Station
Lansing, Iowa

Prepared for:

Alliant Energy

SCS ENGINEERS

25220100.00 | November 25, 2020

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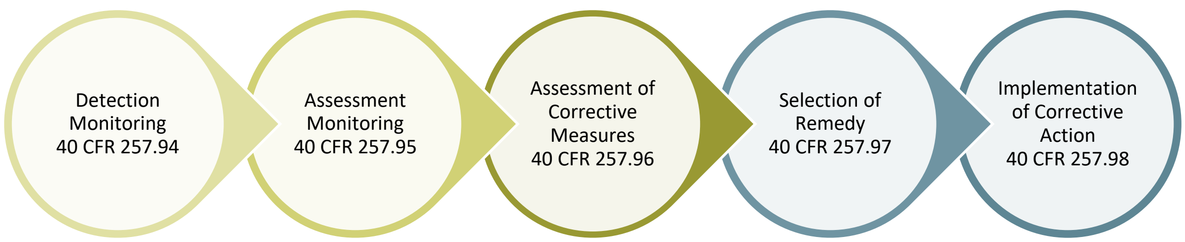
EXECUTIVE SUMMARY

Interstate Power and Light Company (IPL), an Alliant Energy company, operates a dry ash landfill and ash ponds at the Lansing Generating Station (LAN). The landfill and ponds are used to manage coal combustion residuals (CCR) and wastewater from the power plant, which burns coal to generate electricity.

IPL samples and tests the groundwater in the area of the landfill and pond to comply with U.S. Environmental Protection Agency (USEPA) standards for the Disposal of CCR from Electric Utilities, or the “CCR Rule” (Rule). Groundwater monitoring is also conducted under an Iowa Department of Natural Resources (IDNR) sanitary disposal project permit for the landfill.

Groundwater samples from one of the wells installed under the Rule to monitor the landfill and pond contain arsenic at levels higher than the Groundwater Protection Standards (GPS) defined in the Rule. Arsenic occurs naturally and can be present in coal and CCR.

IPL prepared an Assessment of Corrective Measures (ACM) Report in September 2019 in response to the groundwater sampling results obtained to comply with the Rule at the LAN facility. The ACM process is one step in a series of steps defined in the Rule and shown below.



To prepare the ACM, IPL worked to understand the following:

- Types of soil and rock deposits in the area of the LAN facility.
- Depth of groundwater.
- Direction that groundwater is moving.
- Potential sources of the arsenic in groundwater.
- The area where arsenic levels are higher than the USEPA standards.
- The people, plants, and animals that may be affected by levels of arsenic in groundwater that are above the GPS.

Because the time allowed by the Rule to prepare the ACM was limited, IPL has continued work to improve the understanding of the items listed above. Addendum No. 1 has been prepared to update the ACM for LAN based on the information now available.

IPL has identified appropriate options, or Corrective Measures, to bring the levels of arsenic in groundwater below USEPA standards. In addition to stopping landfill disposal of CCR and the discharge of CCR and LAN wastewater to the pond, these corrective measures include:

- Cap CCR in Place with Monitored Natural Attenuation (MNA)
- Consolidate CCR and Cap with MNA
- Excavate and Dispose CCR on Site with MNA

- Excavate and Dispose CCR in Off-site Landfill with MNA
- Consolidate and Cap with Chemical Amendment
- Consolidate and Cap with Groundwater Collection
- Consolidate and Cap with Barrier Wall

IPL has also included a "No Action" alternative for comparison purposes only. This alternative will not be selected as a remedy.

Addendum No. 1 includes an updated evaluation of all eight options using factors identified in the Rule.

IPL will provide semiannual updates on its progress in evaluating Corrective Measures to address the groundwater impacts at LAN.

IPL held a public meeting on October 12, 2020, to discuss the contents of the September 2019 ACM. Before a remedy is selected, IPL will hold a public meeting with interested and affected parties to discuss this addendum.

For more information on Alliant Energy, view our Corporate Responsibility Report at https://poweringwhatsnext.alliantenergy.com/crr/.

1.0 INTRODUCTION AND PURPOSE

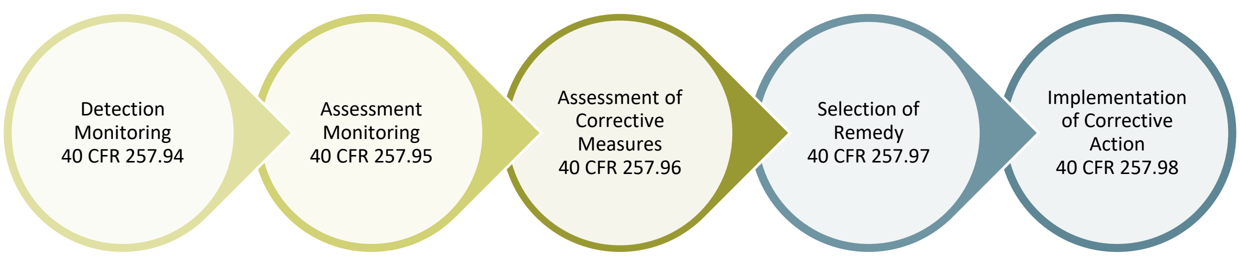
An Assessment of Corrective Measures (ACM) at the Interstate Power and Light Company (IPL) Lansing Generating Station (LAN) was prepared to comply with U.S. Environmental Protection Agency (USEPA) regulations regarding the Disposal of Coal Combustion Residuals from Electric Utilities [40 CFR 257.50-107], or the "CCR Rule" (Rule). Specifically, the ACM was initiated and this report was prepared to fulfill the requirements of 40 CFR 257.96, including:

- Prevention of further releases
- Remediation of release
- Restoration of affected areas

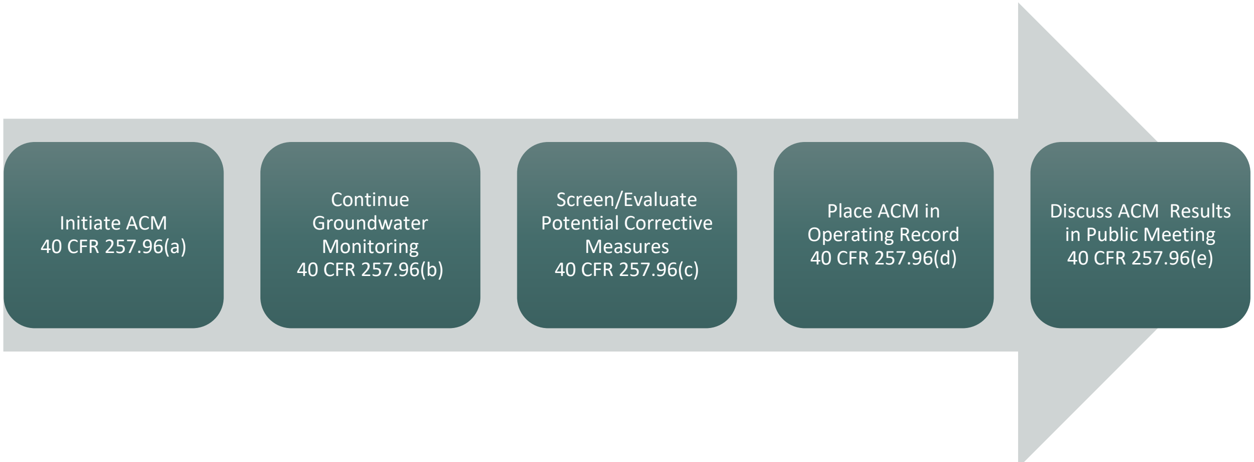
An ACM Report was issued in September 2019 to summarize the remedial alternatives for addressing the Groundwater Protection Standard (GPS) exceedances observed in the 2018 sampling events and identified in the Notification of Groundwater Protection Standard Exceedance dated February 13, 2019. The September 2019 ACM identified additional information needed to inform the selection of a corrective measure (remedy) for LAN according to 40 CFR 257.97. Since the ACM was issued, IPL has worked to obtain the needed information and prepared Addendum No. 1 to update the ACM for LAN and discuss additional remedy alternatives.

1.1 ASSESSMENT OF CORRECTIVE MEASURES PROCESS

As discussed above, Addendum No. 1 was prepared to update the ACM Report developed in response to GPS exceedances observed in groundwater samples collected at the LAN facility. The ACM process is one step in a series of steps defined in the CCR Rule and depicted in the graphic below. To date, IPL has implemented a detection monitoring program per 40 CFR 257.94 and completed assessment monitoring at LAN per 40 CFR 257.95. The September 2019 ACM was required based on the groundwater monitoring results obtained through October 2018. With the ACM completed and now updated with new information, IPL is required to select a remedy according to 40 CFR 257.97. The remedy selection process must be completed as soon as feasible, and, once selected, IPL is required to start the corrective action process within 90 days.



The process for developing the ACM is defined in 40 CFR 257.96 and is shown in the graphic below. IPL held a public meeting on October 12, 2020, to discuss the September 2019 ACM with interested and affected parties. Additional corrective measure alternatives are identified in Addendum No. 1 that were not discussed at the October 12 meeting. Since IPL is required to discuss the ACM results in a public meeting at least 30 days before selecting a remedy, a second public meeting will be held to discuss the new alternatives. To facilitate the selection of a remedy for the GPS exceedances at LAN, IPL continues to investigate and assess the nature and extent of the groundwater impacts. Information about the site, the groundwater monitoring completed, the groundwater impacts as they are currently understood, and the ongoing assessment activities are discussed in the sections that follow.



1.2 SITE INFORMATION AND MAP

LAN is located along the west bank of the Mississippi River, south of the City of Lansing, in Allamakee County, Iowa. The address of the plant is 2320 Power Plant Drive in Lansing, Iowa (**Figure 1**). The facility includes a coal-fired generating plant, a coal combustion residuals (CCR) landfill, and a CCR settling pond. The LAN was originally constructed in 1948, with additional units added in 1957 and 1976.

The groundwater monitoring system at LAN is a multi-unit system monitoring two existing CCR Units that are contiguous:

- LAN Landfill (existing landfill)
- LAN Upper Ash Pond (existing surface impoundment)

The LAN Landfill is operated under a sanitary disposal project permit (Permit #03-SDP-05-01P) administered by the Iowa Department of Natural Resources (IDNR). A separate groundwater monitoring system has been established to monitor the landfill for the state permit. The permitted landfill airspace may, at the earliest, be fully utilized by the end of 2021. Once fully utilized, the landfill will close by installing a state-permitted final cover design that meets the CCR Rule minimum design requirements in 40 CFR 257.102(d)(3).

The LAN Upper Ash Pond is operated with discharges regulated under individual National Pollutant Discharge Elimination System (NPDES) Permit Number IA0300100. The LAN Upper Ash Pond will close to comply with the requirements of 40 CFR 257.101(b)(1) and 103(a). The pond is expected to close by November 1, 2023.

A map showing the CCR Units and all background (or upgradient) and downgradient monitoring wells with identification numbers for the CCR groundwater monitoring program is provided as **Figure 2.** Monitoring wells installed for the state monitoring program for the CCR landfill are also shown on **Figure 2.**

2.0 BACKGROUND

2.1 REGIONAL GEOLOGIC INFORMATION

The uppermost geologic formation beneath LAN that meets the definition of the "uppermost aquifer," as defined under 40 CFR 257.53, is the shallow alluvial aquifer in combination with the hydraulically connected lower Cambrian-Ordovician sandstone unit (Jordan sandstone).

The uppermost bedrock unit in the site area is the Jordan aquifer, which is the lower Cambrian-Ordovician sandstone interbedded with dolostone. The thickness of the Jordan aquifer varies from 50 to more than 120 feet thick in most areas of Allamakee County. Underlying the Cambrian-Ordovician sandstone are the Cambrian confining beds comprised of dolostone, siltstone, and shale. The Cambrian confining beds overly the Dresbach Aquifer, comprised of shaly sandstone. A summary of the regional hydrogeologic stratigraphy is presented in **Appendix A**. A regional bedrock surface hydrogeologic map, hydrogeologic cross sections, and a contour map of the top of the Cambrian-Ordovician sandstone in northeastern Iowa are also included in **Appendix A.** The bedrock surface elevation is highly variable due to erosion.

The Mississippi River and associated alluvial aquifers are a major source of surface water and shallow groundwater in the area. The alluvial aquifer is up to 60 feet thick within the deeply incised valley where LAN is located, but is thin to absent on the surrounding bluffs and hilltops. The lower Cambrian-Ordovician sandstone unit (Jordan sandstone) is the shallowest regional bedrock aquifer. The October 1989 IDNR Water Atlas No. 8 states that the Jordan aquifer is commonly the source of municipal and industrial high-capacity wells in the region. A summary of the regional groundwater units is included in **Appendix A.**

A map showing the regional potentiometric surface in the Jordan sandstone is presented in **Appendix A**. This map shows the potentiometric surface near the site area as sloping to the east-northeast. The flow direction in the shallow unconsolidated aquifer at LAN is generally to the north-northwest (**Figures 3** through **5**). The flow in the Jordan sandstone immediately beneath the landfill and ponds is also likely to the north-northwest due to the influence of incoming groundwater from the bluffs flanking the valley with ultimate discharge to the Mississippi River.

2.2 SITE GEOLOGIC INFORMATION

Monitoring wells MW-301 through MW-306, and MW302A, MW-304A, and MW-306A were installed to intersect the surficial alluvium aquifer at the site. The unconsolidated material found at these well locations is generally sand and silt. The total boring depths were between 16 and 56 feet below ground surface (bgs) and bedrock was not encountered in these borings. Upgradient well MW-6 was previously installed for a state groundwater monitoring program, which is required as part of the solid waste permit for the CCR landfill. MW-6 was installed to a total depth of 93.5 feet bgs and intersects the water table, which is in the Jordan sandstone aquifer at this well location. Boring logs for MW-6 and MW-301 through MW-306A are included in **Appendix B.**

Shallow groundwater at the site generally flows to the north-northwest. The groundwater flow pattern based on water levels measured in 2019 and 2020 is shown on **Figures 3** through **5.** The deeper groundwater within the alluvium flows to the north-northeast as shown on **Figures 6** and **7.** The groundwater elevation data for the CCR rule monitoring wells and the state program monitoring wells are provided in **Table 1.**

A geologic cross-section was prepared along a line through the CCR units and in alignment with the direction of groundwater flow. The cross-section location is provided on **Figure 2** and the geologic cross-section is provided on **Figure 8**. The cross-section line runs through the landfill, the Upper Ash Pond, and the coal pile, and also shows upgradient monitoring well MW-6, several borings or monitoring wells near the landfill and pond, and downgradient assessment monitoring well nest MW-306/306A. Sandstone bedrock, unconsolidated geologic material, and estimated water table levels are identified on the cross section.

2.3 CCR RULE MONITORING SYSTEM

The original groundwater monitoring system established in accordance with the CCR Rule consists of one upgradient (background) monitoring well and three downgradient (compliance) monitoring wells. The background monitoring well is MW-6. The three initial downgradient monitoring wells are MW-301, MW-302, and MW-303, which were installed in November 2015. Three additional downgradient monitoring wells, MW-304, MW-305, and MW-306, were installed in May 2019, and three deeper piezometers MW-302A, MW-304A, and MW-306A were installed in December 2019 in accordance with the requirements of 40 CFR 257.95(g)(1). The CCR Rule wells were installed in the upper portion of the uppermost aquifer at LAN. Well depths range from approximately 14.5 to 91 feet bgs.

3.0 NATURE AND EXTENT OF GROUNDWATER IMPACTS

3.1 POTENTIAL SOURCES

The potential sources of groundwater impacts are currently under evaluation. Based on a review of existing site documents, potential sources of groundwater impacts from the monitored CCR units include the following:

CCR Unit	Potential Sources	Description	Quantity
Landfill	CCR	Bottom ash, economizer ash, fly ash, dry flue gas desulfurization (FGD) byproduct, and pyrites	485,000 CY (permitted maximum volume)
Upper Ash Pond	CCR	Bottom ash, economizer ash, and fly ash	490,000 CY
	Low volume waste waters from plant	Includes Unit 4 hydroveyor water, air heater washes, RO reject water, demineralizer regeneration wastewater, and Unit 4 boiler sump discharge	4.83 million gallons per day (MGD)
	Storm water	Annual precipitation, runoff from landfill and surrounding areas	99 AC-FT (Watershed of 87 acres)

Note: Storm water volume is calculated based on the watershed area for the pond (17 acres) and landfill and surrounding areas (70 acres), and the annual average precipitation for Lansing, Iowa, of 35 inches per year. Runoff from the landfill and surrounding areas (8.5 inches) is estimated using **Figure 1**. Average Annual Runoff, 1951-1980 from USGS publication Average Annual Runoff in the United States, 1951-1980 (Gebert, 1987).

Estimated CCR quantities have been updated with preliminary estimates developed following a recent geotechnical field investigation of the CCR materials in the Upper Ash Pond conducted in June 2020. The volume estimate was prepared using data from soil borings installed in and around the CCR surface impoundments in September 2014, May 2015, and June 2020. IPL initiated the June 2020 fieldwork to investigate the quantity and properties of the CCR present in the open areas of the Upper Ash Pond for the purpose of supporting the selection, design, and construction of the Upper Ash Pond closure. Previous geotechnical drilling in the area of the impoundment identified a very high water content CCR material with very little residual shear strength after disturbance. The latest geotechnical investigation effort helped identify the nature and extent of this CCR.

The volume of CCR in contact with groundwater will need to be considered as the remedy selection process is completed. Groundwater elevation data provided in **Table 1** and information available in the operating record for the Upper Ash Pond including the September 2016 History of Construction report (HHS, 2016) and periodic inspection reports such as the December 2019 CCR Surface Impoundment Annual Inspection Report (HHS, 2019) show that some portion of the CCR in the Upper Ash Pond is likely to be in contact with groundwater at times. This is also depicted on the cross section provided as **Figure 8**.

The high water table depicted on the cross section also shows that CCR in the LAN Landfill may also be in contact with groundwater. This condition was investigated in 2015 when a boring was installed through the CCR in an effort to install a potential monitoring point within the waste limits. The water table was not encountered in this boring and a well was not installed (SCS, 2015). The water table depicted on **Figure 8** is based on groundwater elevations measured at wells located on either side of the landfill and likely does not represent the conditions within the landfill based on the findings of the 2015 boring.

3.2 GROUNDWATER ASSESSMENT

3.2.1 Groundwater Depth and Flow Direction

Depth to groundwater as measured in the site CCR monitoring wells varies from 4 to 75 feet bgs due to topographic variations across the facility. Groundwater flow at the site is generally to the north-northwest. The flow in the Jordan sandstone immediately beneath the landfill and ponds is also likely to the north-northwest due to the influence of incoming groundwater from the bluffs flanking the valley with ultimate discharge to the Mississippi River.

3.2.2 Groundwater Protection Standard Exceedances Identified

The ACM process was triggered by the detection of arsenic at statistically significant levels exceeding the GPS in samples from MW-302.

This statistical evaluation of the assessment monitoring results was based on the first three sampling events for the Appendix IV assessment monitoring parameters, including sampling events in April, August, and October 2018. The complete results for these sampling events are summarized in **Table 3.**

GPS exceedances for arsenic at MW-302 have continued to be identified in monitoring since the initiation of the ACM. Arsenic has not been detected at statistically significant levels above the GPS in any other wells. Therefore, the ACM and Addendum No. 1 address the following GPS exceedance:

Assessment Monitoring Appendix IV Parameters	Location of GPS Exceedance(s)	Historic Range of Detections at Wells With SSL Above GPS	Groundwater Protection Standard (GPS)
Arsenic (µg/L)	MW-302	30.8 to 53	10

µg/L = micrograms per liter
Note: Historic range includes results from assessment monitoring from April 2018 through October 2020.

3.2.3 Expanding the Groundwater Monitoring Network

Monitoring wells MW-304, MW-305, and MW-306 were installed in May 2019 downgradient of the CCR units to expand the groundwater monitoring network at LAN beyond the edge of the CCR unit boundaries and to fulfill the requirements of 40 CFR 257.95(g)(1), which requires additional characterization to support a complete and accurate assessment of corrective measures. Three deeper piezometers MW-302A, MW-304A, and MW-306A were installed in December 2019, also in accordance with the requirements of 40 CFR 257.95(g)(1). Groundwater samples were collected following installation of the new monitoring wells.

The initial sampling results from MW-302A, MW-304/304A, MW-305, and MW-306/306A, shown in **Table 3**, indicate that there was not a statistically significant exceedance of arsenic in any of these wells. The extent of GPS exceedances may be limited to the immediate vicinity of the landfill and impoundment if future sampling results confirm there are no GPS exceedances in wells other than MW-302.

3.2.4 State Monitoring Program Arsenic Results

Arsenic is included in the parameter list for the state monitoring program for the CCR landfill. Monitoring results from the state program, provided in **Table 4**, provide additional information on the nature and extent of arsenic concentrations at the site.

Arsenic GPS exceedances in the state program results are limited to two monitoring well locations (MW-11/11R and MW12). The arsenic levels at these two locations adjacent to the landfill are lower than the concentrations in downgradient CCR well MW-302. Per IDNR requirements, metals sampling was changed from filtered to unfiltered in 2016. Arsenic concentrations appear to be stable since that time. Metals like arsenic tend to adsorb to suspended solids that can be introduced into the sample during collection, which are not removed from unfiltered samples. Arsenic results from other wells in the vicinity of or downgradient from these two wells (including MW-12P, MW-14, TW-17, TW-18, TW-19, and MW-20) were below the GPS defining the horizontal and vertical extent of arsenic impacts in this area.

Groundwater assessments were performed in accordance with the state monitoring program during 2013 and 2014 to evaluate the elevated arsenic concentrations. The assessment reports concluded that elevated arsenic concentrations were due in part to localized geochemical conditions in the immediate vicinity of the landfill. IDNR required no further investigation of the arsenic concentrations.

3.2.5 MNA Data Collection and Evaluation

An evaluation of the potential for LAN to utilize monitored natural attenuation (MNA) as a corrective action alternative began with the initiation of an ACM at LAN. The tiered analysis approach in the USEPA guidance, "Monitored Natural Attenuation of Inorganic Contaminants in Groundwater, Volume 1 – Technical Basis for Assessment" (USEPA, 2007), is being used as a guide for evaluating MNA as a potential corrective action alternative at LAN.

There are four tiers of analysis to be addressed in evaluating the site for MNA:

1. Demonstrate active contaminant removal from groundwater
2. Determine mechanism and rate of attenuation
3. Determine system capacity and stability of attenuation
4. Design a performance monitoring program and identify an alternative remedy

Data collection activities during the assessment monitoring and ACM process that begins to address the objectives of tiers 1 and 2 include:

- Installation of downgradient assessment wells MW-304, MW-305 and MW-306 and deeper downgradient piezometers MW-302A, MW-304A, and MW306A to evaluate groundwater flow direction and horizontal and vertical hydraulic gradients.

- Additional groundwater sampling events and analysis of data from all site wells to evaluate contaminant distribution in groundwater and stability of groundwater concentrations over time.

- Analysis of general groundwater chemistry and field parameters in addition to the App III and IV constituents to provide further characterization of groundwater chemistry.

- Analysis of both total and dissolved constituents for selected parameters.

A hydrogeochemical conceptual model and summary of preliminary evaluation of arsenic attenuation in the aquifer at LAN is included in **Appendix C**. Preliminary findings include:

- One of the seven monitoring wells on the downgradient perimeter of the Lansing Generating Station Ash Pond (MW-302) consistently exceeds the arsenic GPS of 10 µg/L.

- One well (MW-304A) consistently exceeded the molybdenum groundwater protection standard of 100 µg/L. However, this well appears to sample groundwater that cannot be affected by potential releases from the Upper Ash Pond and additional evaluations are ongoing to identify the alternative source.

- Immediate downgradient of MW-302 is Unnamed Creek 2 (see **Figure 2**) that receives the discharge from LAN's NPDES Permit Outfall 001with a water elevation of ~621 feet. MW-305 and MW-1 to the north of the ditch had water levels of 627.24 and 629.38 feet. This shows that the Unnamed Creek 2 is a gaining stream and that Unnamed Creek 2 is likely a drainage divide, with shallow groundwater from beneath the Coal Pile flowing to the southwest toward the Unnamed Creek 2 and to the northwest to MW-306. The hydraulic head at MW-302A is 623.19 feet indicating that groundwater is likely flowing upward toward Unnamed Creek 2 from depths on the order of 50 feet bgs.

- MW-304 and -304A are separated from the Upper Ash Pond and the other monitoring wells by an unnamed creek that flows along the southwest side of the Upper Ash Pond. The vertical gradient at this well cluster is upwards, suggesting that the creek may be a divide.

- The pH and redox are the master variables that significantly control the chemistry and environmental fate of arsenic. The groundwater is near neutral in pH with most wells reflecting high ORP oxic conditions.

- Soil colors (see boring logs in **Appendix B**) suggest reducing conditions and the potential for organic carbon to drive the low ORP reducing conditions. The concentrations of dissolved iron and manganese are negatively correlated with ORP as anoxic conditions favor the dissolution of iron and manganese oxyhydroxides.

- Arsenic is not present in background groundwater and there is no correlation with ORP or DO. When arsenic is present, the concentration increases as the groundwater becomes more reducing. This could be due to the reduction of arsenate (As5+) to arsenite (As3+), or due to the dissolution of iron oxyhydroxides that may release absorbed arsenic

- As the anoxic groundwater with dissolved iron and arsenic moves toward a more aerobic environment, it will be exposed to the atmosphere and the dissolved oxygen content and ORP will increase. This will result in the precipitation of iron oxyhydroxides, which will remove arsenic from solution by adsorption.

- Given the uncertainties in groundwater-surface interactions it is not feasible to estimate the mass of arsenic dissolved in the groundwater until additional data is collected.

A preliminary evaluation of whether the arsenic plume is stable, growing, or decreasing has been completed using a Mann-Kendall trend test. The results of the trend test are provided in **Appendix D.** No statistically significant increasing or decreasing trends were identified in the results obtained since assessment monitoring was initiated. Additional groundwater sampling rounds that include the deep piezometers are required before a complete evaluation is possible.

Based on the investigations completed to date, Arsenic GPS exceedances are limited to the area around monitoring well MW-302 and the elevated concentrations of arsenic appear to be the result of localized reducing conditions. Natural attenuation of arsenic may be a viable alternative for site remediation. Additional investigation is warranted to further characterize the specific natural attenuation processes within the aquifer and to provide the basis for a long-term corrective action monitoring program. Recommendations for additional investigation are provided below:

- The hydrogeological and geochemical conceptual models need to be better defined at a very small scale to better understand the potential arsenic migration pathways. The following are recommendations that will provide the necessary data:

  - Installation of surveyed staff gages:
    - in the Upper and Lower Ash Pond,
    - in Unnamed Creek 2 downstream of Outfall 001 near MW-302, -305 and MW-1, and
    - in Unnamed Creek 1 southwest of the site near MW-304, MW-14 and north of the railroad bridge.

– Installation of an additional water table monitoring well(s) between the coal pile and Unnamed Creek 2 could help in confirming if groundwater is flowing from the coal pile area toward the creek.

– Concurrent seasonal measurements of groundwater and surface water levels to determine discharge relationships.

– Surface water at the suggested staff gage locations should also be sampled concurrently with groundwater for analyses of field parameters; filtered and total major cations, arsenic, iron and manganese; and major anions to assess geochemical changes that may result as groundwater moves from an anaerobic to an aerobic environment.

– Continue to include the measurement of oxidation-reduction potential with groundwater field analyses.

3.3 CONCEPTUAL SITE MODEL

The following conceptual site model describes the arsenic levels above the GPS, discusses potential exposure pathways affecting human health and the environment, and presents a cursory review of the potential impacts. The conceptual site model for LAN has been prepared in general conformance with the Standard Guide for Developing Conceptual Site Models for Contaminated Sites (ASTM E1689-95). This conceptual site model is the basis for assessing the efficacy of likely corrective measures to address the source, release mechanisms, and exposure routes.

3.3.1 Nature of Constituent above GPS

The nature of the constituents in groundwater at LAN that are present at concentrations greater than the GPS (arsenic) were described in the September 2019 ACM. No additional constituents have been identified at statistically significant levels above a GPS. Molybdenum has been detected above a GPS at MW-304A, and is subject to ongoing evaluation. Please refer to the detailed discussion of arsenic previously provided in Section 3.3.1 of the 2019 ACM.

3.3.2 Potential Receptors and Pathways

As described in **Section 3.3**, ASTM E1689-95 provides a framework for identifying potential receptors (people or other organisms potentially affected by the groundwater impacts at LAN) and pathways (the ways groundwater impacts might reach receptors). In accordance with ASTM E1689-95, we have considered both potential human and ecological exposures to groundwater impacted by arsenic, as identified in **Section 3.2.2**.

Human Health

In general, human health exposure routes to contaminants in the environment include ingestion, inhalation, and dermal contact with the following environmental media:

- Groundwater
- Surface Water and Sediments
- Air
- Soil
- Biota/Food

If people might be exposed to the impacts described in **Section 3.0** via one of the environmental media listed above, a potential exposure route exists and is evaluated further. For the groundwater impacts at LAN, the following potential exposure pathways have been identified with respect to human health:

- **Groundwater – Ingestion and Dermal Contact.** The potential for ingestion of, or dermal contact with, impacted groundwater from LAN exists if water supply wells are present in the area of impacted groundwater and are used as a potable water supply. Based on a review of the IDNR GeoSam well database. and information provided by LAN:
  - No off-site water supply wells have been identified downgradient of the CCR Units.
  - A private supply well located across County Highway X52 from the landfill was sampled by Allamakee County in 2014 at the homeowner's request, and the sample was analyzed for arsenic. Arsenic was not detected in the sample. The Allamakee County Sanitarian stated that the well was 400 feet deep and under artesian pressure.
  - Two on-site water supply wells, Well #2 and Well #4, are currently used as sources of potable water.
    - Well #2 is 235 feet deep and is cased to 78 feet. Well #4 is 240 feet deep and is cased to 143 feet. Both wells are open to the sandstone aquifer.
    - The water supply operation permit for these wells (IDNR public water supply ID 0345181) requires sampling for inorganic constituents every 9 years. Arsenic was not detected in the most recent samples, collected on April 21, 2014.
- **Surface Water and Sediments – Ingestion and Dermal Contact.** The potential for ingestion of or dermal contact with impacted surface water and sediments exists if impacted groundwater from the LAN facility has interacted with adjacent surface water and sediments, to the extent that arsenic is present in these media at concentrations that represents a risk to human health.
- **Biota/Food – Ingestion.** The potential for ingestion of impacted food exists if impacted groundwater from the facility has interacted with elements of the human food chain. Based on discussions with facility staff, no hunting or farming occurs within the current area of known groundwater impacts. Elements of the food chain may also be exposed indirectly through groundwater-to-surface water interactions, which are subject to additional assessment.

Based on the lack of groundwater exposure, only the surface water, sediment, and biota/food exposure pathways were retained for further consideration in the September 2019 ACM. However, the implementation of potential corrective measures may introduce secondary exposure pathways that are discussed in **Section 6.0** and will be evaluated further as a corrective measure is selected for LAN.

Ecological Health

In addition to human exposures to impacted groundwater, potential ecological exposures are also considered. If ecological receptors might be exposed to impacted groundwater, the potential exposure routes are evaluated further. Ecological receptors include living organisms, other than humans, the habitat supporting those organisms, or natural resources potentially adversely affected by CCR impacts. This includes:

- Transfer from an environmental media to animal and plant life. This can occur by bioaccumulation, bioconcentration, and biomagnification:
  - Bioaccumulation is the general term describing a process by which chemicals are taken up by a plant or animal either directly from exposure to impacted media (soil, sediment, water) or by eating food containing the chemical.
  - Bioconcentration is a process in which chemicals are absorbed by an animal or plant to levels higher than the surrounding environment.
  - Biomagnification is a process in which chemical levels in plants or animals increase from transfer through the food web (e.g., predators have greater concentrations of a particular chemical than their prey).
- Benthic invertebrates within adjacent waters.

Based on the information available and presented in September 2019 ACM, both of the ecological exposure routes required additional evaluation at the time.

Since the September 2019 ACM was completed, exposure pathways subject to groundwater to surface water interactions have been evaluated further through the following:

- Review of state surface water standards for arsenic.
- Review of application materials and studies conducted by IPL for the renewal of the NPDES permit for LAN.
- Developing a hydrogeochemical conceptual model and a preliminary evaluation of arsenic attenuation (see **Section 3.2.5**).

Based on our evaluation to date, the arsenic impacts to groundwater at LAN are unlikely to impact the river. This preliminary conclusion is based on the following:

- Surface water standards identified in our review are higher than the GPS for arsenic (see 567 Iowa Administrative Code Chapter 61 Water Quality Standards).
- Groundwater near the surface water interface is likely to transition from anaerobic to aerobic, which is expected to precipitate iron oxyhydroxides removing arsenic from solution by adsorption.
- Mussel communities in the channel adjacent to MW-302 and the Mississippi River we observed in support of the NPDES Permit renewal for LAN. Mussels, one of the most sensitive animal groups, present at the likely point of groundwater to surface water interaction showed mussel populations that were "characterized as balanced and indigenous," which is not indicative of chronic or acute impacts (Alliant, 2020).

Although an initial assessment indicates that arsenic in groundwater at LAN is unlikely having a negative impact on the Mississippi River or people and biota utilizing the river, the groundwater-to-surface-water interactions at LAN are the subject of ongoing assessment.

The surface water/sediment, biota/food, and ecological exposure assessment is incomplete as the extent of groundwater impacts is still being evaluated. If groundwater impacts extend to the river, then these exposure pathways will be evaluated further. Evaluation of constituent concentrations in sediment and surface water may be estimated through calculations and/or additional sampling.

4.0 POTENTIAL CORRECTIVE MEASURES

In this section, we identify potential corrective measures to meet the ACM goals identified in 40 CFR 257.96(a), which are to:

- Prevent further releases
- Remediate releases
- Restore affected areas to original conditions

The development of corrective measure alternatives is described further in the following sections. Corrective measure alternatives developed to address the groundwater impacts at LAN are described in **Section 5.0**. The alternatives selected are qualitatively evaluated in **Section 6.0**.

As required under 40 CFR 257.96(c), the following sections provide an analysis of the effectiveness of potential corrective measures. This evaluation includes the requirements and objectives identified in 40 CFR 257.97, which includes:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;

- The time required to begin and complete the remedy; and

- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

4.1 IDENTIFICATION OF CORRECTIVE MEASURES

As described in the USEPA Solid Waste Disposal Facility Criteria Technical Manual (USEPA, 1998), corrective measures generally include up to three components, including:

- Source Control
- Containment
- Restoration

Within each component, there are alternative measures that may be used to accomplish the component objectives. The measures from one or more components are then combined to form corrective measure alternatives (discussed in **Section 5.0**) intended to address the observed groundwater impacts. Potential corrective measures were identified based on site information available during development of the ACM for the purpose of meeting the goals described in **Section 4.0**.

Each component and associated corrective measures are further identified in subsequent paragraphs. The corrective measures are evaluated for feasibility and combined to create the corrective action alternatives identified in this section, and further evaluated in **Section 5.0**. We continue to evaluate site conditions and may identify additional corrective measures based on new information regarding the nature and extent of the impacts.

4.1.1 Source Control

The source control component of a corrective measure is intended to identify and locate the source of impacts and provide a mechanism to prevent further releases from the source. For this site, the sources to be controlled are the CCR materials in the landfill and impoundment, along with plant process water. Each of the source control measures below require closure of the landfill and impoundment, and for waste water to be re-directed from the CCR units to eliminate the flows that may mobilize constituents from the CCR and transport them to groundwater. We have identified the following potential source control measures:

- **Cap in place.** Cap the CCR in uncovered areas of the existing landfill and the CCR surface impoundment in place to reduce the infiltration of rain water into the impoundments, and prevent transport of CCR constituents from unsaturated CCR materials into the groundwater and reduce the potential for CCR to interface with groundwater. The landfill closure will be conducted according to the disposal permit issued by the IDNR.

- **Consolidate and cap.** Consolidate CCR from the surface impoundment into a smaller area adjacent to the landfill to reduce the cap area exposed to infiltration and reduce the potential source footprint. Install a cap over uncovered areas of the existing landfill, and the consolidated CCR from the surface impoundment to prevent transport of CCR constituents from unsaturated CCR materials into the groundwater and minimize the potential for CCR to interface with groundwater. The landfill closure will be conducted according to the disposal permit issued by the IDNR.

- **Consolidate and cap with chemical stabilization.** Consolidate CCR from the surface impoundment into a smaller area adjacent to the landfill to reduce the cap area exposed to infiltration, reduce the potential source footprint, prevent transport of CCR constituents from unsaturated CCR materials into the groundwater, and minimize the potential for CCR to interface with groundwater. Mix a chemical amendment into CCR in-situ prior to placing additional CCR for consolidation and mix the amendment into CCR as it is excavated and placed for consolidation to reduce the mobility of select CCR constituents in the environment. Chemical stabilization may include the use of one or multiple admixtures that serve to physically and/or chemically stabilize the constituents of concern within the CCR. Physically, this may include solidification with cementitious or polymeric materials. Chemically, this may include precipitation or alteration to render arsenic less mobile in the environment. Evaluation of an appropriate commodity amendment, that may include Calcium Polysulfide, Portland Cement, Calcium Oxide, and/or proprietary chemicals such as FerroBlack-H, MAECTITE, 3Dme, and/or MRC, will occur during the remedy selection process.

- **Excavate CCR and create on-site disposal area.** Excavate CCR from the landfill and surface impoundment and place CCR in a new lined disposal area on site to prevent further releases from the CCR and isolate the CCR from potential groundwater interactions. Cap the new disposal area with final cover to prevent the transport of CCR constituents from unsaturated CCR.

- **Excavate impounded CCR and dispose at a licensed off-site disposal area.** Remove all CCR from the site and haul to a licensed landfill to prevent further releases from the CCR areas.

Water movement through the CCR materials is the mechanism for CCR impacts to groundwater. Surface water can move vertically through the CCR materials via infiltration of rainwater and surface water runoff. Groundwater can move horizontally through the CCR material in areas where CCR material is at an elevation that is below the water table. Source control measures have been considered to prevent "vertical" migration of water through the CCR via cap and cover systems and potential contact with groundwater.

Based on the available information for this site, all the source control measures have potential to prevent further releases, thus are retained for incorporation into alternatives for further evaluation.

In conjunction with the ongoing evaluation of MNA mechanisms and site attenuation capacity, chemical stabilization has been added as a source control alternative. Additional source control may be needed to address CCR that could be in contact with groundwater after closure in place, or if MNA mechanisms are not active at LAN or the site does not have the attenuation capacity to reduce groundwater concentrations of arsenic below the GPS.

4.1.2 Containment

The objective of containment is to limit the spread of the groundwater impacts beyond the source. The need for containment depends on the nature and extent of impacts, exposure pathways, and risks to receptors. Containment may also be implemented in combination with restoration as described in **Section 4.1.3**. Containment may be a recommended element of a corrective measure if needed to:

- Prevent off-site migration of groundwater impacts
- Cease completion of an exposure pathway (e.g., water supply well).

Containment may also be used in lieu of active restoration if an active approach is needed but treatment is not warranted by the aquifer characteristics including:

- Water in the affected aquifer is naturally unsuited for human consumption
- Contaminants present in low concentration with low mobility
- Low potential for exposure to contaminants and low risk associated with exposure
- Low transmissivity and low future user demand

The following measures have potential to limit the spread of the existing groundwater impacts:

- **Gradient Control with Pumping.** Gradient control includes a measure to alter the groundwater velocity and direction to slow or isolate impacts. This can be accomplished with pumping wells and/or a trench/sump collection system. If groundwater pumping is considered for capturing an impacted groundwater plume, the impacted groundwater must be managed in conformance with all applicable Federal and State requirements.

- **Gradient Control with Phytotechnology.** Gradient control with phytotechnology relies on the ability of vegetation to evapotranspire sources of surface water and groundwater. Water interception capacity by the aboveground canopy and subsequent evapotranspiration through the root system can limit vertical migration of water from the surface downward. The horizontal migration of groundwater can be controlled or contained using deep-rooted species, such as prairie plants and trees, to intercept, take up, and transpire the water. Trees classified as phreatophytes are deep-rooted, high-transpiring, water-loving organisms that send their roots into regions of high moisture and can survive in conditions of temporary saturation.

- **Chemical Stabilization.** Stabilization refers to processes that involve chemical reactions that reduce the leachability of arsenic. Stabilization chemically immobilizes impacts or reduces their solubility through a chemical reaction. The desired results of stabilization methods include converting metals into a less soluble, mobile, or toxic form.

- **Containment Walls.** Containment walls can be applied in two ways. First, a wall that creates a physical barrier to the flow of groundwater to limit the movement of constituents of concern in groundwater. Second, a passive barrier installed to intercept the flow of groundwater and constructed with a reactive media designed to adsorb, precipitate, or degrade groundwater constituents to limit their movement in the environment (FRTR, 2020).

Based on the currently available information for this site an active MNA mechanism has been identified at LAN, but requires additional assessment. The site capacity to attenuate the arsenic impacts to groundwater is also ongoing. Thus, active containment may be required for this site due to the potential for CCR to remain in contact with groundwater following closure in place.

4.1.3 Restoration

Restoration is the process through which groundwater quality is restored to meet GPSs. This can be accomplished by way of Monitored Natural Attention (MNA) or intensively addressed by groundwater treatment with or without extraction.

MNA can be a viable remedy or component of a remedial alternative for groundwater impacted with metals. MNA requires ongoing involvement and potentially intense characterization of the geochemical environment to understand the attenuation processes involved, and to justify reliance on them and regular, long-term monitoring to ensure the attenuation processes are meeting remedial goals.

MNA is not a “do-nothing” alternative; rather it is an effective knowledge-based remedy where a thorough engineering analysis provides the basis for understanding, monitoring, predicting, and documenting natural processes. To properly employ this remedy, there needs to be a strong scientific basis supported by appropriate research and site-specific monitoring implemented in accordance with quality controls. The compelling evidence needed to support proper evaluation of the remedy requires that the processes that lower metal concentrations in groundwater be well understood.

If active treatment is implemented, water may be treated in situ, on site, or off site. The need for active treatment depends on the nature and extent of impacts, potential exposure pathways, and current and anticipated future risks to receptors. If there are no receptors or if the risks are acceptably low, then MNA is an appropriate option. If existing or future risks require a more rapid restoration of groundwater quality, then active restoration may be needed.

Treated groundwater may be re-injected, sent to a local publicly owned treatment works (POTW), or discharged to a local body of surface water, depending on local, State, and Federal requirements. Typical on-site treatment practices for metals include coagulation and precipitation, ion exchange, or reverse osmosis. Off-site wastewater treatment may include sending the impacted groundwater that is extracted to a local POTW or to a facility designed to treat the contaminants of concern.

The removal rate of groundwater constituents such as arsenic will depend on the rate of groundwater extraction, the cation exchange capacity of the soil, and partition coefficients of the constituents sorbed to the soil. As the concentration of metals in groundwater is reduced, the rate at which constituents become partitioned from the soil to the aqueous phase may also be reduced. The amount of flushing of the aquifer material required to remove the metals and reduce their concentration in groundwater below the GPS will generally determine the time frame required for restoration. This time frame is site-specific.

In-situ methods may be appropriate, particularly where pump and treat technologies may present adverse effects. In-situ methods may include the introduction of a chemical amendment to adsorb, precipitate, or degrade a contaminant or biological restoration requiring pH control, addition of specific micro-organisms, and/or addition of nutrients and substrate to augment and encourage degradation by indigenous microbial populations. Bioremediation requires laboratory treatability studies and pilot field studies to determine the feasibility and the reliability of full-scale treatment.

Based on current available information, an active MNA mechanism at LAN has been identified, but is still being evaluated along with the capacity of the site to attenuate the arsenic impacts to groundwater. Other restoration measures have been included in this addendum to increase the breadth of alternatives evaluated and available for consideration during the remedy selection process. These additional alternatives are discussed in **Section 5.0**.

5.0 CORRECTIVE MEASURE ALTERNATIVES

We have preliminarily identified the following corrective measure alternatives for the groundwater impacts at LAN:

- Alternative 1 – No Action
- Alternative 2 – Close and Cap in Place with MNA
- Alternative 3 – Consolidate and Cap with MNA
- Alternative 4 – Excavate CCR and Dispose On Site with MNA
- Alternative 5 – Excavate CCR and Dispose Off Site with MNA
- Alternative 6 – Consolidate and Cap with Chemical Amendment
- Alternative 7 – Consolidate and Cap with Groundwater Collection
- Alternative 8 – Consolidate and Cap with Barrier Wall

These alternatives were developed by selecting components from the reasonable and appropriate corrective measures components discussed above. Capping areas of the landfill that are currently open is included with all potential source control measures. With the exception of the No Action alternative, each of the corrective measure alternatives meet the requirements in 40 CFR 257.97(b)(1) through (5) based on the information available at the current time. We may identify additional alternatives based on the continued evaluation of site conditions.

5.1 ALTERNATIVE 1 – NO ACTION

IPL is committed to implementing corrective measures as required under the Rule, and the No-Action alternative is only included as a baseline condition and a point of comparison for the other alternatives. The consideration of this alternative assumes the monitoring of groundwater continues under this action.

5.2 ALTERNATIVE 2 – CLOSE AND CAP IN PLACE WITH MNA

Alternative 2 includes closing the landfill in accordance with the CCR Rule and existing State of Iowa sanitary disposal project permit and closing the CCR impoundment with no further discharge. CCR materials will be capped and vegetation established on the final cover in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. The capped areas will be subject to enhanced groundwater monitoring via MNA.

This alternative eliminates CCR sluicing/plant process water discharges and, with the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

5.3 ALTERNATIVE 3 – CONSOLIDATE AND CAP WITH MNA

Alternative 3 includes closing the landfill in accordance with the CCR Rule and existing State of Iowa sanitary disposal project permit, and closing the CCR impoundment (no further discharge). The impounded CCR will be closed by relocating a portion of the impounded CCR and consolidating it into a smaller footprint within the CCR surface impoundment and/or landfill. The impounded CCR materials and currently open areas of the landfill will be capped in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. The capped areas will be subject to enhanced groundwater monitoring via MNA.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Consolidation of CCR into a smaller footprint during closure also reduces the volume of potential source materials that may be in contact with groundwater after closure. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

5.4 ALTERNATIVE 4 – EXCAVATE CCR AND DISPOSE ON SITE WITH MNA

Alternative 4 includes closing the landfill and impoundment (no further disposal or discharge), excavation of CCR from the landfill and surface impoundment, and creation of a new on-site disposal area with a liner and cap system. This alternative will serve to entomb the CCR at the site and allow for the collection and management of liquids generated from the new disposal area. Further releases from the CCR will be prevented by the use of engineering controls constructed/installed to meet the design criteria for new CCR landfills required under 40 CFR 257.70. The capped areas will be subject to enhanced groundwater monitoring via MNA.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a new on-site disposal area liner and cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

If the ongoing assessment of potential sources discussed in **Section 3.1** eliminates either the landfill or surface impoundment as the source of the arsenic impacts, Alternative 4 may be refined to focus on the remaining source. For example, if the landfill can be eliminated as a source of arsenic in groundwater through further evaluation, the landfill may be closed according to the disposal permit issued by the IDNR as described under Alternatives 2 and 3.

5.5 ALTERNATIVE 5 – EXCAVATE CCR AND DISPOSE OFF SITE WITH MNA

Alternative 5 includes closing the landfill and impoundment (no further disposal or discharge), excavation of all CCR, and transport to an approved off-site landfill. Further on site releases from the CCR sources will be prevented by relocating the source material to another site, which eliminates the potential for ongoing leaching of constituents in impounded CCR into groundwater at LAN.

This alternative eliminates CCR sluicing/plant process water discharges and, with the removal of CCR from the site, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. MNA is included with this alternative to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

If the ongoing assessment of potential sources discussed in **Section 3.1** eliminates either the landfill or surface impoundment as the source of the arsenic impacts, Alternative 5 may be refined to focus on the remaining source. For example, if the landfill can be eliminated as a source of arsenic in groundwater through further evaluation, the landfill may be closed according to the disposal permit issued by the IDNR as described under Alternatives 2 and 3.

5.6 ALTERNATIVE 6 – CONSOLIDATE AND CAP WITH CHEMICAL AMENDMENT

Alternative 6 includes closing the landfill and impoundment (no further discharge), adding a chemical amendment to in-place CCR and relocated CCR to reduce the mobilization of arsenic prior to relocating and consolidating CCR into a smaller footprint within the CCR units, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR and the reduced contaminant mobilization achieved by chemical amendment as described in **Section 4.1.1**.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Consolidation of CCR into a smaller footprint during closure also reduces the volume of potential source materials that may be in contact with groundwater after closure. Further leaching of metals and migration within groundwater will be reduced by minimizing the footprint of CCR in contact with groundwater and by fixation using a chemical amendment.

5.7 ALTERNATIVE 7 – CONSOLIDATE AND CAP WITH GROUNDWATER COLLECTION

Alternative 7 includes closing the landfill and impoundment (no further discharge), relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. Impacted groundwater will be collected using pumps and treated prior to discharge according to state and federal requirements as described in **Section 4.1.2**.

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Consolidation of CCR into a smaller footprint during closure also reduces the volume of potential source materials that may be in contact with groundwater after closure. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time as impacted groundwater is collected to contain and restore arsenic concentrations in groundwater to levels below the GPS.

5.8 ALTERNATIVE 8 – CONSOLIDATE AND CAP WITH BARRIER WALL

Alternative 8 includes closing the landfill and impoundment (no further discharge), relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d). This measure is consistent with landfill cover systems to prevent infiltration of surface water into the CCR as described in **Section 4.1.1**. Impacted groundwater will be intercepted with a barrier wall to minimize the migration of arsenic as described in **Section 4.1.2.**

This alternative eliminates CCR sluicing/plant process water discharges and, with the consolidation of the CCR footprint and the installation of a cap, will reduce infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. Consolidation of CCR into a smaller footprint during closure also reduces the volume of potential source materials that may be in contact with groundwater after closure. Further leaching of metals and migration within groundwater will be reduced and may be eliminated over time as impacted groundwater is intercepted with a barrier wall to minimize the spread of arsenic in groundwater.

6.0 EVALUATION OF CORRECTIVE MEASURE ALTERNATIVES

As required by 40 CFR 257.96(c), the following sections provide an evaluation of the effectiveness of corrective measure alternatives in meeting the requirements and objectives outlines in 40 CFR 257.97. The evaluation addresses the requirements and objectives identified in 40 CFR 257.96(c)(1) through (3), which include:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;
- The time required to begin and complete the remedy; and
- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

In addition to the discussion of the items listed above, **Table 6** provides a summary of the initial evaluation of the alternatives including each of the criteria listed in 40 CFR 257.97.

6.1 ALTERNATIVE 1 – NO ACTION

As described in **Section 5.1**, the No Action alternative is only included as a baseline condition and a point of comparison for the other alternatives. This alternative does not satisfy all five criteria in 40 CFR 257.97(b)(1) through (5), so it is not an acceptable corrective measure under the CCR Rule. For comparison only, Alternative 1 is evaluated with regard to the criteria in 40 FR 257.96(c) below:

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – The ability to attain the GPS for arsenic without any additional action is unlikely.
  - Reliability – Alternative 1 does not provide any reduction in existing risk.
  - Implementation – Nothing is required to implement Alternative 1.
  - Impacts – No additional safety or cross-media impacts are expected with Alternative 1. This alternative does not control current suspected routes of exposure to residual contamination.
- **Timing.** No time is required to begin. However, the time required to attain the GPS for arsenic under Alternative 1 is unknown.
- **Institutional Requirements.** No institutional requirements beyond maintaining current regulatory approvals exist for Alternative 1.

6.2 ALTERNATIVE 2 – CLOSE AND CAP IN PLACE WITH MNA

As described in **Section 5.2**, Alternative 2 includes closing the landfill in accordance with the CCR Rule and existing State of Iowa sanitary disposal project permit and closing the CCR impoundment with no further discharge. CCR materials will be capped and vegetation established on the final cover in accordance with the requirements for closure in place in 40 CFR 257.102(d).

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the landfill and impoundments by capping is expected to address infiltration, which is a key contributor to groundwater impacts. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 2 is capable of and expected to attain the GPS for arsenic.

  - Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method.

  - Implementation – The construction of Alternative 2 is moderately complex due to the thixotropic characteristics of the impounded CCR. Dewatering will be required to the extent a suitable subgrade is established in the impoundment for cap construction, which can likely be achieved through standard dewatering methods. Additional subgrade stabilization may be required to support the cap. The cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 2 are not specialized and are generally readily available with the exception of potential stabilization of impounded CCR with thixotropic characteristics.

  - Impacts – Safety impacts associated with the implementation of Alternative 2 are not significantly different than other heavy civil construction projects. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of off-site transportation of CCR. Although the risk to surface water receptors is already low and ending wastewater discharges and capping the landfill and impoundment minimizes infiltration (a significant source of water and CCR interaction), some interaction between CCR in the impoundment and groundwater may remain after closure. The ease of implementation and low-impact nature of MNA as a groundwater restoration method must be evaluated against the effectiveness of passive groundwater restoration, which is the subject of ongoing evaluations. An insufficient MNA mechanism, insufficient site attenuation capacity, or changes in groundwater conditions may require additional action to restore groundwater or prevent cross-media impacts between groundwater and surface water. The potential for exposure to residual contamination is low since CCR will be capped.

- **Timing.** Closure of the landfill and impoundment can be completed within 1 to 2 years of remedy selection. At LAN, the closure of the landfill and impoundment is expected to be complete by October 17, 2023. The time required to attain the GPS for arsenic will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. Alternative 2 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 2:
  - IDNR Closure Permit
  - State and local erosion control/construction stormwater management permits

6.3 ALTERNATIVE 3 – CONSOLIDATE ON SITE AND CAP WITH MNA

As described in **Section 5.3**, Alternative 3 includes closing the landfill, closing the impoundment with no further discharge, relocating and consolidating impounded CCR into a smaller footprint within the CCR surface impoundment and/or landfill, covering the CCR materials with a cap, and establishing vegetation in accordance with the existing State of Iowa sanitary disposal project permit and requirements for closure in place in 40 CFR 257.102(d).

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the landfill and impoundment by capping is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of impounded CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The smaller closure footprint also reduces the potential for ongoing CCR contact with groundwater. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 3 is capable of and expected to attain the GPS for arsenic.

  - Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method. A consolidated cap footprint may enhance reliability by reducing the scale of post-closure maintenance.

  - Implementation – The construction of Alternative 3 is moderately complex due to the thixotropic characteristics of the impounded CCR. Dewatering will be required to the extent required to excavate and relocate CCR within the CCR impoundments and provide a suitable subgrade for cap construction. Additional subgrade stabilization may be required to support the cap. Conditioning (e.g., drying) of relocated CCR is expected during on-site re-disposal. Alternative 3 can likely be achieved through standard dewatering and conditioning methods. Although the cap footprint will be minimized, cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 3 are not specialized and are generally readily available with the exception of potential stabilization of impounded CCR with thixotropic characteristics.

  - Impacts – Safety impacts associated with the implementation of Alternative 3 are not significantly different than other heavy civil construction projects. The level of disturbance required to consolidate CCR before capping may represent some increase in safety risk due to site conditions and on-site construction traffic. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of off-site transportation of CCR. Although the risk to surface water receptors is already low and ending wastewater discharges and capping the landfill and impoundment minimizes infiltration (a significant source of water and CCR interaction), some interaction between CCR in the impoundment and groundwater may remain after closure. The consolidation of CCR prior to capping under Alternative 3 reduces the potential for CCR and groundwater interaction after closure. The ease of implementation and low-impact nature of MNA as a groundwater restoration method must be evaluated against the effectiveness of passive groundwater restoration, which is the subject of ongoing evaluations. An insufficient MNA mechanism, insufficient site attenuation capacity, or changes in groundwater conditions may require additional action to restore groundwater or prevent cross-media impacts between groundwater and surface water. The potential for exposure to residual contamination is low since CCR will be capped and the footprint of the cap minimized.

- **Timing.** Closure of the landfill and impoundment can be completed within 1 to 2 years of remedy selection. At LAN, the closure of the landfill and impoundment is expected to be complete by October 17, 2023. The time required to attain the GPS for arsenic will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The consolidation of CCR into a smaller cap area may decrease the time to reach GPS. Alternative 3 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 3:
  - IDNR Closure Permit
  - State and local erosion control/construction stormwater management permits

6.4 ALTERNATIVE 4 – EXCAVATE AND DISPOSE ON SITE WITH MNA

As described in **Section 5.4**, Alternative 4 includes closing the landfill and impoundment, excavation of impounded CCR from the source area, and creation of a new on-site disposal that meets the design criteria for new CCR landfills required under 40 CFR 257.70.

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the landfill and impoundment by removing and re-disposing CCR in a new lined/capped disposal area in combination with capping open areas of the landfill is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The separation from groundwater and other location criteria for the new on-site disposal facility may enhance the performance of this alternative. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 4 is capable of and expected to attain the GPS for arsenic.

  - Reliability – The expected reliability of on-site re-disposal with a composite liner and cap is good. Disposal facilities that meet the requirements in 40 CFR 257.70 or other similar requirements have been used for solid waste disposal including municipal and industrial waste for numerous years. There is significant industry experience with the design and construction of similar disposal facilities. The composite liner and cover combined with a consolidated disposal footprint may enhance reliability by reducing infiltration and the scale of post-closure maintenance. At the same time, post-closure maintenance is likely more complex due to maintenance of a leachate collection system and geosynthetic repairs requiring specialized personnel, material, and equipment.

- Implementation – The complexity of constructing the new liner and cap is moderate due to the composite design and the management of CCR with thixotropic characteristics. The limited area available at the facility for developing an on-site disposal facility makes this alternative logistically complex. Significant volumes of CCR will be excavated and stored on site while the disposal facility is constructed. Significant dewatering will be required to excavate and relocate CCR to a temporary storage area. Conditioning (e.g., drying) of relocated CCR is expected to facilitate temporary storage and on-site re-disposal. Alternative 4 can likely be achieved through standard dewatering and conditioning methods, but may be impacted by the space available for these activities and the thixotropic character of some CCR. Although the post-closure CCR footprint will be minimized, composite liner and cap construction may put a high demand on the local supply of suitable cap materials. The local availability of liner and cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 4 are not specialized and are generally readily available with the exception of the resources needed to install the geosynthetic portions of the composite liner and cover, which are not locally available.

- Impacts – Safety impacts associated with the implementation of Alternative 4 are not significantly different than other heavy civil construction projects. However, the level of disturbance required to excavate, store, and re-dispose CCR on site and the traffic required to import composite liner and cap material are not typical and likely represent an increase in safety risk due to site conditions, on-site construction traffic, and incoming/outgoing off-site construction traffic. A risk of cross-media impacts is possible due to the large volume of CCR to be excavated, stored, and relocated on site. Although the risk to surface water receptors is already low, Alternative 4 significantly reduces the potential interaction between CCR and water after closure. The ease of implementation and low-impact nature of MNA as a groundwater restoration method must be evaluated against the effectiveness of passive groundwater restoration, which is the subject of ongoing evaluations. An insufficient MNA mechanism, insufficient site attenuation capacity, or changes in groundwater conditions may require additional action to restore groundwater or prevent cross-media impacts between groundwater and surface water. The potential for exposure to residual contamination is low since CCR will be capped and the footprint of the cap minimized.

- **Timing.** Closure of the landfill and impoundment can be completed within 1 to 2 years of remedy selection. At LAN, the closure of the landfill and impoundment is expected to be complete by October 17, 2023. However, the time required to permit and develop the on-site disposal facility may extend this schedule. The time required to attain the GPS for arsenic will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The consolidation of CCR into a new on-site disposal facility with a composite liner and cap may decrease the time to reach GPS. Alternative 4 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 4:
  - IDNR Closure Permit
  - IDNR Disposal Facility (Landfill) Permit
  - State and local erosion control/construction stormwater management permits

6.5 ALTERNATIVE 5 – EXCAVATE AND DISPOSE OFF SITE WITH MNA

As described in **Section 5.5**, Alternative 5 includes closing the landfill and impoundment, excavation of CCR from the source area, and transporting the impounded CCR off site for disposal.

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the landfill and impoundment by removing and re-disposing CCR off site will eliminate the source material exposed to infiltration, which is a key contributor to groundwater impacts. The off-site disposal of CCR prevents further releases at LAN, but introduces the possibility of releases at the receiving facility. Although the risk to surface water receptors is already low, Alternative 5 nearly eliminates the potential interaction between CCR and water after closure. The ease of implementation and low-impact nature of MNA as a groundwater restoration method must be evaluated against the effectiveness of passive groundwater restoration, which is the subject of ongoing evaluations. A lack of active MNA mechanism, insufficient site attenuation capacity, or changes in groundwater conditions may require additional action to restore groundwater or prevent cross-media impacts between groundwater and surface water. MNA monitoring will identify, if active, the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. Alternative 5 is capable of and expected to attain the GPS for arsenic.

  - Reliability – The expected reliability of excavation and off-site disposal of impounded CCR is good. Off-site disposal facilities are required to meet the requirements in 40 CFR 257.70 or other similar requirements, which have been used for solid waste disposal including municipal and industrial waste for numerous years. There is significant industry experience with the design and construction of these disposal facilities.

  - Implementation –The complexity of excavating CCR for off-site disposal is moderate due to the thixotropic characteristics of some of the CCR. The scale of CCR excavation (expected to exceed 840K cy), off-site transportation, and the permitting/development of off-site disposal facility airspace makes this alternative logistically complex. Significant dewatering will be required to excavate CCR. Conditioning (e.g., drying) of relocated CCR is expected to facilitate off site re-disposal. Alternative 5 can likely be achieved through standard dewatering and conditioning methods, but may be impacted by the space available for these activities and the thixotropic character of some CCR. Although the source area at LAN will be eliminated, the development of off-site disposal airspace will put a high demand on the receiving disposal facility, which may not have the current physical or logistical capacity to receive large volumes of CCR in a short period of time. The equipment and personnel required to implement on-site and off-site aspects of Alternative 5 are not specialized and are generally readily available with the exception of the resources needed to install the geosynthetic portions of the off-site composite liner and cover, which are not locally available.

- Impacts – Safety impacts associated with the implementation of Alternative 5 are not significantly different than other heavy civil construction projects. However, the level of disturbance required to excavate, transport, and re-dispose CCR and the traffic required to import composite liner and cap material at the receiving disposal facility are not typical and likely represent an increase in safety risk due to large volumes of incoming/outgoing off-site construction traffic at both sites. A risk of cross-media impacts is possible due to the large volume of CCR to be excavated and transported from the site. The potential for exposure to residual contamination on site is very low since CCR will be capped or removed; however, the off-site potential for exposure to CCR is increased due to the relocation of the source material.

- **Timing.** Closure of the landfill and impoundment can be completed within 1 to 2 years of remedy selection. At LAN, the closure of the landfill and impoundment is expected to be complete by October 17, 2023. However, the time required to secure the off-site disposal airspace required to complete this alternative, including potential procurement, permitting, and construction, may extend this schedule significantly. The time required to attain the GPS for arsenic will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach GPS. The removal of impounded CCR from LAN may decrease the time to reach GPS. Alternative 5 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 5:
  - IDNR Closure Permit
  - Approval of off-site disposal facility owner or landfill permit for new off-site facility
  - State and local erosion control/construction stormwater management permits
  - Transportation agreements and permits (local roads and railroads)

  State solid waste comprehensive planning approvals may also be required.

6.6 ALTERNATIVE 6 – CONSOLIDATE AND CAP WITH CHEMICAL AMENDMENT

As described in **Section 5.6**, Alternative 6 includes closing the landfill and impoundment, relocating and consolidating CCR into a smaller footprint within the CCR surface impoundment, adding a chemical amendment to the CCR to reduce the mobilization of arsenic prior to relocating, covering the CCR materials with a cap, and establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d).

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the landfill and impoundment by capping is expected to address infiltration, which is a key

contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The smaller closure footprint also reduces the potential for ongoing CCR contact with groundwater. The application of a chemical amendment to the CCR that will remain on site may further reduce the potential for ongoing groundwater impacts after closure. Although the risk to surface water receptors is already low, the potential for CCR in the impoundment to interact with groundwater may remain after closure. Alternative 6 further reduces the potential for ongoing groundwater impacts from that interaction between CCR and water. If needed to address changes in groundwater conditions or prevent cross-media impacts between groundwater and surface water, the initial application of a chemical amendment during closure can be supplemented with additional applications in the future outside of capped area. Alternative 6 is capable of and expected to attain the GPS for arsenic.

- Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method. A consolidated cap footprint may enhance reliability by reducing the scale of post-closure maintenance. Based on a review of information in the Federal Remediation Technologies Roundtable (FRTR) Technology Screening Matrix, amending source material using site-specific chemistries can be an effective means of sequestering metals to limit the future release to groundwater from residual source material. The technology can be applied to source material and groundwater plumes. The approach has been used at full scale to remediate inorganics (FRTR 2020).

- Implementation – The construction of Alternative 6 is moderately complex due to the thixotropic characteristics of the impounded CCR. Dewatering will be required to the extent required to excavate and relocate CCR within the CCR impoundments and provide a suitable subgrade for cap construction. Additional subgrade stabilization may be required to support the cap. Conditioning (e.g., drying) of relocated CCR is expected during on-site re-disposal. Alternative 6 can likely be achieved through standard dewatering and conditioning methods. Although the cap footprint will be minimized, cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 6 are not specialized and are generally readily available with the exception of potential stabilization of impounded CCR with thixotropic characteristics. However, the equipment for the in-situ chemical amendment application is more specialized and may be in high demand.

- Impacts – Safety impacts associated with the implementation of Alternative 6 are not significantly different than other heavy civil construction projects. The level of disturbance required to consolidate CCR before capping may represent some increase in safety risk due to site conditions and on-site construction traffic. Some elevated risk may exist due to the use of and application of amendment chemistry, but can likely be addressed with additional worker protective measures. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of offsite transportation of CCR. Although the risk to surface water receptors is already low based on available data, the additional source control provided by Alternative 6 may offer further reduction of risks if groundwater conditions change. The potential for exposure to residual contamination is low since the CCR will be chemically stabilized, capped, and the footprint of the cap minimized.

- **Timing.** Closure of the landfill and impoundment can be completed within 1 to 2 years of remedy selection. At LAN, the closure of the landfill and impoundment is expected to be complete by October 17, 2023. The time required to attain the GPS for arsenic will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach the GPS. The consolidation of CCR into a smaller cap area may decrease the time to reach the GPS. The chemical amendment of source material may also reduce the time to reach the GPS. Alternative 6 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 6:
  - IDNR Closure Permit
  - Federal, state, and local floodplain permits
  - Injection permits
  - State and local erosion control/construction stormwater management permits
  - Federal and state wetland permitting may also be required.

6.7 ALTERNATIVE 7 – CONSOLIDATE AND CAP WITH GROUNDWATER COLLECTION

As described in **Section 5.7**, Alternative 7 includes closing the landfill and impoundments relocating and consolidating CCR into a smaller footprint within the CCR surface impoundment, covering the CCR materials with a cap, establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d), and installing a groundwater pump and treat system to prevent the migration of and/or recover groundwater with arsenic concentrations greater than the GPS.

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the landfill and impoundment by capping is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The groundwater pump and treat system may further reduce the potential for down-gradient migration of groundwater impacts after closure. Although the risk to surface water receptors is already low, the potential for CCR in the impoundment to interact with groundwater may remain after closure. Alternative 7 further reduces the risk of potential ongoing groundwater impacts from that interaction between CCR and water. The groundwater pump and treat system offers additional flexibility to address changes in groundwater conditions or prevent cross-media impacts between groundwater and surface water. Alternative 7 is capable of and expected to attain the GPS for arsenic.

  - Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method. A consolidated cap footprint may enhance reliability by reducing the scale of post-closure maintenance. Similar to capping, groundwater pump and treat is a common method used to limit the migration of impacted groundwater or remove impacted groundwater to restore groundwater concentrations to levels below the GPS.

- Implementation – The construction of Alternative 7 is moderately complex due to the thixotropic characteristics of the impounded CCR. Dewatering will be required to the extent required to excavate and relocate CCR within the CCR impoundments and provide a suitable subgrade for cap construction. Additional subgrade stabilization may be required to support the cap. Conditioning (e.g., drying) of relocated CCR is expected during on-site re-disposal. The complexity of the groundwater pump and treat system is also low. Alternative 7 can likely be achieved through standard dewatering and conditioning methods. Although the cap footprint will be minimized, cap construction may put a high demand on the local supply of suitable cap materials. The local availability of cap materials will be evaluated further during remedy selection. The equipment and personnel required to implement Alternative 7 are not specialized and are generally readily available. The development, operation, maintenance and monitoring of adequate treatment for large volumes of groundwater with relatively low concentrations of arsenic likely increases the complexity of implementing this alternative.

- Impacts – Safety impacts associated with the implementation of Alternative 7 are not significantly different than other heavy civil construction projects. The level of disturbance required to consolidate CCR before capping may represent some increase in safety risk due to site conditions and on-site construction traffic. Some elevated risk may exist due to the additional construction involved with the groundwater pump and treat system and the higher complexity of the long term maintenance required. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of offsite transportation of CCR. Although the risk to surface water receptors is already low based on available data, the active nature of the groundwater plume containment provided by Alternative 7 may offer further reduction of risks if groundwater conditions change. The potential for exposure to residual contaminated source material is low since CCR will be capped and the footprint of the cap minimized. The potential exposure to contaminated groundwater is increased due to the ex-situ groundwater treatment required and the potential for worker exposure and spills.

- **Timing.** Closure of the landfill and impoundment can be completed within 1 to 2 years of remedy selection. At LAN, the closure of the landfill and impoundment is expected to be complete by October 17, 2023. The time required to attain the GPS for arsenic will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach the GPS. The additional time required to design and install the groundwater pump and treat system is unlikely to have a significant impact on the implementation timing but may reduce the time required to attain the GPS. The consolidation of CCR into a smaller cap area may decrease the time to reach the GPS. Alternative 7 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 7:
  - IDNR Closure Permit
  - Federal, state, and local floodplain permits
  - State and local well installation permits
  - NPDES permitting for post-treatment groundwater discharges
  - State and local erosion control/construction stormwater management permits
  - Federal and state wetland permitting may also be required.

6.8 ALTERNATIVE 8 – CONSOLIDATE AND CAP WITH BARRIER WALL

As described in **Section 5.8**, Alternative 8 includes closing the landfill and impoundment, relocating and consolidating CCR into a smaller footprint within the CCR surface impoundments, covering the CCR materials with a cap, establishing vegetation in accordance with the requirements for closure in place in 40 CFR 257.102(d), and installing a downgradient barrier wall to prevent the migration of groundwater with arsenic concentrations greater than the GPS.

- **Performance, Reliability, Implementation, and Impacts.**
  - Performance – Ceasing wastewater discharges and closing the landfill and impoundment by capping is expected to address infiltration, which is a key contributor to groundwater impacts. The consolidation of CCR into a smaller footprint may enhance the performance of the cap by further reducing the area exposed to limited post-construction infiltration through the cap. The barrier wall may further reduce the potential for ongoing groundwater impacts after closure. Although the risk to surface water receptors is already low, the potential for CCR in the impoundment to interact with groundwater may remain after closure. Alternative 8 further reduces the risk of potential ongoing groundwater impacts from that interaction between CCR and water. Although it acts passively, the barrier wall reduces the risk from a more passive groundwater restoration approach such as MNA if MNA mechanisms are not active, the site has insufficient site attenuation capacity, or groundwater conditions change in a way that increases the potential for cross-media impacts between groundwater and surface water. Alternative 8 is capable of and expected to attain the GPS for arsenic.

  - Reliability – The expected reliability of capping is good. Capping is a common practice and standard remedial method for closure in place in remediation and solid waste management. There is significant industry experience with the design and construction of this method. A consolidated cap footprint may enhance reliability by reducing the scale of post-closure maintenance. A barrier wall at LAN will likely have to consist of a permeable reactive barrier (PRB) due to the lack of an impermeable layer to key a low permeability barrier wall into. In general the reliability of PRBs for containment of inorganics is favorable based on information available in the FRTR Technology Screening Matrix (FRTR 2020). The reliability of a PRB requires the identification of a suitable reactive media for the conditions at LAN and the ability to effectively locate the barrier, which are both likely but require additional evaluations. PRB performance can diminish over time as consumptive media is exhausted or hydraulic conditions change due to chemical precipitation or biofouling. Long-term monitoring and maintenance is required to ensure continued performance.

- Implementation – The construction of Alternative 8 is moderately complex due to the thixotropic characteristics of the impounded CCR. Dewatering will be required to the extent required to excavate and relocate CCR within the CCR impoundments and provide a suitable subgrade for cap construction. Additional subgrade stabilization may be required to support the cap. Conditioning (e.g., drying) of relocated CCR is expected during on-site re-disposal. The complexity of the PRB wall significantly increases the level of complexity for implementing this alternative. PRB installation contractors and equipment have lengthy procurement timelines. Alternative 8 can likely be achieved through standard dewatering and conditioning methods. Although the cap footprint will be minimized, cap construction may put a high demand on the local supply of suitable cap materials. The equipment and personnel required to implement the consolidation and capping portion of Alternative 8 are not specialized and are generally readily available. However, the equipment for the barrier wall is more specialized and may be in high demand.

- Impacts – Safety impacts associated with the implementation of Alternative 8 are not significantly different than other heavy civil construction projects. The level of disturbance required to consolidate CCR before capping may represent some increase in safety risk due to site conditions and on-site construction traffic. Some elevated risk may exist due to the additional construction involved with the barrier wall construction and the higher complexity of the long term barrier wall performance monitoring. Cross-media impacts are expected to be limited due to the small volume of CCR expected to be relocated on site, the short duration of cap construction, the effectiveness of standard engineering controls during construction (e.g., dust control), and the lack of offsite transportation of CCR. Although the risk to surface water receptors is already low based on available data, the enhanced nature of the passive groundwater plume containment provided by Alternative 8 may offer further reduction of risks if groundwater conditions change. The potential for exposure to residual contaminated source material is low since CCR will be capped and the footprint of the cap minimized.

- **Timing.** Closure of the landfill and impoundment can be completed within 1 to 2 years of remedy selection. At LAN, the closure of the landfill and impoundment is expected to be complete by October 17, 2023. The time required to attain the GPS for arsenic will be evaluated further during the remedy selection process, but is expected to take between 2 and 10 years after closure construction is complete. The level of source disturbance during construction may increase the time required to reach the GPS. The additional time required to design and install the barrier wall is unlikely to have a significant impact on the implementation timing but may reduce the time required to attain the GPS. The consolidation of CCR into a smaller cap area may decrease the time to reach GPS. Alternative 8 can provide full protection within the 30-year post-closure monitoring period.

- **Institutional Requirements.** The following permits and approvals are expected to be required to implement Alternative 8:
  - IDNR Closure Permit
  - Federal, state, and local floodplain permits
  - State and local well installation permits
  - State and local erosion control/construction stormwater management permits
  - Federal and state wetland permitting may also be required.

7.0 SUMMARY OF ASSESSMENT

Each of the identified corrective measure alternatives exhibits both favorable and unfavorable outcomes with respect to the assessment factors that must be evaluated in accordance with 40 CFR 257.97(c). At the present time, limited impacts have been identified as described in **Section 3.0**. The nature and extent of those impacts are the subject of ongoing assessment and IPL continues to assess remedies to meet the requirements and objectives described in 40 CFR 257.97.

8.0 REFERENCES

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Tables

Table 1. Water Level Summary
Interstate Power & Light - Lansing, Iowa / SCS Engineers Project #25220100.00

Raw Data	MW1(4)	MW2	MW3(3)	MW4	MW5	MW6	MW11	MW11R	MW12	MW12P	MW13	MW14	MW15	TW17	TW18	TW19	MW-16	MW-18	MW-19	MW-22	MW-22P	MW20	MW301	MW302	MW302A	MW303	MW304	MW304A	MW305	MW306	MW306A
Measurement Date																															
May 11, 2001	3.9	28.83	28.07	44.56	43.64	78.21	NM	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
March 8, 2002	8.72	37.15	36.42	47.60	46.66	79.62	32.59	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
February 19, 2004	NM	NM	NM	49.37	48.41	88.06	38.16	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
May 26, 2004	NM	NM	NM	45.28	44.31	77.04	34.10	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
August 23, 2004	NM	NM	NM	46.02	45.08	78.68	36.15	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
November 18, 2004	NM	NM	NM	47.36	46.42	77.45	38.01	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
May 5, 2005	NM	NM	NM	47.75	46.79	79.53	38.42	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
May 19, 2006	NM	NM	NM	47.74	46.80	79.55	DRY	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
May 30, 2007	NM	NM	NM	47.96	47.03	79.64	DRY	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
April 16, 2008	NM	NM	NM	44.18	43.22	76.78	DRY	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
April 3, 2009	NM	NM	NM	42.45	41.51	75.17	DRY	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI		NI	NI		NI	NI	
April 21, 2010	NM	NM	NM	45.90	44.95	78.25	AB	40.01	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
May 4, 2011	NM	NM	NM	44.66	43.71	77.49	AB	39.84	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 25, 2012	NM	NM	NM	46.40	45.43	78.50	AB	39.89	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
October 17, 2012	9.34	37.33	NM(2)	47.44	46.49	79.23	AB	40.26	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
February 19-20, 2013	9.64	37.33	36.10	47.45	46.50	79.20	AB	41.00	41.09	NI	14.66	4.13	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 1, 2013	8.87	36.68	35.57	45.93	45.00	77.17	AB	40.21	39.69	NI	13.77	4.70	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
July 1, 2013	5.10	31.48	30.68	37.04	36.15	68.21	AB	37.69	37.74	NI	9.95	3.63	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 29, 2014	6.83	NM	NM	44.00	43.03	76.47	AB	39.46	39.78	40.25	12.41	4.11	22.99	10.85	11.89	10.97	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
May 29, 2014	6.92	32.99	32.28	44.64	44.65	77.03	AB	39.89	40.35	40.85	12.99	4.63	23.21	11.45	12.60	12.09	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 20, 2015	8.51	37.27	36.00	46.17	45.22	78.03	AB	40.49	41.08	41.53	14.65	4.04	22.97	11.80	12.80	12.08	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
December 10, 2015	NM	NM	NM	NM	NM	79.05	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NI	NI	NI	NI	14.02	18.07	10.52	NI	17.48	NI	NI	NI	NI	NI
April 28, 2016	9.17	37.10	35.95	46.62	45.67	78.53	AB	40.46	41.35	41.58	14.82	4.50	22.11	11.81	--	12.25	NI	NI	NI	NI	NI	13.68	18.16	11.16	NI	18.12	NI	NI	NI	NI	NI
July 20, 2016	NM	NM	NM	NM	NM	78.12	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	12.43	16.85	9.80	NI	16.94	NI	NI	NI	NI	NI
October 27, 2016	NM	NM	NM	NM	NM	70.51	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	10.97	16.64	10.05	NI	17.62	NI	NI	NI	NI	NI
January 18, 2017	NM	NM	NM	NM	NM	75.05	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	12.11	17.52	11.08	NI	18.17	NI	NI	NI	NI	NI
April 19-21, 2017	7.28	35.32	34.76	39.33	38.46	71.51	AB	38.18	37.72	38.18	10.77	3.05	22.32	9.72	10.12	10.04	39.81	101.21	63.95	34.17	34.72	10.58	16.91	9.42	NI	17.07	NI	NI	NI	NI	NI
June 19-20, 2017	NM	NM	NM	NM	NM	70.68	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	12.07	16.72	10.65	NI	17.5	NI	NI	NI	NI	NI
August 15, 2017	NM	NM	NM	NM	NM	70.72	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	12.71	17.52	11.12	NI	18.41	NI	NI	NI	NI	NI
October 16, 2017	NM	NM	NM	NM	NM	71.75	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	11.48	15.91	9.65	NI	17.48	NI	NI	NI	NI	NI
April 16-17, 2018	8.04	36.54	39.28	AB	AB	73.69	AB	39.35	39.15	39.68	12.02	3.45	22.75	10.82	10.66	10.82	NM	NM	NM	NM	NM	11.52	17.32	9.42	NI	17.65	NI	NI	NI	NI	NI
April 26, 2018	8	36.5	39.15	AB	AB	73.37	AB	38.95	39.65	39.04	12	0.6	22.68	10.6	10.8	11.05	43.65	103.3	65.88	36.27	37	11.11	17.05	9.65	NI	17.7	NI	NI	NI	NI	NI
June 4, 2018	NM	NM	NM	AB	AB	NM	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	16.99	10.13	NI	17.46	NI	NI	NI	NI	NI
August 7, 2018	NM	NM	NM	AB	AB	73.20	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	17.10	10.78	NI	18.42	NI	NI	NI	NI	NI
October 8, 2018	NM	NM	NM	AB	AB	76.62	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	15.88	9.81	NI	18.95	NI	NI	NI	NI	NI
April 15-16, 2019	5.72	25.2	28.38	AB	AB	68.55	AB	37.73	37.05	37.59	8.93	2.98	23.11	9.86	10.68	10.95	NM	98.45	61.52	31.50	32.95	9.72	12.42	8.41	NI	18.05	NI	NI	NI	NI	NI
June 20, 2019	NM	NM	NM	NM	AB	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NM	12.82	NI	4.75	14.43	NI
October 2, 2019	NM	NM	NM	NM	AB	65.79	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	9.65	15.07	8.36	NI	18.24	12.64	NI	4.1	15.01	NI
December 5, 2019	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NM	NM	NI	NM	16.88	NI
February 5, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NM	NM	NI	NM	16.65	NI
May 20-21, 2020	7.29	36.75	35.4	NM	NM	66.86	NM	38.25	36.95	37.54	10.44	2.83	23.02	10.77	10.29	9.65	39.18	96.73	60.01	30.39	31.71	12.09	17.15	10.72	15.74	18.29	14.86	13.72	6.63	17.05	19.16
July 6, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	14.73	NM	NM	12.84	NM	NM	17.90
August 19-21, 2020	NM	NM	NM	NM	NM	66.69	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	11.41	16.59	10.87	15.41	18.05	14.68	NM	6.89	17.11	18.93
October 19-20, 2020	7.98	36.98	35.56	AB	AB	67.96	AB	38.71	37.46	38.01	10.88	3.10	23.38	9.92	10.39	10.91	39.84	97.74	61.12	31.34	32.62	12.79	17.19	11.26	15.90	19.31	15.03	14.19	7.33	17.56	19.39

Table 1. Water Level Summary
Interstate Power & Light - Lansing, Iowa / SCS Engineers Project #25220100.00

Well Number	MW1[4]	MW2	MW3[3]	MW4	MW5	MW6	MW11	MW11R	MW12	MW12P	MW13	MW14	MW15	TW17	TW18
Top of Casing Elevation (feet amsl)	636.67	657.36	656.78	698.17	698.46	741.33	686.19	686.42	691.40	691.58	658.38	646.06	656.82	659.59	659.15
Screen Length (ft)	20	10	10	10	10	10	10	10	15	5	15	15	15	15	15
Top of Well Screen Elevation (ft)	626.50	620.50	600.00	650.00	630.00	656.00	657.96	646.94	657.70	627.98	649.48	636.96	640.82	649.39	650.55
Measurement Date															
May 11, 2001	632.77	628.53	629.29	653.61	654.82	663.12	NI	NI	NI	NI	NI	NI	NI	NI	NI
March 8, 2002	627.95	620.21	620.94	650.57	651.80	661.71	653.60	NI	NI	NI	NI	NI	NI	NI	NI
February 19, 2004	NM	NM	NM	648.80	650.05	653.27	648.03	NI	NI	NI	NI	NI	NI	NI	NI
May 26, 2004	NM	NM	NM	652.89	654.15	664.29	652.09	NI	NI	NI	NI	NI	NI	NI	NI
August 23, 2004	NM	NM	NM	652.15	653.38	662.65	650.04	NI	NI	NI	NI	NI	NI	NI	NI
November 18, 2004	NM	NM	NM	650.81	652.04	663.88	648.18	NI	NI	NI	NI	NI	NI	NI	NI
May 5, 2005	NM	NM	NM	650.42	651.67	661.80	647.77	NI	NI	NI	NI	NI	NI	NI	NI
May 19, 2006	NM	NM	NM	650.43	651.66	661.78	DRY	NI	NI	NI	NI	NI	NI	NI	NI
May 30, 2007	NM	NM	NM	650.21	651.43	661.69	DRY	NI	NI	NI	NI	NI	NI	NI	NI
April 16, 2008	NM	NM	NM	653.99	655.24	664.55	DRY	NI	NI	NI	NI	NI	NI	NI	NI
April 3, 2009	NM	NM	NM	655.72	656.95	666.16	DRY	NI	NI	NI	NI	NI	NI	NI	NI
April 21, 2010	NM	NM	NM	652.27	653.51	663.08	DRY	646.41	NI	NI	NI	NI	NI	NI	NI
May 4, 2011	NM	NM	NM	653.51	654.75	663.84	DRY	646.58	NI	NI	NI	NI	NI	NI	NI
April 25, 2012	NM	NM	NM	651.77	653.03	662.83	DRY	646.53	NI	NI	NI	NI	NI	NI	NI
October 17, 2012	627.33	620.03	NM[2]	650.73	651.97	662.10	AB	646.16	NI	NI	NI	NI	NI	NI	NI
February 19-20, 2013	627.03	620.03	621.26	650.72	651.96	662.13	AB	645.42	650.31	NI	643.72	641.93	NI	NI	NI
April 1, 2013	627.80	620.68	621.79	652.24	653.46	664.16	AB	646.21	651.71	NI	644.61	641.36	NI	NI	NI
July 1, 2013	631.57	625.88	626.68	661.13	662.31	673.12	AB	648.73	653.66	NI	648.43	642.43	NI	NI	NI
April 29, 2014	629.84	NM	NM	654.17	655.43	664.86	AB	646.96	651.62	651.33	645.97	641.95	633.83	648.74	647.26
May 29, 2014	629.75	624.37	624.50	653.53	653.81	664.30	AB	646.53	651.05	650.73	645.39	641.43	633.61	648.14	646.55
April 20, 2015	628.16	620.09	620.78	652.00	653.24	663.30	AB	645.93	650.32	650.05	643.73	642.02	633.85	647.79	646.35
December 10, 2015	NM	NM	NM	NM	NM	662.28	AB	NM	NM	NM	NM	NM	NM	NM	NM
April 28, 2016	627.50	620.26	620.83	651.55	652.79	662.80	AB	645.96	650.05	650.00	643.56	641.56	634.71	647.78	NM[5]
July 20, 2016	NM	NM	NM	NM	NM	663.21	AB	NM	NM	NM	NM	NM	NM	NM	NM
October 27, 2016	NM	NM	NM	NM	NM	670.82	AB	NM	NM	NM	NM	NM	NM	NM	NM
January 18, 2017	NM	NM	NM	NM	NM	666.28	AB	NM	NM	NM	NM	NM	NM	NM	NM
April 19-21, 2017	629.39	622.04	622.02	658.84	660.00	669.82	AB	648.24	653.68	653.40	647.61	643.01	634.50	649.87	649.03
June 19-20, 2017	NM	NM	NM	NM	NM	670.65	AB	NM	NM	NM	NM	NM	NM	NM	NM
August 15, 2017	NM	NM	NM	NM	NM	670.61	AB	NM	NM	NM	NM	NM	NM	NM	NM
October 16, 2017	NM	NM	NM	NM	NM	669.58	AB	NM	NM	NM	NM	NM	NM	NM	NM
April 16-17, 2018	628.63	620.82	617.50	AB	AB	667.64	AB	647.07	652.25	651.90	646.36	642.61	634.07	648.77	648.49
April 26, 2018	628.67	620.86	617.63	AB	AB	667.96	AB	647.47	651.75	652.54	646.38	645.46	634.14	648.99	648.35
June 4, 2018	NM	NM	NM	AB	AB	NM	AB	NM	NM	NM	NM	NM	NM	NM	NM
October 8, 2018	NM	NM	NM	AB	AB	664.71	AB	NM	NM	NM	NM	NM	NM	NM	NM
April 15-16, 2019	630.95	632.16	628.40	AB	AB	672.78	AB	648.69	654.35	653.99	649.45	643.08	633.71	649.73	648.47
June 20, 2019	NM	NM	NM	AB	AB	NM	AB	NM	NM	NM	NM	NM	NM	NM	NM
October 2, 2019	NM	NM	NM	AB	AB	675.54	AB	NM	NM	NM	NM	NM	NM	NM	NM
December 5, 2019	NM	NM	NM	AB	AB	NM	AB	NM	NM	NM	NM	NM	NM	NM	NM
February 5, 2020	NM	NM	NM	AB	AB	NM	AB	NM	NM	NM	NM	NM	NM	NM	NM
May 20-21, 2020	629.38	620.61	621.38	AB	AB	674.47	AB	648.17	654.45	654.04	647.94	643.23	633.80	648.82	648.86
July 6, 2020	NM	NM	NM	AB	AB	NM	AB	NM	NM	NM	NM	NM	NM	NM	NM
August 19-21, 2020	NM	NM	NM	AB	AB	674.64	AB	NM	NM	NM	NM	NM	NM	NM	NM
October 19-20, 2020	628.69	620.38	621.22	AB	AB	673.37	AB	647.71	653.94	653.57	647.50	642.96	633.44	649.67	648.76
Bottom of Well Elevation (ft)	606.50	610.50	590.00	640.47	620.36	646.03	647.59	636.94	642.70	622.98	634.48	621.96	625.82	634.39	635.55

Well Number	TW19	MW-16	MW-18	MW-19	MW-22	MW-22P	MW20	MW301	MW302	MW302A	MW303	MW304	MW304A	MW305	MW306	MW306A
Top of Casing Elevation (feet amsl)	659.05	700.26	771.09	716.07	702.55	702.17	662.29	641.61	638.40	638.93	656.27	636.43	638.60	633.87	637.48	639.56
Screen Length (ft)	15	15	15	15	15	5	10	10	10	5	10	10	5	10	10	5
Top of Well Screen Elevation (ft)	648.95	662.18	669.23	651.69	665.27	625.14	648.79	624.01	626.90	594.93	637.97	630.43	593.60	627.87	621.48	589.56
Measurement Date																
May 11, 2001	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
March 8, 2002	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
February 19, 2004	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
May 26, 2004	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
August 23, 2004	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
November 18, 2004	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
May 5, 2005	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
May 19, 2006	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
May 30, 2007	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 16, 2008	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 3, 2009	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 21, 2010	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
May 4, 2011	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 25, 2012	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
October 17, 2012	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
February 19-20, 2013	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 1, 2013	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
July 1, 2013	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 29, 2014	648.08	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
May 29, 2014	646.96	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
April 20, 2015	646.97	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
December 10, 2015	NM	NI	NI	NI	NI	NI	648.27	623.54	627.88	NI	638.79	NI	NI	NI	NI	NI
April 28, 2016	646.80	NI	NI	NI	NI	NI	648.61	623.45	627.24	NI	638.15	NI	NI	NI	NI	NI
July 20, 2016	NM	NM	NM	NM	NM	NM	649.86	624.76	628.60	NI	639.33	NI	NI	NI	NI	NI
October 27, 2016	NM	NM	NM	NM	NM	NM	651.32	624.97	628.35	NI	638.65	NI	NI	NI	NI	NI
January 18, 2017	NM	NM	NM	NM	NM	NM	650.18	624.09	627.32	NI	638.10	NI	NI	NI	NI	NI
April 19-21, 2017	649.01	660.45	669.88	652.12	668.38	667.45	651.71	624.70	628.98	NI	639.20	NI	NI	NI	NI	NI
June 19-20, 2017	NM	NM	NM	NM	NM	NM	650.22	624.89	627.75	NI	638.77	NI	NI	NI	NI	NI
August 15, 2017	NM	NM	NM	NM	NM	NM	649.58	624.09	627.28	NI	637.86	NI	NI	NI	NI	NI
October 16, 2017	NM	NM	NM	NM	NM	NM	650.81	625.70	628.75	NI	638.79	NI	NI	NI	NI	NI
April 16-17, 2018	648.23	NM	NM	NM	NM	NM	650.77	624.29	628.98	NI	638.62	NI	NI	NI	NI	NI
April 26, 2018	648.00	656.61	667.79	650.19	666.28	665.17	651.18	624.56	628.75	NI	638.57	NI	NI	NI	NI	NI
June 4, 2018	NM	NM	NM	NM	NM	NM	NM	624.62	628.27	NI	638.81	NI	NI	NI	NI	NI
October 8, 2018	NM	NM	NM	NM	NM	NM	NM	625.73	628.59	NI	637.32	NI	NI	NI	NI	NI
April 15-16, 2019	648.10	NM	672.64	654.55	671.05	669.22	652.57	629.19	629.99	NI	638.22	NI	NI	NI	NI	NI
June 20, 2019	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NM	623.61	NI	629.12	623.05	NI
October 2, 2019	NM	NM	NM	NM	NM	NM	652.64	626.54	630.04	NI	638.03	623.79	NI	629.77	622.47	NI
December 5, 2019	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NM	NM	NI	NM	620.60	NI
February 5, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NI	NM	NM	NI	NM	620.83	NI
May 20-21, 2020	649.40	661.08	674.36	656.06	672.16	670.46	650.20	624.46	627.68	623.19	637.98	621.57	624.88	627.24	620.43	620.40
July 6, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	624.20	NM	NM	625.76	NM	NM	621.66
August 19-21, 2020	NM	NM	NM	NM	NM	NM	650.88	625.02	627.53	623.52	638.22	621.75	NM	626.98	620.37	620.63
October 19-20, 2020	648.14	660.42	673.35	654.95	671.21	669.55	649.50	624.42	627.14	623.03	636.96	621.40	624.41	626.54	619.92	620.17
Bottom of Well Elevation (ft)	633.95	647.18	654.23	636.69	650.27	620.14	638.79	614.01	616.90	589.93	627.97	620.43	588.60	617.87	611.48	584.56

Notes: NM = not measured NI = not installed AB = abandoned

1. The groundwater elevations recorded for MW11 on 2/19/04, 11/18/04, and 5/05/05 are not considered reliable due to a minimal quantity of water observed in the well. The actual water table elevation could be lower than the reported value.
2. MW3 could not be located during this sampling event.
3. Repairs were completed at MW3 in July 2013. Elevations calculated for February, April, and July 2013 are estimates based on the old top of casing elevation (657.36 feet amsl). MW3 was re-surveyed on June 3, 2014.
4. MW1 was repaired in April 2013. Groundwater elevations measured before this date are calculated using the old top of casing elevation (637.60 ft amsl).
5. TW18 was damaged and could not be accessed for a water level measurement in April 2016. The well was repaired in July 2016.

Created by: MDB Date: 8/9/2013
Last revision by: ACW Date: 10/22/2020
Checked by: RM Date: 10/22/2020

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Table 2. CCR Rule Groundwater Samples Summary
Lansing Generating Station / SCS Engineers

Sample Dates	Downgradient Wells									Background Well
	MW-301	MW-302	MW-302A	MW-303	MW-304	MW-304A	MW-305	MW-306	MW-306A	MW-6
12/10/2015	B	B	NI	B	NI	NI	NI	NI	NI	B
4/29/2016	B	B	NI	B	NI	NI	NI	NI	NI	B
7/20/2016	B	B	NI	B	NI	NI	NI	NI	NI	B
10/26-27/2016	B	B	NI	B	NI	NI	NI	NI	NI	B
1/17-18/2017	B	B	NI	B	NI	NI	NI	NI	NI	B
4/19/2017	B	B	NI	B	NI	NI	NI	NI	NI	B
6/19-20/2017	B	B	NI	B	NI	NI	NI	NI	NI	B
8/15/2017	B	B	NI	B	NI	NI	NI	NI	NI	B
10/16/2017	D	D	NI	D	NI	NI	NI	NI	NI	D
4/16/2018	A	A	NI	A	NI	NI	NI	NI	NI	A
4/26/2018	--	--	NI	--	NI	NI	NI	NI	NI	A-R
6/4/2018	A-R	A-R	NI	A-R	NI	NI	NI	NI	NI	--
8/7/2018	A	A	NI	A	NI	NI	NI	NI	NI	A
10/8/2018	A	A	NI	A	NI	NI	NI	NI	NI	A
4/15/2019	A	A	NI	A	NI	NI	NI	NI	NI	A
6/20/2019	--	--	NI	--	A	NI	A	A	NI	--
10/2/2019	A	A	NI	A	A	NI	A	A	NI	A
12/5/2019	--	--	NI	--	--	NI	--	A-R	NI	--
2/5/2020	--	--	NI	--	--	NI	--	A-R	NI	A
5/19-20/2020	A	A	A	A	A	A	A	A	A	A
7/6/2020	--	--	A	A	--	A	--	--	A	--
8/18-19/2020	A-R	A-R	A-R	A-R	A-R	A-R	A-R	A-R	A-R	A-R
10/19/2020	A	A	A	A	A	A	A	A	A	A

Abbreviations:
B = Background Sample Event
D = Detection Monitoring Program Event
-- = Not Applicable
A = Assessment Monitoring Sample Event
A-R = Assessment Monitoring Resample Event
NI = Not Installed

Created by: NDK Date: 1/8/2018
Last revision by: TK Date: 11/23/2020
Checked by: NDK Date: 11/23/2020

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Table 3. Groundwater Analytical Results Summary - Assessment Monitoring
Lansing Generating Station / SCS Engineers Project #25220100.00

Parameter Name	UPL Method	UPL	GPS	Background Well MW-6 10/16/2017	MW-6 4/16/2018, 4/26/2018 ^	MW-6 8/7/2018	MW-6 10/8/2018	MW-6 4/15/2019	MW-6 10/2/2019	MW-6 5/19/2020	MW-6 8/19/2020	MW-6 10/20/2020	Compliance Wells MW-301 10/16/2017	MW-301 4/16/2018, 6/4/2018 ^	MW-301 8/7/2018	MW-301 10/8/2018	MW-301 4/15/2019	MW-301 10/2/2019	MW-301 5/19/2020	MW-301 8/18/2020	MW-301 10/19/2020
Appendix III																					
Boron, ug/L	P*	100		41.2 J	29.8 J	42.9 J	40.2 J	<110	<110	<73	NA	<80	436	198.0	279	357	250	360	150	NA	260
Calcium, mg/L	P	73.9		66.9	72.7	66.5	69.6	67	70	72	76	69	65.9	64.5	65.1	72.5	73	68	56	65	57
Chloride, mg/L	P	8.52		6.5	6.5	7.3	6.6	6.7	6.9	7.7	6.8	5.6	17.3	20.2	17.7	15.9	17	14	17	15	15
Fluoride, mg/L	P*	0.2		0.14 J	0.084 J	0.12 J	<0.19	0.63	<0.23	<0.23	NA	<0.23	0.24	0.24	0.23	0.27	0.9	0.23 J	0.56	NA	<0.23
Field pH, Std. Units	P	7.9		7.03	7.34	7.18	7.06	7.59	7.46	7.34	7.98	7.42	7.66	8.4	8.08	8.16	8.47	8.11	7.85	8.33	8.06
Sulfate, mg/L	P	29.4		25.8	26.4	24.8	25.5	26	24	27	25	25	52.7	49.3	53.2	64.4	51	56	34	44	48
Total Dissolved Solids, mg/L	P	386.7		318	343	351	319	340	280	580	NA	300	289	300.0	326	320	350	310	480	NA	280
Appendix IV		**UPL**	**GPS**																		
Antimony, ug/L	NP*	0.037	6	NA	<0.026	<0.15	<0.078	<0.53	NA	<0.58	NA	NA	NA	0.071 J	0.16 J	0.085 J	<0.53	NA	<0.58	NA	NA
Arsenic, ug/L	P*	0.37	10	NA	0.23 J	0.26 J	0.24 J	<0.75	<0.75	<0.88	NA	<0.88	NA	3.9	4.4	5.4	5.4	5.6	3.8	NA	6
Barium, ug/L	P	48.5	2,000	NA	44.1	43.1	43	43	46	46	NA	45	NA	163	156	155	160	180	140	NA	150
Beryllium, ug/L	DQ	DQ	4	NA	<0.012	<0.12	<0.089	<0.27	NA	<0.27	NA	NA	NA	<0.012	<0.12	<0.089	<0.27	NA	<0.27	NA	NA
Cadmium, ug/L	DQ	DQ	5	NA	<0.018	NA	<0.033	<0.077	NA	<0.039	NA	<0.049	NA	<0.018	NA	<0.033	<0.077	NA	<0.039	NA	<0.049
Chromium, ug/L	P	1.20	100	NA	0.66 J	0.97 J	0.73 J	<0.98	<0.98	<1.1	NA	<1.1	NA	1.1	<0.19	0.09 J	<0.98	<0.98	<1.1	NA	<1.1
Cobalt, ug/L	NP*	0.34	6	NA	<0.014	<0.15	<0.062	<0.091	<0.091	<0.091	NA	<0.091	NA	0.086 J	0.16 J	0.11 J	0.11 J	0.11 J	0.11 J	NA	0.11 J
Fluoride, mg/L	P*	0.2	4	NA	0.084 J	0.12 J	<0.19	0.63	<0.23	<0.23	NA	<0.23	NA	0.24	0.23	0.27	0.90	0.23 J	0.56	NA	<0.23
Lead, ug/L	NP*	0.13	15	NA	<0.033	<0.12	<0.13	<0.27	<0.27	<0.27	NA	<0.11	NA	0.037 J	<0.12	<0.13	<0.27	<0.27	<0.27	NA	<0.11
Lithium, ug/L	NP*	3	40	NA	<4.6	NA	<4.6	<2.7	<2.7	<2.3	NA	<2.5	NA	<4.6	NA	9.1 J	8.7 J	8.0 J	7.0 J	NA	7.9 J
Mercury, ug/L	DQ	DQ	2	NA	<0.090	<0.090	<0.090	<0.10	NA	<0.10	NA	NA	NA	0.31	<0.090	<0.090	<0.10	NA	<0.10	NA	NA
Molybdenum, ug/L	P*	0.37	100	NA	0.26 J	0.28 J	<0.57	<1.1	<1.1	<1.1	<1.1	<1.1	NA	4.4	5.6	10.3	11	10	8.1	5.8	7.5
Selenium, ug/L	P*	0.72	50	NA	0.47 J	0.5 J	0.46 J	<1.0	NA	<1.0	NA	<1.0	NA	<0.086	0.22 J	0.18 J	<1.0	NA	<1.0	NA	<1.0
Thallium, ug/L	NP*	0.29	2	NA	<0.036	NA	<0.099	<0.27	NA	<0.26	NA	NA	NA	<0.036	NA	<0.099	<0.27	NA	<0.26	NA	NA
Radium 226/228 Combined,	P	1.88	5	NA	1.35	0.974	1.37	0.255	0.495	0.504	NA	pending	NA	0.689	1.66	0.556	0.232	0.488	0.200	NA	pending
Additonal Parameters - Selection of Remedy																					
Arsenic, dissolved#, ug/L	UPL or GPS not applicable			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium, ug/L				NA	NA	NA	NA	NA	NA	NA	NA	74,000	NA	NA	NA	NA	NA	NA	NA	NA	62,000
Iron, dissolved,# ug/L				NA	NA	NA	NA	NA	NA	NA	<50.0	<50.0	NA	NA	NA	NA	NA	NA	NA	330	110
Iron, ug/L				NA	NA	NA	NA	NA	NA	NA	<50.0	<50.0	NA	NA	NA	NA	NA	NA	NA	680	500
Magnesium, ug/L				NA	NA	NA	NA	NA	NA	NA	38,000	37,000	NA	NA	NA	NA	NA	NA	NA	19,000	18,000
Manganese, dissolved, ug/L#				NA	NA	NA	NA	NA	NA	NA	6.6 J	25	NA	NA	NA	NA	NA	NA	NA	810	530
Manganese, ug/L				NA	NA	NA	NA	NA	NA	NA	4	<4.0	NA	NA	NA	NA	NA	NA	NA	800	560
Molybdenum, dissolved,ug/L#				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium, ug/L				NA	NA	NA	NA	NA	NA	NA	1.2	1,100	NA	NA	NA	NA	NA	NA	NA	3,200	3,600
Sodium, ug/L				NA	NA	NA	NA	NA	NA	NA	5,000	4,500	NA	NA	NA	NA	NA	NA	NA	13,000	11,000
Total Alkalinity, mg/L				NA	NA	NA	NA	NA	NA	NA	290	300	NA	NA	NA	NA	NA	NA	NA	200	160
Cabonate Alkalinity, mg/L				NA	NA	NA	NA	NA	NA	NA	<3.8	<3.8	NA	NA	NA	NA	NA	NA	NA	<3.8	<3.8
Bicarbonate Alkalinity, mg/L				NA	NA	NA	NA	NA	NA	NA	290	300	NA	NA	NA	NA	NA	NA	NA	200	160

4.4	Blue highlighted cell indicates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	Yellow highlighted cell indicates the compliance well result exceeds the GPS.
17	Yellow highlighted cell with bold text indicates the compliance well result exceeds the GPS and the result was determined to be statistically significant (1).
17	Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

See Page 4 for abbreviations and notes.

Table 3. Groundwater Analytical Results Summary - Assessment Monitoring
Lansing Generating Station / SCS Engineers Project #25220100.00

Parameter Name	UPL Method	UPL	GPS	Compliance Wells																					
				MW-302									MW-302A				MW-303								
				10/16/2017	4/16/2018, 6/4/2018 ^	8/7/2018	10/8/2018	4/15/2019	10/2/2019	5/20/2020	8/19/2020	10/19/2020	5/20/2020	7/6/2020	8/19/2020	10/19/2020	10/16/2017	4/16/2018, 6/4/2018 ^	8/7/2018	10/8/2018	4/15/2019	10/2/2019	5/19/2020	8/18/2020	10/19/2020
Appendix III																									
Boron, ug/L	P*	100		708	489	648	694	690	690	480	NA	640	190	250	NA	160	592	144	675	474	150 J	520	150	NA	370
Calcium, mg/L	P	73.9		116	120	116	122	130	130	120	130	110	79	78	81	72	84.7	54.6	46.0	35.3	49	46	54	58	34
Chloride, mg/L	P	8.52		13.9	13.0	13.9	13.5	13	12	14	12	11	7.8	6.9	7.1	6	17.2	24.1	14.6	16.3	18	16	15	16	15
Fluoride, mg/L	P*	0.2		0.28	0.24	0.23	0.27	0.79	0.24 J	0.25 J	0.27 J	<0.23	<0.23	<0.23	NA	<0.23	0.25	0.32	0.47	0.72	1.0	0.42 J	0.38 J	NA	<0.23
Field pH, Std. Units	P	7.9		7.1	7.26	6.92	6.93	7.66	7.15	6.93	7.18	7.06	7.27	7.22	7.41	7.33	7.20	8.00	7.66	7.91	7.95	7.83	7.67	7.65	7.77
Sulfate, mg/L	P	29.4		<0.5	<0.24	<0.24	<0.24	<1.8	<1.8	<3.6	<3.6	<3.6	53	47	49	47	69.9	43.5	52.5	29.1	35	39	42	33	20
Total Dissolved Solids, mg/L	P	386.7		507	543	562	518	450	480	710	NA	490	520	350	NA	350	379	296	262	181	280	210	450	NA	180
Appendix IV		**UPL**	**GPS**																						
Antimony, ug/L	NP*	0.037	6	NA	0.035 J	<0.15	<0.078	<0.53	NA	<0.58	NA	NA	<0.58	<0.51	NA	NA	NA	0.16 J	0.34 J	0.19 J	<0.53	NA	<0.58	NA	NA
Arsenic, ug/L	P*	0.37	10	NA	30.8	47.6	50.4	37	**53**	**33**	NA	**48**	<0.88	<0.88	NA	<0.88	NA	1.2	2.3	2.3	1.4 J	2.5	1.4 J	NA	3.2
Barium, ug/L	P	48.5	2,000	NA	789	661	603	690	740	610	NA	630	51	47	NA	46	NA	173	194	121	160	220	210	NA	190.0
Beryllium, ug/L	DQ	DQ	4	NA	<0.012	<0.12	<0.089	<0.27	NA	<0.27	NA	NA	<0.27	<0.27	NA	NA	NA	0.046 J	<0.12	<0.089	<0.27	NA	<0.27	NA	NA
Cadmium, ug/L	DQ	DQ	5	NA	<0.018	NA	<0.033	<0.077	NA	<0.039	NA	<0.049	<0.039	<0.049	NA	<0.049	NA	<0.018	NA	<0.033	<0.077	NA	<0.039	NA	<0.049
Chromium, ug/L	P	1.20	100	NA	0.35 J	0.49 J	0.39 J	<0.98	<0.98	<1.1	NA	<1.1	<1.1	<1.1	NA	1.2 J	NA	0.51 J	0.44 J	0.089 J	<0.98	<0.98	<1.1	NA	<1.1
Cobalt, ug/L	NP*	0.34	6	NA	1.1	1.1	1.1	1.5	1.3	1.0	NA	0.86	0.41 J	0.098 J	NA	<0.091	NA	0.14 J	0.36 J	0.21 J	<0.091	0.12 J	<0.091	NA	0.098 J
Fluoride, mg/L	P*	0.2	4	NA	0.24	0.23	0.27	0.79	0.24 J	0.25 J	NA	<0.23	<0.23	<0.23	NA	<0.23	NA	0.32	0.47	0.72	1.0	0.42 J	0.38 J	NA	<0.23
Lead, ug/L	NP*	0.13	15	NA	0.084 J	0.23 J	<0.13	<0.27	<0.27	<0.27	NA	<0.11	0.48 J	0.14 J	NA	<0.11	NA	<0.033	0.24 J	<0.13	<0.27	<0.27	<0.27	NA	<0.11
Lithium, ug/L	NP*	3	40	NA	<4.6	NA	<4.6	<2.7	<2.7	<2.3	NA	<2.5	<2.3	<2.5	NA	<2.5	NA	<4.6	NA	8.1 J	3.3 J	9.1 J	4.2 J	NA	9.5 J
Mercury, ug/L	DQ	DQ	2	NA	0.35	<0.090	<0.090	<0.10	NA	<0.10	NA	NA	<0.10	<0.10	NA	NA	NA	<0.090	<0.090	<0.090	<0.10	NA	<0.10	NA	NA
Molybdenum, ug/L	P*	0.37	100	NA	0.91 J	1.2	1.5	<1.1	1.4 J	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	NA	7.3	21.6	12	6.2	9.8	3.1	23	10
Selenium, ug/L	P*	0.72	50	NA	<0.086	0.3 J	0.26 J	<1.0	NA	<1.0	NA	<1.0	1.3 J	1.1 J	NA	<1.0	NA	3.3	0.38 J	0.39 J	<1.0	NA	1.4 J	NA	<1.0
Thallium, ug/L	NP*	0.29	2	NA	<0.036	NA	<0.099	<0.27	NA	<0.26	NA	NA	<0.62	<0.26	NA	NA	NA	<0.036	NA	<0.099	<0.27	NA	<0.26	NA	NA
Radium 226/228 Combined,	P	1.88	5	NA	1.96	2.09	3.52	0.146	1.48	1.54	NA	pending	0.24	0.0963	NA	pending	NA	0.787	0.929	1.87	0.543	0.463	0.131	NA	pending
Additonal Parameters - Selection of Remedy																									
Arsenic, dissolved#, ug/L	UPL or GPS not applicable			NA	NA	NA	NA	NA	NA	NA	46	44	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium, ug/L				NA	NA	NA	NA	NA	NA	NA	NA	130,000	NA	NA	NA	81,000	NA	NA	NA	NA	NA	NA	NA	NA	35,000
Iron, dissolved,# ug/L				NA	NA	NA	NA	NA	NA	NA	32,000	30,000	NA	NA	330	56 J	NA	NA	NA	NA	NA	NA	NA	<50	<50
Iron, ug/L				NA	NA	NA	NA	NA	NA	NA	33,000	33,000	NA	NA	230	<50	NA	NA	NA	NA	NA	NA	NA	<50	<50
Magnesium, ug/L				NA	NA	NA	NA	NA	NA	NA	43,000	42,000	NA	NA	39, 000	38,000	NA	NA	NA	NA	NA	NA	NA	19,000	13,000
Manganese, dissolved, ug/L#				NA	NA	NA	NA	NA	NA	NA	2,800	2,500	NA	NA	38	10	NA	NA	NA	NA	NA	NA	NA	120	160
Manganese, ug/L				NA	NA	NA	NA	NA	NA	NA	2,800	2,700	NA	NA	19	<4.0	NA	NA	NA	NA	NA	NA	NA	120	180
Molybdenum, dissolved,ug/L#				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium, ug/L				NA	NA	NA	NA	NA	NA	NA	4,700	4,300	NA	NA	1,200	1,000	NA	NA	NA	NA	NA	NA	NA	5,600	2,200
Sodium, ug/L				NA	NA	NA	NA	NA	NA	NA	17,000	17,000	NA	NA	7,500	6,700	NA	NA	NA	NA	NA	NA	NA	13,000	12,000
Total Alkalinity, mg/L				NA	NA	NA	NA	NA	NA	NA	530	540	NA	NA	290	300	NA	NA	NA	NA	NA	NA	NA	190	120
Cabonate Alkalinity, mg/L				NA	NA	NA	NA	NA	NA	NA	<7.6	<3.8	NA	NA	<3.8	<3.8	NA	NA	NA	NA	NA	NA	NA	<3.8	<3.8
Bicarbonate Alkalinity, mg/L				NA	NA	NA	NA	NA	NA	NA	530	540	NA	NA	290	300	NA	NA	NA	NA	NA	NA	NA	190	120

4.4	Blue highlighted cell indicates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	Yellow highlighted cell indicates the compliance well result exceeds the GPS.
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17	Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

See Page 4 for abbreviations and notes.

Table 3. Groundwater Analytical Results Summary - Assessment Monitoring
Lansing Generating Station / SCS Engineers Project #25220100.00

Compliance Wells

Parameter Name	UPL Method	UPL	GPS	MW-304					MW-304A			
				6/20/2019	10/2/2019	5/20/2020	8/19/2020	10/19/2020	5/20/2020	7/6/2020	8/19/2020	10/19/2020
Appendix III												
Boron, ug/L	P*	100		<110	<110	<73	NA	<80	1,800	1,700	NA	1700
Calcium, mg/L	P	73.9		82	72	70	77	66	54	41	50	35
Chloride, mg/L	P	8.52		5.9	7.0	6.2	7.7	6.2	15	13	13	12
Fluoride, mg/L	P*	0.2		<0.23	<0.23	<0.23	NA	<0.23	0.57	0.42 J	NA	<0.23
Field pH, Std. Units	P	7.9		7.01	7.16	7.32	7.55	7.16	8.04	7.90	8.48	7.89
Sulfate, mg/L	P	29.4		20	17	17	15	16	83	77	76	76
Total Dissolved Solids, mg/L	P	386.7		350	300	470	NA	270	680	330	NA	310
Appendix IV		**UPL**	**GPS**									
Antimony, ug/L	NP*	0.037	6	<0.53	NA	<0.58	NA	NA	<0.58	<0.51	NA	NA
Arsenic, ug/L	P*	0.37	10	<0.75	<0.75	<0.88	NA	<0.88	1.3 J	<0.88	NA	<0.88
Barium, ug/L	P	48.5	2,000	54	47	42.0	NA	42.0	67.0	34.0	NA	28.0
Beryllium, ug/L	DQ	DQ	4	<0.27	NA	<0.27	NA	NA	<0.27	<0.27	NA	NA
Cadmium, ug/L	DQ	DQ	5	<0.077	NA	<0.039	NA	<0.049	0.19	0.098 J	NA	0.07 J
Chromium, ug/L	P	1.20	100	1.6 J	1.0 J	8.2	NA	<1.1	2.2 J	1.1 J	NA	<1.1
Cobalt, ug/L	NP*	0.34	6	1.1	0.19 J	0.22 J	NA	<0.091	3.2	0.83	NA	0.43 J
Fluoride, mg/L	P*	0.2	4	<0.23	<0.23	<0.23	NA	<0.23	0.57	0.42 J	NA	<0.23
Lead, ug/L	NP*	0.13	15	1.2	0.35 J	<0.27	NA	<0.11	4.3	1.2	NA	0.48 J
Lithium, ug/L	NP*	3	40	<2.7	<2.7	<2.3	NA	<2.5	2.7 J	<2.5	NA	<2.5
Mercury, ug/L	DQ	DQ	2	<0.10	NA	<0.10	NA	NA	<0.10	<0.10	NA	NA
Molybdenum, ug/L	P*	0.37	100	<1.1	<1.1	<1.1	1.2 J	<1.1	110	140	140	**130**
Selenium, ug/L	P*	0.72	50	<1.0	NA	<1.0	NA	<1.0	<1.0	<1.0	NA	<1.0
Thallium, ug/L	NP*	0.29	2	<0.27	NA	<0.26	NA	NA	<0.26	<0.26	NA	NA
Radium 226/228 Combined,	P	1.88	5	0.0356	0.900	0.0689	NA	pending	0.630	0.573	NA	pending
Additonal Parameters - Selection of Remedy												
Arsenic, dissolved#, ug/L	UPL or GPS not applicable			NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium, ug/L				NA	NA	NA	NA	75,000	NA	NA	NA	35,000
Iron, dissolved,# ug/L				NA	NA	NA	<50.0	<50.0	NA	NA	<50	55 J
Iron, ug/L				NA	NA	NA	51 J	<50.0	NA	NA	940	270
Magnesium, ug/L				NA	NA	NA	36,000	35,000	NA	NA	21,000	16,000
Manganese, dissolved, ug/L#				NA	NA	NA	6.9 J	4.1 J	NA	NA	16	7.3 J
Manganese, ug/L				NA	NA	NA	11	6.0 J	NA	NA	99	26
Molybdenum, dissolved,ug/L#				NA	NA	NA	NA	NA	NA	NA	NA	140
Potassium, ug/L				NA	NA	NA	1,500	1,300	NA	NA	830	680
Sodium, ug/L				NA	NA	NA	5,600	6,100	NA	NA	69,000	63,000
Total Alkalinity, mg/L				NA	NA	NA	300	310	NA	NA	190	190
Cabonate Alkalinity, mg/L				NA	NA	NA	<3.8	<3.8	NA	NA	<7.6	<3.8
Bicarbonate Alkalinity, mg/L				NA	NA	NA	300	310	NA	NA	190	190

Parameter Name	MW-305					MW-306							MW-306A			
	6/20/2019	10/2/2019	5/19/2020	8/18/2020	10/20/2020	6/20/2019	10/2/2019	12/5/2019	2/5/2020	5/19/2020	8/18/2020	10/20/2020	5/19/2020	7/6/2020	8/18/2020	10/20/2020
Appendix III																
Boron, ug/L	180 J	190 J	210	NA	220	860	660	NA	NA	720	NA	720	290	340	NA	280
Calcium, mg/L	92	97	82	90	76	240	260	NA	NA	340	290	260	83	82	86	76
Chloride, mg/L	6.8	3.2 J	7.5	6.9	6	24	40	NA	NA	32	28	27	7.8	7.1	7.4	7.2
Fluoride, mg/L	<0.23	<0.23	0.23 J	NA	<0.23	<0.23	<0.23	NA	NA	<0.23	NA	<0.23	<0.23	<0.23	NA	<0.23
Field pH, Std. Units	7.19	7.03	6.90	7.23	7.24	6.87	9.00	6.76	6.95	6.66	7.12	6.88	6.99	7.04	7.38	7.18
Sulfate, mg/L	24	26	<3.6	<3.6	<3.6	280	140	NA	NA	430	260	220	44	40	41	41
Total Dissolved Solids, mg/L	440	380	540	NA	320	1,200	1,300	NA	NA	3,400	NA	1,100	610	360	NA	350
Appendix IV																
Antimony, ug/L	<0.53	NA	<0.58	NA	NA	<0.53	NA	NA	NA	<0.58	NA	NA	<0.58	<0.51	NA	NA
Arsenic, ug/L	2.2	3.4	3.6	NA	5.6	8.6	12	9.3	9.4	8.5	NA	10	<0.88	<0.88	NA	<0.88
Barium, ug/L	170	190	220	NA	200.0	280	540	NA	NA	260	NA	250	61.0	58.0	NA	58.0
Beryllium, ug/L	<0.27	NA	<0.27	NA	NA	<0.27	NA	NA	NA	<0.27	NA	NA	<0.27	<0.27	NA	NA
Cadmium, ug/L	<0.077	NA	<0.039	NA	<0.049	<0.077	NA	NA	NA	<0.039	NA	<0.049	<0.039	<0.049	NA	<0.049
Chromium, ug/L	<0.98	<0.98	<1.1	NA	<1.1	<0.98	<0.98	NA	NA	<1.1	NA	<1.1	<1.1	<1.1	NA	<1.1
Cobalt, ug/L	0.52	0.27 J	0.32 J	NA	0.12 J	1.0	0.98	NA	NA	0.53	NA	0.2 J	0.33 J	0.18 J	NA	0.22 J
Fluoride, mg/L	<0.23	<0.23	0.23 J	NA	<0.23	<0.23	<0.23	NA	NA	<0.23	NA	<0.23	<0.23	<0.23	NA	<0.23
Lead, ug/L	<0.27	<0.27	<0.27	NA	<0.11	0.52	<0.27	NA	NA	<0.27	NA	<0.11	<0.27	<0.11	NA	<0.11
Lithium, ug/L	3.4 J	4.6 J	<2.3	NA	<2.5	19	25	NA	NA	25	NA	26	<2.3	<2.5	NA	<2.5
Mercury, ug/L	<0.10	NA	<0.10	NA	NA	<0.10	NA	NA	NA	<0.10	NA	NA	<0.10	<0.10	NA	NA
Molybdenum, ug/L	1.7 J	1.6 J	<1.1	1.8 J	<1.1	<1.1	<1.1	NA	NA	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
Selenium, ug/L	<1.0	NA	<1.0	NA	<1.0	<1.0	NA	NA	NA	<1.0	NA	<1.0	<1.0	<1.0	NA	<1.0
Thallium, ug/L	<0.27	NA	<0.26	NA	NA	<0.27	NA	NA	NA	<0.26	NA	NA	<0.26	<0.26	NA	NA
Radium 226/228 Combined,	0.553	0.557	0.837	NA	pending	0.897	1.79	NA	NA	1.05	NA	pending	1.12	0.525	NA	pending
Additonal Parameters - Selection of Remedy																
Arsenic, dissolved#, ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium, ug/L	NA	NA	NA	NA	87,000	NA	NA	NA	NA	NA	NA	280,000	NA	NA	NA	85,000
Iron, dissolved,# ug/L	NA	NA	NA	11,000	10,000	NA	NA	NA	NA	NA	44,000	39,000	NA	NA	1,900	1,600
Iron, ug/L	NA	NA	NA	13,000	12,000	NA	NA	NA	NA	NA	43,000	40,000	NA	NA	2,100	1,900
Magnesium, ug/L	NA	NA	NA	32,000	32,000	NA	NA	NA	NA	NA	54,000	46,000	NA	NA	38,000	37,000
Manganese, dissolved, ug/L#	NA	NA	NA	2,000	1,800	NA	NA	NA	NA	NA	5,100	4,800	NA	NA	1,200	1,100
Manganese, ug/L	NA	NA	NA	2,000	1,800	NA	NA	NA	NA	NA	5,200	4,800	NA	NA	1,200	1,100
Molybdenum, dissolved,ug/L#	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium, ug/L	NA	NA	NA	2,200	1,800	NA	NA	NA	NA	NA	8,200	7,100	NA	NA	1,400	1,200
Sodium, ug/L	NA	NA	NA	8,900	7,700	NA	NA	NA	NA	NA	110,000	110,000	NA	NA	12,000	11,000
Total Alkalinity, mg/L	NA	NA	NA	340	340	NA	NA	NA	NA	NA	850	800	NA	NA	330	320
Cabonate Alkalinity, mg/L	NA	NA	NA	<7.6	<3.8	NA	NA	NA	NA	NA	<7.6	<3.8	NA	NA	<7.6	<1.9
Bicarbonate Alkalinity, mg/L	NA	NA	NA	340	340	NA	NA	NA	NA	NA	850	800	NA	NA	330	320

4.4	Blue highlighted cell indicates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	Yellow highlighted cell indicates the compliance well result exceeds the GPS.
17	Yellow highlighted cell with bold text indicates the compliance well result exceeds the GPS and the result was determined to be statistically significant (1).
17	Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

See Page 4 for abbreviations and notes.

Table 3. Groundwater Analytical Results Summary - Assessment Monitoring
Lansing Generating Station / SCS Engineers Project #25220100.00

Abbreviations:

UPL = Upper Prediction Limit	LOD = Limit of Detection	DQ = Double Quant
NA = Not Analyzed	LOQ = Limit of Quantitation	NP = Nonparametric UPL (highest background value)
µg/L = micrograms per liter		P = Parametric UPL with 1-of-2 retesting
mg/L = milligrams per liter		GPS = Groundwater Protection Standard

J = Estimated concentration at or above the LOD and below the LOQ.
DQ = Double Quantification rule applies (not detected in background samples)
# = Dissolved parameter samples collected for MNA data review

Notes:

1. An individual result above the UPL or GPS does not constitute a statistically significant increase (SSI) above background or statistically significant level above the GPS. The arsenic GPS exceedances at MW-3 have been determined to be statistically significant. The arsenic GPS exceedance at MW-306 has been determined not to be statistically significant. The molybdenum GPS exceedance has either been determined not to be statistically significant or the determination is ongoing. See the accompanying report text for additional information regarding determinations of statistical significance.
2. GPS is the United States Environmental Protection Agency (US EPA) Maximum Contamination Level (MCL), if established; otherwise, the value from 40 CFR 257.95(h)(2) is used.
3. Interwell UPLs calculated based on results from background well MW-6.

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Last revision by:	NDK	Date:	11/14/2020
Checked by:	ACW	Date:	11/17/2020
Proj Mgr QA/QC:	TK	Date:	11/24/2020

Table 4. Field Monitoring Data
Lansing Generating Station
October 2017 - July 2020

Well	Parameter	Field pH (Std. Units)	Field Oxidation Potential (mV)	Field Specific Conductance (umhos/cm)	Field Temperature (deg C)	Groundwater Elevation (feet)	Oxygen, Dissolved (mg/L)	Turbidity (NTU)
MW-6	10/16/2017	7.03	282	591	10.2	669.58	8.8	0
	4/26/2018	7.34	35	569	11.1	667.96	3.46	0.81
	8/7/2018	7.18	233	609	10.5	668.13	7.4	1.77
	10/8/2018	7.06	119	587	11.5	664.71	9.1	0.01
	4/15/2019	7.59	274	618	10.0	672.78	8.7	0.75
	10/2/2019	7.46	89	590	10.0	675.54	10.29	0.7
	5/20/2020	7.34	120	597	10.0	674.47	9.2	0.01
MW-301	10/16/2017	7.66	-221	497	17.0	625.70	0	0.05
	4/16/2018	8.39	-40	505	9.5	624.29	1	8.31
	6/4/2018	8.10	-145.5	507	12.2	624.62	0.9	2.72
	8/7/2018	8.08	-149	524	14.6	624.51	0.2	5.5
	10/8/2018	8.16	-180	545	17.4	625.73	0.3	9.19
	4/15/2019	8.47	-171	539	11.3	629.19	0.2	9.33
	10/2/2019	8.11	-156.8	502	15.6	626.54	0.13	1.36
	5/19/2020	7.85	-77.6	474	11.3	624.46	0.75	1.39
MW-302	10/16/2017	7.10	-179	1045	16.2	628.75	0	3.96
	4/16/2018	7.26	-152	1098	6.0	628.98	0.8	5.25
	6/4/2018	6.97	-179.3	1068	10.8	628.27	0.12	1.46
	8/7/2018	6.92	-164	1095	15.3	627.62	0.1	11.23
	10/8/2018	6.93	-43.9	1039	17.0	628.59	0.48	5.92
	4/15/2019	7.66	-159	1089	7.1	629.99	0.2	18.39
	10/2/2019	7.15	-160	1049	15.9	630.04	0.11	4.71
	5/20/2020	6.93	-161.5	1070	8.7	627.68	0.19	4.16
MW-302A	5/20/2020	7.27	126.9	644	11.7	623.19	6.55	11.9
	7/6/2020	7.22	47	641	11.7	624.20	6.6	4.68

Table 4. Field Monitoring Data
Lansing Generating Station
October 2017 - July 2020

Well	Parameter	Field pH (Std. Units)	Field Oxidation Potential (mV)	Field Specific Conductance (umhos/cm)	Field Temperature (deg C)	Groundwater Elevation (feet)	Oxygen, Dissolved (mg/L)	Turbidity (NTU)
MW-303	10/16/2017	7.20	49	687	25.2	638.79	1.9	0
	4/16/2018	8.00	53	552	4.1	638.62	3.5	0.4
	6/4/2018	7.59	68	431	17.0	638.81	0.36	1.08
	8/7/2018	7.66	-71	425	31.5	637.85	0.4	4.51
	10/8/2018	7.91	139	328	28.5	637.32	0.4	2.62
	4/15/2019	7.95	-76	448	4.2	638.22	1.4	6.6
	10/2/2019	7.83	156	409	25.2	638.03	0.27	0.58
	5/19/2020	7.67	28.9	464	6.3	637.98	1.29	0
MW-304	6/20/2019	7.01	41	593	10.6	0.00	6.2	104
	10/2/2019	7.16	107.3	578	12.4	623.79	7.51	3.51
	5/20/2020	7.32	104.9	574	9.0	621.57	7.78	3.72
MW-304A	5/20/2020	8.04	61.8	529	12.6	624.88	0.48	585.9
	7/6/2020	7.90	-15.8	541	19.1	625.76	0.3	181.9
MW-305	6/20/2019	7.19	27	638	15.5	0.00	0.2	9.6
	10/2/2019	7.03	-105.6	635	19.0	629.77	0.21	8.87
	5/19/2020	6.90	-138	684	9.8	627.24	0.48	20.44
MW-306	6/20/2019	6.87	22	1632	13.8	0.00	1	25.9
	10/2/2019	9.00	-1205	1998	16.3	622.47	0.27	3.67
	12/5/2019	6.76	-127	2196	16.3	620.60	0.9	10.26
	2/5/2020	6.95	-127.7	2477	13.7	620.83	0.23	4.43
	5/19/2020	6.66	-137	2332	12.7	620.43	0.3	2.63
MW-306A	5/19/2020	6.99	-21.7	697	14.6	620.40	1.18	4.15
	7/6/2020	7.04	-55.8	683	15.3	621.66	1.24	1.4

Table 5. Historical Groundwater Arsenic Results for State Monitoring Wells
Alliant-Lansing CCR Landfill
(Results are in µg/L, unless otherwise noted)

Sample	Date	Arsenic (µg/L)
MW3	5/11/2001	<1.8
MW4	5/11/2001	<1.8
	3/8/2002	<0.88
	2/19/2004	<3.5
	5/26/2004	3.3
	8/23/2004	<0.79
	11/18/2004	<0.79
	5/5/2005	<0.79
	5/19/2006	2.9
	5/30/2007	<1
	4/16/2008	<0.43
	4/3/2009	0.27 J
	4/21/2010	<1.0
	5/4/2011	<1.0
	5/4/2011 (Dup)	<2.0 RL
	4/25/2012	<1.0
	4/2/2013	<1.0
	7/2/2013	<1.0
	4/29/2014	0.62 J
	5/29/2014	<0.18
	4/21/2015	<0.25
	4/28/2016	0.30 J
	4/20/2017	0.33 J
MW5	3/8/2002	<0.88
	2/19/2004	<3.5
	5/26/2004	4.7
	8/23/2004	0.92
	11/18/2004	<0.79
	5/5/2005	<0.79
	5/19/2006	<0.79
	5/30/2007	<1
	4/16/2008	<0.43
	04/16/08 (Dup)	<0.43
	4/3/2009	0.22 J
	4/21/2010	<1.0
	4/21/2010 (Dup)	<1.0
	5/4/2011	<1.0
	4/25/2012	<1.0
	4/2/2013	<1.0
	7/2/2013	<1.0
	4/29/2014	0.65 J
	5/29/2014	1.3
	4/21/2015	<0.25
	4/28/2016	0.26 J
	4/20/2017	0.26 J

Table 5. Historical Groundwater Arsenic Results for State Monitoring Wells
Alliant-Lansing CCR Landfill
(Results are in µg/L, unless otherwise noted)

Sample	Date	Arsenic (µg/L)
MW6	5/11/2001	<1.8
	3/8/2002	<0.88
	2/19/2004	<3.5
	5/26/2004	3.9
	8/23/2004	<0.79
	11/18/2004	<0.79
	5/5/2005	<0.79
	5/19/2006	0.93 J
	5/30/2007	<1.0
	4/16/2008	<0.43
	4/3/2009 (Dup)	0.29 J
	4/3/2009	0.29 J
	4/21/2010	<1.0
	5/4/2011	<1.0
	4/25/2012	<1.0
	4/2/2013	<1.0
	7/2/2013	<1.0
	4/29/2014	0.55 J
	4/20/2015	<0.25
	4/29/2016	0.26 J
	4/19/2017	0.27 J
	4/16/2018	0.19 J
	4/15/2019	<0.75
MW11	3/8/2002	**23**
	5/26/2004	**16**
	8/23/2004	3.8
MW11R	4/21/2010	2.44
	5/4/2011	**11.6**
	4/25/2012	**13.6**
	4/25/2012 (Dup)	**15.7**
	4/2/2013	**25**
	7/2/2013	**23**
	4/30/2014	**27**
	5/29/2014	**27**
	4/21/2015	**23**
	4/28/2016	**33.4**
	4/20/2017	**30.4**
	4/17/2018	**28.5**
	4/16/2019	**28**
MW12	4/2/2013	**16**
	7/2/2013	**17**
	4/30/2014	**16**
	5/29/2014	**14**
	4/21/2015	**13**
	4/28/2016	**24.2**
	4/20/2017	**19.4**
	4/17/2018	**20.6**
	4/16/2019	**20**

Table 5. Historical Groundwater Arsenic Results for State Monitoring Wells
Alliant-Lansing CCR Landfill
(Results are in µg/L, unless otherwise noted)

Sample	Date	Arsenic (µg/L)
MW12P	4/30/2014	1.0
	5/29/2014	0.45 J
	4/21/2015	0.34 J
	4/28/2016	0.44 J
	4/20/2017	0.88 J
	4/17/2018	0.51 J
	4/16/2019	<0.75
MW13	4/2/2013	1.1
	7/2/2013	<1.0
	7/2/2013 (Dup)	<1.0
	4/30/2014	1.6
	5/29/2014	0.65 J
	4/20/2015	1.1
	4/28/2016	3.5
	4/20/2017	1.5
	4/17/2018	0.89 J
	4/16/2019	<0.75
MW14	4/2/2013	<1.0
	7/2/2013	<1.0
	4/30/2014	0.54 J
	5/29/2014	<0.18
	4/20/2015	<0.25
	4/29/2016	0.16 J
	4/20/2017	0.68 J
	4/17/2018	0.16 J
	4/15/2019	<0.75
MW15	4/30/2014	0.95 J
	5/29/2014	0.82 J
	4/20/2015	0.79 J
	4/29/2016	0.39 J
	4/20/2017	0.42 J
	4/17/2018	0.14 J
	4/16/2019	<0.75
TW17	4/30/2014	0.87 J
	5/29/2014	0.25 J
TW18	4/30/2014	1.40
	5/29/2014	<0.18
	4/20/2015	0.47 J
	4/20/2017	1.2
	4/17/2018	2.1
	4/16/2019	<0.75
TW19	4/30/2014	4.6
	5/29/2014	0.59 J
Groundwater Protection Standard (GPS)		10

Abbreviations:
µg/L = micrograms per liter

Notes:
Bold+underlined values meet or exceed GPS.

Laboratory Notes/Qualifiers:
J = Estimated value. Analyte detected at a level less than the reporting limit and greater than or equal to the Method Detection Limit. The user of this data should be aware that this data is of unknown quality.
RL = Reporting limit raised due to sample matrix effects.

Created by:	TLC	Date:	8/20/2013
Last revision by:	SCC	Date:	8/7/2019
Checked by:	NDK	Date:	8/8/2019

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Table 6. Preliminary Evaluation of Corrective Measure Alternatives
Lansing Generating Station / SCS Engineers Project #25220100.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate and Cap with MNA	Alternative #4 Excavate CCR and Dispose On Site with MNA	Alternative #5 Excavate CCR and Dispose Off Site	Alternative #6 Consolidate and Cap with Chemical Amendment	Alternative #7 Consolidate and Cap with Groundwater Collection	Alternative #8 Consolidate and Cap with Barrier Wall
CORRECTIVE ACTION ASSESSMENT - 40 CFR 257.97(b)								
257.97(b)(1) Is remedy protective of human health and the environment?	Potentially	Yes	Yes	Yes	Yes	Yes	Yes	Yes
257.97(b)(2) Can the remedy attain the groundwater protection standard?	Potentially	Yes	Yes	Yes	Yes	Yes	Yes	Yes
257.97(b)(3) Can the remedy control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
257.97(b)(4) Can the remedy remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible?	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR
257.97(b)(5) Can the remedy comply with standards for management of wastes as specified in §257.98(d)?	Not Applicable	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1)								
257.97(c)(1)(i) Magnitude of reduction of existing risks	No reduction of existing risk	Existing risk reduced by achieving GPS	Same as Alternative #2	Same as Alternative #2	Same as Alternative #2	Similar to Alternative #2. Long-term risk may be reduced with additional source control and in-situ stabilization/fixation of CCR that may be in contact with groundwater.	Similar to Alternative #2. Groundwater extraction and treatment presents an additional risk and potential exposure pathways via surface release or disruption of treatment processes.	Similar to Alternative #2. Long-term risk may be reduced with additional containment offered by barrier wall.
257.97(c)(1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy	No reduction of existing risk Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors	Magnitude of residual risk of further releases is lower than current conditions due to final cover eliminating infiltration through CCR Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint However, limited to no additional overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with further reduction in release risk due to composite liner and cover However, limited to no additional overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with further reduction in release risk due to removal of CCR from site However, limited to no additional overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; Residual risk is further reduced by way of chemical / physical alteration of the source of impacts. However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts.	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; Residual risk is potentially reduced by way of the ability to respond to potential future/ongoing releases from CCR that might be in contact with groundwater following closure. However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts.	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; Residual risk of source material in contact with groundwater is further reduced by the containment of groundwater impacts provided by barrier walls; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts.
257.97(c)(1)(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance	Not Applicable	30-year post-closure groundwater monitoring Groundwater monitoring network maintenance and as-needed repair/replacement Final cover maintenance (e.g., mowing and as-needed repair) Periodic final cover inspections Additional corrective action as required based on post-closure groundwater monitoring	Same as Alternative #2	Same as Alternative #2 with increased effort for new leachate collection and management systems	Limited on-site post-closure groundwater monitoring until GPSs are achieved for impoundment Receiving disposal facility for impounded CCR will have same/similar long-term monitoring, operation, and maintenance requirements as Alternative #2	Same as Alternative #2	Same as Alternative #2 with additional effort for groundwater pump operation and maintenance (O&M), groundwater treatment system O&M, and treatment system discharge monitoring/reporting.	Same as Alternative #2 with additional monitoring of wall performance.

Table 6. Preliminary Evaluation of Corrective Measure Alternatives
Lansing Generating Station / SCS Engineers Project #25220100.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate and Cap with MNA	Alternative #4 Excavate CCR and Dispose On Site with MNA	Alternative #5 Excavate CCR and Dispose Off Site	Alternative #6 Consolidate and Cap with Chemical Amendment	Alternative #7 Consolidate and Cap with Groundwater Collection	Alternative #8 Consolidate and Cap with Barrier Wall
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1) (continued)								
257.97(c)(1)(iv) Short-term risks - Implementation								
Excavation	None	Limited risk to community and environment due to limited amount of excavation (likely <100K cy) required to establish final cover subgrades and no off-site excavation	Same as Alternative #2 with increased risk to environment due to increased excavation volumes required for consolidation (>100K cy but <357K cy = published maximum CCR inventory as of February 2018 per Written Closure Plan)	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (>840K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with reduced risk to environment from excavation due to limited on-site storage	Similar to Alternative #3 with some increased potential risk due to exposure during the application of the chemical amendment.	Similar to Alternative #3 with some increased construction risk due to drilling, trenching, and excavation for groundwater pumping and treatment system construction.	Similar to Alternative #3 with some increased construction risk due to excavation or installation of the barrier wall.
Transportation	None	No risk to community or environment from offsite CCR transportation; Typical risk due to construction traffic delivering final cover materials to site	Same as Alternative #2 with reduced risk from construction traffic due to reduced final cover material requirements (smaller cap footprint)	Same as Alternative #2 with increased risk from construction traffic due to increased material import requirements (liner and cap construction required)	Highest level of community and environmental risk due to CCR volume export (>840K cy)	Similar to Alternative #3 with increased risk from importing chemical material for stabilization/treatment.	Similar to Alternative #3 with increased risk from importing groundwater pumping and treatment system materials.	Similar to Alternative #3 with increased risk from importing barrier wall system materials.
Re-Disposal	None	Limited risk to community and environment due to limited volume of CCR re-disposal (likely <100K cy)	Same as Alternative #2 with increased risk to environment due to increased excavation volumes (likely >100K cy but <357K cy) required for consolidation	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~840K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with increased risk to community and environment due to re-disposal of large CCR volume (~840K cy) at another facility Re-disposal risks are managed by the receiving disposal facility	Similar to Alternative #3 with some increased potential risk due to exposure during the application of the chemical amendment.	Same as Alternative #3	Same as Alternative #3
257.97(c)(1)(v) Time until full protection is achieved	Unknown	To be evaluated further during remedy selection Impoundment closure and capping anticipated by end of 2021 Landfill closure and capping anticipated by end of 2021 Groundwater protection timeframe to reach GPS potentially 2 to 10 years following closure construction, achievable within 30 year post-closure monitoring period	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential for decrease in time to reach GPS due to consolidation of impounded CCR	Similar to Alternative #2 Potential for increase in time to reach GPS due to significant source disturbance during construction Potential decrease in time to reach GPS due to CCR source isolation within liner/cover system	Similar to Alternative #2 Potential for increase in time to reach GPS due to significant source disturbance during construction Potential decrease in time to reach GPS due to CCR source removal	Similar to Alternative #2. Potential for reduction in time to reach GPS due to chemical/physical stability of CCR.	Similar to Alternative #2. Potential decrease in time to reach GPS at property line from implementation of groundwater pumping.	Similar to Alternative #2. Potential decrease in time to reach GPS upon implementation of barrier wall.
257.97(c)(1)(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment	No change in potential exposure	Potential for exposure is low Remaining waste is capped	Same as Alternative #2	Same as Alternative #2	No potential for on-site exposure to remaining waste since no waste remains on site Risk of potential exposure is transferred to receiving disposal facility and is likely similar to Alternative #2	Same as Alternative #2	Similar to Alternative #2 with potential for secondary impacts from releases of extracted groundwater or disruption in treatment.	Same as Alternative #2
257.97(c)(1)(vii) Long-term reliability of the engineering and institutional controls	Not Applicable	Long-term reliability of cap is good Significant industry experience with methods/controls Capping is common practice/industry standard for closure in place for remediation and solid waste management	Same as Alternative #2 with potentially increased reliability due to smaller footprint and reduced maintenance	Same as Alternative #3	Success of remedy at LAN does not rely on long-term reliability of engineering or institutional controls Overall success relies on reliability of the engineering and institutional controls at the receiving facility	Same as Alternative #3.	Same as Alternative #3. Remedy relies upon active equipment that will require additional operations and maintenance.	Same as Alternative #3. Remedy relies on continued hydraulic conductivity of the selected barrier. Breaches or short circuiting can develop and must be monitored.
257.97(c)(1)(viii) Potential need for replacement of the remedy	Not Applicable	Limited potential for remedy replacement if maintained Some potential for remedy enhancement due to residual groundwater impacts following source control	Same as Alternative #2 with reduced potential need for remedy enhancement with consolidated/smaller closure area footprint	Same as Alternative #2 with further reduction in potential need for remedy enhancement composite with liner	No potential for remedy replacement Limited potential for remedy enhancement due to residual groundwater impacts following source control	Similar to Alternative #3, with further reduction in potential need for remedy enhancement due to stabilized/solidified CCR material.	Similar to Alternative #2, with reduced potential of remedy replacement, but added expectation for pump, conveyance system and treatment system replacement.	Similar to Alternative #2, with reduced potential of remedy replacement, but added expectation for potential replenishment of consumptive barrier product.

Table 6. Preliminary Evaluation of Corrective Measure Alternatives
Lansing Generating Station / SCS Engineers Project #25220100.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate and Cap with MNA	Alternative #4 Excavate CCR and Dispose On Site with MNA	Alternative #5 Excavate CCR and Dispose Off Site	Alternative #6 Consolidate and Cap with Chemical Amendment	Alternative #7 Consolidate and Cap with Groundwater Collection	Alternative #8 Consolidate and Cap with Barrier Wall
SOURCE CONTROL TO MITIGATE FUTURE RELEASES - 40 CFR 257.97(c)(2)								
257.97(c)(2)(i) The extent to which containment practices will reduce further releases	No reduction in further releases	Cap will reduce further releases by minimizing infiltration through CCR	Same as Alternative #2 with further reduction due to consolidated/smaller closure footprint	Same as Alternative #3 with further reduction due to composite liner and 5-foot groundwater separation required by CCR Rule	Removal of CCR prevents further releases at LAN Receiving disposal site risk similar to Alternative #3	Similar to Alternative #3 with further reduction due to lower mobility of contaminants in residual source material as a result of chemical amendment.	Similar to Alternative #3 with the added ability to contain or restore groundwater impacts if MNA mechanisms are not active or site attenuation capacity is not adequate.	Similar to Alternative #3 with the added ability to contain groundwater impacts if MNA mechanisms are not active or site attenuation capacity is not adequate.
257.97(c)(2)(ii) The extent to which treatment technologies may be used	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative relies on the identification and availability of a suitable chemical amendment. Implementation of and contact with physical/chemical stabilizing agent will require specialized field implementation methods and health and safety measures.	This alternative relies on conventional pump and treat remediation.	Alternative relies on the identification and availability of a suitable barrier wall technology (e.g., permeable reactive barrier material or slurry wall). Implementation of and contact with barrier wall materials will require specialized field implementation methods and health and safety measures.
IMPLEMENTATION - 40 CFR 257.97(c)(3)								
257.97(c)(3)(i) Degree of difficulty associated with constructing the technology	Not Applicable	Moderately complex construction due to impounded CCR thixotropic characteristics Potentially lowest level of dewatering effort - dewatering required for cap installation only	Moderately complex construction due to impounded CCR thixotropic characteristics Moderate degree of logistical complexity Moderate level of dewatering effort - dewatering required for material excavation/placement and capping	Moderately complex construction due to composite liner and cover High degree of logistical complexity due to excavation and on-site storage of ~840K cy of CCR while new lined disposal area is constructed High level of dewatering effort - dewatering required for excavation of full CCR volume	Moderately complex construction due to CCR thixotropic characteristics High degree of logistical complexity including the excavation and off-site transport of ~840K cy of CCR and permitting/development of off-site disposal facility airspace High level of dewatering effort - dewatering required for excavation of full CCR volume	Moderately complex construction due to impounded CCR thixotropic characteristics; Moderate degree of logistical complexity; Moderate level of dewatering effort - dewatering required for material excavation/placement and capping; Moderate complexity construction due to the equipment required to apply the selected amendment; requirements to ensure consistent contact and dosing of amendment; Medium degree of logistical complexity involving the import of specialty chemicals.	Moderately complex construction due to impounded CCR thixotropic characteristics; Moderate degree of logistical complexity; Moderate level of dewatering effort - dewatering required for material excavation/placement and capping; Moderate complexity construction for the installation of extraction wells and conveyance to a site-specific groundwater treatment plant.	Moderately complex construction due to impounded CCR thixotropic characteristics; Moderate degree of logistical complexity; Moderate level of dewatering effort - dewatering required for material excavation/placement and capping; High complexity construction - Barrier walls require specialty installation equipment and knowledge. Highly specialized and experience contractors required to achieve proper installation.
257.97(c)(3)(ii) Expected operational reliability of the technologies	Not Applicable	High reliability based on historic use of capping as corrective measure	Same as Alternative #2	Same as Alternative #2	Success at LAN does not rely on operational reliability of technologies; Overall success relies on offsite disposal facility, which is likely same/similar to Alternative #2	Similar to Alternative #2; however, success at BGS relies on the successful application of specialty chemicals.	Similar to Alternative #2; however, success of this remedy relies on the successful operation of a site-specific groundwater treatment plant.	Similar to Alternative #2; however, success this remedy relies on continued hydraulic conductivity of the selected barrier. Breaches or short circuiting can develop and must be monitored.
IMPLEMENTATION - 40 CFR 257.97(c)(3) (continued)								
257.97(c)(3)(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies	Not Applicable	Need is low in comparison to other alternatives State Closure Permit required	Same as Alternative #2	Need is high in comparison to other alternatives State Closure Permit required State Landfill Permit may be required	Need is highest in comparison to other alternatives State Closure Permit required Approval of off-site disposal site owner required May require State solid waste comprehensive planning approval Local road use permits likely required	Need is moderate in comparison to other alternatives; State Closure Permit required; Underground Injection Control Permit may be required if chemical materials placed within groundwater; State and local erosion control/construction stormwater management permits required; Federal/State/Local Floodplain permitting likely required.	Need is moderate in comparison to other alternatives; State Closure Permit required; Well permitting for extraction well installation; NPDES Permit for groundwater treatment and discharge; State and local erosion control/construction stormwater management permits required; Federal/State/Local Floodplain permitting likely required.	Need is moderate in comparison to other alternatives; State Closure Permit required; Well permitting for barrier wall monitoring; Federal/State/Local Floodplain permitting required; State and local erosion control/construction stormwater management permits required; Federal/State wetland permitting potentially required
257.97(c)(3)(iv) Availability of necessary equipment and specialists	Not Applicable	Necessary equipment and specialists are highly available Highest level of demand for cap construction material	Same as Alternative #2 Lowest level of demand for cap construction material	Same as Alternative #2; Moderate level of demand for liner and cap construction material	Availability of necessary equipment to develop necessary off-site disposal facility airspace and transport ~840K cy of CCR to new disposal facility will be a limiting factor in the schedule for executing this alternative No liner or cover material demands for on-site implementation of remedy	Similar to Alternative #3; Moderate level of demand for liner and cap construction material. Specialized mixing equipment likely required to apply chemical amendment and achieve required dosing.	Similar to Alternative #3; Moderate level of demand for liner and cap construction material. A site-specific, trained employee will be required to operate the groundwater treatment system.	Similar to Alternative #3; Moderate level of demand for liner and cap construction material; Availability of the necessary specialized equipment and extensive experience required for barrier installation is potentially low or in high demand.
257.97(c)(3)(v) Available capacity and location of needed treatment, storage, and disposal services	Not Applicable	Capacity and location of treatment, storage, and disposal services is not a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Available temporary on-site storage capacity of staged re-disposal of ~840K cy of CCR while composite liner is constructed is significant limiting factor	Off-site disposal capacity, facility logistical capacity, or the time required to develop the necessary off-site disposal and logistical capacity is a significant limiting factor	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative
COMMUNITY ACCEPTANCE - 40 CFR 257.97(c)(4)								
257.97(c)(4) The degree to which community concerns are addressed by a potential remedy	No comments were received during the public meeting held on October 12, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on October 12, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on October 12, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on October 12, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on October 12, 2020. Assume all alternatives are acceptable to interested/affected parties.	To be determined. Alternative added after public meeting held on October 12, 2020.	To be determined. Alternative added after public meeting held on October 12, 2020.	To be determined. Alternative added after public meeting held on October 12, 2020.

NOTES:
1) Alternatives #1 through #5 were developed and submitted within the Assessment of Corrective Measures Report (ACM), dated September 2019
2) Alternatives #6 through #8 were added in November 2020 as part of Addendum #1 to the September 2020 ACM Report

Created by: LAB/SK Date: 6/20/2019
Last revision by: SKK Date: 11/19/2020
Checked by: EJN Date: 11/23/2020

I:\25220100.00\Deliverables\ACM Amendment\Tables\[6_Evaluation of Assessment of Corrective Measure_LAN.xlsx]LAN_Evaluation Matrix

Figures

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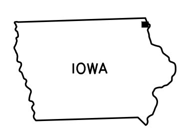
LANSING QUADRANGLE
IOWA–ALLAMAKEE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2018
SCALE: 1" = 2,000'



CLIENT	INTERSTATE POWER AND LIGHT 2320 POWER PLANT DRIVE LANSING, IA 52151-9733	SITE	ALLIANT ENERGY LANSING GENERATING STATION LANSING, IOWA

SITE LOCATION MAP

PROJECT NO.	25219070.00	DRAWN BY:	BSS	ENGINEER: SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830	FIGURE
DRAWN:	11/27/2019	CHECKED BY:	MDB		1
REVISED:	03/12/2020	APPROVED BY:	TK 02/12/2020		

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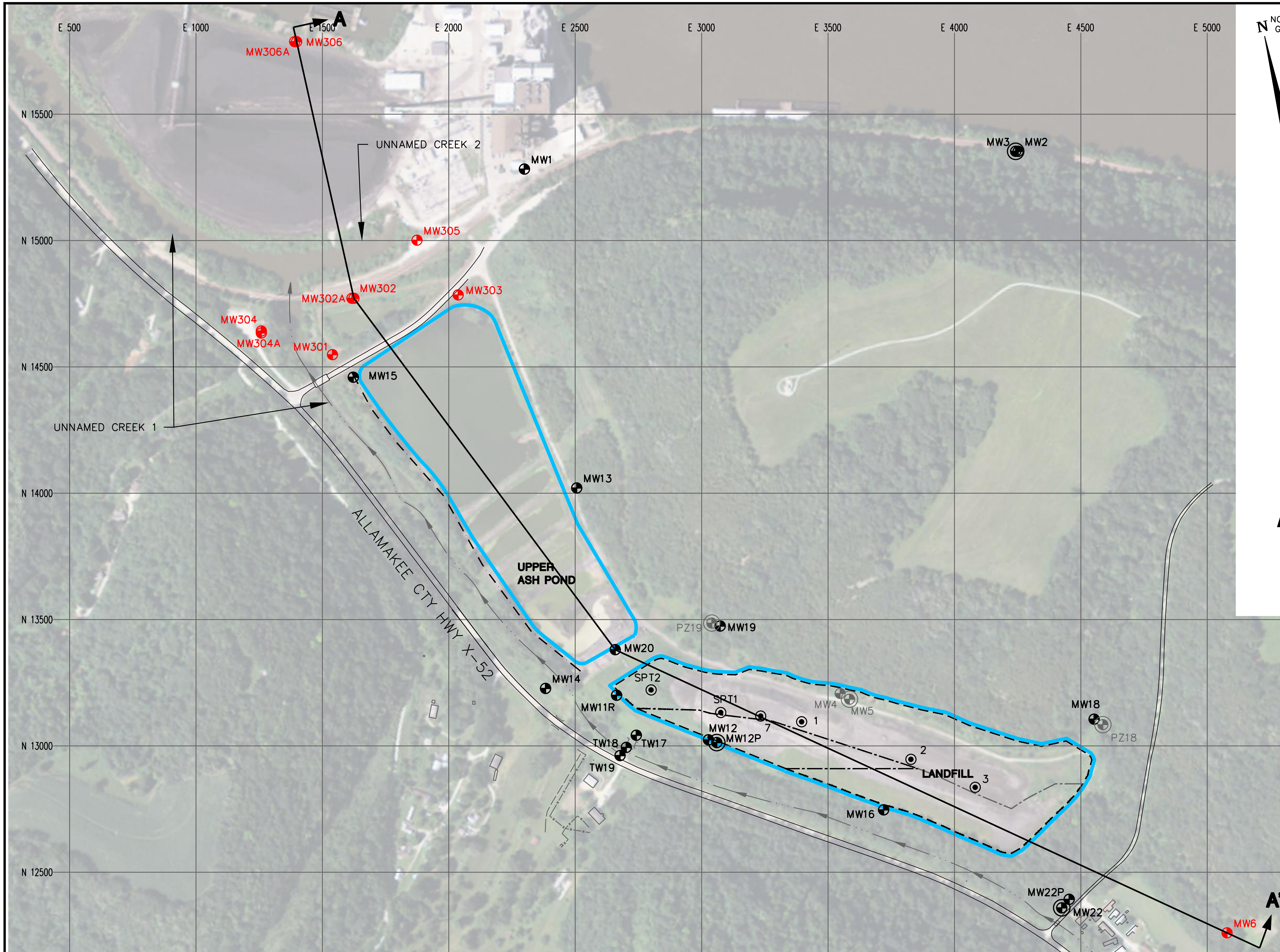

N NORTH GRID

400 0 400

SCALE: 1" = 400'

LEGEND

- - - - -	APPROVED LIMITS OF WASTE
	LIMITS OF PHASE 1 FINAL COVER
	LIMITS OF PHASE 2 FINAL COVER
	SLURRY WALL
	EXISTING STREAM
MW17	EXISTING MONITORING WELL
MW12P	EXISTING PIEZOMETER
MW4	ABANDONED MONITORING WELL
MW5	ABANDONED PIEZOMETER
MW301	CCR MONITORING WELL
	SOIL BORING
	CCR UNITS
	CROSS SECTION LOCATION

NOTES:

1. 2011 AERIAL PHOTOGRAPH FROM THE USDA-FSA AERIAL PHOTOGRAPHY FIELD OFFICE.
2. MONITORING WELL LOCATIONS AND CCR UNIT LIMITS ARE APPROXIMATE.
3. MONITORING WELLS MW20, MW301, MW302, AND MW303 WERE INSTALLED BY CASCADE DRILLING IN NOVEMBER 2015.
4. MONITORING WELLS MW304, MW305, AND MW306 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING IN MAY 2019.
5. MONITORING WELLS MW302A, MW304A, AND MW306A WERE INSTALLED BY CASCADE DRILLING IN DECEMBER 2019.
6. ONLY BORINGS USED FOR GEOLOGIC CROSS SECTION A-A' ARE SHOWN.
7. MW6 IS SAMPLED UNDER BOTH THE STATE AND CCR RULE MONITORING PROGRAMS.

PROJECT NO.	25220100.00	DRAWN BY:	BSS
DRAWN:	11/27/2019	CHECKED BY:	MDB
REVISED:	11/24/2020	APPROVED BY:	TK 11/24/2020

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
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CLIENT: INTERSTATE POWER AND LIGHT
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

SITE: ALLIANT ENERGY
LANSING POWER STATION
LANSING, IOWA

SITE PLAN AND MONITORING WELL LOCATIONS

FIGURE 2

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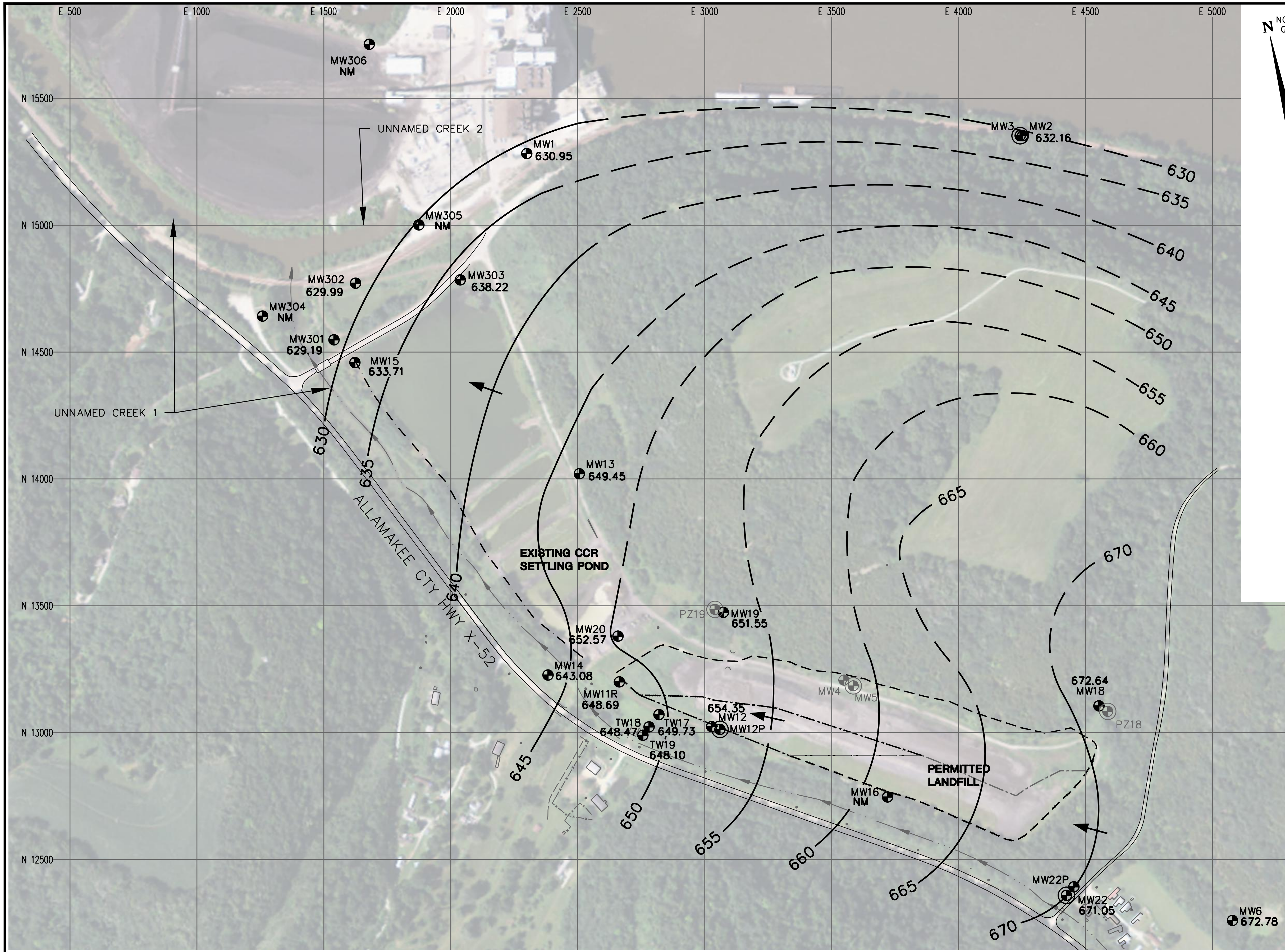

N NORTH GRID

400 0 400

SCALE: 1" = 400'

LEGEND

	APPROVED LIMITS OF WASTE
	LIMITS OF PHASE 1 FINAL COVER
	LIMITS OF PHASE 2 FINAL COVER
MW17	EXISTING MONITORING WELL
MW12P	EXISTING PIEZOMETER
MW4	ABANDONED MONITORING WELL
MW5	ABANDONED PIEZOMETER
	SLURRY WALL
	EXISTING STREAM
629.99	WATER TABLE ELEVATION
NM	NOT MEASURED
	WATER TABLE CONTOUR (DASHED WHERE INFERRED)
	APPROXIMATE GROUNDWATER FLOW DIRECTION

NOTES:

1. MONITORING WELL LOCATIONS ARE APPROXIMATE.
2. MONITORING WELLS MW304, MW305, AND MW306 WERE INSTALLED IN MAY 2019.

PROJECT NO.	25220100.00	DRAWN BY:	BSS
DRAWN:	07/03/2019	CHECKED BY:	NK
REVISED:	11/24/2020	APPROVED BY:	TK 11/24/2020

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT: ALLIANT ENERGY.
INTERSTATE POWER AND LIGHT
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

SITE: INTERSTATE POWER AND LIGHT
LANSING POWER STATION
COAL COMBUSTION RESIDUE LANDFILL
LANSING, IOWA

WATER TABLE MAP – APRIL 15-16, 2019

FIGURE 3

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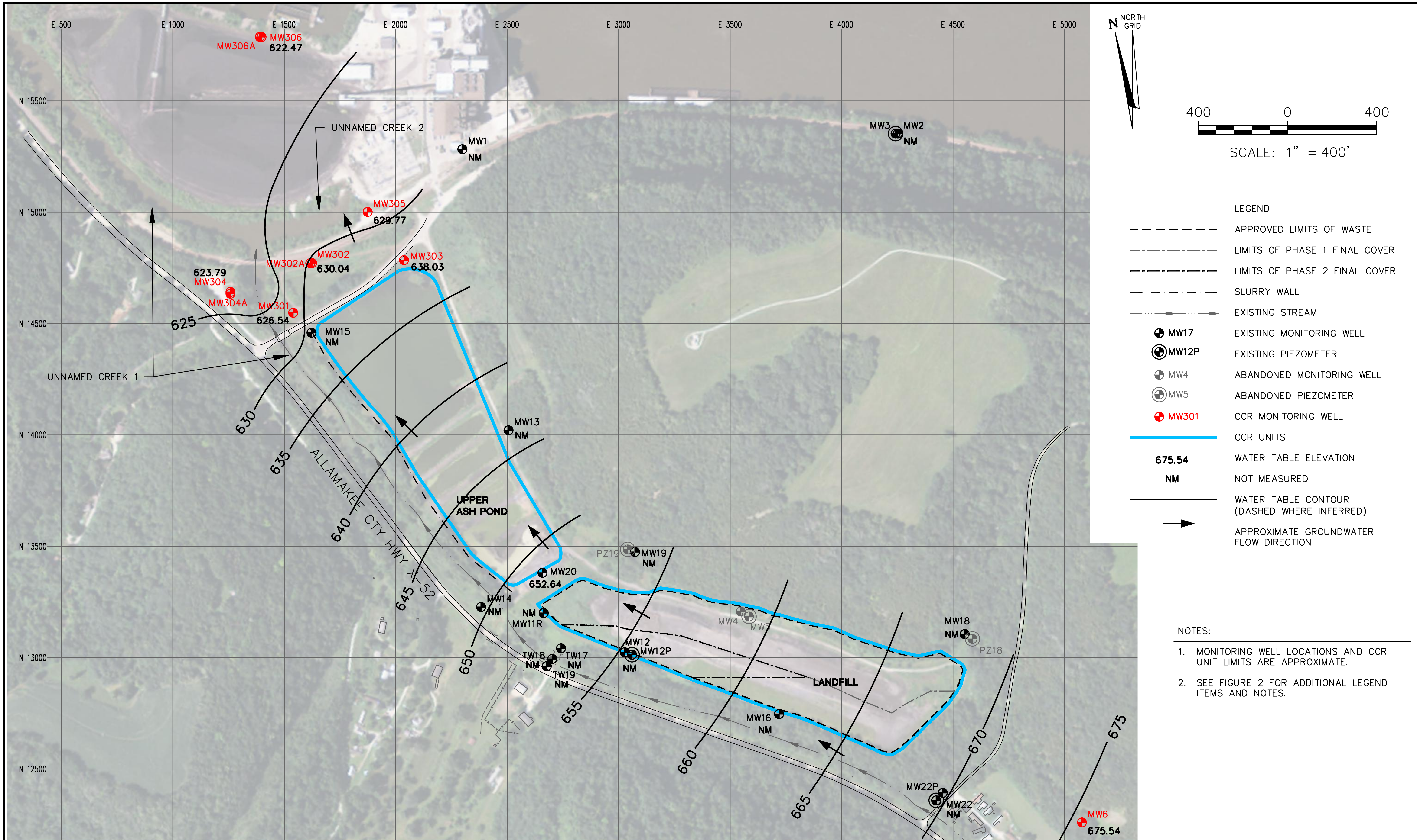

PROJECT NO.	25220100.00	DRAWN BY:	KP
DRAWN:	09/18/2020	CHECKED BY:	MDB
REVISED:	11/24/2020	APPROVED BY:	TK 11/24/2020

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT: INTERSTATE POWER AND LIGHT
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

SITE: ALLIANT ENERGY
LANSING POWER STATION
LANSING, IOWA

WATER TABLE MAP
OCTOBER 9, 2019

FIGURE 4

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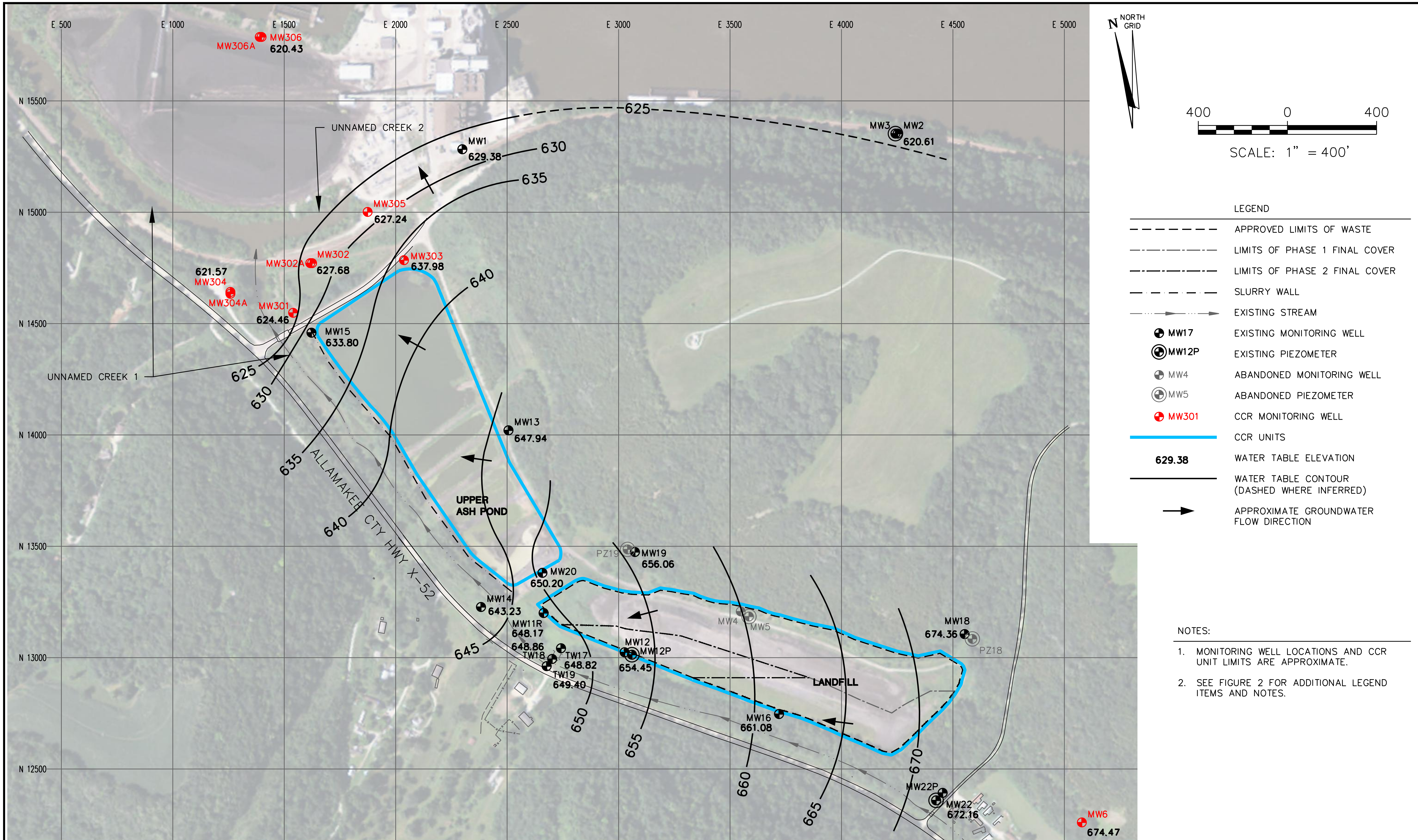

PROJECT NO.	25220100.00	DRAWN BY:	KP
DRAWN:	09/18/2020	CHECKED BY:	MDB
REVISED:	11/24/2020	APPROVED BY:	TK 11/24/2020

ENGINEER
SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT
INTERSTATE POWER AND LIGHT
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

SITE
ALLIANT ENERGY
LANSING POWER STATION
LANSING, IOWA

WATER TABLE MAP
MAY 20-21, 2020

FIGURE
5

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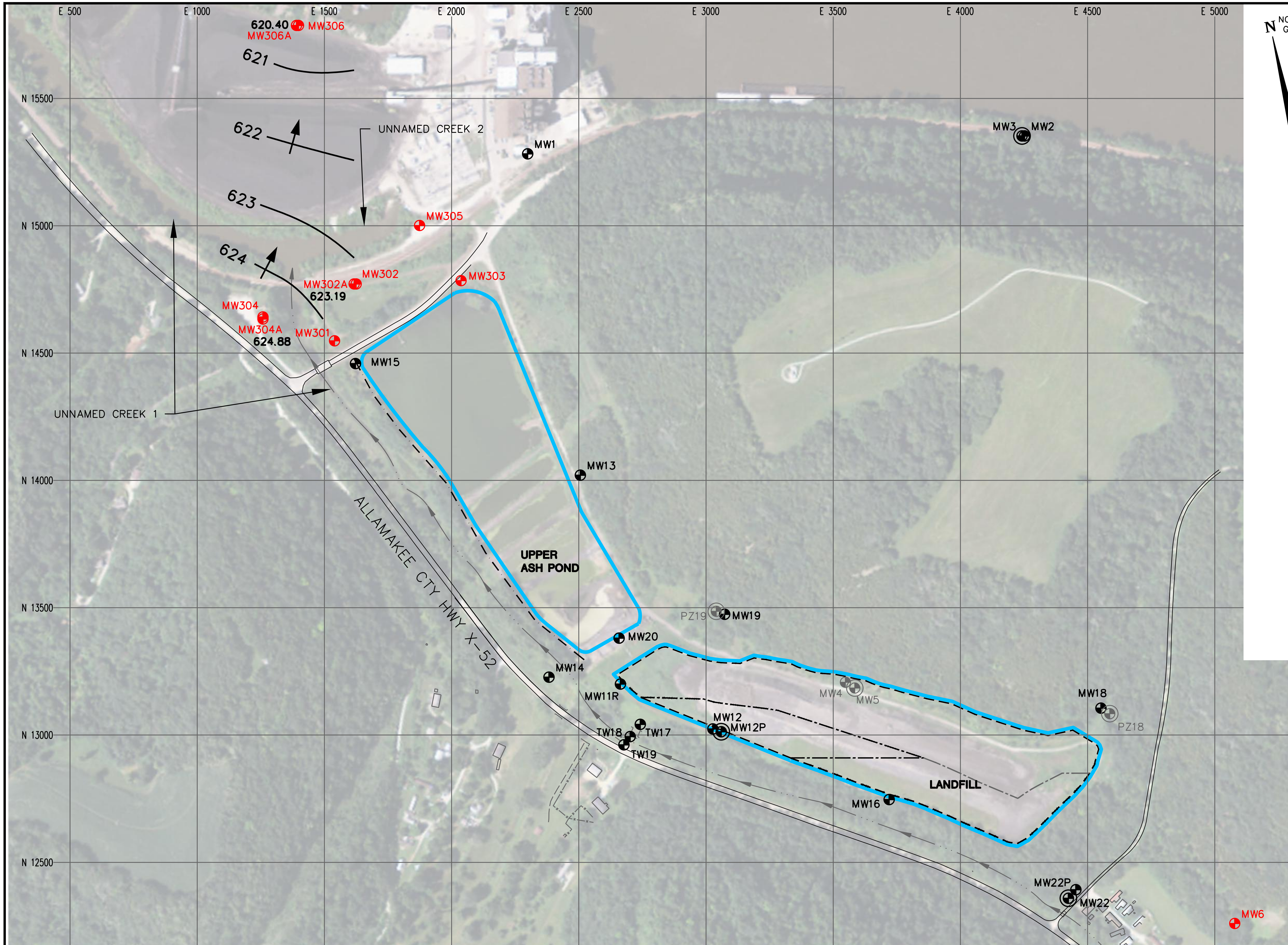

N NORTH GRID

400 0 400

SCALE: 1" = 400'

LEGEND

— — — — —	APPROVED LIMITS OF WASTE
—·—·—·—	LIMITS OF PHASE 1 FINAL COVER
—·—·—·—	LIMITS OF PHASE 2 FINAL COVER
— · — · —	SLURRY WALL
··→··→	EXISTING STREAM
MW17	EXISTING MONITORING WELL
MW12P	EXISTING PIEZOMETER
MW4	ABANDONED MONITORING WELL
MW5	ABANDONED PIEZOMETER
MW301	CCR MONITORING WELL
	CCR UNITS
623.19	POTENTIOMETRIC SURFACE ELEVATION MEASURED ON 05/20-21/2020
	POTENTIOMETRIC SURFACE CONTOUR
→	APPROXIMATE GROUNDWATER FLOW DIRECTION

NOTES:

1. MONITORING WELL LOCATIONS AND CCR UNIT LIMITS ARE APPROXIMATE.
2. SEE FIGURE 2 FOR ADDITIONAL LEGEND ITEMS AND NOTES.

PROJECT NO.	25220100.00	DRAWN BY:	BSS
DRAWN:	07/31/2020	CHECKED BY:	MDB
REVISED:	11/24/2020	APPROVED BY:	TK 11/24/2020

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT: INTERSTATE POWER AND LIGHT
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

SITE: ALLIANT ENERGY
LANSING POWER STATION
LANSING, IOWA

POTENTIOMETRIC SURFACE MAP
MAY 20-21, 2020

FIGURE 6

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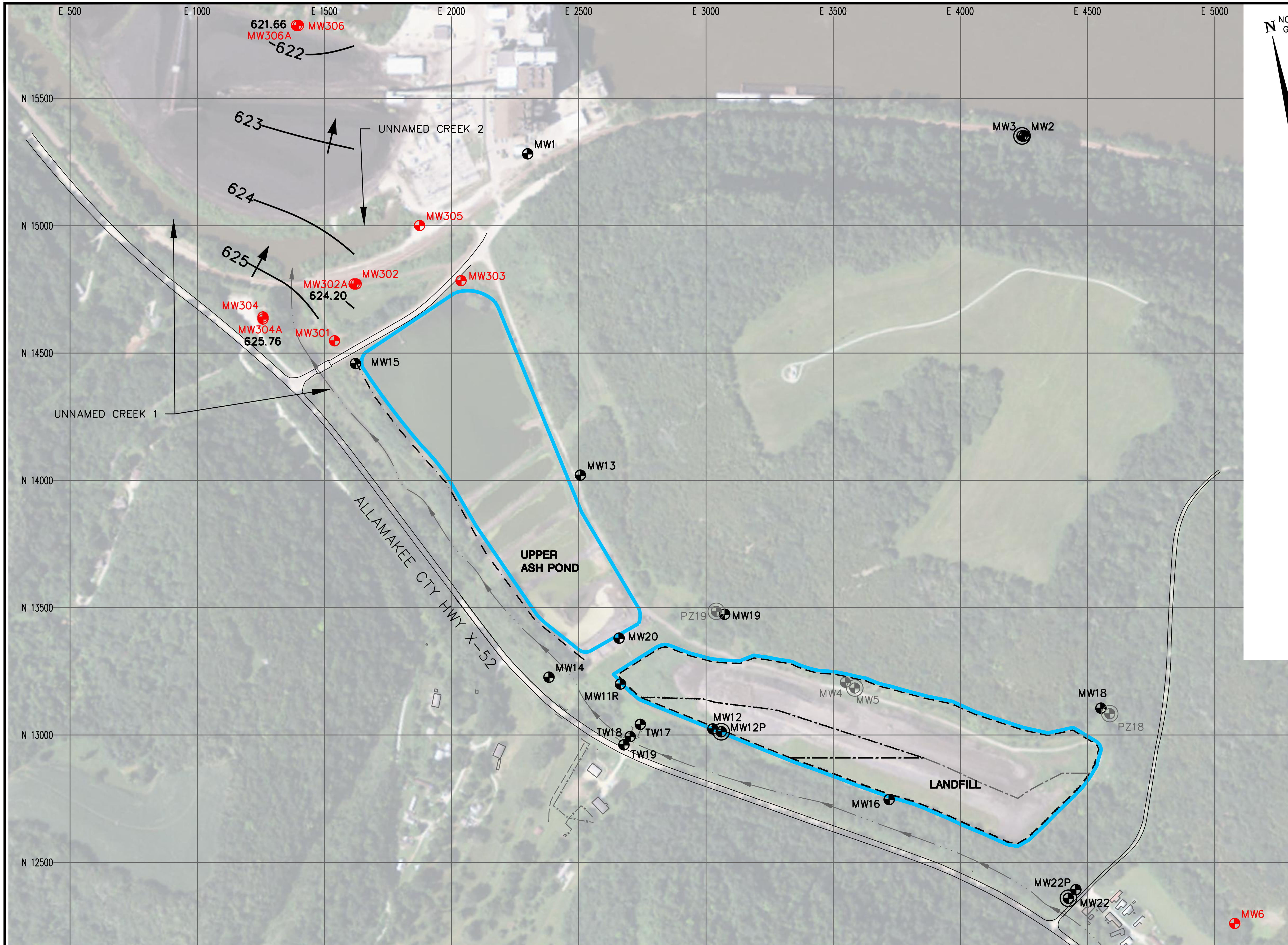

N NORTH GRID

400 0 400

SCALE: 1" = 400'

LEGEND

	APPROVED LIMITS OF WASTE
	LIMITS OF PHASE 1 FINAL COVER
	LIMITS OF PHASE 2 FINAL COVER
	SLURRY WALL
	EXISTING STREAM
MW17	EXISTING MONITORING WELL
MW12P	EXISTING PIEZOMETER
MW4	ABANDONED MONITORING WELL
MW5	ABANDONED PIEZOMETER
MW301	CCR MONITORING WELL
	CCR UNITS
624.20	POTENTIOMETRIC SURFACE ELEVATION MEASURED ON 07/06/2020
	POTENTIOMETRIC SURFACE CONTOUR
	APPROXIMATE GROUNDWATER FLOW DIRECTION

NOTES:

1. MONITORING WELL LOCATIONS AND CCR UNIT LIMITS ARE APPROXIMATE.
2. SEE FIGURE 2 FOR ADDITIONAL LEGEND ITEMS AND NOTES.

PROJECT NO.	25220100.00	DRAWN BY:	BSS
DRAWN:	07/31/2020	CHECKED BY:	MDB
REVISED:	09/24/2020	APPROVED BY:	TK 11/24/2020

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
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CLIENT: INTERSTATE POWER AND LIGHT
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

SITE: ALLIANT ENERGY
LANSING POWER STATION
LANSING, IOWA

POTENTIOMETRIC SURFACE MAP
JULY 6, 2020

FIGURE
7

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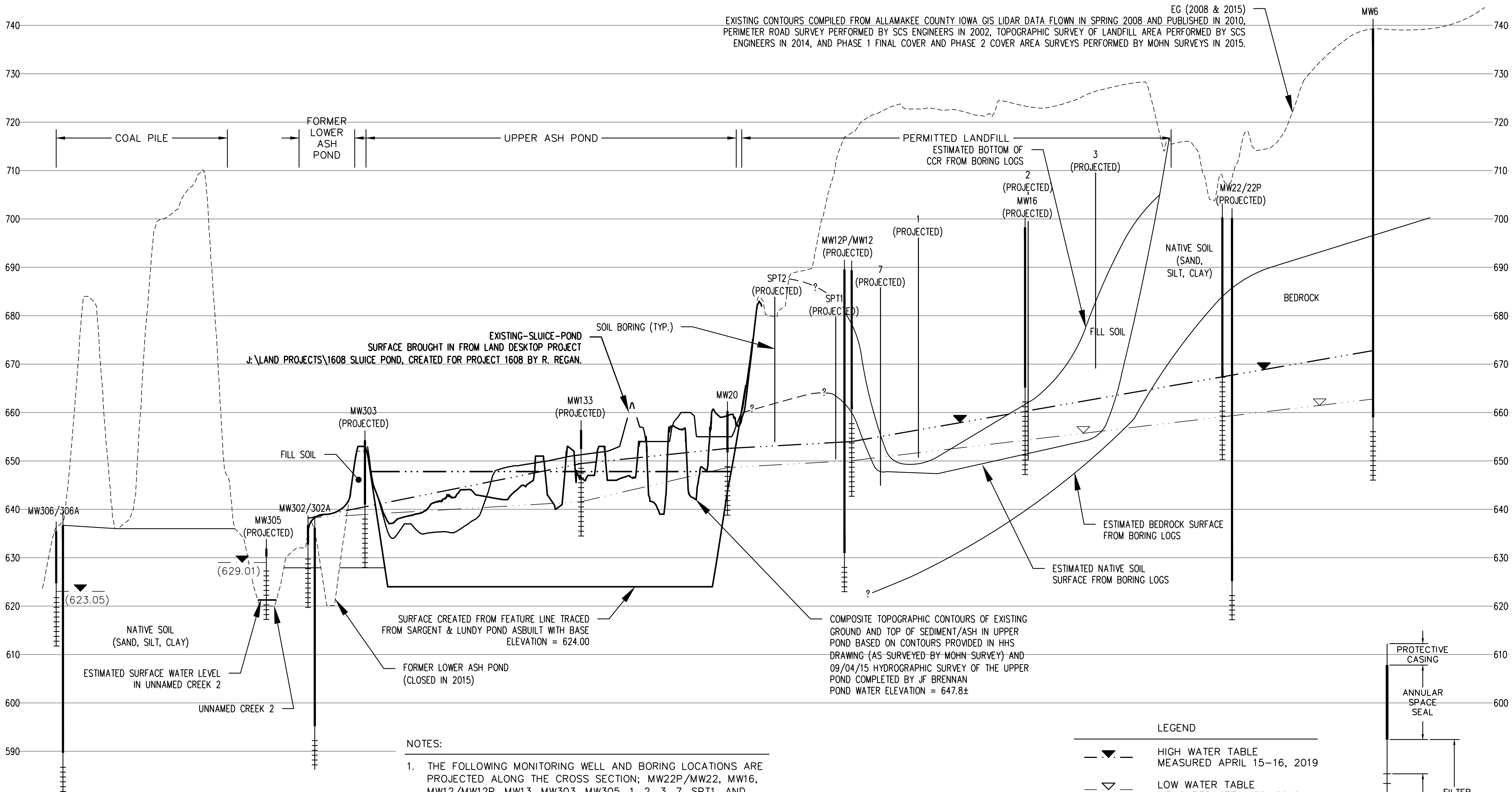

NOTES:

1. THE FOLLOWING MONITORING WELL AND BORING LOCATIONS ARE PROJECTED ALONG THE CROSS SECTION; MW22P/MW22, MW16, MW12/MW12P, MW13, MW303, MW305, 1, 2, 3, 7, SPT1, AND SPT2. SEE FIGURE 2 FOR CROSS SECTION LOCATION.
2. MONITORING WELLS MW305 AND MW306 WERE INSTALLED IN MAY 2019 AND FIRST SAMPLED ON JUNE 20, 2019. WATER TABLE ELEVATIONS FOR JUNE 20, 2019 ARE SHOWN AT THESE WELLS.

0 400

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 20'
VERTICAL EXAGGERATION = 20X

LEGEND

HIGH WATER TABLE MEASURED APRIL 15–16, 2019

LOW WATER TABLE MEASURED APRIL 28, 2016

(623.05) JUNE 20, 2019 WATER TABLE ELEVATION

UPPER ASH POND SURFACE WATER ELEVATION

PROJECT NO.	25220100.00	DRAWN BY:	AHB/RJG
DRAWN:	07/03/2019	CHECKED BY:	MDB
REVISED:	09/18/2020	APPROVED BY:	TK 11/24/2020

ENGINEER: SCS ENGINEERS
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PHONE: (608) 224-2830

CLIENT: INTERSTATE POWER AND LIGHT
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

SITE: ALLIANT ENERGY
LANSING POWER STATION
LANSING, IOWA

CROSS SECTION A–A'

FIGURE 8

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11/25/2020 - Classification: Internal - ECRM7804119

Appendix A

Regional Geological and Hydrogeological Information

Table LAN-3 Regional Hydrogeologic Stratigraphy
Lansing Generating Station / SCS Engineers Project #25215053

Strategic Unit			Hydrogeologic Units	Type of Rock	Hydrologic Conditions	Thickness Range (ft)	Age of Rocks*
Quaternary		Recent and Pleistocene deposits	Surficial aquifers-Alluvium, Drift, Buried-channel	Sand and gravel interbedded with silt and clay	Mostly unconfined local aquifers, some artesian, small-to-large yields	0 – 305	0 – 2.8 million years (m.y.)
Devonian	Yellow Spring Group (Gp)	Lime Creek Formation (Fm)	Confining layers	Shale, some dolostone	Non-aquifer	0 – 50	365 – 405 m.y.
	Cedar Valley Gp	Lithograph City Fm Coralville Fm Little Cedar Fm	Silurian-Devonian aquifer	Limestone and dolostone, thin shales	Major aquifer, mostly artesian, moderate-to-large yields	0 – 400	
	Wapsipinicon Gp	Pinicon Ridge Fm Spillville Fm		Dolostone and limestone			
Silurian		Scotch Grove Fm Hopkinton Fm Blanding Fm Tete des Morts Fm		Dolostone, locally with much chert, local shale as cavern fillings			405 – 425 m.y.
Ordovician	Maquoketa Fm	Brainard Member Fort Atkinson Member Clermont Member Elgin Member	Maquoketa Fm, confining beds Fort Atkinson – Elgin aquifer	Shale and dolostone, some chert	Non-aquifer to local aquifer, small-to-moderate yields	0 – 300	425 – 455 m.y.
	Galena Gp	Dubuque Fm Wise Lake Fm Dunleith Fm Decorah Fm	Galena aquifer	Limestone and dolostone, minor chert, shale at base and locally in upper part	Local aquifer, confined and unconfined, small-to-moderate yields	0 – 240	455 – 460 m.y.
		Platteville Fm Glenwood Fm	Decorah-Platteville-Glenwood confining beds	Limestone and shale	Non-aquifer	0 – 50	
		St. Peter Sandstone	Cambrian-Ordovician aquifer	Sandstone	Major aquifer, mostly artesian, large yields	0 – 580	460 – 500 m.y.
		Prairie du Chien Gr		Dolostone, minor sandstone and chert			500 – 503 m.y.
Cambrian		Jordan Sandstone		Sandstone, dolomitic			
		St. Lawrence Fm	Cambrian confining beds	Dolostone, silty	Non-aquifer	0 – 400	503 – 508 m.y.
		Lone Rock (Franconia) Fm		Fine, sandstone, siltstone, shale, and minor dolostone			
		Wenowoc (incl Ironton-Galesville sandstone) Fm	Dresbach aquifer	Sandstone	Artesian aquifer, large yields	0 – 1,950	508 – 515 m.y.
		Eau Claire Fm		Fine sandstone, siltstone, and shale			
		Mt. Simon Sandstone		Sandstone			
Pre-C		Undifferentiated crystalline rocks	Unknown	Igneous and metamorphic rocks	Unknown	Unknown	570 m.y. – > 2 billion years

*Age determinations as used on COSUNA charts published by AAPG-USGS
Source: "Water Resources of Southeast Iowa," Iowa Geologic Survey Water Atlas No. 4.

I:\25215053\Data\Tables\Table 2_Regional Hydrogeologic Stratigraphy.doc

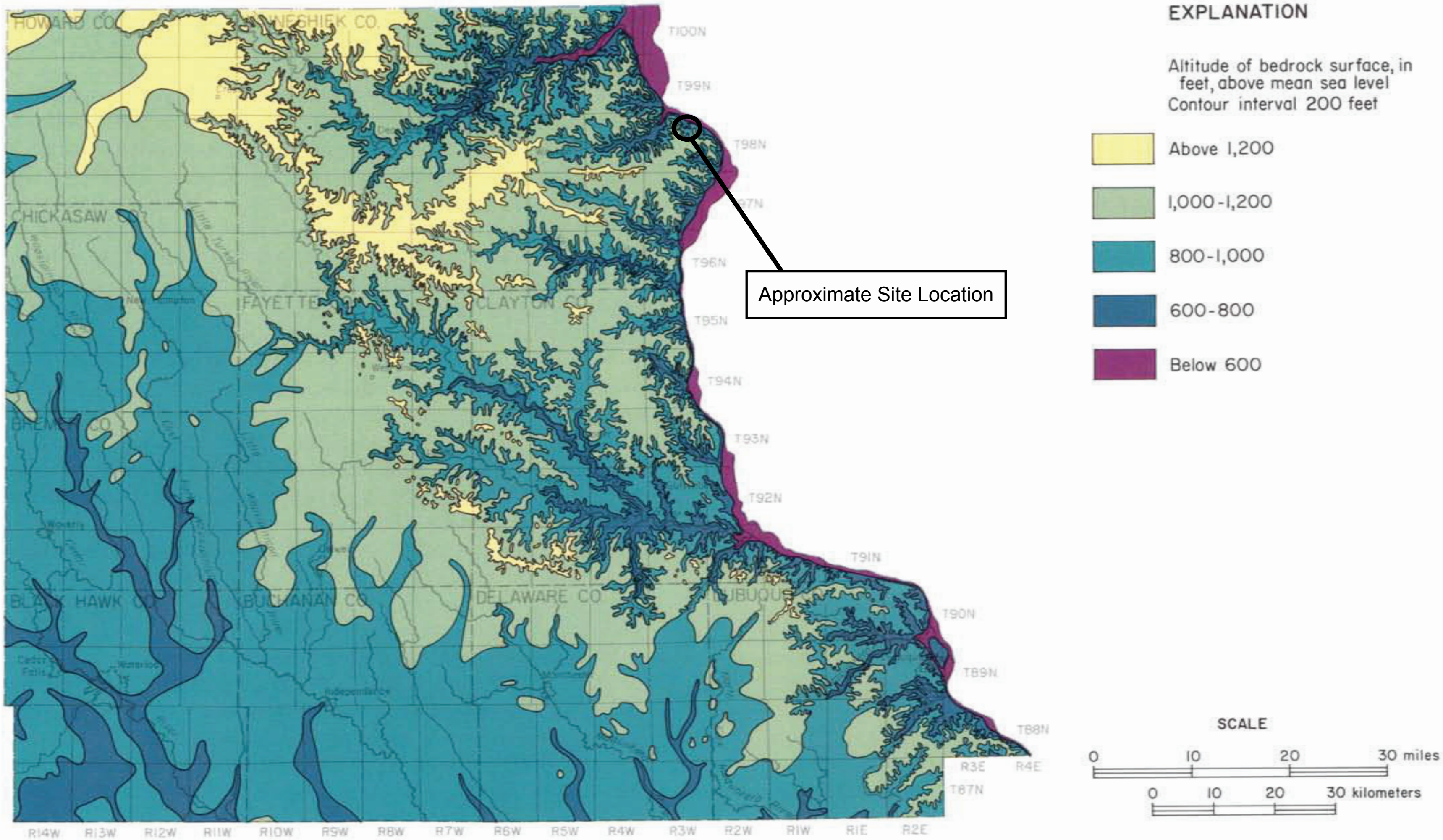


Figure 30. Altitude and configuration of the bedrock surface

Source: Horick, Paul J., Water Resources of Northeast Iowa, Iowa Department of Natural Resources Water Atlas Number 8, October

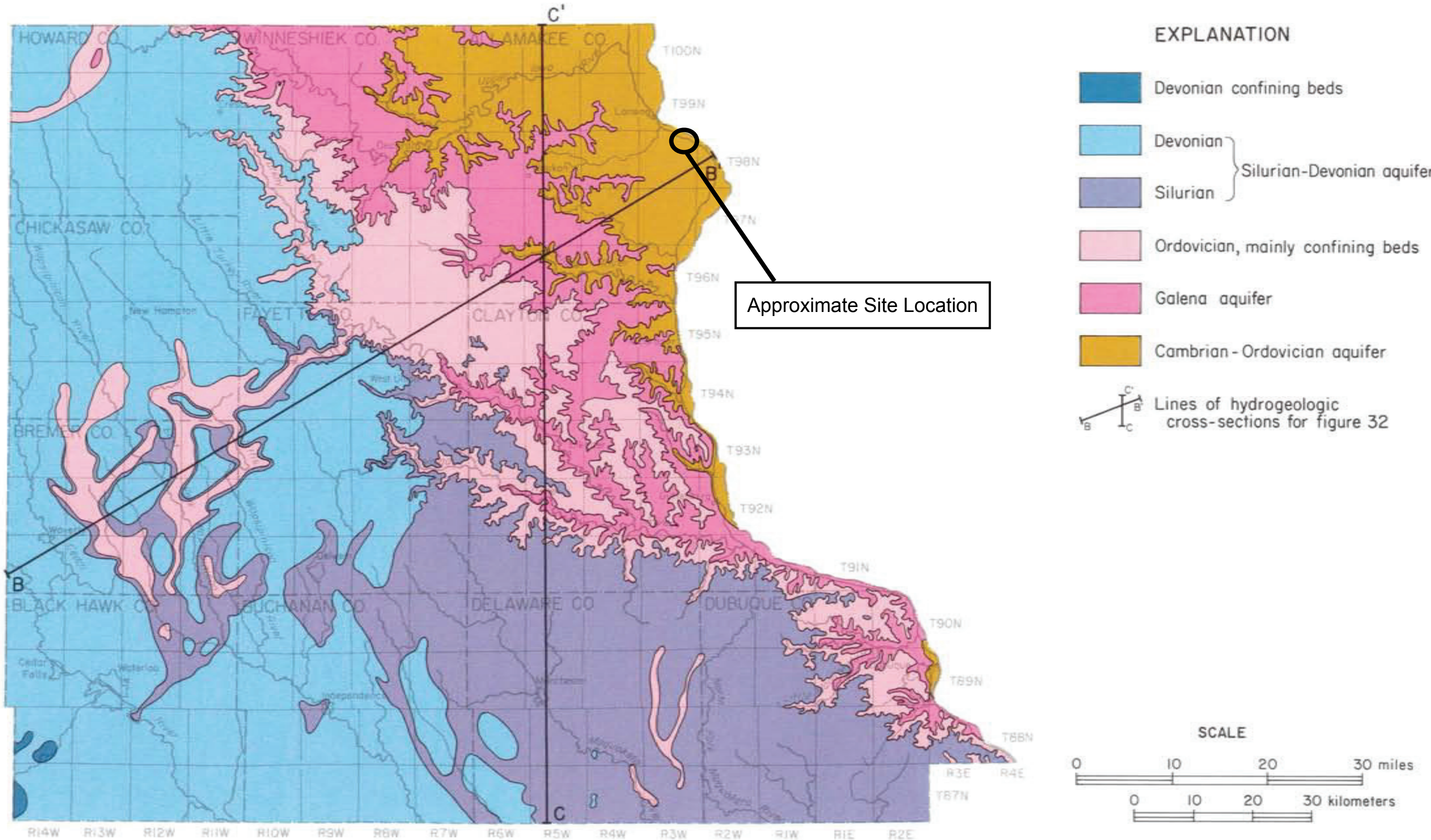


Figure 31. Bedrock hydrogeologic map

Source: Horick, Paul J., Water Resources of Northeast Iowa, Iowa Department of Natural Resources Water Atlas Number 8, October

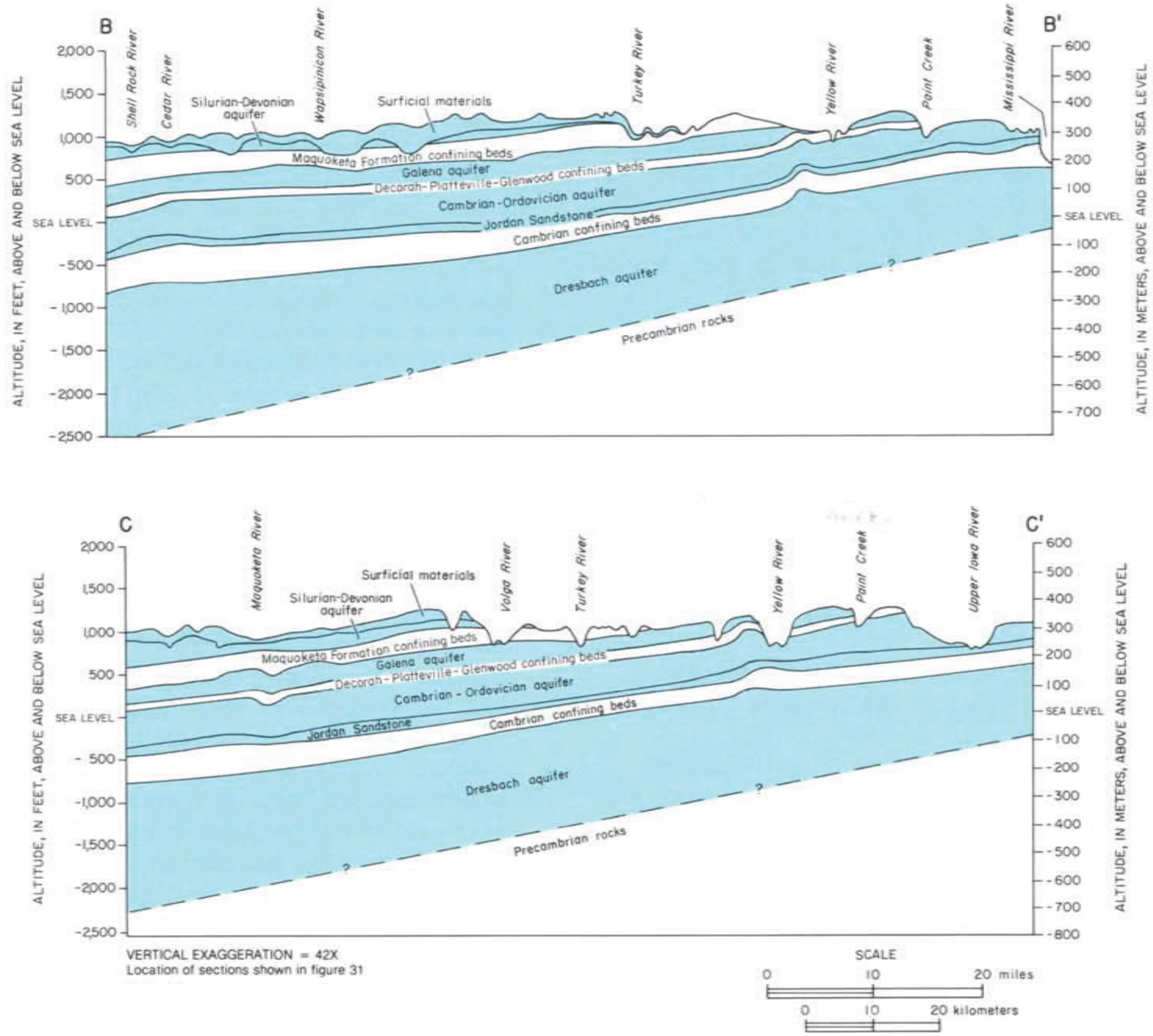


Figure 32. Hydrogeologic cross-sections

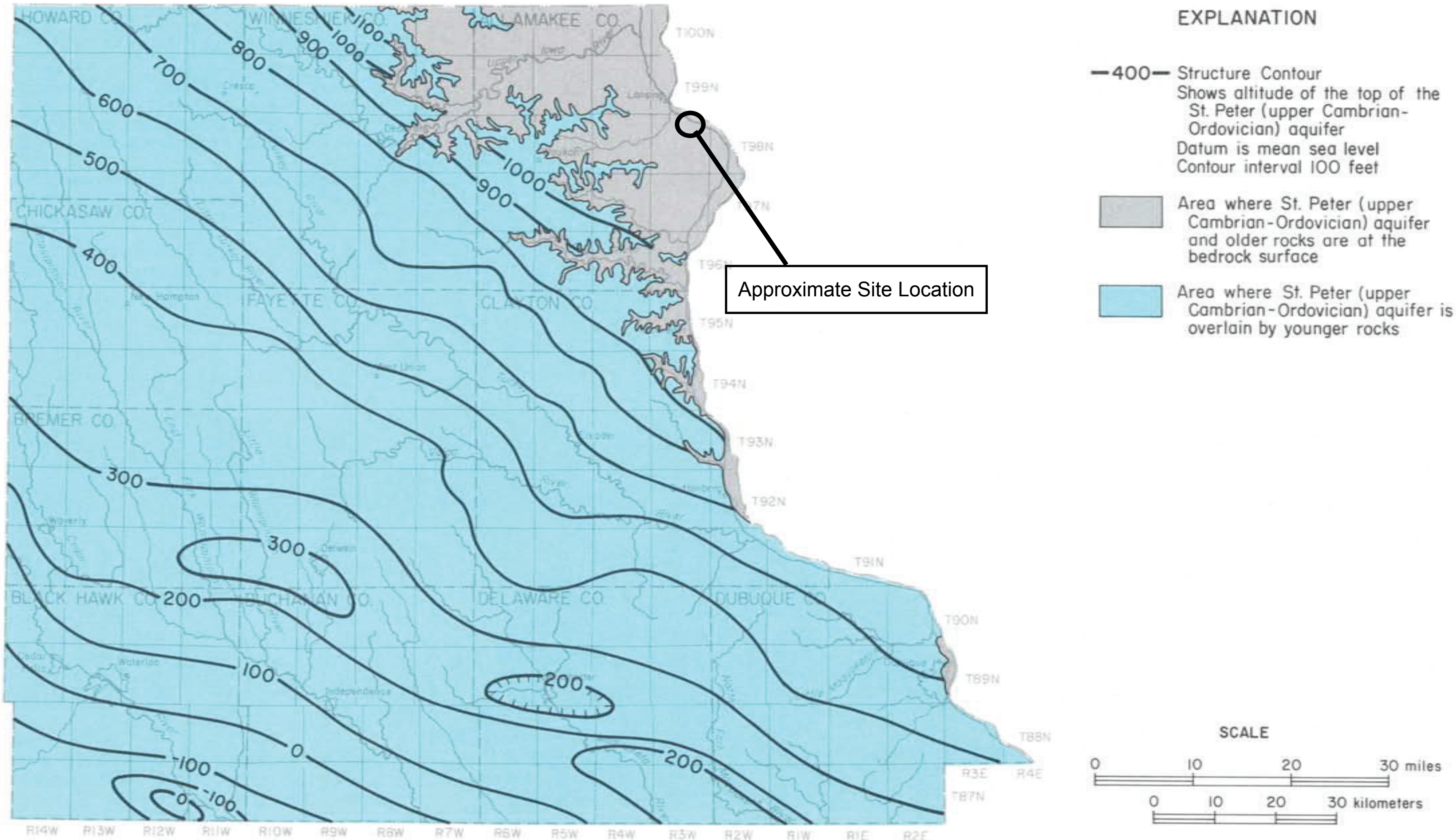


Figure 38. Altitude of the top of the St. Peter (upper Cambrian-Ordovician) aquifer

Source: Horick, Paul J., Water Resources of Northeast Iowa, Iowa Department of Natural Resources Water Atlas Number 8, October

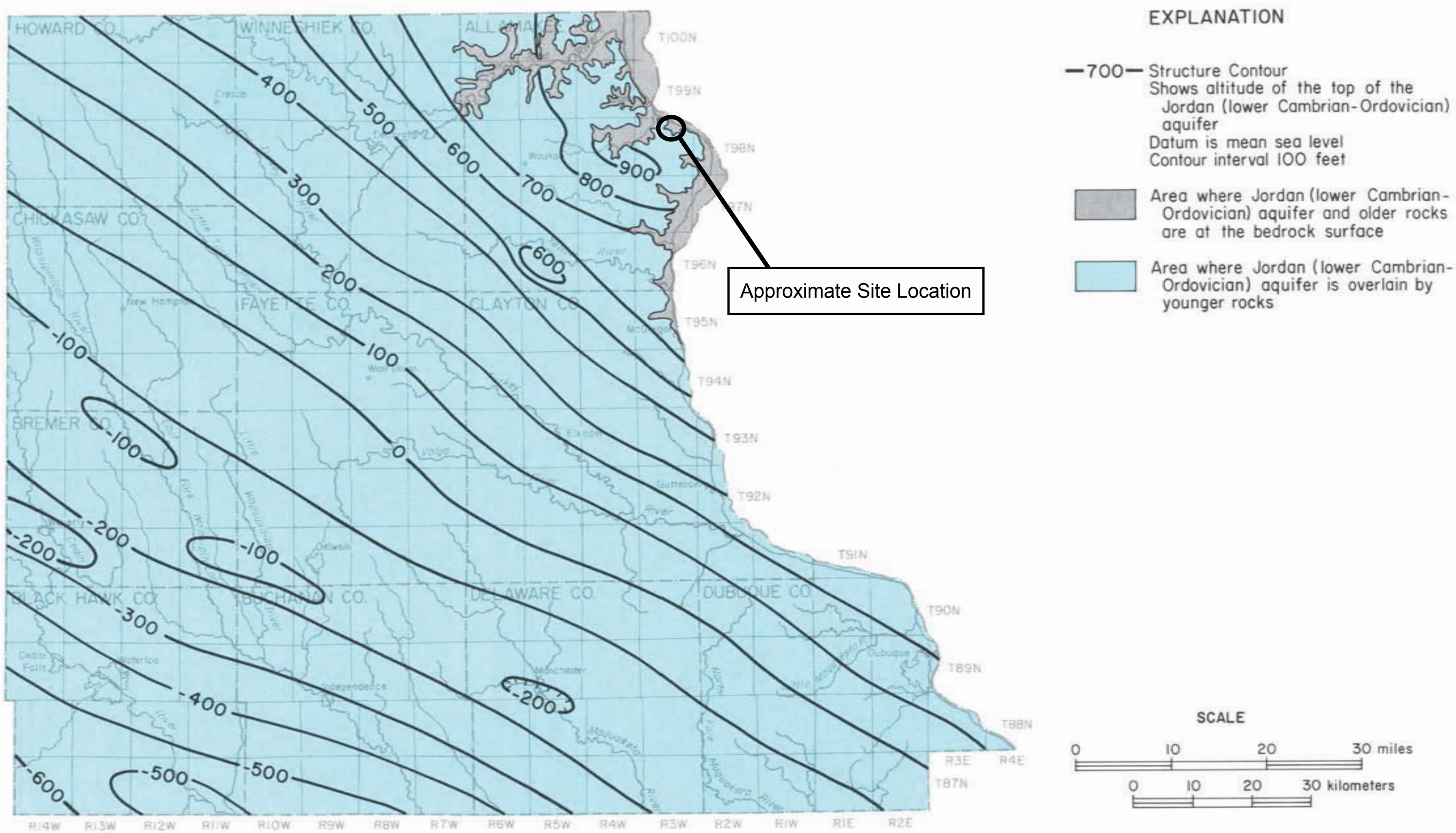


Figure 39. Altitude of the top of the Jordan (lower Cambrian-Ordovician) aquifer

Source: Horick, Paul J., Water Resources of Northeast Iowa, Iowa Department of Natural Resources Water Atlas Number 8, October

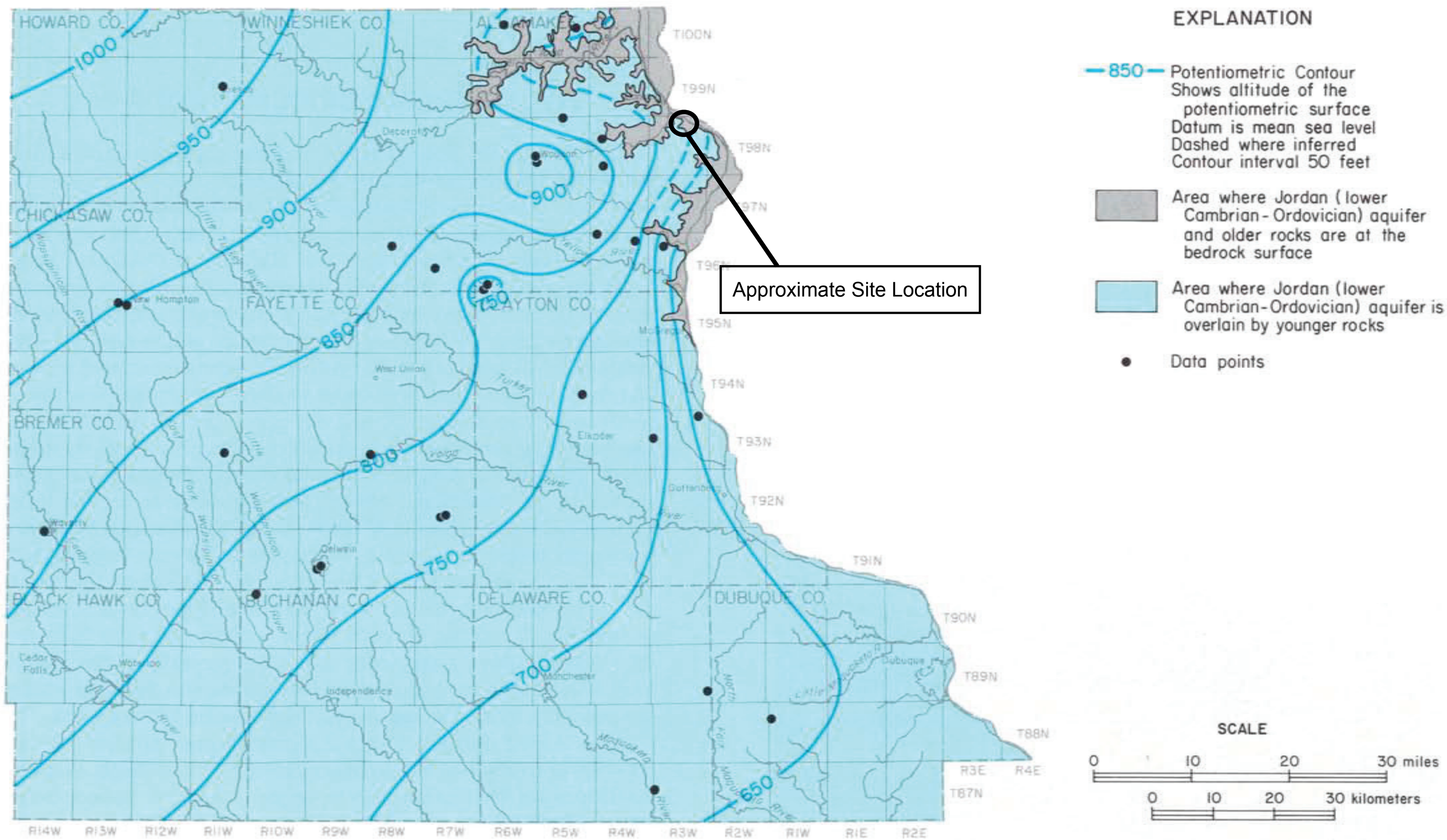


Figure 56. Potentiometric surface of the Jordan (lower Cambrian-Ordovician) aquifer

Source: Horick, Paul J., Water Resources of Northeast Iowa, Iowa Department of Natural Resources Water Atlas Number 8, October

Appendix B

Boring Logs

CaCO3	K (cm/sec)			MW-6	ELEVATION (ft, msl)	DEPTH (feet)	LITHOLOGY
					734.0	5	
					729.0	10	
					724.0	15	
					719.0	20	
					714.0	25	
					709.0	30	
					704.0	35	
					699.0	40	
					694.0	45	
					689.0	50	

MATERIALS DESCRIPTION

0.0 to 6.0 SILT

Topsoil developed in silt from 0.0 to 1.5. Topsoil is dark brown. Clayey silt, trace sand is loess or colluvium (slopewash) derived from loess. Medium brown, changing gradually to yellow brown below 5.0.

6.0 to 37.0 TALUS

Light brown sandy silt with dolomite chunks.

37.0 to 93.5 INTERBEDDED SANDSTONE AND SILTSTONE

Sandstone is fine-grained, with quartz silt matrix, glauconitic. Siltsone contains minor amount of very fine quartz sand and glauconite. Sandstone is laminated light greenish gray with creamy color. Siltstone is light greenish gray.

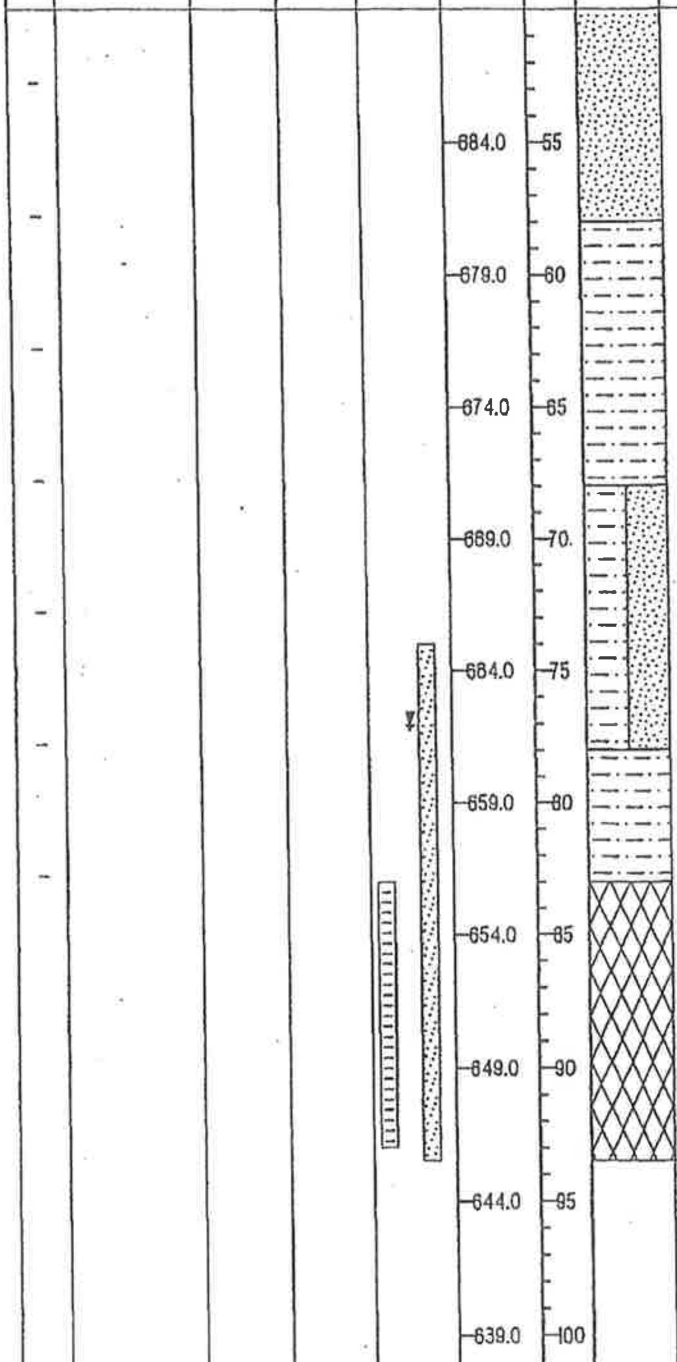
Sandstone from 37.0 to 58.0.

Howard R Green Company
CONSULTING ENGINEERS

PROJECT Interstate Power Company
PROJECT NUMBER 717680-J
SURFACE ELEVATION 739.3 Feet MSL
TOTAL DEPTH OF HOLE 93.5 Feet

LOG OF MW-6
LOCATION Lansing, Iowa
GEOLOGIST Barbara Torney

CaCO3	K (cm/sec)			MW-6	ELEVATION (ft, msl)	DEPTH (feet)	LITHOLOGY	MATERIALS DESCRIPTION



Siltstone from 58.0 to 68.0.

Interbedded sandstone and siltstone from 68.0 to 78.0.

Siltstone from 78.0 to 83.0

No sample from 83.0 to 93.5.
Likely interbedded sandstone and siltstone by comparison to same interval on log of MW-4 and MW-5. Lower few feet may be primarily siltstone.

Howard R. Green Company
CONSULTING ENGINEERS

PROJECT Interstate Power Company
PROJECT NUMBER 717680-J
SURFACE ELEVATION 739.3 Feet MSL
TOTAL DEPTH OF HOLE 93.5 Feet

LOG OF MW-6
LOCATION Lansing, Iowa
GEOLOGIST Barbara Torney

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL- Lansing Generating Station SCS#: 25215135.70		B-301

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Mike Mueller Cascade Drilling	11/2/2015	11/2/2015	hollow stem auger

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-301	Feet	639.4 Feet	8.0 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3,957,744 N, 5,541,108 E S/C/N
NW 1/4 of SW 1/4 of Section 2, T 98 N, R 3 W
Lat ° ' "
Long ° ' "
Local Grid Location
Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID	County	Civil Town/City/ or Village
	Allamakee	Lansing

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–4.5	POORLY GRADED SAND, medium grained, very dark gray brown (10YR 3/2).	SP									
S1	23	10 31 38 48	3							M				
S2	24	32 47 50	5.5	POORLY GRADED SAND WITH SILT, medium grained, dark yellowish brown (10YR 3/4).	SP-SM					M				
S3	22	18 33 47 43	8	POORLY GRADED SAND WITH SILT AND GRAVEL, medium grained sand, large grained gravel, dark yellowish brown (10YR 3/6).	SP-SM					M				
S4	24	36 46 50	10.5	POORLY GRADED SAND WITH SILT, medium grained, dark yellowish brown (10YR 3/6).	SP-SM					S				Water @ 10 ft bgs
S5	22	13 9 7 10	13							S				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
(signature)	SCS Engineers 2830 Dairy Drive Madison, WI 53718	Tel: 608-224-2830 Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number B-301

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
S6	20	3 2 4	15–18	SILT, black (10YR 3/1).	ML					S				
S7	24	2 2 2 2	18–19.5	SILT WITH SAND, black (10YR 3/1).	ML					S				
S8	24	2 2 4	19.5–22.5	POORLY GRADED SAND WITH SILT, black (10YR 3/1).	SP-SM					S				
S9	24	2 9 12 14	22.5–26	SILT, dark olive gray (5Y 3/2).	ML					S				
			26	End of Boring at 26 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name: IPL- Lansing Generating Station SCS#: 25215135.70	License/Permit/Monitoring Number:	Boring Number: B-302	
Boring Drilled By: Name of crew chief (first, last) and Firm: Mike Mueller, Cascade Drilling	Date Drilling Started: 11/4/2015	Date Drilling Completed: 11/4/2015	Drilling Method: hollow stem auger
Unique Well No.: / DNR Well ID No.: / Common Well Name: MW-302	Final Static Water Level: Feet	Surface Elevation: 635.9 Feet	Borehole Diameter: 8.0 in
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒ State Plane 3,957,929 N, 5,541,179 E S/C/N; NW 1/4 of SW 1/4 of Section 2, T 98 N, R 3 W	Lat ° ' " / Long ° ' "	Local Grid Location: Feet ☐ N ☐ S; Feet ☐ E ☐ W	
Facility ID: / County: Allamakee	Civil Town/City/ or Village: Lansing		

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–5.5	POORLY GRADED SAND, medium grained, dark grayish brown (10YR 4/2).	SP									
S1	24	6 14 17 19	3							M				
S2	24	26 45 50	5.5	SANDY SILT, trace small gravel, black (10YR 3/1).	ML					M				
S3	24	12 13 10 8	8							M				
S4	11	9 11 13 12	10.5							S				Saturation @ 11 ft bgs
			11	Large gravel										
S5	8	32 23 30 36	13							S				
			13.5	Large gravel										
			15											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: [signature] | Firm: SCS Engineers, 2830 Dairy Drive Madison, WI 53718 | Tel: 608-224-2830 Fax:

Boring Number B-302

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
S6	24	5 5 6 8	16, 17	SANDY SILT, trace small gravel, black (10YR 3/1). *(continued)*	ML					S				
S7	18		18, 19, 20	Silt, Black (10YR 3/1).	ML					S				
				End of Boring at 20 ft bgs.										

SCS ENGINEERS **SOIL BORING LOG INFORMATION**
Environmental Consultants and Contractors

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name: IPL- Lansing Generating Station SCS#: 25215135.70	License/Permit/Monitoring Number	Boring Number: B-303	
Boring Drilled By: Name of crew chief (first, last) and Firm: Mike Mueller, Cascade Drilling	Date Drilling Started: 11/2/2015	Date Drilling Completed: 11/2/2015	Drilling Method: hollow stem auger
Unique Well No. / DNR Well ID No. / Common Well Name: MW-303	Final Static Water Level: Feet	Surface Elevation: 653.9 Feet	Borehole Diameter: 8.0 in
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒ State Plane 3,957,857 N, 5,541,622 E S/C/N; NW 1/4 of SW 1/4 of Section 2, T 98 N, R 3 W	Lat ___° ___' ___" Long ___° ___' ___"	Local Grid Location: ☐ N Feet ☐ S; ☐ E Feet ☐ W	
Facility ID	County: Allamakee	Civil Town/City/ or Village: Lansing	

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–2.5	SILTY SAND, very dark gray (5Y 3/1).	SM									
S1	24	5 16 17 24	2.5–7	POORLY GRADED SAND, medium grained, dark grayish brown (10 YR 4/2).	SP					M				
S2	24	11 8 10								M				
S3	24	11 38 50	7–15	POORLY GRADED SAND , medium grained, grayish brown (2.5Y 5/2).	SP					M				
S4	18	16 35 50								M				
S5	16	27 50 50								M				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: [signature] | Firm: SCS Engineers, 2830 Dairy Drive Madison, WI 53718 | Tel: 608-224-2830 Fax:

Boring Number B-303

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
S6	0	38 50	16	POORLY GRADED SAND , medium grained, grayish brown (2.5Y 5/2). *(continued)*						M				Rock in Spoon
			17		SP									
S7	18	17 25 40 47	18							S				Saturation @17 ft bgs.
			19											
S8	17	37 48 44	20 / 21	POORLY GRADED SAND, medium grained, very dark gray (5Y 3/1).						S				
			22											
S9	18	11 24 26 27	23 / 24		SP					S				
S10	24	37 50	25 / 26							S				
			27	End of Boring at 27 ft bgs.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL Lansing Generating Station SCS#: 25218221.00		MW304

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Eric Wetzel Roberts Environmental Drilling, Inc.	5/15/2019	5/15/2019	4.25" HSA

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW304	623.61 Feet MSL	635.5 Feet MSL	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3,957,893 N, 5,540,876 E S/C/N
SE 1/4 of NE 1/4 of Section 3, T 98 N, R 3 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E Feet ☐ S Feet ☐ W

Facility ID	County	Civil Town/City/ or Village
	Allamakee	Lansing

Sample: Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–3	SILT, mottled, (10YR 3/2), some black coal looking material.	ML									
	12	3 6 3 3	2							M				
			3–5	LEAN CLAY, (10YR 4/3), soft, some organic material.	CL									
	18	1 2 2 1	4							W				
			5–9	SILT, (10YR 2/2), uniform, trace fine sand and clay.	ML									
	12	2 2 3 2	6							M				
	18	1 1 3 2	8							W				
			9–15	POORLY GRADED SAND, fine to coarse, (10YR 3/4), (Alluvial).	SP									
	18	1 2 1 1	10							W				
	12	0 0 1 1	12							W				
	12	0 0 1 1	14							W				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: for Zach Watson
Firm: SCS Engineers
2830 Dairy Drive, Madison, WI 53718
Tel:
Fax:

Boring Number MW304

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
				POORLY GRADED SAND, fine to coarse, (10YR 3/4), (Alluvial). *(continued)*	SP									
		0 0 1 1	16							W				
			17	Same as above but more coarse, (2.5YR 5/4), trace silt.										
		2 5 6 6	18							W				
			19											
			20	End of Boring at 20 feet.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL Lansing Generating Station SCS#: 25218221.00		MW305

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Eric Wetzel Roberts Environmental Drilling, Inc.	5/16/2019	5/16/2019	4.25" HSA

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW305	629.12 Feet MSL	631.8 Feet MSL	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3,958,109 N, 5,541,533 E S/C/N
SE 1/4 of NW 1/4 of Section 2, T 98 N, R 3 W

Lat ___° ___' ___"
Long ___° ___' ___"

Local Grid Location
Feet ☐ N ☐ S
Feet ☐ E ☐ W

Facility ID	County	Civil Town/City/ or Village
	Allamakee	Lansing

Sample: Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9.5	Hydrovaced to 9.5 feet.										
			9.5	FAT CLAY, dark greenish gray, (GLEY 13/10Y), soft, trace red sand, wood pieces and roots.	CH									
	24	1 1 1 1	11							W				
	24	0 0 0 2	13							W				
			14	Sand seams at 13.5 and 14.5 feet.										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
[signature] For Zach Watson	SCS Engineers 2830 Dairy Drive, Madison, WI 53718	Tel: Fax:

Boring Number MW305

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			16	FAT CLAY, dark greenish gray, (GLEY 13/10Y), soft, trace red sand, wood pieces and roots. *(continued)*	CH					W				
				End of Boring at 16 feet.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL Lansing Generating Station SCS#: 25218221.00		MW306

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Eric Wetzel Roberts Environmental Drilling, Inc.	5/16/2019	5/16/2019	4.25" HSA

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW306	623.05 Feet MSL	636.7 Feet MSL	8.5 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3,958,977 N, 5,541,203 E S/C/N
NE 1/4 of NW 1/4 of Section 2, T 98 N, R 3 W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ S Feet; ☐ E ☐ W Feet

Facility ID	County	Civil Town/City/ or Village
	Allamakee	Lansing

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–12	Hydrovaced to 12 feet.										
	12	1 2 4 3	12–15	POORLY GRADED SAND, medium to coarse, rusty in color, (10YR 4/6), trace fine silt.	SP					W				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
[signature] for Zach Watson	SCS Engineers 2830 Dairy Drive, Madison, WI 53718	Tel: Fax:

Boring Number MW306

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
	18	1 2 2 4		POORLY GRADED SAND, medium to coarse, rusty in color, (10YR 4/6), trace fine silt. *(continued)*						W				
			16	Same as above but gray, (10YR 4/2).										
	18	1 1 2 2	17							W				
			18											
	18		19							W				
			20		SP									
	18		21							W				
			22											
	18	3 1 2 2	23							W				
			24											
	18	2 1 3 2	25							W				
			26	End of Boring at 26 feet.										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL - Lansing Generating Station SCS#: 25218221.00		MW-302A

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Paul Dickinson Cascade Drilling	12/16/2019	12/17/2019	Rotosonic

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			13.01 Feet	636.2 Feet	6 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3957930.08 N, 5541186.04 E S / C / N
SW 1/4 of NW 1/4 of Section 02 , T 98 N, R 03 W

Lat ° ' "
Long ° ' "

Local Grid Location: Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID	County	Civil Town/City/ or Village
	Allamakee	Lansing

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9	Hydrovac to 9' to check for utilities.										
S1	46"		9–11	POORLY GRADED SAND with silt, clay and trace gravel, dark gray.	SP					W				
			11–13	SILT, gray, trace gravel.	ML									
S2	39"		13–16	SILTY GRAVEL WITH SAND, gray, sand is fine to medium grained, gravel is subangular to angular.	GM					W				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
	SCS Engineers	Tel: Fax:

Boring Number MW-302A

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			17	SILTY GRAVEL WITH SAND, gray, sand is fine to medium grained, gravel is subangular to angular. *(continued)*	GM									
S3	48"		18, 19, 20, 21	SILT, dark gray, trace roots.	ML					W				
S4	40"		22, 23, 24, 25, 26, 27, 28	LEAN CLAY, dark gray, roots. Same but dark brown.	CL					W				
			29, 30	SILTY SAND, gray to dark gray, fine to medium grained.	SM									
S5	48"		31, 32	LEAN CLAY, tan with yellow to brown mottling and gray layers, trace silt.	CL					W				
			33, 34, 35	LEAN CLAY, reddish brown, massive, very dense.	CL									
S6	48"		36, 37, 38	LEAN CLAY, gray.	CL					W				
S7	48"		39, 40, 41, 42	POORLY GRADED SAND, brown, fine to medium grain, trace gravel. Same with trace shells	SP					W				

Boring Number MW-302A

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			43	POORLY GRADED SAND, brown, fine to medium grained, trace gravel. *(continued)*	SP									
			44	SILTY GRAVEL, light brown, subangular.	GM									
			45											
			46	LEAN CLAY, mostly light brown, trace gray, trace silt.	CL									
S8	48"		47							W				
			48											
			49	SILTY GRAVEL WITH SAND, light brown, gravel is subangular.	GM									
			50	End of boring at 50 feet.										

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SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL - Lansing Generating Station SCS#: 25218221.00		MW-304A

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Paul Dickinson Cascade Drilling	12/18/2019	12/19/2019	Rotosonic

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			10.7 Feet	635.6 Feet	6 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3957884.99 N, 5540876.5 E S/C/N
SE 1/4 of NE 1/4 of Section 03 , T 98 N, R 03 W
Lat ____ ° ____ ' ____ "
Long ____ ° ____ ' ____ "
Local Grid Location: Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID	County	Civil Town/City/ or Village
	Allamakee	Lansing

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9	Hydrovac to 9' to check for utilities.										
			10–11	SILT, grayish brown, toots and sticks.	ML									
S1	49"		11–14	POORLY GRADED SAND WITH SILT AND GRAVEL, fine to medium grained, reddish brown.	SP-SM					W				
			14–16	POORLY GRADED SAND, reddish brown, fine to medium grained.	SP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
	SCS Engineers	Tel: Fax:

Boring Number MW-304A

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
				POORLY GRADED SAND, reddish brown, fine to medium grained. *(continued)*										
			17											
S2	21"									W				
			18											
			19		SP									
			20	Same but light brown, mostly fine grained.										
			21											
			22											
S3	59"									W				
			23	SANDY SILT, brown, fine grained.										
			24											
			25											
			26											
					ML									
			27											
S4	24"									W				
			28											
			29											
			30	SILTY SAND, light brown, fine grained.										
			31											
			32											
S5	30"									W				
			33		SM									
			34											
			35											
			36	POORLY GRADED SAND, light brown, fine to medium grained.										
			37											
S6	57"									W				
			38		SP									
			39											
			40											
			41	POORLY GRADED SAND, orange, fine grained.	SP									
			42	SANDY SILT WITH GRAVEL, sand is fine grained.	ML									

Boring Number MW-304A

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S7	54"		43–45	SANDY SILT WITH GRAVEL, sand is fine grained.*(continued)*	ML					W				
S8	9"		45–46	POORLY GRADED SAND, light brown, fine grain, trace coarse grained.	SP					W				
S9	48"		46–51	SANDY SILT WITH GRAVEL, light brown with trace yellow, fine grained.	ML					W				
			51	End of boring at 51 feet.										

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Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
IPL - Lansing Generating Station SCS#: 25218221.00		MW-306A

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Paul Dickinson Cascade Drilling	12/17/2019	12/18/2019	Rotosonic

Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
			16.3 Feet	636.7 Feet	6 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 3958980.99 N, 5541196.46 E S / C / N
NE 1/4 of NW 1/4 of Section 02, T 98 N, R 03 W

Lat ___° ___' ___"
Long ___° ___' ___"

Local Grid Location
Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID	County	Civil Town/City/ or Village
	Allamakee	Lansing

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–9	Hydrovac to 9' to check for utilities.										
S1	52"		10–16	POORLY GRADED SAND, reddish brown, trace shells, medium grained.	SP					W				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm	
	SCS Engineers	Tel: Fax:

Boring Number MW-306A

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			17	POORLY GRADED SAND, reddish brown, trace shells, medium grained. *(continued)*										
S2	56"		18		SP					W				
			19											
			20	POORLY GRADED SAND, gray, fine to medium grained, trace coarse grained and shells.										
			21											
			22											
S3	57"		23							W				
			24											
			25	Same, mostly medium grained with fine grained.										
			26											
			27											
S4	54"		28							W				
			29											
			30	Same, fine to medium grained with trace coarse grained.	SP									
			31											
			32											
S5	58"		33							W				
			34											
			35	Same with shell fragments.										
			36											
			37											
S6	53"		38							W				
			39											
			40											
			41	LEAN CLAY, dark gray, massive, very dense with roots and sticks.										
			42		CL									

Boring Number MW-306A

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
S7	58"		43	LEAN CLAY, dark gray, massive, very dense with roots and sticks. *(continued)*	CL					W				
S8	52"		44–50	POORLY GRADED SAND, gray to dark gray, fine grained, trace coarse grain with shell fragments.	SP					W				
			50–52	POORLY GRADED SAND, light gray, fine to medium grained.	SP									
S9	58"		52–56	POORLY GRADED SAND, reddish tan, fine to medium grained with shell fragments.	SP					W				
			56	End of boring at 56 feet.										

Appendix C

Hydrogeochemical Conceptual Model and Preliminary Summary of Groundwater Contaminant Attenuation

ReSolution Partners, LLC

Subject: Arsenic assessment in response to November 2020 information

From: Bernd W. Rehm Date: 24 November 2020

Project: SCS – Alliant Lansing GS CCR Evaluations 158-002a

Introduction.

One of the seven monitoring wells on the downgradient perimeter of the Lansing Generating Station Ash Pond (MW-302) consistently exceed the arsenic groundwater protection standard of 10 µg/L. One well (MW-304A) consistently exceeded the molybdenum groundwater protection standard of 100 µg/L. However, this well appears to sample groundwater that cannot be affected by potential releases from the Ash Pond.

This document focuses on the potential application of monitored natural attenuation with respect to arsenic in the Selection of Remedy for the Ash Pond.

Conceptual Site Model.

Hydrogeology. The monitoring wells except for the background well (MW-6) are completed in surficial sediments consisting of sand, silt and clay layers and lenses. MW-6 is completed in the underlying bedrock consisting of interbedded sandstone and siltstone because the overlying soils are above the water table.

Shallow groundwater generally flows from the south southeast to the north northwest, entering the south side of the Upper Ash Pond and discharging from the north side. The Upper Ash Pond water elevation is assumed to be on the order of 645 to 650 feet. The water table elevation immediately downgradient of the Upper and Former Lower Ash Ponds in May 2020 ranged from 637.98 to 627.68 feet. Immediate downgradient of MW-302 is Unnamed Creek 2 with a water elevation of ~621 feet. MW-305 and MW-1 to the north of the ditch had water levels of 627.24 and 629.38 feet. This shows that the Unnamed Creek 2 is a gaining stream and that Unnamed Creek 2 is likely a drainage divide, with shallow groundwater from beneath the Coal Pile flowing to the southwest toward the Unnamed Creek 2 and to the northwest to MW-306. The hydraulic head at MW-302A is 623.19 feet indicating that groundwater is likely flowing upward toward Unnamed Creek 2 from depths on the order of 50 feet below ground surface.

MW-304 and -304A are separated from the Ash Ponds and the other monitoring wells by an Unnamed Creek 1 that flows along the southwest side of the Upper Ash Pond. The

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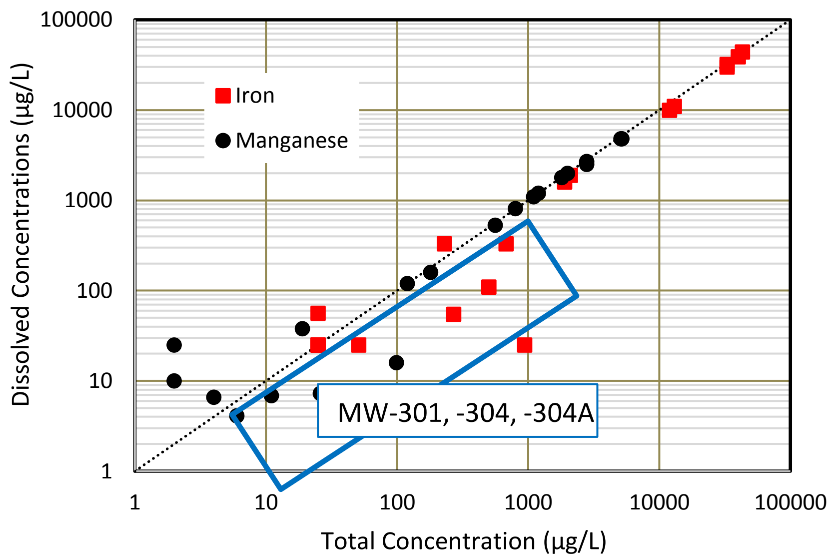
water table at MW-304 is 621.57 feet and the hydraulic head at MW-304A is 624.88. The surface water elevation for Unnamed Creek 1 is not known so it cannot be determined whether the Unnamed Creek 1 is a groundwater divide between MW-304 and the Upper Ash Pond groundwater. The vertical gradient at this well cluster is upwards, suggesting that the Unnamed Creek 1 may be a divide.

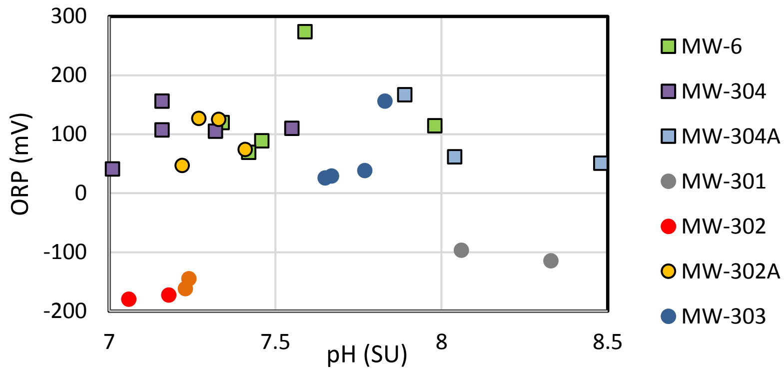
Geochemistry. The geochemistry evaluation focuses on data collected in 2019 and 2020. Selected portions of that data set that are used in this evaluation are summarized in Table 1. In the discussions, it is assumed that groundwater from MW-6, -304 and -304A represents background water quality unaffected by the Ash Pond. MW-306 and -306A are also not included because it appears to be separated from the Ash Pond and the Unnamed Creek 1 and 2 groundwater divide.

Most groundwater samples collected to date have been analyzed for total element contents that represent the sum of dissolved elements and elements associated with suspended sediment. Except for MW-304 and -305 the suspended sediment contents have been low as estimated by turbidity. This is reflected in the correlation between dissolved and total concentrations for iron and manganese.

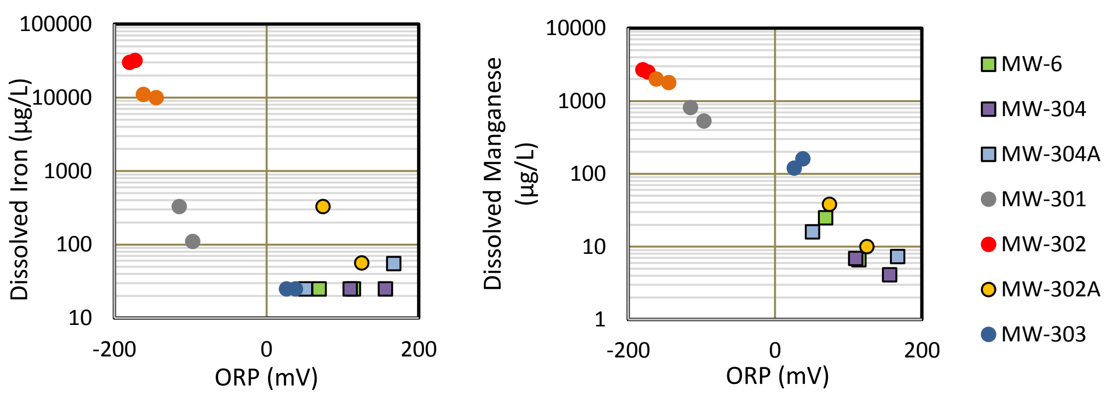


The one pair of measurements of dissolved and total arsenic at MW-302 reflected comparable concentrations of 45 and 48 µg/L.

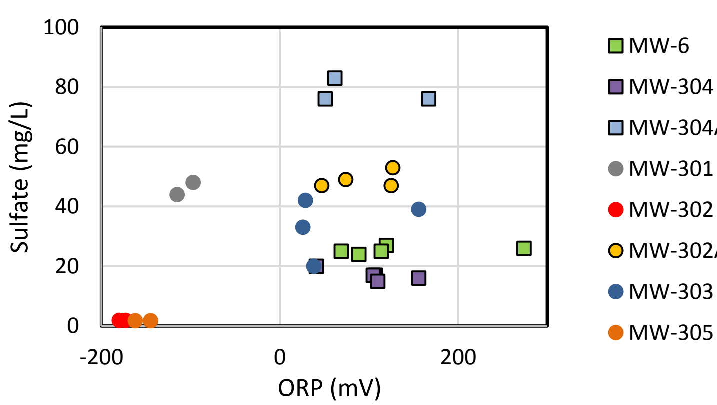
The pH and redox are the master variables that significantly control the chemistry and environmental fate of arsenic. The groundwater is near neutral in pH with most wells reflecting high ORP oxic conditions. The exceptions are MW-301, -302 and -305 with screens in dark olive to black silt or clay.



The soil colors suggest reducing conditions and the potential for organic carbon to drive the low ORP reducing conditions. The concentrations of dissolved iron and manganese are negatively correlated with ORP as anoxic conditions favor the dissolution of iron and manganese oxyhydroxides.



Sulfate would also be expected to reflect the presence of the reducing conditions as the sulfate is reduced to sulfide.



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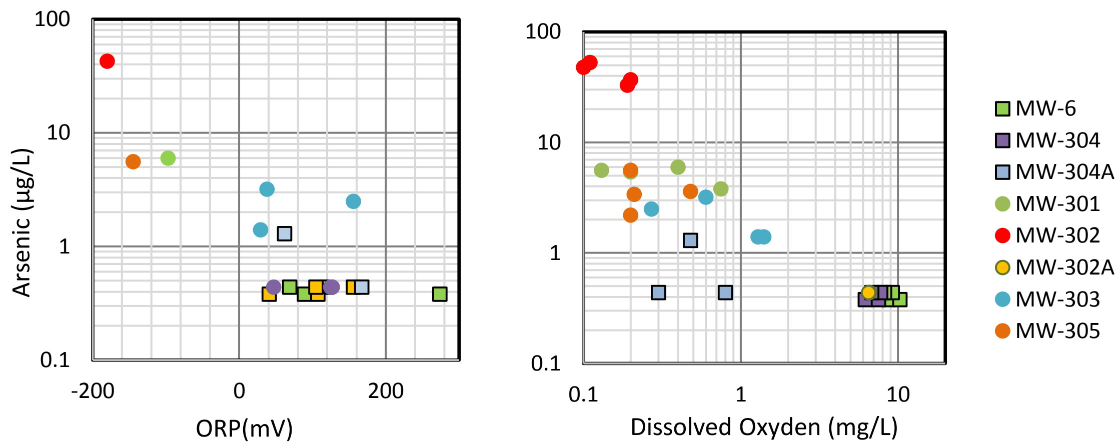
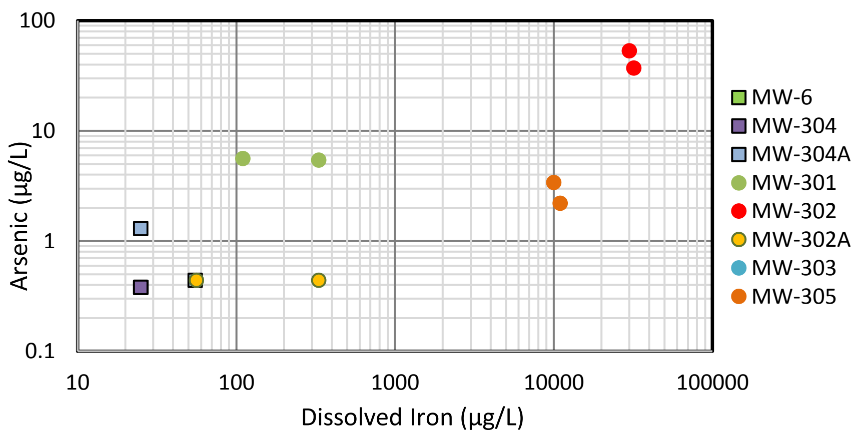
This may be occurring at MW-302 and -305 as the ORP falls below -150 mV assuming that sulfate is flowing into this area.

Note that MW-302A chemistry is similar to other wells unaffected by potential Ash Pond releases. It may reflect background groundwater quality that is flowing upward towards the Unnamed Creek 2.

Arsenic concentrations are a function of ORP or dissolved oxygen as a surrogate to supplement a limited number of ORP observations.



Arsenic is not present in background groundwater and there is no correlation with ORP or DO. When arsenic is present, the concentration increases as the groundwater becomes more reducing. This could be due to the reduction of arsenate (As^{5+}) to arsenite (As^{3+}), or due to the dissolution of iron oxyhydroxides that may release absorbed arsenic as noted in this chart.



As the anoxic groundwater with dissolved iron and arsenic moves toward a more aerobic environment, it will be exposed to the atmosphere and the dissolved oxygen content and

ORP will increase. This will result in the precipitation of iron oxyhydroxides, which will remove arsenic from solution by adsorption.

Given the uncertainties in groundwater-surface interactions it is not feasible to estimate the mass of arsenic dissolved in the groundwater.

Recommendations for Additional Assessment of Site-Specific Monitored Natural Attenuation

The hydrogeological and geochemical conceptual models need to be better defined at a very small scale to better understand the potential arsenic migration pathways:

- Installation of surveyed staff gages:
    - in the Upper and Lower Ash Pond,
    - in Unnamed Creek 2 near MW-302, -305 and MW-1 and
    - in Unnamed Creek 1 southwest of the site near MW-304, MW-14 and north of the railroad bridge.

- Installation of an additional water table monitoring well(s) between the coal pile and the Unnamed Creek 1 could help in confirming if groundwater is flowing from the beneath the coal pile to the Unnamed Creek 1.

- Concurrent seasonal measurements of groundwater and surface water levels to determine discharge relationships.

- Surface water at the suggested staff gage locations should also be sampled concurrently with groundwater for analyses of field parameters; filtered and total major cations, arsenic, iron and manganese; and major anions to assess geochemical changes that may result as groundwater moves from an anaerobic to an aerobic environment.

- Future groundwater sampling no longer needs to include aliquots filtered at 0.45 µm.

- Continue to include the measurement of oxidation-reduction potential with groundwater field analyses.

ReSolution Partners, LLC

Table 1. Geochemical data for Lansing GS.

Location	Collection Date	Field pH	Field SEC	Field Temp.	Oxygen, Dissolved	Tur-bidity	Field ORP	As- T	As- D	Fe- T	Fe- D	Mn-T	Mn-D	Sulfate
		SU	µS	deg C	mg/L	NTU	mV	µg/L						mg/L
MW-301	4/15/2019	8.47	539	11.3	0.2	9		5.4						51
	10/2/2019	8.11	502	15.6	0.1	1		5.6						56
	5/19/2020	7.85	474	11.3	0.8	1		3.8						34
	8/18/2020	8.33	476	15.0	0.2	2	-115			680	330	800	810	44
	10/19/2020	8.06	489	14.7	0.4	1	-97	6.0		500	110	560	530	48
	Average	**8.16**	**496**	**13.6**	**0.3**	**3**	**-106**	**5.2**		**590**	**220**	**680**	**670**	**47**
MW-302	4/15/2019	7.66	1089	7.1	0.2	18		37						0.9
	10/2/2019	7.15	1049	15.9	0.1	5		53						0.9
	5/20/2020	6.93	1070	8.7	0.2	4		33						1.9
	8/19/2020	7.18	1039	16.2	0.1	4	-173		46	33000	32000	2800	2500	1.9
	10/19/2020	7.06	1074	14.4	0.1	3	-180	48	44	33000	30000	2800	2700	1.9
	Average	**7.20**	**1064**	**12.5**	**0.1**	**7**	**-177**	**43**	**45**	**33000**	**31000**	**2800**	**2600**	**1.5**
MW-302A	5/20/2020	7.27	644	11.7	6.6	12	127	0.44						53
	7/6/2020	7.22	641	11.7	6.6	5	47	0.44						47
	8/19/2020	7.41	638	11.8	6.2	0	74			230	330	19	38	49
	10/19/2020	7.33	650	11.4	6.5	1	125	0.44		25	56	2	10	47
	Average	**7.31**	**643**	**11.7**	**6.5**	**4**	**93**	**0.44**		**128**	**193**	**11**	**24**	**49**
MW-303	4/15/2019	7.95	448	4.2	1.4	7		1.4						35
	10/2/2019	7.83	409	25.2	0.3	1	156	2.5						39
	5/19/2020	7.67	464	6.3	1.3	0	29	1.4						42
	8/19/2020	7.65	468	30.4	0.2	2	26			25	25	120	120	33
	10/19/2020	7.77	340	23.5	0.6	0	38	3.2		25	25	180	160	20
	Average	**7.77**	**426**	**17.9**	**0.8**	**2**	**62**	**2.1**		**25**	**25**	**150**	**140**	**34**

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Location	Collection Date	Field pH	Field SEC	Field Temp.	Oxygen, Dissolved	Tur-bidity	Field ORP	As- T	As- D	Fe- T	Fe- D	Mn-T	Mn-D	Sulfate
		SU	µS	deg C	mg/L	NTU	mV	µg/L						mg/L
MW-304	6/20/2019	7.01	593	10.6	6.2	104*	41	0.38						20
	10/2/2019	7.16	578	12.4	7.5	4	107	0.38						17
	5/20/2020	7.32	574	9.0	7.8	4	105	0.44						17
	8/19/2020	7.55	583	11.8	6.8	1	110			51	25	11	6.9	15
	10/19/2020	7.16	602	11.8	6.8	0.4	156	0.44		25	25	6.0	4.1	16
	Average	**7.24**	**586**	**11.1**	**7.0**	**2.2**	**104**	**0.41**		**38**	**25**	**9**	**6**	**17**
MW-304A	5/20/2020	8.04	529	12.6	0.5	586	62	1.3						83
	7/6/2020	7.90	541	19.1	0.3	182		0.44						77
	8/19/2020	8.48	533	14.0	0.3	240	51			940	25	99	16	76
	10/19/2020	7.89	547	10.1	0.8	90	167	0.44		270	55	26	7.3	76
	Average	**8.08**	**538**	**14**	**0.5**	**274**	**93**	**0.73**		**605**	**40**	**63**	**12**	**78**
MW-305	6/20/2019	7.19	638	15.5	0.2	10	27*	2.2						24
	10/2/2019	7.03	635	19.0	0.2	9		3.4						26
	5/19/2020	6.90	684	9.8	0.5	20		3.6						1.8
	8/18/2020	7.23	654	19.0	0.1	27	-162			13000	11000	2000	2000	1.8
	10/20/2020	7.24	634	15.6	0.2	4	-145	5.6		12000	10000	1800	1800	1.8
	Average	**7.12**	**649**	15.8	0.2	**14**	**-154**	**3.7**		**12500**	**10500**	**1900**	**1900**	**11**
MW-306	6/20/2019	6.87	1632	13.8	1.0	26	22*	8.6						280
	10/2/2019	9.00	1998	16.3	0.3	4		12						140
	12/5/2019	6.76	2196	16.3	0.9	10		9.3						
	2/5/2020	6.95	2477	13.7	0.2	4		9.4						
	5/19/2020	6.66	2332	12.7	0.3	3		8.5						430
	8/18/2020	7.12	1911	15.0	0.1	0	-139			43000	44000	5200	4800	260
	10/20/2020	6.88	1832	16.2	0.3	3	-142	10		40000	39000	5100	4800	220
	Average	**7.18**	**2054**	**14.9**	**0.4**	**7**	**-141**	**9.6**		**41500**	**41500**	**5150**	**4800**	**303**
MW-306A	5/19/2020	6.99	697	14.6	1.2	4		0.44						44
	7/6/2020	7.04	683	15.3	1.2	1		0.44						40
	8/18/2020	7.38	654	15.5	1.2	3	21			2100	1900	1200	1200	41
	10/20/2020	7.18	681	14.4	1.3	2	-39	0.44		1900	1600	1100	1100	41
	Average	**7.15**	**679**	**15.0**	**1.2**	**3**	**-9**	**0.44**		**2000**	**1750**	**1150**	**1150**	**42**

ReSolution Partners, LLC

Location	Collection Date	Field pH	Field SEC	Field Temp.	Oxygen, Dissolved	Tur-bidity	Field ORP	As- T	As- D	Fe- T	Fe- D	Mn-T	Mn-D	Sulfate
		SU	µS	deg C	mg/L	NTU	mV	µg/L						mg/L
MW-6	4/15/2019	7.59	618	10.0	8.7	1	274	0.38						26
	10/2/2019	7.46	590	10.0	10.3	1	89	0.38						24
	5/20/2020	7.34	597	10.0	9.2	0	120	0.44						27
	8/19/2020	7.98	597	9.8	9.5	0	114			25	25	4	6.6	25
	10/20/2020	7.42	578	9.7	8.2	0	69	0.44		25	25	2	25	25
	Average	**7.56**	**596**	**9.9**	**9.2**	**0.3**	**133**	**0.41**		**25**	**25**	**3**	**16**	**25**

Notes: 0.44 Green shading indicates value is 1/2 of the laboratory reporting limit

* Possible outlier, not used in statistical summary.

T - total co0ncentrations

D- dissolved concentrations

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Appendix D

Mann-Kendall Trend Test

Trend Test

Lansing Generating Station   Client: SCS Engineers   Data: LAN_Export_201121_Rev   Printed 11/21/2020, 6:07 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Arsenic (ug/L)	MW-301	0.4294	4	13	No	6	0	n/a	n/a	0.02	NP
Arsenic (ug/L)	MW-302	2.643	3	13	No	6	0	n/a	n/a	0.02	NP
Arsenic (ug/L)	MW-302A	0	NaN	NaN	No	2	100	n/a	n/a	NaN	NP
Arsenic (ug/L)	MW-303	0.09555	3	13	No	6	0	n/a	n/a	0.02	NP
Arsenic (ug/L)	MW-304	0.1416	NaN	NaN	No	3	100	n/a	n/a	NaN	NP
Arsenic (ug/L)	MW-304A	-3.262	NaN	NaN	No	2	50	n/a	n/a	NaN	NP
Arsenic (ug/L)	MW-305	1.53	NaN	NaN	No	3	0	n/a	n/a	NaN	NP
Arsenic (ug/L)	MW-306	-0.9342	-2	-10	No	5	0	n/a	n/a	0.02	NP
Arsenic (ug/L)	MW-306A	0	NaN	NaN	No	2	100	n/a	n/a	NaN	NP
Arsenic (ug/L)	MW-6 (bg)	0.3471	12	13	No	6	50	n/a	n/a	0.02	NP

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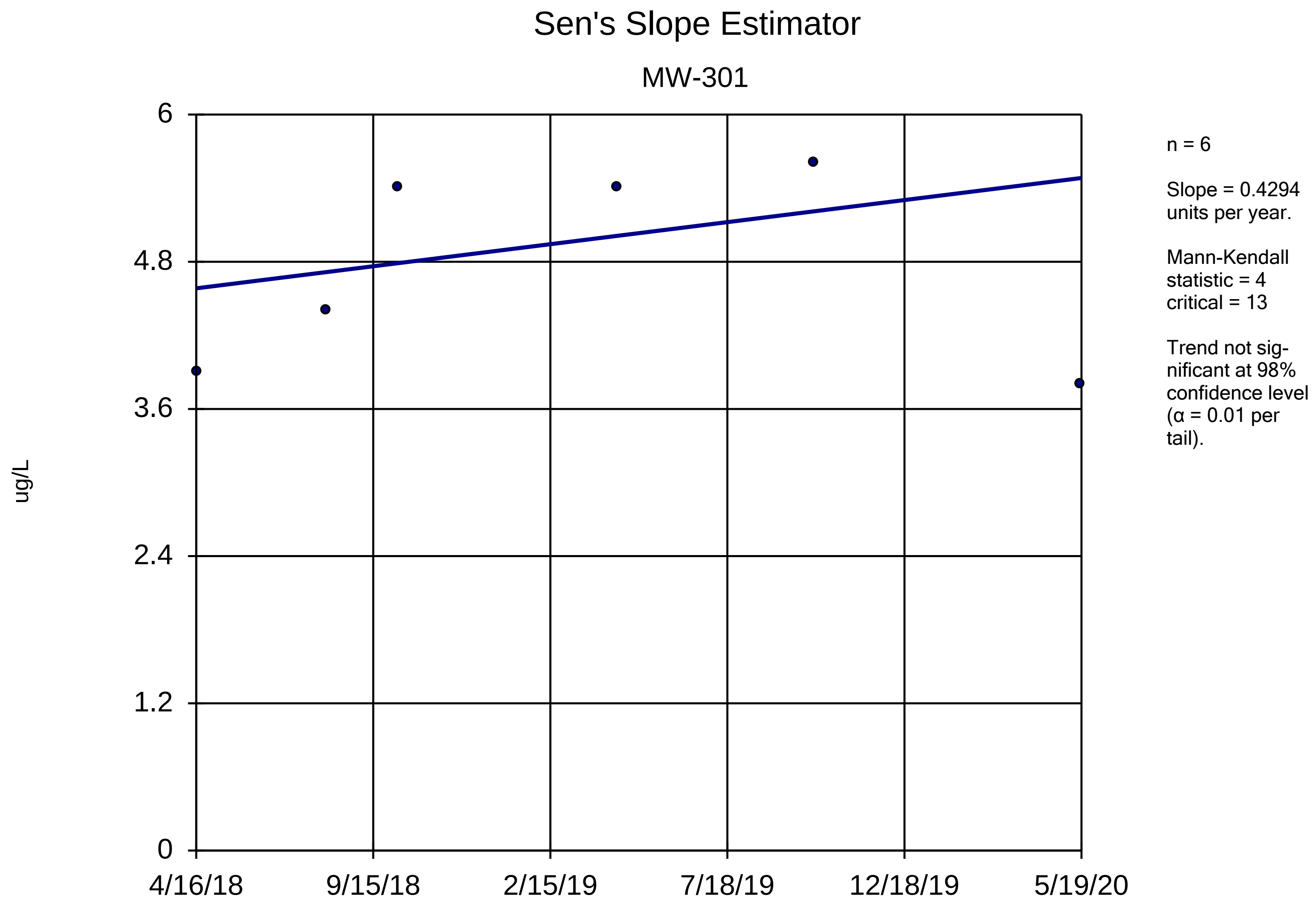
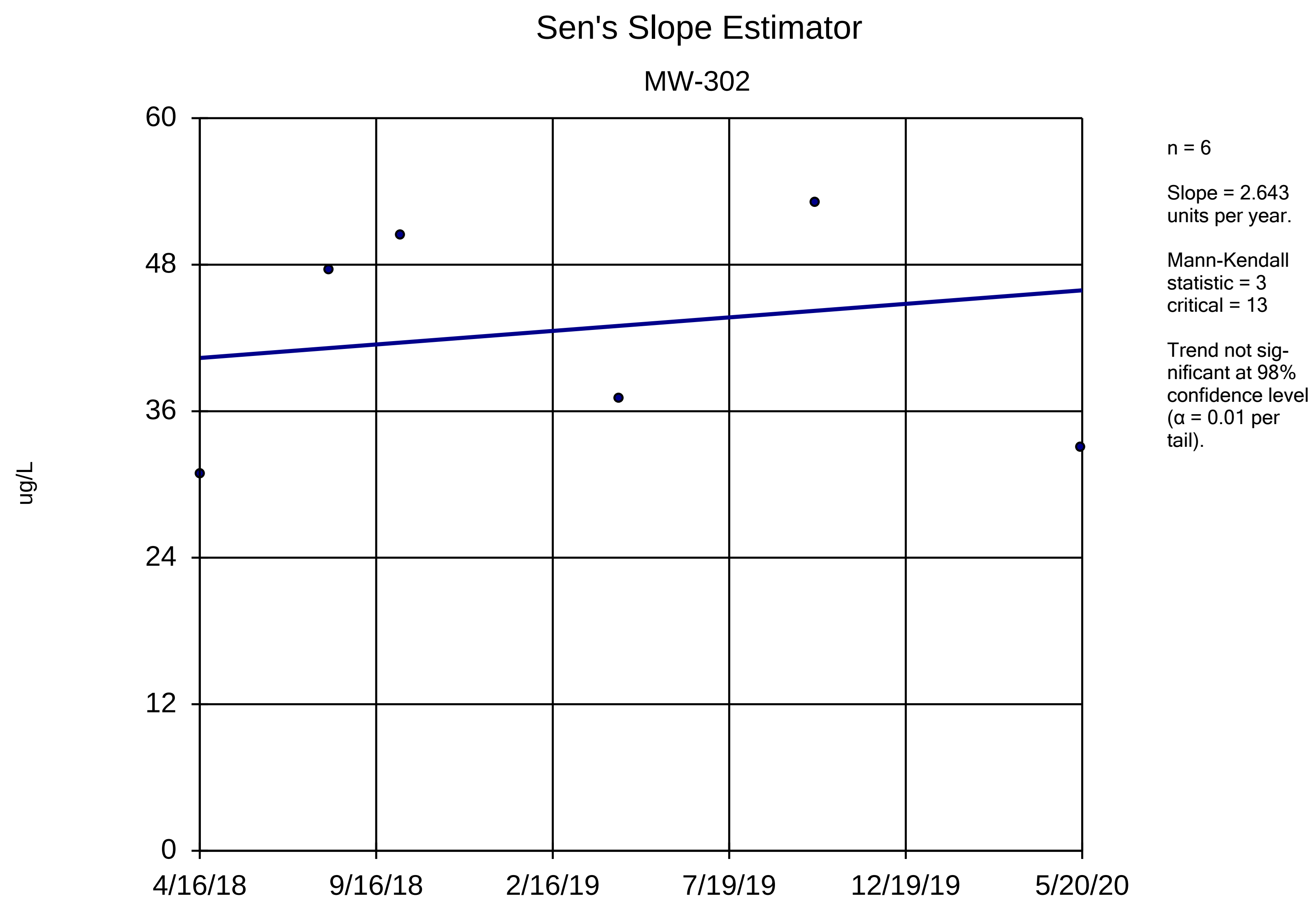


Constituent: Arsenic   Analysis Run 11/21/2020 6:05 PM

Lansing Generating Station   Client: SCS Engineers   Data: LAN_Export_201121_Rev



Constituent: Arsenic   Analysis Run 11/21/2020 6:05 PM

Lansing Generating Station   Client: SCS Engineers   Data: LAN_Export_201121_Rev

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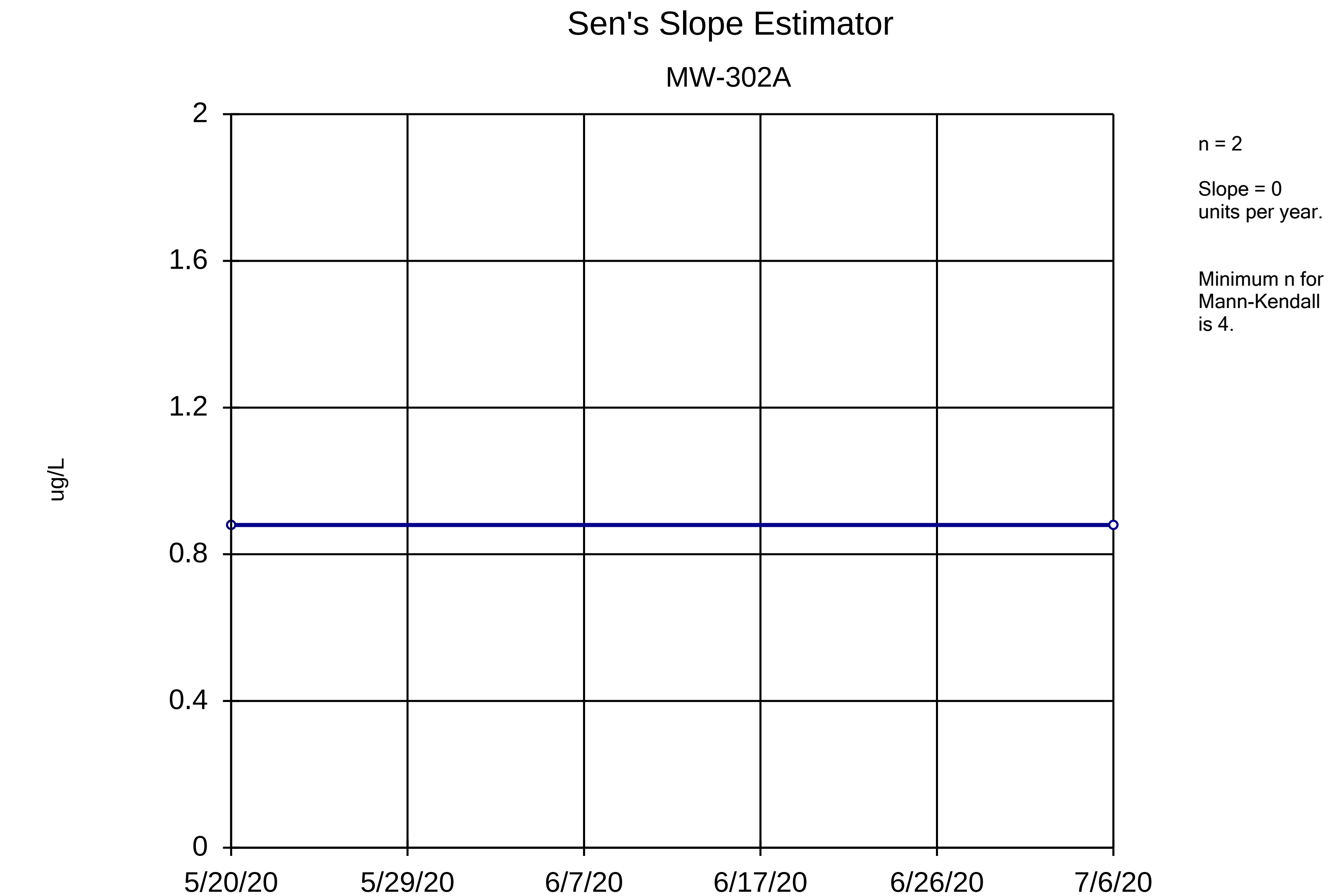
Hollow symbols indicate censored values.



Constituent: Arsenic   Analysis Run 11/21/2020 6:05 PM

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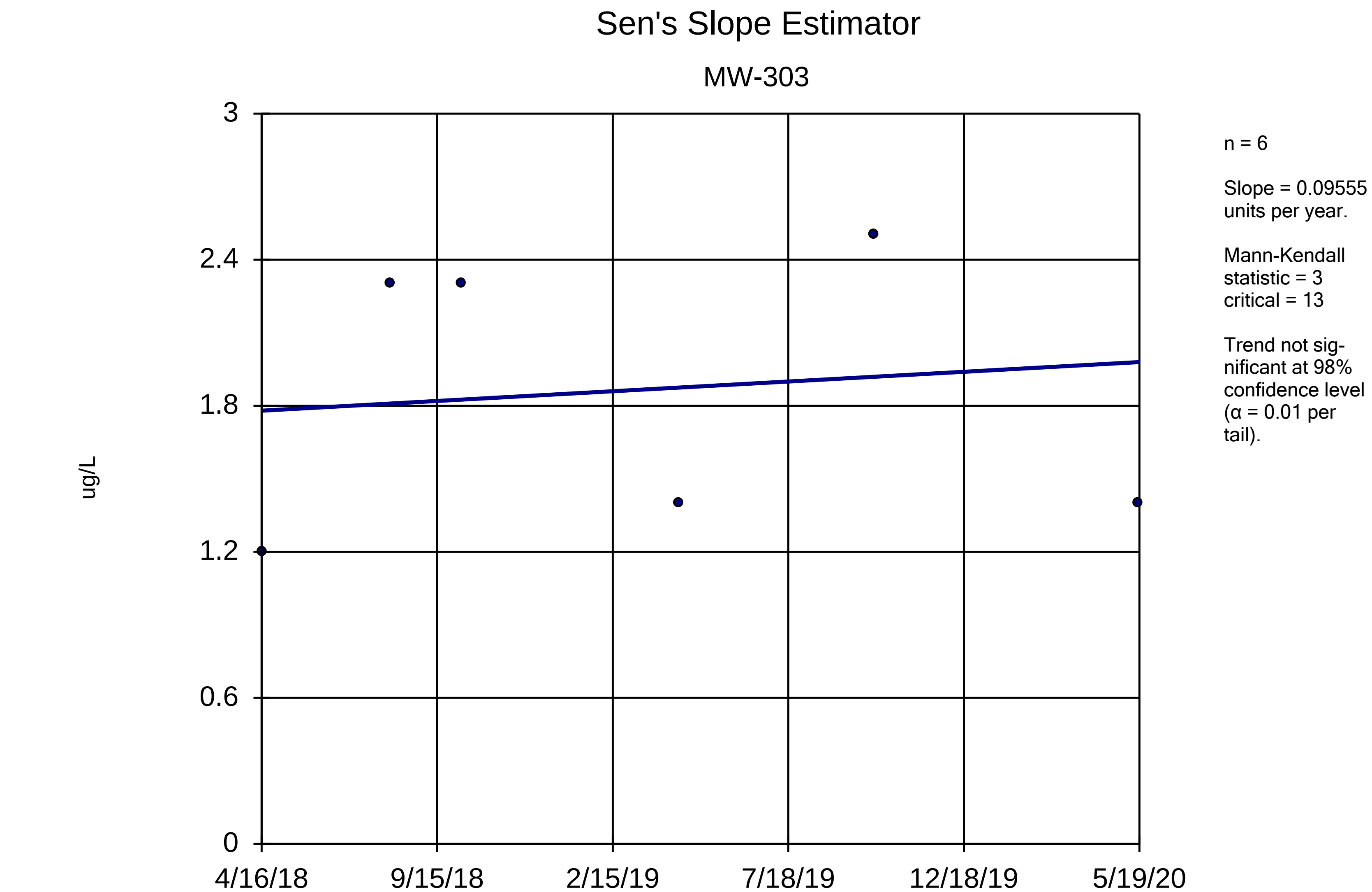

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Lansing Generating Station   Client: SCS Engineers   Data: LAN_Export_201121_Rev

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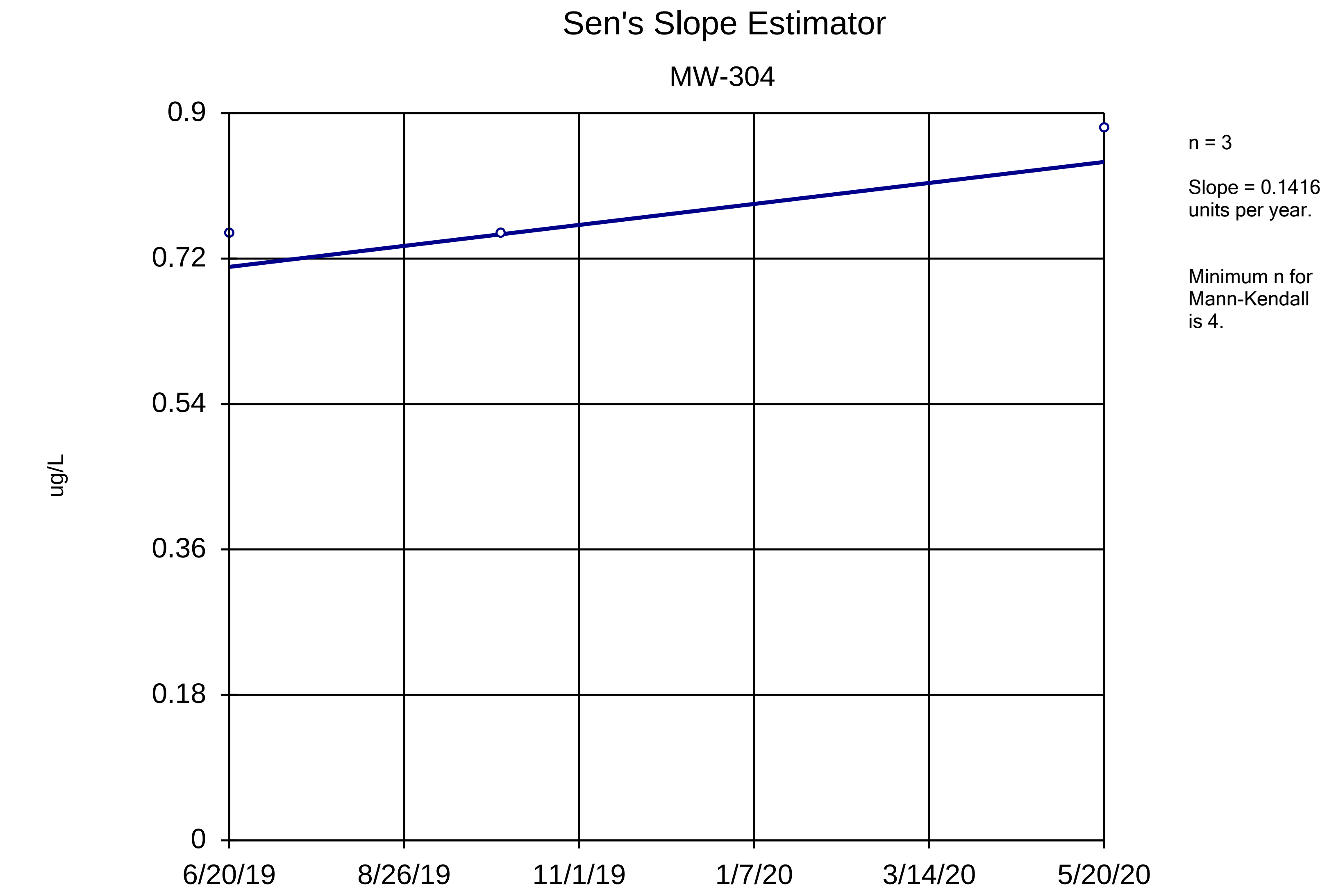
Hollow symbols indicate censored values.



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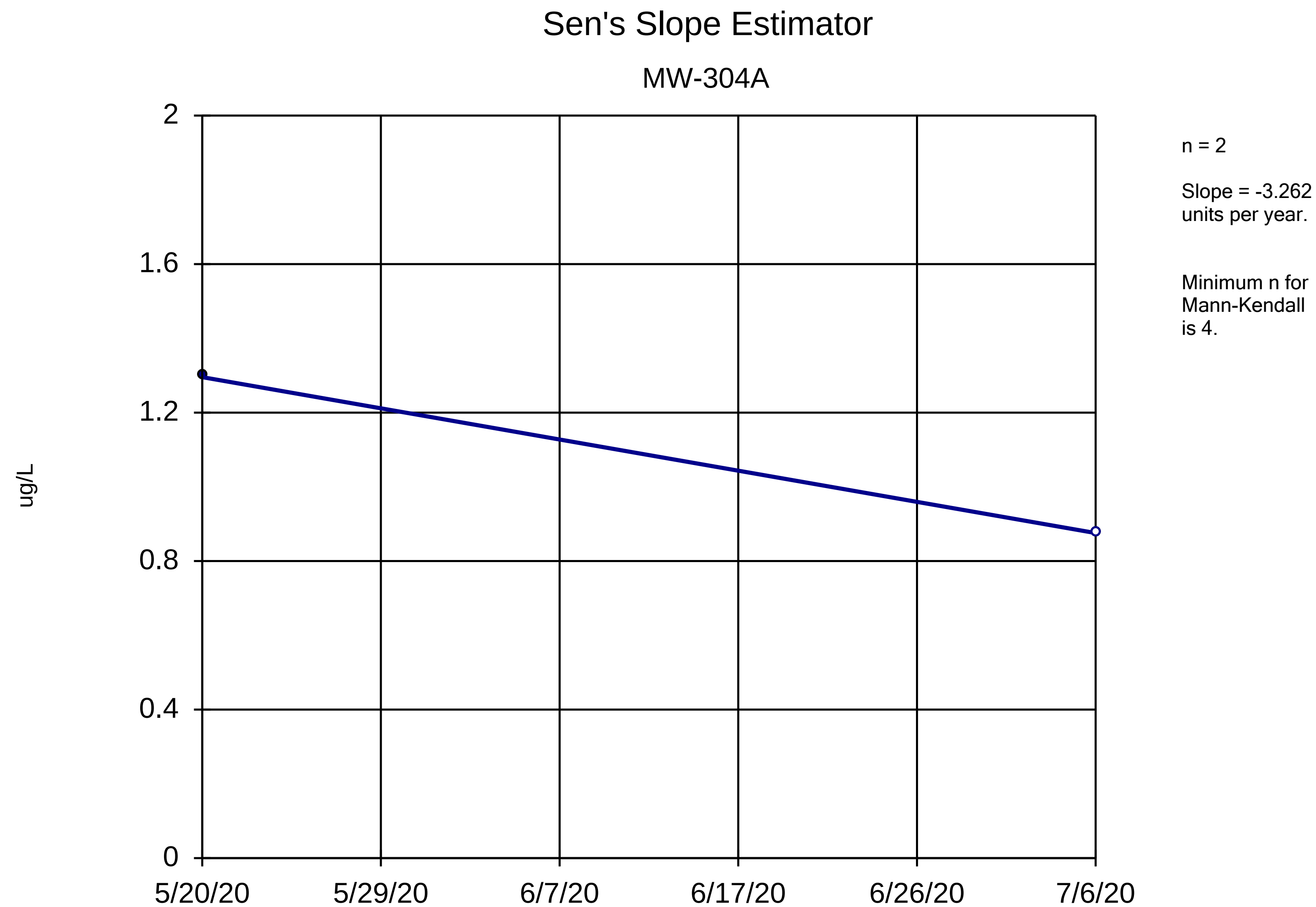
Lansing Generating Station   Client: SCS Engineers   Data: LAN_Export_201121_Rev

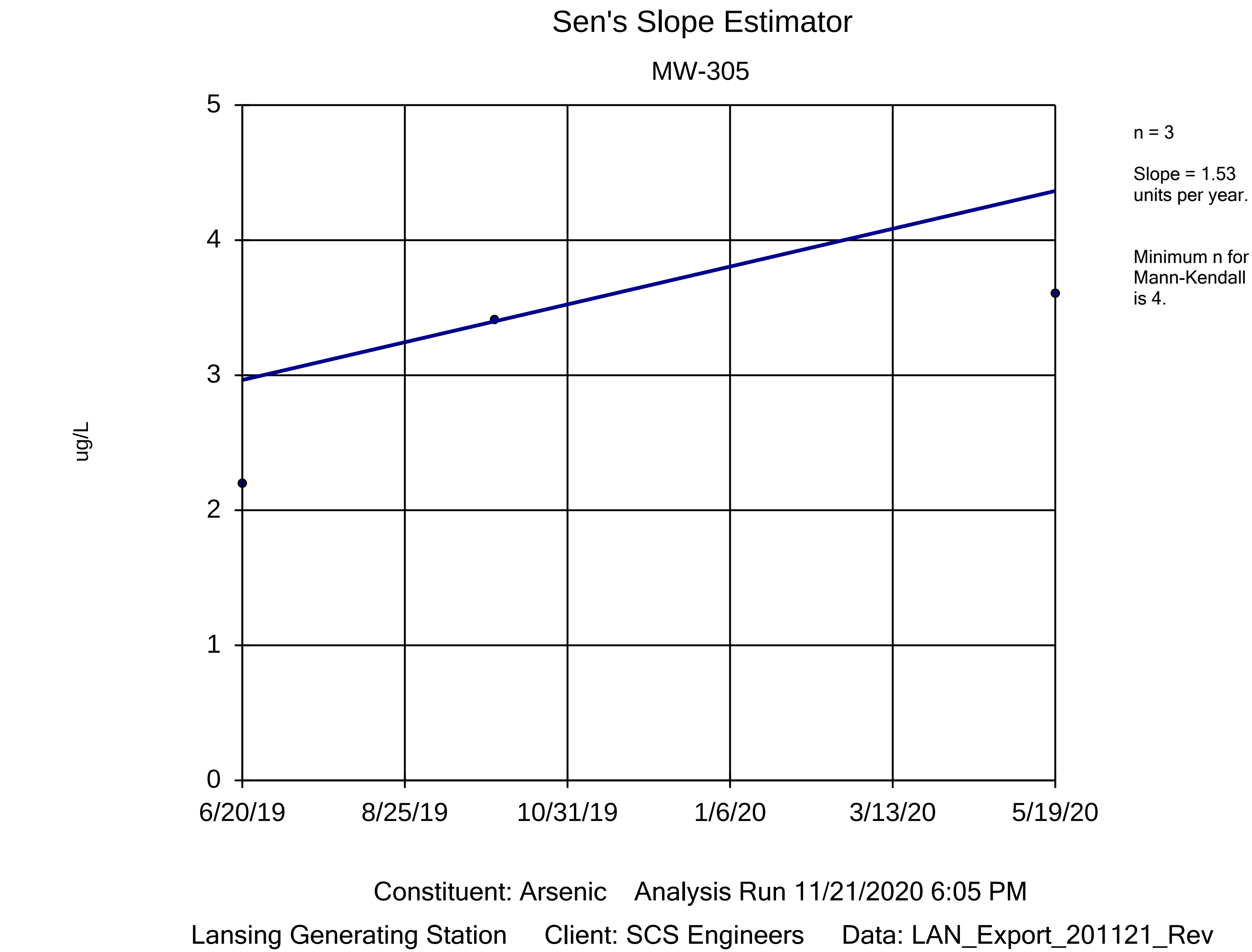
Sanitas™ v.9.6.27 Software licensed to SCS Engineers. UG
Hollow symbols indicate censored values.



Constituent: Arsenic Analysis Run 11/21/2020 6:05 PM

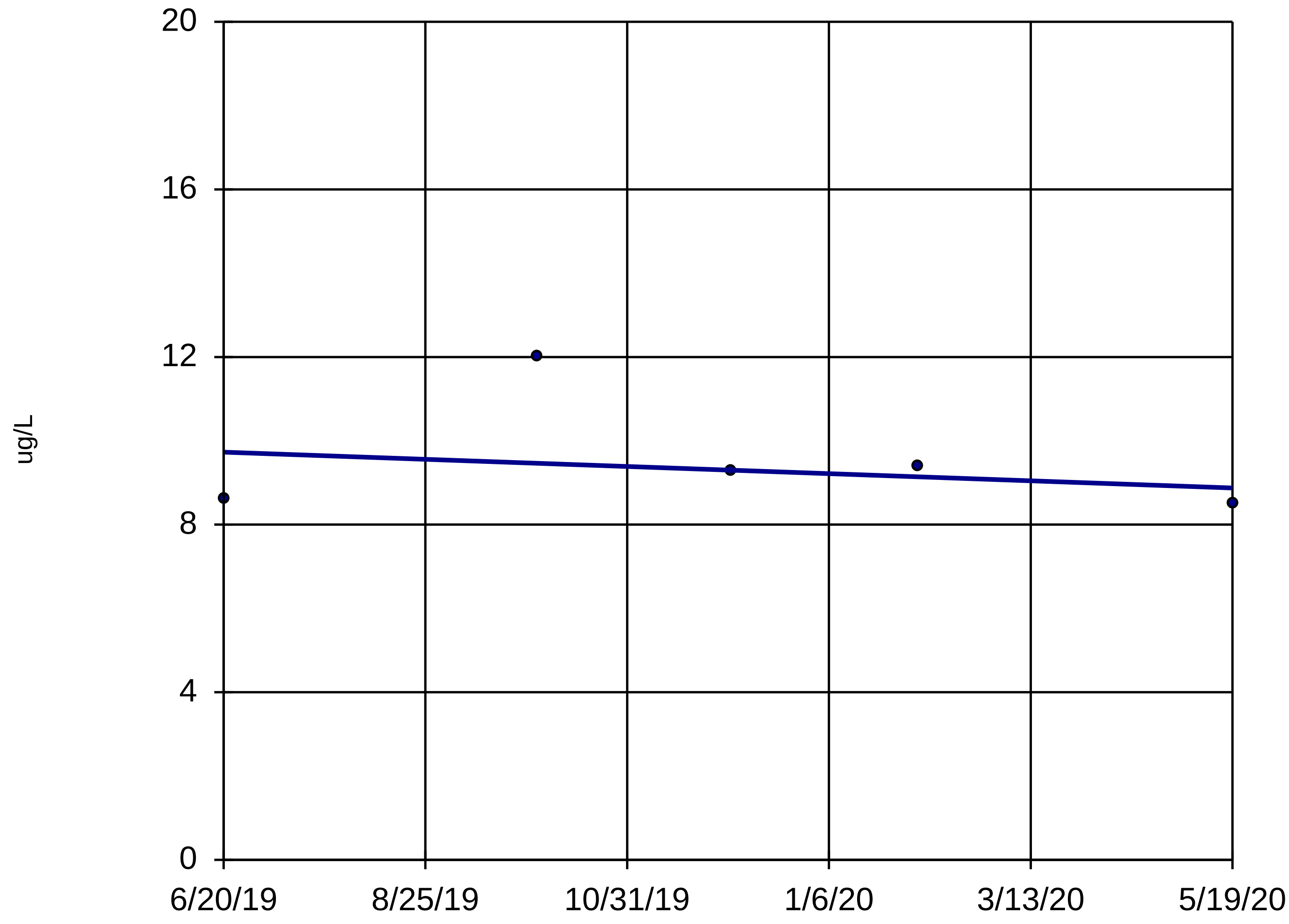
Lansing Generating Station Client: SCS Engineers Data: LAN_Export_201121_Rev

11/25/2020 - Classification: Internal - ECRM7804119


Sen's Slope Estimator
MW-305
ug/L
5
4
3
2
1
0
6/20/19
8/25/19
10/31/19
1/6/20
3/13/20
5/19/20
n = 3
Slope = 1.53
units per year.
Minimum n for
Mann-Kendall
is 4.
Constituent: Arsenic Analysis Run 11/21/2020 6:05 PM
Lansing Generating Station Client: SCS Engineers Data: LAN_Export_201121_Rev

Sen's Slope Estimator

MW-306



n = 5

Slope = -0.9342 units per year.

Mann-Kendall statistic = -2 critical = -10

Trend not significant at 98% confidence level (α = 0.01 per tail).

Constituent: Arsenic Analysis Run 11/21/2020 6:05 PM

Lansing Generating Station Client: SCS Engineers Data: LAN_Export_201121_Rev

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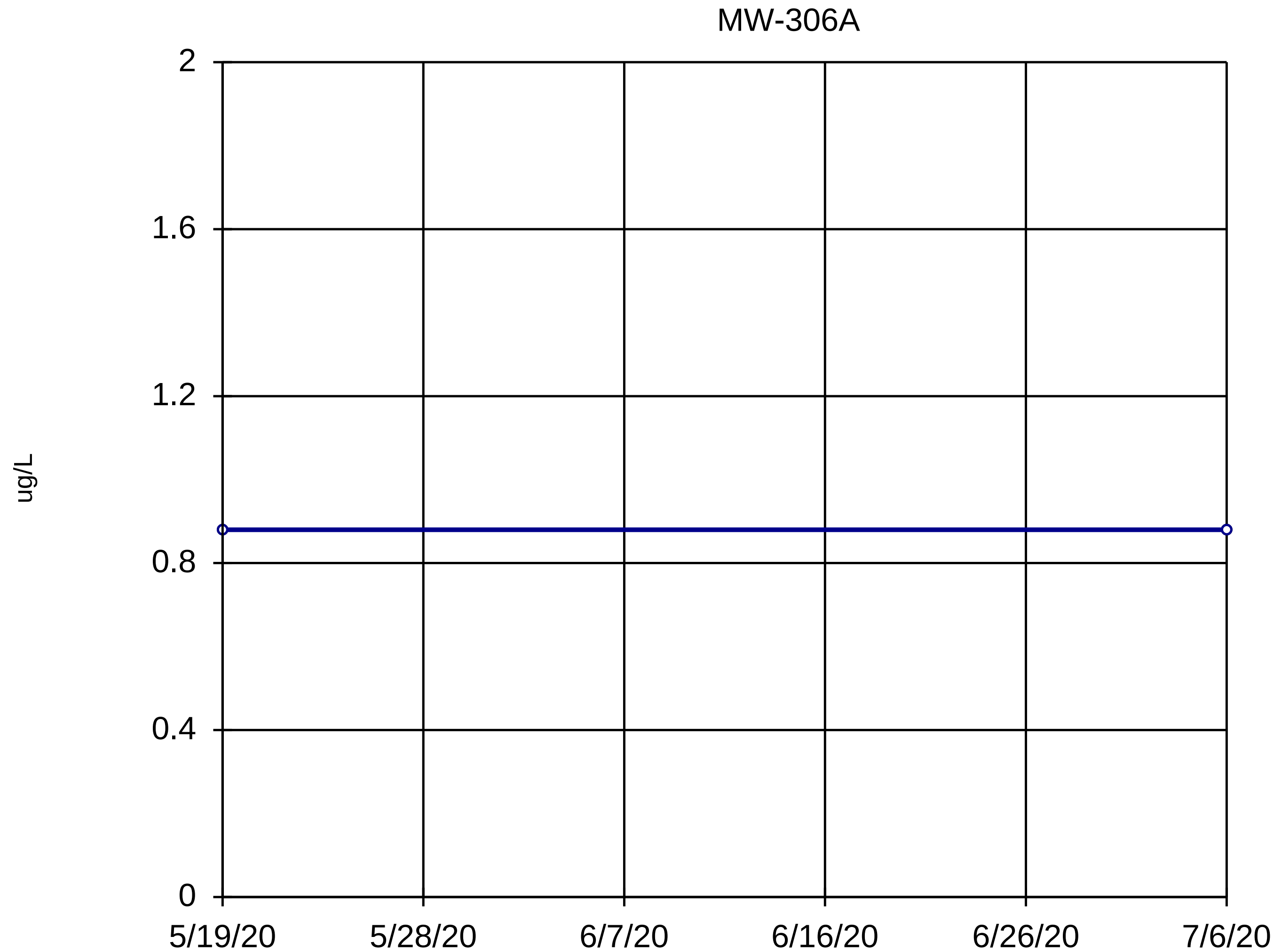
Hollow symbols indicate censored values.

Sen's Slope Estimator



n = 2

Slope = 0
units per year.

Minimum n for
Mann-Kendall
is 4.

Constituent: Arsenic   Analysis Run 11/21/2020 6:05 PM

Lansing Generating Station   Client: SCS Engineers   Data: LAN_Export_201121_Rev

11/25/2020 - Classification: Internal - ECRM7804119

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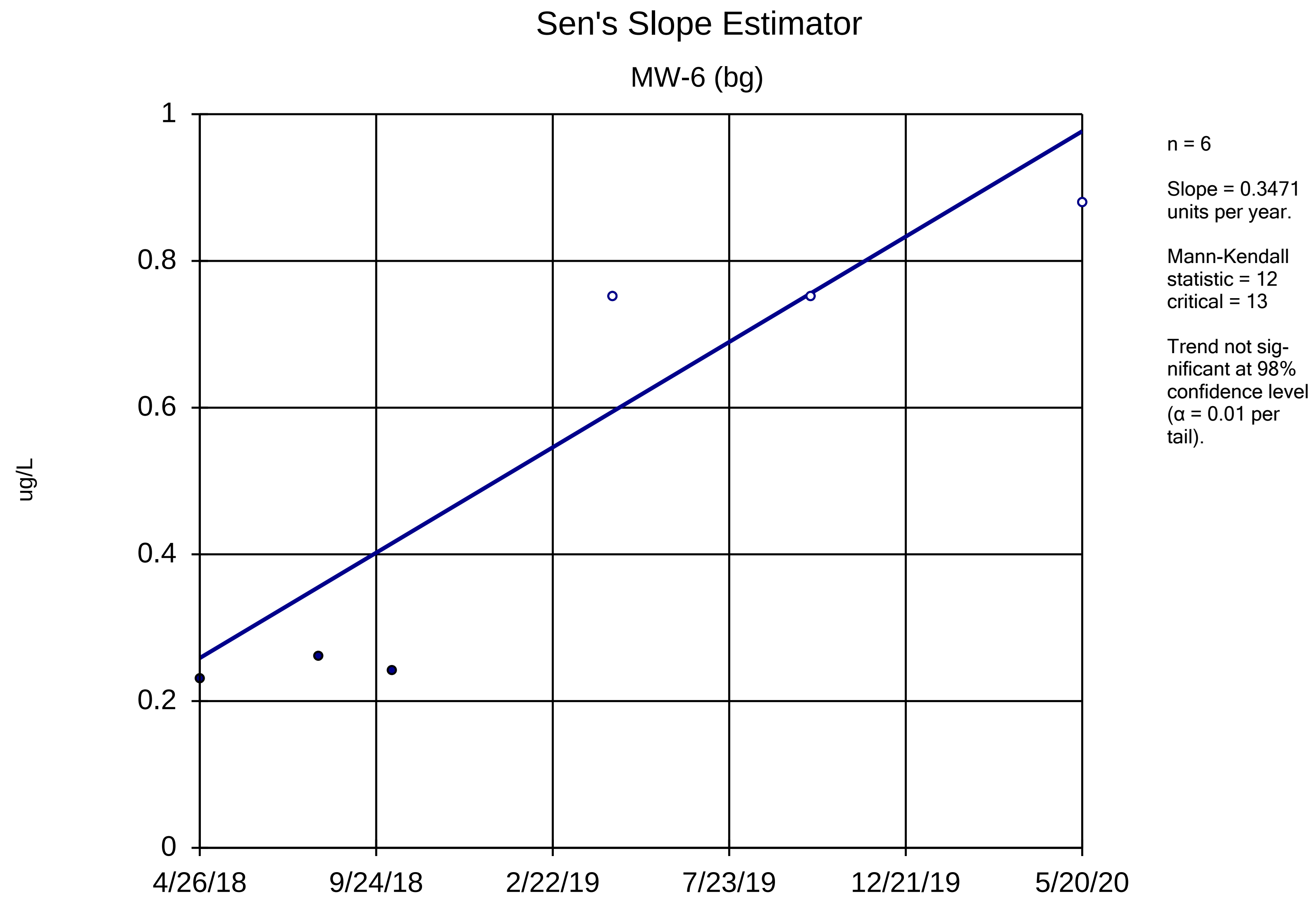
Hollow symbols indicate censored values.



Constituent: Arsenic   Analysis Run 11/21/2020 6:05 PM

Lansing Generating Station   Client: SCS Engineers   Data: LAN_Export_201121_Rev