Location Restrictions for Ash Landfill Expansion

Leland Olds Station
Basin Electric Power Cooperative
Stanton, Mercer County, North Dakota

AECOM Project Number: 60545172
November 20, 2017

Prepared for:

Basin Electric Power Cooperative
1717 East Interstate Avenue
Bismarck, ND 58503

Prepared by:

AECOM
558 North Main Street
Oshkosh, WI, 54901
aecom.com

Table of Contents

Figures

Tables

Appendices

Executive Summary

This Locations Restrictions Report for the Basin Electric Power Cooperative Leland Olds Station Ash Landfill Expansion has been prepared in accordance with the requirements specified in 40 Code of Federal Regulations (CFR) §257.60 through §257.64, which states the coal combustion residuals (CCR) Rule requirements for location restrictions[1]. More specifically, the location restrictions sections are as follows:

- §257.60 Placement Above the Uppermost Aquifer
- §257.61 Wetlands
- §257.62 Fault Areas
- §257.63 Seismic Impact Zones
- §257.64 Unstable Areas

Each requirement of the CCR Rule requires the owner or operator to obtain certification from a qualified professional engineer stating that the demonstration meets the requirements of the applicable CCR Rule citation prior to placing CCR in the new unit. The Leland Olds Station CCR Ash Landfill Expansion represents a lateral expansion and meets the location restriction requirements, as outlined by this report.

[1] U.S. Environmental Protection Agency. (USEPA). (2015). *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule*, 40 CFR §257. Federal Register, Volume 80, Subpart D, April 17, 2015

1. Introduction

The purpose of the CCR Location Restrictions Report for the Basin Electric Power Cooperative Leland Olds Station Ash Landfill Expansion presented in this report is to document that the requirements in 40 Code of Federal Regulations (CFR) §257.60(a), §257.61(a), §257.62(a), §257.63(a), and §257.64(a) have been met to support certification for the existing active CCR units to remain in operation. These regulations require the owner or operator to obtain certification from a qualified professional engineer stating that the demonstration meets the specified aquifer separation, wetlands, fault distance, seismic acceleration, and unstable area requirements of the CCR Rule prior to placing CCR in the Ash Landfill Expansion area.

2. Facility and CCR Unit Description

Basin Electric Power Cooperative (BEPC) owns and operates the Leland Olds Station (LOS) located near Stanton, Mercer County, North Dakota. The station is located approximately four miles southeast of Stanton along the Missouri River (Figure 2.1-Site Location Map, Appendix A). The LOS is a lignite-based electric generating station with two units that generate a combined power of 669 megawatts. The plant first began commercial operation in June 1966.

As part of their continuing operations, BEPC is planning to expand their current operational ash landfill located at the former Glenharold Coal Mine. The location of the operational landfill and proposed Ash Landfill Expansion area are presented in Figure 2.2 (Site Map) included in Appendix A. The Glenharold Coal Mine was a Coal (Lignite) surface mine that ended operations in 1982. After mine closure, the land was reclaimed beginning with soil replacement in 1985. Reclamation operations were completed at the site in 1996, which included reestablishment of native grasslands, native woodlands, and permanent ponds for use as livestock water source and wildlife habitat.

The primary waste type that will be accepted by the proposed Ash Landfill Expansion will consist of CCR as defined by the United States Environmental Protection Agency (EPA), which includes bottom ash/boiler slag, fly ash and flue-gas desulfurization (FGD) waste, which is a synthetic form of gypsum (calcium sulfate). Minor amounts of other solid wastes generated at the power plant will also be accepted, as authorized in North Dakota Department of Health (NDDH) solid waste management facility permit SP-0143 (NDDH, 2017).

3. §257.60 Placement Above the Uppermost Aquifer

3.1 §257.60(a) Citation

New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table).

3.2 Separation of Aquifer to Base of CCR Unit

The LOS Ash Landfill Expansion is subject to Section §257.60 of the CCR Rule concerning the placement of the base of the CCR unit above the uppermost aquifer[2]. As stated on page 21362 of the Preamble of the CCR Rule, the base is considered to be located at the bottom of the liner components:

…the minimum vertical separation be at least three to five feet from the base of the liner components. After additional research, EPA is finalizing a minimum buffer of five feet instead of two feet. EPA's research confirmed the commenter's claims. In addition, EPA determined that several states consider five feet between the base of the surface impoundment and the top of the uppermost aquifer to be the minimum distance that is protective of human health and the environment. These are California, Michigan, Nebraska, New York, West Virginia, and Wisconsin. The Agency has concluded from geographic and climatic spacing of these states that the hydrogeologic conditions within them encompass the range of conditions found in the United States. Therefore, EPA is finalizing a minimum buffer of five feet instead of two feet.

Site subsurface investigations have been performed at the site location in 2011 and 2016. In 2011, BEPC contracted Braun Intertec Corporation to perform a site subsurface investigation that included installation of five (5) monitoring wells. In 2016, a supplemental site subsurface investigation was performed by AECOM under contract with BEPC. As part of the supplemental site subsurface investigation, 10 geotechnical soil borings and 11 site characterization borings were completed by Terracon and Cascade drill crews, respectively. In addition, an extensive laboratory testing program was performed on samples recovered from the geotechnical soil borings. Upon boring completion, the 11 site characterization borings were converted into monitoring wells. Locations of the geotechnical borings and monitoring wells installed at the site are shown on Figure B-1 in Appendix B. Additional information regarding drilling and sampling procedures, well installation procedures, and laboratory test results from the 2016 subsurface investigation can be found in the "Supplemental Site Characterization Report (AECOM, 2017)."

Based on the conditions observed during the subsurface investigations performed in 2011 and 2016, the general encountered soil profile consisted of layers of mine spoils underlain by native hard cohesive soils with layers of lignite. Mine spoils within the proposed Ash Landfill Expansion footprint were encountered near ground surface (+1955.4 to +1891.1 feet NAVD29) to depths ranging between 44.5 and 100 feet below ground surface (+1871.9 to +1835.2 feet NAVD29). Laboratory results from the 2016 supplemental investigation indicate that the underlying mine spoil material and native hard cohesive soils are classified as high plasticity clay (USCS: CH). Boring logs containing soil information and depths explored from the 2016 supplemental investigation are presented in Appendix B.

A review of AECOM's drawings for proposed Ash Landfill Expansion base grades indicate that the minimum base liner elevation is +1886 feet NAVD29. The base liner system for the proposed expansion will consist of a 1-foot drainage layer underlain by a 60-mil High Density Polyethylene (HDPE) liner and 2

[2] Excerpt from the Preamble of the CCR Rule (Page 21362): EPA is revising the definition of "uppermost aquifer" to specify that the measurement of the upper limit of the aquifer must be made at a point nearest to the natural ground surface to which the aquifer rises during the wet season. This definition of "uppermost aquifer" will encompass large seasonal variations, and is more appropriate parameter than "seasonal high groundwater table" as suggested by several commenters and the proposed "natural water table" because it is more clearly defined

feet of compacted clay. When considering the base liner thickness, the minimum subgrade elevation of the proposed Ash Landfill Expansion is +1883 feet NAVD29. The permit drawing of the Ash Landfill Expansion base grades is included in Appendix C.

Of the monitoring wells that have been installed at the site, two (2) of them are within the proposed Ash Landfill Expansion footprint and six (6) are near the footprint perimeter. A quarterly sampling program has been implemented since the installation of the 2011 monitoring wells. In September 2016, water level measurements were performed in the 2011 and in some of the 2016 monitoring wells. The geologic cross sections in Appendix D show the base of the landfill and the piezometric surface derived from water level measurements taken during the September 2016 monitoring event. Groundwater measurements from September 2016 were compared to the minimum subgrade elevation of the proposed Ash Landfill Expansion and are presented in Table 1. In addition, the Ash Landfill Expansion minimum subgrade elevation was also compared to groundwater levels observed since 2011 in monitoring wells within and near the proposed Ash Landfill Expansion footprint and are presented in Figure 3.2 included in Appendix E.

Table 1. Groundwater Elevation Data from September 2016

Monitoring Well	Groundwater Elevation [NAVD29, ft]	Subgrade Elevation [NAVD29, ft]	Separation Distance [ft]
MW-2011-1(1)	1847.4	1883.0(2)	35.6
MW-2011-2	1844.9	1883.0(2)	38.1
MW-2011-3	1844.1	1883.0(2)	38.9
MW-2011-4	1843.8	1883.0(2)	39.3
MW-2011-5	1851.0	1883.0(2)	32.0
MW-2016-1(1)	1836.8	1883.0(2)	46.2
MW-2016-2(1)	1836.0	1883.0(2)	47.0
MW-2016-3	1839.8	1883.0(2)	43.2
MW-2016-4	1843.0	1883.0(2)	40.0
MW-2016-5	1845.3	1883.0(2)	37.7
MW-2016-6	1847.0	1883.0(2)	36.0
MW-2016-7(1)	1862.8	1883.0(2)	20.2
MW-2016-8(1)	1846.2	1883.0(2)	36.8

Note: (1) The locations of these wells are not within or near the proposed Ash Landfill Expansion footprint
(2) Lowest elevation based on AECOM design drawings. Subgrade elevation at actual well location may be greater than +1883 NAVD29 feet; therefore greater separation distance will exist.
Source: Supplemental Site Characterization Report by AECOM

In summary, the comparison of the minimum subgrade elevation of the proposed LOS Ash Landfill Expansion to the unconfined uppermost aquifer indicates a greater than 5 feet separation exists between the upper limit of the uppermost aquifer and the base of the CCR surface impoundment. In addition, the proposed expansion will have an impermeable HDPE liner and low permeable clay liner that will limit the hydraulic interaction between the landfilled material and the in-place site soils. Therefore, the proposed LOS Ash Landfill Expansion meets the requirements of §257.60(a).

3.3 Federal Requirement [40 CFR § 257.60]

Certification Statement 40 CFR § 257.60 – Placement of the Lateral Expansion of an Existing CCR Surface Impoundment Above the Uppermost Aquifer

CCR Unit: Leland Olds Station Ash Landfill Expansion

I, John Cannon, being a Registered Professional Engineer in good standing in the State of North Dakota, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above referenced CCR Units, that the information contained in the Location Restrictions Report dated November 20, 2017 meets the requirements of 40 CFR § 257.60.

John Cannon
Printed Name

November 20, 2017
Date

4. §257.61 Wetlands

4.1 §257.61(a) Wetlands Citation

New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in wetlands, as defined in §232.2 of this chapter, unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that the CCR unit meets the requirements of paragraphs (a)(1) through (5) of this section.

(1) Where applicable under section 404 of the Clean Water Act or applicable state wetlands laws, a clear and objective rebuttal of the presumption that an alternative to the CCR unit is reasonably available that does not involve wetlands.

(2) The construction and operation of the CCR unit will not cause or contribute to any of the following:

(i) A violation of any applicable state or federal water quality standard;

(ii) A violation of any applicable toxic effluent standard or prohibition under section 307 of the Clean Water Act;

(iii) Jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of a critical habitat, protected under the Endangered Species Act of 1973; and

(iv) A violation of any requirement under the Marine Protection, Research, and Sanctuaries Act of 1972 for the protection of a marine sanctuary.

(3) The CCR unit will not cause or contribute to significant degradation of wetlands by addressing all of the following factors:

(i) Erosion, stability, and migration potential of native wetland soils, muds and deposits used to support the CCR unit;

(ii) Erosion, stability, and migration potential of dredged and fill materials used to support the CCR unit;

(iii) The volume and chemical nature of the CCR;

(iv) Impacts on fish, wildlife, and other aquatic resources and their habitat from release of CCR;

(v) The potential effects of catastrophic release of CCR to the wetland and the resulting impacts on the environment; and

(vi) Any additional factors, as necessary, to demonstrate that ecological resources in the wetland are sufficiently protected.

(4) To the extent required under section 404 of the Clean Water Act or applicable state wetlands laws, steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function) by first avoiding impacts to wetlands to the maximum extent reasonable as required by paragraphs (a)(1) through (3) of this section, then minimizing unavoidable impacts to the maximum extent reasonable, and finally offsetting remaining unavoidable wetland impacts through all appropriate and reasonable compensatory mitigation actions (e.g., restoration of existing degraded wetlands or creation of man-made wetlands); and

(5) Sufficient information is available to make a reasoned determination with respect to the demonstrations in paragraphs(a)(1) through (4) of this section.

4.2 Wetlands Study

BEPC contracted AECOM to perform an environmental and wetland delineation within the proposed Ash Landfill Expansion in Mercer County. The purpose of the delineation was to provide a summary of available desktop data and wetland delineations conducted on August 19, 2016 and an evaluation of potential waters of the United States (WOTUS). In addition, a desktop analysis and literature search were also performed to identify federally listed species of concern with potential to occur within the site area. The executive summary and figures from the AECOM report titled, "*Environmental and Wetland Delineation Report for LOS Landfill Expansion*" are included in Appendix F.

A desktop analysis and literature search indicated that seven threatened and endangered (T&E) species of concern with potential to occur within the site area. As part of the analysis, each species was assigned a "determination affect." The assigned determinations for the species identified ranged from "no effect" to "may effect, but not likely to occur."

For the wetlands study, four wetlands were delineated within the site area by AECOM. After evaluation, AECOM concluded that the wetlands appeared to be non-relatively permanent waters (non-RPW) that are formed by geomorphic position, are isolated from jurisdictional waters, and appear without significant nexus. In summary, the delineated wetlands were formed following mine land reclamation when soils settled or as a result of road construction.

4.3 Federal Requirement [40 CFR §257.61]

Certification Statement 40 CFR § 257.61 – Location of the Lateral Expansion of an Existing CCR Surface Impoundment in Wetlands

CCR Unit: Leland Olds Station Ash Landfill Expansion

I, John Cannon, being a Registered Professional Engineer in good standing in the State of North Dakota, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the demonstration that the CCR Unit is not located in wetlands, as included in the Location Restrictions Report dated November 20, 2017 meets the requirements of 40 CFR §257.61.

John Cannon
Printed Name

November 20, 2017
Date

5. §257.62 Fault Areas

5.1 §257.62(a) Citation

New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit.

5.2 Distance to Holocene Faults

As stated in the CCR Rule, a CCR unit is considered to be in a fault area if it's within 200 feet of the outermost damage zone of a fault that has seen displacement during the Holocene epoch, or within the last 12,000 years. As stated on page 21366 of the Preamble of the CCR Rule:

> *To investigate active faults, EPA expects owners and operators of CCR units to follow standard engineering and geologic practices. Technical considerations include:*
>
> > *(1) A geologic reconnaissance of the site to determine the location of active faults. Such a reconnaissance would include utilizing the seismic analysis maps and tools (Quaternary fault maps, earthquake probability maps) of the United States Geological Survey (USGS) Earthquake Hazards Program (http:// earthquake.usgs.gov/hazards/apps/); and*
> >
> > *(2) A site fault characterization within 1000 meters of a site to determine whether it is within 60 meters of an active fault. Such characterizations would include subsurface exploration, including drilling or trenching, to locate any fault zones and evidence of faulting, trenching perpendicular to any faults or lineaments found within 60 meters of the site, and determination of the age of any displacements.*

AECOM researched the United States Geological Survey (USGS) Geographic Information Systems (GIS) Database for known Holocene faults. Since the Holocene faults are defined within the Quaternary Period, which is the last 2.6 million years to present, a figure presenting a USGS map showing Quaternary faults in proximity to the LOS Ash Landfill Expansion is provided in Appendix G. In addition, the North Dakota Geologic Survey has produced a geologic map of Mercer and Oliver Counties (Appendix G).

Findings from the research performed did not indicate the presence of active faults within 1000 meters of the CCR units. Therefore, no further action (e.g., a site characterization) was performed.

Based on the results of the evaluation described herein, the LOS Ash Landfill Expansion is not located within 60 meters (200 feet) of the outermost damage zone of a fault that has seen displacement during Holocene time.

5.3 Federal Requirement [40 CFR §257.62]

Certification Statement 40 CFR § 257.62 – Location of the Lateral Expansion of an Existing CCR Surface Impoundment within 60 Meters of a Fault Area

CCR Unit: Leland Olds Station Ash Landfill Expansion

I, John Cannon, being a Registered Professional Engineer in good standing in the State of North Dakota, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the demonstration regarding that the CCR Unit is not located within 60 meters (200 feet) of the outermost damage zone of a fault that has had a displacement in Holocene time, as included in the Location Restrictions Report dated November20, 2017, meets the requirements of 40 CFR §257.62.

John Cannon
Printed Name

November 20, 2017
Date

6. §257.63 Seismic Impact Zones

6.1 §257.63(a) Citation

CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

6.2 Seismic Impact Zones

As stated on page 21471, the CCR Rule defines a *seismic impact zone* as "an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years". The USGS produced a national map of the two-percent probability of exceedance in 50 years map of peak ground acceleration (Figure 6.1). The LOS Ash Landfill Expansion is in the area of less than 0.1g, and the USGS provides a method to calculate the PGA of specific sites.

The United States Geologic Survey National Seismic Hazards Mapping Project, PSHA Deaggregation program, 2008 version was used to find the PGA for the site location. The results of the Deaggregation program are found in Figure 6.2. The results for the Ash Landfill Expansion are presented in Table 2.

Table 2. Peak Ground Acceleration at Leland Olds Station

Location	Longitude	Latitude	Peak Ground Acceleration
Leland Olds Station	-101.3714	47.2469	0.022 g

The PSHA deaggregation program reports all PGA results for lithified earth materials, which corresponds to seismic site classes A, B, or C. The PGA is below 0.1 g and meets the criteria. Therefore, the LOS Ash Landfill Expansion is not located in a seismic impact zone.

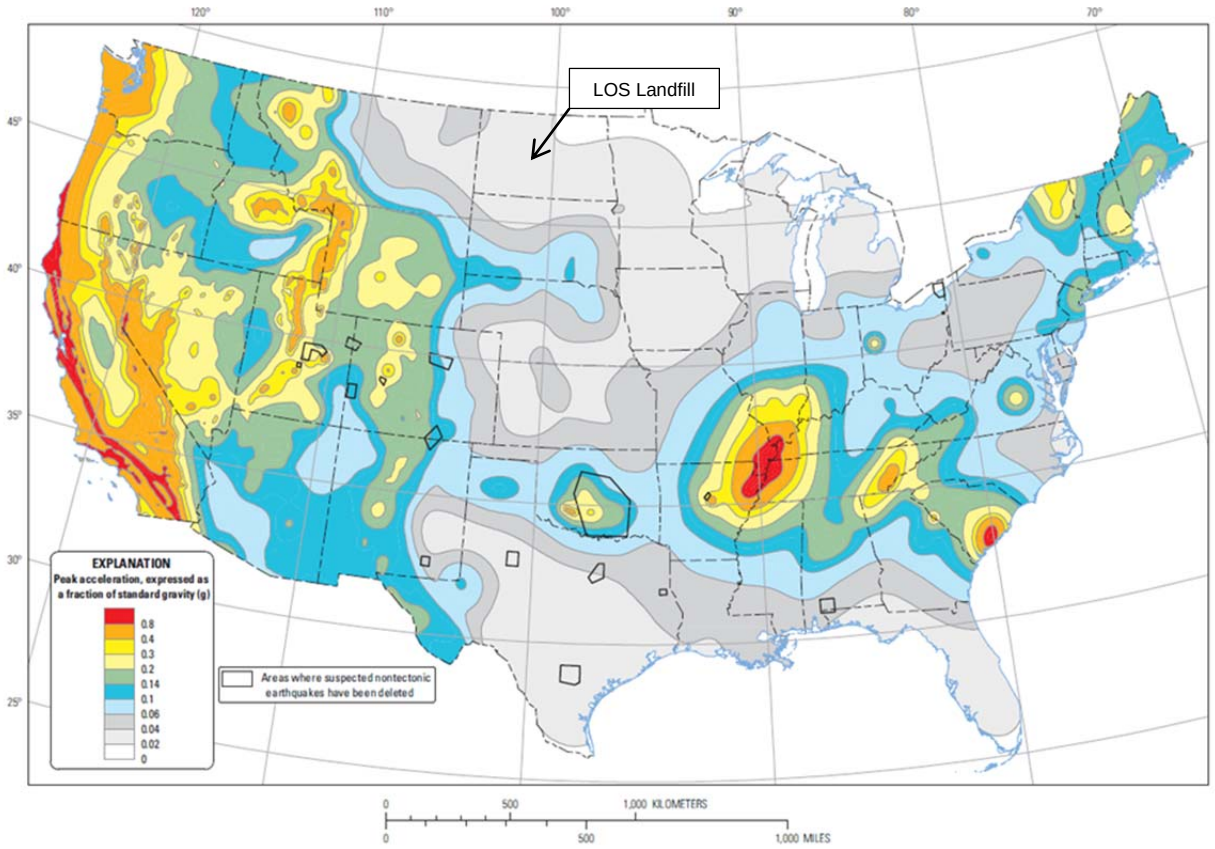


Figure 6.1 Two-Percent Probability of Exceedance in 50 Years Map of Peak Ground Acceleration

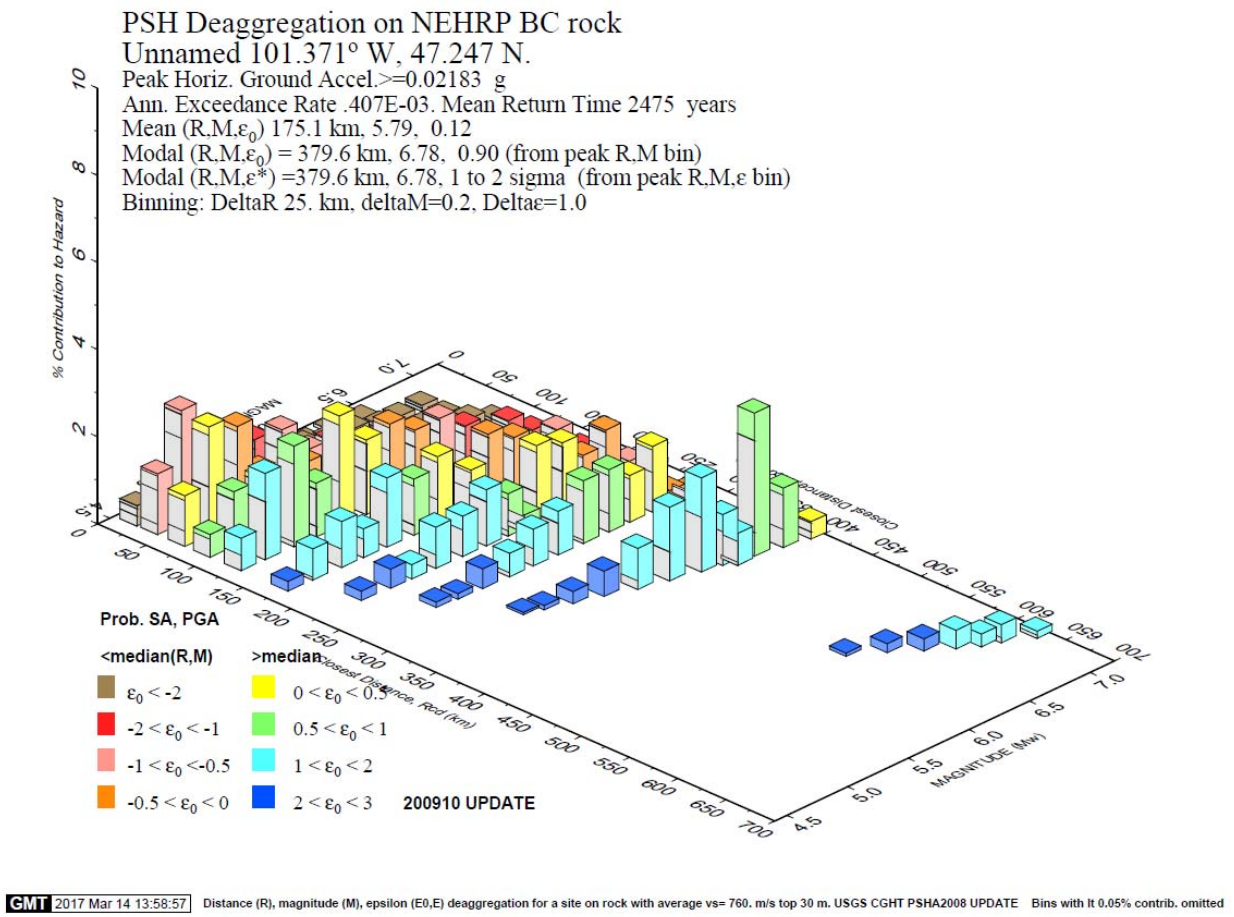


Figure 6.2 The PSHA Deaggregation Program Result (PGA=0.022 g)

6.3 Federal Requirement [40 CFR §257.63]

Certification Statement 40 CFR § 257.63 – Location of the Lateral Expansion of an Existing CCR Surface Impoundment in a Seismic Impact Zone

CCR Unit: Leland Olds Station Ash Landfill Expansion

I, John Cannon, being a Registered Professional Engineer in good standing in the State of North Dakota, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the demonstration that the CCR Unit is not located in a seismic impact zone, as included in the Location Restrictions Report dated November 20, 2017, meets the requirements of 40 CFR §257.63.

John Cannon
Printed Name

November 20, 2017
Date

7. §257.64 Unstable Areas

7.1 §257.64(a)-(b) Citation

(a) An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted.

(b) The owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable:

(1) On-site or local soil conditions that may result in significant differential settling;

(2) On-site or local geologic or geomorphologic features; and

(3) On-site or local human-made features or events (both surface and subsurface).

7.2 Unstable Areas, Settlement, Collapsible Soils

All CCR landfill lateral expansions are subject to the unstable areas location restriction.

Due to the site history, a geotechnical subsurface investigation was completed as part of the design process. The subsurface investigation included drilling 10 geotechnical soil borings within and near the proposed Ash Landfill Expansion footprint. After completion of drilling activities, a laboratory testing program that included direct shear, triaxial shear, and consolidation testing was completed on select recovered samples. Results from geotechnical drilling and laboratory testing were used to analyze the subsurface foundation soils for settlement and overall stability of base grades based on the proposed Ash Landfill Expansion design. Results from the material tests and the methods used for the geotechnical analysis can be found in the "*Supplemental Site Characterization Report (AECOM, 2017b)*."

Results from the geotechnical analysis indicated that settlement will occur as the Ash Landfill Expansion is constructed. Although settlement will occur, the anticipated amount will be within tolerance of the landfill design. In addition, results from the stability analysis indicate that proposed base grades of in-place site soils should remain stable during construction. Based on the soils encountered and the geotechnical analysis performed, the expansion is considered to be stable based on the factors outlined in §257.64(b).

7.3 Federal Requirement [40 CFR §257.64]

Certification Statement 40 CFR § 257.63 – Location of the Lateral Expansion of an Existing CCR Surface Impoundment in an Unstable Area

CCR Unit: Leland Olds Station Ash Landfill Expansion

I, John Cannon, being a Registered Professional Engineer in good standing in the State of North Dakota, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the demonstration that the CCR Unit is not located in an unstable area, as included in the Location Restrictions Report, November 20, 2017, meets the requirements of 40 CFR §257.64..

John Cannon
Printed Name

November 20, 2017
Date

8. Limitations

In preparing this report, AECOM has reviewed background information, design basis, and other additional data furnished to AECOM by BEPC, as well as relevant available information from previous and current investigations performed by AECOM and others at the site. AECOM has relied on this information as furnished without independent verification, and is not responsible for the accuracy or completeness of this information. AECOM shall not be held responsible for conditions or consequences arising from relevant facts that were concealed, withheld, or not fully disclosed by BEPC at the time this report was prepared. In addition, the conclusions expressed in this report are subject to certain conditions and assumptions, which are noted in this report and below. Any party reviewing this report must carefully review and consider all such conditions and assumptions.

The conclusions made in this report are based on the assumption that the subsurface soil, rock, and groundwater conditions at the site do not deviate appreciably from those conditions disclosed in the site-specific exploratory borings. The conclusions in this report are also based on AECOM's understanding of current plant operations, maintenance, storm water handling, and ash handling procedures at the station based on information provided by BEPC. The passage of time may result in changes in site conditions and variations, technology, economic conditions, and regulatory provisions, all which could render the report inaccurate.

This report was prepared by AECOM in accordance with generally accepted engineering and scientific practice in effect at the time of AECOM's assessment of the subject property. This report was prepared pursuant to an agreement between AECOM and BEPC and is for the exclusive use of the BEPC. Any reliance on this report shall be at the user's sole risk.

9. References

NDDH (2017). Leland Olds Station Ash Landfill Expansion–Phase 6 Special Waste Landfill Permit SP-143. Prepared for Basin Electric Power Cooperative.

AECOM (2017). Supplemental Site Characterization Report. Prepared for Basin Electric Power Cooperative.

Braun Intertec Corporation. (2012). Monitoring Well Installation/Abandonment Report. Prepared for Basin Electric Power Cooperative.

AECOM (2016). Environmental Desktop Review and Wetland Delineation Report for the Landfill Expansion at the Leland Olds Station. Prepared for Basin Electric Power Cooperative.

North Dakota State Water Commission and North Dakota Geological Survey (1973). Geology of Mercer and Oliver Counties. Accessed from (https://ngmdb.usgs.gov/maps/mapview/).

U.S. Environmental Protection Agency. (USEPA). (2015). Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, 40 CFR §257. Federal Register, Volume 80, Subpart D, April 17, 2015.

U.S. Geologic Survey. (2015), National Map. Website: //ngmdb.usgs.gov/maps/mapview/

U.S. Geologic Survey (2015). National Seismic Hazards Mapping Project, PSHA Deaggregation program, 2008 version. Website: eohazards.usgs.gov/deaggint/2008/

Appendix A – Site Maps

Project Management Initials: Drawn by:MLB Checked:XXX Approved:XXX 8.5" x 11"

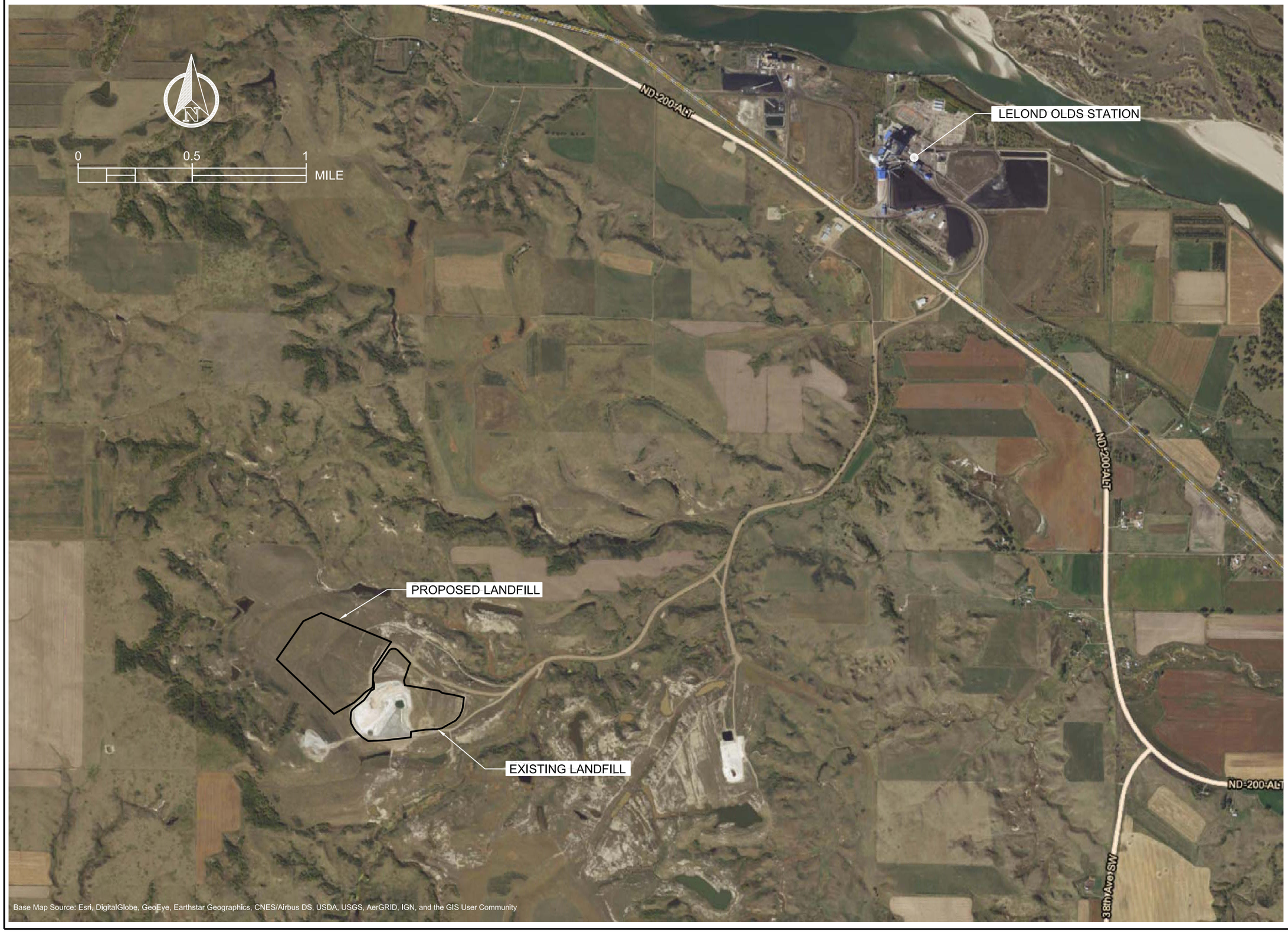
Location Restrictions Report
Basin Electric Power Cooperative
Project No.: 60545172

Site Location Map
Ash Landfill Expansion
Leland Olds Station
Mercer County, North Dakota

AECOM

FIGURE 1

\\172.25.156.10\12Projects\Projects\60545172_LOS Construction Oversight\900-CAD-GIS\920-GIS or Graphics\Restriction Report\8.5X11_Site Location Map.mxd



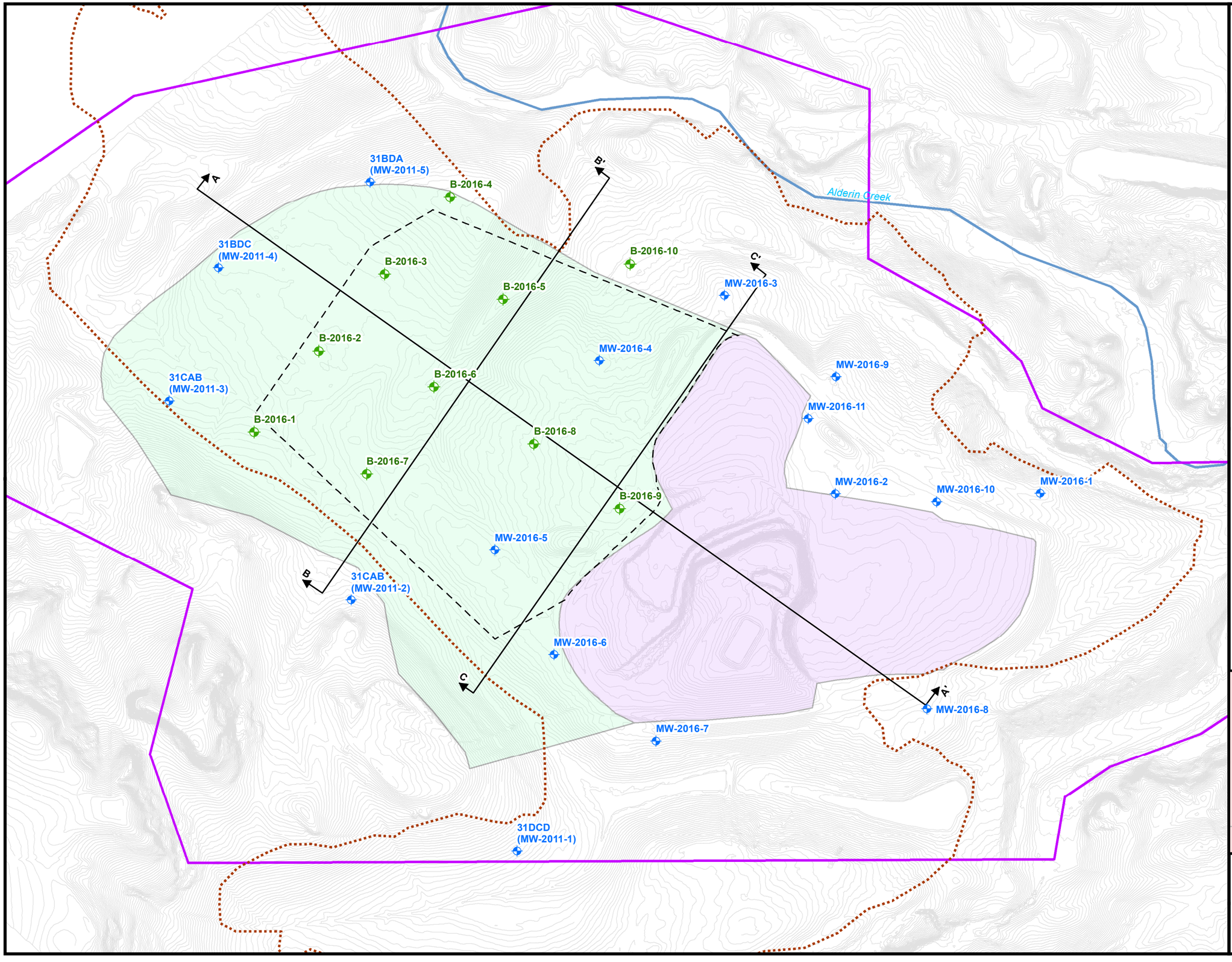
AECOM
558 North Main Street
Oshkosh, WI 54901
920.235.0270
www.aecom.com

SITE MAP
ASH LANDFILL EXPANSION
BASIN ELECTRIC POWER COOPERATIVE
LELOND OLDS STATION
MERCER COUNTY, NORTH DAKOTA

PROJECT NUMBER 60545172

FIGURE NUMBER 2.2

Appendix B – Boring Location Map, 2016 Boring Logs/Well Diagrams



Legend

- Geotechnical Soil Boring
- Monitoring Well
- Geotechnical Cross Section
- Proposed Ash Landfill Expansion
- Mine Boundary
- Existing Landfill Boundary
- Future Expansion Limit
- Landfill Permit Boundary
- Suface Contours (2-foot Intervals)

NOTE: Shapefile Adapted USGS Open-File Report 2005-1351 (2005)

N
W E
S

0 500 1,000 Feet

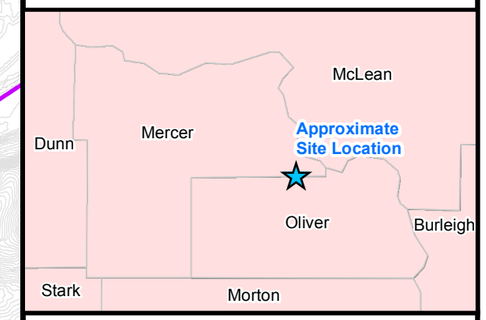


FIGURE 3.1
BORING LOCATION MAP

AECOM

January 2017

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-01**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,913.2	
	1	SS			1.0 FILL - SANDY SILT - little clay - trace plant roots - brown - medium dense (ML)	
		HS			FILL - CLAY - little to trace fine sand and silt - gray - very stiff to hard (CH)	
5.0	2	SS				
		HS				
10.0	3	SS				
		HS				
15.0	4	ST				
	5	SS				
		HS				
20.0	6	SS				
		HS			24.0	
25.0	7	ST			FILL - SANDY CLAY - gray - stiff (CH)	
	8	SS			28.0	
		SS			29.0 FILL - CLAY - little to trace silt - gray - hard (CH)	
		HS				
30.0	9	SS			FILL - CLAY - trace hard clay nodules - intermitent sand seams - gray - stiff to hard (CH)	
		HS				
35.0	10	ST				
	11	SS				
		HS			39.0	
40.0	12	SS			FILL - CLAY - little to trace sand and silt - gray to dark gray - hard to very stiff (CH)	
		HS				
45.0	13	ST			trace coal in sample 13	
	14	SS				
		HS				
50.0	15	SS			trace gravel in sample 15	
		HS			54.0	
55.0	16	ST			FILL - CLAY - little to trace sand and silt - trace gravel - gray - hard (CH)	
	17	SS				
		HS				
60.0						

. . . continued

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. **60494667** | SHEET NO. **1** OF **2**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-01**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

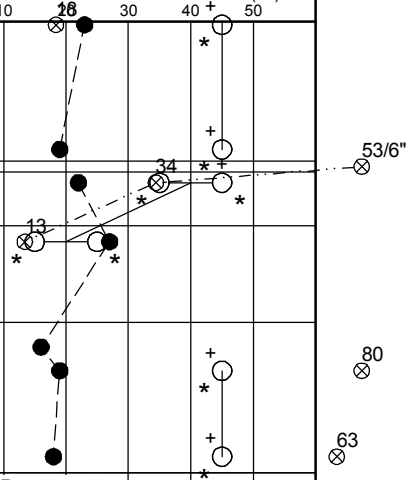
SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,913.2 (Continued)	
	18	SS			FILL - CLAY - little to trace sand and silt - trace gravel - gray - hard (CH)	
		HS				
65.0						
	19	ST				
	20	SS			66.5	
	20A	SS			67.0 FILL - SILTY GRAVEL - light gray - dry - extremely dense (GM)	
		HS			69.5 FILL - CLAY - little to trace silt - gray - very stiff to hard (CH)	
70.0	21	SS			FILL - CLAY - little silt - trace fine sand - gray - stiff to very stiff (CH)	
		HS			74.0	
75.0	22	ST			SENTINEL BUTTE FORMATION - CLAY - trace silt - bluish gray to gray - hard (CH)	
	23	SS			Shelby tube refusal at 75.5 feet	
		HS				
80.0						
81.0	24	SS			81.0	
					End of Boring Boring advanced to 79.5 feet with 3.25-inch hollow-stem auger Standard Penetration Test performed with automatic hammer Boring backfilled with chipped bentonite	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2}: 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %: 10 20 30 40 50

STANDARD PENETRATION BLOWS/(FT): 10 20 30 40 50



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **577904.547**	BORING STARTED: **7/25/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1782313.198**	BORING COMPLETED: **7/25/16**	ENTERED BY: **MLB**	SHEET NO.: **2** OF **2**
WL: **Not Encountered WD / cave in @ 75'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-02**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,915.7	
	1	SS			FILL - SILTY CLAY - trace coarse sand - dark brown (CL-ML)	
		HS				
					4.0	
5.0	2	SS			FILL - CLAY - trace silt, sand, and coal - gray - very stiff to hard (CH)	
		HS				
10.0	3	SS				
		HS				
15.0	4	ST				
	5	SS				
		HS				
20.0	6	SS				
		HS				
25.0	7	ST				
	8	SS				
		HS				
30.0	9	SS				
		HS				
					34.0	
35.0	10	ST			FILL - CLAY - some to little sand and silt - trace coal - gray - hard (CH)	
	11	SS				
		HS				
40.0	12	SS				
		HS				
45.0	13	ST				
	14	SS				
		HS				
					49.0	
50.0	15	SS			FILL - CLAY - little silt - trace sand and coal - grayish brown - very stiff to hard (CH)	
		HS				
					54.0	
55.0	16	ST			FILL - CLAY - little sand, silt, - brown - hard (CH)	
	17	SS				
		HS				
					59.0	
60.0					FILL - CLAY - trace silt - gray to dark gray - hard (CH)	
					. . . continued	

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. **60494667** | SHEET NO. **1** OF **2**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-02**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

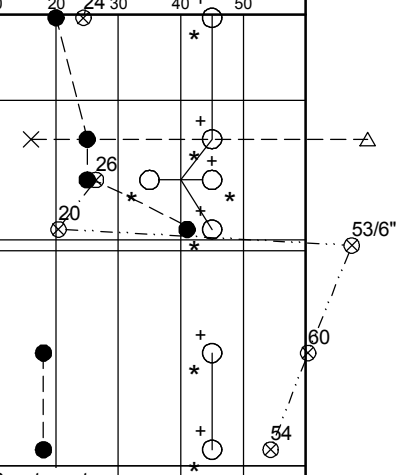
SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +1,915.7 (Continued)	
		18	SS			FILL - CLAY - trace silt - gray to dark gray - hard (CH)	
			HS				
						64.0	
65.0						FILL - CLAY - little silt - dark gray to brown - very stiff to hard (CH)	
		19	ST				
		20	SS			trace coal in sample 19	
			HS				
70.0		21	SS			70.5	
		21A	SS			71.0 LIGNITE - dark brown to black	
			HS			SENTINEL BUTTE FORMATION - CLAY - little to trace silt - bluish gray to gray - hard (CH)	
75.0							
		22	SS				
			HS				
80.0							
81.0		23	SS			81.0	
						End of Boring Boring advanced to 79.5 feet with 3.25-inch hollow-stem auger Standard Penetration Test performed with automatic hammer Boring backfilled with chipped bentonite	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2}: 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %: 10 20 30 40 50

STANDARD PENETRATION BLOWS/(FT): 10 20 24 30 40 50



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **578347.815**	BORING STARTED: **7/22/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1782669.572**	BORING COMPLETED: **7/22/16**	ENTERED BY: **MLB**	SHEET NO.: **2** OF: **2**
WL: **Not Encountered WD / cave in @ 41'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-03**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

SURFACE ELEVATION +1,918.7

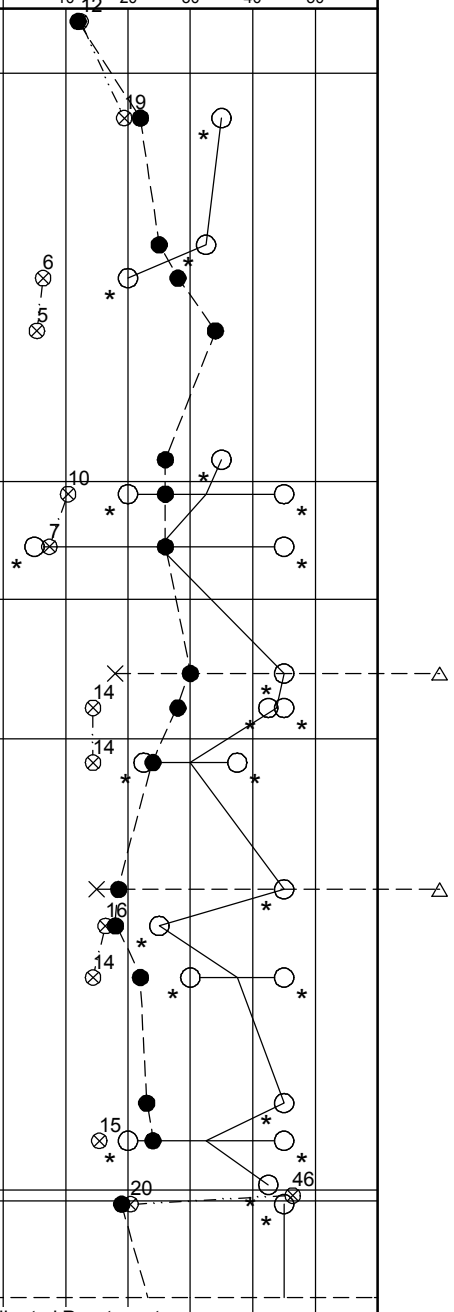
DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			FILL - SANDY SILT - trace clay and plant roots - brown - dry (ML)	
			HS			3.0	
5.0		2	SS			FILL - CLAY - trace sand and silt - brownish gray to dark brown - very stiff (CH)	
			HS				
10.0		3	ST				
		4	SS				
			HS				
15.0		5	SS				
			HS				
20.0		6	ST			22.0	
		7	SS			FILL - CLAY - trace to little silt - intemittent soft clay layers - gray - soft to hard (CH)	
			HS				
25.0		8	SS			trace coal in sample 8	
			HS			27.5	
30.0						FILL - CLAY - trace sand and silt - gray - hard (CH)	
		9	ST				
		10	SS				
			HS			34.0	
35.0		11	SS			FILL - CLAY - little to trace silt and fine sand - brownish gray to gray - very stiff to hard (CH)	
			HS				
40.0		12	ST				
		13	SS				
			HS				
45.0		14	SS				
			HS				
50.0		15	ST				
		16	SS				
			HS				
55.0		17	SS			55.0	
		17A	SS			55.5 FILL - fine to coarse SILTY GRAVEL - light gray - dense (GM)	
		17B	SS				
			HS			FILL - CLAY - little sand and silt - seams of lignite, sand, and silt - brown to gray - very stiff to hard (CH)	
60.0							

. . . continued

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

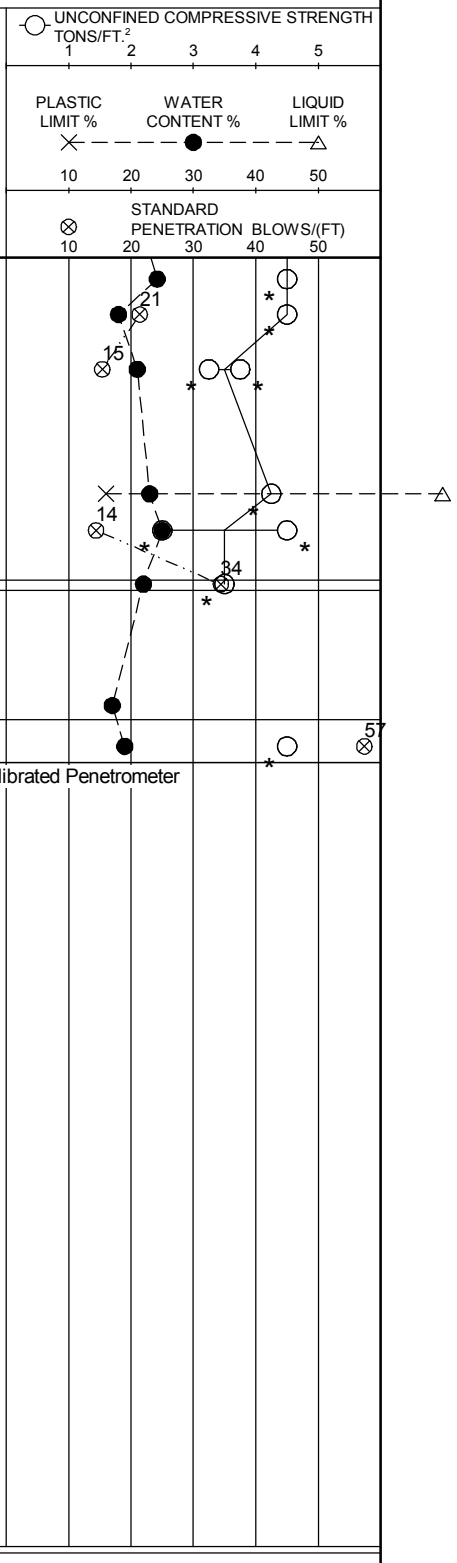
AECOM JOB NO. **60494667** | SHEET NO. **1** OF **2**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-03**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,918.7 (Continued)	
	18	ST			FILL - CLAY - little sand and silt - seams of lignite, sand, and silt - brown to gray - very stiff to hard (CH)	
	19	SS				
		HS				
65.0	20	SS				
		HS				
70.0	21	ST				
	22	SS			trace coal in sample 21	
		HS				
75.0	23	SS			75.0	
					75.5 LIGNITE - black	
		HS			SENTINEL BUTTE FORMATION - SANDY CLAY - trace coal - grayish brown - very stiff (CH)	
80.0						
	24	ST			81.5 Shelby tube refusal at 81.5 feet	
83.5	25	SS			83.5 SENTINEL BUTTE FORMATION - CLAY - trace silt - bluish gray to gray - hard (CH)	
					End of Boring Boring advanced to 80.0 feet with 3.25-inch hollow-stem auger Standard Penetration Test performed with automatic hammer Boring backfilled with chipped bentonite	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **578768.181**	BORING STARTED: **7/21/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1783029.47**	BORING COMPLETED: **7/22/16**	ENTERED BY: **MLB**	SHEET NO. **2** OF **2**
WL: **Not Encountered WD / cave in @ 74'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-04**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

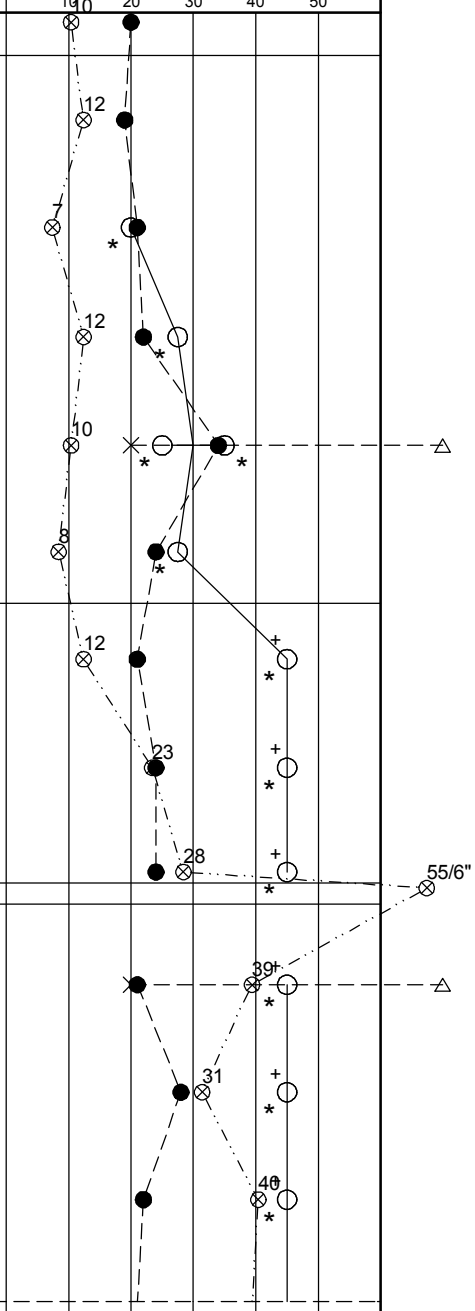
SITE LOCATION: **Stanton, Mercer County, North Dakota**

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +1,943.7	
		1	SS			FILL - SILTY CLAY - trace gravel and plant roots - dark brown (CL-ML)	
			HS			2.0 FILL - CLAY - little to trace silt - trace fine sand - gray to brownish gray - very stiff (CH)	
5.0		2	SS				
			HS				
10.0		3	SS				
			HS				
15.0		4	SS				
			HS				
20.0		5	SS			trace coal in sample 5	
			HS				
25.0		6	SS			trace coal in sample 6	
			HS			27.5 FILL - CLAY - trace silt and fine sand - gray - hard (CH)	
30.0		7	SS				
			HS				
35.0		8	SS				
			HS				
40.0		9	SS			40.5	
		9A	SS			41.5 FILL - LIGNITE and SHALE fragments	
			HS			SENTINEL BUTTE FORMATION - CLAY - little to trace silt - gray - hard (CH)	
45.0		10	SS				
			HS				
50.0		11	SS			coal seam in sample 11	
			HS				
55.0		12	SS				
			HS				
60.0							



. . . continued

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. **60494667** | SHEET NO. **1** OF **2**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-04**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

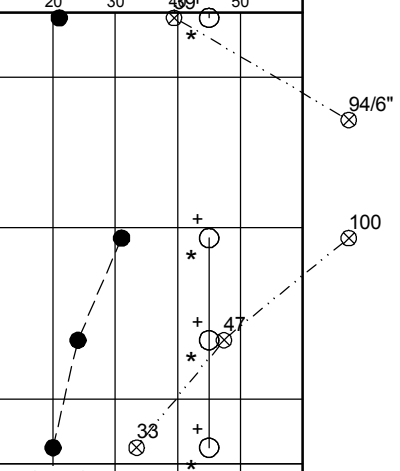
SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,943.7 (Continued)	
	13	SS			SENTINEL BUTTE FORMATION - CLAY - little to trace silt - gray - hard (CH)	
		HS			63.0	
65.0	14	SS			LIGNITE	
		HS				
70.0		SS			70.0	
	15	SS			SENTINEL BUTTE FORMATION - CLAY - trace silt and fine sand - gray - hard (CH)	
		HS				
75.0	16	SS				
		HS			78.0	
80.0					SENTINEL BUTTE FORMATION - SILTY CLAY - little fine sand - gray - hard (CL-ML)	
81.0	17	SS			81.0	
					End of Boring Boring advanced to 79.5 feet with 3.25-inch hollow-stem auger Standard Penetration Test performed with automatic hammer Boring backfilled with chipped bentonite	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2}: 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %: 10 20 30 40 50

STANDARD PENETRATION BLOWS/(FT): 10 20 30 40 50



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **579189.483**	BORING STARTED: **7/21/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1783387.04**	BORING COMPLETED: **7/21/16**	ENTERED BY: **MLB**	SHEET NO.: **2** OF **2**
WL: **65.5' WS / 64.0 @ 24 hr. / cave in @ 77'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-05**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

SURFACE ELEVATION +1,891.1

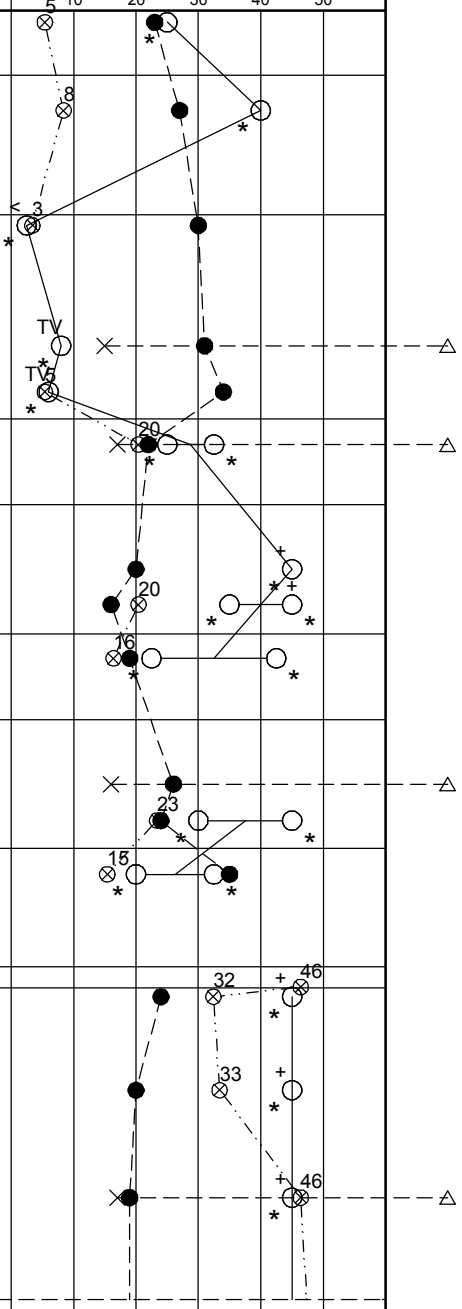
DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
		1	SS			FILL - CLAY - little to trace silt - trace plant roots - brownish gray - very stiff (CH)
			HS			
						3.0
5.0		2	SS			FILL - CLAY - little to trace silt - trace coal - gray - hard (CH)
			HS			
						9.5
10.0		3	SS			FILL - CLAY - little to trace silt and coal - grayish brown to brown - soft to medium (CH)
			HS			
15.0		4	ST			
		5	SS			
			HS			19.0
20.0		6	SS			FILL - CLAY - little silt - trace coal and clinker - grayish brown - very stiff (CH)
			HS			23.0
25.0						FILL - CLAY - little sand and silt - trace coal - gray - very stiff to hard (CH)
		7	ST			
		8	SS			
			HS			29.0
30.0		9	SS			FILL - CLAY - little to trace silt, sand, coal, and clinker - grayish brown to brown - very stiff to hard (CH)
			HS			33.0
35.0						FILL - CLAY - little sand and silt - trace coal - gray - very stiff to hard (CH)
		10	ST			
		11	SS			
			HS			39.0
40.0		12	SS			FILL - CLAY - little to trace silt and coal - dark gray - very stiff (CH) coal seam from 40.1 to 40.3 feet
			HS			
						44.5
45.0		13	ST			45.5 LIGNITE
		14	SS			
		14A	SS			SENTINEL BUTTE FORMATION - CLAY - little to trace silt - bluish gray to gray - hard (CH)
			HS			
50.0		15	SS			
			HS			
55.0		16	SS			
			HS			
60.0						

UNIT DRY WT. LBS./FT.^{3}

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)



. . . continued

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. **60494667**

SHEET NO. **1** OF **2**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-05**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}	UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)
				SURFACE ELEVATION +1,891.1 (Continued)		
	17	SS		SENTINEL BUTTE FORMATION - CLAY - little to trace silt - bluish gray to gray - hard (CH)		
		HS				
65.0	18	SS				44
		HS		67.0 LIGNITE		
70.0	19	SS				100/5"
		HS		72.0 SENTINEL BUTTE FORMATION - CLAY - dark gray - hard (CH)		
75.0	20	SS				79
		HS		78.0 SENTINEL BUTTE FORMATION - fine CLAYEY SAND - little silt - bluish gray - dense (SC)		
80.0 / 81.0	21	SS		81.0 End of Boring Boring advanced to 79.5 feet with 3.25-inch hollow-stem auger Standard Penetration Test performed with automatic hammer Boring backfilled with chipped bentonite		35

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **578631.494**	BORING STARTED: **7/27/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1783677.343**	BORING COMPLETED: **7/27/16**	ENTERED BY: **MLB**	SHEET NO.: **2** OF: **2**
WL: **45.0' WS / cave in @ 74.5'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-06**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,909.8	
	1	SS			FILL - SILTY CLAY - trace sand, coal, and plant roots - brown - hard to very stiff (CL-ML)	
		HS				
4.0						
5.0	2	SS			FILL - CLAY - little to trace silt, sand, and coal - brownish gray to gray - medium to very stiff (CH)	
		HS				
10.0	3	SS				
		HS				
15.0	4	ST				
	5	SS				
		HS				
20.0	6	SS			hard 4-inch clay seem in sample 6	
		HS				
25.0	7	ST				
	8	SS			trace clinker in samples 8 and 9	
		HS				
30.0	9	SS				
		HS				
35.0	10	ST			hard clay seam in sample 10	
	11	SS				
		HS				
40.0	12	SS				
		HS				
45.0	13	ST				
	14	SS			hard clay seam in sample 14	
		HS				
50.0	15	SS				
		HS				
55.0	16	ST				
57.0						
	17	SS			FILL - CLAY - little to trace silt, sand, and coal - brown - very stiff (CH)	
		HS				
60.0						

. . . continued

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. **60494667** | SHEET NO. **1** OF **2**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-06**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

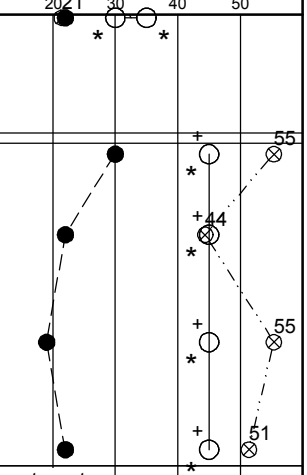
SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,909.8 (Continued)	
	18	SS			FILL - CLAY - little to trace silt, sand, and coal - brown - very stiff (CH)	
		HS			hard clay seam in sample 18	
65.0	19	ST				
	20	SS			65.5	
	20A	SS			66.0 LIGNITE - coarse sand to fine gravel sized grains	
		HS			SENTINEL BUTTE FORMATION - CLAY - trace silt - bluish gray to gray - hard (CH)	
70.0	21	SS				
		HS				
75.0	22	SS				
		HS				
80.0						
81.0	23	SS			81.0	
					End of Boring Boring advanced to 79.5 feet with 3.25-inch hollow-stem auger Standard Penetration Test performed with automatic hammer Boring backfilled with chipped bentonite	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **578151.055**	BORING STARTED: **7/26/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1783299.158**	BORING COMPLETED: **7/26/16**	ENTERED BY: **MLB**	SHEET NO.: **2** OF **2**
WL: **65.0' WS / cave in @ 54'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-07**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

SURFACE ELEVATION +1,924.8

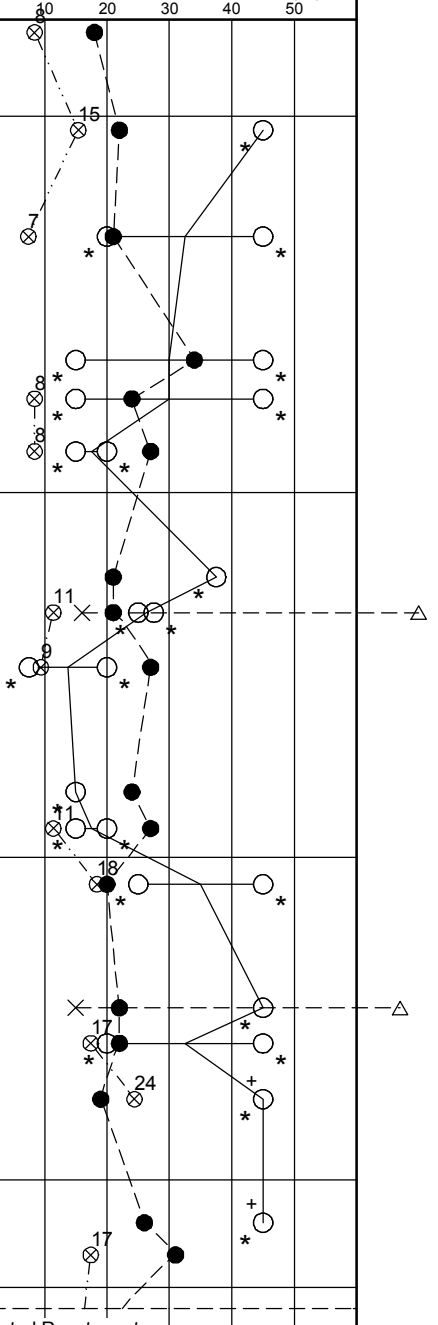
DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
	1	SS			FILL - SILTY CLAY - trace sand and plant roots - dark brown - dry to moist - hard (CL-ML)	
		HS				
5.0					4.5	
	2	SS			FILL - CLAY - little to trace silt, sand, and coal - dark gray to gray - stiff to hard (CH)	
		HS				
10.0	3	SS				
		HS				
15.0	4	ST			trace hard clay nodules in sample 4	
	5	SS				
		HS				
20.0	6	SS			trace hard clay nodules in sample 6	
		HS			22.0	
25.0					FILL - CLAY - some sand and silt - gray to dark gray - very stiff to stiff (CH)	
	7	ST				
	8	SS				
		HS				
30.0	9	SS				
		HS				
35.0	10	ST				
	11	SS				
		HS			39.0	
40.0	12	SS			FILL - CLAY - little to trace silt, sand, and coal - brownish gray to gray - very stiff to hard (CH)	
		HS				
45.0	13	ST				
	14	SS				
		HS				
50.0	15	SS				
		HS			54.0	
55.0	16	ST			FILL - CLAYEY to SANDY SILT - little to trace coal - dark brown to brown - hard (CL-ML)	
	17	SS				
		HS			59.0	
60.0						

. . . continued

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. **60494667** | SHEET NO. **1** OF **2**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-07**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

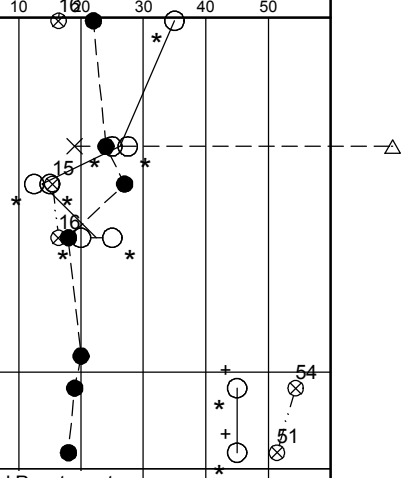
SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,924.8 (Continued)	
	18	SS			FILL - CLAY - little to trace silt - trace coal - dark brown to gray - very stiff to stiff (CH)	
		HS				
65.0						
	19	ST				
	20	SS				
		HS				
70.0	21	SS				
		HS				
75.0						
	22	ST			76.5	
	23	SS			SENTINEL BUTTE FORMATION - CLAY - little to trace silt - bluish gray - hard (CH)	
		HS				
80.0						
81.0	24	SS			81.0	
					End of Boring Boring advanced to 79.5 feet with 3.25-inch hollow-stem auger Standard Penetration Test performed with automatic hammer Boring backfilled with chipped bentonite	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **577674.841**	BORING STARTED: **7/25/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1782930.337**	BORING COMPLETED: **7/25/16**	ENTERED BY: **MLB**	SHEET NO.: **2** OF **2**
WL: **Not Encountered WD / cave in @ 78'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-08**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,944.6	
	1	SS			FILL - SILTY CLAY - trace sand, coal, and plant roots - dark brown (CL-ML)	
2.0		HS			FILL - CLAY - little to trace silt and coal - grayish brown to brown - very stiff to hard (CH)	
5.0	2	SS				
		HS			collected bulk sample of auger cuttings from 2.0 to 9.5 feet	
10.0	3	SS				
		HS				
15.0	4	SS			collected bulk sample of auger cuttings from 9.5 to 19.5 feet	
		HS				
20.0	5	SS				
24.0		HS				
25.0	6	ST			FILL - CLAYEY SILT to SILTY CLAY - trace fine sand - gray - medium to stiff (CL-ML)	
	7	SS				
		HS				
30.0	8	SS				
33.0		HS				
35.0	9	ST			FILL - CLAY - little to trace silt - gray - hard to very stiff (CH)	
	10	SS				
		HS				
40.0	11	SS				
		HS				
45.0	12	ST				
	13	SS				
49.0		HS				
50.0	14	SS			FILL - CLAY - some sand and silt - trace coal - intermittent sand and silt seams - brown - very stiff to hard (CH)	
		HS				
55.0	15	ST				
	16	SS				
59.0		HS				
60.0						

. . . continued

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. **60494667** | SHEET NO. **1** OF **2**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-08**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

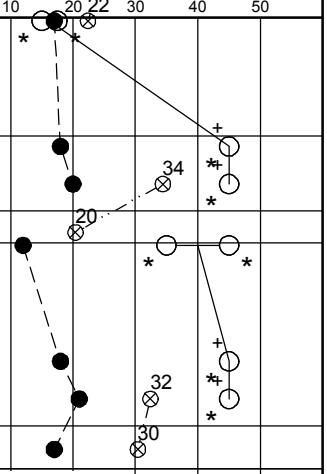
SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,944.6 (Continued)	
	17	SS			FILL - CLAY and SILT - little to trace sand - brownish gray - stiff (CL-ML)	
		HS				
65.0					65.5	
	18	ST			FILL - CLAY - little to trace silt - gray - hard (CH)	
	19	SS			69.0	
		HS				
70.0	20	SS			70.5 FILL - fine SILTY SAND - trace clay - light brown - medium dense (SM)	
	20A	SS				
		HS			FILL - SANDY CLAY - some silt - trace coal - brown - hard (CH)	
75.0						
	21	ST				
	22	SS			79.0	
80.0		HS				
81.0	23	SS			81.0 FILL - fine CLAYEY SAND - intermitent hard clay layers - gray - dense (SC)	
					End of Boring	
					Boring advanced to 79.5 feet with 3.25-inch hollow-stem auger	
					Standard Penetration Test performed with automatic hammer	
					Boring backfilled with chipped bentonite	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **577839.047**	BORING STARTED: **7/27/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1783845.503**	BORING COMPLETED: **7/27/16**	ENTERED BY: **MLB**	SHEET NO.: **2** OF **2**
WL: **Not Encountered WD / cave in @ 76'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-09**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

SURFACE ELEVATION +1,955.4

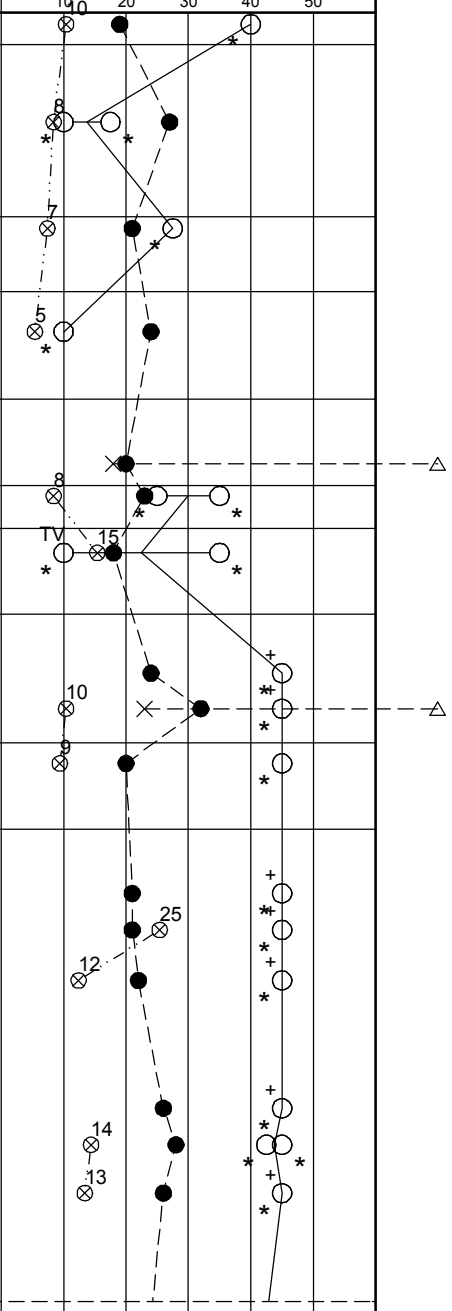
DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
	1	SS			FILL - SILTY CLAY - trace sand, coal, and plant roots - dark brown - hard (CL-ML)	
		HS			1.5 FILL - CLAY - little sand and silt - trace coal - grayish brown - stiff to very stiff (CH)	
5.0	2	SS				
		HS			collected bulk sample of auger cuttings from 1.5 to 9.5 feet	
10.0	3	SS			9.5 FILL - fine CLAYEY SAND - little silt - gray - moist - loose (SC)	
		HS			13.0 FILL - CLAY - little to trace silt and coal - trace hard clay nodules - gray - stiff (CH)	
15.0	4	SS			collected bulk sample of auger cuttings from 9.5 to 20.0 feet	
		HS			18.0 FILL - SANDY CLAY - trace clay - gray - moist (CH)	
20.0	5	ST			22.0 FILL - CLAY - little to trace silt and sand - gray - very stiff (CH)	
	6	SS			24.0 FILL - fine CLAYEY SAND - little silt - gray - moist - medium dense (SC)	
25.0		HS				
	7	SS				
		HS			28.0 FILL - CLAY - trace silt and coal - gray - hard (CH)	
30.0	8	ST				
	9	SS				
		HS			34.0 FILL - SANDY CLAY - little silt - trace coal - gray - hard (CH)	
35.0	10	SS				
		HS			38.0 FILL - CLAY - little to trace silt - dark gray to gray - hard to very stiff (CH)	
40.0	11	ST				
	12	SS				
		HS				
45.0	13	SS				
		HS				
50.0	14	ST				
	15	SS				
		HS				
55.0	16	SS				
		HS				
60.0						

. . . continued

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. 60494667 | SHEET NO. 1 OF 2

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-09**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

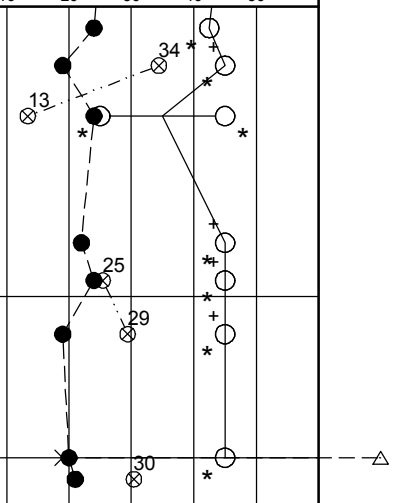
SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
					SURFACE ELEVATION +1,955.4 (Continued)	
	17	ST			FILL - CLAY - little to trace silt - dark gray to gray - hard to very stiff (CH)	
	18	SS				
		HS				
65.0	19	SS				
		HS				
70.0	20	ST				
	21	SS				
		HS			73.5	
75.0	22	SS			FILL - SILTY CLAY - gray - hard (CL-ML)	
		HS				
80.0	23	ST			81.0	
83.5	24	SS			FILL - CLAY - little to trace silt, sand, and coal - brownish gray to gray - hard (CH)	
					83.5	
					End of Boring Boring advanced to 80.0 feet with 3.25-inch hollow-stem auger Standard Penetration Test performed with automatic hammer Boring backfilled with chipped bentonite	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2}: 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %: 10 20 30 40 50

STANDARD PENETRATION BLOWS/(FT): 10 20 30 40 50



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **577484.589**	BORING STARTED: **7/28/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1784314.822**	BORING COMPLETED: **7/28/16**	ENTERED BY: **MLB**	SHEET NO.: **2** OF: **2**
WL: **Not Encountered WD / cave in @ 77'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-10**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

SURFACE ELEVATION +1,910.5

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
	1	SS			FILL - CLAYEY SILT - little sand - trace plant roots - light brown - dry to moist (ML)	
		HS				
5.0	2	SS				
		HS			FILL - CLAY - little to trace silt and coal - grayish brown to brownish gray - stiff to very stiff (CH)	
10.0	3	SS				
		HS				
15.0	4	SS			FILL - CLAY - trace to little silt and coal - gray - medium (CH)	
	ST-1	ST				
		HS				
20.0	5	SS				
		HS			FILL - SILTY CLAY - trace coal - gray - stiff to very stiff (CL-ML)	
25.0	6	SS				
		HS			FILL - fine CLAYEY SAND - little silt - trace coal - gray to bluish gray - medium dense to loose (SC)	
30.0	7	SS				
		HS				
35.0	8	SS				
		HS				
40.0	9	SS				
		HS				
45.0	10	SS			FILL - CLAY - little to trace sand, silt, and coal - grayish brown - medium to stiff (CH)	
		HS			FILL - fine CLAYEY SAND - little silt - gray to bluish gray - loose to medium dense (SC)	
50.0	11	SS				
		HS				
55.0	12	SS				
		HS			FILL - CLAY - little silt - trace coal - grayish brown - stiff to very stiff (CH)	
60.0						

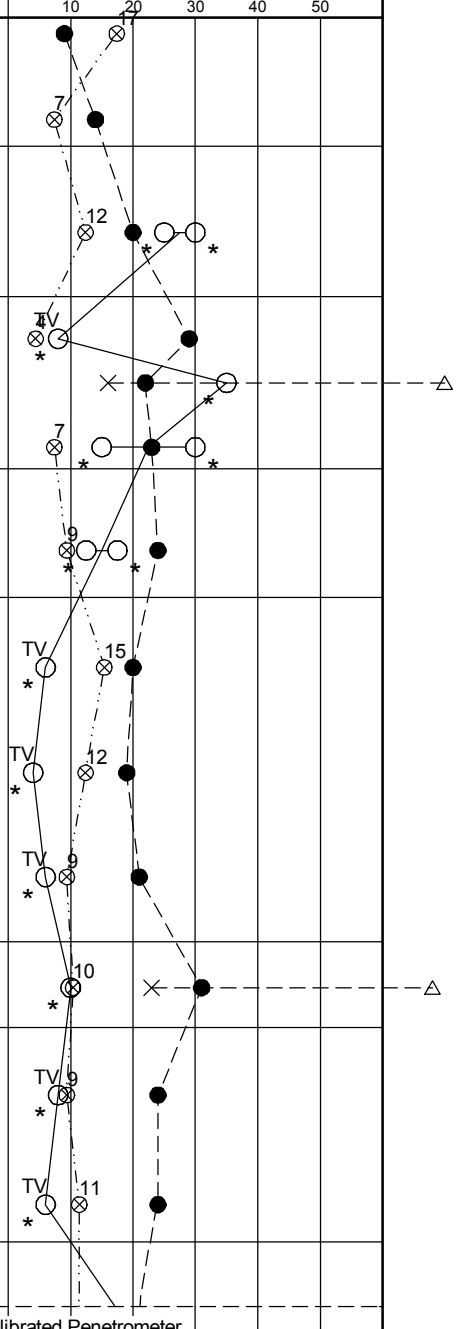
6.0 / 13.0 / 21.0 / 27.0 / 43.0 / 47.0 / 57.0

. . . continued

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

AECOM JOB NO. 60494667 | SHEET NO. 1 OF 2

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM	CLIENT: **Basin Electric Power Cooperative**	LOG OF BORING NUMBER: **B-2016-10** — **Boring offset 50 feet NW**
	PROJECT NAME: **LOS ASH Landfill Expansion**	ARCHITECT-ENGINEER: **AECOM**

SITE LOCATION: **Stanton, Mercer County, North Dakota**

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}	UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS/(FT) (10 20 30 40 50)
					SURFACE ELEVATION +1,910.5 (Continued)		
	13	SS			FILL - CLAY - little silt - trace coal - grayish brown - stiff to very stiff (CH)		11
		HS					
65.0	14	SS					10
		HS					
70.0	15	SS					14
		HS			73.0		
75.0	16	SS			SENTINEL BUTTE FORMATION - CLAY - trace silt - dark gray - hard (CH)		54
		HS					
80.0							
81.0	17	SS			81.0		54
					End of Boring Boring advanced to 79.5 feet with 3.25-inch hollow-stem auger Standard Penetration Test performed with automatic hammer Boring backfilled with chipped bentonite		* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING: **578825.726**	BORING STARTED: **7/28/16**	AECOM OFFICE: **Oshkosh, Wisconsin**	
EASTING: **1784372.785**	BORING COMPLETED: **7/28/16**	ENTERED BY: **MLB**	SHEET NO.: **2** OF **2**
WL: **Not Encountered WD / cave in @ 77'**	RIG/FOREMAN: **D-90/MR (Terracon)**	APP'D BY: **BH**	AECOM JOB NO.: **60494667**

AECOM_LOG_WSAMPLENOTES 60494667_LOS LANDFILL EXPANSION.GPJ DATATEMPLATE_CURRENT.GDT 1/13/17

AECOM

WELL NUMBER MW-2016-1

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 8/7/2016 **COMPLETED** 8/7/2016 **GROUND ELEVATION** 1929.2 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klutes **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 577563.4 N 1786605.09 E **AFTER DRILLING** 67.87 ft / Elev 1861.33 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 1.93 (ft) Casing Type: 2" PVC Pipe Top of Casing (estimated 1.93' ags)
5	SONIC	100				CLAY, reworked material; light brown	
10	SONIC	100		CL			Grout (0' - 78' bgs)
15	SONIC	100					PVC Pipe (1.93' ags - 96' bgs)
16.0						1913.2	
20				CL		CLAY, trace gravel, reworked material; brown to light brown	
20.0						1909.2	
25						CLAY, very sticky, trace gravel, reworked material; brown to light brown	
30	SONIC	100		CL			
35						35.0 1894.2	

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:43 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35						CLAY, sticky, reworked material; brown	Grout (0' - 78' bgs)
40	SONIC	100		CL		40.0 1889.2 SILTY CLAY, reworked material; light brown	PVC Pipe (1.93' ags - 96' bgs)
45				CL		45.0 1884.2 SANDY CLAY, very hard, crumbly; red	
50	SONIC	100					
55	SONIC	100					
60	SONIC	100		CL			
65							
70	SONIC	100				66.0 1863.2 CLAY, very hard, native material; gray	
75				CL		75.0 1854.2	

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:43 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-1

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
75								
				CL		CLAY, hard, native material; gray		Grout (0' - 78' bgs); PVC Pipe (1.93' ags - 96' bgs)
80						80.0	1849.2	
	SONIC	100		CL		CLAY, hard; gray		Bentonite Seal (78'-83' bgs)
85						86.0	1843.2	
	SONIC	100		COAL		LIGNITE, dry, crumbly; brown to black		#40 Sand (83' - 97' bgs); 0.010 Slotted Pipe (86' - 96' bgs)
90								
95						96.0	1833.2	Total Depth of Well 98.93' BTOC
	SONIC	100		CL		CLAY, hard; gray		Bentonite Chip Fill Below Well
100						100.0	1829.2	

Bottom of borehole at 100.0 feet.

AECOM

WELL NUMBER MW-2016-2

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 8/6/2016 **COMPLETED** 8/6/2016 **GROUND ELEVATION** 1954.7 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

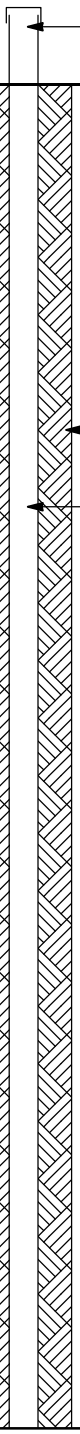
LOGGED BY Ryan Klutes **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 577560.64 N 1785497.98 E **AFTER DRILLING** 107.05 ft / Elev 1847.65 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						CLAY, very sticky, reworked material; brown
5	SONIC	100				
10	SONIC	100		CL		
15						
20	SONIC	100				20.0 1934.7
						CLAY, trace silt, reworked material; brown to light brown
25				CL		
30	SONIC	100				30.0 1924.7
						SILTY CLAY, reworked material; gray
35				CL		

Casing Top Elev: 1.79 (ft)
Casing Type: 2" PVC Pipe

WELL DIAGRAM



LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:44 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
35				CL		SILTY CLAY, reworked material; gray		Grout (0' - 119' bgs)
						37.0	1917.7	
				CL		CLAY, sticky, reworked; brown		PVC Pipe (1.79' ags - 136' bgs)
40	SONIC	100				40.0	1914.7	
				CL		S.A.A., brown to light brown		
45						46.0	1908.7	
				CL		SILTY CLAY, reworked material; light brown to gray		
50	SONIC	100						
55						54.0	1900.7	
				CL		SILTY CLAY, reworked material; gray		
						58.0	1896.7	
				CL		CLAY, reworked material; brown to gray		
60	SONIC	100				60.0	1894.7	
				ML		CLAYEY SILT, crumbly, reworked material; gray		
65								
70	SONIC	100				72.0	1882.7	
				CL		CLAY, very sticky, reworked material; brown		
75								

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:44 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75				CL		CLAY, very sticky, reworked material; brown	Grout (0' - 119' bgs)
						78.0 1876.7	PVC Pipe (1.79' ags - 136' bgs)
				CL		CLAY, reworked material; gray	
80	SONIC	100				80.0 1874.7	
				CL		CLAY, stiff, reworked material; gray	
						82.0 1872.7	
				COAL		LIGNITE; brown	
						84.0 1870.7	
85				CL		CLAY, reworked material; gray with orange clay fragments	
90	SONIC	100				90.0 1864.7	
				CL		CLAY, with lignite fragments, reworked material; brown to light brown	
95							
						97.0 1857.7	
				CL		CLAY, hard, trace silt, native material; gray Slow drilling	
100	SONIC	100				100.0 1854.7	
						CLAY, very hard; gray	
105							
	SONIC	100		CL			
110							
	SONIC	100					
115							

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:44 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-2

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115						CLAY, very hard; gray	Grout (0' - 119' bgs)
120				CL			PVC Pipe (1.79' ags - 136' bgs)
	SONIC	100					Bentonite Seal (119'-124' bgs)
125						127.0 1827.7	
						LIGNITE, dry, crumbly; brown to black	
130	SONIC	100		COAL			#40 Sand (124' - 137' bgs)
							0.010 Slotted Pipe (126' - 136' bgs)
135						136.0 1818.7	
	SONIC	100				CLAY, very hard; gray	Total Depth of Well 138.79' BTOC
140				CL		140.0 1814.7	Bentonite Chip Fill Below Well

Bottom of borehole at 140.0 feet.

AECOM

WELL NUMBER MW-2016-3

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 8/5/2016 **COMPLETED** 8/5/2016 **GROUND ELEVATION** 1937.1 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klutes **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 578652.16 N 1784880.82 E **AFTER DRILLING** 93.14 ft / Elev 1843.96 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						CLAY, with fragments of lignite, reworked material; brown to light brown
5	SONIC	100		CL		
10	SONIC	100				10.0 1927.1 CLAY, trace silt, reworked material; brown
15						
20	SONIC	100		CL		
25						24.0 1913.1 SILTY CLAY, reworked material; gray
30	SONIC	100		CL		
35						32.0 1905.1 CLAY, trace gravel, very sticky, reworked material; brown

Casing Top Elev: 1.72 (ft)
Casing Type: 2" PVC Pipe

WELL DIAGRAM

Top of Casing (estimated 1.72' ags)

Grout (0' - 109' bgs)

PVC Pipe (1.72' ags - 126' bgs)

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:45 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35						CLAY, trace gravel, very sticky, reworked material; brown	Grout (0' - 109' bgs)
40	SONIC	100		CL			PVC Pipe (1.72' ags - 126' bgs)
						43.0 1894.1	
45						CLAY, with gray silt, reworked material; dark brown	
50	SONIC	100		CL			
55							
60	SONIC	100				60.0 1877.1	
				CL		CLAY, very sticky, reworked material; dark brown	
						62.5 1874.6	
65				CL		SILTY CLAY, hard, reworked material; gray	
70	SONIC	100		CL		68.0 1869.1	
						CLAY, reworked material; brown to orange	
						74.0 1863.1	
75				CL		CLAY, sticky, reworked material; brown	

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75						CLAY, sticky, reworked material; brown	Grout (0' - 109' bgs); PVC Pipe (1.72' ags - 126' bgs)
80	SONIC	100		CL			
84.0						1853.1	
85						CLAY, trace silt, very hard, native soil; gray Very hard drilling	
90	SONIC	100					
95	SONIC	100		CL			
100	SONIC	100					
100.0						1837.1	
105	SONIC	100				CLAY, very hard; gray Very hard drilling	Grout (0' - 109' bgs); PVC Pipe (1.72' ags - 126' bgs)
110	SONIC	100		CL			Bentonite Seal (109'-113')
115						115.0 1822.1	

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-3

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115							
120	SONIC	100		COAL		LIGNITE, dry, very crumbly; brown	#40 Sand (113'-127' bgs)
125	SONIC	100					0.010 Slotted Pipe (116' - 126' bgs)
130	SONIC	100		CL		128.0 1809.1 CLAY, very hard; gray	Total Depth of Well 128.72' BTOC
						134.0 1803.1	Bentonite Chip Fill Below Well

Bottom of borehole at 134.0 feet.

AECOM

WELL NUMBER MW-2016-4

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 8/2/2016 **COMPLETED** 8/4/2016 **GROUND ELEVATION** 1937.1 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klutes **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 578282.62 N 1784229.27 E **AFTER DRILLING** 75.41 ft / Elev 1861.69 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				OL		0.5 ORGANIC SILT, top soil; black 1936.6	Casing Top Elev: 1.93 (ft) Casing Type: 2" PVC Pipe Top of Casing (estimated 1.93' ags)
						CLAY, reworked material; red to brown	
5	SONIC	100		CL		5.5 1931.6	
						CLAYEY SILT, reworked material; light brown to gray	
10	SONIC	100		ML			Grout (0' - 106' bgs)
							PVC Pipe (1.93' ags - 127' bgs)
15						16.0 1921.1	
						CLAY, sticky, reworked material; brown to light brown	
20	SONIC	100		CL			
25							
30	SONIC	100				31.0 1906.1	
						SILTY CLAY, reworked material; light brown Lenses of sticky brown clay	
35				CL			

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:46 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35				CL		SILTY CLAY, reworked material; light brown Lenses of sticky brown clay	Grout (0' - 106' bgs)
						38.0 1899.1	
40	SONIC	100		ML		CLAYEY SILT, crumbly, reworked material; gray	PVC Pipe (1.93' ags - 127' bgs)
45						45.0 1892.1	
				CL		CLAY, trace silt, reworked material; light brown to gray	
50	SONIC	100				51.0 1886.1	
				ML		CLAYEY SILT, reworked material; gray	
55							
60	SONIC	100				64.0 1873.1	
65				CL		CLAY, sticky, reworked material; moist, brown to light brown	
70	SONIC	100				73.0 1864.1	
				COAL		73.5 LIGNITE, crumbly; brown to black 1863.6	
75				CL		CLAY, sticky, reworked material; brown to gray	

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:46 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75						CLAY, sticky, reworked material; brown to gray	Grout (0' - 106' bgs); PVC Pipe (1.93' ags - 127' bgs)
80	SONIC	100					
85				CL			
90	SONIC	100					
95							
	SONIC	100		CL		96.0 1841.1 CLAY, very hard, native material; gray	
				COAL		97.0 1840.1 LIGNITE, very hard; brown 97.5 1839.6	
100				CL		CLAY, very hard; gray	
	SONIC	100				100.0 1837.1 CLAY, very hard, trace silt; gray	
105				CL			
	SONIC	100					
110						110.0 1827.1	Bentonite Seal (106'-114' bgs)
	SONIC	100		CL		SILTY CLAY, with small lignite horizons; gray	
115							

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-4

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115							
				CL		SILTY CLAY, with small lignite horizons; gray	
						118.0 1819.1	
				COAL		LIGNITE; brown	
120	SONIC	100				120.0 1817.1	
				COAL		LIGNITE, dry, crumbly; brown to black	#40 Sand (114' - 128' bgs)
							0.010 Slotted Pipe (117' - 127' bgs)
125							
	SONIC	100				126.0 1811.1	
						CLAY, very hard; gray	Total Depth of Well 129.93' BTOC
130							
	SONIC	100		CL			Bentonite Chip Fill Below Well
135						136.0 1801.1	

Bottom of borehole at 136.0 feet.

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:46 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

WELL NUMBER MW-2016-5

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 8/10/2016 **COMPLETED** 8/10/2016 **GROUND ELEVATION** 1935.2 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klutes **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 577257.45 N 1783618.06 E **AFTER DRILLING** 49.81 ft / Elev 1885.39 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						CLAY, reworked material; brown
5	SONIC	100				
10	SONIC	100		CL		
15						
20						20.0 (1915.2)
25	SONIC	100		CL		CLAY, with lignite fragments, reworked material; brown
30						31.0 (1904.2)
35				CL		SANDY CLAY, reworked material; light brown
40						40.0 (1895.2)

Casing Top Elev: 1.11 (ft)
Casing Type: 2" PVC Pipe

WELL DIAGRAM

- Top of Casing (estimated 1.11' ags)
- Grout (0' - 97' bgs)
- PVC Pipe (1.11' ags - 118' bgs)

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:47 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
40	SONIC	100		CL		CLAY, reworked material; brown		Grout (0' - 97' bgs)
						43.5	1891.7	PVC Pipe (1.11' ags - 118' bgs)
45				CL		SANDY CLAY, reworked material; gray		
						47.0	1888.2	
50	SONIC	100		CL		CLAY, sticky, reworked material; brown		
						52.0	1883.2	
55				CL		SANDY CLAY, reworked material; brown with orange clay horizons		
60	SONIC	100				60.0	1875.2	
				CL		SANDY CLAY, trace gravel, reworked material; gray		
65						65.0	1870.2	
70	SONIC	100		CL		SANDY CLAY, trace gravel, crumbly, reworked material; light brown		
						73.0	1862.2	
75				CL		CLAY, with lignite fragments, very hard; gray		
						77.5	1857.7	
80	SONIC	100		CL		CLAY, sticky, trace gravel and lignite fragments, reworked materials; brown		
						80.0	1855.2	
				CL		CLAY, with lignite fragments, reworked materials; brown to light brown		
						84.0	1851.2	
85				CL		CLAY, with lignite, reworked horizons; brown with orange clay horizons		

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-5

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
				CL		CLAY, with lignite, reworked horizons; brown with orange clay horizons		Grout (0' - 97' bgs)
						88.5	1846.7	PVC Pipe (1.11' ags - 118' bgs)
90	SONIC	100		CL		SANDY CLAY, very hard, crumbly, reworked material; light brown		
						94.0	1841.2	
95				CL		CLAY, trace silt, very hard, native material; gray Very hard drilling		
100	SONIC	100				100.0	1835.2	
				CL		CLAY, trace silt, very hard; gray Very hard drilling		Bentonite Seal (97'-105' bgs)
105								
	SONIC	100						
110						110.0	1825.2	
	SONIC	100		COAL		LIGNITE, dry, crumbly; brown		#40 Sand (105' - 119' bgs) 0.010 Slotted Pipe (108' - 118' bgs)
115						116.0	1819.2	
	SONIC	100		CL		CLAY, hard; gray		Total Depth of Well 120.11' BTOC
120						123.0	1812.2	Bentonite Chip Fill Below Well

Bottom of borehole at 123.0 feet.

AECOM

WELL NUMBER MW-2016-6

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 8/9/2016 **COMPLETED** 8/9/2016 **GROUND ELEVATION** 1936.3 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klutes **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 576684.53 N 1783949.78 E **AFTER DRILLING** 41.47 ft / Elev 1894.83 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 2.15 (ft) Casing Type: 2" PVC Pipe Top of Casing (estimated 2.15' ags)
	SONIC	100		CL		CLAY, reworked material; brown to light brown	
5							
							Grout (0' - 95' bgs)
10	SONIC	100					PVC Pipe (2.15' ags - 113' bgs)
						11.0 1925.3	
						CLAY, sticky, reworked material; brown	
15							
20				CL			
25	SONIC	100					
30							
						31.0 1905.3	
						SANDY CLAY, reworked material; gray	
				CL			
35						35.0 1901.3	

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35						CLAY, reworked material; light brown	Grout (0' - 95' bgs)
40	SONIC	100		CL		40.0 1896.3	PVC Pipe (2.15' ags - 113' bgs)
						SILTY CLAY, stiff, reworked material; gray	
45				CL		45.0 1891.3	
						SANDY CLAY, very soft, reworked material; gray with brown clay lenses	
50	SONIC	100					
55				CL			
60						60.0 1876.3	
						SANDY CLAY, reworked material; gray with brown clay lenses	
65	SONIC	100		CL			
70							
						71.5 1864.8	
						SANDY CLAY, with lignite fragments, reworked material; gray	
75				CL			

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 13:37 - C:\CAROL B GINT\LOGS\SAMPLE TEMPLATE.GPJ

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-6

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
75								
				CL		SANDY CLAY, with lignite fragments, reworked material; gray		Grout (0' - 95' bgs)
								PVC Pipe (2.15' ags - 113' bgs)
						79.0	1857.3	
80	SONIC	100		CL		CLAY, with lignite fragments, reworked material; brown		
						84.0	1852.3	
85						CLAY, very hard, native material; gray		
	SONIC	100						
90								
	SONIC	100						
95				CL				
	SONIC	100						Bentonite Seal (95'-100' bgs)
100						100.0	1836.3	
	SONIC	100		CL		CLAY, very hard, native material; gray Very hard drilling		
105						106.0	1830.3	
	SONIC	100		COAL		LIGNITE, crumbly; brown		#40 Sand (100' - 114' bgs)
110								0.010 Slotted Pipe (103' - 113' bgs)
	SONIC	100				113.0	1823.3	Total Depth of Well 116.15' BTOC
				CL		CLAY, very hard; gray		
						114.0	1822.3	

Bottom of borehole at 114.0 feet.

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 13:37 - C:\CAROL B GINT\LOS\SAMPLE TEMPLATE.GPJ

AECOM

WELL NUMBER MW-2016-7

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 8/8/2016 **COMPLETED** 8/8/2016 **GROUND ELEVATION** 1926.6 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klutes **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 576226.36 N 1785071.11 E **AFTER DRILLING** 72.93 ft / Elev 1853.67 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 1.7 (ft) Casing Type: 2" PVC Pipe Top of Casing (estimated 1.70' ags)
5	SONIC	100		CL		CLAY, sticky, reworked material; brown to light brown	
10	SONIC	100				9.5 1917.1 SILTY CLAY, reworked material; gray	Grout (0' - 56' bgs) PVC Pipe (1.70' ags - 75' bgs)
15				CL			
20						19.0 1907.6 CLAY, reworked material; brown to light brown	
25	SONIC	100		CL			
30						30.0 1896.6 SILTY CLAY, reworked material; gray	
35				CL			
40				CL		36.0 1890.6 CLAY, sticky; brown 40.0 1886.6	Grout (0' - 56' bgs) PVC Pipe (1.70' ags - 75'

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:50 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-7

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
40								bgs)
	SONIC	100		CL		CLAY, sticky, reworked material; brown		
						43.0	1883.6	
45				ML		CLAYEY SILT, hard, reworked material; gray		
						47.5	1879.1	
				CL		CLAY, sticky, reworked material; brown		
50	SONIC	100				51.0	1875.6	
				CL		CLAY, with lignite and gravel fragments, reworked material; brown		
						54.0	1872.6	
55				CL		SILTY CLAY, reworked material; gray		
						58.5	1868.1	Bentonite Seal (56'-61 bgs')
				CL		CLAY, sticky, reworked material; brown		
60	SONIC	100				60.0	1866.6	
				CL		CLAY, sticky, reworked material; brown to orange		
65						65.0	1861.6	
				CL		66.0 CLAY, hard, native material; gray	1860.6	
				COAL		LIGNITE, powdery; black to brown		#40 Sand (61' - 76' bgs)
70	SONIC	100						0.010 Slotted Pipe (65' - 75' bgs)
						74.0	1852.6	
75						CLAY, very hard; gray		Total Depth of Well 77.70' BTOC
	SONIC	100		CL				
80								Bentonite Chip Fill Below Well
						82.0	1844.6	

Bottom of borehole at 82.0 feet.

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:50 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

AECOM

WELL NUMBER MW-2016-8

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 8/8/2016 **COMPLETED** 8/9/2016 **GROUND ELEVATION** 1936.9 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klutes **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 576383.7 N 1785994.31 E **AFTER DRILLING** 57.93 ft / Elev 1878.97 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 1.67 (ft) Casing Type: 2" PVC Pipe Top of Casing (estimated 1.67' ags)
5	SONIC	100				CLAY, reworked material; brown	
10	SONIC	100		CL			Grout (0' - 87' bgs) PVC Pipe (1.67' ags - 106' bgs)
15						14.0 1922.9 SANDY CLAY, reworked material; light brown	
20				CL		20.0 1916.9	
25	SONIC	100				CLAY, reworked material; brown with light brown sandy clay horizons	
30				CL			
35							

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 8/23/16 14:52 - C:\CAROL B GINT\LOS\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
35								
				CL		CLAY, reworked material; brown with light brown sandy clay horizons		Grout (0' - 87' bgs)
40	SONIC	100				40.0	1896.9	PVC Pipe (1.67' ags - 106' bgs)
				CL		CLAY, with sandy clay, reworked material; brown with gray clay horizons		
45						47.5	1889.4	
				CL		CLAY, reworked material; brown		
50	SONIC	100				52.0	1884.9	
				CL		CLAY, with lignite, reworked material; brown		
55						55.0	1881.9	
				CL		SANDY CLAY, reworked material; brown		
						58.5 ▼	1878.4	
				CL		CLAY, with lignite fragments, sticky, reworked material; brown		
60	SONIC	100				60.0	1876.9	
				CL		CLAY, sticky, reworked material; brown		
						64.0	1872.9	
65						SANDSTONE, poorly cemented, very crumbly; red to orange		
70	SONIC	100	SANDSTONE					
75								

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-8

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
75								
			SANDSTONE			SANDSTONE, poorly cemented, very crumbly; red to orange		Grout (0' - 87' bgs)
								PVC Pipe (1.67' ags - 106' bgs)
80	SONIC	100				80.0	1856.9	
				CL		CLAY, very hard; light brown		
						83.5	1853.4	
85						CLAY, very hard, native material; gray		
90	SONIC	100						Bentonite Seal (87'-93' bgs)
				CL				
95								
	SONIC	100						
100						100.0	1836.9	#40 Sand (93' - 107' bgs)
						LIGNITE, crumbly; brown to black		0.010 Slotted Pipe (96' - 106' bgs)
				COAL				
105	SONIC	100						
						106.0	1830.9	Total Depth of Well 108.67' BTOC
				CL		107.0 CLAY, hard; gray	1829.9	

Bottom of borehole at 107.0 feet.

AECOM

WELL NUMBER MW-2016-9

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 11/2/2016 **COMPLETED** 11/3/2016 **GROUND ELEVATION** 1945.505 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klute **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 578206.826 N 1785499.348 E **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 2.55 (ft) Casing Type: 4" PVC Pipe Top of Casing (estimated 2.55' ags)
						FILL - CLAY, reworked; brown	
5	SONIC	100					
10							Grout (0' - 111' bgs)
							PVC Pipe (2.55' ags - 130' bgs)
15	SONIC	100		CL			
20							
25							
30	SONIC	100					
35							

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 12/21/16 15:11 - C:\BISMARK GINTAVS LOGS\112816 121516LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35						FILL - CLAY, reworked; brown	Grout (0' - 111' bgs)
40							PVC Pipe (2.55' ags - 130' bgs)
45							
50	SONIC	100					
55				CL			
60							
65	SONIC	100					
70							
75							

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75	SONIC	100				FILL - CLAY, reworked; brown	Grout (0' - 111' bgs); PVC Pipe (2.55' ags - 130' bgs)
80							
85	SONIC	100		CL			
90							
95	SONIC	100				95.0 1850.5	
				CL		CLAY, native material, very hard; gray	
100						99.0 1846.5	
				COAL		LIGNITE, clay; gray	
105	SONIC	100				104.0 1841.5	
				CL		CLAY, very hard; moist; gray	
110							
115							Bentonite Seal (111'-115' bgs)

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 12/21/16 15:12 - C:\BISMARK GINTAVS LOGS\112816 121516LOS_082316.GPJ

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-9

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115	SONIC	100		CL		CLAY, very hard; moist; gray	
120						120.0 1825.5	
	SONIC	100				LIGNITE; brown and black	
125	SONIC	100		COAL			#60 (top 2') and #40 Sand (115' - 133' bgs) 0.010 Slotted Pipe (120' - 130' bgs)
	SONIC	100				128.0 1817.5	
130						CLAY, very hard; gray	Total Depth of Well 132.55' BTOC
	SONIC	100		CL			Sump with sand below well screen
135						135.0 1810.5	Bentonite Chip Fill Below Well

Bottom of borehole at 135.0 feet.

WELL NUMBER MW-2016-10

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 11/4/2016 **COMPLETED** 11/5/2016 **GROUND ELEVATION** 1951.612 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klute **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 577524.198 N 1786051.255 E **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 1.7 (ft) Casing Type: 4" PVC Pipe Top of Casing (estimated 1.7' ags)
						FILL - CLAY, reworked; brown	
5	SONIC	100					
10							Grout (0' - 114' bgs)
15	SONIC	100					PVC Pipe (1.7' ags - 132' bgs)
20				CL			
25	SONIC	100					
30							
35	SONIC	100					
40							

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 12/21/16 15:10 - C:\BISMARK GINTA\VS LOGS\112816 121516\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
40						FILL - CLAY, reworked; brown	Grout (0' - 114' bgs); PVC Pipe (1.7' ags - 132' bgs)
45	SONIC	100					
50							
55	SONIC	100					
60							
65	SONIC	100		CL			
70							
75	SONIC	100					
80							
85	SONIC	100					

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 12/21/16 15:10 - C:\BISMARK GINTAVS LOGS\112816 121516\LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
90				CL		FILL - CLAY, reworked; brown	Grout (0' - 114' bgs); PVC Pipe (1.7' ags - 132' bgs)
						94.0 1857.6	
95	SONIC	100		COAL		LIGNITE; black and brown	
						96.0 1855.6	
100						CLAY, very hard; gray	
105	SONIC	100					
110				CL			
115	SONIC	100					Bentonite Seal (114'-117' bgs)
120							
						122.0 1829.6	
125	SONIC	100		COAL		LIGNITE; brown	#60 (top 2') and #40 Sand (117' - 132.5' bgs); 0.010 Slotted Pipe (122' - 132' bgs)
130						130.0 1821.6	
				CL		CLAY, very hard; gray	

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 12/21/16 15:10 - C:\BISMARK GINTAVS LOGS\112816 121516LOS_082316.GPJ

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-10

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
135	SONIC	100		CL		CLAY, very hard; gray LIGNITE (<1")		Total Depth of Well 133.70' BTOC
140						140.0	1811.6	Bentonite Chip Fill Below Well
	SONIC	100		SANDSTONE		SANDSTONE, unconsolidated; gray and light brown		
						142.0	1809.6	
				LIMESTONE		LIMESTONE		
145						145.0	1806.6	

Bottom of borehole at 145.0 feet.

AECOM

WELL NUMBER MW-2016-11

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DATE STARTED 11/18/2016 **COMPLETED** 11/20/2016 **GROUND ELEVATION** 1954.851 ft **HAMMER TYPE** Not Applicable

DRILLING CONTRACTOR Cascade Drilling **GROUND WATER LEVELS:**

DRILLING METHOD Rotary Sonic **AT TIME OF DRILLING** ---

LOGGED BY Ryan Klute **CHECKED BY** A. Lanning **AT END OF DRILLING** ---

COORDINATES 577977.515 N 1785347.299 E **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0							Casing Top Elev: 1.2 (ft) Casing Type: 4" PVC Pipe Top of Casing (estimated 1.2' ags)
						FILL - CLAY, reworked; brown	
5	SONIC	100					
10							Grout (0' - 120' bgs)
15	SONIC	100					PVC Pipe (1.2' ags - 140' bgs)
20				CL			
25	SONIC	100					
30							
35	SONIC	100					
40							

LGE GHENT SOIL-WELL LOG - GHENT.GDT - 12/21/16 15:11 - C:\BISMARK GINTAVS LOGS\112816 121516LOS_082316.GPJ

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
40						FILL - CLAY, reworked; brown	Grout (0' - 120' bgs) PVC Pipe (1.2' ags - 140' bgs)
45	SONIC	100					
50							
55	SONIC	100					
60							
65	SONIC	100		CL			
70							
75	SONIC	100					
80						CLAY, reworked; brown trace lignite fragments	
85	SONIC	100					

(Continued Next Page)

CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
90				CL		FILL - CLAY, reworked; brown	Grout (0' - 120' bgs); PVC Pipe (1.2' ags - 140' bgs)
						94.0 1860.9	
95	SONIC	100		SANDSTONE		SANDSTONE/CHERT, unconsolidated, reworked material; orange	
						97.0 1857.9	
				CL		FILL - CLAY, reworked; brown and orange	
100						100.0 1854.9	
				CL		FILL - CLAY, reworked, minor lignite fragments; brown and orange	
						103.0 1851.9	
105	SONIC	100		CL		FILL - CLAY, reworked material; orange	
						106.0 1848.9	
				CL		CLAY/SILT, very hard; gray	
110						LIGNITE (<1")	
						110.0 1844.9	
115	SONIC	100		CL		CLAY, crumbly, native material; gray	
120						120.0 1834.9	
	SONIC	100		CL		CLAY, very hard; gray	Bentonite Seal (120'-124' bgs)
125							
						128.0 1826.9	
130	SONIC	100		COAL		LIGNITE, minor moisture present in fractures; brown and black	

(Continued Next Page)

AECOM

WELL NUMBER MW-2016-11

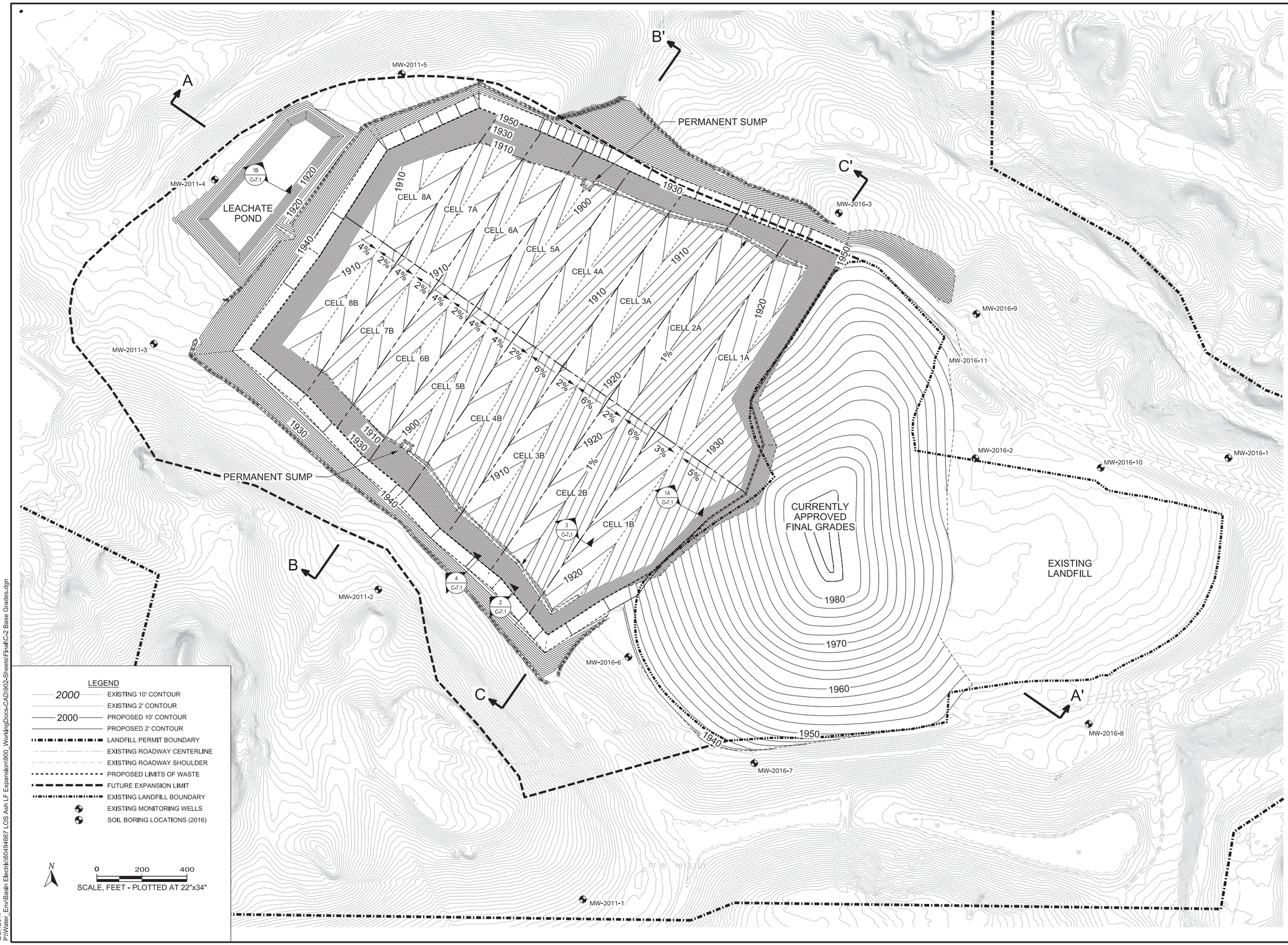
CLIENT Basin Electric **PROJECT NAME** Lelands Olds Landfill

PROJECT NUMBER 60514340 **PROJECT LOCATION** Stanton, ND

DEPTH (ft)	SAMPLE TYPE NUMBER	% RECOVERY	POCKET PENE-TROMETER, TSF	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
135	SONIC	100		COAL		LIGNITE, minor moisture present in fractures; brown and black 135.0 1819.9	#60 (top 1') and #40 Sand (124' - 145' bgs) 0.010 Slotted Pipe (130' - 140' bgs)
140	SONIC	100		CL		CLAY, very hard; gray	Total Depth of Well 142.20' BTOC
145	SONIC	100		LIMESTONE		145.0 1809.9 LIMESTONE/SANDSTONE, unconsolidated; yellow 148.0 1806.9	
150	SONIC	100		CL		CLAY, very hard; gray	
155	SONIC	100					Bentonite Chip Fill Below Well
160						162.0 1792.9	

Bottom of borehole at 162.0 feet.

Appendix C – Permitted Base Grade Plan Sheet



2/27/2017
P:\Water_Env\Basin Electric\60494667 LOS Ash LF Expansion\900_WorkingDocs-CAD\902-Sheets\Final\C-2 Base Grades.dgn

PROJECT

LELAND OLDS STATION
ASH LANDFILL
EXPANSION - PHASE 6
SPECIAL WASTE
LANDFILL PERMIT
SP-143

CLIENT

BASIN ELECTRIC
POWER COOPERATIVE
1717 EAST INTERSTATE AVE
BISMARCK, NORTH DAKOTA
58503-0564

CONSULTANT

AECOM
800 LASALLE AVENUE, SUITE 500
MINNEAPOLIS, MN 55402
612-376-2000 tel 612-376-2271 fax
www.aecom.com

REGISTRATION

REGISTERED PROFESSIONAL ENGINEER
JOHN CAMPION
PE-10886
DATE 2/24/17
NORTH DAKOTA

ISSUE/REVISION

1	2017-02-24	ISSUED-PERMIT SUBMITTAL
I/R	DATE	DESCRIPTION

NOTES

TOPOGRAPHIC SURVEY BY KBM, NOVEMBER 2015. TOPOGRAPHY UPDATED BY BEPC, OCTOBER 5, 2016.

COORDINATES ARE ND STATE PLANE SOUTH, NAD 1929.

PROJECT NUMBER

60494667

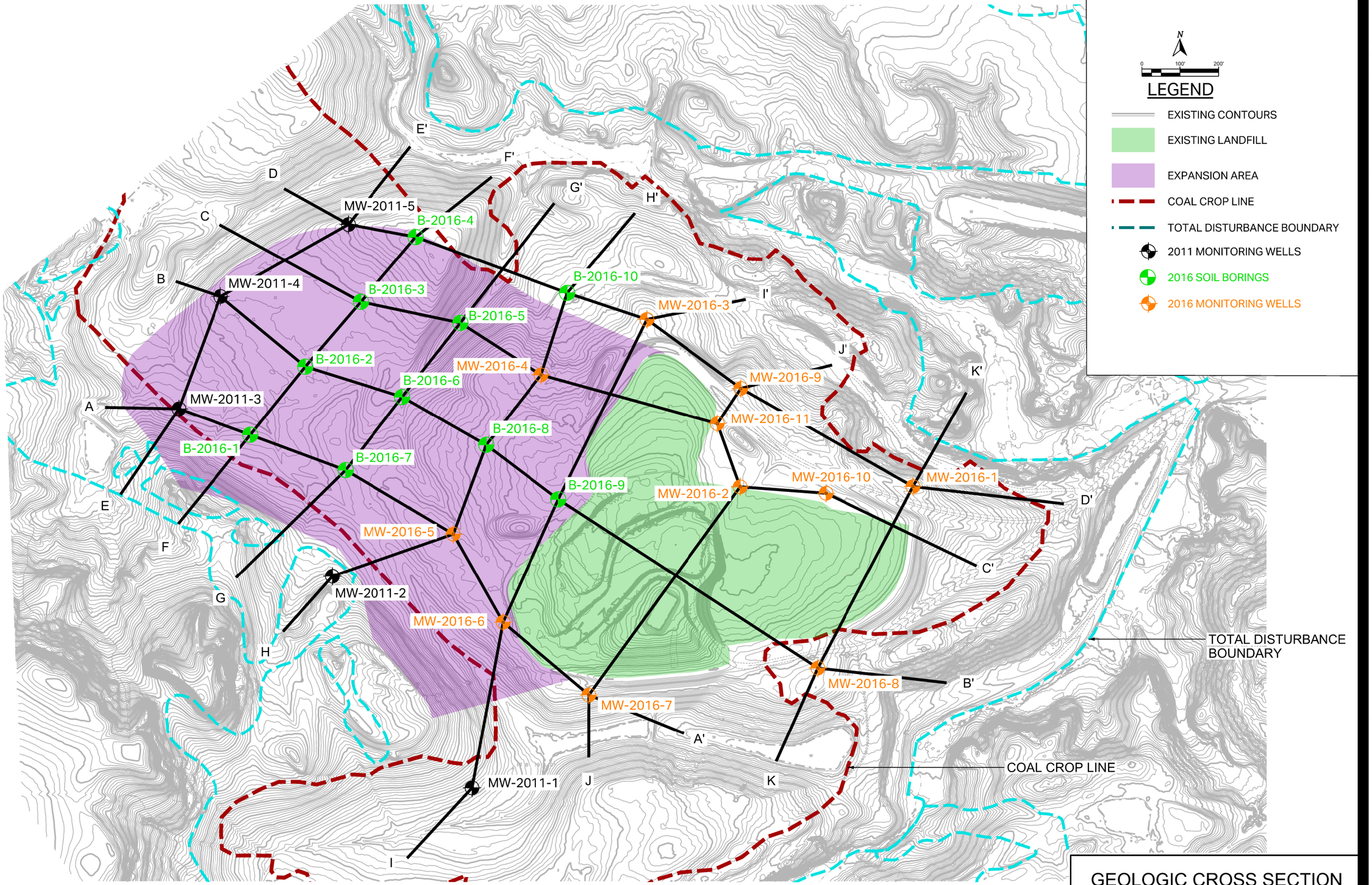
SHEET TITLE

BASE GRADES

SHEET NUMBER

C-2.0

Appendix D – Geologic Cross Sections



GEOLOGIC CROSS SECTION LOCATION MAP

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

SUPPLEMENTAL SITE CHARACTERIZATION REPORT

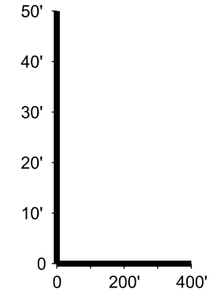
PROJECT NUMBER
60494667

DRAWING NUMBER
1

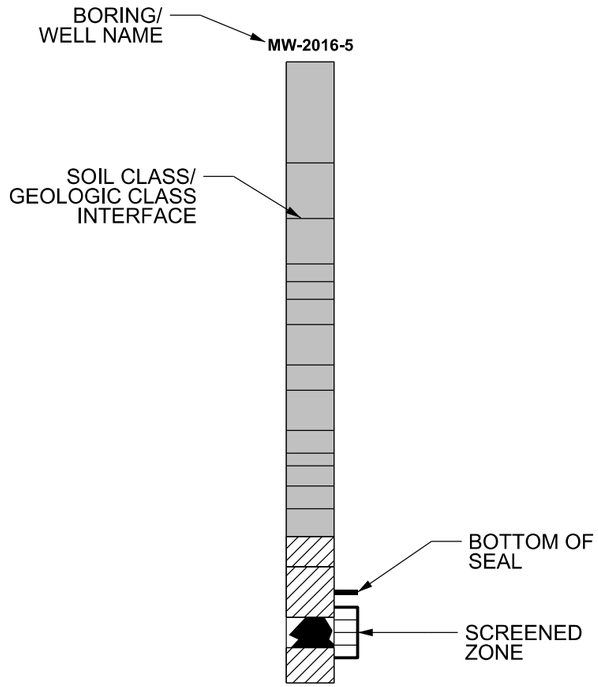
11/7/2017
P:\Water_Env\Basin Electric\60494667 LOS Ash LF Expansion\900_WorkingDocs-CAD/902-Sheets\Geotech\LOS Geotech Sections Locations.dgn

EXISTING GRADE
PROPOSED EXPANSION BASE GRADE
PROPOSED EXPANSION FINAL GRADE
EXISTING LANDFILL BASE GRADE
EXISTING LANDFILL FINAL GRADE
CONTACT BETWEEN GEOLOGIC UNITS
INFERRED CONTACT BETWEEN GEOLOGIC UNITS
PIEZOMETRIC SURFACE (SEPT. 27, 2016, 3rd QUARTER)

FILL (SEE LOGS FOR DESCRIPTIONS)
COAL/LIGNITE
CLAY
SANDSTONE
SILTY CLAY
CLAYEY SAND
LIMESTONE



NOTE:
VERTICAL EXAGGERATION = 15X



NOTES:

1. ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1927. HORIZONTAL DATUM IS BASED ON THE NORTH DAKOTA STATE PLANE COORDINATE SYSTEM OF 1927 SOUTH ZONE.
2. BORING LOG ELEVATIONS REPRESENT GROUND SURFACE ELEVATIONS AT THE TIME OF DRILLING.
3. FINAL BORING LOGS BASED ON FIELD VISUAL IDENTIFICATION AND GEOTECHNICAL LABORATORY TEST RESULTS.
4. THE DEPTH AND THICKNESS OF SUBSURFACE STRATA INDICATED ON THESE CROSS-SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE BORINGS.
5. GROUNDWATER ELEVATIONS WERE OBTAINED ON SEPTEMBER 27, 2016.

LEGEND OF THE GEOLOGIC CROSS SECTIONS

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

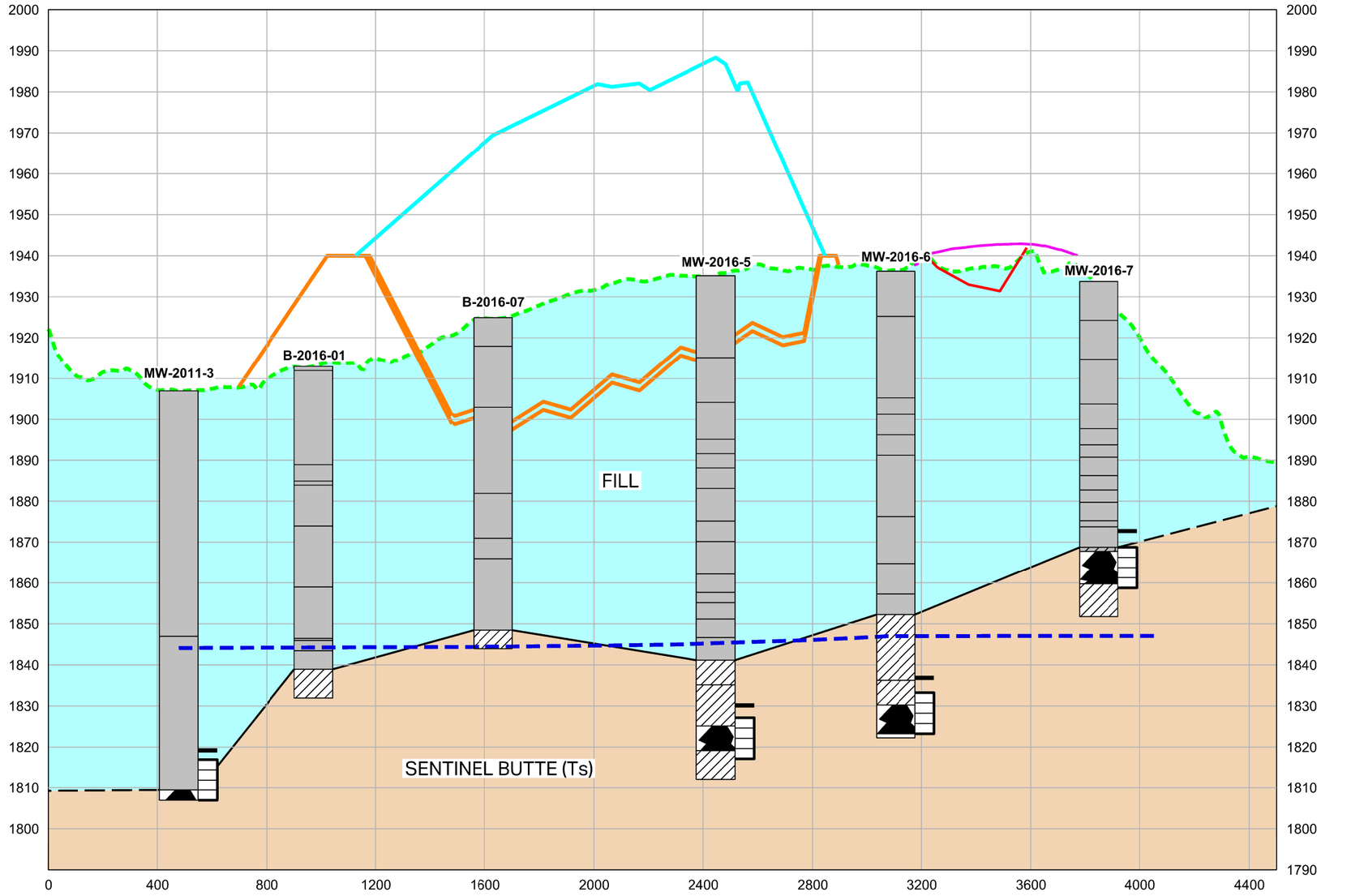
SUPPLEMENTAL SITE CHARACTERIZATION REPORT

PROJECT NUMBER
60494667

DRAWING NUMBER
2

A
(NORTHWEST)

A'
(SOUTHEAST)



GEOLOGIC CROSS SECTION A - A'

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

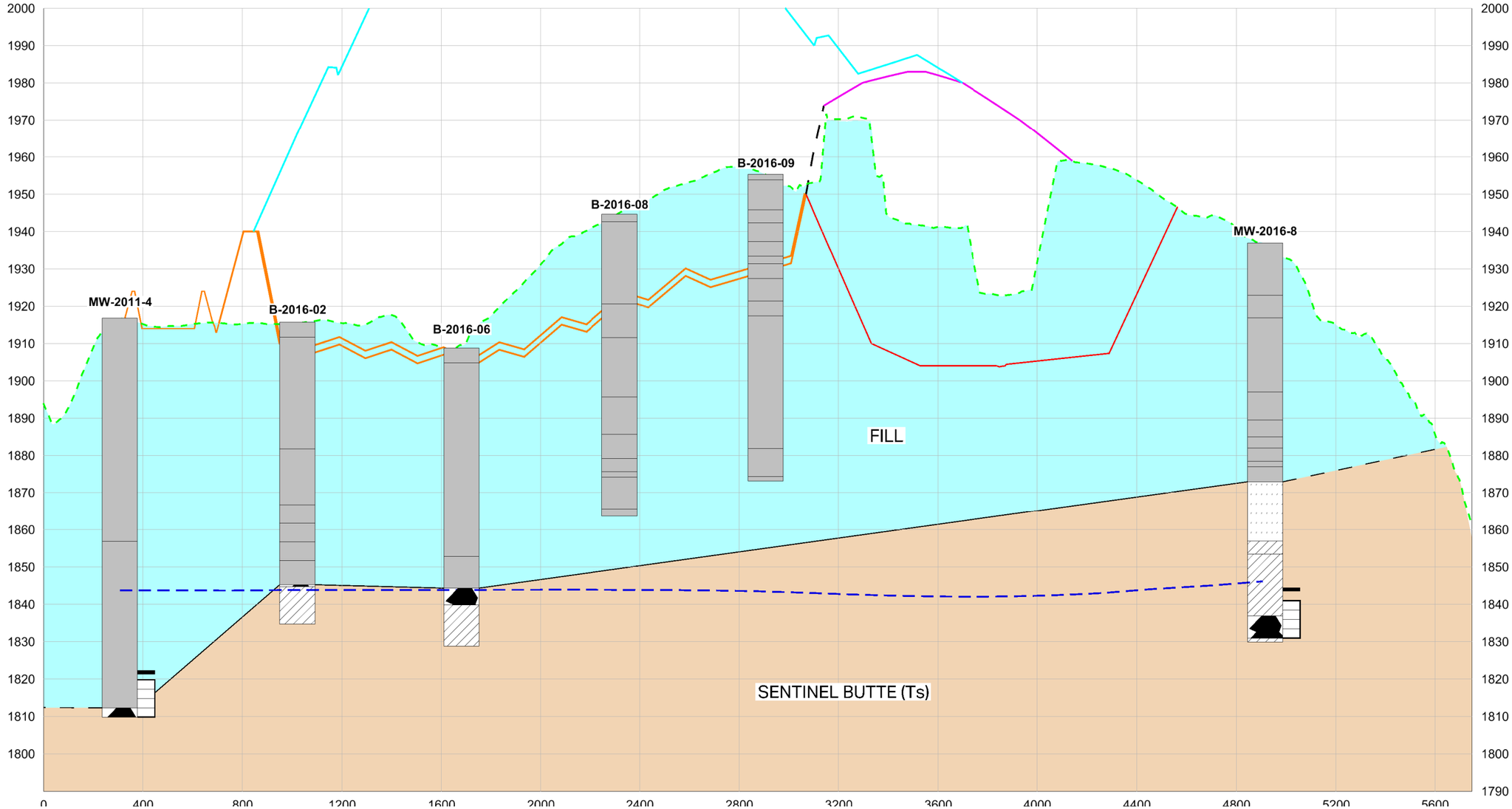
SUPPLEMENTAL SITE CHARACTERIZATION REPORT

PROJECT NUMBER
60494667

DRAWING NUMBER
3

B
(NORTHWEST)

B'
(SOUTHEAST)



GEOLOGIC CROSS
SECTION B - B'

$DATES
$FILENAMES

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

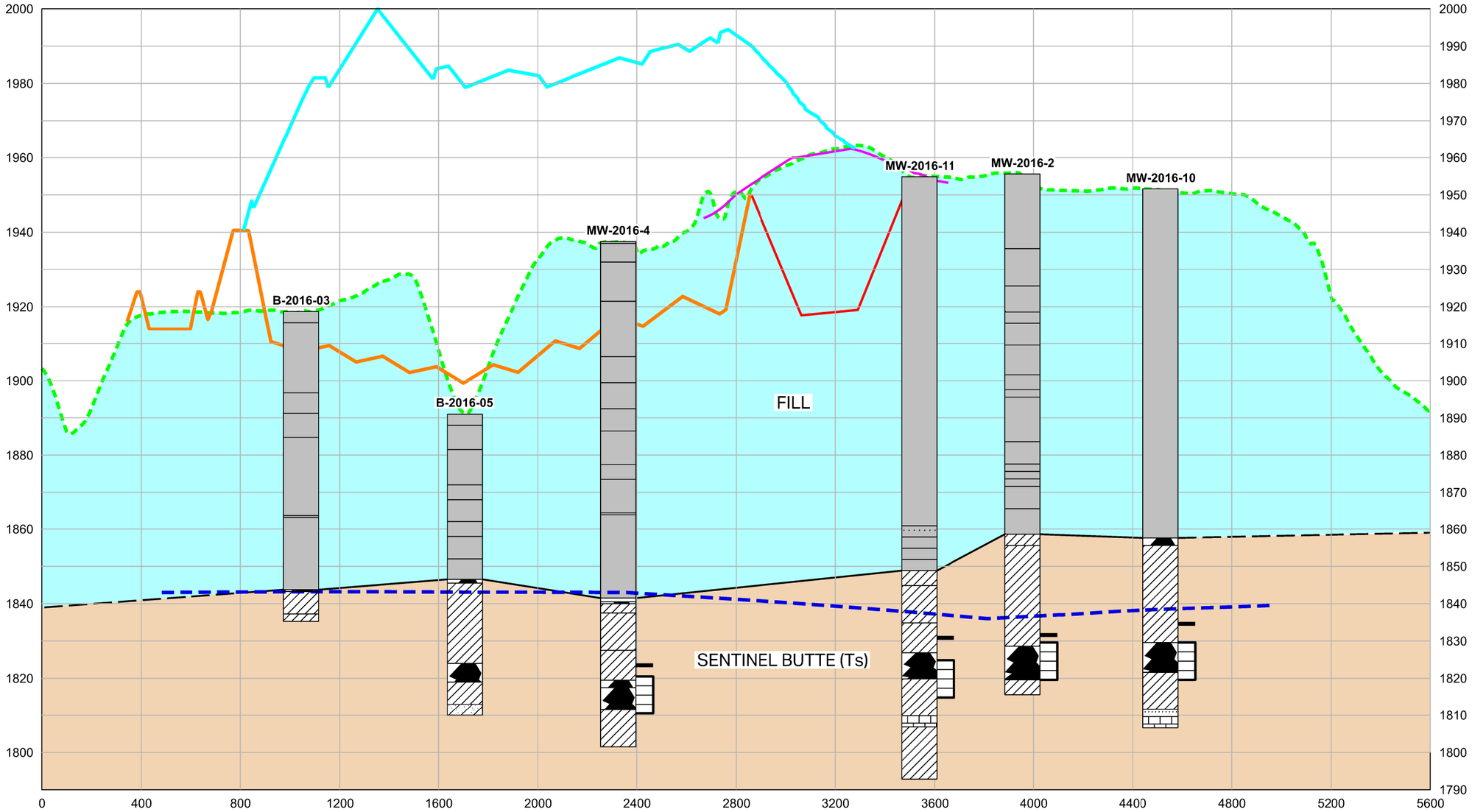
LOCATION RESTRICTIONS REPORT

PROJECT NUMBER
60545172

DRAWING NUMBER
4

C
(NORTHWEST)

C'
(SOUTHEAST)



GEOLOGIC CROSS SECTION C - C'

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

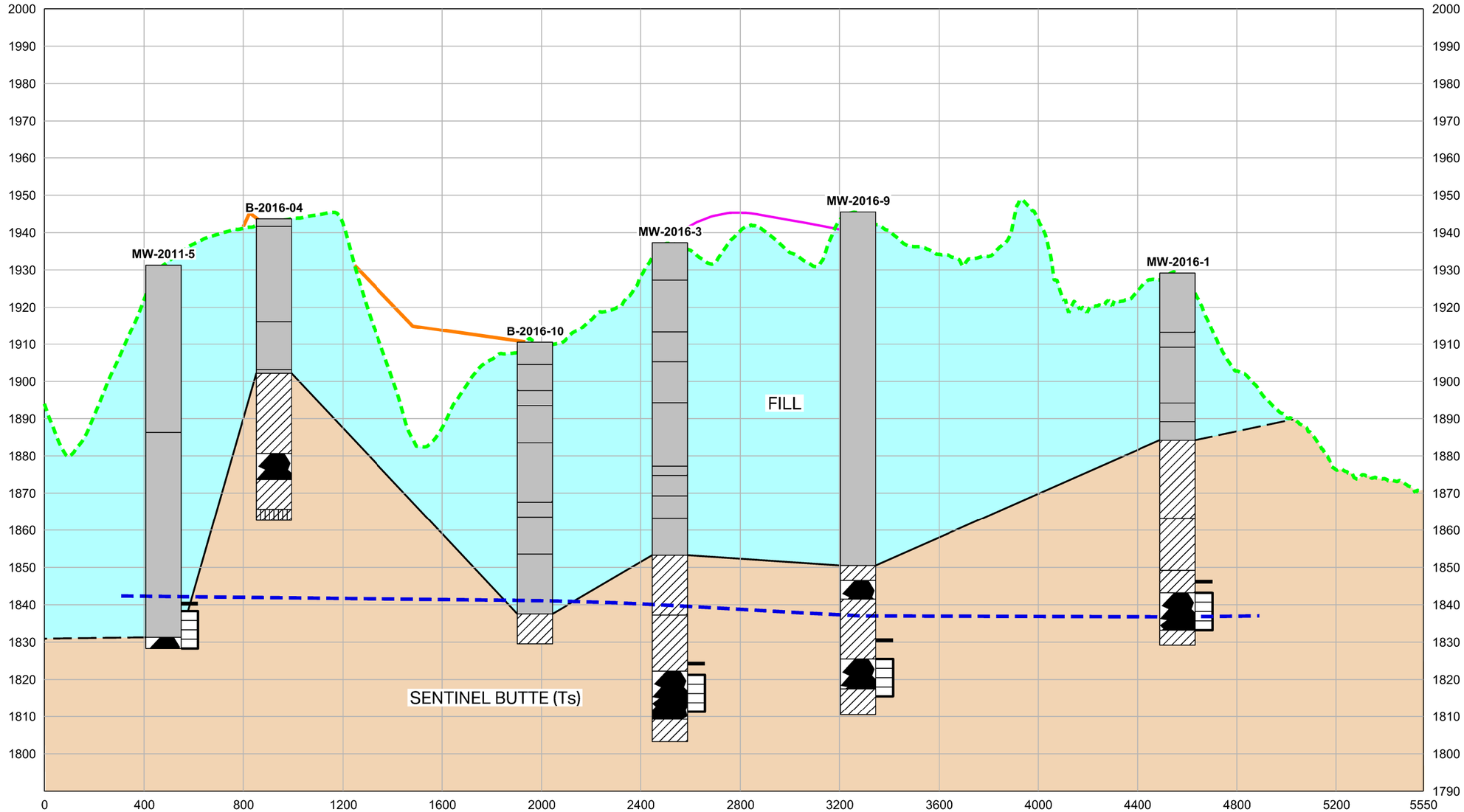
SUPPLEMENTAL SITE CHARACTERIZATION REPORT

PROJECT NUMBER
60494667

DRAWING NUMBER
5

D
(NORTHWEST)

D'
(SOUTHEAST)



GEOLOGIC CROSS SECTION D - D'

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

SUPPLEMENTAL SITE CHARACTERIZATION REPORT

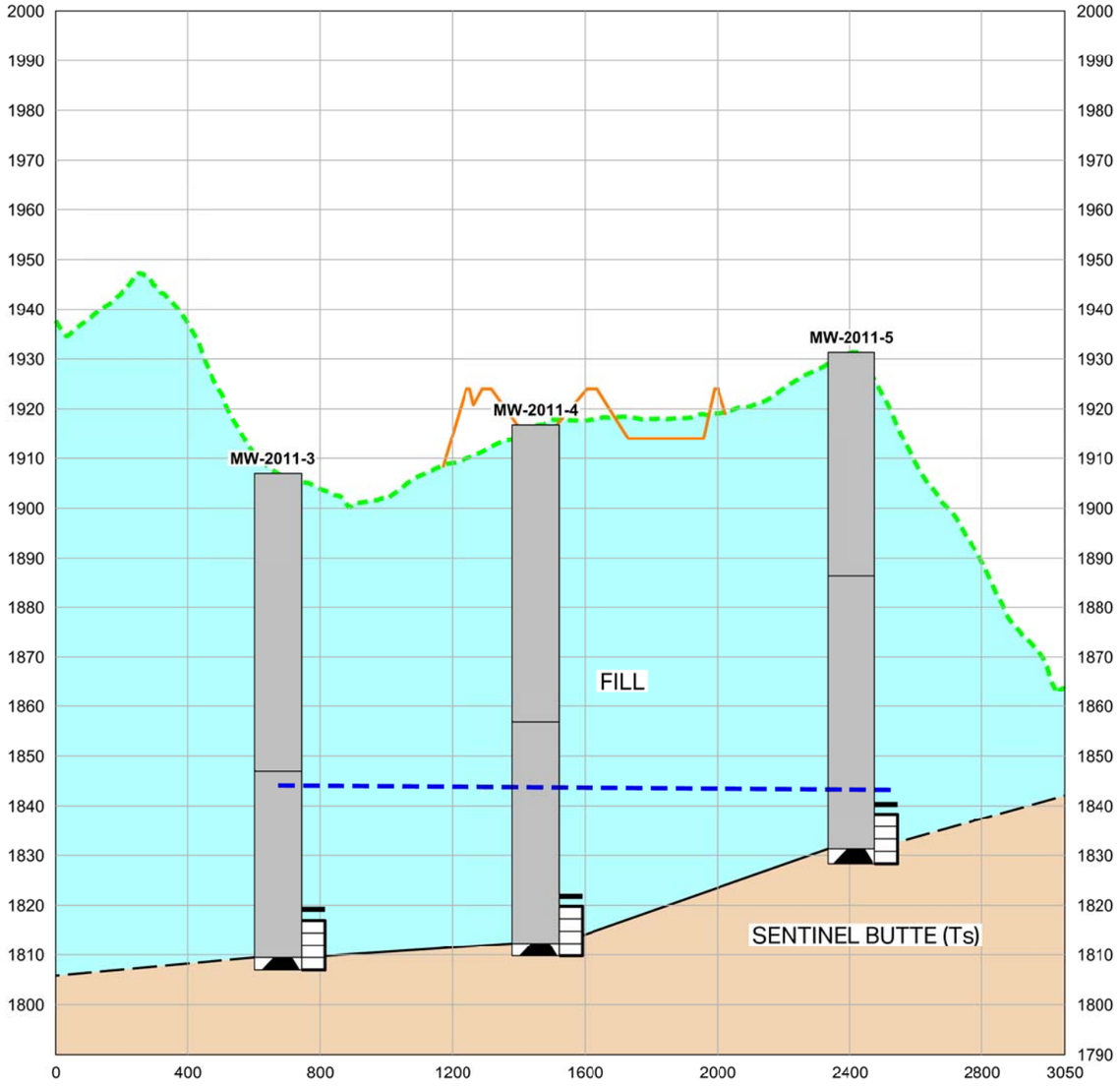
PROJECT NUMBER
60494667

DRAWING NUMBER
6

11/7/2017
P:\Water_Env\Basin Electric\60494667 LOS Ash LF Expansion\900_WorkingDocs-CAD\902-Sheets\Geotech\LOS Geotech Section D.dgn

E
(SOUTHWEST)

E'
(NORTHEAST)



GEOLOGIC CROSS
SECTION E - E'

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

LOCATION RESTRICTIONS REPORT

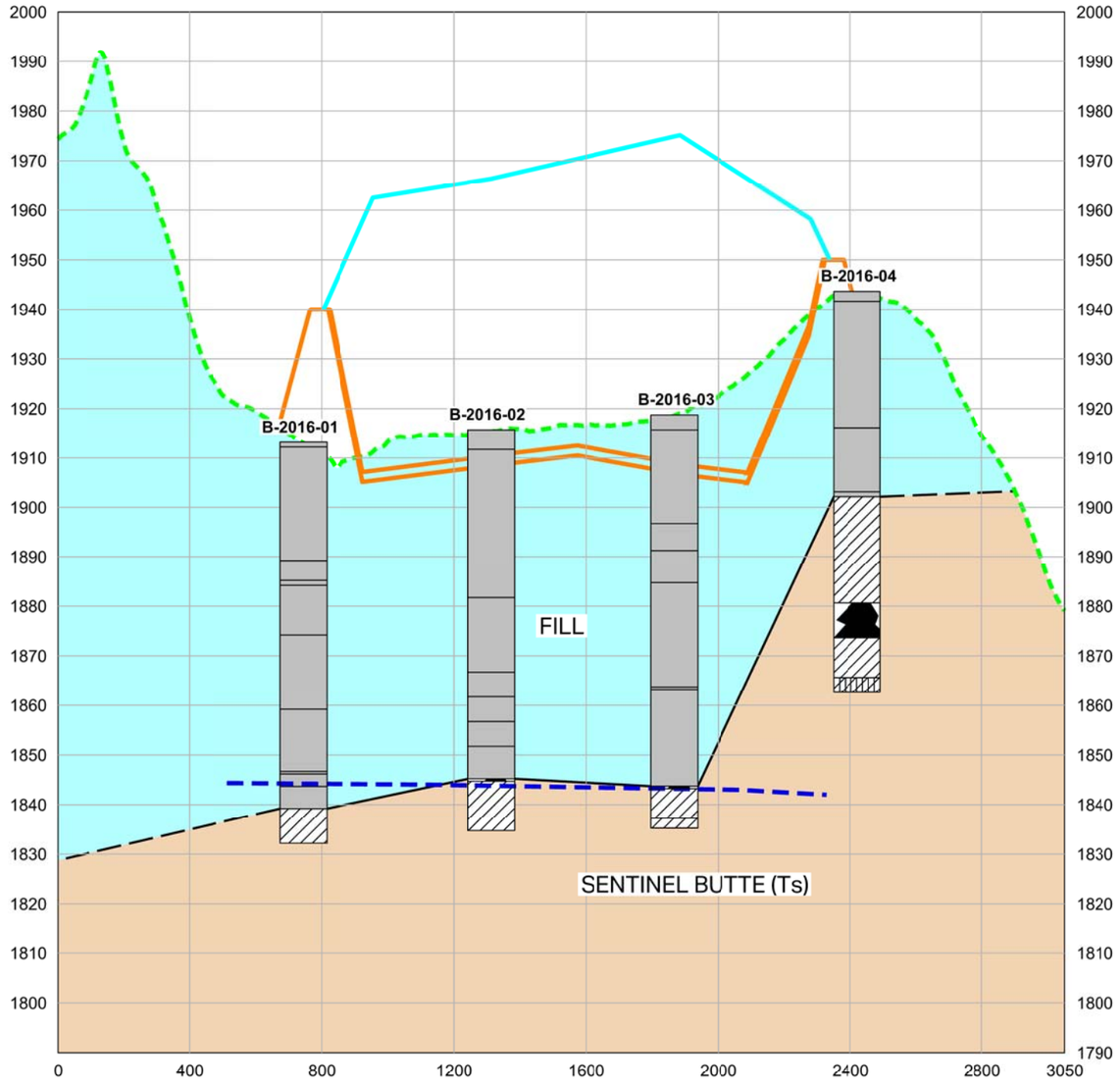
PROJECT NUMBER
60545172

DRAWING NUMBER
7

$DATE$
$FILENAME$

F
(SOUTHWEST)

F'
(NORTHEAST)



GEOLOGIC CROSS
SECTION F - F'

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

LOCATION RESTRICTIONS REPORT

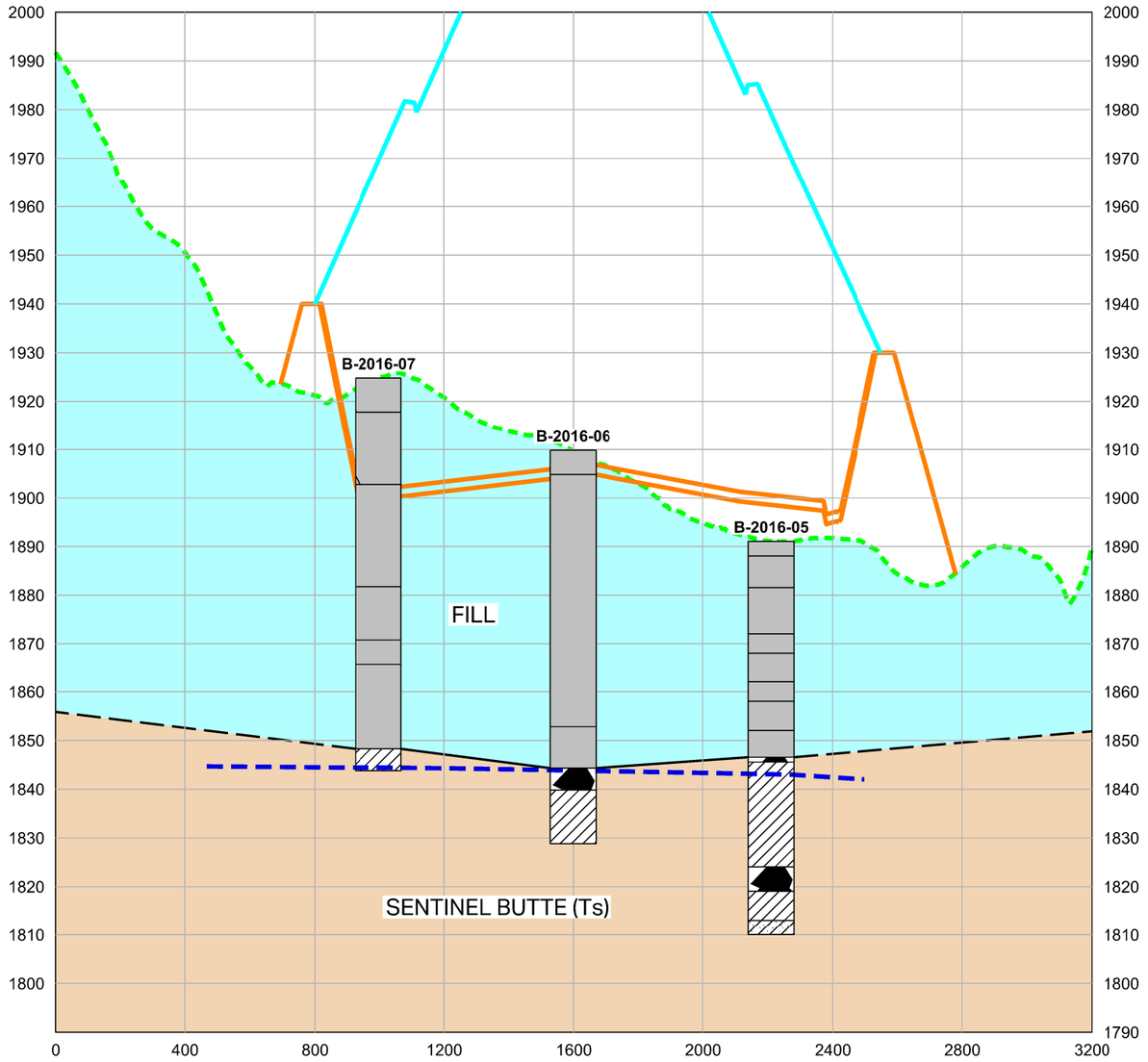
PROJECT NUMBER
60545172

DRAWING NUMBER
8

$DATE$
$FILENAME$

G
(SOUTHWEST)

G'
(NORTHEAST)



GEOLOGIC CROSS
SECTION G - G'

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

LOCATION RESTRICTIONS REPORT

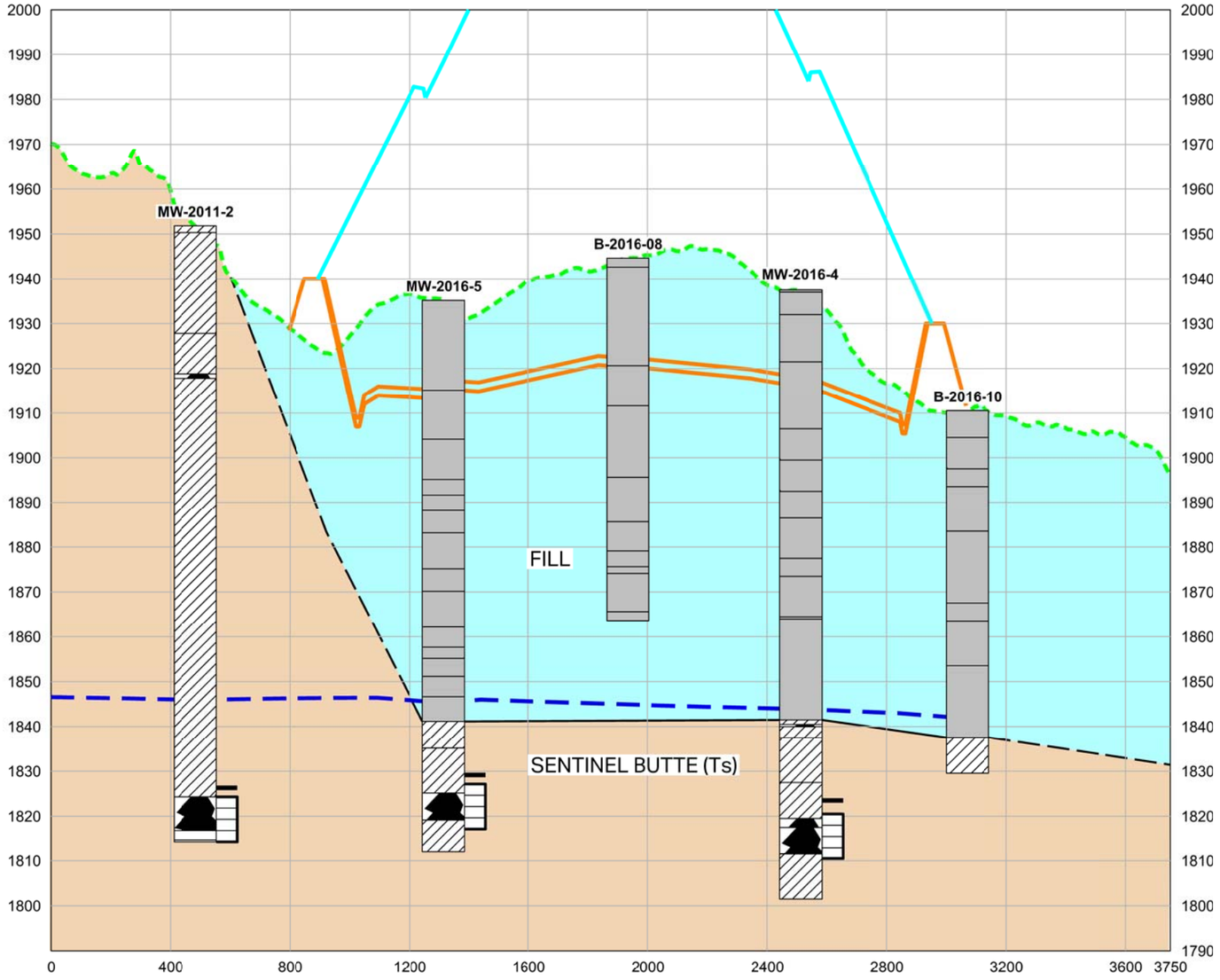
PROJECT NUMBER
60545172

DRAWING NUMBER
9

$DATE$
$FILENAME$

H
(SOUTHWEST)

H'
(NORTHEAST)



AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

LOCATION RESTRICTIONS REPORT

PROJECT NUMBER
60545172

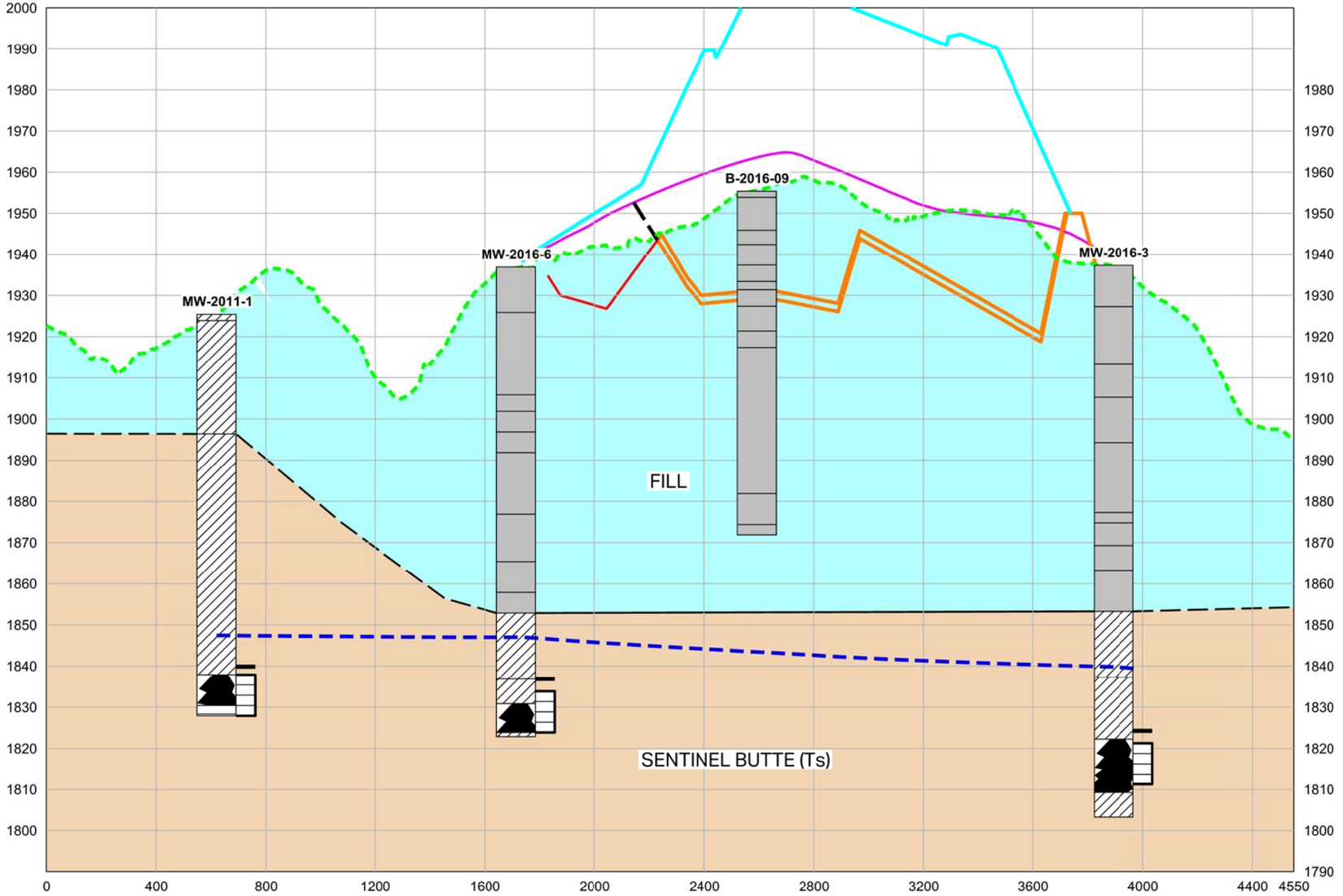
DRAWING NUMBER
10

GEOLOGIC CROSS
SECTION H - H'

$DATES
$FILENAMES

I
(SOUTH)

I'
(NORTHEAST)



GEOLOGIC CROSS SECTION I - I'

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2090 tel 612-376-2271 fax
www.aecom.com

LOCATION RESTRICTIONS REPORT

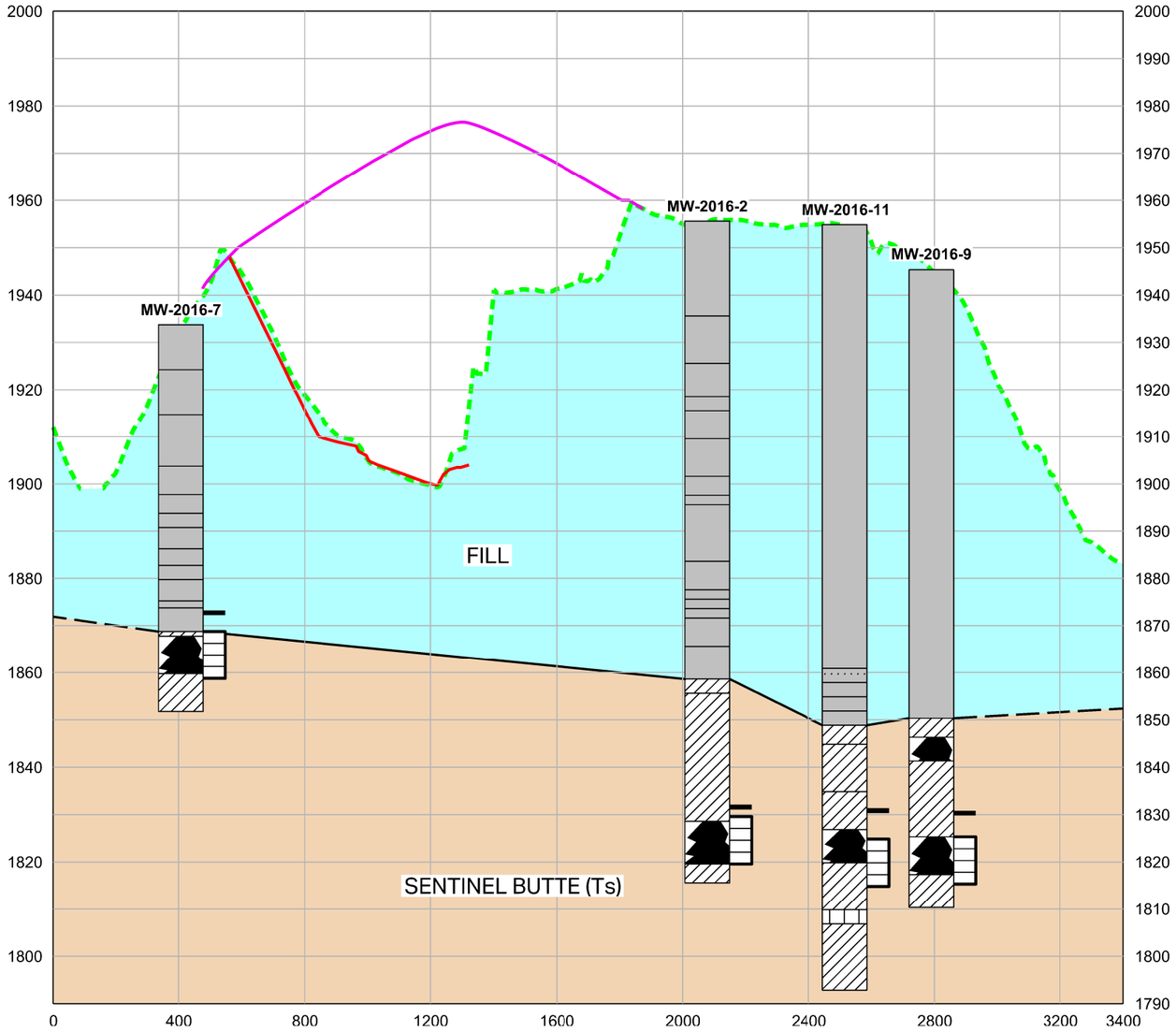
PROJECT NUMBER
60545172

DRAWING NUMBER
11

$DATES
$FILENAMES

J
(SOUTH)

J'
(NORTHEAST)



11/7/2017
P:\Water_Env\Basin Electric\60494667 LOS Ash LF Expansion\900_WorkingDocs-CAD\902-Sheets\Geotech\LOS Geotech Section J.dgn

GEOLOGIC CROSS
SECTION J - J'

AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

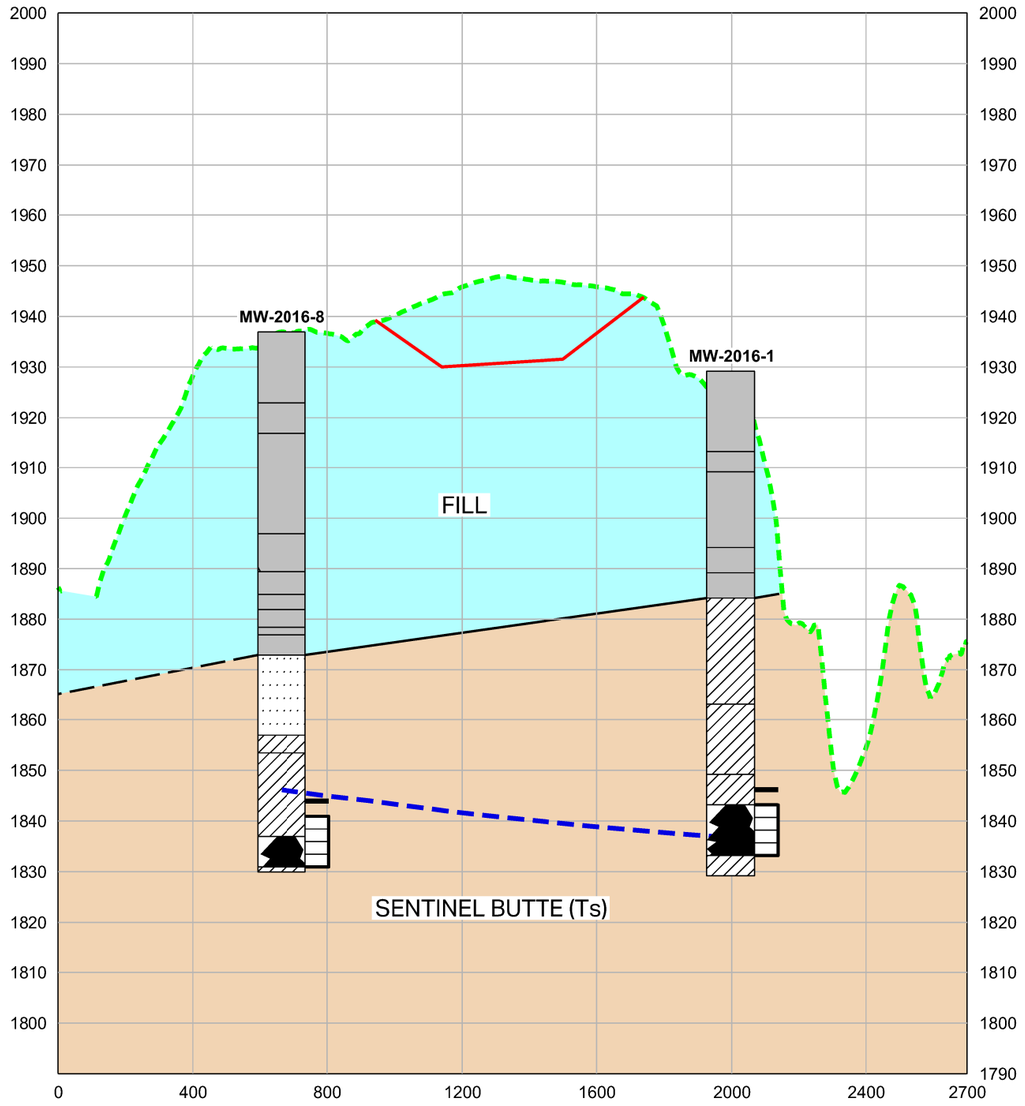
CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

PROJECT NUMBER
60494667

DRAWING NUMBER
12

K
(SOUTH)

K'
(NORTHEAST)



AECOM

PROJECT
Leland Old Station
Glenharold Mine
Landfill Expansion

CLIENT
Basin Electric
Power Cooperative
1717 E. Interstate Ave
Bismarck, ND
58503-0564

CONSULTANT
AECOM
800 LaSalle Ave.
Suite 500
612-376-2000 tel 612-376-2271 fax
www.aecom.com

SUPPLEMENTAL SITE
CHARACTERIZATION REPORT

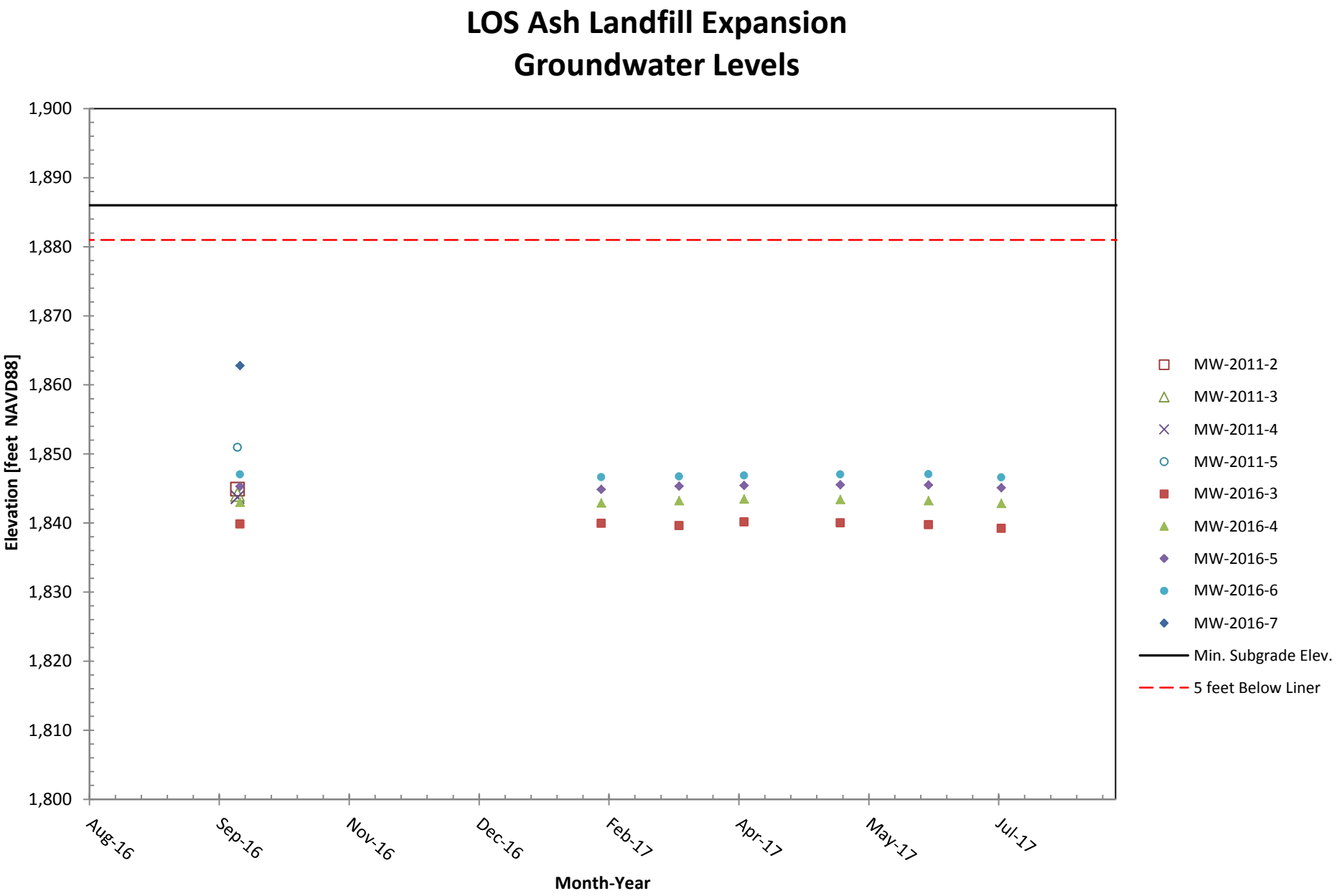
PROJECT NUMBER
60494667

DRAWING NUMBER
13

GEOLOGIC CROSS
SECTION K - K'

11/7/2017
P:\Water_Env\Basin Electric\60494667 LOS Ash LF Expansion\900_Working\Docs-CAD\902-Sheets\Geotech\LOS Geotech Section K.dgn

Appendix E – Groundwater Data


LOS Ash Landfill Expansion
Groundwater Levels
1,900
1,890
1,880
1,870
1,860
1,850
1,840
1,830
1,820
1,810
1,800
Elevation [feet NAVD88]
Aug-16
Sep-16
Nov-16
Dec-16
Feb-17
Apr-17
May-17
Jul-17
Month-Year
MW-2011-2
MW-2011-3
MW-2011-4
MW-2011-5
MW-2016-3
MW-2016-4
MW-2016-5
MW-2016-6
MW-2016-7
Min. Subgrade Elev.
5 feet Below Liner

Groundwater Level Data Collected Since 2012

2011 Wells - Groundwater Data

Well ID	MW-2011-1		MW-2011-2		MW-2011-3		MW-2011-4		MW-2011-5	
Reference Elevation Top of Casing* (ft, NAVD88)	1928.39		1954.80		1910.09		1919.80		1934.26	
Date	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)
2/21/2012	77.88	1850.51	106.23	1848.57	62.3	1847.79	72.33	1847.47	81.44	1852.82
4/17/2012	78.42	1849.97	106.94	1847.86	62.9	1847.19	73.99	1845.81	82.23	1852.03
7/31/2012	79.06	1849.33	107.7	1847.10	63.68	1846.41	73.78	1846.02	82.13	1852.13
10/8/2012	79.27	1849.12	108.06	1846.74	64.03	1846.06	74.15	1845.65	82.01	1852.25
1/9/2013	79.64	1848.75	108.44	1846.36	64.48	1845.61	74.58	1845.22	82.6	1851.66
5/6/2013	80.04	1848.35	108.75	1846.05	64.84	1845.25	74.97	1844.83	82.77	1851.49
7/29/2013	79.48	1848.91	108.25	1846.55	64.3	1845.79	74.42	1845.38	82.55	1851.71
10/7/2013	79.14	1849.25	107.95	1846.85	63.94	1846.15	74.01	1845.79	82.42	1851.84
5/12/2014	80.14	1848.25	108.69	1846.11	64.77	1845.32	74.85	1844.95	82.64	1851.62
9/22/2014	79.3	1849.09	108.17	1846.63	64.16	1845.93	74.2	1845.60	82.05	1852.21
4/13/2015	80.17	1848.22	109.4	1845.40	64.69	1845.40	74.72	1845.08	82.34	1851.92
9/27/2016	80.95	1847.44	109.89	1844.91	65.98	1844.11	76.05	1843.75	83.29	1850.97

2016 Wells - Groundwater Data

Well ID	MW-2016-1		MW-2016-2		MW-2016-3		MW-2016-4		MW-2016-5		MW-2016-6	
Reference Elevation Top of Casing* (ft, NAVD88)	1931.73		1957.98		1939.88		1939.97		1937.54		1939.31	
Date	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)
9/28/2016	94.97	1836.76	121.99	1835.99	100.04	1839.84	96.96	1843.01	92.24	1845.30	92.29	1847.02
1/25/2017	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
2/14/2017	95.59	1836.14	115.22	1842.76	99.92	1839.96	97.05	1842.92	92.65	1844.89	92.69	1846.62
3/16/2017	93.04	1838.69	123.02	1834.96	100.27	1839.61	96.72	1843.25	92.20	1845.34	92.58	1846.73
4/10/2017	92.94	1838.79	118.36	1839.62	99.73	1840.15	96.50	1843.47	92.10	1845.44	92.45	1846.86
5/17/2017	92.55	1839.18	116.32	1841.66	99.85	1840.03	96.57	1843.40	91.99	1845.55	92.26	1847.05
6/20/2017	92.70	1839.03	116.26	1841.72	100.13	1839.75	96.71	1843.26	92.03	1845.51	92.24	1847.07
7/18/2017	93.20	1838.53	118.18	1839.80	100.66	1839.22	97.12	1842.85	92.44	1845.10	92.70	1846.61

Well ID	MW-2016-7		MW-2016-8		MW-2016-9		MW-2016-10		MW-2016-11	
Reference Elevation Top of Casing* (ft, NAVD88)	1936.11		1939.36		1947.39		1953.32		1956.73	
Date	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)	DTW (feet)	GW Elev. (ft, NAVD88)
9/28/2016	73.31	1862.80	93.21	1846.15	NM	NM	NM	NM	NM	NM
1/25/2017	NM	NM	NM	NM	109.22	1838.17	112.1	1841.22	117.26	1839.47
2/14/2017	NM	NM	92.77	1846.59	116.77	1830.62	112.12	1841.20	124.68	1832.05
3/16/2017	NM	NM	92.66	1846.70	113.65	1833.74	111.60	1841.72	123.05	1833.68
4/10/2017	NM	NM	92.36	1847.00	113.57	1833.82	111.20	1842.12	122.60	1834.13
5/17/2017	NM	NM	92.62	1846.74	111.30	1836.09	111.56	1841.76	119.91	1836.82
6/20/2017	NM	NM	92.71	1846.65	113.43	1833.96	111.69	1841.63	121.12	1835.61
7/18/2017	NM	NM	92.97	1846.39	115.69	1831.70	112.03	1841.29	123.09	1833.64

NAVD = North American Vertical Datum of 1988 (NAVD 88)
NM = Not Measured (Well did not exist or no longer sampled)
DTW = Depth To Water
GW = Groundwater

Appendix F – Environmental and Wetland Delineation Report (Excerpt)

EXECUTIVE SUMMARY

Basin Electric Power Cooperative (BEPC) contracted AECOM to conduct wetland delineations within the ash landfill expansion (Project) near Stanton, North Dakota in Mercer County. The purpose of this report is to provide a summary of the available desktop data and wetland delineations conducted on August 19, 2016 and an evaluation of potential waters of the U.S. (WOTUS). A desktop analysis and literature search were also conducted to identify federally listed species of concern with the potential to occur within the proposed Project area.

One soil type was found within the Project area, mined land complex with 0 to 60 percent slopes (Figure 4-1). The mined land complex soils are not characterized as having hydric characteristics. Hydrology of the Project area is influenced by drainages and creeks contributing to the Missouri River, and the Project area is entirely within the Missouri River Basin. Historically, the dominant natural vegetation type of the Project area is shortgrass prairie (Dyke, S.R., S.K. Johnson, and P.T. Isakson. 2015. North Dakota State Wildlife Action Plan. North Dakota Game and Fish Department, Bismarck, ND). Found mostly in the Missouri Slope ecoregion of North Dakota, this vegetation type is dominated by warm season species that can survive on little rainfall (Figure 4-2).

A desktop analysis and literature search were conducted to identify federally listed species of concern with the potential to occur within the proposed Project area. Using the United States Fish and Wildlife Service's (USFWS's) Information for Planning and Conservation tool, AECOM identified seven threatened and endangered (T&E) species of concern and assigned each a determination of affect. North Dakota does not have a state endangered or threatened species list; only those species listed by the Endangered Species Act are considered threatened or endangered in North Dakota, and the USFWS has primary oversight over these species.

A no effect determination was given to the least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), whooping crane (*Grus Americana*), pallid sturgeon (*Scaphirhynchus albus*), gray wolf (*Canis lupus*), and northern long-eared bat (*Myotis septentrionalis*). Additionally, no T&E species were observed during the field survey on August 19, 2016.

AECOM conducted a desktop evaluation of wetlands to determine potential United States Army Corps of Engineers (USACE) jurisdictional waters. Potential impacts to WOTUS are subject to USACE permitting under Section 404 of the Clean Water Act. The Project area lies entirely within the Omaha District of the USACE. The Project area evaluated by AECOM contains two mapped National Wetlands Inventory (NWI) features and one National Hydrography Dataset (NHD) tributary (Figure 4-3). The two NWI features did not meet wetland criteria in the field. The NHD-mapped creek appeared to be an upland drainage that flowed into Alderin Creek. This drainageway did not contain hydrophytic vegetation or an ordinary high water mark.

Four wetlands were delineated within the Project area (Figures 4-4, 4-5 and 4-6). AECOM has evaluated the characteristics of Wetland-1, Wetland-2, Wetland-3, and Wetland-4 and has come to the conclusion that these wetlands appear to be non-relatively permanent waters (non-RPW) that are formed by geomorphic position, are isolated from jurisdictional waters, and appear to be without significant nexus. Wetlands-1-3 formed following the mineland reclamation when soils settled forming small basins. Wetland-4 is a depressional wetland formed within a ditch created during the construction of the adjacent road.

However, these are the recommendations of AECOM based on our experience, observations and data collected in the field, and best professional judgement. The final authority over wetland jurisdiction is the responsibility of the USACE. AECOM recommends that an official jurisdictional determination (JD) is obtained from the USACE for the wetlands and drainageway in question.

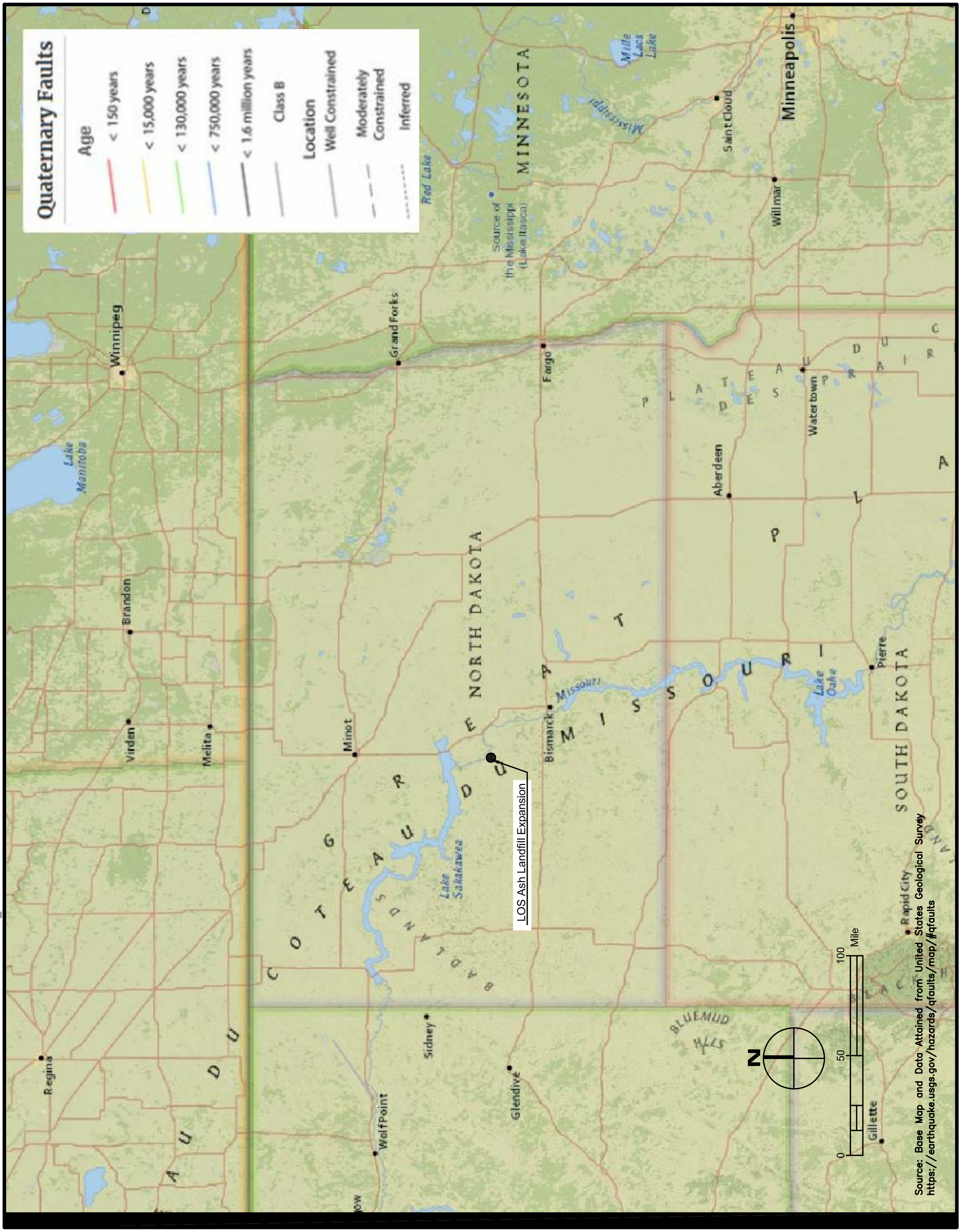
STATEMENT OF LIMITATIONS

This report was prepared by the staff of AECOM under the supervision of experienced professionals. The data interpretation, conclusions, and recommendations presented in the report were governed by AECOM's experience and professional judgment. This report has been prepared based on data current at

the time of preparation. Assumptions based on this data, although believed reasonable and appropriate based on the data provided herein, may not prove to be true in the future as new data are collected. The conclusions and recommendations of AECOM are conditioned upon these assumptions.

Appendix G – Geologic Maps

Last saved by: BLOECHERM(2017-11-02) Last Plotted: 2017-11-02
Filename: \\172.25.156.10\12PROJECTS\PROJECTS\60545172_LOS CONSTRUCTION OVERSIGHT\900-CAD-GIS\920-GIS OR GRAPHICS\RESTRICTION REPORT\QUATERNARY FAULTS\QUATARNARY FAULTS.DWG



Location Restrictions Report
LOS Ash Landfill Expansion
Basin Electric Power Cooperative
Project No.: 60545172 2017-03-14

Quaternary Faults in Proximity to
Leland Olds Station
Mercer County, North Dakota

AECOM
FIGURE 5.1

PART I PLATE I
COUNTY GROUND-WATER STUDIES 15
BULLETIN 56

PLATE I. - GEOLOGY OF MERCER AND OLIVER COUNTIES

NORTH DAKOTA STATE WATER COMMISSION
NORTH DAKOTA GEOLOGICAL SURVEY

LOS Landfill Expansion Area

RECENT AND PLEISTOCENE MAP UNITS

	SYMBOL	FORMATION	LITHOLOGY	LANDFORM
HOLOCENE	A	WALSH FORMATION	Dark brown, gray or black silt, clay and sand.	Alluvium - Floodplain, terrace or lowland deposits.
	Aut			Upper terrace along Missouri River.
	Alt			Lower terrace along Missouri River.
	E	WALSH FORMATION	Well sorted, fine to medium grained sand.	Sand dunes.
QUATERNARY	Cs	COLEHARBOR FORMATION	Sorted and unsorted glacial deposits.	
	Cs		Sand Facies - Generally well sorted, fine to medium grained sand; some gravelly sand.	Outwash, "Inwash," and terrace deposits.
	Cg		Gravel Facies - Accumulations of gravel and sandy gravel; sorting variable.	Ice contact, outwash.
	Cbh		Boulder Clay Facies - An unsorted mixture of clay, silt, and sand with some interspersed pebbles, cobbles, and boulders.	Hummocky Moraine - Some glacial constructional relief; undrained depressions common.
	Cbg			Ground Moraine - Low or no glacial constructional relief; mostly slightly modified bedrock topography; undrained depressions absent.

TERTIARY MAP UNITS

	SYMBOL	FORMATION	LITHOLOGY
TERTIARY	Tgv	GOLDEN VALLEY FORMATION	Upper Member - Interbedded silt, clay, sand, and lignite. Lower Member - Light colored silt and silty clay.
	Tsb	SENTINEL BUTTE FORMATION	Interbedded silt, clay, lignite, sand, and shale.
	Ttr	TONGUE RIVER FORMATION	Interbedded sand, silt, clay, lignite, and shale.
	Tc	CANNONBALL FORMATION	Thinly interbedded sand and clay-shales; also silt and clay-shales.

Base prepared by the United States Geological Survey

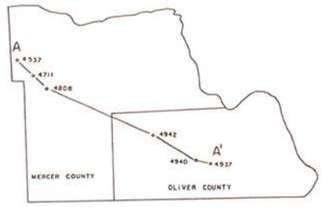
MERCER COUNTY
OLIVER COUNTY

0 1 2 3 4 5 6 MILES

North Dakota State Water Commission
North Dakota Geological Survey

Plate 2. Cross section showing Fox Hills, Hell Creek, and Cenozoic Formations of Mercer and Oliver Counties

Part I. Plate II
County Ground-Water Studies 15
Bulletin 56



A

4537
SUN OIL - LINDEMAN NO.1
SE NW 21-146-90

4711
TEXACO - SIELER NO.1
NW SW 27-145-89

4808
W.H. HUNT - BUCKFINK NO. 1
NW SE 11-144-89

4942
GENERAL AMERICAN - JENSEN NO. 1-34
SE NE 34-143-86

4940
GENERAL AMERICAN - HENKE NO. 1-24
SE SW 24-142-85

4937
GENERAL AMERICAN - DRESSER NO. 1-34
SE NW 34-142-84

A'

SENTINEL BUTTE FORMATION

TONGUE RIVER FORMATION

CANNONBALL FORMATION

LUDLOW FORMATION

HELL CREEK FORMATION

FOX HILLS FORMATION

Top of Pierre Formation

North Dakota State Water Commission
North Dakota Geological Survey

Plate 3. Typical measured sections of the Tongue River Formation

Part I. Plate III
County Ground - Water Studies 15
Bulletin 56

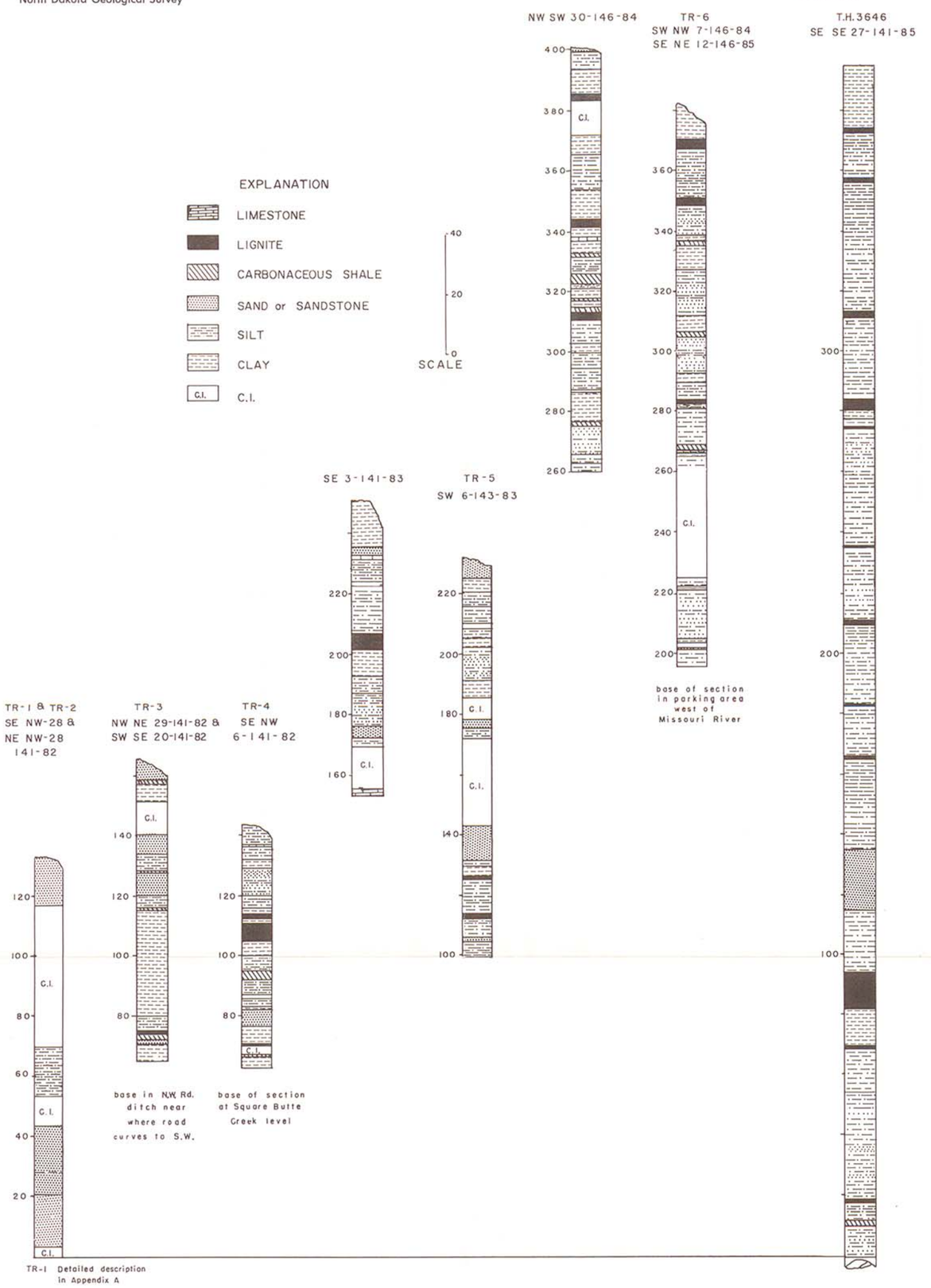


Plate 4. Typical measured sections of the Sentinel Butte Formation