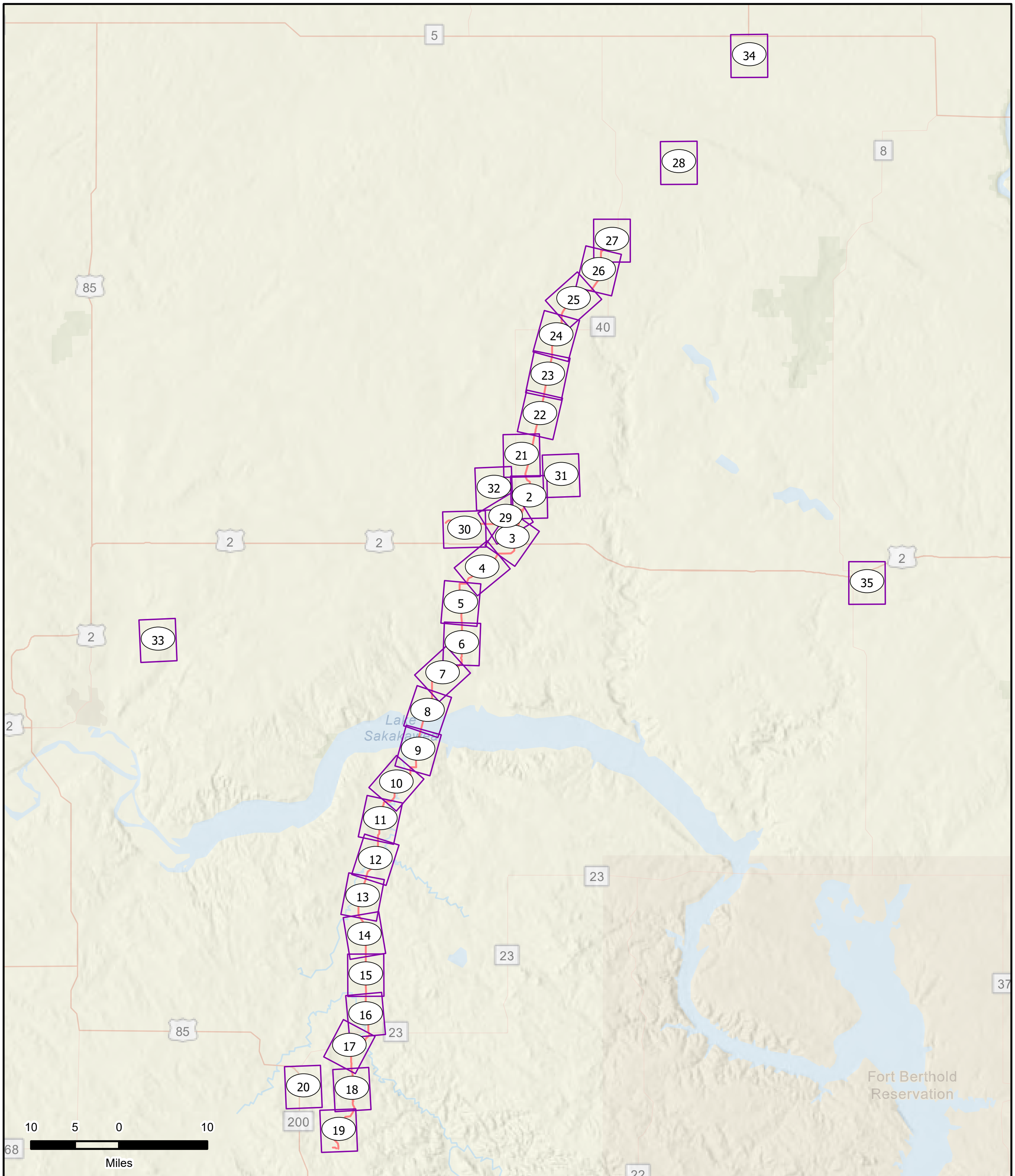
WBI ENERGY TRANSMISSION, INC.
NORTH BAKKEN EXPANSION PROJECT

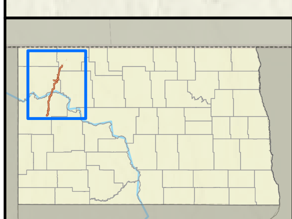
Resource Report 1
Revised Appendices

- Appendix 1A, Project Route Maps (Topographic)
- Appendix 1B, Aerial Photo-based Alignment Sheets Mapping Supplement (*filed under separate cover due to file size*)
- Appendix 1D, Summary of Collocated Facilities
- Appendix 1E, Revised Plot Plan for the Northern Border Interconnect
- Appendix 1F-1, Revised Spill Prevention, Control, and Countermeasure Plan
- Appendix 1F-3, Revised Noxious Weeds Management Plan
- Appendix 1F-6, Plan for Unanticipated Discovery of Historic Properties or Human Remains during Construction
- Appendix 1F-7, Plan for Unanticipated Discovery of Paleontological Resources during Construction
- Appendix 1F-8, Revised Horizontal Directional Drill/Guided Bore Drilling Fluid Monitoring and Operations Plans
- Appendix 1H and 1H-A, Updated Landowner List and Landowner Correspondence (*filed under separate cover as Controlled Unclassified Information/Privileged and Confidential [CUI//PRIV] in Volume IV*)
- Appendix 1J, Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project

WBI ENERGY TRANSMISSION, INC.
NORTH BAKKEN EXPANSION PROJECT

Resource Report 1
Revised Appendix 1A
Project Route Maps (Topographic)





Appendix A Sheet Page

Preliminary Route

N
W E
S

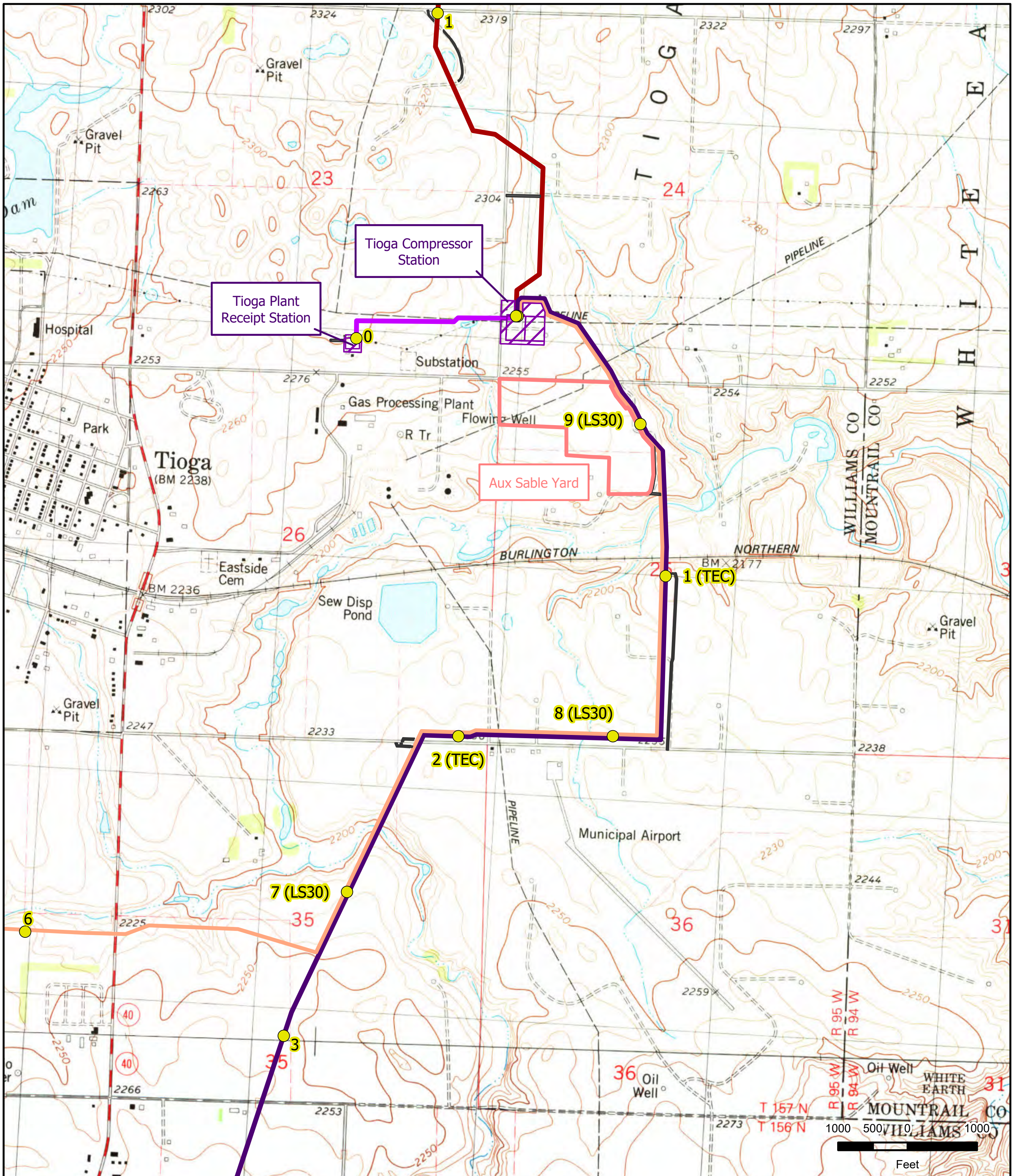
1:1,000,00

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 01 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 8/31/2020

Drawn By: RJC

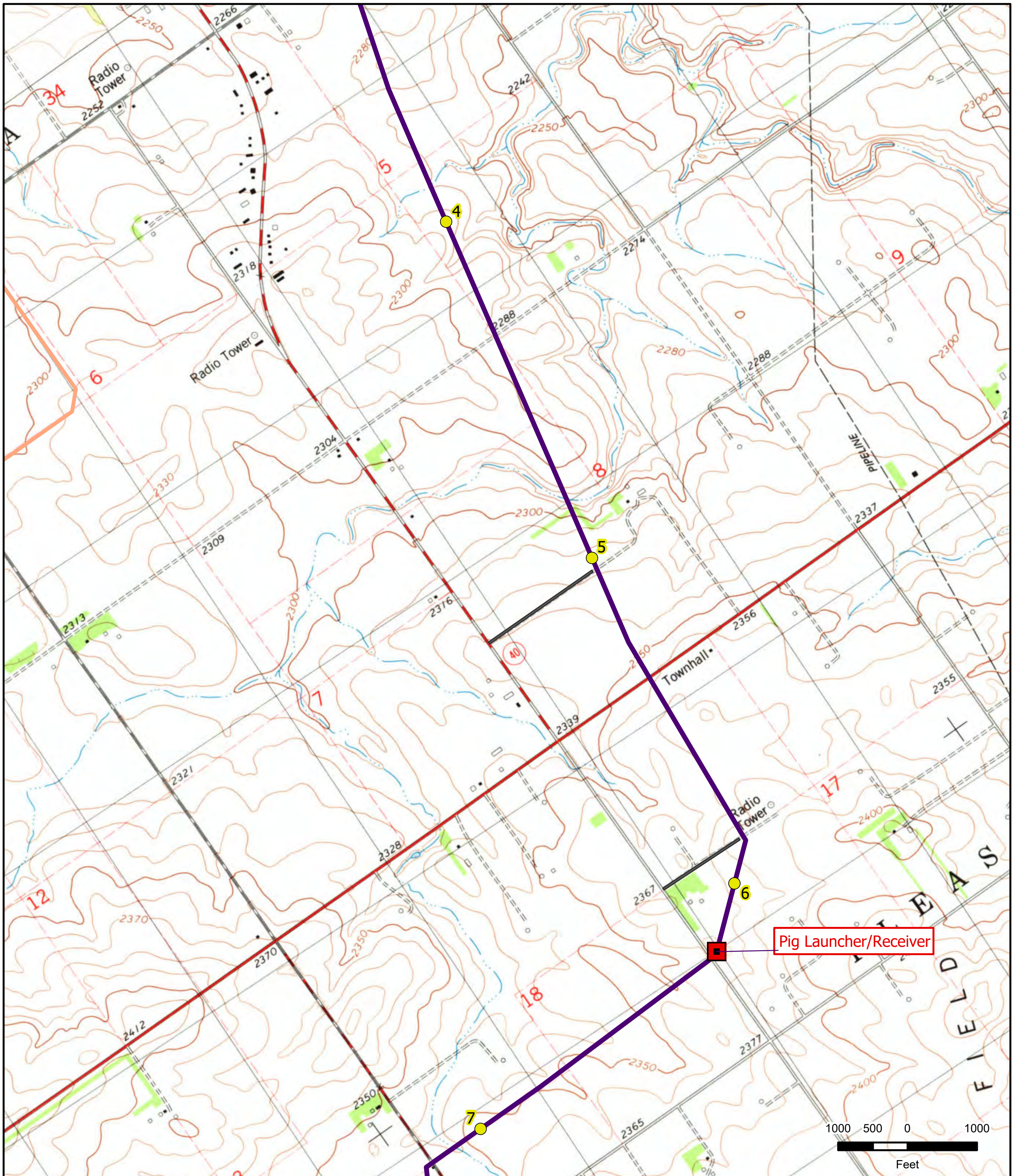


- Milepost
- Proposed Line Section 25 Loop
- Proposed Line Section 30 Loop
- Proposed Tioga-Elkhorn Creek
- Proposed Tioga Compressor Lateral
- Aboveground Facility
- Staging Area
- Access Road

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 02 of 35

WBI ENERGY TRANSMISSION



- Milepost
- Proposed Line Section 30 Loop
- Proposed Tioga-Elkhorn Creek
- Access Road

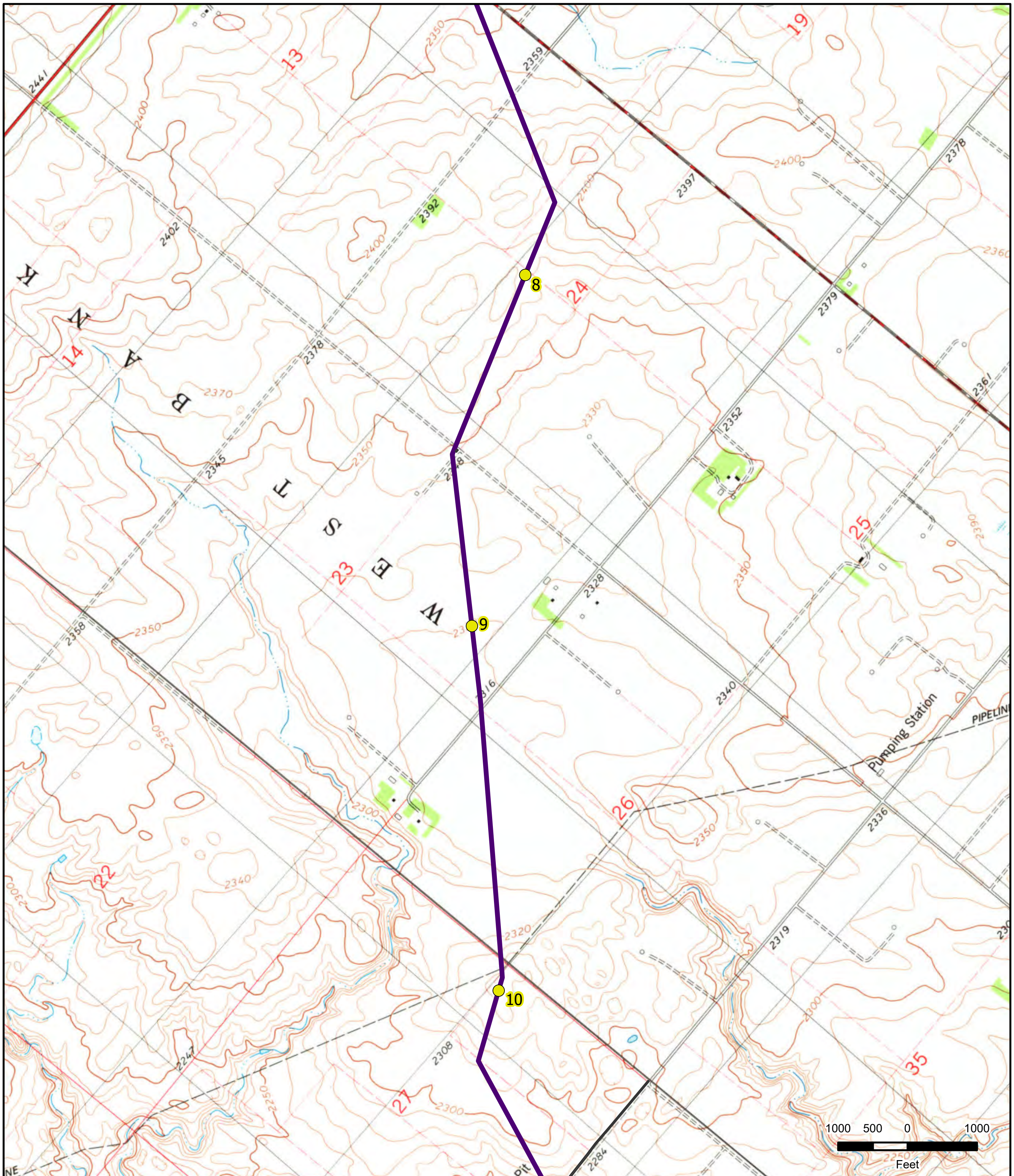
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 03 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost

Proposed Tioga-Elkhorn Creek

Access Road

1:24,000

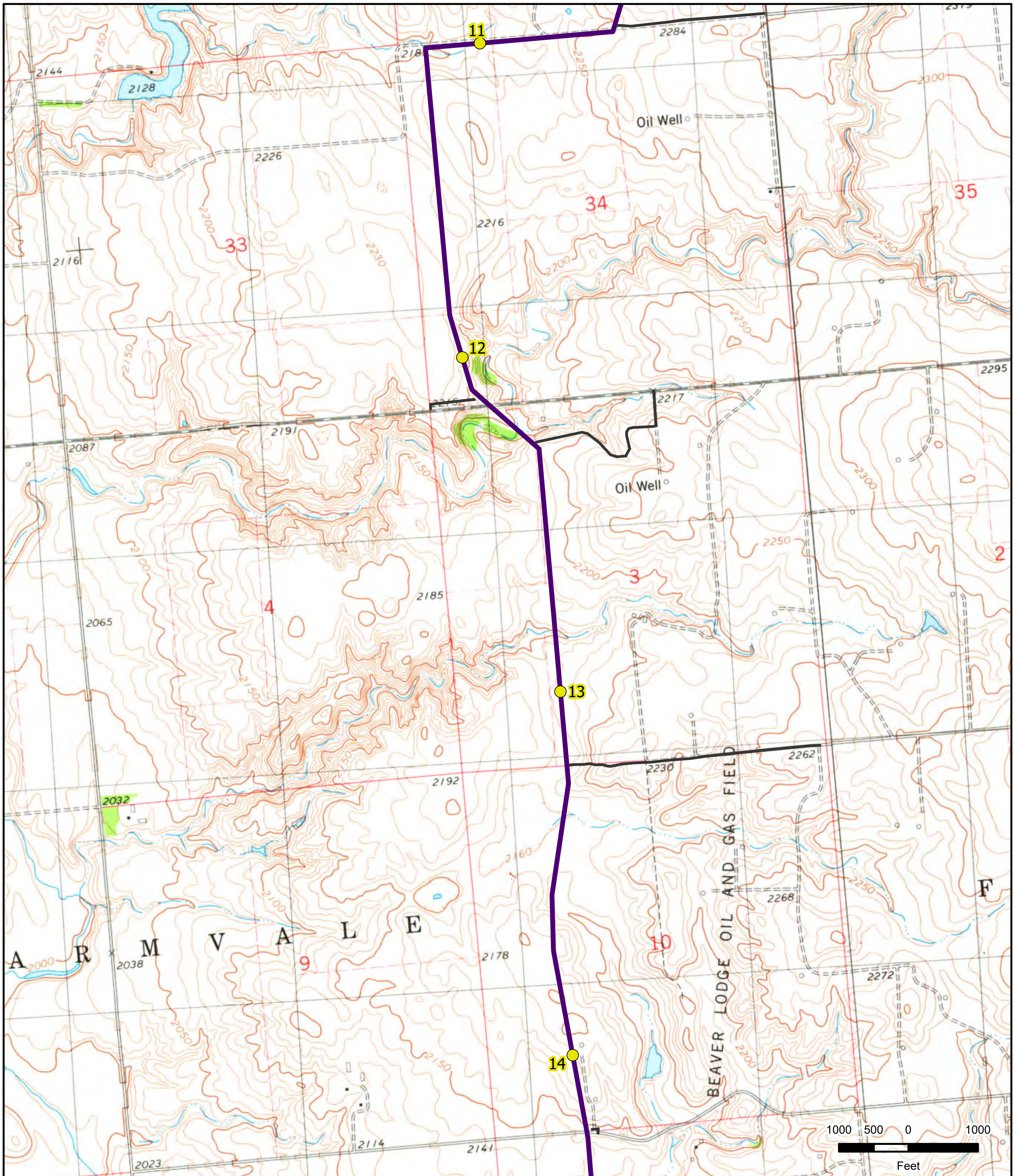
Appendix 1A
North Bakken Expansion Project
Project Route Maps

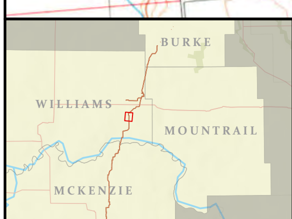
Sheet 04 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC





Milepost

Proposed Tioga-Elkhorn Creek

Access Road

N
W E
S

1:24,000

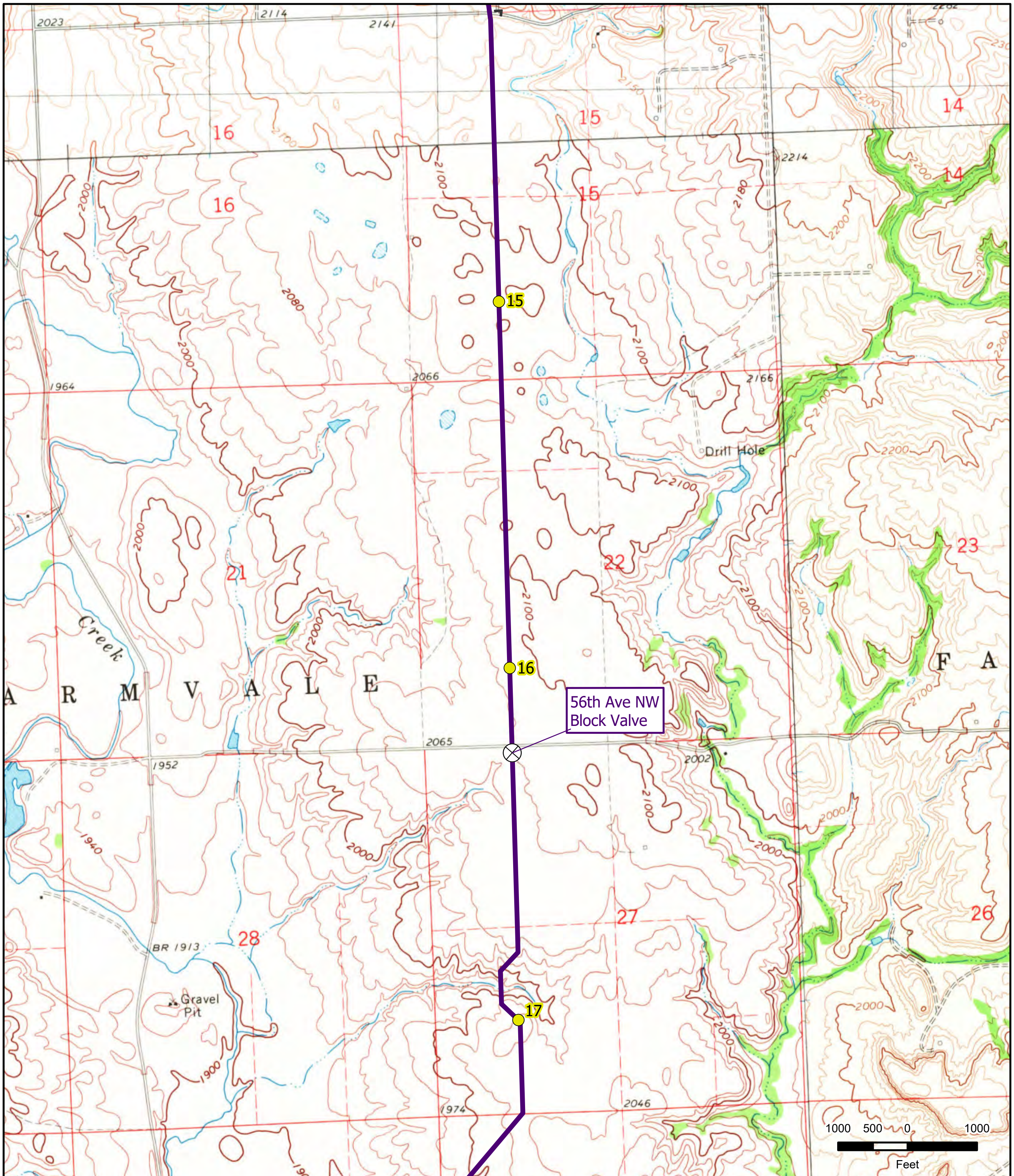
Appendix 1A
North Bakken Expansion Project
Project Route Maps

Sheet 05 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost

Valve Site

Proposed Tioga-Elkhorn Creek

Access Road

N
W E
S

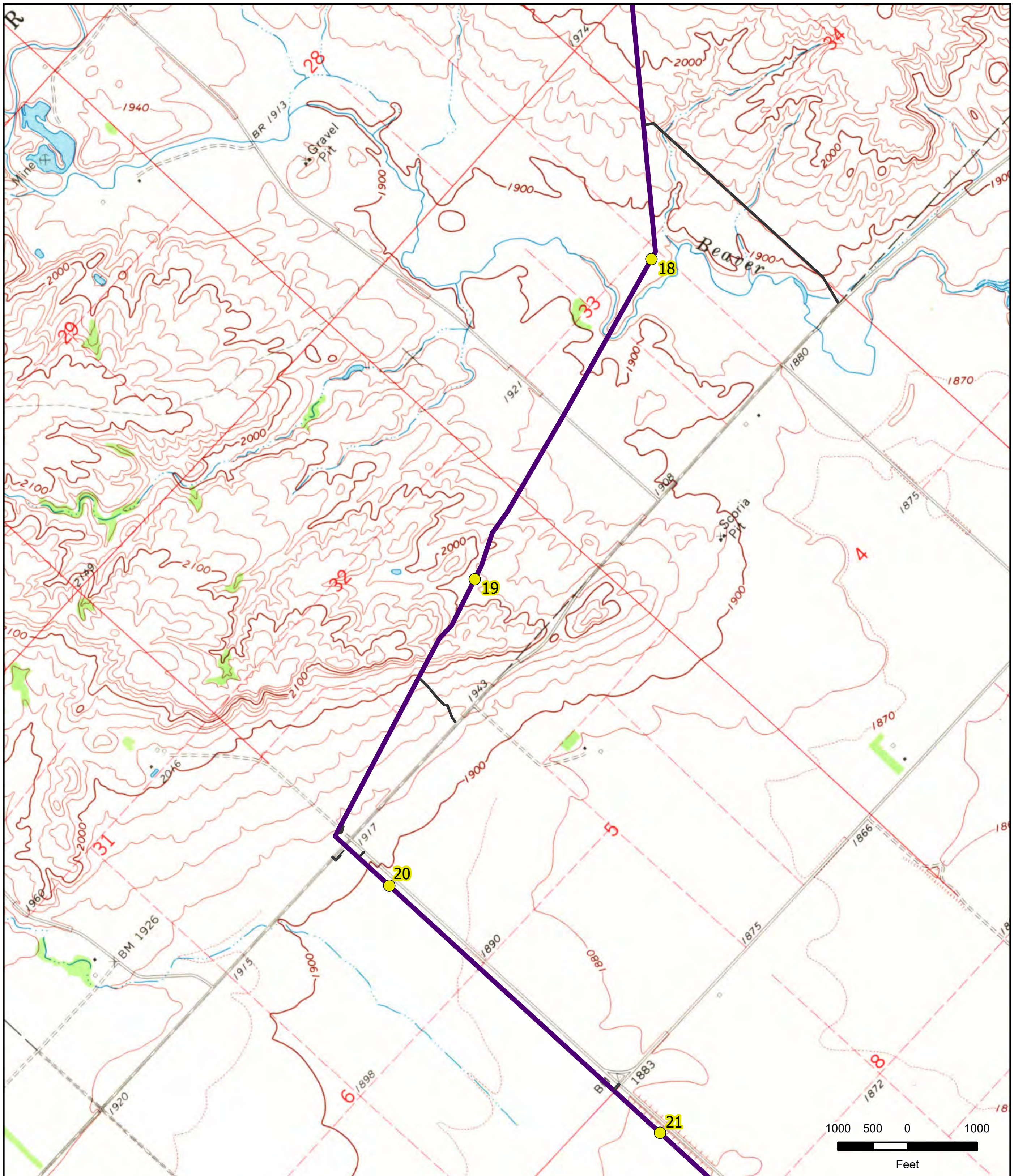
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps

Sheet 06 of 35

WBI ENERGY TRANSMISSION

An MDU Resources Group company



Milepost

Proposed Tioga-Elkhorn Creek

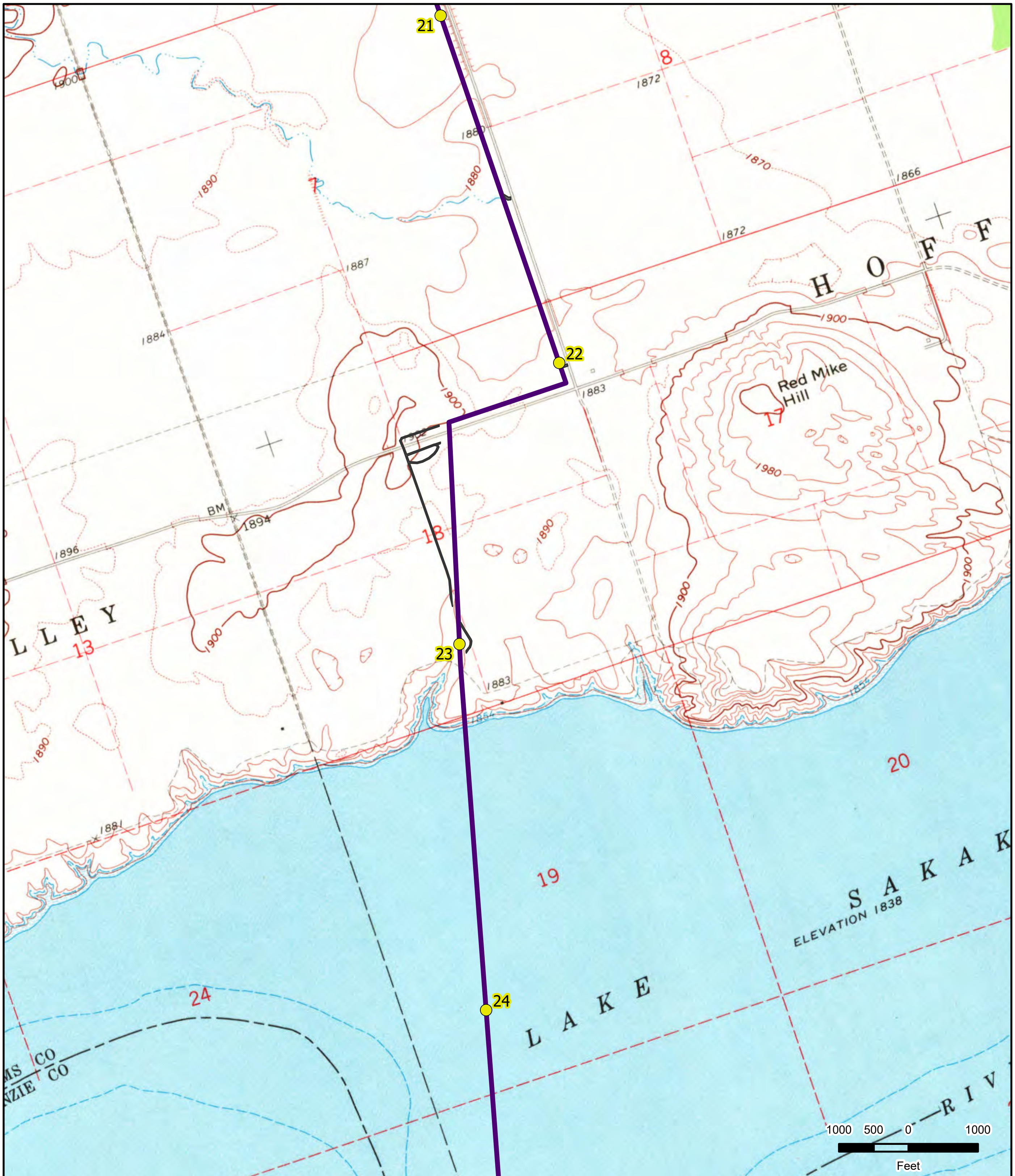
Access Road

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps

Sheet 07 of 35

WBI ENERGY TRANSMISSION



Milepost
Proposed Tioga-Elkhorn Creek
Access Road

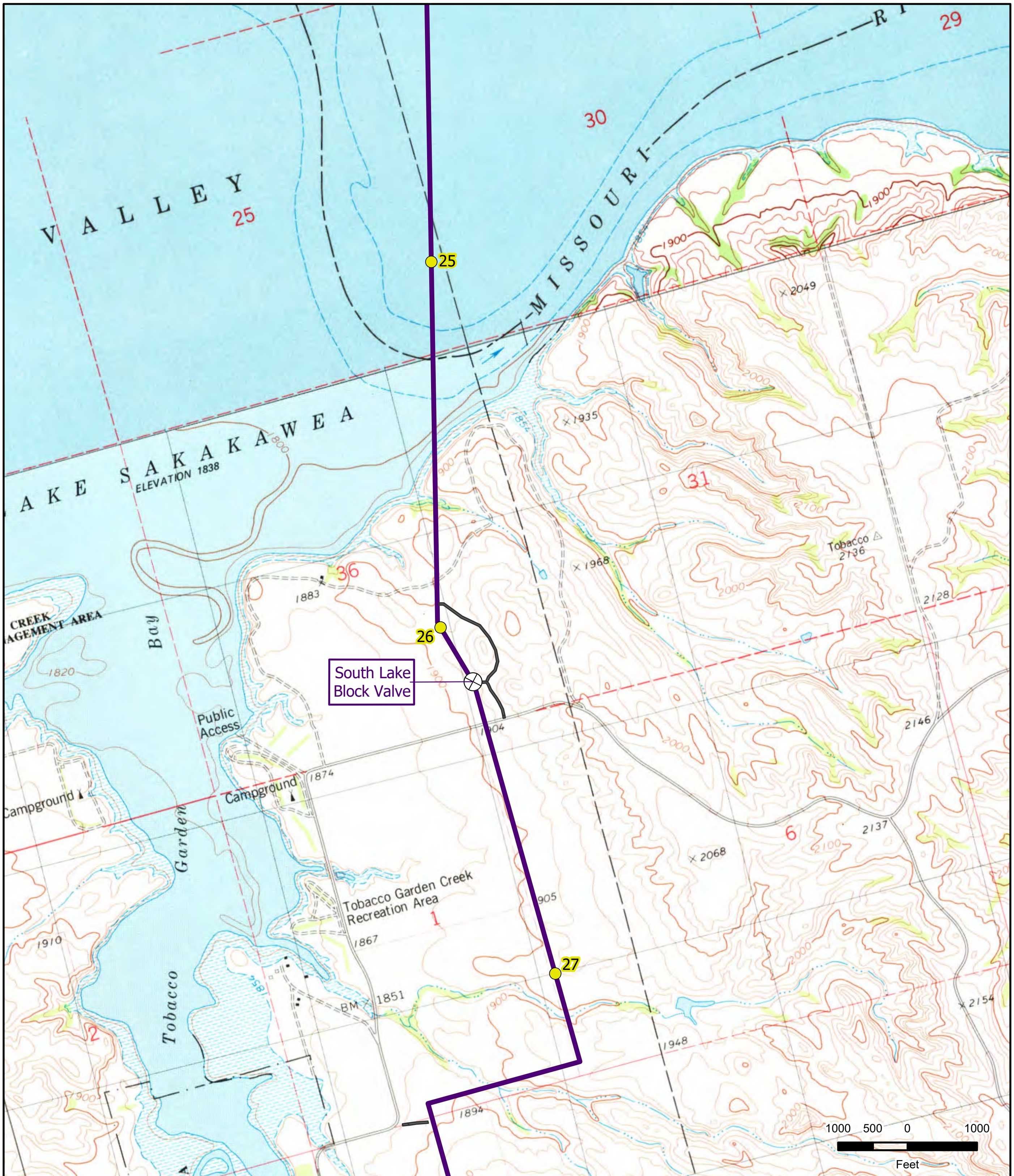
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 08 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost

Valve Site

Proposed Tioga-Elkhorn Creek

Access Road

1:24,000

Appendix 1A

North Bakken Expansion Project

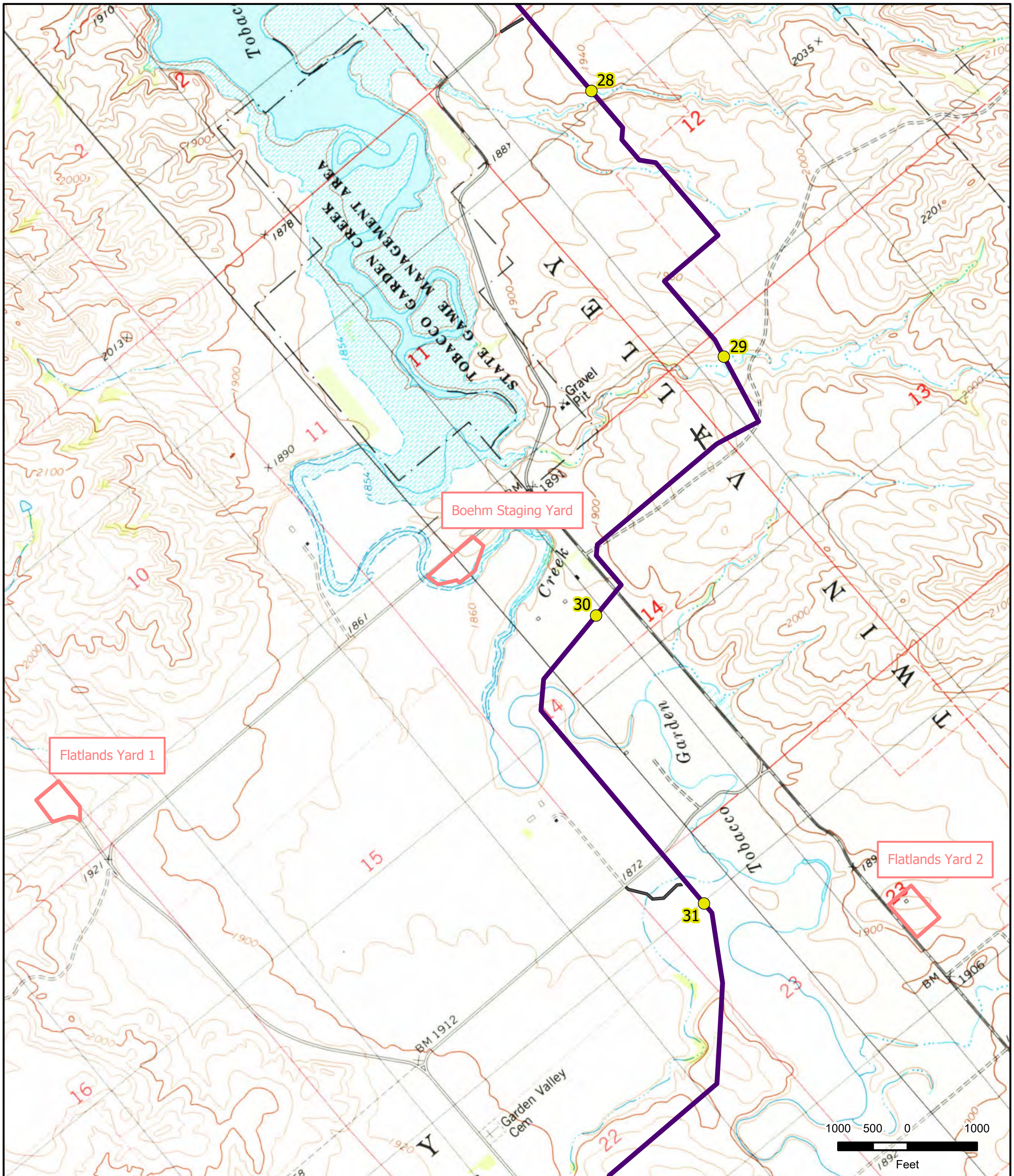
Project Route Maps

Sheet 09 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/3/2020

Drawn By: RJC



● Milepost
Proposed Tioga-Elkhorn Creek
Staging Area
Access Road

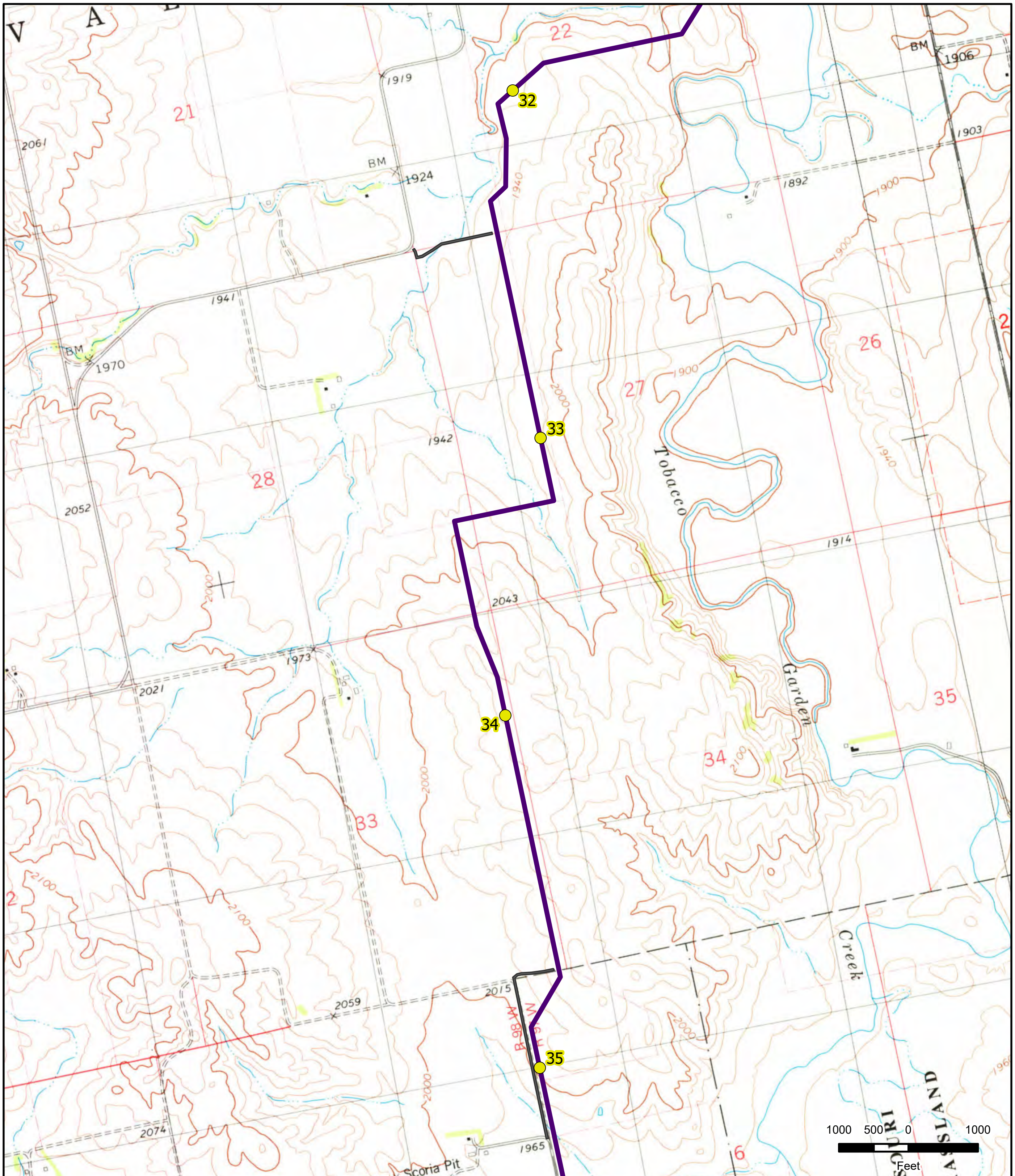
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 10 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost
Proposed Tioga-Elkhorn Creek
Access Road

N
W
E
S

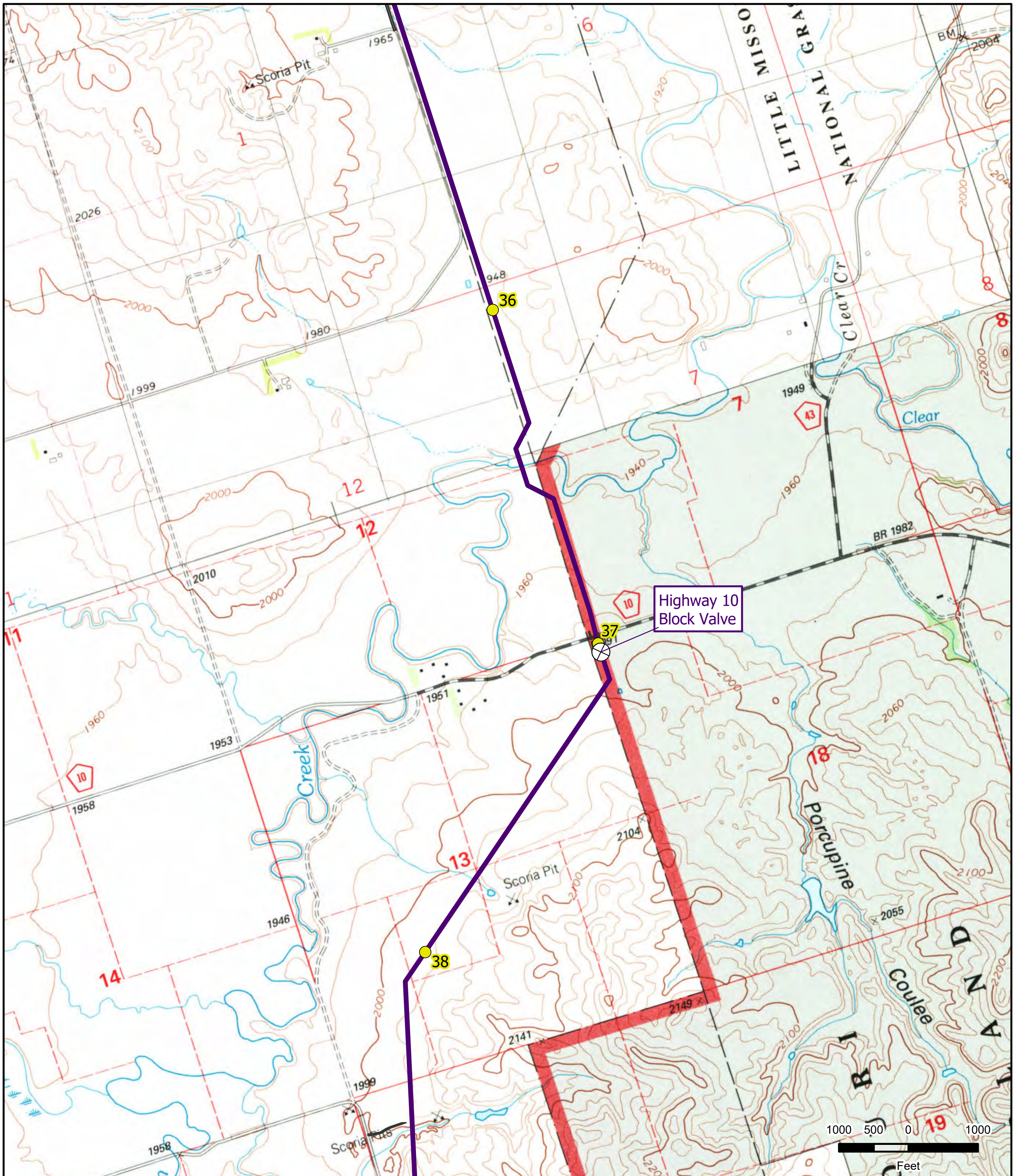
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 11 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



- Milepost
- Valve Site
- Proposed Tioga-Elkhorn Creek
- Access Road

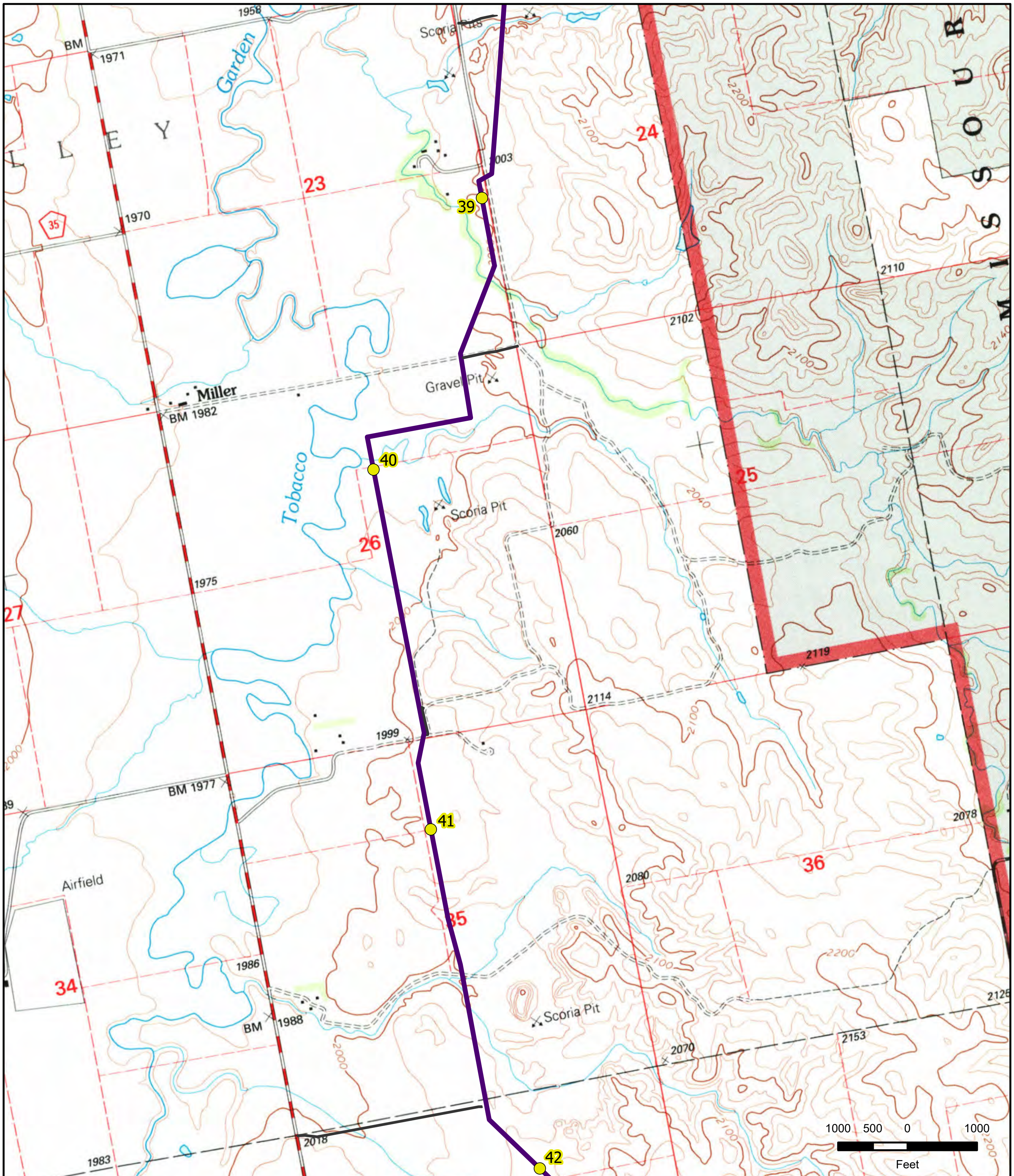
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 12 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost
Proposed Tioga-Elkhorn Creek
Access Road

N E S W

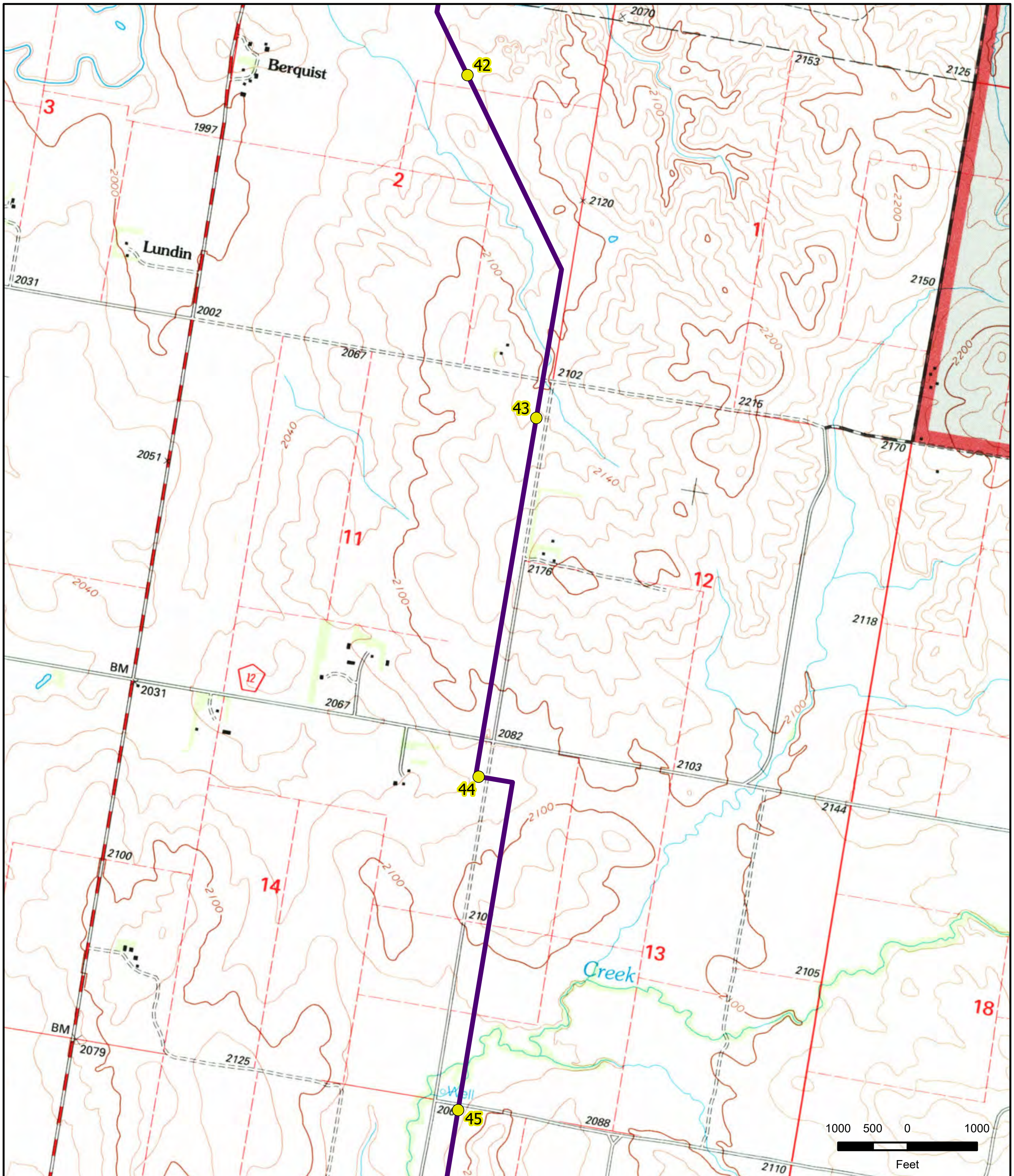
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 13 of 35

WBI ENERGY TRANSMISSION
An MDU Resources Group company

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost

Proposed Tioga-Elkhorn Creek

1:24,000

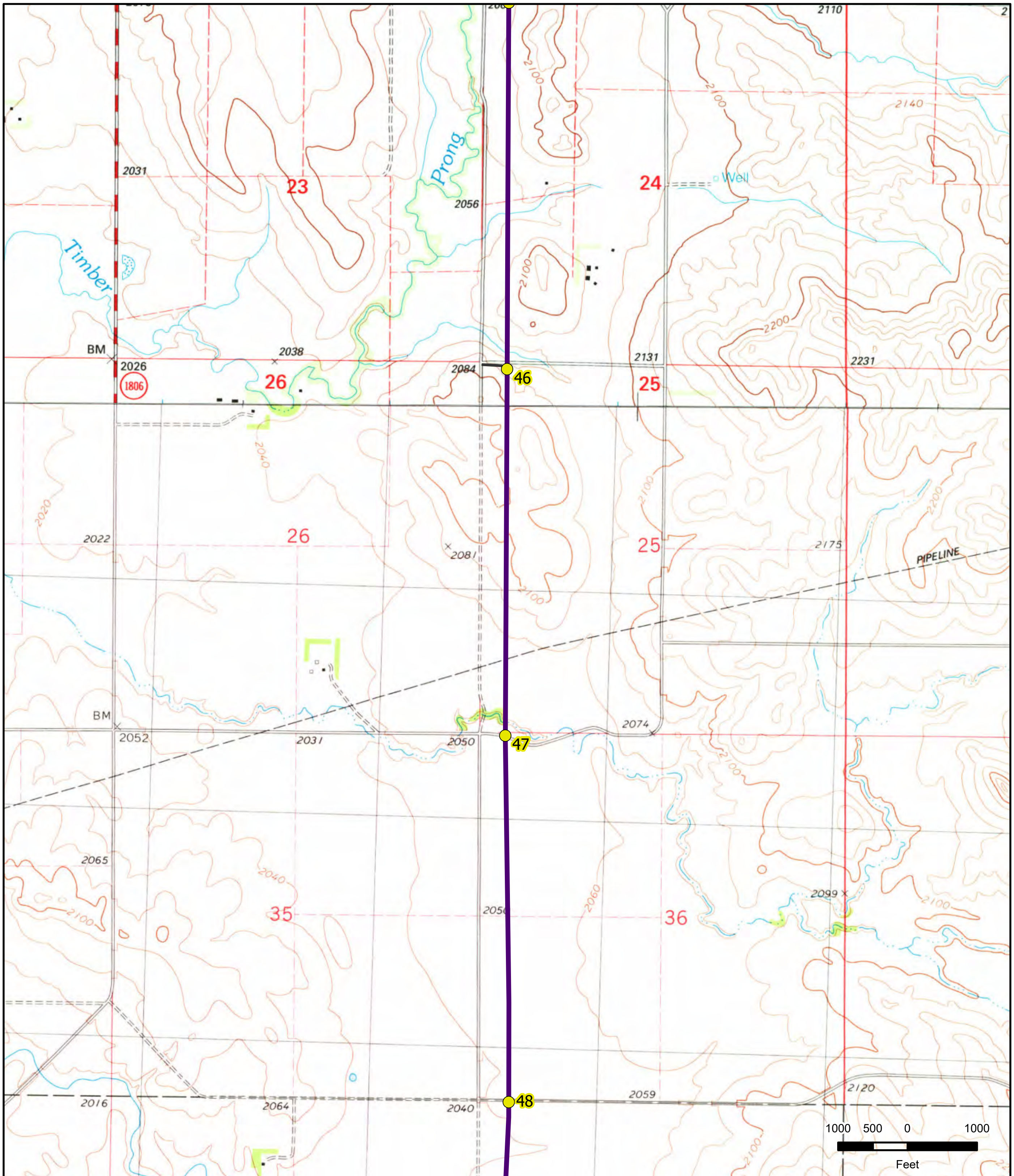
Appendix 1A
North Bakken Expansion Project
Project Route Maps

Sheet 14 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost

Proposed Tioga-Elkhorn Creek

Access Road

N
W E
S

1:24,000

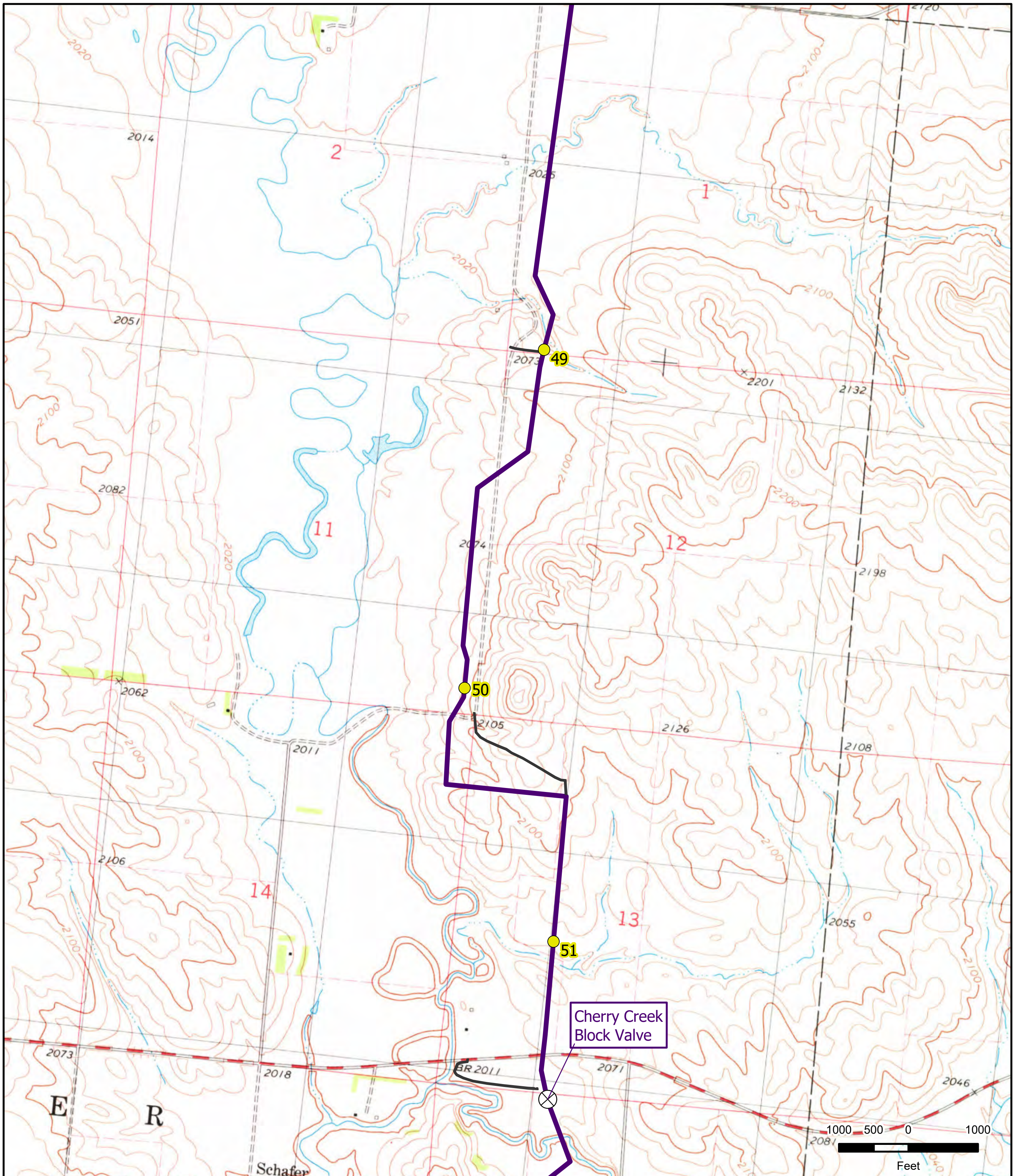
Appendix 1A
North Bakken Expansion Project
Project Route Maps

Sheet 15 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



- Milepost
- Valve Site
- Proposed Tioga-Elkhorn Creek
- Access Road

N W E S

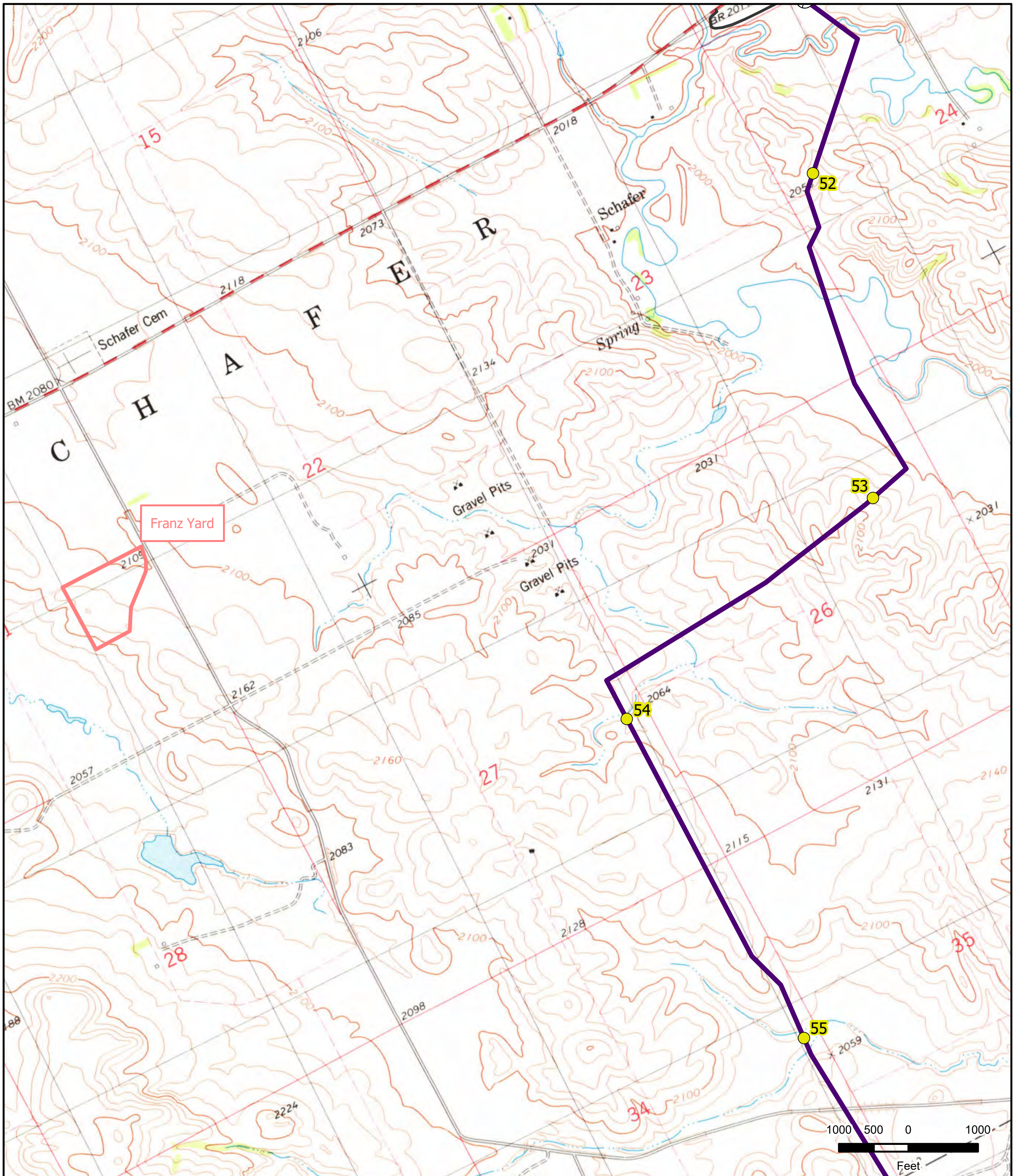
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 16 of 35

WBI ENERGY TRANSMISSION
An MDU Resources Group company

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost

Valve Site

Proposed Tioga-Elkhorn Creek

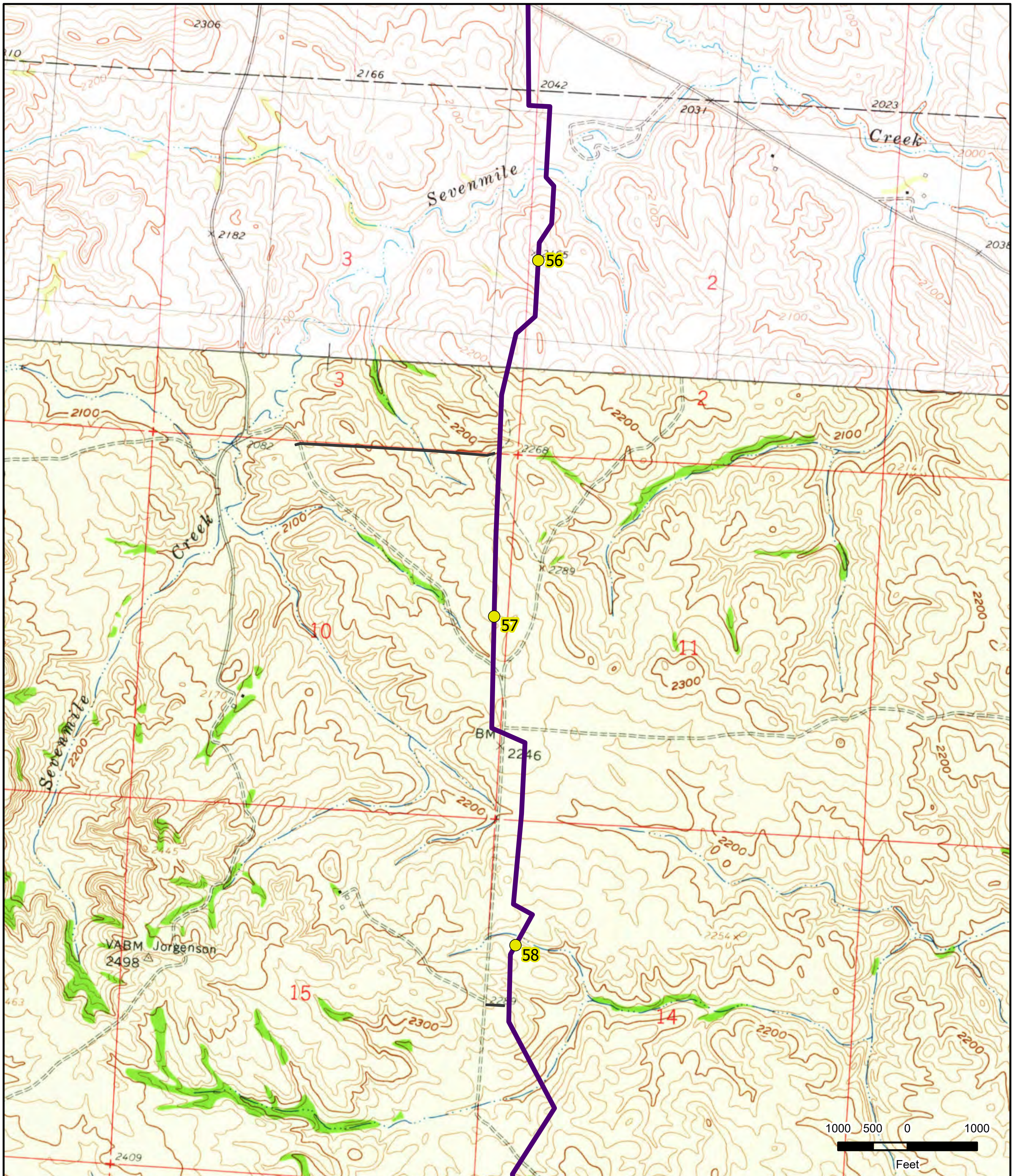
Staging Area

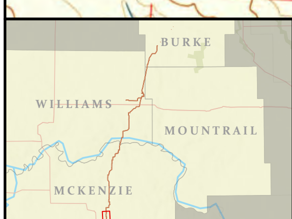
Access Road

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 17 of 35

WBI ENERGY TRANSMISSION





Milepost

Proposed Tioga-Elkhorn Creek

Access Road

N
W E
S

1:24,000

Appendix 1A

North Bakken Expansion Project

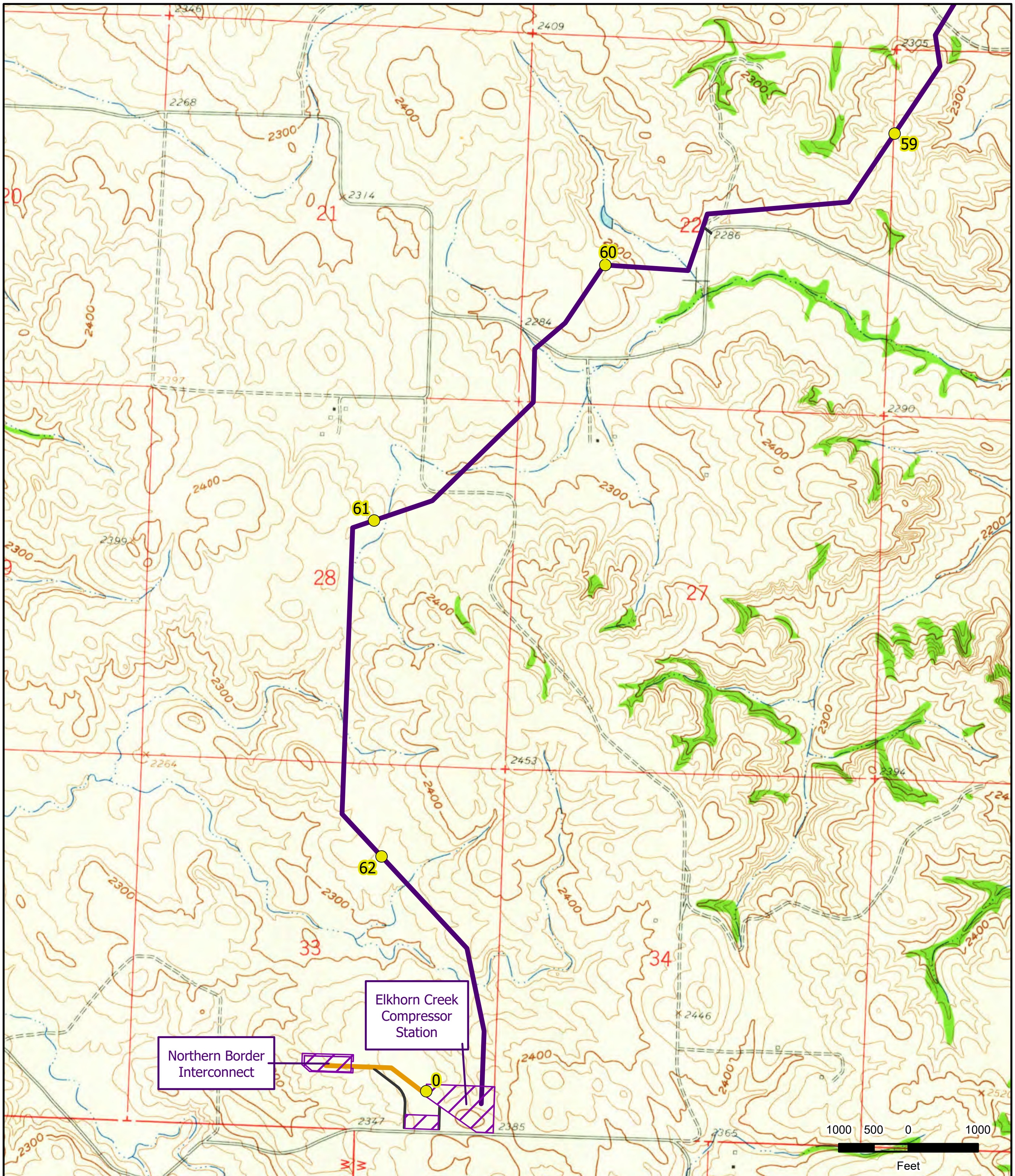
Project Route Maps

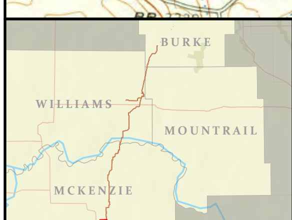
Sheet 18 of 35

WBI ENERGY TRANSMISSION
An MDU Resources Group company

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/3/2020

Drawn By: RJC





- Milepost
- Proposed Tioga-Elkhorn Creek
- Proposed Elkhorn Creek-Northern Border
- Aboveground Facility
- Access Road

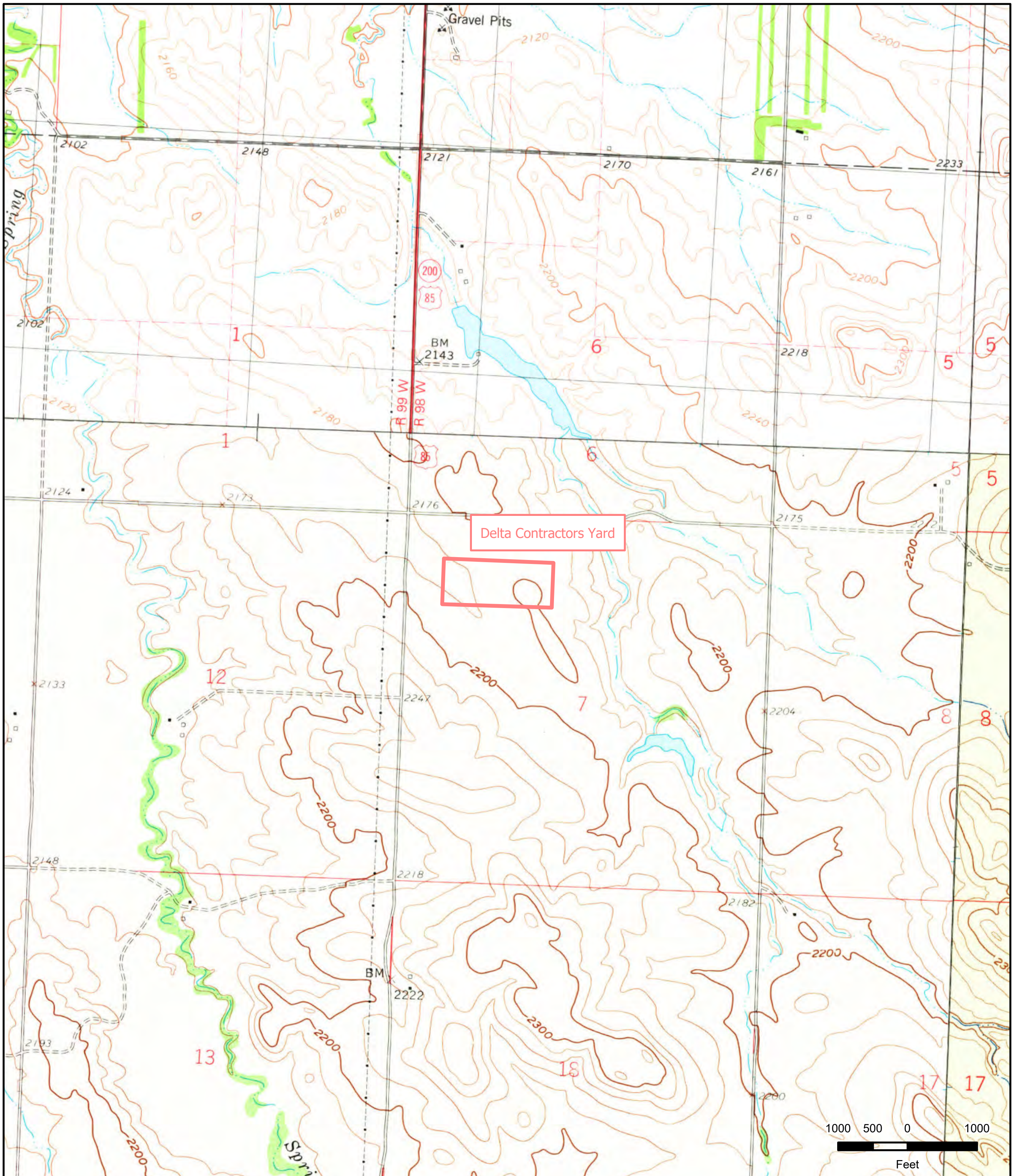
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 19 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Staging Area

N
W E
S

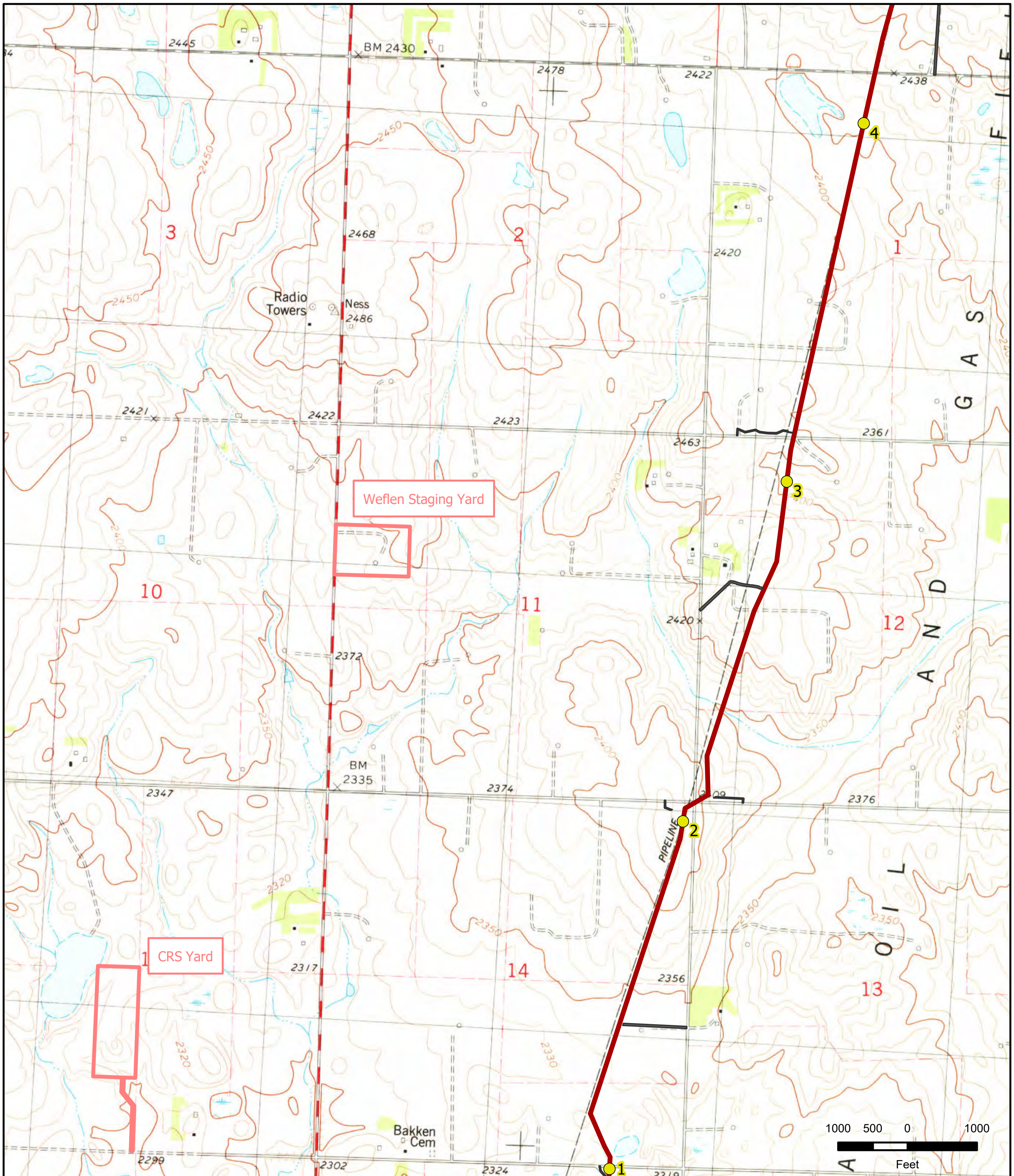
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 20 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC

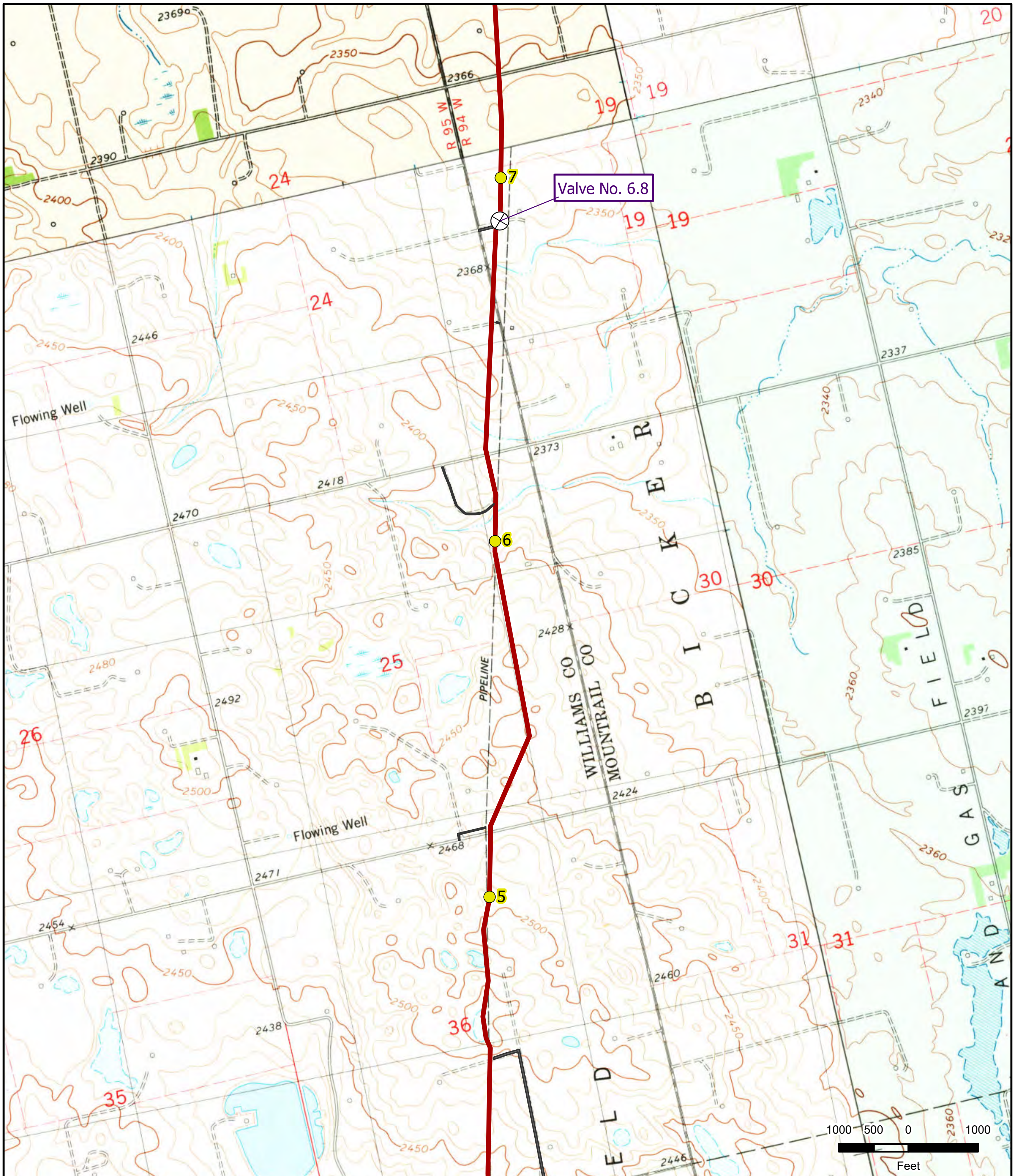


Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 21 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost

Valve Site

Proposed Line Section 25 Loop

Access Road

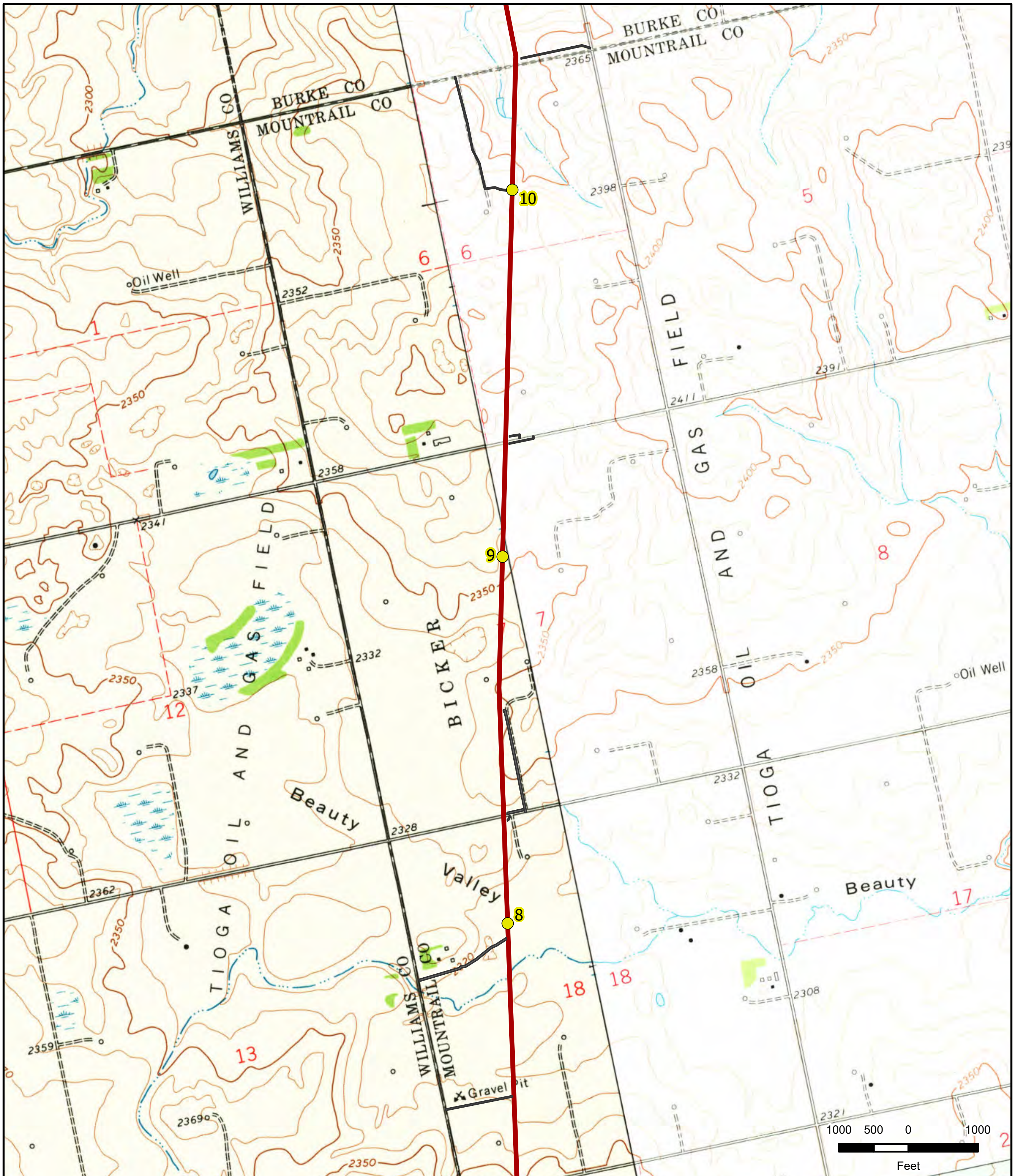
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps

Sheet 22 of 35

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



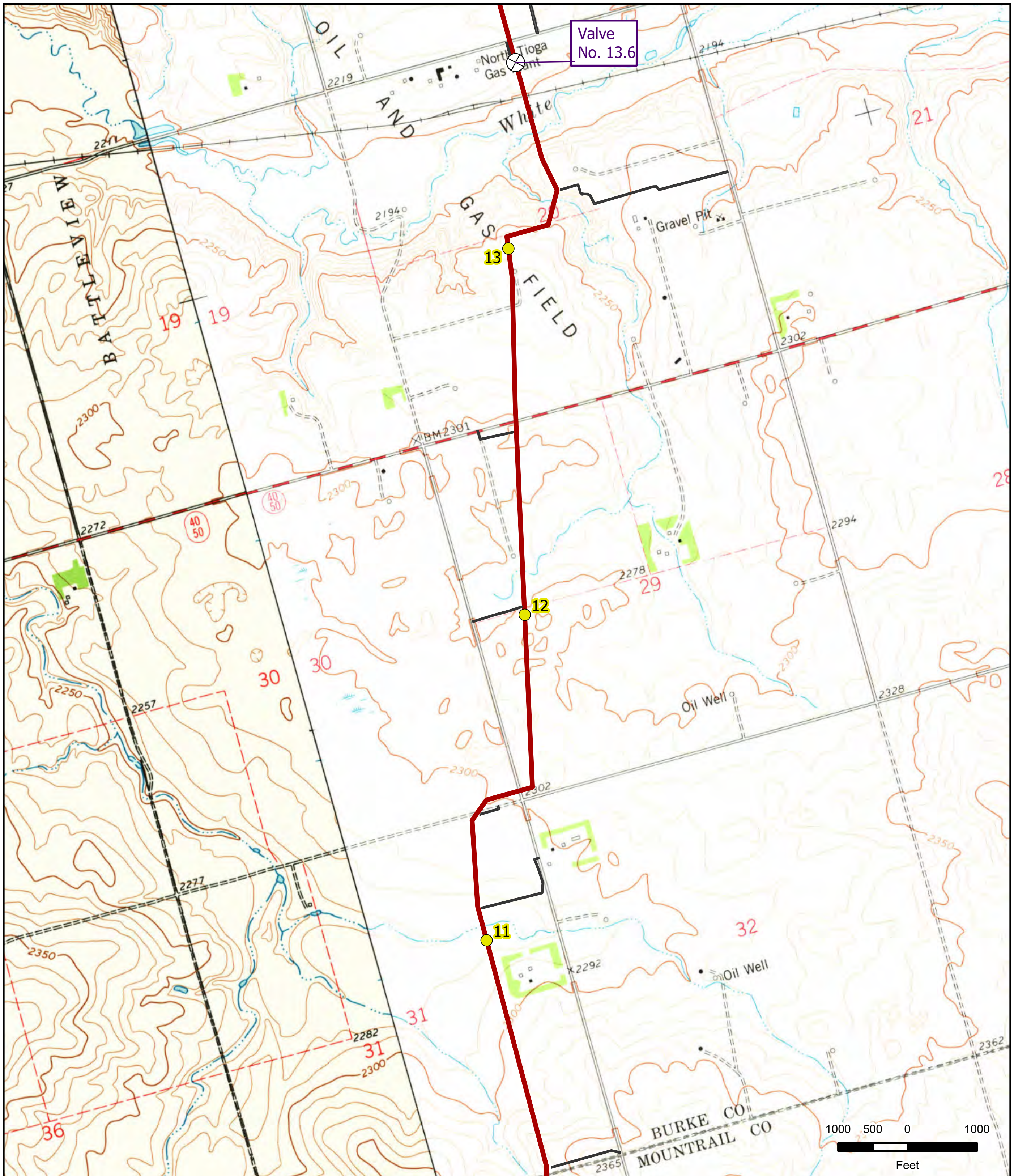
- Milepost
- Proposed Line Section 25 Loop
- Access Road

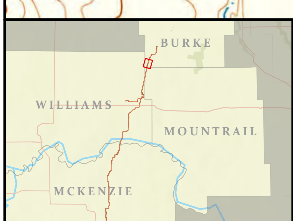
N
W E
S

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 23 of 35

WBI ENERGY TRANSMISSION





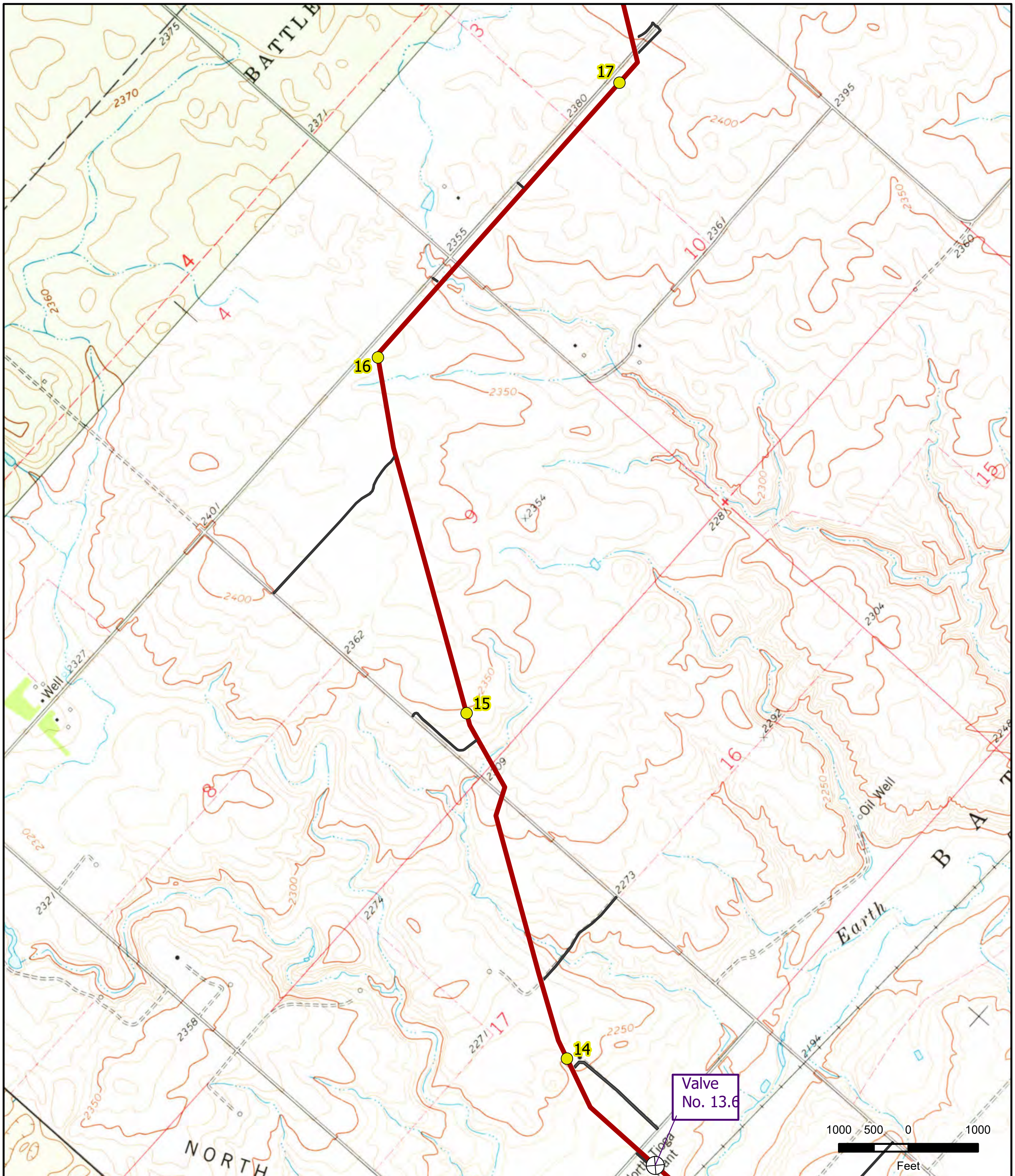
- Milepost
- Valve Site
- Proposed Line Section 25 Loop
- Access Road

N E S W

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 24 of 35

WBI ENERGY TRANSMISSION

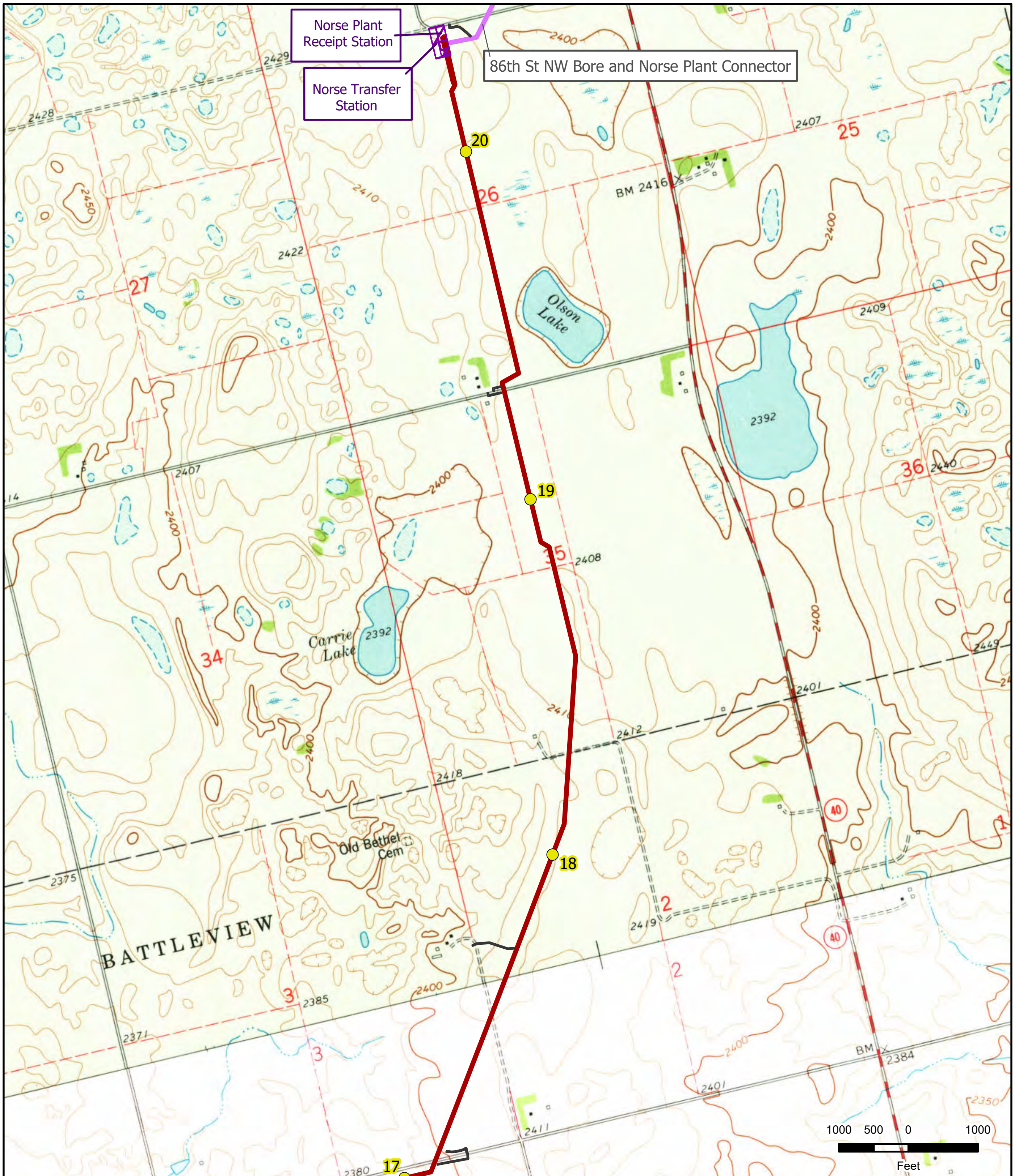


- Milepost
- Valve Site
- Proposed Line Section 25 Loop
- Access Road

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 25 of 35

WBI ENERGY TRANSMISSION



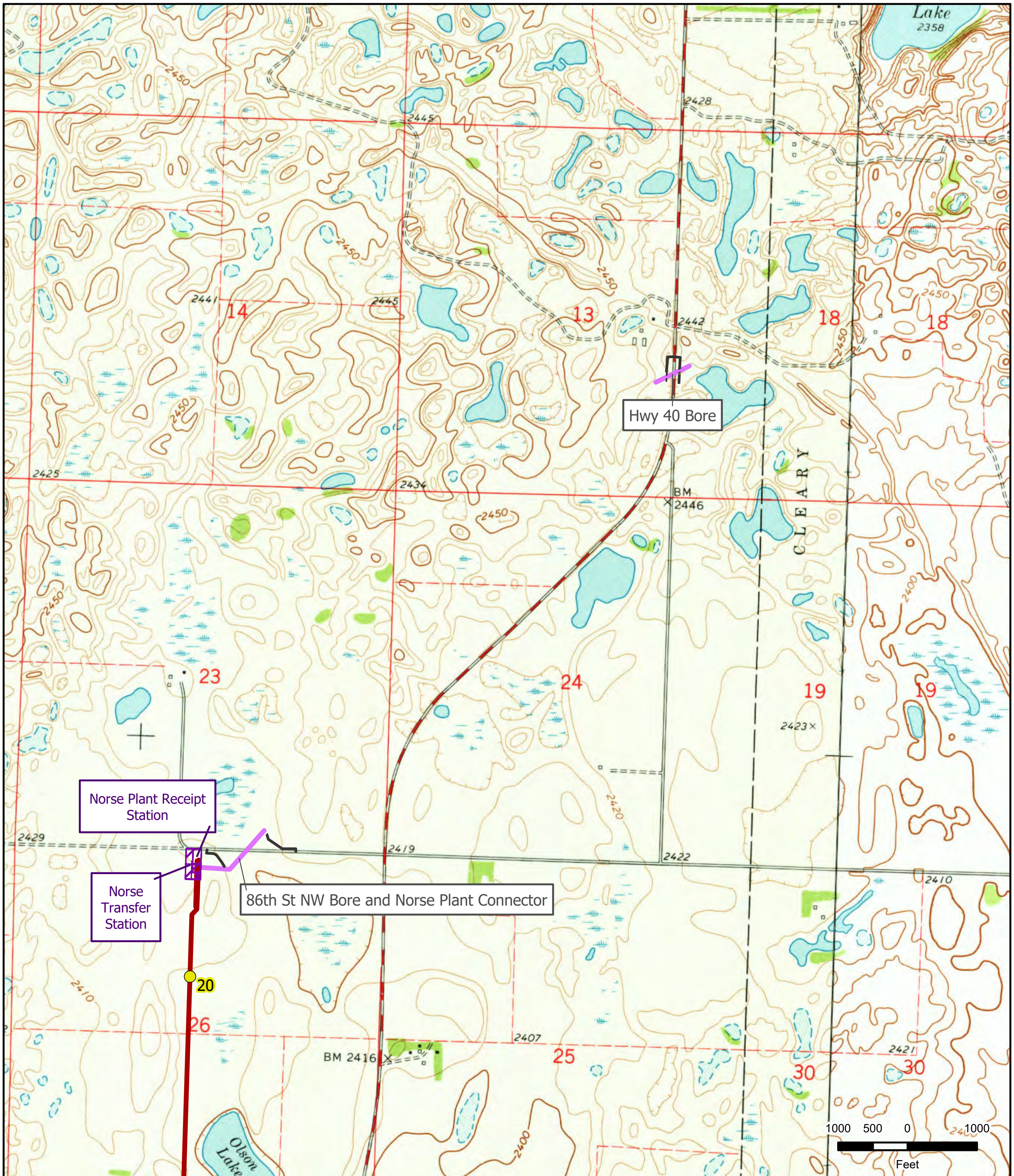
Milepost
Proposed Line Section 25 Loop
Proposed Uprating Site
Aboveground Facility
Access Road

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 26 of 35

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Milepost
Proposed Line Section 25 Loop
Proposed Uprating Site
Aboveground Facility
Access Road

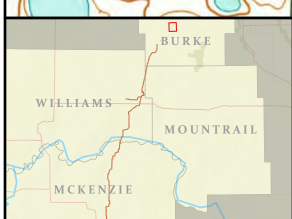
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 27 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



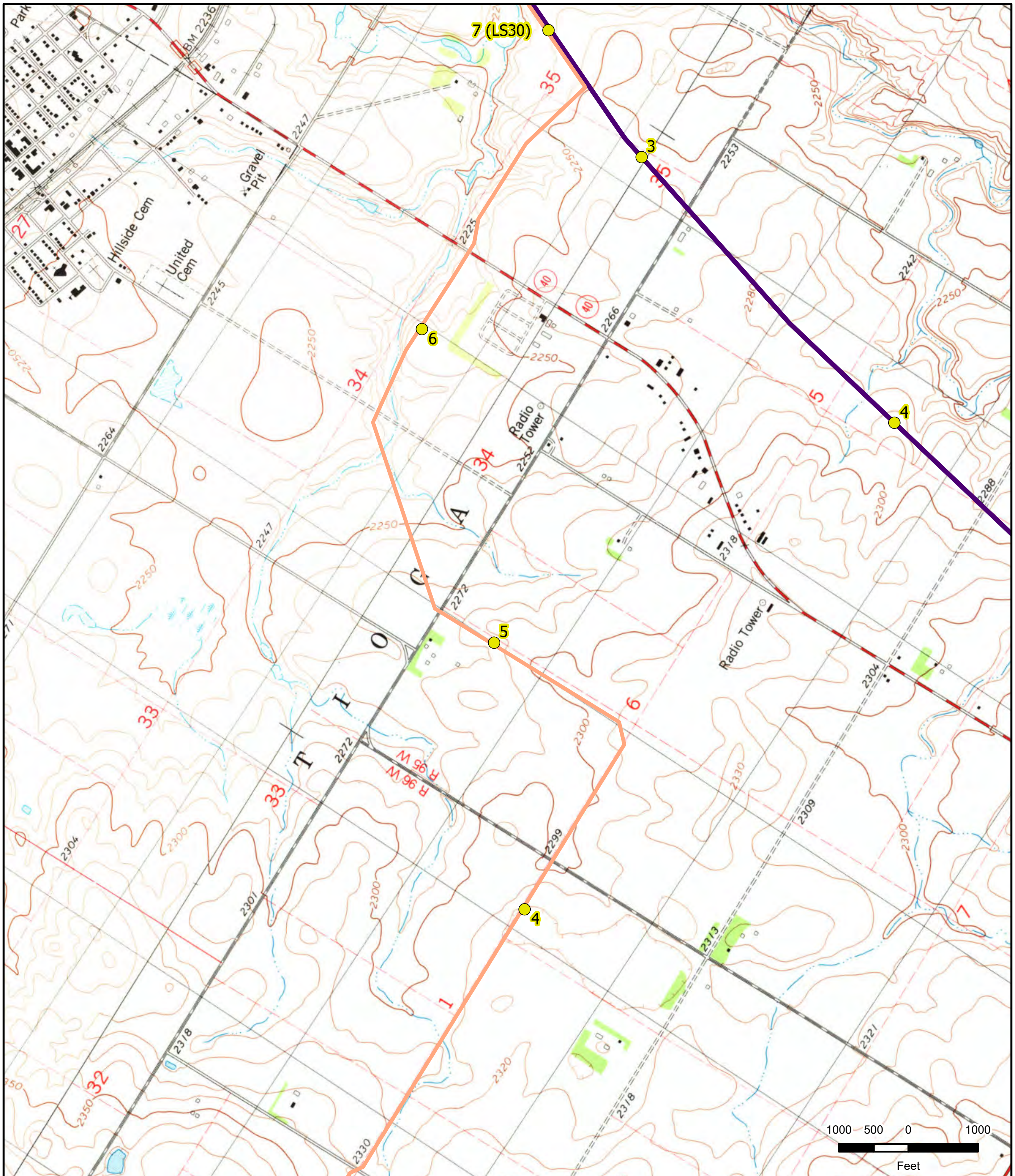
Proposed Uprating Site

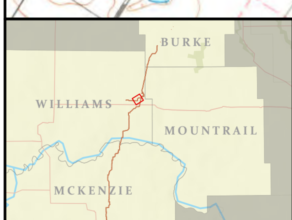
N
W E
S

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 28 of 35

WBI ENERGY TRANSMISSION



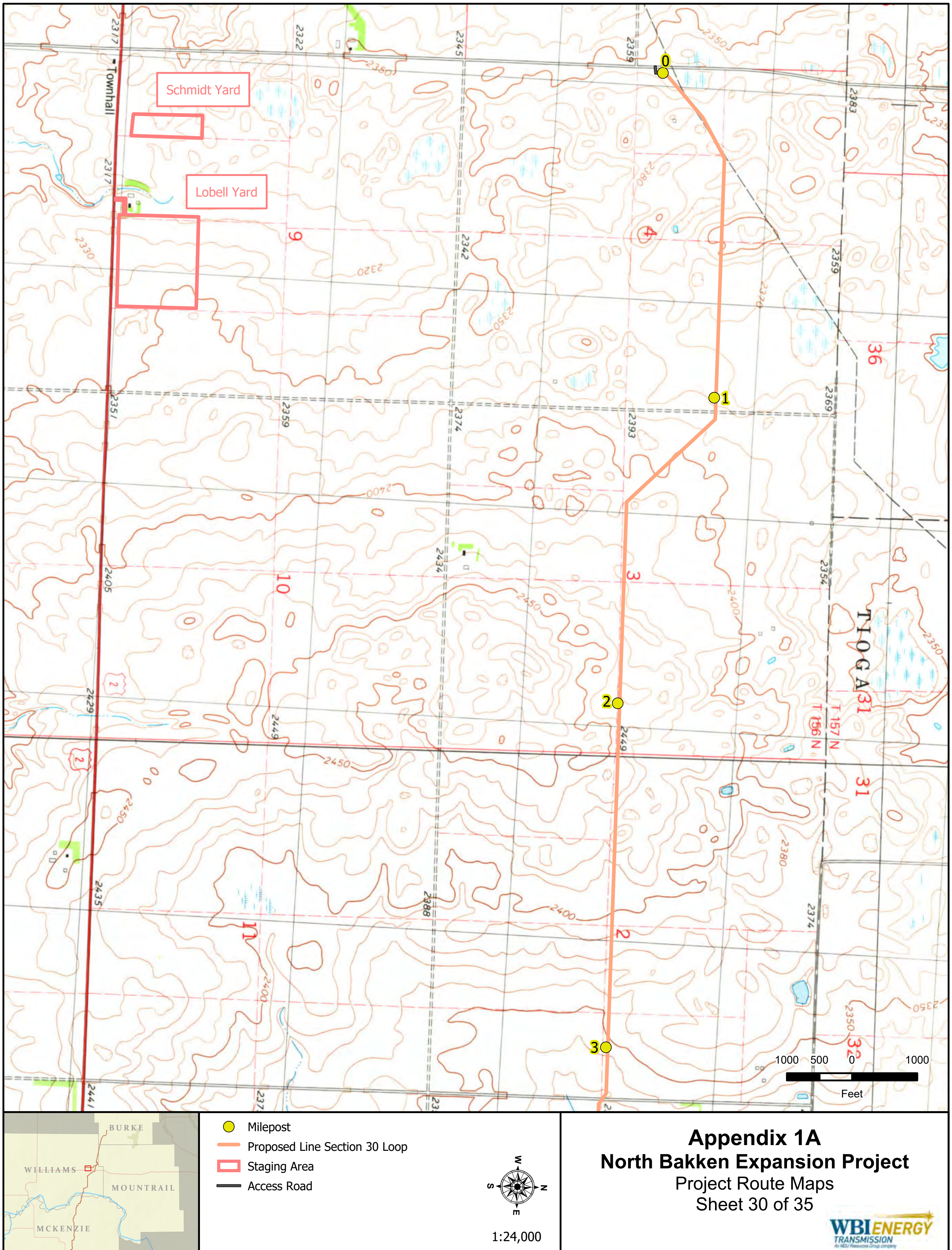


- Milepost
- Proposed Line Section 30 Loop
- Proposed Tioga-Elkhorn Creek

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 29 of 35

WBI ENERGY TRANSMISSION
An MDU Resources Group company

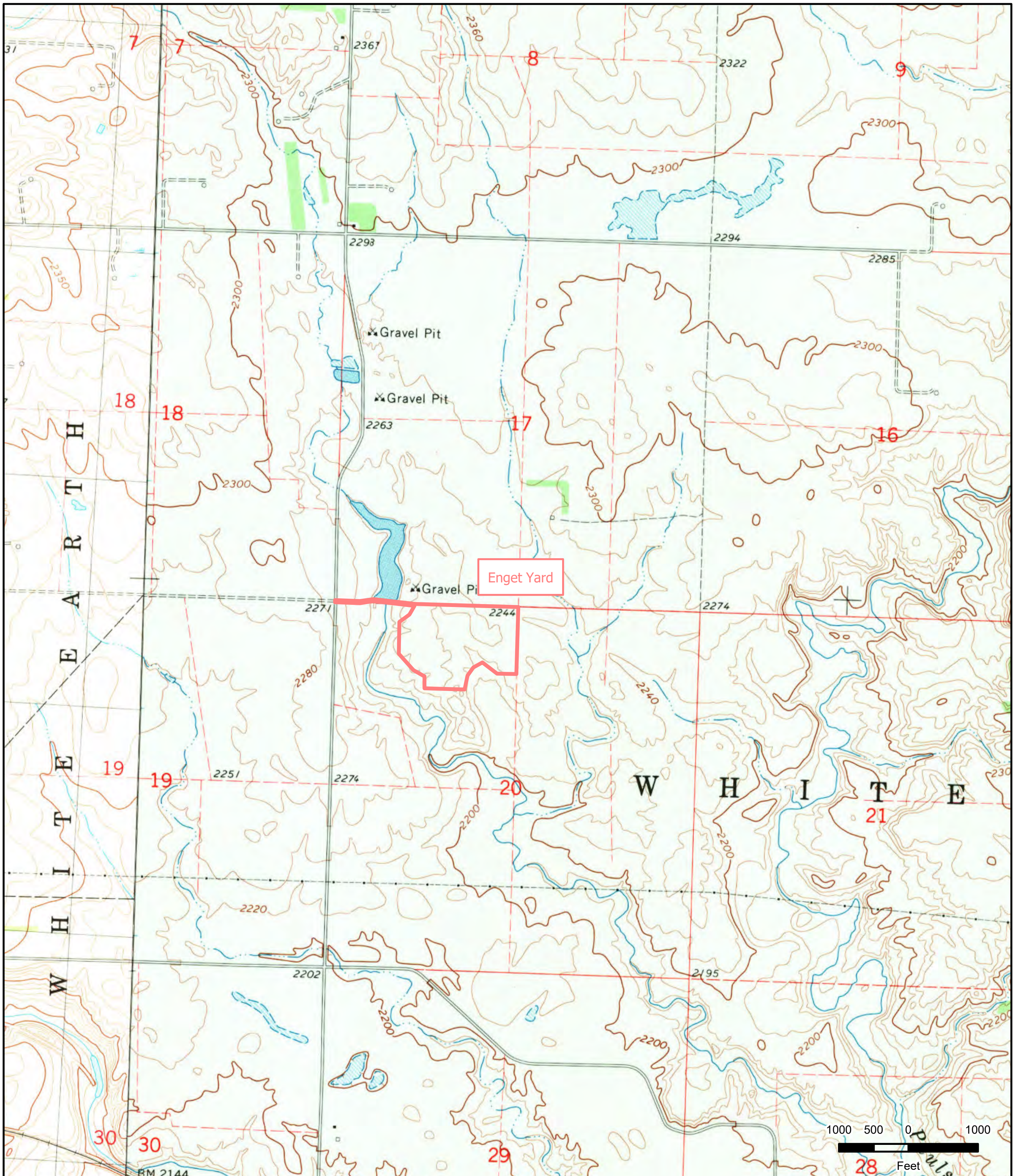


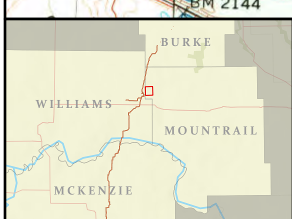
Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 30 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC





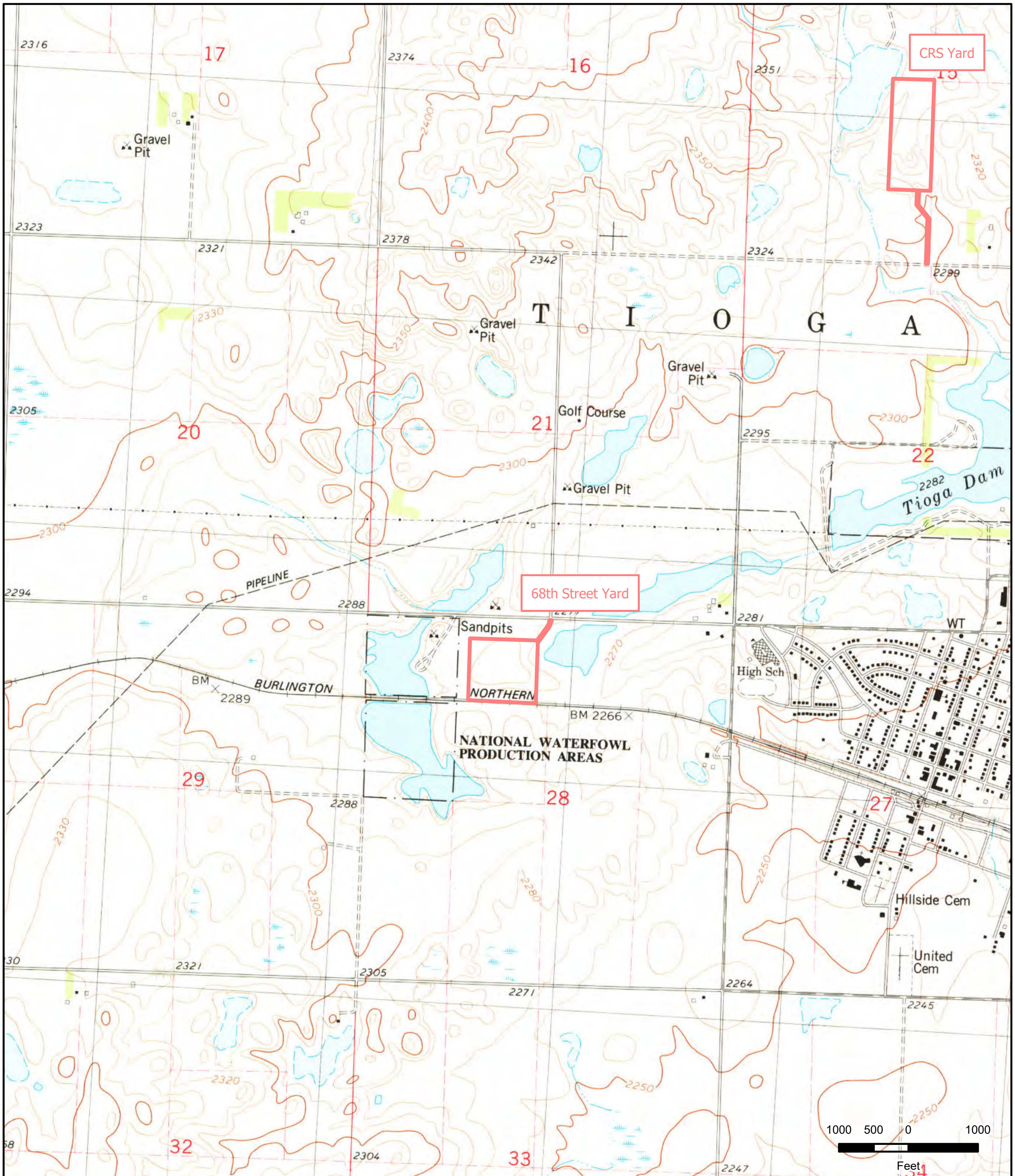
Staging Area

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 31 of 35

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



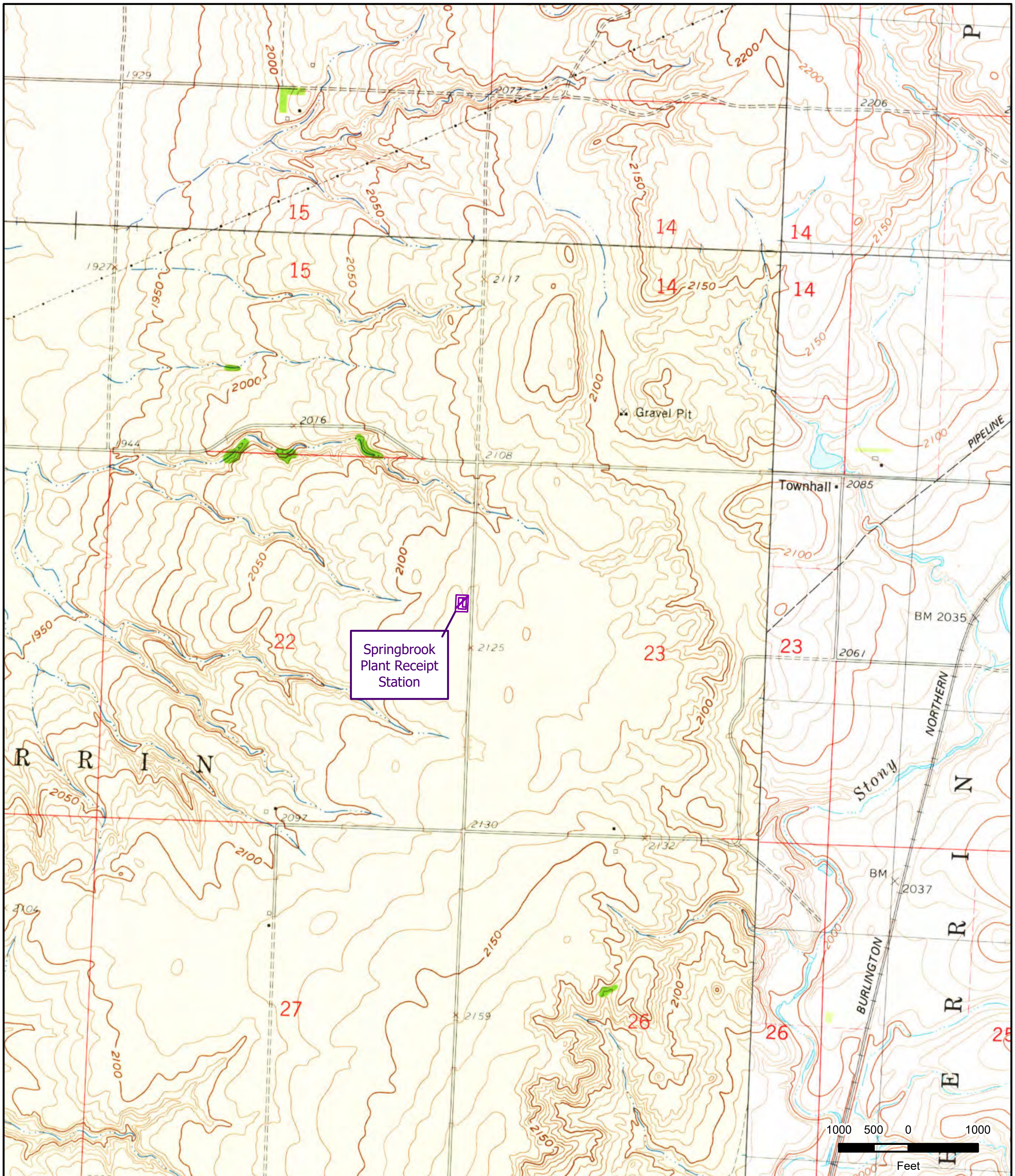
Staging Area

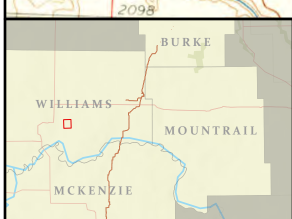
N
W E
S

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 32 of 35

WBI ENERGY TRANSMISSION





Aboveground Facility

N
W E
S

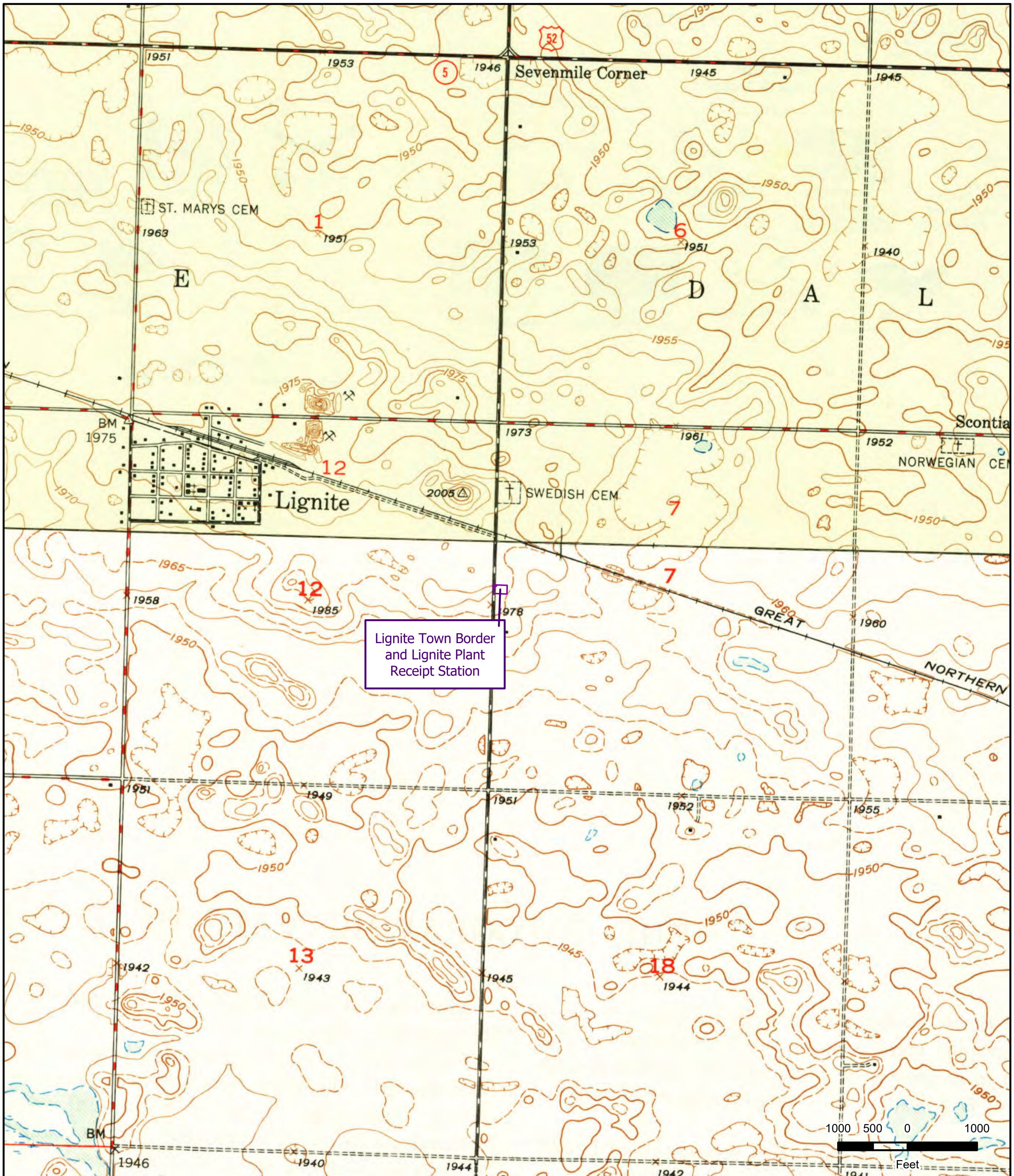
1:24,000

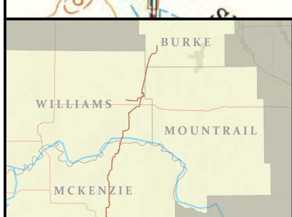
Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 33 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC





Aboveground Facility

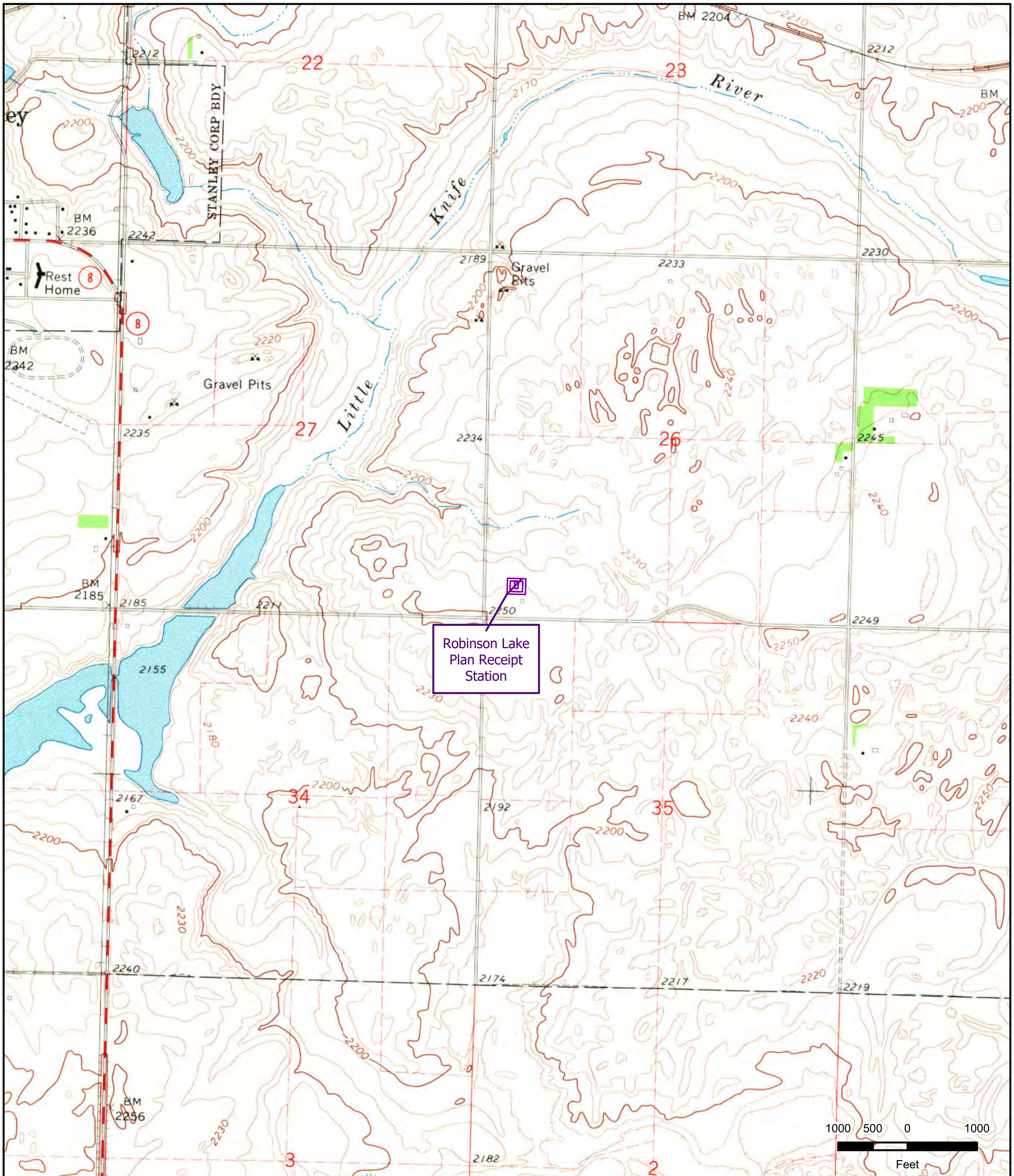
1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 34 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC



Aboveground Facility

1:24,000

Appendix 1A
North Bakken Expansion Project
Project Route Maps
Sheet 35 of 35

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\FERC_ResourceReportMaps_FERC_RR_FERC_RR.aprx | Revised: 9/1/2020

Drawn By: RJC

NORTH BAKKEN EXPANSION PROJECT

Resource Report 1

APPENDIX 1D
Summary of Collocated Facilities

APPENDIX 1D

North Bakken Expansion Project
Summary of Collocated Facilities

New Pipeline Facility/Collocated Utility Owner	Utility Type	Begin Milepost	End Milepost	Direction to Existing Utility/Road Right-of-Way	Paralleled Length [a]
Tioga-Elkhorn Creek					
WBI Energy Transmission	Natural gas pipeline	0.0	0.3	South	0.3
Road	Road	1.6	2.1	South	0.6
Hess Corporation	Natural gas pipeline	2.4	5.5	West	3.1
Enable Bakken Crude Services, Mountrail-Williams Electric Cooperative	Crude oil pipeline, electric utility, road	19.2	22.4	East/West/South	3.2
ONEOK Inc.	Natural gas pipeline	27.2	27.7	South	0.5
Road	Road	33.4	33.7	East	0.3
ONEOK Inc.	Natural gas pipeline	34.8	35.8	West	1.0
Road	Road	38.8	39.2	East/West	0.5
Kinder Morgan Inc. and Oasis Petroleum Inc.	Crude oil pipeline, natural gas pipeline	43.2	46.1	East/West	3.0
Oasis Midstream Services, LLC, ONEOK Inc., Kinder Morgan Inc., WBI Energy Transmission	Crude oil pipeline, natural gas pipeline	47.5	50.2	East/West	2.7
WBI Energy Transmission, Kinder Morgan Inc., ONEOK Inc.,	Natural gas pipeline	50.3	51.5	West	1.2
Energy Transfer LP Enbridge Inc. , Hess Corporation Global Infrastructure Partners, Kinder Morgan Inc., Marathon Petroleum Corporation, MDU Resources Group Inc., ONEOK Inc., Targa Resources Partners LP The Blackstone Group LP, WBI Energy Transmission	Crude oil pipeline, natural gas pipeline	51.6	56.1	East/West	4.5
MDU Resources Group Inc., ONEOK Inc., road, Targa Resources Partners LP The Blackstone Group LP, WBI Energy Transmission	Crude oil pipeline, natural gas pipeline, road	56.2	58.2	East/West	2.0
MDU Resources Group Inc., Targa Resources Partners LP The Blackstone Group LP, WBI Energy Transmission	Natural gas pipeline	60.3	61.1	West	0.8
Subtotal					**23.6**
Elkhorn Creek-Northern Border					
ONEOK Inc.	Natural gas liquids (unspecified)	0.0	0.2	South/West	0.2
Subtotal					**0.2**

APPENDIX 1D (cont'd)

North Bakken Expansion Project
Summary of Collocated Facilities

New Pipeline Facility/Collocated Utility Owner	Utility Type	Begin Milepost	End Milepost	Direction to Existing Utility/Road Right-of-Way	Paralleled Length
Line Section 25 Loop					
WBI Energy Transmission	Natural gas pipeline, road	0.0	0.1	West	0.1
Hess Corporation, WBI Energy Transmission	Crude oil pipeline, natural gas pipeline	0.9	5.3	East/West	4.4
Hess Corporation Global Infrastructure Partners, MDU Resources Group Inc., WBI Energy Transmission	Natural gas pipeline, crude oil pipeline	5.7	10.6	East	4.9
Hess Corporation Global Infrastructure Partners, road, WBI Energy Transmission	Natural gas pipeline, crude oil pipeline, road	11.3	13.0	West	1.7
WBI Energy Transmission	Natural gas pipeline	13.7	17.1	North/West	3.4
WBI Energy Transmission	Natural gas pipeline	20.1	20.3	East	0.2
Subtotal					**14.8**
Line Section 30 Loop					
WBI Energy Transmission	Natural gas pipeline	0.0	0.4	North	0.4
Road	Road	2.3	3.1	South	0.9
Hess Corporation	Crude oil pipeline, natural gas pipeline	4.5	7.1	West	2.6
Road	Road	7.4	8.0	South	0.6
WBI Energy Transmissions	Natural gas pipelines	9.3	9.6	North/South	0.3
Subtotal					**4.7**
Tioga Compressor Lateral					
WBI Energy Transmission	Natural gas pipeline, road	0.0	0.5	North/South	0.5
WBI Energy Transmission	Natural gas pipeline, road	0.5	0.5	West	0.1
Subtotal					**0.5**
PROJECT TOTAL					**43.8**

[a] The totals may not match the sum of addends due to rounding.

NORTH BAKKEN EXPANSION PROJECT

Resource Report 1

APPENDIX 1E

Revised Plot Plan the Northern Border Interconnect

NO.	DATE	DRWN BY	DSGN BY	CHKD BY	DESCRIPTION
–	–	–	–	–	–

PRELIMINARY
PRINT
DO NOT CONSTRUCT FROM THIS PRINT

WBI ENERGY
TRANSMISSION
An MDU Resources Group Company

LAST REVISED	XX/XX/XX
W.O. #	XXXXXXX.XXXX.XXXX
DESIGNED BY	M.ROBINSON
DRAWN BY	KM
CHECKED BY	XXX
DATE CREATED	8/10/20

WBI Energy
Norther Border Interconnect
Plot Plan

SCALE	FILE NAME	DWG. NO.	SHEET NO.
1"=25'-0"	C1812	C-10-1812	1 OF 1

NORTH BAKKEN EXPANSION PROJECT

Resource Report 1

APPENDIX 1F-1
Revised Spill Prevention, Control, and Countermeasure Plan

WBI ENERGY TRANSMISSION, INC.

North Bakken Expansion Project

Spill Prevention, Control, and Countermeasure Plan

Docket No.
CP20-52-000

September 2020

WBI ENERGY TRANSMISSION, INC.
NORTH BAKKEN EXPANSION PROJECT
SPILL PREVENTION, CONTROL, AND COUNTERMEASURE PLAN

TABLE OF CONTENTS

APPENDICES

ACRONYMS AND ABBREVIATIONS

EI	Environmental Inspector
Project	North Bakken Expansion Project
SPCC Plan	Spill Prevention, Control, and Countermeasure Plan
WBI Energy	WBI Energy Transmission, Inc.

WBI ENERGY TRANSMISSION, INC.
NORTH BAKKEN EXPANSION PROJECT

1.0 INTRODUCTION

This Spill Prevention, Control, and Countermeasure Plan (SPCC Plan) was prepared for WBI Energy Transmission, Inc.'s (WBI Energy) proposed North Bakken Expansion Project (Project) to be implemented during construction of the Project. This SPCC Plan outlines specific preventive measures and practices to reduce the likelihood of an accidental release of a hazardous or regulated liquid and, in the event such a release occurs, to expedite the response to and remediation of the release.

This SPCC Plan restricts the location of fuel storage, fueling activities, and construction equipment maintenance along the construction right-of-way and provides procedures for these activities. Training and lines of communication to facilitate the prevention, response, containment, and cleanup of spills during construction activities are also described.

All contractor personnel working on the Project are responsible for implementation of the measures and procedures defined in this SPCC Plan. Contractors are expected to meet or exceed WBI Energy's standards for spill response, reporting, and cleanup. Contractors whose activities could result in a spill of fuel or other regulated or hazardous materials on the right-of-way will adopt the measures identified in this SPCC Plan. All measures outlined in this SPCC Plan are consistent with the applicable requirements of the Federal Energy Regulatory Commission's *Wetland and Waterbody Construction and Mitigation Procedures*.

1.1 TRAINING

Experienced, well-trained staff are essential for the successful implementation of the SPCC Plan. Contractors will provide spill prevention training as well as safety training to their work crews. The training program will be designed to improve awareness of safety requirements, pollution control laws, and proper operation and maintenance of equipment. Contractors will train all employees who handle fuels and other regulated substances to prevent spills and to quickly and effectively contain and clean up spills in accordance with applicable regulations and the provisions of this plan.

1.2 ROLES AND RESPONSIBILITIES

1.2.1 Spill Coordinator

Contractors will appoint a Spill Coordinator who will be responsible for coordinating Contractor Work Crews for spill cleanup, conducting site investigations, and assisting with completing spill reports. The Spill Coordinator will report all spills to an Environmental Inspector (EI). The Spill Coordinator will be responsible for completing WBI Energy's internal Spill Report Form as soon as possible but no later than the end of the work day that the spill occurred, regardless of the size of the spill. The Spill Report Form will be submitted to the WBI Energy Designated Representative.

Spill Coordinator:	[To Be Determined Prior to Construction]
Phone Number:	[To Be Determined Prior to Construction]

1.2.2 Contractor Work Crews

Contractor Work Crews will comply with this SPCC Plan and will notify the Spill Coordinator immediately of any spill of fuel or other regulated or hazardous material, regardless of the volume of the spill. Contractor Work Crews will assist with the cleanup of the spill as directed by the Spill Coordinator, if trained to do so.

1.2.3 Environmental Inspectors

The EIs will monitor the Contractors' compliance with the provisions of the SPCC Plan to ensure that spill resources are allocated and cleanup accomplished in accordance with this plan and any applicable regulatory requirements. The EIs will work in conjunction with WBI Energy's Designated Representative to promptly report spills to appropriate federal, state, and local agencies, as required, and to coordinate with these agencies regarding contacting additional parties or agencies.

Environmental Inspector:	[To Be Determined Prior to Construction]
Phone Number:	[To Be Determined Prior to Construction]

1.2.4 WBI Energy's Designated Representative

The Designated Representative has the authority to commit resources to implement this SPCC Plan. The Designated Representative will work in conjunction with the EIs to promptly report spills to appropriate federal, state, and local agencies.

ALL SPILLS, REGARDLESS OF SIZE, MUST BE REPORTED TO THE SPILL COORDINATOR AND ENVIRONMENTAL INSPECTORS

2.0 PREVENTATIVE MEASURES

Contractors will minimize the potential for a spill during construction activities at WBI Energy's facilities and on its right-of-way by implementing appropriate measures to prevent and contain spills. Equipment and materials will be located on site to meet the provisions of this SPCC Plan. The Contractor shall supply each construction crew with a quantity of absorbent and barrier materials sufficient to contain and recover spills that could potentially occur from the equipment with the largest on-board volume of fuel and lubricant. These materials may include, but are not limited to, drip pans, buckets, absorbent pads, containment booms, straw bales, absorbent clay, saw dust, floor drying agents, spill containment barriers, plastic sheeting, skimmer pumps, covered holding tanks, and fire extinguishers.

The Contractor shall make known to all construction personnel the locations of staging areas where spill response equipment and materials are stored, and have them readily accessible during construction. Contractors will comply with applicable environmental and safety laws and regulations and will ensure that a copy of this plan is available on site to all Construction Work Crew members.

In addition, periodic discussions between construction personnel and their supervisors must be held. These are conversations where problems in field operations are discussed and solved. This SPCC Plan, together with specific techniques, will be reviewed with the appropriate employees at a safety meeting before construction starts.

The contractor will provide, maintain, and make available the appropriate Safety Data Sheets for vehicle and equipment fuel, lubricating oil, and any other regulated or hazardous materials utilized for the Project.

The following sections describe spill prevention measures to be taken on Project locations.

2.1 PETROLEUM AND HAZARDOUS LIQUID STORAGE, REFUELING, AND EQUIPMENT MAINTENANCE

2.1.1 Staging Areas and Facility Sites:

- Contractors will construct temporary liners and seamless impermeable berms, or other appropriate containment, around aboveground storage containers so that liquids will be contained and collected in specified areas isolated from waterbodies in the event of a leak or spill. Storage containers will not be placed in areas subject to periodic flooding and washout.

- Contractors will visually inspect aboveground storage containers for leaks and spills frequently and whenever containers are refilled.

- Secondary containment structures must provide a containment volume equal to a minimum of 110 percent of the maximum storage volume of the largest storage container in the containment structure.

- Secondary containment structures must be constructed so that no outlet is provided and any spill will be contained within the containment structure. Accumulated rainwater may be removed if authorized by an EI. Accumulated water with a visible sheen will be collected for proper storage, transport and disposal.

- Contractors will remove all secondary containment structures at the conclusion of the Project. Contractors also will be responsible for returning any storage impoundment areas to original contours and appearance upon completion of the Project.

- Fuels and lubricants will be stored only at designated staging areas and in appropriate service vehicles. The storage areas will be located at least 100 feet away from edges of wetlands and waterbodies, at least 100 feet away from designated municipal watershed areas, at least 200 feet away from private water supply wells, and at least 400 feet away from municipal water-supply wells unless a larger buffer is required by regulatory agencies.

- Storage containers will display labels that identify the contents of the container and whether the contents are hazardous. Contractors will maintain and provide to WBI Energy, when requested, copies of all Safety Data Sheets.

- Contractors will conduct routine equipment maintenance such as oil changes in staging areas, or as necessary in additional temporary workspace, and will dispose of waste oil in an appropriate manner (e.g. the Contractors will collect the waste oil in labeled, sealed containers and transport the waste oil to a recycling facility).

- Contractors will correct visible leaks in storage containers as soon as possible. Leaks outside of secondary containment, regardless of volume, will be reported to an EI.

- All fuel nozzles will be equipped with functional automatic shut-off valves.

- The drivers of tank trucks will be responsible for spill prevention and secondary containment during loading and unloading operations. Procedures for loading and unloading tank trucks will meet the minimum requirements established by applicable regulations. Drivers will observe and control the fueling operations at all times to prevent overfilling. Contractors will be responsible for training drivers of tank trucks to comply with these provisions.

- Prior to departure of any tank truck, all outlets of the vehicle will be closely examined by the driver for leakage and tightened, adjusted, or replaced, as necessary, to prevent liquid leakage while in transit. Contractors will be responsible for training drivers of tank trucks to comply with these provisions.

2.1.2 Project Right-of-Way

- All machinery will arrive on the right-of-way in a clean, washed condition, and free of fluid leaks.

- Contractors will wash, refuel, and service machinery at locations well away from any wetlands and waterbodies to prevent petroleum or chemical substances from entering surface waters.

- Overnight parking of equipment, as well as refueling and lubricating of construction equipment, will be restricted to upland areas at least 100 feet away from stream channels and wetlands, at least 200 feet from private water-supply wells, and at least 400 feet from municipal water-supply wells. Where this is not possible, and where an EI finds in advance no reasonable alternative, the equipment will be fueled by designated personnel with specific training in refueling, spill containment, and cleanup, under the supervision of an EI. Prior to refueling, appropriate steps will be taken (including deployment of secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill.

- Fuel trucks transporting fuels to construction areas will only travel on approved access roads.

- Contractors will keep a spill kit on site in case of machinery leaks or spills.

2.1.3 Restricted Refueling Areas

Restricted refueling areas include areas where the appropriate buffer (e.g., 100 feet from a wetland or waterbody) cannot be maintained. All restricted refueling areas will be identified in the field with flagging or signs. A site-specific plan and written approval from an EI will be required to refuel in restricted areas.

- Approval must be received from an EI and, where necessary, appropriate regulatory permits must be obtained, prior to refueling in restricted refueling areas.
- In large wetlands where no upland site is available for refueling, auxiliary fuel tanks may be mounted to equipment to minimize the need for refueling.
- Trained personnel must be available for refueling, and an EI must be present unless a case-specific exemption is obtained in writing from WBI Energy's Designated Representative.
- Equipment such as large, stationary pumps will be fitted with auxiliary tanks as appropriate. The auxiliary tanks will be placed within secondary containment which provides for a containment volume equal to a minimum of 110 percent of the volume of the largest tank in the containment structure.
- Refueling within restricted refueling areas will take place only in areas designated by an EI. Fuel trucks with a capacity in excess of 300 gallons will not be allowed within a restricted refueling area unless adequate secondary containment is provided.
- Refueling of dewatering pumps, generators, and other small, portable equipment will be performed using approved containers with a maximum volume of 5 gallons.
- Fuel trucks will be prohibited from traveling on temporary equipment bridges at stream crossings. An EI may waive this restriction on a site-specific basis if a reasonable refueling option is not available. Such case-specific exemptions must be approved in writing by WBI Energy's Designated Representative.

2.2 SPILL RESPONSE EQUIPMENT

2.2.1 Staging Areas and Facility Sites

- Contractors will stock a sufficient supply of sorbent and barrier materials at construction staging areas to allow the rapid containment and recovery of spilled material. Sorbent and barrier materials will also be used to contain runoff from spill areas.
- Shovels and labeled drums will be kept at each of the individual staging areas. If small quantities of soil become contaminated within the staging area, they will be collected and placed in the drums. Large quantities of contaminated soil will be

collected using heavy equipment and will be stored in drums, lined bermed areas, or other suitable containment, prior to disposal. The Contractors will dispose of all contaminated soil in accordance with applicable state and federal regulations.

2.2.2 Project Right-of-Way

- Each construction crew must have adequate absorbent materials and containment booms on hand to enable the rapid and complete cleanup of spills, as well as sufficient tools and materials to stop leaks.
- Contractors must maintain spill kits containing a sufficient quantity of absorbent and barrier materials to adequately contain and recover foreseeable spills. These kits may include, but are not limited to, absorbent pads, straw bales, absorbent clay, saw dust, floor drying agents, spill containment barriers, plastic sheeting, skimmer pumps, and drums. The equipment will be located near fuel storage areas and other locations as necessary to be readily available in the event of a spill.
- All fuel, and where possible, service trucks, will carry adequate spill response materials. Spill response materials present on trucks should consist of absorbent pads, absorbent material, plastic bags, and a shovel.
- The Spill Coordinator will inform an EI, and all Contractor personnel of the location of spill control equipment and materials, and have them readily accessible while construction activities are occurring.

2.3 CONCRETE COATING

Concrete coating activities will not be performed within 100 feet of a wetland or waterbody unless the location is an existing industrial site designated for such use.

3.0 STORAGE, CONTAINMENT AND FACILITY TRANSFER

All chemical storage containers, tanks, or barrels will be made of compatible materials with the appropriate temperature and pressure rating, overpressure protection, valving, and equalization lines necessary to comply with the appropriate state and federal regulations regarding storage of regulated substances. All chemicals, regardless of container size, will be stored in secondary containment or designated storage areas when not actively in use.

Fuel valves used for the final control of flow shall be of the self-closing type and shall be manually held open except were automatic means are provided for shutting off the flow when the vehicle is full.

Contaminated liquids inside containment areas will not be allowed to be drained outside the containment structures onto the ground or into any open water course. These liquids will be pumped or wiped out of containment structures and disposed of appropriately.

4.0 SPILL RESPONSE

Any employee who detects a spill incident while it is occurring should take the necessary measures to stop the flow but only if that employee has been trained to do so. If the employee is unprepared to effectively control the spill, caution and good judgment should be used as to personal safety until a cleanup crew arrives. Immediate containment by the discovering person can reduce the extent of the spill damage.

4.1 FIRST PRIORITIES

The first priorities after discovering a spill are to protect the safety of personnel and the public, minimize damage to the environment, and control costs associated with cleanup and reclamation. Actions to be taken immediately following a spill include the following:

1. Assess the safety of the situation (including the surrounding public).
2. Sources of ignition will be removed from the area, **if safe to do so**.
3. The source of the spill will be shut off, **if safe to do so**.
4. Efforts to contain the spill immediately will be initiated, **if safe to do so**.

Cleanup activities will be initiated as soon as possible after the spill is contained using properly trained and protected personnel with adequate spill cleanup materials and equipment.

5.0 SPILL REPORTING

All spills will be reported immediately to the Spill Coordinator who will in turn work with an EI and WBI Energy's Designated Representative to address and report the spill as necessary. The Spill Coordinator will record at a minimum the following information (found on the Spill Report Form in appendix A):

1. Date, time, and location of the spill.
2. Type of material spilled.
3. Amount of material spilled.
4. Extent of spill area.
5. Whether the material has reached or has the potential to reach a waterbody.
6. Status of spill containment and cleanup.
7. Circumstances leading up to the spill.

WBI Energy's Designated Representative will report the spill to the appropriate regulatory agencies if the spill meets or exceeds a reportable threshold. Appropriate agencies include, but may not be limited to, the following:

1. North Dakota Department of Health at 1-701-328-5210 for non-emergencies or North Dakota Department of Emergency Services at 1-800-472-2121 (24 hour hotline) for emergencies. The North Dakota Department of Health also requires completion of an online "General Environmental Incident" form available at http://www.ndhealth.gov/ehs/eir/eirform.htm for any spill of any volume.

2. National Spill Response Center (Washington D.C.) at 1-800-424-8802 (24 hours).

3. U.S. Army Corp of Engineers – Jeremy Thury (701-654-7761) and Reece Nelson (402-995-2505) for any spills occurring on U.S. Army Corp of Engineers owned land.

4. U.S. Forest Service Little Missouri National Grasslands– McKenzie Ranger District (701-842-8500) Cale Bickerdyke or Kim Grotte for any spills occurring on U.S Forest Service owned land.

Contractors are responsible for assisting WBI Energy with preparing follow-up written incident reports to regulatory agencies upon request and with accommodating any inspections performed by regulatory agencies.

WBI Energy's internal Spill Report Form will be completed by the Spill Coordinator and provided to WBI Energy's Designated Representative as soon as possible but no later than the end of the day on the day the spill event occurred so agencies can be notified in a timely manner and pertinent information is available for reporting. State and federal agencies must be notified within 24 hours of a reportable spill event. Field personnel will report the spill to the state and federal agencies only if the WBI Energy's Designated Representative is unavailable to do so. All Spill Report Forms and other reporting documentation will be kept on file by WBI Energy's Designated Representative.

6.0 SPILL CONTROL AND CLEANUP

Spill control should only be done by employees trained and prepared to effectively control the spill. Good judgment should be made by employees as to their personal role in the containment actions; however, prompt action can often prevent extensive spill damage. Employees engaged in spill control will use the proper precautions and safety equipment as specified in the Safety Data Sheet(s). The Designated Representative and EI will devise a cleanup plan, as necessary, based on location, quantity, and type of substance spilled.

Upon learning of the spill, the Spill Coordinator will implement the measures in the following sections.

6.1 LAND SPILL

- As necessary, berms will be constructed with available equipment to physically contain the spill and sorbent materials will be applied to the spill area. Traffic on contaminated soils will be minimized.
- Contaminated soils and vegetation will be removed and disposed of at a licensed waste disposal facility.
- Waste materials from the spill will be disposed of according to state and federal regulatory requirements.
- The following information will be provided to the EI and the WBI Energy Designated Representative:
    - The amount of spilled material that was recovered during cleanup.

- Proposed reclamation of remaining contaminated areas.
- Storage method for the contaminated waste material before transport and disposal.
- Transport and disposal documentation for the contaminated waste material.

6.2 WETLAND AND WATERBODY SPILL

Regardless of size, the following conditions apply if a spill occurs near or into a stream, wetland, or an open surface water source.

- For spills in standing water, floating booms, skimmer pumps, and holding tanks shall be used as appropriate by the contractor to recover and contain released materials on the surface of the water.
- For a spill threatening a waterbody, berms and/or trenches will be constructed to contain the spill before it reaches the waterbody. Deployment of booms, sorbent materials, and skimmers may be necessary if the spill reaches the water. The spilled product will be collected and the affected area cleaned up in accordance with appropriate state or federal regulations.
- Contaminated soils in wetlands must be excavated from the wetland. The soils must be placed on and covered by plastic sheeting in approved containment areas a minimum of 100 feet away from wetlands or waterbodies. Contaminated soil will be disposed of as soon as possible in accordance with appropriate state or federal regulations.

All cleanup activities will be conducted according to this SPCC Plan. Personnel involved in cleanup activities will meet the minimum requirements for hazardous materials training and will use approved Occupational Safety and Health Administration safety equipment.

WBI Energy's contractor responsible for the HDD has also developed an activity-specific SPCC plan for the HDD of Lake Sakakawea. In event of a spill or inadvertent release of drilling fluid during the HDD crossing of Lake Sakakawea, the SPCC plan included as Appendix B will be implemented.

NORTH BAKKEN EXPANSION PROJECT
Spill Prevention, Control, and Countermeasure Plan

APPENDIX A
Spill Report Form

WBI Energy Transmission, Inc.
Spill Report Form

Date of Spill:	Date of Spill Discovery:	
Time of Spill:	Time of Spill Discovery:	
Name and Title of Discoverer:		
Type of material spilled and manufacturer's name:		
Legal description of spill location to the quarter section:		
Directions to nearest community:		
Estimated volume of spill (gallons):		
Weather conditions:		
Topography and surface conditions of spill site:		
Spill medium (pavement, sandy soil, water, etc.)		
Proximity of spill to surface waters:		
Did the spill reach a waterbody?	Yes	No
If so, was a sheen present?	Yes	No
Describe the causes and circumstances of the spill:		

Describe the extent of observed contamination, both horizontal and vertical (i.e., spill-stained soil in a 5-foot radius to a depth of 1 inch):

Describe immediate spill control and/or cleanup methods used and implementation schedule:

Current status of cleanup actions:

Name and Company of:

Construction Superintendent:

Spill Coordinator:

Environmental Inspector:

Person who reported spill:

Form completed by: Date:

NORTH BAKKEN EXPANSION PROJECT
Spill Prevention, Control, and Countermeasure Plan

APPENDIX B
Michels SPCC Plan

SPILL PREVENTION/CONTROL/ COUNTERMEASURE PLAN (SPCC)

For HDD - Crossings

A DIVISION OF MICHELS CORPORATION

MICHELS®

DIRECTIONAL DRILLED CROSSINGS

Revision 1

August 4, 2020

MICHELS DIRECTIONAL CROSSINGS
A DIVISION OF MICHELS CORPORATION

SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN (SPCC)

HORIZONTAL DIRECTIONAL DRILLING

Table of Contents

TABLE OF CONTENTS

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

I. Introduction

This Spill Prevention Control and Countermeasure Plans (SPCC) have been developed by Michels Corporation (Michels) to serve as a guideline for horizontal directional drilling (HDD) operations. This plan is intended to ensure that the equipment utilized to perform the work and the fuel, oil, and lubricant products used in the day to day operation of the equipment will have no long-term adverse environmental impact on the staging areas required for construction. The guidelines contained in this plan will be implemented by field personnel to prevent accidental releases of hazardous material to the environment and to outline measures taken should an accidental release occur. The drilling project manager for the project is experienced in these matters and is typically the designated Spill Coordinator for Michels.

This SPCC plan was developed using Federal Energy Regulatory Commission (FERC) guidelines for construction activities along a pipeline right-of-way. This plan is intended to comply with all applicable requirements of FERC and local State and County authorities. Since HDD operations are generally confined to two distinct locations, the rig (entry) side and pipe (exit) side, this SPCC plan addresses construction operations at these specific locations only for hazardous materials. This SPCC plan consists of three sections:

- Preventative measures to be taken prior to initiating construction with hazardous materials;
- Preventative procedures to be followed while using hazardous materials during construction;
- Procedures to be implemented should an accidental spill of hazardous material occur;

II. Pre-Construction Hazardous Material Spill Prevention

Prior to construction, all Michels' personnel who will be performing work on site will have attended a FERC-approved environmental training program within the last year. This training program will serve to indoctrinate the personnel and make them aware of the pollution control laws, rules, and regulations applicable to the pipeline right-of-ways. Michels' personnel are highly experienced with the equipment to be used in HDD operations and have worked on numerous FERC governed projects in the past. However all personnel will be refreshed by the project manager and drill superintendent in the operation and maintenance of construction equipment to prevent the accidental discharge or spill of fuel, oil, or lubricants.

Through the environmental training program and the project manager's guidance along with knowledge obtained from past experience, all Michels' personnel will be thoroughly educated on the following topics:

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

- Precautionary measures to prevent spills;
- Potential sources of spills, such as equipment failure or malfunction and re-fueling procedures;
- Standard operating procedures in case of a spill, including applicable notification requirements;
- Equipment, Materials, and Supplies available for clean-up of a spill;
- Review of known spill events, if any.

Prior to mobilizing equipment to the proposed alignment R.O.W., Michels will thoroughly inspect and if necessary repair or replace equipment components that could potentially leak hazardous material. The equipment will be cleaned of any debris or material observed to be hazardous. All hazardous material storage containers and secondary containment devices will be inspected and if necessary repaired or replaced.

The spill containment and clean-up materials used by Michels will be inventoried and if necessary re-stocked prior to initiating construction operations. At a minimum, the following spill containment and clean-up materials will be located in a central location at each side of the HDD crossings where equipment is in use or hazardous materials are stored in sufficient quantities to contain and clean-up a spill or release should one occur:

- Spill containment kits typically consisting of the following items
    - 1 x 55 gal poly drum
    - 50 x 18" x 18" absorbent pads
    - 8 x 3" x 4' absorbent socks
    - 6 x 18" x 18" absorbent pillows
    - 3 x 5" x 10' absorbent booms
    - 4 Disposable plastic bags with ties
    - 4 pair nitrile gloves
- Plastic sheeting
- Floor Dry absorbent material (50 pound bag-typical)
- Personal protective equipment (i.e. gloves and safety glasses)
- Replacement parts and equipment for repair of tanks, hoses, nozzles, etc.
- Equipment and tools to divert spilled fluids and create earthen barriers

III. <u>HDD Construction Operations Hazardous Material Spill Prevention</u>

Once construction activities for the HDD are underway, hazardous material spill prevention will be a continuous element of the operations. During equipment set up, potential sources of hazardous material releases, i.e. fuel tanks, hydraulic oil tanks and hoses, antifreeze tanks, and lubricant storage bins will be located as far away as practicably possible from streams, wetlands, and drainage ways. If necessary, and if practicable, temporary barriers may be constructed or placed between the potential sources of spills and areas identified as extremely sensitive to accidental

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

spills. Spill containment and clean-up materials/kits will be located in a central location at each side of the drill site location where equipment is in operation or hazardous materials are stored and all personnel will be made aware of the location.

Secondary containment devices will be placed to enclose major sources of potential hazardous spill locations (i.e. fuel storage tanks and hazardous materials storage areas). A site layout drawing for entry locations and exit locations showing the placement of significant sources of hazardous material releases and secondary containment measures are attached in **Appendix A** of this plan. The exact location of the equipment will vary to address specific site conditions after the temporary work space has been prepared for equipment set-up. Access to the sites will be limited by the Project Manager to only authorized personnel and visitors.

During construction, spill refresher briefings will be scheduled quarterly and conducted by Michels. The briefings will refresh Michels' personnel on the topics covered during the pre-construction environmental training as well as review operations to date, including any accidental spills that may have occurred and measures taken for prevention of future spills.

Michels will store, handle and transfer hazardous materials used during HDD operations in a manner to prevent accidental releases or spills of these materials. **Table-1** attached in **Appendix-A** to this plan summarizes the hazardous materials, combined expected volumes, and storage methods for both the entry and exit locations. The Material Safety Data Sheets (MSDS) for every product used by Michels are maintained on file in the drilling survey trailer on site should they be required to assess the hazard potential of a spill. The list of primary hazardous materials (petroleum-based products) to be used by Michels over the course of each HDD crossing is as follows:

- Gasoline
- Diesel Fuel
- Hydraulic Oil
- Lubricants
- Penetrating Oils
- Antifreeze

Michels' personnel will follow specific guidelines set forth in this plan during operation and maintenance of equipment and vehicles used in support of the HDD operations. All waste oil or fuel collected during routine maintenance of the equipment will be contained and disposed of in accordance with state and federal requirements.

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

IV. Potential Sources of Hazardous Spill-Preventative Measures to be Implemented

For day to day operations, Michels' personnel will follow these guidelines to prevent the accidental release or spill of hazardous materials:

Potential Source of Hazardous Spill	**Preventative Measures To be Implemented**
Fuel stored in a storage tank	• Except as specified in **Attachment-A** of Appendix-B, locate storage tank at least 100 feet from wetlands or surface waters, at least 200 feet from private water supplies, and at least 400 feet from public water supplies. • Install secondary containment devices around tank in excess of 150% of the maximum volume to be stored. • Inspect tank and secondary containment daily and before filling, implement corrective action upon discovery of deterioration that could cause a spill or result in a leak. Record inspection results weekly on log attached in the appendix to this plan. • Remove any precipitation found within the secondary containment. Prior to removing the precipitation, inspect for film, sheen, discoloration, sludge, emulsion or tarry residue, if present then collect the liquid for disposal. Do not discharge to land or surface waters. • Plug or close all tank openings when not in use. • Maintain sufficient quantities of spill control and clean-up materials in a central location near the storage tank, inspect supply daily. • Provide security measures to protect against vandalism of stored materials
Liquid material stored in a container	• Except as specified in **Attachment-A** of Appendix-B, store container at least 100 feet from wetlands or surface waters, at least 200 feet from private water supplies, and at least 400 feet from public water supplies. • If practicable and if room allows, store containers in a central location within a common secondary containment device. All significant container storage (i.e. greater than 5 gallon) will have secondary containment in excess of 150% of the maximum volume proposed to be stored. • Use small containers which are in good condition (maximum 55 gallon drum). • Take measures to protect the containers from the elements or physical damage. • Inspect containers daily, replace immediately if damaged or leaking. Record inspection results weekly on log attached in **Attachment-B** of Appendix-B to this plan • Close containers when not in use. • Maintain sufficient quantities of spill control and clean-up materials in a central location where the containers are regularly used, inspect supply daily. • Provide security measures to protect against vandalism of stored materials

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Liquid material transferred from a storage tank or container to vehicles or equipment	• Except as specified in **Attachment-A** of Appendix-B**,** transfer materials at least 100 feet from wetlands or surface waters, at least 200 feet from private water supplies, and at least 400 feet from public water supplies. Exercise extreme caution for transfers in areas where set-back distances from sensitive areas cannot be met such as placement of absorbent pads or drip pans beneath transfer points, creating temporary earthen berms, or other similar precautionary spill measures. • Transfer during daylight hours or where lighting is adequate to illuminate the area. • Monitor transfer operations at all times. • Maintain sufficient quantities of spill control and clean-up materials in a central location where transfers regularly occur, inspect supply daily. • Provide security measures to protect against vandalism of stored materials

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Liquid material used in vehicles and equipment	• Except as specified in **Attachment-A** of Appendix-B, park at least 100 feet from wetlands or surface waters, at least 200 feet from private water supplies, and at least 400 feet from public water supplies. • Inspect daily for leaks or signs of deterioration that could result in a leak. • Repair or replace defective tanks, hoses, fittings, etc. • Maintain sufficient quantities of spill control and clean-up materials in a central location where equipment or vehicles are in use, inspect supply daily. • Provide security measures to protect against vandalism of stored materials

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Liquid material transferred from tank vehicle to vehicles & equipment	• Except as specified in **Attachment A** of Appendix-B, tank vehicle used during re-fueling operations shall be specifically designed for supplying fuel to vehicle or equipment tanks and will comply with the requirements of NFPA 385 and other applicable state and federal requirements. • Tank vehicle and its equipment shall be maintained in good repair. • Drivers to be thoroughly trained in the proper method and operation of tank vehicles and in acceptable unloading procedures. • The driver or operator will not leave vehicle unattended during re-fueling operations • All engines to be shut off and operators not on the equipment during refueling operations. • Smoking is to be forbidden on or near any vehicle involved in re-fueling operations. Extreme precaution shall be exercised to prevent people in the vicinity from smoking, lighting matches, or carrying any flame or lighted device. Signs prohibiting smoking or open flames to be prominently displayed in open view on the tank vehicle. • Re-fueling procedures will not be initiated until precautions have been taken to prevent the motion of vehicles involved. Parking brakes to be utilized if available. • Length of refueling hose is typically limited to 50-feet from the hose reel. Tank vehicle to be positioned with respect to vehicles being fueled in order to prevent unwanted traffic between the tank vehicle and vehicle/equipment being fueled. • Each vehicle must contain one portable fire extinguisher that has a minimum rating of 4A, or 4-B,C. Ratings to be in accordance with NFPA-10. Signage on vehicles shall clearly indicate location of fire extinguisher. • Fueling/Re-fueling operations should typically take place during daylight hours. Nighttime fueling operations conducted in adequately lighted areas. • Documentation of training to be made available upon request. • Provide security measures to protect against vandalism of stored materials

Should these guidelines prove to be inadequate to prevent the accidental release or spill of hazardous material, they will be revised and implemented as required to ensure that every possible preventative effort is being taken. All personnel will be made aware of any such revisions at the time of the revision and at the environmental refresher meetings.

V. HDD Construction Operations Hazardous Material Spill Procedures

A spill is an unintentional release of hazardous material to the environment. In the unlikely event that an inadvertent spill of a hazardous material occurs the following steps will be followed at a minimum:

- Step 1 - Containment: Assess the situation prior to attempting to control the spill. Secure the spill scene and attempt to identify and stop the source of spill and

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

contain at source. Limit access to the site in order to prevent/limit personal and/or property damage. Responders must have knowledge of the spilled material and immediately utilize all available resources (i.e. equipment, personnel, and materials), to contain spill. If adequate resources are not available, expedite mobilization of additional resources from other construction activities as required to fully contain the spill. If the spill cannot be adequately handled by additional resources, Michels will arrange for an approved spill response contractor to mobilize to the site and contain, clean up, and perform required sampling and disposal of spilled materials and residual contaminated debris.

- Step 2 - Remediation: Properly trained personnel shall clean up hazardous material immediately after spill is contained to prevent further migration of hazardous materials into the environment. Responders should consult with proper governmental resource agencies as required. In no case shall containment equipment be used to permanently store contaminated material. Containerize in DOT-approved containers, label, and remove all contaminated material from the construction area and dispose of material in accordance with applicable regulatory guidelines (i.e. transport to hazardous waste disposal facility by licensed waste hauler). The Owner will be provided with proper documentation showing that material was disposed of in a proper manner.

- Step 3 - Notification: Reporting requirements will depend on the quantity of spill. A spill constituting less than a significant spill event will be reported to Owner and/or Owner's representative Chief Inspector **(CI)-____________: ( ) - (office), or ( ) - (cell).**

  Significant spills are defined as: any amount of petroleum, oils, or lubricants discharged to a receiving stream that causes a film, sheen, or discoloration of surface water or adjoining shoreline; or any reportable quantity of hazardous material as defined by 40CFR320. If a significant spill should take place, Michels' Project Manager (PM), will notify the Prime Contractors' Project Manager and Owner's representative Chief Inspector **(CI)-_________( ) - (office), or ( ) - (cell)** of the spill as soon as he has confirmed that the spill has been completely contained. Michels' PM will assist the Owner's representative in submitting the regulatory-required information for hazardous spill notification in accordance with Governing Agency procedures. At the very minimum the project superintendent will provide the CI with the information required on the "Spill Report" included as **Attachment C** in Appendix C.

- Step 4 – Michels' Project Manager will be responsible for any applicable agency reporting requirements. The notification requirements for petroleum and hazardous materials spills are as follows:

  - Federal Contacts:
    National Spill Response Center 1-800-424-8802

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

- State Contacts:
  State Department of Environmental
  Quality - Spill Notification ( ) - (Business Hours)
  ( ) - (After Hours)

- Local Contacts:
  Local Fire Department ________

- A completed Petroleum and Hazardous Materials Spill Report must be submitted to OWNER & Governmental Agencies within 48 hours.
- Prior to continuing work, Michels will determine the cause of the spill and implement measures to ensure that further spills will not occur.

A More detailed list of Local Emergency Response Personnel and Hospital Location will be attached and filled out as **Attachment D** in Appendix C.

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

APPENDIX-A

TABLE I

HAZARDOUS SUBSTANCE INVENTORY

Material	Quantity (gallons)	Storage Location	Reportable Quantity (include reference)
Oil/Fuel:			
Unleaded Gasoline	10 Gallons	5 Gallon DOT-Approved Re-fill able Cans - Storage Trailer	
	80 Gallons	Fuel Tank in Bed of Pick-Up Truck	
Diesel Fuel	120 Gallons	Fuel Tank in Bed of Pick-Up Truck	
	500 Gallons	Fuel Tank w/Secondary Containment on Site in excess of 150% of maximum volume	
Motor Oil	1 or 5 Gallons	Reinforced Plastic Container - Storage Trailer	
Hydraulic Oil	110-Gallons	Two 55-gallon drums w/Secondary Containment on Site in excess of 150% of maximum volume	
Commercial Chemicals:			
Ethylene Glycol	40-Gallons	1 or 5 Gallon Reinforced Plastic Containers - Storage Trailer	
Hazardous Wastes:			

APPENDIX-B

Attachment A

The setbacks specified for refueling, fuel storage, and parking of equipment may not be practicable for certain construction activities, including horizontal directional drilling. Exceptions to the setback requirements may be allowed for:

- Areas where removing equipment from a wetland for servicing or overnight parking would increase adverse impacts to the wetland and/or result in significant construction delays;
- Construction sites where moving equipment to refueling stations from pre-fabricated equipment pads is impracticable or where there is a natural barrier from the water-body or wetland (i.e., dike, road or railroad);
- Locations where the water-body or wetland is located adjacent to a road crossing (from which the equipment can be serviced);
- Refueling and fuel storage for immobile equipment including, but not limited to, bending and boring machines, air compressors, padding machines, and hydro-test fill pumps.

ATTACHMENT B
WEEKLY HAZARDOUS MATERIALS/WASTE INSPECTION LOG

For each item listed below, Contractor will indicate whether existing conditions are acceptable (A) or unacceptable (U). Resolution of all unacceptable conditions must be documented. Contractor will inspect all storage facilities on a regular basis, but not less than weekly. Contractor will keep records of all inspections on file. Contractor will provide a coy of the completed form to the Chief Inspector and Environmental Inspector on a weekly basis.

I. STORAGE AREAS FOR FUELS, LUBRICANTS AND CHEMICALS

General

A/U

______ Construction yard or storage areas secured

______ National Fire Protection Association symbol posted in storage area or at yard entrance

______ Storage areas properly prepared and signed

______ Material Safety Data Sheets available

______ Hazardous Materials Management Plan/Spill Prevention and Countermeasure Plan available

Hazardous Materials Management

A/U

______ No evidence of spilled or leaking materials

______ Incompatible materials separated

______ All containers labeled properly

______ All containers securely closed

______ All containers upright

______ No evidence of container bulging, damage, rust or corrosion

Secondary Containment Areas

A/U

______ Containment berm intact and capable of holding 110% of material stored plus precipitation

______ Lining intact

______ No materials overhanging berms

______ No materials stored on berms

______ No flammable materials used for berms

Compressed Gases

A/U

______ Cylinders labeled with contents

______ Cylinders secured from falling

______ Oxygen stored at least 25 feet away from fuel

______ Cylinders in bulk storage are separated from incompatible materials by fire barriers or by appropriate distance

II. HAZARDOUS WASTE MANAGEMENT

Waste Container Storage

A/U

______ No evidence of spilled or leaking wastes

______ Adequate secondary containment for all wastes

______ Separate containers for each waste stream—no piles

______ Waste area not adjacent to combustibles or compressed gases

______ All containers securely closed

______ Bungs secured tightly

______ Open-top drum hoops secured

______ All containers upright

______ No evidence of container bulging, corrosion

______ No severe container damage or rust

______ Containers are compatible with waste (e.g. plastic liner for corrosives, metal liner for solvents)

______ No smoking and general danger/warning signs posted

Waste Container Labeling

A/U

______ Containers properly labeled

______ Name, address and EPA ID number or ID Number of generator listed (Not required if Contractor is an exempt small quantity generator.)

______ Accumulation start date listed

______ Storage start date listed

______ Chemical and physical composition of waste listed

______ Hazardous property listed

Nonhazardous Waste Areas

A/U

______ No litter in yard

______ No hazardous wastes or used oil mixed with trash (e.g., contaminated soil, oily rags, diapers, or other oily materials)

______ Empty oil and aerosol containers for disposal are completely emptied

III. EMERGENCY RESPONSE EQUIPMENT

A/U

________ Shovels

________ Absorbent materials (booms, pads, pillows, socks, "Speedy Dry"

________ Personal protective equipment (goggles, gloves)

________ Fire-fighting equipment

________ First aid supplies (e.g. medical supplies, squeeze bottle eye wash)

________ DOT-approved containers

________ Plastic sheeting, bags and ties

________ Communication equipment

________ Bung wrench (non-sparking)

(Required for all unacceptable conditions)

IV. CORRECTIVE ACTIONS TAKEN

____

____

____

____

____

____

____

____

____

Date: ______________________ **Contractor Name :** ______________________

Inspected by (Contractor's Inspector): ______________________________

Signature: ______________________________

APPENDIX-C

ATTACHMENT C

Petroleum and Hazardous Material Spill Report

Date of spill: ____________________ Incident No: ______________ Date of spill discovery: ______________

Time of spill: ____________________ Time of spill recovery: ______________

Location Name: ________________________ Spread: _______ County: ____________________________

Section: _______ Township: _______ Range: _______

Name and Title of Discoverer: ____

Type of material spilled and product name: ____

Manufacturer's Name: ____

Legal description of spill location: ____

Directions from nearest community: ____

____

____

Estimated volume of spill: ____________________________ Estimated material recovered: ______________________

Weather Conditions: ____

Topography and surface conditions of spill site: ____

Spill medium (pavement, sandy soil, water, etc.): ____

Proximity of spill to surface waters or wetland: ____

Did the spill reach a water body? __________ Yes __________ No

If so, was a sheen present? __________ Yes __________ No

Direction and time of travel (if in stream): ____

Responsible party (name, phone number): ____

Describe the causes and circumstances resulting in the spill: ______________________________

____

____

Describe the extent of observed contamination, both horizontal and vertical (i.e., spill-stained soil in a 5'' radius to a depth of 1"):

____

____

Resources and installations that may be affected: ____

____

____

Potential impact on human health: ______________________________

____

Describe immediate spill control and/or cleanup methods used and implementation schedule: ______________

____

Current status of cleanup actions: ______________________________

____

Name/Company/Address/Phone Number for the following:

Construction Superintendent: ______________________________

OWNER
Representative: ______________________________

Environmental Director: ______________________________

Person Who Reported the Spill: ______________________________

Environmental Inspector: ______________________________

On-Scene Agency Coordinator (where applicable): ______________________________

Form completed by: ______________________ Date: ______________

The Contractor must complete this for any petroleum or hazardous material spill regardless of size, and submit the form to OWNER or OWNER's designated representative for construction observation within 48 hours of the occurrence.

ATTACHMENT D
LOCAL Emergency RESPONSE PERSONNEL-HOSPITAL LOCATION

The contractor should provide a listing by municipality of the local emergency response organizations near the HDD project site, and the name and phone number of a contact person for each. For example, list fire and police departments, emergency management organizations, etc. The contractor should update and complete this information as required for his/her work locations. Additions will be made by the Project Manager once they become available prior to drilling operations.

Local Emergency Contacts

- Federal Contacts:

National Spill Response Center	1-800-424-8802
US Army Corps of Engineers	(402) 995-2505 office (785) 213-1507 cell

- State Contacts:

North Dakota Department of Emergency Services	(701) 328-8100 (24 hr.) (800) 773-3259 (toll free) (800) 472-2121 (Div. State Radio Notification)
North Dakota Department of Health	(701) 328-5210 (24 hr.)
North Dakota Oil & Gas Division	(701) 328-8020

- Local Contacts:

Emergency Response -	
Emergency Response -	
Local Fire Department	911
Local Police Department	911

- Nearest Hospital:

North Drill Site:

Tioga Medical Center - Hospital
810 Welo St N
Tioga, ND 58852
(701) 664-3305

South Drill Site: **McKenzie County Healthcare Systems, Inc.** - Hospital
709 4th Ave NE
Watford City, ND 58854
(701) 842-3000

Other Phone Numbers to be added to this form if necessary.

NORTH BAKKEN EXPANSION PROJECT

Resource Report 1

APPENDIX 1F-3
Revised Noxious Weeds Management Plan

WBI ENERGY TRANSMISSION, INC.

North Bakken Expansion Project

Noxious Weeds Management Plan

Final

Docket No.
CP20-52-000

September 2020

NORTH BAKKEN EXPANSION PROJECT
WBI ENERGY TRANSMISSION, INC.
NOXIOUS WEED MANAGEMENT PLAN

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

EI	Environmental Inspector
NDCC	North Dakota Century Code
Project	North Bakken Expansion Project
WBI Energy	WBI Energy Transmission, Inc.

1.0 INTRODUCTION

This *Noxious Weed Management Plan* was prepared for WBI Energy Transmission, Inc.'s (WBI Energy) proposed North Bakken Expansion Project (Project) to identify noxious weed control practices that will be implemented for the Project. Pursuant to North Dakota Century Code (NDCC) § 4.1-47, North Dakota Law requires that measures be taken to control the spread of noxious weeds. Noxious weeds have the potential to invade areas disturbed by construction and may spread along the cleared areas of the pipeline rights-of-way. Soil disturbance may also allow weed seed already present to germinate and grow.

Weeds are defined as plant species that grow out of place and are "competitive, persistent, and pernicious" (James et al., 1991). Noxious weeds are plant species designated by federal, state, or county governments as injurious to public health, agriculture, recreation, wildlife, or property (Sheley et al., 1999). Under NDCC § 4.1-47, 11 plant species have been designated as noxious weeds. In addition, North Dakota law allows county and city weed boards to develop lists of additional noxious weeds.

NDCC § 4.1-47 requires "every person to do all things necessary and proper to control the spread of noxious weeds." At the state and county levels, the State Agricultural Commissioner and County Weed Control Officer respectively, are responsible for the enforcement of the weed laws. Once a noxious weed problem has been identified, it is the responsibility of the landowner to control or rectify the problems. In addition, it is a Class B misdemeanor to willfully do the following:

- transport any material that contains noxious weed seeds or propagating parts on a public road in a manner that allows for the dissemination of noxious weeds;
- drive or transport any equipment on a public road in a manner that allows for the dissemination of noxious weeds; or
- dispose of any material that contains noxious weeds or propagating parts in a manner that allows for the dissemination of noxious weeds.

1.1 PLAN PURPOSE

The purpose of this plan is to prescribe methods to prevent and control the spread of noxious weeds (hereinafter referred to as weeds) during and following construction of the Project. WBI Energy and their contractors will be responsible for carrying out the methods described in this plan.

This plan is applicable to the installation of the pipelines and aboveground facilities within the temporary construction right-of-way, permanent operational right-of-way, staging areas, access roads, and other areas disturbed by the Project's construction activities.

1.2 GOALS AND OBJECTIVES

The goals of weed control are to implement preventative measures to eliminate the spread of weeds during construction of the pipelines and to implement prescribed treatments to eliminate, to the maximum extent possible, the invasion of weeds from surrounding lands. Monitoring during construction and operation of the Project will ensure that these goals are achieved.

2.0 WEED INVENTORY

WBI Energy identified the presence of noxious weeds in the right-of-way using field surveys (attachment A) and online research to identify existing weed infestations along the pipeline rights-of-way and adjacent extra workspaces, along new or improved access roads, and within aboveground facility locations where clearing will be required. Early identification of existing infestations is intended to help minimize the spread of weeds by identifying sites where preventive measures could be implemented. Information resulting from identification before, during, and after construction, including species identified within or adjacent to the Project area, locations of infestations, and extent of infestations will be kept on file by WBI Energy.

Table 2-1 lists the weeds that have the potential to occur within the four counties crossed by each Project's facilities (as identified on agency websites).

TABLE 2-1

North Bakken Expansion Project
Designated Noxious Weed Species within the Project Area

Noxious Weed Species	McKenzie County	Williams County	Burke County	Mountrail County
Absinth wormwood (*Artemisia absinthium L.*)	X			
Baby's breath (*Gypsophila paniculata*)	X			
Black Henbane (*Hyoscyamus niger L.*)	X			
Common tansy (*Tanacetum vulgare*)			X	X
Common burdock (*Arctium minus)*	X			
Canada thistle (C*irsium arvense (L.) Scop*.)	X			
Dalmatian toadflax (*Linaria genistifolia spp. dalmatica*)	X			
Diffuse knapweed (*Centaurea diffusa Lam.*)	X			
Halogeton (*Halogeton glomeratus*)	X			
Houndstongue (*Cynoglossum officinale L*.)	X			
Leafy spurge (*Euphorbia esula L*.)	X			
Musk thistle (*Carduus nutans L*.)	X			
Narrowleaf hawksbeard (*Crepis tectorum*)		X		
Palmer amaranth (*Amaranthus palmeri*)	X	X		
Purple loosestrife (*Lythrum salicaria L., Lythrum virgatum L., and all cultivars*)	X			
Russian knapweed (*Centaurea repens L.*)	X			
Saltcedar (*Tamarisk spp*.)	X			
Spotted knapweed (*Centaurea maculosa Lam*.)	X			
Yellow toadflax (*Linaria vulgaris*)	X			

3.0 WEED MANAGEMENT

Weeds are spread by a variety of means including pedestrian vectors (e.g., hiking, recreation, etc.), construction equipment, construction and reclamation materials, livestock, and wildlife. Implementation of preventative measures to control the spread of weeds is the most cost effective management approach. WBI Energy will implement weed control management measures that are consistent with state and county regulations.

3.1 EDUCATION

WBI Energy and the Environmental Inspectors (EI) will provide information regarding weed identification, management, and impacts on agriculture, livestock, and wildlife to their employees prior to the commencement of construction. Critical information regarding the prevention of spreading weeds in areas not infested, controlling the proliferation of weeds already present, adhering to measures to prevent the spread of weeds (e.g., not driving off the cleared right-of-way, cleaning equipment that collects soil and plant seeds, and quickly identifying new infestations of weeds) will be provided to all personnel working on the Project.

3.2 PREVENTIVE MEASURES

The following preventive measures will be used to prevent the spread of weeds along the Project right-of-way and within aboveground facilities:

- Prior to construction, the EIs will mark areas of noxious weed infestation, including additional areas identified during preconstruction inspections, by using color-coded flagging, staking, and/or signs on the construction right-of-way to alert construction personnel to implement weed control measures during construction.

- All contractor equipment will arrive at the work site clean and weed-free. Prior to being allowed access to the right-of-way or aboveground facilities, verification that all equipment will be power or high-pressure air washed will be provided. In addition, all equipment leaving an area infested with noxious weeds will first be cleaned with an air compressor to limit the spread of noxious weed seeds and propagules.

- An EI or other designated personnel will ensure that equipment is free of soil and debris capable of transporting weed seeds, roots, or rhizomes.

- In the construction right-of-way, topsoil will be segregated and will not be mixed with spoil material before or during replacement. Once the disturbed areas have been de-compacted as needed, topsoil will be re-distributed over the entire disturbed area from which it was salvaged and re-contoured. Final revegetation will occur within the approved seeding window.

- The contractor will implement reclamation of disturbed lands following construction as outlined in the Federal Energy Regulatory Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan* and *Wetland and Waterbody Construction and Mitigation Pro*cedures. Continuing revegetation efforts will ensure adequate vegetative cover to prevent the invasion of weeds.

- The contractor will ensure that straw bales, used on the Project for sediment barrier installations, or mulch, are certified weed-free.

- Equipment will not be sprayed with pre-emergent chemicals as a preventive measure as these chemicals target a wide range of vegetation. As a result, the use of such chemicals could affect the success of revegetation efforts.

3.3 TREATMENT METHODS

Weed controls will be used in accordance with existing regulations and landowner or agency agreements.

Prior to clearing and grading operations, pre-treatment of noxious weed infestations may be conducted if it is determined that pre-treatment will aid in controlling the spread of weeds during construction. The weed control measures implemented at these locations may include the application of herbicide or mechanical measures. The weed control measure chosen will be the best method available for the time, location, and species of weed.

- Herbicide application is an effective means of reducing the size of weed populations. Herbicide application and handling methods are described in section 4.0 below.

- Mechanical methods such as mowing or disking are reliant on the use of equipment to disk or excavate weed populations. Because of the timing of the Project (late summer and fall construction), mechanical methods are not likely to be effective control methods. However, this method may be used during operation of the Project.

During construction, WBI Energy or their contractor will periodically monitor the Project right-of-way to allow for early detection of noxious weed species infestations. If such species are found in numbers that are significantly different from existing nearby off right-of-way locations, appropriate control measures will be implemented in an attempt to eradicate the identified weed infestations along the right-of-way and to reduce the spread or proliferation of weeds. Post-construction monitoring and control measures are discussed in section 5.0 below.

4.0 HERBICIDE APPLICATION, HANDLING, SPILLS, AND CLEANUP

Herbicide selection (if required) will be based on information gathered from local county weed control districts and/or the North Dakota Department of Agriculture.

4.1 HERBICIDE APPLICATION AND HANDLING

Prior to herbicide application, WBI Energy's contractor will obtain any required permits or approvals from the local weed district and landowner. The chemical application will be done by a licensed contractor in accordance with all applicable laws and regulations.

Herbicide label instructions and manufacturer's guidelines will be strictly adhered to. For example, manufacturer's guidelines recommend that herbicides only be applied under appropriate weather conditions (i.e., periods of low wind speeds, when precipitation is not imminent, etc.), that application sprayers be mounted low to the ground, and that sprayer booms incorporate specialized nozzles designed to produce large droplet sizes with limited drift potential. Adherence to these specifications and manufacturer label directions would minimize the potential for drift or transport of herbicides to off right-of-way areas.

Vehicle-mounted sprayers (e.g., handgun, boom, and injector) will be used primarily in open areas that are readily accessible by vehicle. Hand application methods (e.g., backpack spraying) that target individual plants will be used to treat small scattered weed populations in rough terrain. Calibration checks of equipment will be conducted at the beginning of spraying and periodically thereafter to ensure proper application rates are being achieved.

Herbicides will be transported daily to the Project site with the following provisions:

- Herbicides will be premixed and delivered in returnable/refillable containers and transferred by closed system to application tanks to limit worker and environmental exposure and eliminate the need for disposal of herbicide containers in area landfills.
- Herbicides will be transported in a manner that will prevent tipping or spilling.
- Mixing of surfactants or other additives with water or other carriers and refilling of containers will typically be conducted at road crossings, and no mixing or filling will occur within 100 feet of open or flowing water, wetlands, or other sensitive resources, greater than 200 feet from private wells, and greater than 400 feet from public wells.
- Mixing and application procedures will be supervised by a licensed commercial applicator, and monitoring will be conducted to ensure that proper mixing, application, cleanup, personal protection and safety procedures are followed.
- All herbicide equipment and containers will be inspected daily for leaks.

4.2 HERBICIDE SPILLS AND CLEANUP

WBI Energy has developed a *Spill Prevention, Control, and Countermeasure Plan* that incorporates reasonable precautions to be taken to avoid spills of potentially hazardous materials. In the event of a spill, cleanup will be immediate. Herbicide contractors will be responsible for keeping spill kits in their vehicles and in herbicide storage areas to allow for quick and effective response to spills.

Response to an herbicide spill will vary depending on the material spilled and the size/location of the spill. The order of priorities after discovering a spill are to protect the safety of personnel and the public, minimize damage to the environment, and conduct cleanup and remediation activities.

4.3 WORKER SAFETY AND SPILL REPORTING

Herbicide contractors will obtain and have readily available copies of the appropriate Safety Data Sheets and the product labels for the herbicides used. Herbicide spills will be reported in accordance with applicable laws and requirements. Further information regarding spill response and reporting is provided in the WBI Energy's *Spill Prevention, Control, and Countermeasure Plan*.

5.0 MONITORING AND OPERATION

Following construction, weed infestations will be monitored as part of the WBI Energy's restoration monitoring activities. WBI Energy's operations staff will monitor and treat noxious weeds as a part of its normal operations and maintenance activities in accordance with state regulations.

Weed control measures will be implemented at those locations where noxious weed populations are greater than the surrounding areas. WBI Energy may implement post-construction application of herbicides or mechanical measures to control noxious weeds. The weed control measure chosen will be the best method available for the time, location, and species of weed.

- Herbicide application is an effective means of reducing the size of weed populations. Herbicide application and handling methods are described in section 4.0 above.

- Mechanical methods such as mowing or disking are reliant on the use of equipment to disk or excavate weed populations. Mechanical treatments will be conducted prior to seed maturation if needed. In addition, subsequent reseeding will be conducted, if necessary, to re-establish a desirable vegetative cover that will stabilize the soils and slow the potential of reinvasion of noxious weeds.

- Where appropriate, WBI Energy will further consult with the county weed boards regarding the use of biological and other alternate noxious weed control methods. These may be implemented consultation with and approval of private landowners.

6.0 REFERENCES

James, L., J. Evans, M. Ralphs, and R. Child, editors.1991. Noxious Range Weeds. Westview Press. Boulder, CO.

Sheley, R., J. Petroff, M. Borman. 1999. Introduction to Biology and Management of Noxious Rangeland Weeds, Corvallis, OR.

NORTH BAKKEN EXPANSION PROJECT

Noxious Weeds Management Plan

ATTACHMENT A
Noxious Weeds Identified Within or Adjacent to Project Workspaces During Field Surveys

ATTACHMENT A

North Bakken Expansion Project
Noxious Weeds Identified Within or Adjacent to Project Workspaces During Field Surveys

Species	Route Identifier	Start Milepost	End Milepost [a]	Length [b] (feet)	Acres [c]
Absinth wormwood (*Artemisia absinthium L.*)	Line Section 25 Loop	19.3	19.3	179.8	0.1
Canada thistle (*Cirsium arvense* (*L.*) *Scop.*)	Schmidt Yard	NA	NA	NA	NA
	Tioga-Elkhorn Creek	40.9	NA	NA	NA
	Tioga-Elkhorn Creek	53.6	53.7	286.5	<0.1
	Tioga-Elkhorn Creek	62.4	NA	NA	NA
Leafy spurge (*Euphorbia esula L.*)	Boehm Staging Yard	NA	NA	NA	NA
	Bore #4	0.0	NA	NA	NA
	Bore #4	0.1	NA	NA	NA
	Bore #4	0.1	NA	NA	NA
	Line Section 25 Loop	5.0	5.0	53.9	<0.1
	Line Section 25 Loop	5.1	5.1	57.4	<0.1
	Line Section 25 Loop	5.1	5.1	NA	N/A
	Tioga Compressor Lateral	0.4	NA	NA	NA
	Tioga-Elkhorn Creek	0.4	NA	NA	NA
	Tioga-Elkhorn Creek	5.9	5.9	23.8	<0.1
	Tioga-Elkhorn Creek	16.9	NA	NA	NA
	Tioga-Elkhorn Creek	17.9	NA	NA	NA
	Tioga-Elkhorn Creek	19.1	19.3	954.1	2.0
	Tioga-Elkhorn Creek	51.5	NA	NA	NA
Purple loosestrife (*Lythrum salicaria* [*L.*, *Lythrum vigatum L.*], and all cultivars)	Line Section 25 Loop	4.7	NA	NA	NA
Russian knapweed (*Centaurea repens L.*)	Line Section 30 Loop	3.4	3.5	428.7	0.1

[a] Points were taken for many of these noxious weed locations; however, end mileposts were not recorded. Therefore, not applicable (NA) was recorded.
[b] Length (feet) of proposed pipeline centerlines crossed. NA = Not applicable as the distance was minimal.
[c] Points were taken for many of these noxious weed locations, and acreages were not calculated; therefore, not applicable (NA) was recorded.

NORTH BAKKEN EXPANSION PROJECT

Resource Report 1

APPENDIX 1F-6
Plan for Unanticipated Discovery of Historic Properties or Human Remains during Construction

WBI ENERGY TRANSMISSION, INC.

North Bakken Expansion Project

Plan for Unanticipated Discovery of Historic Properties or Human Remains During Construction

Draft

Docket No.
CP20-52-000

September 2020

WBI ENERGY TRANSMISSION, INC.
NORTH BAKKEN EXPANSION PROJECT
PLAN FOR UNANTICIPATED DISCOVERY OF HISTORIC PROPERTIES OR HUMAN REMAINS DURING CONSTRUCTION

TABLE OF CONTENTS

LIST OF ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

COE	U.S. Army Corps of Engineers
EI	Environmental Inspector
FERC	Federal Energy Regulatory Commission
Project	North Bakken Expansion Project
SHSND	State Historical Society of North Dakota
THPO	Tribal Historic Preservation Officer
USFS	U.S. Forest Service
WBI Energy	WBI Energy Transmission, Inc.

1.0 INTRODUCTION

This plan identifies procedures to be implemented in the event that previously unreported and unanticipated cultural materials, human remains, or paleontological remains are found during construction of WBI Energy Transmission, Inc.'s (WBI Energy) North Bakken Expansion Project (or Project).

2.0 TRAINING

Prior to the start of construction, WBI Energy will conduct environmental training, including instruction on the identification of cultural materials, unmarked burials, and human remains, for Company and Contractor personnel. WBI Energy also will provide large-group training sessions before each work crew commences construction with periodic follow-up training for groups of newly assigned personnel.

3.0 UNANTICIPATED DISCOVERY OF CULTURAL MATERIALS OR HUMAN REMAINS

The following measures will be implemented if known or suspected cultural materials, unmarked burials, or human remains are discovered during construction.

1. The Contractor will stop work in the area of the find (i.e., within 100 feet of the find or the outer perimeter of a group of finds) to protect the integrity of the find.

2. The Contractor will notify a WBI Energy Environmental Inspector (EI) of the find. The Contractor will not restart work in the area of the find until approved by an EI.

3. The EI will notify WBI Energy's Designated Representative, who will coordinate with WBI Energy's Archaeological Consultant to conduct a preliminary assessment of the find.

    a. If the find occurs on lands owned by the U.S. Army Corps of Engineers (COE), WBI Energy's Designated Representative will call the Omaha District Hotline and follow their directions. See attachment A for instructions on responding to unanticipated finds of human remains on COE lands in the Omaha District.

    b. If the find occurs on lands owned by the U.S. Forest Service (USFS), WBI Energy's Designated Representative will notify the USFS of the find by telephone and follow their directions. See attachment B for instructions on responding to finds of unanticipated cultural resources or human remains on USFS lands.

4. Following the investigation, the Archaeological Consultant will notify WBI Energy's Designated Representative by telephone regarding the preliminary assessment of the find.

5. WBI Energy's Designated Representative will notify the Federal Energy Regulatory Commission (FERC), State Historical Society of North Dakota (SHSND), COE (for finds on COE lands), USFS (for finds on USFS lands), and

federally recognized Indian tribes (as appropriate) by telephone regarding the preliminary evaluation of the find.

6. If the materials found are cultural materials (e.g., artifacts or archaeological features), the procedures in section 4.0 will be implemented. If the materials found are human remains, the procedures in section 5.0 will be implemented.

4.0 DISCOVERY OF CULTURAL MATERIALS

1. The EI will flag or fence off the site (including the area within 100 feet of the find or the outer perimeter of a group of finds).

2. WBI Energy's Designated Representative will direct the Archaeological Consultant to begin an assessment of the significance of the find and the potential effect of construction on the site.

3. The Archaeological Consultant will assess and document the find within 2 days of its discovery.

4. If the Archaeological Consultant determines the find is not significant, and the FERC, SHSND, COE (for finds on COE lands), USFS (for finds on USFS lands), and any consulting federally recognized Indian tribes concur, the Archaeological Consultant will notify WBI Energy's Designated Representative that construction may proceed across the find without additional action. The Archaeological Consultant will prepare a brief report on the find for submittal to the FERC, SHSND, COE (for finds on COE lands), USFS (for finds on USFS lands), and any consulting federally recognized Indian tribes within 7 days of discovery of the find.

5. If the Archaeological Consultant determines that the find may be significant, and the FERC, SHSND, COE (for finds on COE lands), USFS (for finds on USFS lands), and any consulting federally recognized Indian tribes concur, then the following additional steps will be implemented.

6. WBI Energy's Designated Representative will notify other parties of the find as directed by the FERC, SHSND, COE (for finds on COE lands), and/or USFS (for finds on USFS lands).

7. If the find is determined to be significant and continuing construction may damage more of the find, WBI Energy's Designated Representative will request recommendations from the FERC, SHSND, COE (for finds on COE lands), USFS (for finds on USFS lands), and any consulting federally recognized Indian tribes regarding measures for site treatment. These measures may include:

    a. a variance request to re-route the pipeline around the site;

    b. archaeological evaluation of the site;

    c. site visits by the FERC, SHSND, COE (for finds on COE lands), USFS (for finds on USFS lands), and any consulting federally recognized Indian tribes;

d. preparation of a mitigation plan by WBI Energy for approval by the FERC, SHSND, COE (for finds on COE lands), USFS (for finds on USFS lands), and any consulting federally recognized Indian tribes;

e. implementation of the mitigation plan; and

f. approval to resume construction following completion of the fieldwork component of the mitigation plan.

8. If, upon further analysis by the Archaeological Consultant, the find is determined to lack significance, WBI Energy's Designated Representative will consult with the FERC, SHSND, COE (for finds on COE lands), USFS (for finds on USFS lands), and any consulting federally recognized Indian tribes and will request approval to resume construction subject, as warranted, to further mitigation required by the FERC.

9. WBI Energy's Designated Representative will notify the EI who will grant clearance to the Contractor to start work.

5.0 DISCOVERY OF UNMARKED BURIALS OR HUMAN REMAINS

1. If an unmarked human burial or skeletal remains are encountered during construction activities, WBI Energy will comply with North Dakota's "Protection of human remains, and burial goods – Unlawful acts – Penalties - Exceptions" law (North Dakota Century Code [NDCC] 23-06-27) and its accompanying administrative rules (North Dakota Administrative Code [NDAC] 40-02-03).

2. If an unmarked human burial, skeletal remains, or associated or unassociated funerary objects or objects of cultural patrimony are discovered on federal lands, WBI Energy will comply with the requirements of the Native American Graves Protection and Repatriation Act, as directed by the COE (for finds on COE lands) or USFS (for finds on USFS lands).

3. WBI Energy's Designated Representative will direct the EI to flag or fence off the find (including the area within 100 feet of the find or the outer perimeter of a group of finds), and will notify the appropriate local law enforcement agency as required by NDCC 23-06-27.

4. WBI Energy's Designated Representative will notify the FERC, SHSND, COE (for finds on COE lands), USFS (for finds on USFS lands), and any consulting federally recognized Indian tribes of the find.

5. If the local law enforcement agency determines that the remains are not modern or do not reflect a crime scene, and/or if they otherwise relinquish their jurisdiction over the remains, the FERC, COE (for finds on COE lands), and/or USFS (for finds on USFS lands) will consult appropriate parties (e.g., WBI Energy, SHSND, federally recognized Indian tribes, and the landowner) regarding additional steps to be followed.

6. If it can be determined that the identified human remains have affinity to federally recognized Native American tribes, a reasonable effort will be made to identify, locate, and notify these tribes.

7. The parties will make a good faith effort to exclude the public from viewing Native American burial sites or associated funerary artifacts and that no photographs of Native American burial sites or associated funerary artifacts are released to the press or public.

8. The measures to protect the remains and associated artifacts will remain in effect until they have been fully evaluated, appropriate treatment of the discovery (if applicable) has been completed, and WBI Energy has received written notice from the FERC to proceed with construction at the discovery site.

9. WBI Energy's Designated Representative will notify the EI who will grant clearance to the Contractor to resume work at the discovery site.

6.0 CONTACTS FOR UNANTICIPATED DISCOVERIES

WBI ENERGY CONTACTS:

Lead Environmental Inspector
Name: To be determined
Cell: To be determined
Email: To be determined

Environmental Inspector
Name: To be determined
Cell: To be determined
Email: To be determined

WBI Energy Designated Representative
Name: Greg Huncovsky
Address: 2010 Montana Avenue, Glendive, MT 59330
Phone: 406-359-7451
Cell: 406-989-1068
Email: Greg.Huncovsky@WBIEnergy.com

Archaeological Consultant
Name: Bill Stanyard
Address: 3300 Breckinridge Boulevard, Suite 300, Duluth, GA 30096
Phone: 678-781-1372
Cell: 404-317-0543
Email: bill.stanyard@erm.com

FEDERAL CONTACTS:

FERC Project Manager and Archaeologist
Name: Dawn Ramsey
Address: 888 First Street, Washington, DC 20426
Phone: 202-502-6856
Email: dawn.ramsey@ferc.gov

U.S. Forest Service
Name: Liv Fetterman
Address: 2000 Miriam Circle, Bismarck, ND 58501
Phone: 701-989-7306
Email: liv.fetterman@usda.gov

U.S. Army Corps of Engineers
Name: Omaha District Hotline
Phone: 888-761-2772

U.S. Army Corps of Engineers
Name: Richard R. Rogers
Address: 201 1st Street, RM210, Riverdale, ND 58565
Phone: 701-654-7744
Email: Richard.r.rogers@usace.army.mil

STATE CONTACTS:

State Historical Society of North Dakota, Division Director
Name: Fern Swenson
Address: 612 East Boulevard Avenue, Bismarck, ND 58505
Phone: 701-328-2666
Email: fswenson@nd.gov

State Historical Society of North Dakota, State Archaeologist

Name: Andrew Clark
Address: 612 East Boulevard Avenue, Bismarck, ND 58505
Phone: 701-328-3574
Email: andrewclark@nd.gov

TRIBAL CONTACTS:

Northern Cheyenne Tribe, Tribal Historic Preservation Officer (THPO)
Name: Teanna Limpy
Address: PO Box 128, Lame Deer, MT 59043
Phone: 406-477-4839
Email: teanna.limpy@cheyennenation.com

Three Affiliated Tribe of the Fort Berthold Reservation, THPO
Name: Pete Coffey
Address: 404 Frontage Road, New Town, ND 5863-9404
Phone: 701-862-247
Email: pcoffey@mhanation.com

Assiniboine and Sioux Tribes of the Fort Peck Reservation, THPO

Name: Dyan Youpee
Address: PO Box 1027, Poplar, MT 59255
Phone: 406-768-2382
Email: d.youpee@fortpecktribes.net

Rosebud Sioux Tribe, THPO
Name: Ben Rhodd
Address: PO Box 809, Rosebud, SD 57570
Phone: 605-747-4255
Email: brodd1@yahoo.com

Fort Belknap Indian Community, THPO
Name: Michael Black Wolf
Address: 656 Agency Main Street, Harlem, MT 59526
Phone: 406-353-2295
Email: mblackwolf@ftbelknap.org

Oglala Sioux Tribe, THPO
Name: Tom Brings
Address: PO Box 320, Pine Ridge, SD 57770-2070
Phone: 605-867-5624
Email: t.brings@oglala.org

Standing Rock Sioux Tribe, THPO
Name: Jon Eagle
Address: PO Box D, Fort Yates, ND 58538
Phone: 701-854-8645
Email: j.eagle@standingrock.org

Northern Arapaho Tribe, THPO
Name: Ben Ridgley
Address: PO Box 67, St. Stevens, WY 82524
Phone: 307-856-1628
Email: benridgley007@gmail.com

Cheyenne River Sioux Tribe, THPO
Name: Steven Vance
Address: PO Box 590, Eagle Butte, SD 57625
Phone: 605-964-7554
Email: steve.vance@crstpreservation@outlook.com

Spirit Lake Tribe, THPO
Name: Dr. Erich Longie
Address: PO Box 76, Fort Totten, ND 58335
Phone: 701-766-4032
Email: thpo@gondtc.com

Yankton Sioux Tribe, THPO
Name: Kip Spotted Eagle
Address: Box 1153 / 800 Main Avenue SW, Wagner, SD 57380
Phone: 605-384-3641 x 1033
Email: yst.thpo@gmail.com

Turtle Mountain Band of Chippewa, THPO
Name: Jeff Desjarlais, Jr.
Address: PO Box 900, Belcourt, ND 58316
Phone: 701-477-2640
Email: desjarlaisjr.jerffrey@yahoo.com

Sisseton Wahpeton Oyate, THPO
Name: Dianne Desrosiers
Address: PO Box 907, Sisseton, SD 57262
Phone: 605-698-3584
Email: dianned@swo-nsn.gov

LOCAL LAW ENFORCEMENT CONTACTS:

Burke County Sheriff
Name: Shawn Brien
Address: 103 Railway Street SE, Bowbells, ND 58721
Phone: 701-377-2311
Email: To be determined

Mountrail County Sheriff
Name: Corey Bristol
Address: 101 N Main St, Stanley, ND 58784
Phone: 701-628-2975
Email: coreyb@co.mountrail.nd.us

Williams County Sheriff
Name: Verlan Kvande
Address: 223 East Broadway, Williston, ND 58801
Phone: 701-577-7700
Email: sheriff@co.williams.nd.us

McKenzie County Sheriff
Name: Matthew Johansen
Address: 1201 12th Street SE, Suite B, Watford City, ND 58854
Phone: 701-444-3654
Email: To be determined

NORTH BAKKEN EXPANSION PROJECT

Plan for Unanticipated Discovery of Historic Properties or Human Remains During Construction

Attachment A
U.S. Army Corps of Engineers, Omaha District
Discovery of Human Remains

US Army Corps of Engineers
Omaha District

DISCOVERY OF HUMAN REMAINS

If you suspect that you have found human remains on property managed by the Corps of Engineers, please follow these steps:

1. Do not collect or move the remains.
2. Visually mark your location. The exact location is very important.
3. Take a photo or GPS point, if you have the equipment available.
4. If the remains are in danger of being damaged or removed by others, try to camouflage the remains with vegetation, sand, soil, etc.
5. Call the Omaha District Hotline at 888-761-2772. You will be asked a series of questions and your discovery will be logged. The hotline operator will contact Rick Rogers, Sandy Barnum and Julie Price. One of these individuals will contact you as soon as possible. Have maps and photos ready to email.
6. A site visit may be needed, and you may be asked to accompany an archeologist to the site.
7. The archeologist will follow the necessary steps to properly protect the remains.

HOTLINE: 888-761-2772

NORTH BAKKEN EXPANSION PROJECT

Plan for Unanticipated Discovery of Historic Properties or Human Remains During Construction

Attachment B
U.S. Forest Service, Northern Region
Unanticipated Discovery Plan and
Discovery of Human Remains Protocols

Unanticipated Discovery Plan and Discovery of Human Remains Protocols
Northern Region, USDA Forest Service

If unanticipated cultural resources or human remains are identified during project activity and construction, Northern Region forests and grasslands will ensure that the agency and its agents (contractors, cooperators) comply with the following protocols. These protocols are based on federal law, regulation and Forest Service Manual (FSM) policy and direction.

<u>Unanticipated Discovery of Cultural Resources (see FSM 2364.13)</u>

1. Forest Service line officer (Forest Supervisor, District Ranger) or delegated staff will:

    A. Cease all project activity within (at minimum) 100ft of the unanticipated discovery until after the affected cultural resource(s) is evaluated and adverse effects to the cultural resource have been avoided, minimized, or mitigated.

    B. Notify the Contracting Officer of work-stoppage if this discovery was caused by a contractor or cooperator. Ensure that the appropriate contracting procedures are being followed.

    C. Protect the discovery from further damage, theft, or removal. Leave all artifacts and cultural materials in place. Involve law enforcement as necessary.

    D. Follow the protocols below if the discovery involves human remains.

    E. Follow the requirements of NAGPRA if associated or unassociated funerary objects or objects of cultural patrimony are discovered.

    F. Involve FS Law Enforcement if the unanticipated discovery also involves deliberate removal or destruction of cultural resources.

    G. Allow resumption of work only following resolution of the discovery incident. In most cases, this decision will be the District Ranger, but when human remains are involved the Forest Supervisor will make this decision.

2. Forest Heritage Program Leader, or delegated heritage program staff, will:

    A. Document the unanticipated discovery using appropriate site recordation procedures and forms. This should include, but is not limited to, documenting exposed artifacts and features; mapping the extent of artifacts, features, and cultural horizons; and documenting natural and cultural stratigraphy in open trenches or pits.

    B. Notify the SHPO, tribes, and other consulting parties, including any cultural resource consultants assigned to the project as appropriate.

    C. Evaluate the cultural resources for National Register of Historic Places (NR) eligibility. Testing will be limited to a sufficient level needed to provide a recommendation of NR eligibility. Funding to support evaluation may provided by benefiting function (or the cause of unanticipated discovery).

1) If the affected cultural resource is eligible for the NR, the heritage program leader will consult with the SHPO, tribes and consulting parties about measures to avoid, minimize, or mitigate further effects to the NR eligible cultural resource. Mitigation measures will be contingent on the type and extent of the disturbed resource, the extent of the adverse effect, and whether or not it is possible to avoid any further effects.

2) If the affected cultural resource is determined to be NR-ineligible, with SHPO concurrence, work may resume with appropriate monitoring for further cultural resource disturbances.

3) If NR evaluation is not possible due to circumstances beyond control, the affected cultural resource will be treated as NR eligible in accordance with FSM 2363.22.

D. Develop an action plan, mitigation plan, or emergency treatment plan for the affected cultural resources if the cultural resource is NR eligible or is being treated as eligible absent formal evaluation. Fund the action plan and necessary emergency treatment or mitigation work via benefiting function or heritage program contingent on the cause and nature of the discovery.

E. Document the unanticipated discovery in annual reports to the SHPO under programmatic agreements, and include an Event record in Infra, as appropriate.

Discovery of Human Remains (FSM 2361.3 and 2364.1)

Heritage professionals are often the first point of contact when human remains are discovered on National Forest System land. Advise the appropriate line officer to follow State burial laws or and these protocols.

1. Forest Service line officer (Forest Supervisor, District Ranger) or delegated staff will:

A. Ensure that all discovered human remains are treated with dignity and respect. Viewing and photographing exposed human remains by agency employees is generally an affront to American Indian peoples and may compromise forensic or law enforcement efforts.

B. Ensure that the discovery area is secure the area; leave human remains in place; cease project activity as necessary until a plan of action is developed and; involve law enforcement as necessary

C. Allow resumption of work only when the disposition of the human remains is determined and a written binding agreement is executed between the necessary parties in accordance with 43 CFR Part 10.4(e).

2. Forest Heritage Program Leader or delegated heritage program staff will:

A. Promptly notify SHPO, the appropriate Indian tribe(s), and the County Coroner/Medical Examiner, who will officially determine the nature of the remains (forensic or archaeological).

1) If the remains are not forensic and non-Native American, leave the remains in place and assist in the development of a plan for avoidance (in place preservation) or removal. Consult with SHPO and other interested parties as appropriate.

2) If the remains are not forensic and Native American, ensure that NAGPRA regulations at Section 10.4 of Title 43, Code of Federal Regulations, Part 10, are followed. Notify the appropriate Indian tribe(s) by telephone followed by written confirmation as soon as practicable. Develop an Action Plan for disposition of Human Remains.

3) If the remains are forensic, Forest Service law enforcement and/or the County Coroner/Medical Examiner take control of the situation.

B. Coordinate and communicate with the Line Officer, forest staff, tribes, SHPO, and consulting contractors regarding progress and status of human remains discovery incident, as necessary and appropriate. Otherwise, treat this information as confidential.

C. Document the human remains incidents in annual reports to the SHPO under programmatic agreements, and include an Event record in Infra, as appropriate. Specifics of the discovery incident may be inappropriate but a general summary is important since these incidents are important to track.

NORTH BAKKEN EXPANSION PROJECT

Resource Report 1

APPENDIX 1F - 7
Plan for the Unanticipated Discovery of Paleontological Resources during Construction

WBI ENERGY TRANSMISSION, INC.

North Bakken Expansion Project

Plan for Unanticipated Discovery of Paleontological Resources During Construction

Draft

**Docket No.
CP20-52-000**

September 2020

WBI ENERGY TRANSMISSION, INC.
NORTH BAKKEN EXPANSION PROJECT
PLAN FOR UNANTICIPATED DISCOVERY OF PALEONTOLOGICAL RESOURCES DURING CONSTRUCTION

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

EI	Environmental Inspector
Project	North Bakken Expansion Project
WBI Energy	WBI Energy Transmission, Inc.

1.0 INTRODUCTION

This Plan for Unanticipated Discovery of Paleontological Resources during Construction was prepared for WBI Energy Transmission, Inc.'s (WBI Energy) proposed North Bakken Expansion Project (Project). This plan identifies procedures to be implemented in the event that previously unreported and unanticipated paleontological resources are found during construction of the Project.

2.0 TRAINING

Prior to the commencement of construction, WBI Energy and contractor personnel will receive environmental training that will include instruction on the identification of paleontological resources and implementation of the procedures outlined in this plan.

3.0 UNANTICIPATED DISCOVERY OF PALEONTOLOGICAL RESOURCES

Paleontological resources on land owned by the State of North Dakota and its political subdivisions are protected and managed under Chapters 54-17.3 and 43-04 of the North Dakota Century Code and North Dakota Administrative Code, respectively. A permit is required to investigate, excavate, collect, or otherwise record paleontological resources on these lands (North Dakota Geological Survey, 2016). North Dakota Century Code Chapter 54-17.3-05 requires the reporting of all quaternary paleontological finds that potentially or actually contain cultural resources to the state historical society in addition to the State Geologist (State of North Dakota, 2016).

Paleontological resources on U.S. Army Corps of Engineers and U.S. Forest Service lands are protected under the Paleontological Resources Preservation Act per Title 36 of the Code of Federal Regulations Part 291.1. WBI Energy obtained an Archaeological Resources Protection Act permit, which is required to conduct paleontological surveys within U.S. Forest Service and U.S. Army Corps of Engineers lands. These surveys were completed in October 2019.

WBI Energy will implement the following procedures if paleontological resources are discovered during construction on federal, state, or private lands:

1. The contractor will stop work in the immediate area of the find to protect the integrity of the find.

2. The contractor will notify WBI Energy's Environmental Inspector (EI) of the find. The contractor will not restart work in the area of the find until approved by the EI.

   Environmental Inspector:

Name	To be determined
Cell:	To be determined
Email:	To be determined

3. The EI will notify WBI Energy's Designated Representative. The representative will notify the Federal Energy Regulatory Commission Project Manager of the find.

   WBI Energy Designated Representative:
   Name: Greg Huncovsky
   Address: 2010 Montana Avenue, Glendive, MT 59330
   Phone: 406-359-7451
   Cell: 406-989-1068
   Email: Greg.Huncovsky@WBIEnergy.com

   Federal Energy Regulatory Commission Project Manager:
   Name: Dawn Ramsey
   Address: 888 First Street, Washington, DC 20426
   Phone: 202-502-6856
   Email: dawn.ramsey@ferc.gov

4. The EI will confirm the presence of paleontological resources. Upon confirmation, the EI will photograph representative specimens of fossils identified at the site. The EI will prepare a brief written description that identifies the location of the potential fossil material along the route, the depth and apparent thickness of the stratum containing the fossil material, local topography, and other pertinent conditions or observations.

5. If the paleontological resources are identified on federally owned land, the WBI Energy Designated Representative will notify the U.S. Army Corps of Engineers or U.S. Forest Service representative in order to determine if a permit will be required to investigate, excavate, collect, or otherwise record the fossil resources.

   U.S. Army Corp of Engineers:
   Name: Richard Rogers
   Address: 201 1st Street, Room 210
   Phone: 701-654-7744
   Email: richard.r.rogers@usace.army.mil

   U.S. Forest Service:
   Name: Cale Bickerdyke
   Address: 1905 South Main Street, Watford City
   Phone: 701-842-8502
   Email: cale.bickerdyke@usda.gov

6. If the paleontological resources are identified on state-owned land, the WBI Energy Designated Representative will notify the North Dakota Geological Survey in order to determine if a North Dakota Paleontological Resource Collecting Permit will be required to investigate, excavate, collect, or otherwise record the fossil resources.

North Dakota Geological Survey:
Name: Jeff Person, Paleontologist
Phone: 701-328-8000
Email: jjperson@nd.gov

7. The WBI Energy Designated Representative will notify the State Geologist and, upon request, provide copies of the written and photographic documentation of the paleontological materials.

State Geologist: Edward Murphy
Phone: 701-328-8000
Email: emurphy@nd.gov

8. Once documentation of the find is completed, WBI Energy's Designated Representative will direct the EI to grant clearance to the contractor to resume work in the vicinity of the site.

NORTH BAKKEN EXPANSION PROJECT

Resource Report 1

APPENDIX 1F-8
Revised Horizontal Directional Drill/Guided Bore Drilling Fluid Monitoring and Operations Plans

WBI ENERGY TRANSMISSION, INC.

North Bakken Expansion Project

Horizontal Directional Drill/Guided Bore
Drilling Fluid Monitoring and Operations Plan

Final

Docket No.
CP20-52-000

September 2020

WBI ENERGY TRANSMISSION, INC.
NORTH BAKKEN EXPANSION PROJECT
HORIZONTAL DIRECTIONAL DRILL/GUIDED BORE
DRILLING FLUID MONITORING AND OPERATIONS PLAN

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

ACRONYMS ABD ABBREVIATIONS

EI	environmental inspector
FERC	Federal Energy Regulatory Commission
HDD	horizontal directional drill
HDD Plan	Horizontal Directional Drill Monitoring, Inadvertent Return Response, and Contingency Plan
Project	North Bakken Expansion Project
WBI Energy	WBI Energy Transmission, Inc.

1.0 INTRODUCTION

This *Horizontal Directional Drill/Guided Bore Drilling Fluid Monitoring and Operations Plan* (HDD Plan) describes procedures that WBI Energy Transmission, Inc. (WBI Energy) and its contractors will follow during horizontal directional drill (HDD) and guided bore crossings associated with the proposed North Bakken Expansion Project (Project). The intent of the HDD Plan is to identify procedures to be implemented that minimize environmental impacts in the event that an inadvertent return of drilling fluids occurs during Project construction. The HDD Plan communicates the roles and responsibilities of personnel involved with the HDD/guided bores, provides monitoring procedures, and describes contingency plans in the event of an unsuccessful HDD/guided bore.

As part of the Project, WBI Energy proposes to install a 24-inch-diameter natural gas pipeline, referred to as the Tioga-Elkhorn Creek pipeline, beneath Lake Sakakawea using the HDD intersect method in Williams and McKenzie Counties, North Dakota. Refer to Attachment A for the HDD plan specific to the crossing of Lake Sakakawea completed by Michels, the contractor for that HDD crossing. The plan includes detailed scaled HDD plan and profile drawings, drilling additive Safety Data Sheets, and additional details regarding the Lake Sakakawea crossing. Refer to Attachment B for the HDD Design Report specific to the crossing of Lake Sakakawea including the risk assessment and geotechnical reports.

2.0 PERSONNEL AND RESPONSIBILITIES

This section lists the personnel that will be involved with planning and performing the HDD and guided bores, and specifies the responsibilities of WBI Energy and its contractors. Qualified contractors will be retained for completion of HDD and guided bore activities associated with the Project. The contractors (hereafter collectively referred to as "HDD Contractors") will be trained and knowledgeable of requirements and procedures outlined in this HDD Plan. Environmental inspectors (EI) will work with the HDD Contractors to monitor drilling activities and conduct inspections for potential signs of inadvertent returns. The EI will work with WBI Energy personnel to notify regulatory and/or resource agency staff of any releases that occur. More detailed descriptions of the roles and responsibilities of personnel involved in HDD/guided bore activities are described below.

- <u>HDD Contractors</u> – The HDD Contractors will be responsible for overall operation and monitoring of drill equipment and drilling conditions. The HDD Contractors must be trained and knowledgeable of the requirements and procedures described in this HDD Plan. The HDD Contractors will continually monitor drilling conditions and maintain the records described in this HDD Plan. The HDD Contractors are responsible for communicating loss of drilling fluid circulation and stopping or changing the drill program in the event of an observed or anticipated inadvertent return. Michels will be completing the HDD of Lake Sakakawea. The contractor information for the remaining guided bores is currently pending and will be provided prior to construction.

- <u>Environmental Inspector</u> – The EI, in conjunction with the HDD Contractors, will periodically visually inspect the bore alignment for signs of inadvertent returns. In the event of an inadvertent return, the EI will work with the HDD Contractors to implement the remediation activities described in this HDD Plan. The EI will report any inadvertent returns to the designated WBI Energy Representative and work with the WBI Energy Representative to notify regulatory and/or resource agencies of the inadvertent return, as required. The EI will document response and remediation actions taken for the inadvertent return.

- WBI Energy Representative – A designated WBI Energy Representative will be responsible for notifying regulatory and/or resource agencies of inadvertent returns, as required, and working with the agencies, HDD Contractors, EIs, and other Project personnel, as appropriate, to develop and implement any corrective actions associated with an inadvertent return.

3.0 PRECONSTRUCTION ACTIVITIES

3.1 TRAINING

Prior to initiation of Project activities, all contractors and WBI Energy personnel involved in Project construction will be required to attend formal environmental training. The training will include review of the elements and procedures described in this HDD Plan. The WBI Energy Representative will maintain documentation of training topics and personnel in attendance. The EI will provide subsequent training to personnel who arrive on the Project during construction. The level of training received will be commensurate with the roles and responsibilities of the individuals, and will focus on measures to be implemented to minimize risk of an inadvertent return, HDD/guided bore-specific health and safety topics, and inadvertent return containment equipment and materials.

Additional training will be completed in the event that personnel changes or conditions change that affect the implementation of the HDD/guided bore (e.g., weather, scope changes).

3.2 INSPECTION

HDD Contractor personnel and the EI will inspect the land-based portions of the drill path prior to construction to identify any conditions that would impede the visual and pedestrian field inspection and develop modifications to the inspection routine, as needed.

3.3 NOTIFICATION PROCEDURES

3.3.1 Landowner Notification

Prior to commencing the HDD/guided bore, landowners will be notified in writing of the upcoming construction, which will include the anticipated start and end dates, planned access routes to the construction sites, and contact information for WBI Energy personnel. Landowner permission will be obtained prior to conducting the pedestrian survey and land-based inspection of the drill path.

3.3.2 Agency Notification

WBI Energy will notify appropriate agencies, including FERC, the U.S. Army Corps of Engineers, and state agencies, prior to the commencement of the HDD and guided bore crossings in accordance with agency requirements. The notification will include the anticipated duration of drilling and contact information for appropriate WBI Energy personnel.

4.0 DOCUMENTATION

This HDD Plan will be available and accessible to all personnel on site during HDD and guided bore activities. Additional documentation that will be available and accessible on site is described in table 4-1.

TABLE 4-1

North Bakken Expansion Project
Documentation to Be Available/Accessible On Site

Procedure	Responsible Party	Documentation
Employee Training	WBI Energy Representative and EI	Record of employee training detailing when training was conducted, material covered, and employees in attendance.
Visual Monitoring	HDD Contractor and EI	Record name of inspector, time of inspection, and observations for each inspection.
Instrument Logs	HDD Contractor	Logs that document pilot hole progression, drill string axial and torsional loads, annulus pressures, and drilling fluid discharge rate and pressure.
Drilling Fluid Composition	HDD Contractor	Logs of drilling fluid composition and physical properties throughout drilling activities. Safety Data Sheets for drilling fluid and any additives will be maintained.
Public and Agency Correspondence	WBI Energy Representative and EI	Records of communication with the public and agencies and any response actions taken if required.

A summary of HDD/guided bore activities will be included in construction status reports provided to the FERC.

5.0 DRILLING FLUID MANAGEMENT

Drilling fluid (also referred to as drilling mud) will consist of water mixed with in-situ material and/or bentonite, a non-toxic, naturally occurring sedimentary clay. Although not currently proposed, there is potential that the HDD Contractors may propose to use drilling fluid additives. Drilling fluid additives used during construction will be limited to non-petrochemical-based, non-hazardous additives currently certified to the American National Standards Institute/National Sanitation Foundation International Standard 60. Use of additives other than those certified to the American National Standards Institute/National Sanitation Foundation International Standard 60 would not be allowed unless approved by appropriate regulatory authorities. In addition, use of any drilling fluid additive or lost circulation material that has not been previously disclosed would require advance notification to and approval by FERC. Documentation of the composition and properties of all drilling fluids to be used will be maintained at the job site and available for review by WBI Energy and the EI, as well as by any jurisdictional authorities. No fluid additives will be used that do not comply with the permit requirements and environmental regulations applicable to the Project.

WBI Energy will be obtaining water from a local water depot and transporting the water either by lay flat line or truck to various project HDD and guided bore locations. Attachment A includes potential drilling fluid additives and Safety Data Sheets for the HDD crossing of Lake Sakakawea. If drilling fluid additives are deemed necessary for any guided bore crossings, this information would be provided to the appropriate agencies (e.g., North Dakota Department of Environmental Quality) for approval prior to use. WBI Energy is coordinating with landowners on potential locations within agricultural areas for the beneficial reuse of HDD drilling fluid. All Project drilling fluid would be disposed of in accordance with federal, state, and local regulations.

6.0 DRILLING OPERATIONAL CONDITIONS AND MONITORING AND RESPONSE ACTIONS

Table 6-1 provides an overview of the drilling operational conditions and corresponding monitoring and response actions. Subsequent sections of this HDD Plan provide details regarding each of the three conditions identified in table 6-1.

TABLE 6-1

North Bakken Expansion Project
Overview of Drilling Operational Conditions and Monitoring and Response Actions

Condition	Status	Actions
Condition 1: Normal Drilling Conditions	Normal drilling fluid circulation is maintained	• Perform routine collection of drilling fluid at endpoints. • Perform routine drilling data collection. • Conduct routine visual monitoring.
Condition 2: Loss of Circulation	Loss, or significant reduction, of drilling fluid circulation	• Discontinue drilling; continue pumping and rotating, and slowly swab the drill string, if appropriate. • Notify the EI. • Adjust drilling fluid and parameters in an effort to regain circulation. • Perform focused visual monitoring. • Continue drilling if no release to surface is detected.
Condition 3: Drilling Fluid Release and Remediation	Drilling fluid release to surface or waterbody is confirmed	• Notify EI and the WBI Energy Representative. • Notify regulatory agencies and authorities having jurisdiction. • Discontinue pumping; continue rotating and slowly swab the drill string, if appropriate. • Monitor and document the release area. • Contain and collect the release, if practical. • If the release is contained and collected, resume pumping and drilling. • If containment and collection is not practical, suspend HDD operations. • WBI Energy, in consultation with jurisdictional authorities, will issue a notice to proceed, notice to relocate, or notice to shut down.

6.1 CONDITION 1 – NORMAL DRILLING CONDITIONS

6.1.1 Drilling Operations

Documentation of the composition and properties of all drilling fluids to be used will be maintained at the job site and will be available for review by WBI Energy, its designated representative, and the EI, as well as by authorities having jurisdiction. Documentation shall include complete manufacturer's literature and Safety Data Sheets. No fluid will be used that does not comply with permit requirements and environmental regulations.

The HDD Contractor shall maximize reuse of drilling fluid surface returns by providing solids control and fluid cleaning equipment of a configuration and capacity that can process surface returns and produce drilling fluid suitable for reuse.

The HDD Contractor shall provide and maintain instrumentation that will accurately locate the pilot hole, measure drill string axial and torsional loads, and measure drilling fluid discharge rate and pressure. Drilling fluid pressure can only be monitored during drilling of the pilot hole. During reaming and swab passes, drilling fluid pressure is negligible due to the open ends of the drill path. WBI Energy and its designated representatives will have access to these instruments and readings at all times. If requested, WBI Energy will provide this information to regulatory agencies having jurisdiction. A log of all recorded readings shall be maintained at the drill rig site and will become a part of the "As-Built" information to be supplied by the HDD Contractor.

6.1.2 Routine Monitoring

Routine monitoring under Condition 1 will consist of a visual examination by HDD Contractor personnel or the EI along the drilled alignment, including observing for turbidity plumes within waterbodies. These examinations will be made periodically on a time interval not to exceed 4 hours and may be curtailed during hours of darkness. If a sudden loss in drilling fluid pressure is detected, aerial or over-water equipment will be used to observe and monitor for turbidity plumes during the HDD/guided bore crossings, as needed. The HDD Contractor personnel or EI will have appropriate operational communication equipment (e.g., radio, cell phone) available at all times while observing the installation of the HDD/guided bore crossings. The name of the examiner, time of the examination, and observations shall be kept in a log at the rig site and will be available for inspection by WBI Energy and its designated representatives. Upon request, WBI Energy will also make the logs available to the regulatory agencies having jurisdiction.

If loss of circulation and possible release of drilling fluid to the surface is detected, Condition 2 will be implemented.

6.2 CONDITION 2 – LOSS OF CIRCULATION

6.2.1 Drilling Operations

The following procedures shall be implemented if a loss, or significant reduction, of drilling fluid circulation occurs:

- Discontinue drilling or reaming activities. Continue pumping and rotating, and slowly swab the drill string, if appropriate. Swabbing involves withdrawing the drill string to mechanically clean the drilled hole and reduces chances of the drill string getting stuck.
- The HDD Contractor shall immediately notify the EI. The EI will document that operations are continuing under Condition 2 in the daily report and notify the WBI Energy representative as necessary.
- The HDD Contractor shall immediately take steps to restore circulation. These steps shall include, but are not limited to, the following:
    - Adjust drilling fluid properties and parameters to encourage annular flow by specifically weighting up or down, increasing viscosity, or adding lost circulation material (walnut shells, mica, or other additives to promote circulation) to plug the seam where fluid is being lost. Flow shall be maintained such that annular velocities promote returns to the drilling pits.
    - At the HDD Contractor's option, employ lost circulation material as long as such materials have been approved by WBI Energy and comply with permit requirements and environmental regulations.

- Perform focused monitoring along the drill path for drilling fluid release to surface.
- If circulation is restored or drilling fluid is not observed at surface, drilling will continue under Condition 2 for a period of not less than 8 drilling hours. If a release is not identified and loss, or significant reduction, of drilling fluid circulation does not occur, the HDD Contractor shall notify the EI that drilling under Condition 1 has resumed. The EI will document that drilling under Condition 1 has resumed.
- If drilling fluid release is identified through focused monitoring, Condition 3 shall be implemented.
- If circulation cannot be restored, the HDD Contractor shall notify the EI and WBI Energy and continue drilling under Condition 2.

6.2.2 Focused Monitoring

Focused monitoring under Condition 2 will consist of continuous visual observation along the drilled alignment by HDD Contractor personnel and/or the EI with no other jobsite responsibilities. Focused monitoring will take place over the minimum 8-hour Condition 2 drilling timeline, as indicated above. The time and results of drilled alignment observations shall be kept in a log at the rig site and shall be available for inspection by WBI Energy and its designated representatives. Upon request, WBI Energy will also make the logs available to the regulatory agencies having jurisdiction. If a drilling fluid release to the surface is detected, Condition 3 shall be implemented.

6.3 CONDITION 3 – DRILLING FLUID RELEASE AND REMEDIATION

6.3.1 Drilling Operations

The following procedures will be implemented if a drilling fluid release to the surface is detected:

- The HDD Contractor will cease drilling immediately and notify the EI. The EI will document the location of the release as well as the containment and cleanup of the release in the daily report. WBI Energy will be notified immediately of any releases into waterbodies or other environmentally sensitive areas, or if a release threatens to enter these areas.
- In the event of a release into waterbodies or other environmentally sensitive areas, WBI Energy shall immediately notify the following*:*

TABLE 6.3.1-1

North Bakken Expansion Project
Inadvertent Release Notification Information

Agency	Name	Phone Number
FERC	Dawn Ramsey	202-502-6856
Department of Health, Division of Water Quality (for releases into waterbodies)	Division of Water Quality	701-328-5210
U.S. Fish and Wildlife Service (for release in sensitive habitat areas)	Jerry Reinisch	701-250-4481 Ext 8267
Game and Fish Department (for release in sensitive habitat areas)	Greg Link	701-328-6331
U.S. Army Corps of Engineers (for release on U.S. Army Corps of Engineers land or waters of the U.S)	Jeremy Thury	701-654-7751
State Historical Society of North Dakota	Andrew Clark	701-328-3574
State Water Commission (for release in Lake Sakakawea)	Gerald Heiser	701-328-2750
U.S. Forest Service (for releases on U.S. Forest Service Land)	Cale Bickerdyke	701-842-8502

- The HDD Contractor will discontinue pumping, and will rotate and slowly swab the drill string, if appropriate. Swabbing involves withdrawing the drill string to mechanically clean the drilled hole and reduces chances of the drill string getting stuck.

- If public health and safety are threatened by the inadvertent release, drilling operations will be shut down until the threat is eliminated.

- If the release occurs on land, it shall be contained with hand-placed barriers (e.g., hay bales, sand bags, silt fences) and collected for disposal or reuse. If the amount of the release exceeds that which can be contained with hand-placed barriers, small excavated collection sumps (less than 5 cubic yards) may be used. Pumping and drilling may continue under Condition 2 as long as the release is being contained and collected.

- If the amount of the release occurring on land exceeds that which can be contained and collected using small sumps, drilling operations shall be suspended until released volumes can be brought under control.

- If the release occurs near a potable water source or water well, the HDD Contractor will test the water quality and yield for the water well owner, and will provide an alternate supply of water to affected landowners until the water source or well is repaired. Water well repairs will occur at WBI Energy's expense.

- If the amount of any drilling fluid release on land exceeds that which can be practically contained and collected, or if a turbidity plume within surface waterbodies is observed to be excessively large, drilling operations shall be suspended and the HDD Contractor will notify WBI Energy that drilling cannot continue without a continuous release of drilling fluid. WBI Energy, in consultation with jurisdictional authorities, will then issue a notice to proceed or issue a notice to shut down until further notice.

- If impacts are noted to be occurring to fish or wildlife due to exposure to released drilling fluids, drilling operations shall be suspended and the HDD Contractor will notify WBI Energy immediately. WBI Energy, in consultation with jurisdictional authorities, will issue a notice to proceed or issue a notice to shut down until further notice.

6.3.2 Focused Monitoring

Focused monitoring under Condition 3 will consist of continuous visual observation along the drilled alignment and at any and all release areas. Focused monitoring shall be conducted by HDD Contractor personnel and/or the EI with no other jobsite responsibilities. The time and results of the focused monitoring observations shall be kept in a written log at the jobsite and shall be available for inspection by WBI Energy and its designated representatives. Upon request, WBI Energy will also make the logs available to the regulatory agencies having jurisdiction.

7.0 RESPONDING TO INADVERTENT RETURNS

7.1 MATERIALS AND EQUIPMENT

Materials that will be stored on site in the event of an inadvertent return include the following:

- wood stakes,
- sandbags;
- plastic sheeting;
- spill sorbent pads and booms;
- certified weed-free straw bales;
- silt fence;
- corrugated plastic pipe;
- shovels; and
- push brooms.

Mechanical equipment that will be either immediately available or staged on site in case of an inadvertent return include:

- vacuum truck;
- centrifugal, trash, and sump pumps;
- rubber-tired or wide-track backhoe;
- storage tanks;
- floating turbidity curtains; and
- skidsteer, as needed.

7.2 RETURNS WITHIN CERTIFICATED WORKSPACE

Containment and cleanup of returns within uplands and wetlands within the certificated workspace will occur immediately following the discovery. Contractor personnel will utilize the materials described above to contain and control the spread of any released drilling fluid. Drilling fluid will generally be cleaned by hand using hand shovels, buckets, and soft-bristled brooms where possible to avoid damage to existing vegetation. In heavily impacted areas, mechanized equipment may be utilized and restoration techniques will be implemented in accordance with FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan* and *Wetland and Waterbody Construction and Mitigation Procedure*s. Fresh water washes will also be employed if deemed beneficial and feasible. Material will be collected in containers for temporary storage prior to removal from the site.

7.3 RETURNS OUTSIDE CERTIFICATED WORKSPACE

Should an inadvertent return be discovered outside of certificated workspace, WBI Energy will attempt to gather landowner permission, obtain all required environmental clearances, and seek a FERC variance in order to access the impacted area as soon as possible. WBI Energy plans to consult with adjacent landowners prior to construction in order to limit downtime during drilling operations and expedite the environmental response.

8.0 RESTORATION

If an inadvertent return were to occur, the HDD Plan will be implemented to contain and recover the drilling fluid. Areas that were affected by the inadvertent return will be restored to preconstruction conditions to the extent practicable in accordance with FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan* and *Wetland and Waterbody Construction and Mitigation Procedures* and the proposed modifications described in table 1.3-1 of Resource Report 1, and the restoration plans prepared for the Project (appendix 1F of Resource Report 1).

9.0 CONTINGENCY PLANNING

If the actions described above do not address the issue, WBI Energy may opt to implement mitigation measures, select a new drill path, or abandon the drill and consider alternate crossing measures. Abandonment procedures and alternative crossing measures will be discussed with appropriate permitting and regulatory agencies, and required approvals will be obtained prior to implementing alternative crossing measures.

9.1 MITIGATION MEASURES

Before identifying alternative crossing locations or techniques, an attempt will be made to identify and assess the reason for the drill failure and implement measures to reduce additional inadvertent returns. Potential mitigation measures include:

- utilize surface (conductor) casing(s);
- use the intersect drill method;
- pre-grout permeable ground or fractured rock;

- install relief wells to provide a preferential pathway for drilling fluids to migrate to the surface; and/or

- plan for use of special drilling fluids, viscosity, pressure, and/or drill speed.

9.2 NEW DRILL PATH

Depending on the nature of the problem, WBI Energy may choose to select a new drill path that mitigates the cause of the problem. This would result in an altered alignment or depth of drill path, which may retain sections of the original drilled path that are not at risk to the problem. For any section of abandoned hole, the abandonment procedures identified in section 9.3 below would apply only to the abandoned section of the hole.

9.3 ABANDONMENT

In the event a drill hole is to be abandoned, the following procedures will be implemented:

- heavy drilling mud or cement mixture will be pumped into the hole as the drill assembly is extracted to seal the abandoned drill hole; and

- the drill end points will be cut and sealed within approximately 5 feet of the surface, filled with soil, and graded to the original contour.

9.4 ALTERNATIVE CROSSING METHODS

WBI Energy's preferred crossing method for certain surface waterbodies is via HDD or guided bore; however, in the event that the above options have been exhausted WBI Energy is committed to completing the Project in an effective and timely manner and will consider alternative crossing options. In developing an appropriate alternative consideration will be given to:

- stream bank type, flow width, depth, velocity, and flow volume;
- surrounding topography;
- lakebed substrate;
- condition of riparian areas;
- condition and extent of wetlands, if any, on each side of the crossing; and
- aquatic biota.

These and other factors will be considered and discussed with the appropriate regulatory agencies to minimize environmental impact and secure appropriate approvals.

NORTH BAKKEN EXPANSION PROJECT

Horizontal Directional Drill/Guided Bore Drilling Fluid Monitoring and Operations Plan

Attachment A

Horizontal Directional Drilling Installation Plan, WBI Energy Transmission Lake Sakakawea/Missouri River HDD Crossing, Prepared by Michels

HORIZONTAL DIRECTIONAL DRILLING INSTALLATION PLAN

WBI Energy Transmission
Lake Sakakawea/ Missouri River HDD Crossing

Proprietary Michels Corp

August 10, 2020
REVISION -2

HDD INSTALLATION PLAN
Michels Directional Crossings
WBI Energy Transmission
North Bakken Expansion Project
Lake Sakakawea / Missouri River Crossing
Installation of ~15,442' / 24" Steel Pipe

Table of Contents:

Intro:
The proposed Lake Sakakawea/Missouri River HDD crossing consists of installation of ~15,442' of 24" steel pipe. HDD has been the selected installation method to minimize surface and water body disruption/impact. Environmental considerations were also a factor in choosing HDD as the construction method. HDD is a trenchless installation method that installs the pipeline far deeper under the waterbody with minimal surface and environmental impact when compared to traditional open-cut installations.

Drill Support and Manpower:
Michels proposes drilling and installing this crossing utilizing the pilot-hole intersect method, which requires cutting edge directional drilling technology & the use of two drill rigs drilling simultaneously toward each other in performance of the installation. Michels has been perfecting this unique cutting-edge method for the past 12-years, while successfully completing numerous complicated and long distance directional drill installations that otherwise would not have been attempted. Each drill rig site requires one shift of 8-12 men. The primary drill rig to be utilized will be a minimum DD-840 Drill Rig with the secondary rig being a minimum DD-840 Drill Rig. The crews will be scheduled to work approximately 12 to 14 hours per day and up to 7-days per week. 24-hour per day operations may be required at any given time on the crossing depending on conditions encountered in the bore-hole & specific requirements which must be met. Michels reserves the right to supply and substitute personnel as required but will provide WBI Energy notice prior to personnel changes being implemented.
(Attachment – Potential On-Site Specialized Manpower and Resumes)
(Attachment- Safety and JSA Information)
(Attachment- SPCC Plan)
(Attachment – Drill Rig Specifications)

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Drill Configuration/Geometry:
Directional drilling using the pilot-hole intersect method is proposed for this crossing. The planned borehole geometry is anticipated to follow the attached HDD plan and profile drawing. Adequate depth of cover should be maintained beneath contours and obstacles in accordance with industry standards at all crossings to minimize the risk for inadvertent drilling fluid returns. The HDD crossing will be installed within the tolerances listed in the construction contract so that the factor of safety ratings will be maintained. Conductor casing may also be installed at either or both the entry and exit locations in order to traverse unconsolidated formation if necessary, this is done in order to alleviate conditions associated with inadvertent drilling fluid returns and settlement or to allow a better transition into more consolidated formation.

(Attachment – HDD Plan and Profile Drawing)

Drill Work Sites Preparation:
The drill work sites required for staging equipment should be prepared by the prime contractor readied for Michels' mobilization to the job site. Cleared and level work pads at both sides of the crossing are necessary for the support and movement of semi-trucks and heavy equipment. The pad may require the installation of matting, gravel or other means for a stable workable surface. A work pad is required at both sides of the proposed crossing capable of supporting a drill rig with ancillary equipment. The two work areas are shown on the attached HDD design drawing and pipe laydown drawing. The two work areas should be connected by a straight centerline alignment. A drill rig dead-man is typically installed in front of the unit to support minimal movement of the rig during drilling operations. The dead-man consists of an 8' x 20' steel plate installed vertically down into the ground placed in front of the rig. It is used to distribute load bearing support across and to the surrounding ground formation during rigorous drilling operations.
(Attachment – Anticipated Entry/Exit Equipment)
(Attachment – HDD Equipment Noise Information)

Pilot Hole:
Michels uses two main pilot hole tracking systems for large scale HDDs such as the Lake Sakakawea / Missouri River crossing. The first being a wireline tracking system called the Para-track system. This system requires a surface cable or solenoid. The second pilot hole tracking system is the Gyroscope which requires no surface cable or solenoid. The typical hole intersect procedure for the two systems are described separately below.

<u>Hole Intersect using the Para-Track System</u>
A 12-1/4" drill bit is advanced from the entry points (Rig Side Entry and Pipe Side Entry) toward the pre-designated intersect point along the proposed bore-hole path alignment using a directional jetting bottom-hole assembly or mud motor with bit and bottom-hole assembly. The pilot hole drilling from Rig Side Entry can be prior to or concurrent with pilot hole drilling from the pipe side entry as intersect procedures do not have to occur at exactly half the distance. The intersect location ±500 feet is pre-determined prior to drilling however, conditions encountered during pilot hole drilling will dictate the approximate location of performing the intersect. The bottom-hole assembly will be advanced from the entry side toward the second pilot-hole projection which will be drilled or is being drilled from the other side. The bottom-hole assembly includes the bit (12-1/4" in diameter), drilling mud motor if required, orientation and pressure measurement sub, steering guidance tool (Vector Magnetics Para Track2 Survey and Guidance System) and non-magnetic drill collars. The drill stem

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

added behind this bottom-hole assembly will be S-135 grade 7 5/8” FHDS (Full Hole Double Shoulder) series drill pipe or better and in random 30(±) foot lengths.

The location of the pilot-hole drill paths will be continuously monitored, surveyed then recorded from its respective drill rig location utilizing the data from the down-hole probe (Para Track2 Probe) as drilling proceeds. Critical tracking information to be processed includes elevation, alignment and distance away from each rig which is calculated then recorded in accordance with industry standard, once at the end of every drill stem length (approximately 30-feet).

Constant communication is maintained between the two drill crews as pilot-hole intersect operations progress. Prior to the pilot holes reaching the projected intersect location, the magnetic signal being monitored on the instrument tracking computer inside the control trailer will increase in strength. After the two pilot holes are overlapped by approximately 30’, a PMR (Passive Magnetic Ranging) survey will be conducted. At this time, the Para Track2 Probe will be used to collect static magnetic field readings relative to the adjacent drill stem. To perform this operation, the 7 5/8” drill pipe positioned in the previously drilled borehole from the entry end will be retracted in predetermined distance increments, these distance retractions are sensed by the probe and recorded. The magnetic field readings collected by the Para Track2 probe will then be analyzed to verify that sufficient and accurate data has been collected and a position offset between the two boreholes can be calculated and determined. This PMR survey will be repeated once every 30’ until the two boreholes are connected.

Hole Intersect using the Gyroscope System

A 12-1/4” drill bit is advanced from the entry points (Rig Side Entry and Pipe Side Entry) toward the pre-designated intersect point along the proposed bore-hole path alignment using a directional jetting bottom-hole assembly or mud motor with bit and bottom-hole assembly. The pilot hole drilling from Rig Side Entry can be prior to or concurrent with pilot hole drilling from the pipe side entry as intersect procedures do not have to occur at exactly half the distance. The intersect location (±500 feet) is pre-determined prior to drilling however, conditions encountered during pilot hole drilling will dictate the approximate location of performing the intersect. The bottom-hole assembly will be advanced from the entry side toward the second pilot-hole projection which will be drilled or is being drilled from the other side. The bottom-hole assembly includes the bit (12-1/4” in diameter), drilling mud motor if required, orientation and pressure measurement sub, steering guidance tool (Gyroscope Guidance System). The drill stem added behind this bottom-hole assembly will be S-135 grade minimum 7 5/8” FHDS (Full Hole Double Shoulder) series drill pipe or better and in random 30(±) foot lengths.

The location of the pilot-hole drill paths will be continuously monitored, surveyed then recorded from its respective drill rig location utilizing the data from the down-hole probe (Gyroscope) as drilling proceeds. Critical tracking information to be processed includes elevation, alignment and distance away from each rig which is calculated then recorded in accordance with industry standard, once at the end of every drill stem length (approximately 30-feet).

As the pilot holes approach the planned intersect area the following steps are typically followed to complete the intersect:

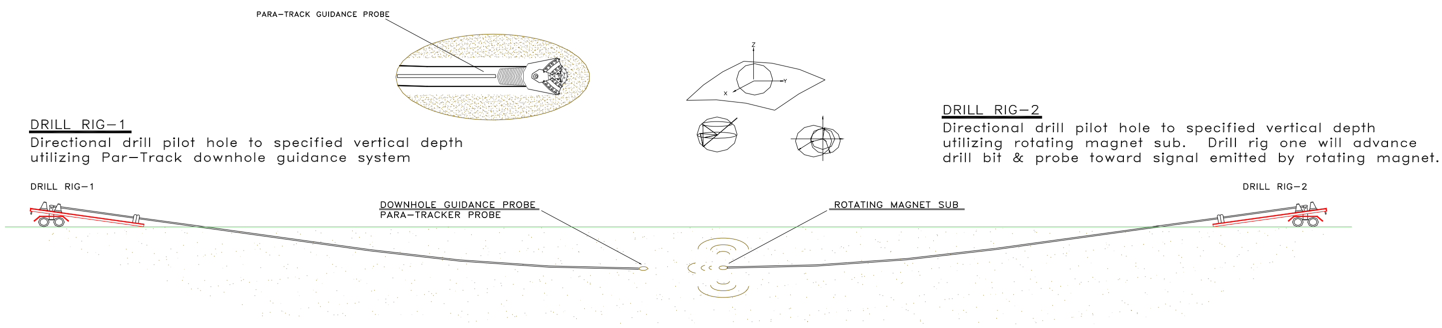
1. A pair of radars are placed, one behind each gyro on either side.
2. The drilling surveyors on both sides stay in contact sharing their survey data as the bore progresses.

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

3. When they get within 30' of the bits overlapping, one side will pull a joint of pipe to the top of the rig and wait for the opposite side to overlap their hole with the bit.
4. While the drilling side is progressing, the other side will monitor annular pressure (if annular pressure is being monitored) and watch for vibrations indicated on survey readouts.
5. If at this time the drilling side notices any changes to the push or rotation indicating they may be coming into the hole drilled from the opposite side, the side which is waiting will slowly push down and see if they bump into the other bit. If they do bump, the drilling superintendent and surveyors will then decide based on the angles at which the intersect occurred, the push and torque on the strings of pipe, and the distance from the intersect point to the ends of the hole, which side will push out of the ground. They will also decide, based on ground conditions how much space to keep between the bits as one side pulls back and the other pushes forward.
6. If the bits do no bump after the two holes are overlapped in a horizontal direction, the side which is not drilling forward will pull back drill stem and bit an appropriate distance so that the drilling side can drill far enough forward without the bits being overlapped until the side which is waiting can push down slowly while the other side monitors for vibrations until the radars are parallel to each other.
7. At this time the surveyors will take a radar survey. Based on the survey, the drilling superintendent and surveyors will determine the best option to drill from one side or the other until the holes are intersected. Usually, another radar survey will be taken in 1 to 3 drill pipes as the hole progresses to verify that the distance between the holes is matching what is expected based on the first set of data.
8. When the holes get close enough in a lateral and vertical direction that intersection is expected one side will pull back far enough that the drilling side can safely drill into the hole without causing damage to the tools. When the drilling superintendent and surveyor believe based on the pressures and survey data the holes are intersected, the other side will push down slowly until the bits are verified to have touched. Usually this is accomplished by pushing until either the push pressure rises above that in open hole, or the other side notices movement. Then one side will move a set distance and see if the other side can now push freely again.
9. When it is verified that the holes are intersected the drilling superintendent and surveyors will then decide based on the angles at which the intersect occurred, the push and torque on the strings of pipe, and the distance from the intersect point to the ends of the hole, which side will push out of the ground. They will also decide, based on ground conditions how much space to keep between the bits as one side pulls back and the other pushes forward. They will also decide, based on ground conditions how much space to keep between the bits as one side pulls back and the other pushes forward.
10. If the ground is soft, it can be necessary for both sides to bump the bits against each other and one side to push as the other side pulls back slowly maintaining contact with the bits to insure that the pushing side stays in the hole.

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Pilot Hole Intersect Sketch



(Attachment – MGS Steer Tool System; Attachment – Gyroscope; Attachment - Para Tracker Gyro Module; Attachment - Para Tracker, Attachment Tensteer Tool, Attachment – Drill Rig Specification Hercules 1200, Atlas-840, Titan-440 and UNI 250X400, Attachment – Daily Tracking Forms)

Drilling Fluids:
Essential to any successful HDD process is the selection and proper utilization of drilling fluid, which is primarily made up of water and bentonite having pH values between 8 and 9. Bentonite is a naturally occurring, non-toxic, inert substance that meets NSF/ANSI-60 Drinking Water Additive Standards and is used for drilling potable water wells. Often soda ash is added to the drilling fluid to increase the pH to 8 and reduce the soluble calcium. This allows bentonite to perform at its maximum and reduces the amount of bentonite added to the drilling fluid. Soda ash is also NSF standard 60 certified and is used to drill potable water wells. Using these products minimizes the impact to any environmentally sensitive area in the unlikely event that an inadvertent return should occur.

Bentonite serves many notable purposes in the HDD process, which includes but is not limited to:

1) Cleans the drilled cuttings from the bore hole and cools the drilling tools,
2) Transports cuttings to the surface for recycling,
3) Aids in stabilizing formations by supplying a cohesive nature to the surrounding geological formation and preventing fluid loss from the bore hole,
4) Provides lubrication for the drill string and downhole assembly, which reduces frictional forces at the formation,
5) Drives a down-hole drill motor for rock drilling,
6) Provides hydrostatic fluid pressure in the bore hole to offset ground formation pressures.

Drilling fluid is composed of a carrier fluid and solids. The selected carrier fluid for this crossing consists of water (approximately 96%) and an inorganic, bentonite clay (approximately 4%). Michels has access to

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

several different brands of bentonite. The selection of which brand to use is typically based on price, availability and proximity to the proposed drill site. The following brands all exhibit similar characteristics providing the same results as listed above.
(Attachment – Potential Bentonite Brands – Product Data Sheets/MSDS Sheets)

Potential Bentonite Brands

- Max Gel
- Super-Gel X
- Bara-Kade

The bentonite will be mixed in a mud mixing tank of up to 5,000 gallons, depending on mud rig size, in accordance with manufacturer's recommendation. Approximately 15 to 20 pounds of powder bentonite will be mixed with 100 gallons of fresh water *(Mud Composition),* and will be used throughout the entire drilling process to establish and maintain optimum drilling fluid properties. Estimated proportions listed above are based on past experience and do not take into account unexpected conditions encountered. Michels maintains fluid performance through the daily sampling, testing and recording of fluid properties throughout drilling operations. This provides Michels' Mud Technician the information required to make educated recommendations regarding maintenance of efficient drilling fluid rheology consistent with hole-stabilization with the intention of limiting inadvertent surface returns and optimizing drilling fluid performance. Following is one of the tables used as a guideline by the Mud Technician referencing recommended fluid consistencies targeted during typical testing. Consistencies of powder and water are varied to achieve these recommended viscosities.

Targeted Drilling Fluid Viscosities Recommended	
Sand	60-80 Viscosity
Silt	50-70 Viscosity
Clay	40-50 Viscosity
Rock	60-80 Viscosity
Gravel	70-90 Viscosity

Once the drilling fluid is thoroughly mixed to an acceptable consistency, it is pumped from the mud tank to the back end of the drill rig. From here it is injected under high pressure through the drill stem at a rate of between 300 to 800 gpm to the apex of the drill head. The spent drill fluid with mixed cuttings maintains a return flow back along the annular space created between the drill stem and the formation wall. Drill fluid returns to the entry pit where it is pumped by a 6hp submersible pump to the fluid recycle and processing system.

Additives may be deemed necessary based on evaluations and recommendations made by the Mud Technician during drilling and hole-opening operations. If the need for drill fluid additives does arise, it is anticipated that one of the attached additives may be required in order to maintain adequate fluid rheology down-hole. Michels formally submits the attached drilling fluid additives for approval and use on this project. (Attachment – Drilling Additives / LCMs for approval)

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

MICHELS®

Reaming Passes:
Michels anticipates performing one ream pass with a final hole dimeter of ~36” accommodate the 24” steel pipe. However, the final determination as to size and number of ream passes will be based on conditions encountered during pilot-hole drilling and the initial reaming operation.

The reamers proposed for the crossings will be various types of dirt and rock reamers custom fabricated by Michels specifically for this type of formation, which could include conventional fly-cutter type reamers and hole-openers. Michels also has additional resources for various rock-tooling which can be supplied at a moment’s notice if needed. Equivalent or better tools may be substituted depending on availability of other supplier’s products or if changes in anticipated drilling conditions are encountered.
(Attachment- Michels’ Downhole Tools)

Cleaning Pass:
A swab pass will need to be conducted up to the same size as the final ream pass but no larger. The swab pass is typically pulled back from exit to entry.

Drill Mud Cleaning:
The first phase of the mud cleaning system is displacement of solid returns at the shaker. Heavy solids are sifted out by a shaker with screens and deposited into a pit. From here they will be transported by dump truck to a site for disposal.

Drill Mud Cleaning Equipment Specifications

Volume of Mixing/Scalper Tank	54.0-Bbls
Volume of Desander Tank	72.0-Bbls
Volume of Desilter Tank	72.0-Bbls
Quantity of Scalping Shakers	1.0-Shakers
Mesh Size of Scalping Shakers	10-20 Double Stacked
Desander Capability	2 @ 500-GPM (1,000 GPM Total)
Desander Cones	2.0-Cones
Desander Mesh Size	40 to 165
Quantity of Desilter Cones	10 Ea @ 100-GPM
Desilter Mesh Size	60 to 250
Steel Mud Circulating Tank Volume	160-Bbls
Returns Tank Volume (Mud Pit)	320-Bbls
Cuttings Tank Volume (20-yd Roll-off)	150-Bbls
Mud Screening, Max Pass Size	40-Mesh

(Attachment – Mud Cleaning Equipment Specifications)

Bentonite Pump Capabilities (ENTRY/EXIT) (Based on Availability)

Name Brand	Ellis Williams W-446 Triplex Piston Model
Liner Size	6-Inches
Maximum Pressure	1,027 PSI
Maximum Flow Rate	661 GPM
Gallons Per Stroke	2.20 Gallons Per Stroke

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Bentonite Pump Capabilities (ENTRY/EXIT) (Based on Availability)
Name Brand .... Gardner Denver OPI-350
Liner Size 6-Inches
Maximum Pressure ....1,469 PSI
Maximum Flow Rate... 529 GPM
Gallons Per Stroke .... 2.94 Gallons Per Stroke

Pull Pipe:
The 24" pipe will be welded and placed on top of rollers in preparation for pullback. The pipe will be pulled into place utilizing an approved pull head, swivel and reamer from exit to entry. This is a continuous operation which takes place until the product pipe is pulled through the opened hole back to the entry point.
(Attachment - Michels' Support Rollers)

Contingency Planning:
Contingency planning is conducted in response to unforeseen events and conditions which could occur during normal operating sequences.

Included in the contingency plans, Michels has developed an environmentally responsive set of contingency plans including contingency planning for inadvertent returns to be invoked for expeditious attention and handling of various incidence as they arise.
(*Attachment – Contingency Plans for HDD crossing)*

Solids Control and Separation:
The first phase of the mud cleaning system is displacement of solid returns at the shaker. Solid control systems will vary for the various drill rigs however the end product is the same. Heavy solids are sifted out by a shaker with screens and deposited into a pit. From here they will be transported by dump truck to a site for disposal. Spent drill fluids are collected at the drill site and transferred to tanker trucks for disposal at an approved location. *(Attachment – Drill Fluid Recycle Flow Chart)*

Demobilization:
Excess drilling fluid is removed from the site and transported to the approved disposal site. Equipment and personnel will be moved off-site after successful completion of the hydrostatic test and clean-up operations will take place. Mud pits will be backfilled with the native soil that was excavated and temporarily stored. Topsoil will be segregated separately from the subsoil and backfilled appropriately to restore conditions as close to pre-construction as possible.

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

MICHELS®

ATTACHMENT

ON SITE
SPECIALIZED MANPOWER
AND RESUMES

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

MICHELS®

PERSONNEL STATEMENT

Personnel for each newly contracted job, from the Project Manager to the Mud Technician, are duly assigned to a project based on a number of circumstances. These may include but are not limited to the following; current projects under contract, geographic location of previous project, scope of work required for the directional drill. Our personnel and equipment have been assembled so that they are interchangeable from project to project.

The key to any directional drilling project is obviously having qualified personnel who are experienced in dealing with unforeseen circumstances as they arise. Michels' personnel are some of the most experienced and highly qualified drilling experts in the industry, as demonstrated on past projects accumulated on our reference list. With the appropriate resources at their disposal, Michels has overcome risks associated with some of the most difficult drilling projects ever attempted and has evolved into one of the foremost leaders in the directional drilling industry.

Each of the Drilling Superintendents employed by Michels is highly experienced in utilizing drill rigs of every size. Michels' Drilling Superintendents are well respected throughout the industry, as represented on the attached resumes. Each has completed countless difficult drills including installation of large diameter pipe and at great lengths. Our Drilling Superintendents have worked up through the ranks providing them a complete and comprehensive understanding of safety, hazards, environmental monitoring, manpower, equipment operations and repairs for each phase of the directional drilling operation. Michels' personnel maintain continuous schooling for all phases of the drilling operation.

As noted on the attached resumes, each Superintendent has drilled throughout North America as well as internationally, and has encountered various soil conditions, from sands, gravels, clay and cobble to solid rock formations.

MICHELS®

Directional Crossings

A Division of Michels Corporation

Jeff Mueller
Vice President of Michels Directional Crossings

Sean Nicholson
Vice President of HSE

Jason Pederson
Director of Safety for HDD

Ed Dye
Safety Coordinator

Michael Miller
Safety Coordinator

Spencer Rusk
Safety Coordinator

Tim McGuire
Senior Advisor

Mark Franz
Environmental Manager

Paul Krings
Sr. Equipment and Logistics Manager

Eric McBrair
HDD Tooling Manager

Dan Pucker
Directional Drill Shop Manager

Scott Nehls
HDD Logistics QA/ QC Manager

Matt Smith
General Manager Contracts and Business Administration

Greg Goral
Senior Design Engineer

Brad Eifert
Engineering Tech

Zach Osborn
Estimator

Diane Dalle Nogare
Executive Assistant

Toni Budahn
Administrative Assistant

Dustin Branscomb
Trenchless Engineer

Don Mueller
Eastern Operations Manager

Bob Spennati
Assistant Operations Manager

Randy Robinson
Midwest Operations Manager

Kurt Myhre
Western Operations Manager

Ray Viator
Marine Operations Manager

Ted Foltz
Special Projects Manager

Project Managers: to be assigned to Operations Managers on a per project basis.

Ken Coleman	Wendell Long	Eric Frawley	Larry Shilman
Jim McGovern	Karl Kornkven	Rick Zavitz	Jeremiah Yliniemi
Dale Schinderle	Michael Geelan	Doug Houska	Chad Johnson

Field Superintendents: to be assigned to Operations Managers on a per project basis.

Mike Brever	Marcus Carratt	Jack Edmunds	Brian Guelig	Nick Leblanc	Tim Monroe	Clifford McLain	Seth Strean	Matt Rohwer	Brady Hickey	Branden Cole
Dan Kriesel	Curt Rischmueller	Steve Sanders	Richard Wulff	Bobby Skipworth	Dave Williams	James Day	Josh Bush	Garrett Derrerr	Steve Case	Carl Bresser
Jamie Hollenbeck	Mark Matthews	Doug Stebbins	Seth Matheny	Ryan Jackson	Nate Mecklenburg	Jason Freund	Tim Bunkelman	Brian Morgan		

Survey Engineers: to be assigned to Operations Managers on a per project basis.

Jeff Nehmer	Cale Mullenix
Lorenzo Rivera	Eric Riha
Jeremiah Erickson	Dan Reynolds

MICHELS®

Jeffrey S. Mueller

Vice President

PROFESSIONAL EXPERIENCE

2020 – Present: **Vice President | Michels Directional Crossings | Brownsville, WI**

Responsible for horizontal directional drilling division construction operations. Duties include profit and loss responsibility for multiple and simultaneous directional drilling gas, product, water, sewer, civil, electric, telephone cable, and environmental projects. Day-to-day involvement with bid estimating, construction feasibility evaluation, specification and design criteria review, proposal preparation, contract and subcontract negotiations, project planning and oversight, cost scheduling, allocation of divisional resources, and interface with utility construction managers, engineers, and owners. Report directly to the Senior Vice President and President of the company.

2003 – Present: **Operations Manager | Michels Directional Crossings | Brownsville, WI**

Supervisor of field operation superintendents and directional drilling project managers. Oversee large inventory of drilling tools and materials during storage and field use. Monitors production by Fleet Department of directional drilling personnel and equipment. Duties include coordinating and scheduling the mobilization of equipment, personnel and materials to remote job sites throughout the United States and Internationally. Involved in estimating of various directional drilling projects. Specialize in the engineering design, build and maintenance of directional drilling fleet. Responsible for pilot hole drilling & survey for complicated bores which include implementing and integrating new technology necessary for successful completion of leading edge HDD crossings (i.e. hole-intersects). Complete project experience available upon request.

Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
42"	3980'	Susquehanna River MP 99.6, PA	2018
20"	7354'	Susquehanna River, PA	2018
36"	6238'	Ohio River, OH/WV	2017
30"	3483'	Ford Island to Landing C, HI	2017
42" Steel with 36" HDPE	3983'	St John's River, FL	2016
30"	6119'	Lake Whitney, TX	2016
12"	11,548'	Union Canal & Martin Barge Canal, TX	2015
24"	7432'	Houston Ship Channel, TX	2015
12"	11,563'	Holland Bottoms Wetlands, AR	2015
18"	12,459'	Houston Ship Channel, TX	2015
6"	6999'	Navajo Reservoir/San Juan River, NM	2014

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Crossing/Location	Year
48"	2060'	Tres Palacios River, TX	2014
36"	9040'	Mississippi River & Levees, Il/MO	2014
42"	3008'	I-95 & Tidal Wetlands, NJ	2013
30"	6544'	1st Street, NJ	2013
42"	4441'	Goethals Bridge, NY	2013
30"	8101'	Kill Van Kull River, NY/NJ	2013
30"	5378'	Hudson River, NY/NJ	2012
30"	4850'	Red River, TX/OK	2012
42"	4519'	Freeman Road, LA	2011
42"	5117'	Nature Conservatory, LA	2011

1996 – 2003: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record-keeping of plots and production. Oversees drilling survey during crossing.

1991 – 1996: **Drilling Survey Technician | Michels Directional Crossings | Brownsville, WI**

Responsible for surveying, staking and design of directional drill path and curve, monitoring the drill path and calculating and interpreting the ground elevations and contours. Computer literate with knowledge and experience operating various software. Complete surveying skills and experience utilizing a Total Station for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points. Additional duties include on-site maintenance of technical equipment and necessary record-keeping of plots and drilling logs.

1989 – 1991: **Skilled Laborer | Michels Directional Crossings | Brownsville, WI**

Experience in working on and around directional drilling rigs as an integral member of a specialized team. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs; hydraulics; fluids; set-up and operation of drill motors; power generators; mud pumps; bentonite mixers; drill pipe; reamers; couplings; and overall equipment maintenance and operation.

EDUCATION

1989 **Lomira High School | Lomira , WI**

High School Diploma

MICHELS®

Tim McGuire

Senior Advisor

PROFESSIONAL EXPERIENCE

2020 – Present: Senior Advisor | Michels Directional Crossings | Brownsville, WI

Provide advice in the management of domestic and international horizontal directional drilling operations. Responsibilities include business development, contract procurement and negotiation, project oversight and management, and client communication.

2002 – 2020: Vice President | Michels Directional Crossings | Brownsville, WI

Responsible for horizontal directional drilling division construction operations. Duties include profit and loss responsibility for multiple and simultaneous directional drilling gas, product, water, sewer, civil, electric, telephone cable, and environmental projects. Day-to-day involvement with bid estimating, construction feasibility evaluation, specification and design criteria review, proposal preparation, contract and subcontract negotiations, project planning and oversight, cost scheduling, allocation of divisional resources, and interface with utility construction managers, engineers, and owners. Report directly to the Senior Vice President and President of the company.

1998 – 2002: General Manager | Michels Directional Crossings | Brownsville, WI

1994 – 1998: Project Engineer/Project Manager | Michels Corporation | Brownsville, WI

1992 – 1994: Division Manager | Michels Environmental Services | Brownsville, WI

1991 – 1992: Drilling Division Manager | Harrison Western Mining Corporation | Denver, CO

1987 – 1992: Project Manager/Geotechnical & Environmental Engineer | Ebasco Corporation | Denver, CO

INDUSTRY INVOLVEMENT

- MCI Engineer Training Seminar “Horizontal Directional Drilling Design, Specification and Construction for Trenchless Placement of Underground Utilities”
- Midwest Gas Association “Horizontal Directional Drilling Large Diameter Pipeline Installations”
- National Groundwater Association Outdoor Action Conference “Horizontal Directional Drilling Demonstration for Installation of Horizontal Wells”

EDUCATION

Colorado School of Mines | Golden, CO

Bachelor of Science: Geological Engineering - Minor: Hydrogeology

Matthew Smith

General Manager/Contracts & Business Administration

PROFESSIONAL EXPERIENCE

2019 – Present: **General Manager/Contracts & Business Administration | Michels Directional Crossings | Brownsville, WI**

Oversee day-to-day divisional business operations and management of operational costs.
Duties include profit and loss responsibility for multiple and simultaneous trenchless construction projects in the oil/gas, civil, power and communication business sectors.
Day to day involvement with bid estimating, construction feasibility evaluation, specification and design criteria review, contract and subcontract negotiations, project planning, cost scheduling and interface with utility construction managers, engineers and owners.

2013 – 2019: **Manager-Direct Pipe | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating Direct Pipe projects for various size gas, water, sewer, electrical and communication lines. Assists with project design and methods of operation. Oversees clarification and interpretation of construction drawings. Assumes accountability for the direction and performance of construction personnel. Oversees project schedule, safety, profitability and cost control. Direct pipe installations/pipe assists:

Diameter	Length	Crossing/Location	Year
48"	651'	Juniata River, PA - HK 750PT Installation	2018
42"	484'	Highway 50, West Virginia - HK 500PT Installation	2018
36"	856'	Qu`Appelle River, Canada - HK 750PT Installation	2017
36"	1,280'	Highway #1, Canada - HK 750PT Installation	2017
36"	1,027'	United Blvd & Mundy Creek, Canada - HK 750PT Installation	2017
36"	1,047'	Lougheed Hwy, Canada - HK 750PT Installation	2017
42"	7,200'	Athabasca River, Canada - HK 750PT Installation	2016
36"	827'	Leslie Street, Ontario, Canada - HK 300PT Installation	2015
42"	1,299'	Lisgar Meadowbrook, Ontario, Canada - HK750PT Installation	2015
42"	1,008'	Highway 63, Canada - HK750PT Installation	2015
48"	4,039'	Dow Barge Channel, Clute TX - HK750PT Installation	2015
36"	1,002'	Hwy 225, Deer Park, TX - HK300PT Installation	2015
36"	1,092'	Lubrizol Drainage, LaPorte, TX - HK300PT Installation	2015
48"	2,455'	Rio Grande River, El Refugio, TX - HK750PT Installation	2014
42"	1,200'	Railroad Crossing, Groves, TX - HK750PT Installation	2014
42"	1,050'	Beaver River, Alberta, Canada - HK750PT Installation	2013
42"	470'	I-84, Westfall, PA - HK750PT Installation	2013

PROFESSIONAL EXPERIENCE (continued)

2013: Project Manager | Michels Tunneling | New Berlin, WI

Responsible for overall site/field management and safety of microtunneling/tunneling projects. Monitor project budget including month end computations and projections. Coordinate project development between project engineer, superintendent and foreman. Prepare/submit all submittals, RFIs, extra work, contract change orders and pay requests.

2011 – 2013: Project Engineer | Michels Tunneling | New Berlin, WI

Planned, scheduled, conducted, and coordinated assigned engineering work; monitored work for compliance to appplicable codes, accepted engineering practices, and ensured effective communication and coordination on projects between all disciplines and project participants.

2010: Engineer Internship | Michels Tunneling | New Berlin, WI

2009: Pipeline Laborer | Michels Pipeline Construction | New Berlin

2003 – 2007: Concrete/General Laborer | Forino Developers | Skinking, PA

PROJECT PROFILES

OCI Project No. DB10-WASD-01 ESP - Miami, FL
Mico-tunnel installation of 1200 LF of 72" Permalok steel casing under the Government Cut Channel in Miami. The casing will be installed through the coral rock formation from a shaft constructed by others on Fisher Island to a shaft in the water off South Beach.

Intracoastal Waterway Pipeline Relocation, Galveston Causeway, Galveston, TX
700' of 48" Permalok tunnel drives through clay underneath the Galveston Bay for installation of new waterline for the City of Galveston. Michels Tunneling was the 4th contractor to attempt this project and completed it successfully and under budget.

Akron II - Akron, Ohio
The second phase of a sewer installation, including 2 microtunneling runs installed 1,086 LF 48" Hobas.

Massillon Road Sanitary Sewer Improvement - Akron, Ohio
Massillon Road 2,925 LF of 42" Cenrifugally Cast Fiberglass Reinforced Polymer Motar Pipe sanitary sewer gravity sewer, microtunnel installation; 1,328 LF of 48" CCFRPM pipe on micropile support, 29 LF of 36" OH CCFRPM pipe, gravity sewer, micropile support. 7 EA shaft excavations with steel sheeted ground and 7 EA manholes structures. 250 LF of open cut excavation with steel sheeted support.

SFPUC Bay Tunnel - San Francisco, CA
The project includes 26,208 LF of 12'-10" diameter concrete segmented tunnel under the San Francisco Bay from Menlo Park on the S.F. Peninsula Bay to Newark in the East Bay area, two slurry diaphragm wall shafts, and 108" cement motor lined steel pipe welded in the tunnel and shafts as a final liner carrier pipe.

TRAINING & CERTIFICATIONS

- Crane Signaler Certified
- Confined Space Certified

INDUSTRY INVOLVEMENT

- 2018 Trent Ralston Young Trenchless Achievement Award
- No-Dig Paper Presentation (2019): Crossing the Calumet

INDUSTRY INVOLVEMENT (continued)

- No-Dig Paper Presentation (2018): Lengthy crossings shortened by Direct Pipe Technology
- No-Dig Paper Presentation (2017): Direct Pipe method using water

EDUCATION

Gonzaga University | Spokane, WA

Bachelors of Science: International Business

817 Main Street, PO Box 128 • Brownsville, WI 53006-0128 | 920.583.3132

MICHELS®

Greg Goral

Senior Design Engineer

PROFESSIONAL EXPERIENCE

1988 – Present: Senior Design Engineer | Michels Directional Crossings | Brownsville, WI

Create forms for and compile various informational submittals for Directional Drilling and Line and Cable Divisions. Planning and design drawings on AutoCAD from preliminary designs to as-built drawings. Developed computer programs for simplifying preliminary and correction computations required for Directional Drilling. Composed dissertations for various projects proposed and awarded. Compiled engineering computations and studied stress and loading analysis for pipeline installation. Responsible for take-offs, material estimates, material purchasing and project coordination, and map route reproduction.

1986 – 1987: Estimator/Purchasing | LaForce Hardware and Manufacturing | Green Bay, WI

Involved in the bid process using skills in estimating and pricing. Scheduled materials for architect's review and approval. Responsible for the purchasing of materials and coordinating shipments to job sites.

1981 – 1984: Machine Operator | Badger Wood Products, Inc. | De Pere, WI

Machine operator responsible for setup operations for various machines in a production line process. Responsible for quality control at various machines.

TRAINING & CERTIFICATIONS

- Construction Materials & Techniques
- General Construction Estimating
- Route Laying and Photogramitry
- Engineering Mechanics-Statics
- Elements of Surveying

EDUCATION

1986 University of Wisconsin–Platteville | Platteville, WI

Bachelor of Science with Construction Management Major

MICHELS®

Dustin Branscomb

Trenchless Engineer

PROFESSIONAL EXPERIENCE

2018 – Present: **Trenchless Engineer | Michels Directional Crossings | Brownsville, WI**

Responsible for the design & engineering evaluation of trenchless pipeline installations, inclusive but not limited to design & build projects, constructability, feasibility, plan & procedure creation, pre-qualifications, calculations, specification review and/or insight, bid & proposal process, submittals, estimating, scheduling, pre-bid meeting attendance, pre-construction meeting attendance, as-built's, design changes, and ensuring project continuity from inception to execution.

2011 – 2018: **Drilling Survey Supervisor | Michels Directional Crossings | Brownsville, WI**

Responsible for surveying, staking and design of directional drill path and curve, drilling the pilot hole, tracking and monitoring the drill path and calculating and interpreting the ground elevations and contours. Computer literate with knowledge and experience operating various software including: 1) Magnetic Guidance System, 2) Survey, 3) Tru-Tracker and 4) Microsoft applications. Applied working knowledge of advanced mathematics including: 1) Fluid Dynamics, 2) Advanced Algebra, 3) Trigonometry, 4) Calculus, 5) Statistics and 6) Stress Engineering. Complete surveying skills and experience utilizing a Total Station (Theodolite with built-in EDM) for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points (benchmarks). Additional duties include on-site maintenance of technical equipment, and necessary record-keeping of plots and drilling logs. Performed the above operations for crossings which include, but not limited to:

Diameter	Length	Crossing/Location	Year
42"	3087'	Victoria Harbor, Canada	2018
36"	1511'	Hwy #1, Canada	2017
36"	1116'	United Blvd & Mundy Creek, Canada	2017
36"	1076'	Hwy 7 & CP Rail, Canada	2017
36"	827'	Leslie Street, Ontario, Canada - HK 300PT Installation	2015
42"	1,299'	Lisgar Meadowbrook, Ontario, Canada - HK750PT Installation	2015
42"	1,008'	Highway 63, Canada - HK750PT Installation	2015
48"	4,039'	Dow Barge Channel, Clute TX - HK750PT Installation	2015
36"	1,002'	Hwy 225, Deer Park, TX - HK300PT Installation	2015
36"	1,092'	Lubrizol Drainage, LaPorte, TX - HK300PT Installation	2015
48"	2,455'	Rio Grande River, El Refugio, TX - HK750PT Install.	2014
8"	7321'	MP 49.3 Landslide, MT	2014
36"	9040'	Mississippi River, IL/MO	2014
36"	2264'	Otter Creek,IL	2013

PROFESSIONAL EXPERIENCE (continued)

36"	1311'	Fraizer Creek, IL	2013
36"	1518'	Vermillion River, IL	2013
48"	1943'	West Neck Creek, VA	2013
48"	819'	Hunt Club Creek, VA	2013
8"	7177'	115 KV Power Duct, SC	2013
8"	7304'	115 KV Power Duct, SC	2013
36"	3571'	Angelina River, TX	2013
36"	2908'	Neches River & RR, TX	2013
8"	3503'	Hamlin Creek, Charleston, SC	2013
8"	4911'	115 KV Power Duct, SC	2013
36"	1444'	Hwy 155 & UPRR, TX	2012
36"	1740'	Sabine River, TX	2012
30"	2906'	Hickory Creek, Marietta, OK	2012
30"	4850'	Red River, Thackerville, TX/OK	2012
42"	1661'	Cordele, TX	2012
16"	1656'	Chicolete River, TX	2012
16"	1717'	Morales, TX	2012
42"	1670'	Morales, TX	2012
42"	1658'	Dewitt, TX	2012
8"	6675'	Wilmington, NC	2012
8"	6669'	Wilmington, NC	2012

2006 – 2011: **Project Engineer | GeoEngineers, Inc. | Springfield, MO**

Responsible for project management, HDD Design, construction observation, field program planning and conducting technical briefings of field staff, feasibility studies for various natural gas and product pipeline projects, geotechnical exploratin, geotechnical borehole logging and soil classificatino, completion of technical reports and proposals, budget management, client billings and collections, and client interaction.

2004 – 2006: **Assistant Civil Engineer | Coastland Civil Engineering, Inc, | Santa Rosa, CA**

Responsible for project management, land development projects, improvement plan and map review, flood and drainage review, city master plan development, specification and eingineer's estimate development, city engineering and all-embracing experience in struction inspection.

TRAINING & CERTIFICATIONS

- HDD profile design
- Analysis of operating and installation stresses
- Determination of minimum allowable radius of curvature
- Evaluation of pipe buoyancy and potential pull loads
- Slope stability analysis, Subsurface exploration, Laboratory Testing and Structual design

INDUSTRY INVOLVEMENT

- Registered Professional Engineering, Licence No. 20100000796. Missouri Board for Architects, Professional Engineers, Professional Land Surveyors and Landscape Architects
- Registered Professional Engineer, License No. 108030. Texas Board of Professional Engineers
- LEED Accredited Professional. Leadership in Energy and Environmental Design Green Building Accredited Professional (LEED AP)
- National Association of the Remodeling Industry Certified Green Building Professional

EDUCATION

2004 California Polytechnic State University | San Luis Obispo, CA

Bachelor of Science, Civil Engineering 2004

El Molino High School | Forestville, CA

High School Diploma

MICHELS®

Bradley J. Eifert

Engineering Technician

PROFESSIONAL EXPERIENCE

2005 – Present: **Engineering Technician | Michels Directional Crossings | Brownsville, WI**

Create forms for and compile various informational submittals for Directional Drilling. Planning and design drawings on AutoCAD from preliminary designs to as-built drawings. Developed computer programs for simplifying preliminary and correction computations required for Directional Drilling. Composed dissertations for various projects proposed and awarded. Compiled engineering computations and studied stress and loading analysis for pipeline installation. Responsible for take-offs, material estimates, and map route reproduction.

2004 – 2005: **Assistant Project Coordinator | Michels Directional Crossings | Brownsville, WI**

Performed As-builts, scheduling, dispatch, and project tracking for communication cable burial. Designed and preformed anticipated loads and stress calculations for the following projects:

Diameter	Length	Location	Year
24"	2645'	Corning, NY	2011
36"	4992'	Melville, LA	2011
30"	5786'	Sussex, NJ	2010
16"	9931'	Goose Creek, SC	2010
42"	4512’	Vicksburg, MS	2009
30” Steel	34,000’ (19 Drills)	Atlanta, GA	2008-2009
30” HDPE	3076’	Albany, NY	2008
36” HDPE	2144’	Charleston, SC	2007
8” Steel	8400’	Okaloosa, FL	2006
20” HDPE	2300’	Honolulu, HA	2006
30” Steel	5700’	Trinidad	2006
36” Steel	2130’	Albuquerque, NM	2006
42” Steel	2078’	South Amboy, NJ	2006
24” Steel	24,000’ (6 Drills)	Sacramento, CA	2005-2006

EDUCATION

2005 **Moraine Park Technical College | Fond du Lac, WI**

Associate Degree- Civil Engineering Technician

1995 **Hartford Union High School | Hartford, WI**

High School Diploma

MICHELS®

Zach Osborn

Estimator

PROFESSIONAL EXPERIENCE

2019 – Present: **Estimator | Michels Directional Crossings | Brownsville, WI**

Prepare estimates for Directional Drill projects across the United States. Review designs and feasibility of projects. Point of contact for customers during bid process. GIS mapping and tracking of current bids. Follow up on project status. Hand offs to operations when a project is awarded.

2017 – 2019: **Assistant Project Manager | Michels Pipeline Construction | Lakeville, MN**

Oversee projects and provide estimates. Manage projects through the full cycle. Profile HDD's for crews and create asbuilts on completed projects. /worked directly with customer with HDD feasibility and design. Pursue new business opportunities and customer relations. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
10"	1948'	Roads & Bluff, MN	2019
24"	2000'	Woods and Creek, MN	2019
8"	4650'	Little Falls, MN	2019
16"	1200'	Hwy & Railroad, MN	2018
10"	2450'	Missouri River, MT	2018
24"	1200'	I-494, MN	2018
24"	1800'	Crossing Bluff, WI	2017

2015 – 2017: **Foreman | Michels Pipeline Construction | Lakeville, MN**

Point of contact for non contract bores for the Distribution West Division. Managed and tracked units for billing. Time and equipment recording. Managed HDD worksite and constructed gas service work. Worked with distribution crews on miscellaneous projects around the Twin Cities Metropolitan area.

2009 – 2015: **Laborer/Operator | Michels Pipeline Construction | Lakeville, MN**

Labored and Operated equipment for the Distribution West Division. Worked with HDD Operations. Fused for outside projects outside of Centerpoint contract. Traveled and worked on out of state projects.

TRAINING & CERTIFICATIONS

- Class A CDL, HDD Academy, EWN Proctor Certification

EDUCATION

University of Wisconsin - La Crosse | La Crosse , WI

Triton High School | Dodge Center, MN

Diploma

MICHELS®

Don Mueller

Eastern Operations Manager

PROFESSIONAL EXPERIENCE

2011 – Present: Eastern Operations Manager | Michels Directional Crossings | Brownsville, WI

Supervisor of field operation superintendents and directional drilling project managers. Oversee large inventory of drilling tools and materials during storage and field use. Monitors production by Fleet Department of directional drilling personnel and equipment. Duties include coordinating and scheduling the mobilization of equipment, personnel and materials to remote job sites throughout the United States and Internationally. Involved in estimating of various directional drilling projects. Specialize in the engineering design, build and maintenance of directional drilling fleet. Responsible for pilot hole drilling & survey for complicated bores which include implementing and integrating new technology necessary for successful completion of leading edge HDD crossings (i.e. hole-intersects). Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	4381'	Pennsylvania Drive, PA	2019
16"	6601'	Arch Bishop/S Chester Rd, PA	2019
16"	4399'	Valley Rd/Darlington Rd, PA	2019
16"	7402'	Susquehanna River, PA	2019
30"	3746'	Dix River, KY	2019
16"	3728'	Village Square Dr, PA	2019
16"	1888'	West Baltimore Pike Rd, PA	2019
16"	3981'	Glendale Rd & Concord Ave, PA	2019
20"	2236'	Lower Piney Creek, PA	2018
20"	2355'	Joanna Road, PA	2018
12"	1369'	Rocky Point Landing, Jamaica	2018
20"	2209'	Horse Valley Road, PA	2018
20"	7354'	Susquehanna River, PA	2018
16"	2346'	Frankstown Branch-Juniata River, PA	2018
20"	3874'	Waltonville Rd, PA	2018
20"	1337'	Berry Ridge & Old Mill Rd, PA	2018
16"	5869'	Conrail RR, Perth Amboy, NJ	2018
16"	2766'	Hall Street, NJ	2018
16"	1999'	Route-35, Perth Amboy, NJ	2018
20"	5841'	Ohio River MP 33.8, OH/WV	2017
20"	4771'	Raystown Lake, PA	2017
48"	3595'	Road 771 Canal, TX	2017
48"	2222'	Hwy 803, CA Rd & Supply Canal, TX	2017

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Crossing/Location	Year
20"	2005'	Hwy 20, PA	2017
36"	6238'	Ohio River, OH/WV	2017
36"	7194'	Ohio River MP 16.07, OH/WV	2017
42"	2431'	Maumee River & State Hwy 24, OH	2017
48"	2807'	Oliver Creek & SH 188, TX	2017
48"	3291'	Meter to LNG Facility, TX	2017
48"	2263'	US Hwy 181/Hwy 35, TX	2017
30"	2278'	Chattahoochee River, GA	2017
24"	2293'	Interstate 20, GA	2017
36"	1606'	Hannahatchee Creek, GA	2017
30"	2757'	Little Rock River, IA	2016
30"	6328'	Big Sioux River, SD/IA	2016
16"	11,397'	Lake Sacagawea South, ND	2016
30"	5714'	James River, SD	2016
30"	2291'	PCN3/Wetland, SD	2016
30"	3352'	Cliff Crossing, ND	2016
30"	1791'	200th St, SD	2016
16"	11,229'	Lake Sacagawea North, ND	2016
30"	1516'	408th & Wetland MP 360, SD	2016
16"	1112'	Palermo Railroad, ND	2016
30"	1407'	Lewis & Clark/274th St, SD	2016
30"	1519'	Turtle Creek, SD	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
36"	1862'	State Highway 50, IL	2015
36"	3461'	Kennedy Ave/Griffith Terminal, IN	2015
36"	2510'	Deep Creek, IL	2015
36"	3011'	Highway 41 & RR, IN	2015
36"	5128'	Lake Ave & RR, IL	2015
10"	4654'	Allegheny River, PA	2015
18"	12,459	Houston Ship Channel, TX	2015
24"	2003'	Highway 612, MS	2014
24"	2750'	Escatawpa River, MS	2014
36"	9040'	Mississippi River, IL/MO	2014
20"	2364'	Missouri River, IA/NE	2014

PROFESSIONAL EXPERIENCE (continued)

1998 – 2011: Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States and Canada; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Oversees drilling survey during crossing.

1996 – 1998: Pipe-Side Superintendent/Pullback Coordinator | Michels Directional Crossings | Brownsville , WI

Lead person responsible for coordinating the pipe string-out and welding subcontractor located at the exit side of directional drill. Duties include overseeing of pipe string for pullback without delay, maintenance of equipment, material organization, and coordination of labor for specialized pipe coating and testing. Accountable for the critical path of having pipe prepared for pullback. Responsible for maintaining constant communication with Drilling Superintendent during pullback operation and coordinating efforts to pull the pipe in one well-balanced effort.

1995 – 1996: Operator | Michels Directional Crossings | Brownsville, WI

Crane operator responsible for safe operation and timely placement of drill stem and equipment. Integral link in the drilling operation, from drill rig set-up, pipe pull back and rig-down of equipment. Also conducted pipe support operations at the exit side during pipeline pullback. Responsible for permitting and mobilization/demobilization of heavy and non-dimensional equipment to drill sites.

1993 – 1995: Skilled Laborer | Michels Directional Crossings | Brownsville, WI

Specialized in mechanical repairs, land surveying, hydraulics, fluids, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation.

1987 – 1993: United States Marine Corps | San Diego, CA

EDUCATION

1987 Winnebago Luthern Academy | Fond du Lac, WI

High School Diploma

MICHELS®

Randy Robinson

Midwest Operations Manager

PROFESSIONAL EXPERIENCE

2015 – Present: **Midwest Operations Manager | Michels Directional Crossings | Brownsville, WI**

Manage field crews on the installation of assigned pipeline projects. Specific duties include: material and supply coordinator, field liaison between engineering, estimating and subcontractors to ensure construction compliance, monitor work performance and craft productivity, enforce project quality, safety and environmental issues, regulation and resolution of field construction problems. Plan day-to-day operations onsite and line up the necessary resources to accomplish the plan. Work hand in hand with customers and third party inspection personnel to resolve issues.

2003 – 2015: **Superintendent | Michels Pipeline Construction | Lakeville, MN**

Supervises and assigns duties to directional drill rig crews installing plastic and steel pipelines. Generates daily work progress reports, trains new staff and orders materials and equipment necessary for overall success of the project. Prepares documents on cost, budget, contracts, estimates and other essential aspects of operations.

1993 – 2003: **Crew Foreman | Mueller Pipeline | New Berlin, WI**

Worked in the capacity of a foreman on pipeline related projects. Responsible for safety, schedule and budget of all assigned work. Directly managed crews performing distribution of gas, electric, telephone, and water directional drill instillation. Ensured conformance to specifications, drawings, procedures, and quality.

1987 – 1992: **Line Supervisor | McNeilus Truck & Manufacturing, Inc. | Dodge Center, MN**

1985 – 1987: **Laborer | Donaldson Construction | Dodge Center, MN**

1984 – 1985: **Forklift & Crane Operator | McNeilus Truck & Manufacturing, Inc. | Dodge Center, MN**

1982 – 1984: **Laborer | Steve Kutzler Family Farm | West Concord, MN**

EDUCATION

Marquette University | Milwaukee, WI

EUC Academy for Management

West Concord High School | West Concord, MN

High School Diploma

Kurt Myhre

Western Operations Manager

PROFESSIONAL EXPERIENCE

2020 – Present: Western Operations Manager | Michels Directional Crossings | Brownsville, WI

Supervisor of field operation superintendents and directional drilling project managers. Oversee large inventory of drilling tools and materials during storage and field use. Monitors production by Fleet Department of directional drilling personnel and equipment. Duties include coordinating and scheduling the mobilization of equipment, personnel and materials to remote job sites throughout the United States and Internationally. Involved in estimating of various directional drilling projects. Specialize in the engineering design, build and maintenance of directional drilling fleet. Responsible for pilot hole drilling & survey for complicated bores which include implementing and integrating new technology necessary for successful completion of leading edge HDD crossings (i.e. hole-intersects).

2017 – 2020: Project Manager | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production recordkeeping, and overall on-site management. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
20"	2236'	Lower Piney Creek, PA	2018
20"	2209'	Horse Valley Road, PA	2018
16"	1912'	Trough Creek Valley Pike/SR 829, PA	2018
20"	1720'	Everett RR-Juniata River, PA	2018
20"	1507'	Trough Creek Valley Pike/SR 829, PA	2018
16"	2346'	Frankstown Branch-Juniata River, PA	2018
20"	1337'	Berry Ridge & Old Mill Rd, PA	2018
20"	1260'	Hollow Road, PA	2017
20"	2307'	Frankstown Branch-Juniata River, PA	2017
20"	4771'	Raystown Lake, PA	2017
36"	7194'	Ohio River MP 16.07, OH/WV	2017

2015 – 2017: Pipeline Major Maintenance Superintendent | Phillips 66 Pipeline, LLC | Billings, MT

Supervisor for seven maintenance team members and lead on special projects. Managed the execution for all pipeline and field major maintenance work including the 6 year Division River Mitigation Program.

PROFESSIONAL EXPERIENCE (continued)

2014 – 2015: **Maintenance Craft Team Leader | Phillips 66 Refining | Borger, TX**

Supervisor for area maintenance team and lead on special projects.

2012 – 2014: **Pipeline Major Maintenance Coordinator | Phillips 66 Pipeline, LLC | Missoula, MT**

Provided coordination and oversight for all pipeline maintenance and construction projects for pipeline assets in Montana, Idaho and Washington.

1996 – 2011: **Construction Superintendent | Michels Pipeline (Formally Pilchuck Contractors, Inc.) | Kirkland, WA**

Held multiple positions ranging form laborer to superintendent. Expertise included construction of gas pipelines, phone, fiber optics and installations by directional drilling.

TRAINING & CERTIFICATIONS

- CPR/1st Aid and OSHA 10
- Operator Qualifications for Liquid & Gas Pipelines
- Competent Person Trench Safety Training
- Asbestos Inspector Level Certified
- CEPA Erosion Training
- FMCSA Supervisor Training
- FEMA ICS 100 through 400

EDUCATION

Central Washington University

817 Main Street, PO Box 128 • Brownsville, WI 53006-0128 | 920.583.3132

MICHELS®

Ray J. Viator

Marine Operations Manager

PROFESSIONAL EXPERIENCE

2002 – Present: **Marine Operations Manager | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects across the country. Duties include mobilization of all equipment and personnel to remote job sites: the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment: and necessary record-keeping of plots and production. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
12" Beach Offshore	1,500'	Old Harbour, Jamaica	2018
16" Beach Approach	1,508'	Beverly Harbor, MA	2015
16"	3,27'	Collins Cove, MA	2015
8" Water Approach	7,177'	Charleston, SC	2013
8" Land to Water	7,304'	Charleston, SC	2013
8" Land to Water	3,580'	Charleston, SC	2013
30" Water Exit	5,378'	Hudson River, NY	2012
12" Water to Water	1612'	WBC62, Cameron, LA	2011
36" Beach Approach	3492'	Trinidad/Tabago	2010
42" Land to Water	2208'	Guam	2008
32" Land to Water	1943'	Guam	2007
30" Land to Water	5668'	Trinidad	2006
24"	6183'	Corsicana, TX	2005
30"	2996'	Columbia, LA	2005
24" Beach Approach	3402'	Trinidad & Tobago	2005
12" Beach Approach	2714'	Hadera, Israel	2004
30" Beach Approach	2823'	Dor, Israel	2004
30" Beach Approach	2836'	North Redding, Israel	2004
30" Beach Approach	2728'	South Redding, Israel	2004
30" Water to Water	4300'	Georges Island, MA	2003
30" Water to Water	4631'	Beverly, MA	2003
30" Land to Water	4829'	Salem, MA	2003
30" Land to Water	3041'	Weymouth, MA	2003

1989 – 2001: **Operations Manager | Smit Land & Marine, Inc. | Houston, TX**

Provided pre-contract technical input and operational management of directionally drilled crossings. Contracts completed are briefly described below:

PROFESSIONAL EXPERIENCE (continued)

1985 – 1989: **Rig Superintendent | Smit Land & Marine, Inc. | Houston, TX**

Provided technical input and site supervision of all horizontal directional drilled crossings throughout the United States.

PROJECT PROFILES

Jacob Riis State Park; Construction of 5800' of 12"steel water main pipe. (2001) – Rockaway, NY

City of Newport | Construction of a 24" HDPE x 2800' and a 20" HDPE with two 4" steel cable ducts x 2800' crossing of Yaquinna Bay on the Pacific coast at Newport Oregon. The pipelines will be used for sewer/reclaimed water and fiber optic cables.; (2001) – Newport, OR

Georgetown County Water & Sewer District | Design and construction of a 10" HDPE x 4530' crossing of the Waccamaw River near Myrtle Beach South Carolina. The pipeline will be used for potable water supply to Sandy Island.; (2001)

AT&T (Concert Global Networks USA) | Construction of four 5" x 3000' to 3600' shore crossings drilled in rock and exiting in 35' water depths on the Pacific coast of California at Manchester. The 5" dia. drill pipe will be used as a conduit for fiber optic cables linking the US with Japan.; (2000)

Daikin America | Design and construction of a 16" HDPE x 3000' shore crossing into the Tennessee River. The pipeline will be used as a NaCl/water outfall.; (2000) – Decatur, AL

City of Fort Lauderdale | Construction of a 24" x 1230' steel water main and 7 No. 6" x 1220' HDPE ducts crossing the Intracoastal Waterway.; (2000) – Fort Lauderdale, FL

City of Austin | Construction of two 24" steel water main crossings for the Davenport Ranch Water Supply Line Project in Austin, Texas: 1640' Lake Austin (Colorado River) crossing and 1170' FM 2222 crossing.; (2000)

Solutia | Construction of a 24" x 900' railroad and pipeline corridor crossing.; (1999) – Chocolate Bayou, TX

Exxon Pipeline Company | Construction of a 20" x 3830' shore crossing for the Hoover Offshore Oil Production System.; (1999) – Freeport, TX

Conoco, Inc. | Construction of a 10" x 4650' crossing of the Old & Lost River Lake to replace an existing ethane line.; (1999) – Mont Belvieu, TX

Exxon Pipeline Company | Construction of the following crude and products pipelines for the "SOLA Project," 24" x 2300' Mississippi River crossing, Dual 12" x 4300' Mississippi River crossing, 24" x 4300' Mississippi River crossing, Dual 12" + 24" x 1200' Intracoastal Waterway cr; (1998) – Baton Rouge, LA

A.K. Steel | Design and construction of a 16" x 2350' crossing through rock, below Interstate 75 and a creek for gas distribution.; (1998) – Middletown, OH

Dauphin Island Gathering Partners | Design and construction of a 24" x 1800' shore crossing for gas distribution.; (1998) – Mobile Bay, AL

PROJECT PROFILES (continued)

Transco | Design and construction of a 30" x 4000' shore crossing for gas distribution and a 30” x 2800’ water-to-water crossing of Dauphin Island. Drilled from 7' of water to 22' of water.; (1998) – Mobile Bay, AL

Beaufort Jasper Water & Sewer Authority | Design and construction of a 28; (1998) – Hilton Head Island, SC

Amoco Trinidad Oil Company | Design and construction of a 12" x 4030' shore crossing for Trinidad LNG Project.; (1997) – Galeota Point, Trinidad

Dauphin Island Gathering Partners (OEDC) | Construction of a 24” x 4700’ water-to-water crossing. Drilled from 12' of water to 20' of water.; (1997) – Dauphin Island, AL

City of Charleston, CPW | Construction of a 30; (1997) – Charleston, SC

Mobil E & P | Design and construction of a 5" x 5200' and a dual 2" x 5200' water-to-water crossings of Little Dauphin Island and a bundled 6"+2-3"+2" x 900' shore approach in Aloe Bay.; (1996-1997) – Alabama

Texas Eastern Products Pipeline | Construction of an 8" x 5500' crossing of the Red River, an 8" x 570' crossing of the Old River and 2900' of 8" conventionally laid with two (2) valve sites and tie-ins.; (1996) – Louisiana

Shell Pipeline | Construction of a 20” x 4000’ crossing of the Mississippi River at Nairn from outside the flood protection levee.; (1996) – Louisiana

City of Savannah | Construction of a 30” x 5300’ crossing under Presidents Street, Savannah with a 28” HDPE pipeline within a 30” steel casing pipe.; (1996) – Savannah, GA

Dixie Pipeline | Construction of 10" x 2800' gas pipeline crossing the Atchafalaya River.; (1995) – Louisiana

Chevron Pipeline | Design and construction of a 12" x 3500' water-to-water crossing. Drilled from 21' of water to 12' of water.; (1995) – Dauphin Island, AL

City of Charleston, CPW | Construction of a 26” x 5280' crossing of the N. Cooper River with a 24” HDPE pipeline within a 26” steel casing pipe. Construction of a 26” x 5100' shore crossings into 30' of water from Fort Moultrie into Charleston Bay near Fort Sumter again with a 24; (1995) – Charleston, SC

AT&T | Construction of four (4) 5” x 4300’ shore crossings drilled in rock and exiting in 35’ water depths on the Pacific coast of Oregon at Bandon. The 5" dia. drill pipe will be used as a conduit for fiber optic cables linking the US with Japan (the TPC-5 pro; (1995)

Hampton Roads Sanitation District | Construction of five (5) river crossings: Pagan River 24” x 1300’; Bennetts Creek 36” x 1600’; Cypress Creek 30” x 1850’; Nansemond River 30” x 4750’; and Chuckatuck Creek 30” x 3100’.; (1994-1995) – Virginia

PROJECT PROFILES (continued)

Chevron Company USA | Construction of two shore approaches with bundled pipelines from Fourchon with exits in 13' of water: 10"+8" x 1560' and 2-8"+3" x 1350'.; (1994) – Louisiana

Exxon Company USA | Construction of a 12" x 3550' shore approach drilled from Grand Isle with an exit in 12' of water and pipe lay by the SubSea Constructor.; (1994) – Louisiana

Mobile Gas Service Corp. | Construction of a 12" x 2000' gas pipeline crossing of the Mobile River.; (1994) – Alabama

Dixie Pipeline | Construction of a 12" x 3500' gas pipeline crossing of the Amite River.; (1993) – Louisiana

Dixie Pipeline | Construction of a 12" x 2500' gas pipeline crossing of Baton Rouge Bayou in Baker.; (1993) – Louisiana

ARCO | Operational assistance to South East Asian office for the construction of a 26" x 3300' shore approach (drilled from land with pullback from the McDermott derrick / laybarge DB15) and a 26" x 4000' crossing in the open waters of the Java Sea. The 4000' c; (1993) – Jakarta, Indonesia

Chevron Pipeline | Construction of a 20" x 1600' crude oil pipeline replacement crossing of a ship channel in open waters in the approaches to Gulfport. Drilled from lift-boat barges and pullback from a laybarge in water depths of 20'.; (1992) – Mississippi

Corpoven | Construction of a 36" x 4450' pipeline crossing of the Rio Orinoco at Puerto Ordaz.; (1992) – Venezuela

BP Exploration | Construction of 3-12" pipeline bundle under Dauphin Island with a drilled length of 3900'. Drilled from self elevating platforms (lift-boats) and pullback from a laybarge in water depths of 14' and 20' respectively.; (1991) – Alabama

Lagoven | Installation of a 36" x 3300' pipeline crossing of the Rio Morichal Largo on the "orimulsion" trunkline project.; (1991) – Venezuela

Lagoven | Construction of a 36" x 1700' pipeline crossing of the Rio Tigre as part of the "orimulsion" project.; (1991) – Venezuela

Shell Pipeline | Construction of a 4" x 3500' crossing of the Saginaw River in Bay City.; (1991) – Michigan

Columbia Gas | Installation of two 20" diameter pipeline river crossings - Mantua Creek (1650') and Raccoon Creek (1550').; (1990) – New Jersey

Sun Pipeline | Replacement of an 8" x 2200' gas pipeline by drilling through rock on hillside.; (1990) – Ohio

Shell Pipeline | Construction of a 10" x 1500' crossing of the Kawkawlin River.; (1990) – Michigan

Amoco Gas | Construction of a 16" x 3900' crossing of Wolf Creek in Dollar Bay, Texas City.; (1990) – Texas

PROJECT PROFILES (continued)

City of Norfolk | Construction of a 20" x 1600' water pipeline crossing of the Elizabeth River in Norfolk.; (1990) – Norfolk, VA

Seagull | Installation of two beach crossings (drilled from land) and two water-to-water crossings (drilled from spud barges) for a 1-10" and 3-8" pipeline bundle across the Houston Ship Channel at Baytown. The pipelines were pulled from a shallow draft laybarge. ; (1990) – Texas

Dixie Pipe Line | Construction of a 12" x 3000' emergency replacement crossing of the Tangipahoa River at Zachary.; (1990) – Louisiana

City of Chesapeake | Construction of a 24" x 1600' water pipeline crossing of the Elizabeth River at Chesapeake.; (1990) – Chesapeake, VA

Dixie Pipe Line | Installation of a 12" x 2300' crossing of the Comite River at Baton Rouge.; (1990) – Louisiana

Phillips Petroleum | Construction of two 12" diameter crossings near Houston: a 700' crossing of the Brazos River and a similar length crossing of Clear Creek.; (1990) – Texas

ARKLA | Installation of two 12" crossings near Fort Coffee: 2000' at the Arkansas River and 950' at the Poteau River.; (1990) – Oklahoma

Texas Power | Construction of three 16" crossings at Freeport as part of Wacker Oil's offshore development: 1600' Ship Channel crossing, 2300' Intracoastal Waterway crossing and 2700' shore approach.; (1989) – Texas

Transco | Installation of two 20" diameter crossings at Corpus Christi: an 1800' highway crossing and a 2000' lagoon crossing.; (1989) – Texas

Dixie Pipeline | Installation of a 12" x 1800' crossing of the Pearl River near Columbia.; (1989) – Mississippi

Union Camp | Construction of two Savannah River crossings: 42" x 1850' and 10"+6" bundle x 1850'.; (1989) – Georgia

Contel | Construction of a 5" x 750' crossing of the Altamaha River crossing near Jessup.; (1989) – Georgia

Phillips Petroleum | Installation of a 20" x 1800' crossing of the Brazos River at Freeport.; (1989) – Texas

Phillips Petroleum | Construction of two 2300' crossings of the Osage River at Jefferson City for 12" and 6" pipelines.; (1989) – Missouri

AT&T | Installation of five crossings with 5" conduit between Little Rock and Tulsa: Little Maumelle River - 1100' and 650', Fourche La Fave River - 550', Arkansas River - 2000' and Petit Jean River - 550'.; (1989) – Arkansas & Oklahoma

MICHELS®

Robert Spennati

Assistant Operations Manager

PROFESSIONAL EXPERIENCE

2020 – Present: Assistant Operations Manager | Michels Directional Crossings | Brownsville

Assistant Supervisor of field operation superintendents and directional drilling project managers. Oversee large inventory of drilling tools and materials during storage and field use. Monitors production by Fleet Department of directional drilling personnel and equipment. Duties include coordinating and scheduling the mobilization of equipment, personnel and materials to remote job sites throughout the United States and Internationally. Involved in estimating of various directional drilling projects. Specialize in the engineering design, build and maintenance of directional drilling fleet. Responsible for pilot hole drilling & survey for complicated bores which include implementing and integrating new technology necessary for successful completion of leading edge HDD crossings (i.e. hole-intersects). Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
16"	6976'	Matlock/W Chester Rd, PA	2020

1993 – 2020: Project Manager | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production record-keeping, and overall on-site management.

Diameter	Length	Location	Year
16"	4381'	Pennsylvania Drive, PA	2019
16"	6601'	Arch Bishop/S Chester Rd, PA	2019
16"	4399'	Valley Rd/Darlington Rd, PA	2019
16"	3728'	Village Square Dr, PA	2019
16"	1888'	West Baltimore Pike Rd, PA	2019
16"	3981'	Glendale Rd & CConcord Ave, PA	2019
12"	1070'	Indiana Harbor Canal - 12" & 10" Bundle, IN	2018
20"	7354'	Susquehanna River, PA	2018
20"	3874'	Waltonville Rd, PA	2018
16"	1198'	Harrisburg Pike, PA	2017
20"	2205'	Hwy 15, PA	2017
48"	2807'	Oliver Creek & SH 188, TX	2017
48"	2349'	Chiltipan Creek, TX	2017
48"	2263'	US Hwy 181/Hwy 35, TX	2017

PROFESSIONAL EXPERIENCE (continued)

36"	3829'	Flint River, GA	2016
12"	3144'	Monkton Swamp, VT	2016
12"	2765'	Lewis Creek, VT	2016
12"	1491'	Drinkwater Road, VT	2016
12"	2856'	Wetland Replacement, OH	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
24"	3716'	Barbour's Cut, TX	2015
24"	7432'	Houston Ship Channel, TX	2015
24"	5908'	Tabbs Bay, TX	2015
10"	4654'	Allegheny River, PA	2015
28"	1741'	Lafayette River, VA	2014
12"	2557'	Arkansas River, AR	2014
20"	1193'	SR-265/Leatherwood Rd, OH	2014
36"	1277'	Bear Creek, IL	2013
36"	2264'	Hwy 336 & 172, IL	2013
30"	4987'	Monksville Reservoir, NJ	2013
42"	3008'	I-95 & Tidal Wetlands, NJ	2013
42"	4441'	Goethals Bridge, NY	2013
30"	8101'	Kill Van Kull River, NY/NJ	2013

1988 – 1993: **Labor/Operator/ Foreman | Henkles & McCoy**

Fiber Work

1987 – 1988: **Drywall/Construction**

1985 – 1987: **Gas work/Service Lines | Circle M Construction**

1978 – 1988: **United States Army**

1978-80, Germany, 1980-82 Georiga, 1982-84 Germany, 1984-85 Georiga, 1985-88 US Army Reserves PA

EDUCATION

1978 **Mount Union High School**

High School Diploma

MICHELS®

Paul Krings

Senior Equipment and Logistics Manager

PROFESSIONAL EXPERIENCE

2019 – Present: **Senior Equipment and Logistics Manager | Michels Directional Crossings | Brownsville, WI**

Strategically manage operations in overseeing the coordinating of equipment and personnel to project jobsites. Plan, direct, coordinate purchasing, distribution and forecasting of daily operations. Oversee equipment repair and building of new, inventory control, material handling, customer service, coordinate transportation and hiring of employees. Ensures that project milestones/goals are met and adhering to approved budgets.

Provides direct supervision to supervisors and field personnel in daily operational activities, maintains regular on-site contact to assure services being performed are within Company guidelines and in accordance with consumer specifications.

Reviews daily reports and time tickets to determine hours worked, mechanical problems, etc. to effectively plan and schedule daily operational activities.

Ensures routine and preventative maintenance and repairs to keep all equipment in optimum operating condition, thus minimizing down time.

1996 – 2019: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation.

Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
36"	5841'	Ohio River MP 33.8, OH/WV	2017
25"	5788'	Hwy 41/45, WI	2017
30"	1614'	Mill Creek, IA	2016
20"	996'	O'Plaine Road, IL	2016
30"	6119'	Lake Whitney, TX	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
24"	3716'	Barbour's Cut, TX	2015
24"	7432'	Houston Ship Channel, TX	2015
24"	5908'	Tabbs Bay, TX	2015
36"	3461'	Kennedy Ave/Griffith Terminal, IN	2015
36"	2510'	Deep Creek, IL	2015

PROFESSIONAL EXPERIENCE (continued)

18"	12,459	Houston Ship Channel, TX	2015
1x6" & 2x4" Bundle	1568'	Bore #3, Nageezi, NM	2014
2 x 4" Bundle	1809'	Hwy 550, Nageezi, NM	2014
6"	6999'	Lake Navajo/San Juan River, NM	2014
36"	9040'	Mississippi River, IL/MO	2014
24"	2020'	Unnamed Creek, AL	2014
24"	2884'	Hatchett Creek, AL	2014
36"	1277'	Bear Creek, IL	2013
30"	4987'	Monksville Reservoir, NJ	2013
42"	4441'	Goethals Bridge, NY	2013
30"	8101'	Kill Van Kull River, NY/NJ	2013
30"	3042'	Wyalusing, PA	2012
36"	4505'	Medicine Hat, Alberta Canada	2012
24"	2458'	Jonestown, PA	2012
36"	4992'	Melville, LA	2011
42"	5732'	Melrose, LA	2011
24"	6091'	Homestead, FL	2011
16"	2566'	Hitchcock Plaza, SC	2010
42"	2144'	Lafourche, LA	2010

1992 – 1996: **Fluid Dynamics Technician and Laborer | Michels Directional Crossings | Brownsville, WI**

Solely responsible for mixing bentonite solution to the right consistency with an emphasis in directional drilling. Proficient working in and around drilling rigs and in the overall operation as an integral member of the specialized team. Multi-capable to assist with all types of drilling tasks and familiar with repair, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, steer tool wireline connections, couplings, etc. Involved in various types of directional drilling projects, line and cable, water and setting manholes.

TRAINING & CERTIFICATIONS

- OSHA 510 - OSHA Standards for Construction
- 40-Hour Hazmat Training – Approved for PPE Level A
- Safety Trained – Competent Person
- Veriforce and Various DOT Pipeline Safety Training
- Forklift Training
- CDL with ABCDMNT Endorsements

EDUCATION

1989 **Moraine Park Technical College**

Mig and Tig Welding; Rod, Wire and Brazing Applications;Torch Use, Cutting and Welding

1984 **Waupun High School | Waupun, WI**

High School Diploma

MICHELS®

Eric McBrair

Direct Pipe Equipment Manager

PROFESSIONAL EXPERIENCE

2017 – Present: **Direct Pipe Equipment Manager | Michels Directional Crossings | Brownsville, WI**

Responsible for equipment logistics, as well as assisting with the oversight and management of direct pipe field personnel. Support Direct Pipe field operations by developing, initiating and managing appropriate action plans to ensure quality and efficient performance of Direct Pipe resources. Duties include but not limited to: Collaborate with field operations to determine most suitable resources and means and methods of construction, troubleshoot equipment operation issues. Develop, create and maintain maintenance protocols to be utilized across the division. Coordinate equipment needs between project managers and prioritize work assignments. Manage and coordinate division equipment assets, ensuring proper allocation and efficient utilization.

2011 – Present: **Superintendent/DIRECT PIPE | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling Direct Pipe boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Skilled equipment operator with the operation of technical, lifting and heavy equipment for direct pipe & directional micro-tunnel operations as well as directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
20"	826'	Qu'Appelle River, Canada - HK750PT Installation	2017
36"	1,535'	Calumet River, IL - HK300PT Installation	2017
36"	827'	Leslie Street, Ontario, Canada - HK 300PT Installation	2015
42"	1,299'	Lisgar Meadowbrook, Ontario, Canada - HK 750PT Installation	2015
48"	4,039'	Dow Barge Channel, Clute TX - HK750PT Installation	2015
36"	1,002'	Hwy 225, Deer Park, TX - HK300PT Installation	2015
36"	1,092'	Lubrizol Drainage, LaPorte, TX-HK300PT Installation	2015
48"	2,455	Rio Grande River, El Refugio, TX-HK750PT Installation	2014
42"	1,200'	Railroad Crossing, Groves, TX-HK750PT Installation	2014
42"	1,050'	Beaver River, Alberta, Canada-HK750PT Installation	2013
42"	470'	I-84, Westfall, PA - HK750PT Installation	2013
48"	333'	18th Street, Jersey City, NJ - HK750PT Installation	2012

PROFESSIONAL EXPERIENCE (continued)

30"	5,378'	Hudson River, Manhattan, NJ/NY - HK300PT Assist	2012
36"	6,500'	St. Johns River, Jacksonville, FL - HK300PT Assist	2012
42"	426'	Chemung River, Corning, NY - HK750PT Installation	2011

2011 – 2014: **Operator/Surveyor HDD | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation.

2003 – 2011: **General Laboror | Michels Directional Crossings | Brownsville, WI**

Experience in working on and around directional drilling rigs as an integral member of a specialized team. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs; hydraulics; fluids; set-up and operation of drill motors; power generators; mud pumps; bentonite mixers; drill pipe; reamers; couplings; and overall equipment maintenance and operation.

2001 – 2003: **House Builder**

EDUCATION

2001 **Fox Valley Technical College | Appleton, WI**

2000 **Berlin High School | Berlin, WI**

High School Diploma

Scott Nehls

HDD Logistics QA/QC Manager

PROFESSIONAL EXPERIENCE

2009 – Present: HDD Logistics QA/QC Manager
Michels Directional Crossings | Brownsville, WI

Responsible for truck load out and receiving, organization of HDD tooling and equipment, coordination of drill stem supply, tracking and calibration, new hire training, orientation, dispatch, manage divisional labor pool, tractor trailer inspection/maintenance program implementation, safety training/OQ program implementation, on-site review of HDD personnel & operations.

1989 – 2009: Project Manager
Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects across the country. Duties include mobilization of all equipment and personnel to remote job sites; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Provides safety training and performs evaluations. Assists with estimating and bid preparation. Some more noteable crossings include, but are not limited to:

Diameter	Length	Location	Year
20” & 42”	1544’ & 2127’	Wisconsin River, WI	2007
20” & 42”	2530’ & 2299’	Chippewa River, WI	2007
20” & 42”	2280’ & 2294’	Flambeau River, WI	2007
42” (2)	2294’ & 2775’	Lake Arrowhead, WI	2007
24”	2172’	Biscayne Bay, FL	2006
30”	2453’	Jackson Creek, WI	2006
30”	1301’	Jackson Creek, WI	2006
30” (2)	1400’ & 2661’	Rausonville & Willis Rd, MI	2005
24”	2429’	Kinnickinnic River, WI	2005
36” (3)	1276’ to 1531’	Clarkston, MI	2005
8”	1374’	Detroit, MI	2005
12” (10)	375’ to 750’	Lansing, MI	2004
16” (2)	2723’ & 2925’	Packard Rd & Washtenaw Ave, MI	2004
22”	2308’	St. Joseph River, MI	2004
30” (2)	1532’ & 1661’	Darien, WI	2004

PROFESSIONAL EXPERIENCE (continued)

6" (6)	1564' to 1880'	Lean, WI	2004
12" (3)	1668' to 3524'	New York/New Jersey	2003
30"	1673'	Huron River, MI	2002
36"	3395'	Huron River, MI	2002

1986 – 1989: **Superintendent**

Michels Mid-America Line & Cable | Brownsville, WI

Working foreman responsible for managing utility construction crews. Accountable for tie-ins behind our rail-mounted plow which consists of horizontal boring operations and dig downs. Implemented supervisory skills for material and labor coordination.

1980 – 1986: **Equipment Operator**

Michels Mid-America Line & Cable | Brownsville, WI

Rubber tire backhoe operator responsible for location of utility line obstructions and the timely placement of telephone pedestals to keep production oriented cable placing operations flowing smoothly.

1977 – 1983: **Marine Corp Sergeant/Section Leader**

Active Reserve Company-G, 24th Marines, 4th Division | Madison, WI

1977 – 1980: **General Laborer/Operator**

Michels Mid-America Line & Cable | Brownsville, WI

General laborer responsible for boring operations for telephone cable with various types of equipment.

1973 – 1977: **Project Set-Up Coordinator**

Michels Pipeline Construction | Brownsville, WI

Involved in coordinating materials and supplies for various job locations. Helped in attaining storage yards for equipment and supplies around the United States. Responsible for establishing accounts at various retailers and suppliers within the job working area.

INDUSTRY INVOLVEMENT

- Midwest Energy Association (MEA) Evaluator

EDUCATION

1977 **Lomira High School | Lomira, WI**

High School Diploma

MICHELS®

Sean O. Nicholson

Vice President of HSE

PROFESSIONAL EXPERIENCE

2017 – Present: **Vice President of HSE | Michels Corporation | Brownsville, WI**

2007 – 2017: **Director of Health & Safety | Michels Corporation | Brownsville, WI**

Assigned the responsibility of developing, implementing and maintaining the health, safety and environmental program for Michels Pipeline Construction and Michels Directional Crossing divisions of Michels Corporation. Advise executive management pertaining to matters of safety and health, and monitor day-to-day operations to ensure compliance with applicable regulatory requirements and the company's health and safety policies and procedures.

2000 – 2007: **Corporate Director HSE/Risk Management | Mears Group, Inc.**

Responsible for all facets of HSE initiative compliance and training on an international level. Complied and reviewed incident/injury data to determine trends and develop corrective actions and/or programs to prevent recurrence and improve performance. Managed/directed all aspects of litigation issues and legal proceedings. Conducted investigations on suspected workers' compensation and property damage fraud cases. Developed and audited HSE programs and policies to ensure compliance with regulatory agencies governing the energy industry.

1999 – 2001: **Regional Manager of Safety Training & Environmental Compliance | 360networks Inc.**

Planned, implemented and coordinated programs to reduce and eliminate occupational injuries, illnesses, fatalities and financial losses. Developed accident prevention, loss control systems and programs for incorporation into operational policies of the organization. Duties also included, preparing and presenting various required training; performing routine environmental and safety inspections; leading investigations of accidents and injuries.

1999: **Clearing Foreman–Railway Services Division | 360networks Inc./Ledcor Industries**

Trained and managed 45 flagmen and achieved significant improvements in their productivity and safety. Conferred with department heads concerning problems such as near misses and accidents, and recommended measures and procedure to improve safety.

1998 – 1999: **Lead Hand | Ledcor Communications**

Assisted superiors in planning and coordinating activities of workers engaged in constructing, installing and inspecting long haul fiber optic infrastructures. Inspected work in progress to ensure the work conformed to company specifications.

TRAINING & CERTIFICATIONS

- Certified HSE Auditor with the Albert Construction Safety Association
- Completed "Auditor Certification Training Program" with NCCER
- OSHA 500 and 510
- OSHA Outreach Instructor
- Certified in HSE Law from the Institute of Applied Management and Law
- Certified Defensive Driving Instructor with National Safety Council
- Certified Instructor "Speed Shore" (Competent Person, Trenching and Excavation)

TRAINING & CERTIFICATIONS (continued)

- Certified Instructor–American Traffic Safety Services Association
- Traffic Control Supervisor and Technician
- “TaprooT” Investigations Course
- Certified Medic First Aid/CPR
- Master Trainer–NCCER

EDUCATION

1997 **Trent University | Ontario, Canada**

Bachelor of Arts (Honors)

Jason Pedersen, CSM

Safety Director

PROFESSIONAL EXPERIENCE

2017 – Present: **Safety Director | Michels Corporation | Brownsville, WI**

The primary function of the HSE Director is to work within corporate strategies and policy frameworks to design, implement and direct safety programs, guidelines and procedures. This position provides personal leadership and sets an example of following all safe work practices and procedures. Regularly interfaces with Senior Management, peers, subordinates and client personnel, overseeing project site HSE plans and alliance with corporate values, requirements and initiatives.

The primary responsibility is to coordinate the company's safety activities including:

Develop procedures and lead the implementation of processes which have been established to ensure compliance with applicable standards, requirements and identified practices. Ensure Michels Corporation has effective programs to protect the safety of employees and comply with or exceed regulations through personal observation, HSE Manager review and audits.

Demonstrate leadership by giving clear, complete, and accurate information on HSE requirements, process standards, potential health and safety hazards, and potential process difficulties. Interface with operations providing leadership and coaching to facilitate continuous HSE performance improvement.

Participate in incident/injury investigations, including on-site presence, preparation of reports, analysis and exhibits. Identify regulatory and civil parties needing involvement.

Work with all employees to instill a safe and environmentally conscientious work environment, determining the awareness level, discussing policies and procedures, advising on the best means of following those policies and procedures and coaching to improve behavior as needed.

Recommend, implement, and manage safety devices, equipment, and/or products that help protect employees and customers and mitigate losses.

Work closely with Operations, Quality Assurance, HR, Risk, and various other departments to enhance HSE systems. Communicate HSE information to key management as directed.

2013 – 2017: **HSE – Senior Manager, Compliance Specialist | Michels Pipeline Construction | Brownsville, WI**

Manage the HSE Team. Carry out supervisory responsibilities in accordance with the organization's policies and applicable laws. Responsibilities include interviewing, hiring, and training employees; planning, assigning, and directing work; providing feedback; rewarding and disciplining employees; addressing complaints and resolving problems. Identify and leverage HSE best practices across divisions. Maintain open communication with divisional and department leads to ensure coordination of HSE needs. Advises HSE Director on Health, Safety, and Environmental-related matters throughout the corporation. Review project safety requirements prior to bid and advise division on site specific training or equipment that may be needed. Is present at or delegates to HSE Coordinators to be present during regulatory site visits. Assist with and participate in client sales presentations and formal client meetings. Represent Michels at conferences, committees, and customer meetings. Work with Information Systems and Technology to identify and implement tools to drive better communication, process-management, and reporting tools. Other duties as assigned.

PROFESSIONAL EXPERIENCE (continued)

2006 – 2013: **Senior Project HSE Manager | Michels Pipeline Construction | Brownsville, WI**

2006: **IL & IA North West Region Local 309 Steward | Minnesota Limited, Inc. | Big Lake, MN**

2005: **IL & IA North West Region Local 309 Steward | J & L Pipeline Services, Inc. | Tipton, IA**

1996 – 2004: **Safety Coordinator/Foreman | Murphy Brothers, Inc. | East Moline, IL**

1989 – 1995: **United States Navy**

1988 – 1989: **Laborer/Oiler | Southern Gas Pipeline Company | Corpus Christie, TX**

PROJECT PROFILES

Dominion | Atlantic Coast Pipeline (ACP), Spread 2-1 and 6; Approximately 71.9 miles of 42" OD mainline pipeline. - Buckhannon, WV and Farmville, VA

Enbridge Energy | NEXUS Gas Transmission, Spreads 4, 3 and 1; Approximately a total of 177.2 miles of 36" steel pipeline. - Belleville, MI, Northwood, OH and Canton, OH

Sunoco | Mariner East II - PPP3, Spread 4; Approximately62.9 miles of dual line 20" and 16" steel pipeline. – Hollidaysburg & Shirleysburg, PA

Williams | Atlantic Sunrise Pipeline (ASR) - Spread 1; 37 miles of 30" – Tunkhannock, PA

Enbridge Energy | Line 3 Replacement, Segment 18; 13 miles of 36" – Superior, WI

Energy Transfer Company | Dakota Access Pipeline Project; 380 Miles of 30" pipe along three mainline spreads, thirteen HDD and three pump stations in Il, IA, SD, and ND

Enbridge | Flanagan South Pipeline Project; 300 miles of 36" – Illinois & Missouri

TransCanada | Keystone XL Gulf Coast Project; 360 miles of 36" – Texas & Oklahoma

Shell Appalachia | 70 miles 20" & 10"; Pennsylvania

Energy Transfer | Tiger Expansion Project; 27 miles 42" – Louisiana

Enbridge | Hot Works Line 6B Replacement Project; 67 Miles 30" – Michigan

Energy Transfer | Tiger Pipeline Project; 100 miles 42 – Louisiana

Enbridge | Alberta Clipper Project; 110 miles 42" – North Dakota & Minnesota

Enbridge/Michels/GPP | Southern Lights; 310 miles 42" & 20" – Wisconsin & Illinois

El Paso/Michels | Two Launcher Stations; 10 miles 30" & 16" – Wisconsin

Kinder Morgan | Rockies Express Project; 53 miles 42" – Ohio

Lake Head | 120 miles 36"; Illinois & Wisconsin

Alliance Ltd | 150 miles 36"; Illinois & Iowa

El Paso | 10 miles 20"; Indiana

TRAINING & CERTIFICATIONS

- Certified Safety Manger/Trainer (CSM)
- Certified Occupational Safety Specialist (COSS)
- DNV Incident Investigation Certified
- Safety Auditor Certificate (SAC)
- OSHA 502 - Update for Construction Trainers
- OSHA 500 - Trainer Course for the Construction Industry
- OSHA 510 - OSHA Standards for Construction
- OSHA 10- and 30-Hour Certified Trainer
- Accident Investigation Technician (AIT)
- Hazard Analysis Techinician (HAT)
- Safety Inspections Technician (SIT)
- CMC Confined Space Rescue
- Reasonable Suspicion Trainer
- HAZWOPER Certification 4 Hour
- NCCER Instructor / Performance Evaluator
- Certified MES Q41 Evaluator
- AMSE Rigging Trainer (Crosby)
- Hazardous Material Trainer
- National Safety Council Defensive Driving Certified Instructor
- ATSSA Flagger Instructor
- ATSSA Certified Traffic Control Supervisor/Technician
- Medic First Aid/CPR/AED Trainer
- Respirator Fit Testing & Certification

MICHELS®

Mark Franz

Environmental Manager

PROFESSIONAL EXPERIENCE

2009 – Present: **Environmental Manager | Michels Corporation | Brownsville, WI**

Responsible for environmental due diligence, oversight and compliance for mainline spreads. Function as environmental liaison between Michels and Client.

2009: **Environmental Coordinator | Michels Corporation | Brownsville, WI**

Environmental oversight of Michels-Spread 2 of the Alberta Clipper Pipeline Project for client Enbridge Energy. Project consists of installation of 64 miles of 36" mainline pipeline crossing through 41 permitted waterbodies and 136 wetlands in northwestern Minnesota. Responsible for environmental crew management, and support and oversight for field construction issues. Functioned as environmental liaison between Michels and Enbridge.

2006 – 2009: **Environmental Manager | Global Pipeline Partners, LLC | New Berlin, WI**

Environmental oversight of Phase 1 of the alliance agreement between Global Pipeline Partners LLC (Michels Pipeline, Welded Construction, Precision Pipeline and U.S. Pipeline) and client Enbridge Energy. Phase 1 consisted of installation of 321 miles of 20" and 42" mainline pipeline crossing through over 800 permitted wetlands and 230 permitted water bodies. Responsible for contractor environmental planning, support and oversight for field construction issues. Function as environmental liaison between Enbridge and each of the four contractors. Also responsible for preparation of necessary baseline information, environmental variance submittals and management of contractor compliance issues related to the projects Wisconsin Department of Natural Resources and US Army Corp of Engineers execution permits.

2005 – 2006: **Natural Resource Specialist | Michels Corporation | Brownsville, WI**

Responsible for environmental due diligence, wetland delineations and assessments, storm water management, habitat assessments, regulatory permitting, threatened and endangered species survey, and water resource management. Proficient in native vegetation identification in the midwestern and southeastern United States, and in the use of AutoCAD and ArcGIS.

2004 – 2005: **Environmental Specialist/Project Manager | Earth Tech**

1999 – 2004: **Reclamation Specialist/Project Manager | Michels Corporation | Brownsville, WI**

1996 – 1999: **Ecologist | Biological Research Associates, Ltd.**

1994 – 1996: **Biologist | Sarasota County Department of Natural Resources**

1992 – 1994: **Environmental Scientist | Reynolds Smith and Hill, Inc.**

1990 – 1992: **Assistant Biologist | Florida Department of Environmental Protection**

1984 – 1987: **Assistant Planner | Wiles, Dailey, Kane & Associates**

EDUCATION

New College of the University of South Florida | Sarasota, FL

Bachelor of Arts, Biology/Environmental Science

MICHELS®

Edward J. Dye

HDD Safety Coordinator

PROFESSIONAL EXPERIENCE

2017 – Present: **HDD Safety Coordinator**

Michels Directional Crossings | Brownsville, Wisconsin

Develop and implementation of on-site procedure, emergency response plan, on-site safety inspections, equipment inspections and reporting to supervisors. Assigned the responsibility for coordinating and maintaining the company safety program. Advises management in matters of safety and health, and monitors day-to-day operations to ensure that the company's safety policies and procedures are followed.

2016 – 2017: **HSE Coordinator**

Michels Pipeline Construction | Brownsville, WI

Promotes Michels' Core Values, leads by example and is an ambassador for HSE Department and Michels Corporation. Assigned the responsibility for coordinating and maintaining the company safety and health program. Advises management in matters of safety and health, and monitors day-to-day operations to ensure that the company's safety policies and procedures are followed. The primary responsibility is to coordinate the company's safety activities are: daily job safety audits, ensure safety on all construction projects, edit and submit safety plan for projects, Ensure all personal protective equipment in on site when necessary, new hire orientation process, assist with organization of annual safety training, tailgate safety meeting coordination, and write up job hazard analysis. Represents Michels during regulatory inspections, client audits and meetings.

2013 – 2016: **Foreman**

Michels Pipeline Construction | Brownsville, WI

Direct activities of workers pertaining to the repair, maintenance, construction, installation, and reconditioning of pipelines. Determine tie-in locations and coordinate their installations with operating units on project sites while providing leadership and support in field production operations. Lead the crews in quality, safety and environmental compliance.

2006 – 2013: **Foreman**

River City Cutting | River City Cutting, IA

Led a multifunctional team of 6 employees on the demolition and precision cutting of concrete. Bid projects by evaluating blueprints, timelines, square footage, and customer operational needs. All projects under my supervision met their timeline, came in at or under bid, and turned a profit for the company. Performed work at numerous types of project sites such as military installations, nuclear power plants, hospitals, schools, bridges, roads, courthouses, jails, and multiple lock and dams. Taught formal classes to apprentices through the union hall on the use of core drills, concrete chainsaws, walk-behind saws, and remote control wall saws. Conducted interviews and background checks on new employees.

2002 – 2006: **Laborer**

Valley Construction | Rock Island, IL

TRAINING & CERTIFICATIONS

- OSHA 30-Hour
- OSHA 510 - OSHA Standards for Construction

TRAINING & CERTIFICATIONS (continued)

- OSHA 500 - Trainer Course for the Construction Industry
- OSHA 3015 - Excavation, Trenching and Soil Mechanics
- Construction Plan Reading Course
- Power Industrial Truck Operations
- Coating Maintenance Course
- Scaffold Builder
- Locating Pipelines
- First Aid/CPR Certified
- Damage Prevention During Excavation First Aid
- Traffic Control Certification
- Leak and Strength Test Course
- Cathodic Protection Systems
- Backfilling
- Underground Clearance
- Receiving Pigs for Lines In-Service
- Internal Devices for Lines In-Service
- Mechanical Joints

MICHELS®

Michael Miller

HSE Safety Coordinator

PROFESSIONAL EXPERIENCE

2019 – Present: **HSE Safety Coordinator | Michels Corporation | Brownsville, WI**

Promotes Michels' Core Values, leads by example and is an ambassador for the HSE Department and Michels Corporation. Assigned the responsibility for coordinating and maintaining the company safety and health program. Advises management in matters of safety and health, and monitors day-to-day operations to ensure that the company's safety policies and procedures are followed. The primary responsibility is to coordinate the company's safety activities, which include but are not limited to: daily job safety audits, ensuring the safety on all construction projects, editing and submitting safety plans for projects, ensuring all personal protective equipment is on site when necessary, new hire orientation process, assisting with the organization of annual safety training, tailgate safety meeting coordination, and writing up job hazard analysis. Represents Michels during regulatory inspections, client audits and meetings.

2014 – 2018: **Safety Coordinator | LMC Industrial Contractors, Inc.**

Responsible for coordinating all safety efforts in both LMC's 550,000 square foot facility, as well as on all active sites. Evaluating all personnel to be Veriforce certified. Properly practice respiratory protection, SABC, confined space principals, hazardous abatement procedures, fall protection practices, trenching & excavation safety and compliance, fatigue management, critical lifts, rigging best practices, electrical safety/LOTO, and proper equipment use. Forklift operator certification and Forklift operation trainer. Conduct new hire orientations for all employees and subcontractors. Lead daily safety meetings for all shop and field work. Perform weekly jobsite safety assessments and reporting any deficiencies and near misses/violations. Perform accident investigations/Root Cause Analysis and enforcement of all environmental, safety, health and accident prevention procedures. Reporting of near hits, spills, releases, and safety or environmental non-compliance issues. Create and review task specific safety analysis/JSA/JHA.

2014: **Safety Coordinator Assistant | Holloman Corporation**

Ensure strict compliance with all federal, state and local safety requirements. Properly practice respiratory protection, SABC, confined space principals, hazardous abatement procedures, fall protection practices and proper equipment use.

2013: **Fleet Vehicle Maintenance Inventory/Tracking | Somerset Regional Water Resources**

Maintained inventory tracking for 70+ company vehicles. Ensure safety, inspection, and scheduled maintenance for all assets.

1993 – 2013: **Aircraft Electrical & Environmental Systems Craftsman/Quality & Safety Inspector | United States Air Force**

Performed and supervised aircraft electrical functions and activities. Compiled maintenance data and daily safe maintenance practice evaluations. Performed off equipment maintenance of system components and associated/special test equipment. Performed cryogenic maintenance on mobile servicing units.

TRAINING & CERTIFICATIONS

- Crosby Communication 4 Hour Fundamentals of Rigging
- Erosion and Sediment Control Lead Certified

TRAINING & CERTIFICATIONS (continued)

- Erosion & Sediment Control Training
- OSHA 10-Hour – Construction Safety & Health
- OSHA 30-Hour Construction
- OSHA 500 - Trainer Course for the Construction Industry
- OSHA 510 - OSHA Standards for Construction
- OSHA 511 - Occupational Safety & Health Standards for General Industry
- OSHA 5810 - Hazards Recognition and Standards for On-Shore Oil and Gas Exploration and Production
- Rigging Training

EDUCATION

USAF Non-Commissioned Officer Academy

1998 **Airforce Leadership School**

1996 **Community College of the Air Force**

Business Associates Degree

1993 **Aircraft Electrical & Environmental System Technical School**

Honors

MICHELS®

Spencer Rusk

PROFESSIONAL EXPERIENCE

2018 – Present: **HSE Safety Coordinator | Michels Corporation | Brownsville, WI**

Promotes Michels' Core Values, leads by example and is an ambassador for the HSE Department and Michels Corporation. Assigned the responsibility for coordinating and maintaining the company safety and health program. Advises management in matters of safety and health, and monitors day-to-day operations to ensure that the company's safety policies and procedures are followed. The primary responsibility is to coordinate the company's safety activities, which include but are not limited to: daily job safety audits, ensuring the safety on all construction projects, editing and submitting safety plans for projects, ensuring all personal protective equipment is on site when necessary, new hire orientation process, assisting with the organization of annual safety training, tailgate safety meeting coordination, and writing up job hazard analysis. Represents Michels during regulatory inspections, client audits and meetings.

2017 – 2018: **Welder Helper | Michels Corporation | Cedar Rapids, IA**

- Local 25 Plumbers/Pipefitters Welder Helper. Extra duties include sandblasting & painting pipe, hot wraps and applying epoxy coatings in compliance with OSHA.
- Performed pipeline construction removal and installation e.g. digging, backfilling, final grading while being vocal with peers to make sure Michels safety standards and policies were followed.
- Involved in pigging operations to ensure pipe is clean and inspected ensuring it is up to standards.
- Wrote JSA's, step back for safety cards and actively participated in safety meetings.

2009 – 2018: **Firefighter & EMT | Geneseo Fire Protection District | Geneseo, IL**

- Serve as both firefighter and EMT supporting basic life support/trauma and medical patient care.
- Trained in fire suppression, structural fire classes, vehicle and confined space training as well as vehicle extrication.
- Conduct and teach fire safety education and first aid throughout the area schools.

2005 – 2018: **Automotive Collision Repair Technician | Pro/Tech Auto Body Inc. & Pinks' Paint & Body | Geneseo, IL**

- Analyzed requirements on fulfilling estimation paperwork, while maintaining a budget and completing the job within the time requirements; ensuring damage was repaired flawlessly.
- Created detailed damage assessment to optimize vehicle quality after repairs.
- Worked with customers to answer all questions to ensure customer service was paramount.
- Kept accurate logs of MSDS for the chemicals and paints used on site.

TRAINING & CERTIFICATIONS

- OSHA 10-Hour – Construction Safety & Health
- OSHA 30-Hour Construction
- First Aid/CPR Certified
- Hazardous Materials Awareness
- Basic Wildland Firefighter: I-200, L-180, S-130, S-190
- Firefighter II
- EMT – Basic

Scott Nehls

HDD Logistics QA/QC Manager

PROFESSIONAL EXPERIENCE

2009 – Present: **HDD Logistics QA/QC Manager**

Michels Directional Crossings | Brownsville, WI

Responsible for truck load out and receiving, organization of HDD tooling and equipment, coordination of drill stem supply, tracking and calibration, new hire training, orientation, dispatch, manage divisional labor pool, tractor trailer inspection/maintenance program implementation, safety training/OQ program implementation, on-site review of HDD personnel & operations.

1989 – 2009: **Project Manager**

Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects across the country. Duties include mobilization of all equipment and personnel to remote job sites; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Provides safety training and performs evaluations. Assists with estimating and bid preparation. Some more noteable crossings include, but are not limited to:

Diameter	Length	Location	Year
20” & 42”	1544’ & 2127’	Wisconsin River, WI	2007
20” & 42”	2530’ & 2299’	Chippewa River, WI	2007
20” & 42”	2280’ & 2294’	Flambeau River, WI	2007
42” (2)	2294’ & 2775’	Lake Arrowhead, WI	2007
24”	2172’	Biscayne Bay, FL	2006
30”	2453’	Jackson Creek, WI	2006
30”	1301’	Jackson Creek, WI	2006
30” (2)	1400’ & 2661’	Rausonville & Willis Rd, MI	2005
24”	2429’	Kinnickinnic River, WI	2005
36” (3)	1276’ to 1531’	Clarkston, MI	2005
8”	1374’	Detroit, MI	2005
12” (10)	375’ to 750’	Lansing, MI	2004
16” (2)	2723’ & 2925’	Packard Rd & Washtenaw Ave, MI	2004
22”	2308’	St. Joseph River, MI	2004
30” (2)	1532’ & 1661’	Darien, WI	2004

PROFESSIONAL EXPERIENCE (continued)

6” (6)	1564’ to 1880’	Lean, WI	2004
12” (3)	1668’ to 3524’	New York/New Jersey	2003
30”	1673’	Huron River, MI	2002
36”	3395’	Huron River, MI	2002

1986 – 1989: **Superintendent**

Michels Mid-America Line & Cable | Brownsville, WI

Working foreman responsible for managing utility construction crews. Accountable for tie-ins behind our rail-mounted plow which consists of horizontal boring operations and dig downs. Implemented supervisory skills for material and labor coordination.

1980 – 1986: **Equipment Operator**

Michels Mid-America Line & Cable | Brownsville, WI

Rubber tire backhoe operator responsible for location of utility line obstructions and the timely placement of telephone pedestals to keep production oriented cable placing operations flowing smoothly.

1977 – 1983: **Marine Corp Sergeant/Section Leader**

Active Reserve Company-G, 24th Marines, 4th Division | Madison, WI

1977 – 1980: **General Laborer/Operator**

Michels Mid-America Line & Cable | Brownsville, WI

General laborer responsible for boring operations for telephone cable with various types of equipment.

1973 – 1977: **Project Set-Up Coordinator**

Michels Pipeline Construction | Brownsville, WI

Involved in coordinating materials and supplies for various job locations. Helped in attaining storage yards for equipment and supplies around the United States. Responsible for establishing accounts at various retailers and suppliers within the job working area.

INDUSTRY INVOLVEMENT

- Midwest Energy Association (MEA) Evaluator

EDUCATION

1977 **Lomira High School | Lomira, WI**

High School Diploma

MICHELS®

Ken Coleman

Project Manager

PROFESSIONAL EXPERIENCE

2008 – Present: **Project Manager | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production recordkeeping, and overall on-site management. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
24"	3183'	Crow River, MN	2019
24"	2100'	Spanish Lake, MO	2019
22"	4986'	Atchafalaya River, LA	2019
42"	4687'	Lake Scranton Finished H2O Tunnel, PA	2018
42"	3980'	Susquehanna River MP 99.6, PA	2018
42"	1810'	Interstate 80, PA	2018
42"	2826'	San Joaquin River, CA	2017
10"	5697'	Mississippi River, LA	2017
6"	3309'	Hauser River, MT	2017
8"	1980'	CHS Yellowstone River, MT	2017
30"	7531'	Lake Oahe & Missouri River, ND	2017
12"	1178'	Howard Cove, ME	2016
12"	1023'	Cutler Site, ME	2016
12"	1114'	Sunflower Field, VT	2016
12"	1129'	Arch Site & Town Hill Rd, VT	2016
12"	686'	Laplatte River, VT	2016
12"	922'	Arch Site & Monkton Rd, VT	2016
12"	492'	Arch Site, VT	2016
42" Steel with 36" HDPE	3983'	St John's River, FL	2016
27" HDPE Bundle	3737'	Little Creek, VA	2016
16"	2249'	Ohio River, OH/KY	2015
24"	1405'	Platte River, MO	2015
36"	1755'	New York St, IL	2015

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
36"	2303'	Liberty Street,IL	2015
24"	3275'	Transfer Line 1, IN	2014
8"	2545'	MP266, Mountain Green, UT	2013
30"	1881'	Bennekill Stream, NJ	2013
30"	6544'	1st Street, NJ	2013
36"	1392'	Seacaucus, NJ	2012
30"	1186'	Bowman Cty., ND	2011
20"	1814'	Marion, OR	2011
20"	3075'	Marion, OR	2011
30"	5786'	Vernon, NJ	2011
42"	3008'	White River, AR	2010
42"	1010'	Albany Ave, NJ	2010

1993 – 2008: **Supervisor | Mears**

Supervised over HDD projects with pipe diameters of 6” to 60” with lengths of 600’ to 7,200’ in the United States, Canada, and Mexico.

1990 – 1993: **Operator | ARB**

Experience operating the following equipment: forklift, front end loader, dozer scraper, motor grader, back hoe, excavator, crane, hot mix plants, trenching machine, rock crusher, horizontal drilling rig and fusing machines from 4” to 32” HDPE.

1968 – 1990: **Operator | Reading & Bates**

Worked as Operator, low boy driver, horizontal drilling rig, and supervisor of equipment yard and warehouse.

EDUCATION

1962 **Harrison Central High School | Gulfport, MS**

High School Diploma

MICHELS®

Jim McGovern

Project Manager

PROFESSIONAL EXPERIENCE

1995 – Present: **Project Manager | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production recordkeeping, and overall on-site management. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
24"	3183'	Crow River, MN	2019
20"	2740'	West Branch Escanaba River, MI	2019
20"	2173'	Escanaba River 2, MI	2019
20"	1421'	Middle Branch Escanaba River, MI	2019
42"	2007'	Las Moras Creek, TX	2019
36"	2438'	Huron River MP 117.2, OH	2018
36"	3199'	Vermillion River MP 104.4, OH	2018
36"	1863'	E. Branch Black River MP 86.7, OH	2018
36"	1886'	Nimisila Rexervoir MP 40.9, OH	2018
16"	5869'	Conrail RR, NJ	2018
16"	2766'	Hall Street, NJ	2018
16"	1999'	Route-35, NJ	2018
12"	5170'	Larch Dr & Wetland, MN	2017
24"	5788'	Hwy 41/45, WI	2017
16"	3065'	Rock Creek & US HWY 67, IA	2016
16"	6693'	Wapsipinicon River, IA	2016
24"	1898'	Vermillion River, IL	2016
20"	1904'	North St Mary's River, IN	2016
20"	1076'	South St Mary's River, IN	2016
36"	1862'	State Highway 50, IL	2015
36"	3461'	Kennedy Ave/Griffith Terminal, IN	2015
36"	1813'	Calumet Ave, IN	2015
36"	2510'	Deep Creek, IL	2015
36"	1803'	Dyer Ditch, IN	2015
36"	3011'	Highway 41 & RR, IN	2015
36"	5128'	Lake Ave & RR, IL	2015

36"	1812'	Highway 394, IL	2015
36"	9040'	Mississippi River, IL/MO	2014
36"	2264'	Otter Creek, IL	2013
36"	3544'	Illinois River, IL	2013
36"	1611'	Mackinaw Rover, IL	2013
36"	3892'	Red River, OK	2013
36"	4213'	Menard Creek, TX	2013
36"	3571'	Angelina River, TX	2013
36"	2908'	Neches River & RR, TX	2013
36"	1867'	Flora, TX	2012
36"	1740'	Sabine River, TX	2012
36"	2567'	South Sulphur River, TX	2012
30"	2906'	Hickory Creek, Marietta, OK	2012
16"	1656'	Chicolete River, TX	2012
42"	1650'	Chicolete River, TX	2012
16"	1717'	Morales, TX	2012
42"	1670'	Morales, TX	2012
16"	1658'	Cordele, TX	2012
42"	1658'	Dewitt, TX	2012
16"	1717'	Morales, TX	2012
16"	1664'	Morales, TX	2012
42"	3205'	Dewitt, TX	2012
42"	1661'	Morales, TX	2012
24"	1386'	Jonestown, PA	2012
24"	2458'	Jonestown, PA	2012
8"	6675'	Wilmington, NC	2012
8"	6669'	Wilmington, NC	2012
8"	7019'	Missouri River, NE	2011
42"	3035'	Rambling Bayou, LA	2011
42"	5340'	Boise Cascade, LA	2011
42"	4932'	Bayou Jean De Jean, LA	2011
12"	2484'	Wetland #13, NC	2011
42"	2094'	Hwy 9, LA	2010
42"	5248'	Saline Bayou, LA	2010
42"	1838'	Steep Bayou, LA	2010

42"	2243'	Beouf River, LA	2010

1991 – 2005: **Pipe-Side Superintendent/Pullback Coordinator | Michels Directional Crossings | Brownsville, WI**

Responsible for coordination of pipe welding subcontractor located on exit side of directional drill. Duties include operation and maintenance of equipment, coordination of labor for specialized pipe coating and testing. Solely responsible for maintaining constant communication with the driller during control of ballasting, which is one of the most critical aspects of pipe pulling.

1987 – 1991: **Operator/Foreman | Michels Directional Crossings | Brownsville, WI**

Skilled in the operation of technical, lifting and heavy equipment for directional drilling operation. Working knowledge of hydraulic engineering and applied mechanical engineering. Experience in working on and around directional drilling rigs as an integral member of a specialized team. Familiar with mechanical repairs, hydraulics, fluids, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation.

1972 – 1987: **Operator | Gas Division of Michels Pipeline Construction | Brownsville, WI**

Track-hoe and backhoe operator responsible for maintaining line and grade on civil and gas pipeline projects. Duties include trench maintenance and safety as well as equipment repairs and maintenance.

1968 – 1972: **Skilled Laborer | Michels Pipeline Construction | Brownsville, WI**

Laborer working with underground construction crew. Responsibilities include upholding safety consciousness while performing various duties to help maintain progressive pipe/cable laying production.

EDUCATION

1967 **Waupun High School | Waupun, WI**

High School Diploma

MICHELS®

Larry Shilman

Project Manager

PROFESSIONAL EXPERIENCE

1999 – Present: **Project Manager | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production recordkeeping, and overall on-site management. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	7402'	Susquehanna River, PA	2019
20"	2355'	Joanna Road, PA	2018
4"	1495'	Des Moines River, IA	2018
16"	5869'	Conrail RR, NJ	2018
36"	5841'	Ohio River MP 33.8, OH/WV	2017
14"	9154'	Nansemond River, VA/ ND	2017
30"	7531'	Lake Oahe & Missouri River, ND	2017
16"	11,397'	Lake Sacagawea South, ND	2016
30"	3352'	Cliff Crossing, ND	2016
16"	11,229'	Lake Sacagawea North, ND	2016
8"	4022'	Lake Macatawa, MI	2016
8"	1957'	Grand River, MI	2016
30"	1418'	Highway 250, OH	2015
16"	1402'	Deer Lake, ND	2015
10"	1971'	Tank Farm/Central Ave, PA	2015
8"	3320'	Yellowstone River, MT	2015
24" HDPE	1061'	Lake Sakakawea, ND	2014
8"	7321'	MP 49.3 Landslide, MT	2014
8"	4159'	MP 54.8 Landslide, MT	2014
20"	2364'	Missouri River, IA/NE	2014
16"	2951'	Line 82, ND	2014
36"	5687'	Missouri River, MO	2013
36"	2355'	Salt Fork River, MO	2013
36"	2077'	Chariton River, MO	2013
48"	1943'	West Neck Creek, VA	2013

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Crossing/Location	Year
48"	819'	Hunt Club Creek, VA	2013
8"	7177'	115 KV Power Duct, SC	2013
8"	7304'	115 KV Power Duct, SC	2013
8"	4911'	115 KV Power Duct, SC	2013
36"	1366'	Big Sandy, Maple Springs, TX	2012
36"	1444'	Hwy 155 & UPRR, Big Sandy, TX	2012
36"	1761'	Private Lake, Maple Springs, TX	2012
30"	4850'	Red River, Thackerville, TX/OK	2012
30"	3042'	Wyalusing, PA	2012
24"	2458'	Jonestown, PA	2012

1998 – 1999: **Construction Supervisor | InterCon Construction, Inc. | Lakeville, MN**

Supervisor of 210 mile fiber optic installation, underground and aerial in Minneapolis and surrounding suburbs. Responsible for subcontractors, directional drilling, underground, aerial and InterCon crews.

1998: **Project Engineer | Brungardt, Honimichl & Company, P.A. | Overland Park, KS**

AT&T switched engineering firms from C&S Contract Services to Brungardt, Honimichl & Company. Responsibilities included project management for concurrent multiple projects including route selection, courthouse search, surveying, land acquisition, writing job specifications, bid meetings, inspection, as-built records and permitting. Total start up to completion construction.

1990 – 1997: **Project Manager | C & S Contract Services, Inc. | Martinville, IN**

Responsibilities include project management for concurrent multiple projects including route selection, courthouse search, surveying, land acquisition, writing job specifications, bid meetings, inspection, as-built records and permitting. Total start up to completion construction.

1988 – 1990: **Right-of-Way Supervisor | Bucher, Willis & Ratliff, Inc. | Aurora, IL**

Responsibilities include all start up activities, pre-construction, construction and post-construction damages for 126 miles of fiber optic projects across Northern Indiana as well as three diversity routes in South Bend, Indiana.

EDUCATION

1990 **State of Indiana**

Real Estate License

1973 **Warner High School | Warner, SD**

High School Diploma

MICHELS®

Eric Frawley

Project Manager

PROFESSIONAL EXPERIENCE

2015 – Present: Project Manager | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production recordkeeping, and overall on-site management. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
30"	3746'	Dix River, KY	2019
20"	2355'	Joanna Rd, PA	2018
12"	1369'	Rocky Point Landing, Jamaica	2018
20"	7354'	Susquehanna River, PA	2018
20"	3874'	Waltonville Rd, PA	2018
16"	1198'	Harrisburg Pike, PA	2017
24"	2026'	Highway 120, GA	2017
24"	2293'	Interstate 20, GA	2017
16"	11,397'	Lake Sacagawea South, ND	2016
30"	2069'	Floyd River/RR/HWY 60, IA	2016
16"	11,229'	Lake Sacagawea North, ND	2016
16"	1112'	Palermo Railroad, ND	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
24"	7432'	Houston Ship Channel, TX	2015
16"	1508'	Beverly Harbor, MA	2015
16"	3827'	Collins Cove, MA	2015

2013 – 2015: Project Manager | Oceaneering International Inc. | Houston, TX

2010 – 2013: Project Manager and Project Coordinator | Triton Diving Services | Houston, TX

2006 – 2009: Commercial Diver/Saturation Diver | Deep Marine Technology | Houston, TX

2003 – 2005: Commercial Diver/Supervisor | Epic Divers | Harley, LA

2001 – 2003: Dive Tender/Commercial Diver/EMT | Torch Offshore | LA

TRAINING & CERTIFICATIONS

- American Petroleum Institute - Certified RIgger an Crane Operator Class A per API RP 2D 2002
- Offshore Water Survival (HUET) per API RP T-4 and T-7

TRAINING & CERTIFICATIONS (continued)

- "Association of Diving Contractors International - Surface-Supplied Air Diver, Surface -Supplied Mixed Gas Diver, Saturation Diver
- American Red Cross - First Aid, Adult, Infant and Child CPR, and CPR for the Professional Rescuer
- TWIC (Transportation Worker Identification Credential)
- EPIC Divers - Visual Weld Inspection, Flange Trained, Safety Incident Support Team 2003
- EMT (Emergency Medical Technician) Nationally Registered 2002
- LOLER (Lifting Operations Lifting Equipment and Regulations)
- BOSET (Basic Offshore Safety and Emergency Training)
- HAZWOPER First Responder
- Hydrogen sulfide safety awareness certified
- Captain 100 Ton License USA Coast Guard
- NORM (Naturally Occurring Radioactive Material Surveyor)
- Confined Space Supervisor/Rescuer 2003

EDUCATION

2010 **VTC, Virtual Training Company**

Major: Microsoft Excel, Word, Projects, Outlook, Adobe Acrobat X

2000 **United States Coast Guard**

One Hundred Ton Captain License

1999 **Santa Barba City College | Santa Barbara, CA**

Major: Marine Diving Technology

MICHELS®

Dale Schinderle

Project Manager

PROFESSIONAL EXPERIENCE

2018 – Present: Project Manager | Michels Directional Crossings

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production record-keeping, and overall on-site management. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	4145'	Loyalhanna Lake, PA	2020
24"	795'	Great Passage Blvd, VA	2018
24"	426'	Amanda Dr, VA	2018
24"	300'	Riva Ridge Dr, VA	2018

1998 – 2018: Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
20"	1665'	Aughwick Creek, PA	2018
20"	2209'	Horse Valley Rd, PA	2018
20"	1337'	Berry Ridge & Old Mill Rd, PA	2018
20"	4771'	Raystown Lake, PA	2017
20"	1260'	Hollow Rd, PA	2017
20"	845'	Patterson Rd/RR, IL	2016
20"	748'	Wetlands #1, IL	2016
24"	1029'	Drainage Ditch, IL	2015
36"	9040'	Mississippi River & Levees, IL/MO	2014
12"	2535'	Arkansas River, AR	2014
36"	2908'	Neches River & RR, TX	2013

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
16"	1110'	New Berlin, WI	2012
10"	3745'	Fort Lauderdale, FL	2012
12"	4300'	Marathon County, WI	2012
30"	7600'	Livingston & Oakland County, MI	2011
12"	6106'	Westmoreland County, PA	2010

1992 – 1998: **Foreman | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating directional boring rigs for various size gas, water, sewer, electrical and communication lines throughout the United States. Complete knowledge of directional drilling technology and procedures. Duties include rig set-up, operation and maintenance, employee management.

1987 – 1992: **Laborer/Operator | Michels Pipeline Construction | Brownsville, WI**

Experience in working on and around directional drilling rigs as an integral member of a specialized team. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs; hydraulics; fluids; set-up and operation of drill motors; power generators; mud pumps; bentonite mixers; drill pipe; reamers; couplings; and overall equipment maintenance and operation. Was a member or the IBEW out of Michigan.

INDUSTRY INVOLVEMENT

- Member of Operating Engineers-1995

EDUCATION

NWTI (Norheast Wisconsin Technical Institute)

Mechanical Drawing

MICHELS®

Michael Geelan

Project Manager

PROFESSIONAL EXPERIENCE

2016 – Present: **Project Manager | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production recordkeeping, and overall on-site management.

Diameter	Length	Crossing/Location	Year
16"	3728'	Village Square Dr, PA	2019
24"	3817'	Missouri River, MO	2019
24"	6336'	Mississippi River, IL/MO	2019
12"	1070'	Indiana Harbor Canal - 12" & 10" Bundle, IN	2018
36"	1805'	Portage River MP162.5 OH	2018
36"	2730'	Sanddusky River MP145.8, OH	2018
36"	1522'	Findlay Road MP 179.96, OH	2018
36"	4034'	Maumee River MP 181.7, OH	2018
42"	1501'	Platte River, NE	2018
42"	1861'	San Martin Lake Channel, TX	2018
42"	3717'	Bahia Grande Channel #2, TX	2018
42"	4869'	Bahia Grande Channel #1, TX	2018
48"	3235'	Arroyo Colorado Canal, TX	2017
48"	3085'	Rancho Viego Floodway, TX	2017
48"	3649'	IBWC North Floodway, TX	2017
48"	3595'	Road 771 Canal, TX	2017
48"	2222'	Hwy 803, CA Rd & Supply Canal, TX	2017
48"	2033'	Resaca De Los Cuates Canal, TX	2017
48"	2183'	Resaca De Los Fresnos Canal #2, TX	2017
48"	2555'	Resaca De Los Fresnos Canal #1, TX	2017
48"	2126'	Pinson Rd Canal, TX	2017
48"	2042'	County Rd 300 Canal, TX	2017

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Crossing/Location	Year
48"	2398'	CR2340 & Los Olmos Creek, TX	2017
36"	1594'	Dupage River #2, IL	2017
36"	1525'	Dupage River #1, IL	2017
36"	1545'	Van Dyke Road, IL	2017
30"	7282'	Mississippi River, IA/IL	2016

2014 – 2016: **Project Manager | Michels Corporation | New York, NY**

Responsible for contract management and project coordination, including personnel and material, cost and budget control, tracking progress and schedule, submission of proper submittals and support engineering, and review of daily field reports. Serving as the point of contact for the project and maintaining communication with clients, general/subcontractors, vendors, and suppliers.

2011 – 2016: **HSE-Safety Coordinator | Michels Corporation | New York, NY**

Development and implementation of on-site procedure, emergency response plan, on-site safety inspections, equipment inspections and reporting to supervisors. Assigned the responsibility for coordinating and maintaining the company safety program. Advises management in matters of safety and health, and monitors day-to-day operations to ensure that the company's safety policies and procedures are followed.

2007 – 2011: **Project/Field Engineer | Michels Tunneling | New Berlin, WI**

Holds responsibility for coordination of all technical activities on assigned projects. Plans, schedules, conducts, and coordinates assigned engineering work; monitors work for compliance to applicable codes, accepted engineering practices, and ensures effective communication and coordination on assigned projects between all disciplines and all other project participants.

PROJECT PROFILES

MED609 – 62nd St. Tunnel Project; 620 LF of 76" Hard Rock Tunnel using a Robbins TBM. Included pipe jacking operations of 72" Casing pipe for a new water main. Construction in Manhattan – New York City. — New York, NY

East Side Access Tunnel – Contract CM005; interior structures, interior structures, and fit-out for caverns and tunnels beneath the existing Grand Central Terminal in Manhattan. Work included installation of piping/drainage systems, embedded conduits & ground mesh, waterproofing membrane & contact grout pipes, >9 million pounds of rebar, and placement of >70,000 cubic yards of concrete & wet/dry mix shotcrete. — New York, NY

Novartis Institute | Campus Expansion Project at 181 Massachusetts Ave.; Construct a 72" dia. steel Utility Tunnel by Microtunneling one run by jacking a 72" dia. Permalok steel casing pipe for a total of 120'. Jacking from a new building foundation excavation to and existing parking garage basement. — Cambridge, MA

University of Massachusetts | Central Campus Infrastructure; Construct a Jacking Shaft 30' diameter by 40' deep. Microtunnel two runs by jacking 48" dia. Permalok steel casing pipe for a total of 950'. Install 24" dia. PVC carrier pipe inside the casing pipe and gill the annulus with grout. — Amherst, MA

PROJECT PROFILES (continued)

City of Milwaukee | 26th Street Combined Sewer Sliplining; 4,500 LF of slip lining a 126” diameter Hobas pipe inside an existing 144” combined sewer concrete pipe. Included excavation of 2 access shafts (approx. 80’ deep) using rib and lagging construction methods to lower the Hobas pipe into the existing tunnel. — Milwaukee, WI

San Francisco Public Utilities Commission | Bay Division Pipeline Reliability Upgrade, Bay Tunnel; 26,208 LF of 12’ – 10” diameter concrete segmented tunnel under the San Francisco Bay from Menlo Park on the S.F. Peninsula Bay to Newark in the East Bay area, two slurry diaphragm wall shafts, and 108” cement motor lined steel pipe welded in the tunnel and shafts as a final liner carrier pipe. — San Francisco, CA

Massillon Road Sanitary Sewer Improvement; 2,925 LF of 42” Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe sanitary sewer gravity sewer, microtunnel installation; 1,328 LF of 48” CCFRPM pipe on micropile support, 29 LF of 36” OH CCFRPM pipe, gravity sewer, micropile support. 7 EA shaft excavations with steel sheeted ground and 7 EA manholes structures. 250 LF of open cut excavation with steel sheeted ground support. — Akron, OH

Brazos River Authority East Williamson County Regional Water System Contract A; Raw Water Intake Pump Station; Two 60-inch Raw Water Intake Pipelines by Microtunnel Construction; 303 LF — Austin, TX

Galveston Causeway; Two 700’ tunnel drives through clay underneath Galveston Bay. 48” Permalok. — Galveston, TX

OCI Project No. DB10-WASD-01 ESP; 1,200 LF of 72” Permalok steel casing under the Government Cut Channel — Miami, FL

Fairfax Department of Public Works & Environmental Services | Dogue Creek Force Main Replacement; Dogue Creek Force Main Replacement – Fairfax County, VA 4,200 LF of 74” dia. Microtunnel between 6 drop shafts and tied into the existing pump station and out fall structures in order to replace an existing sewer. The majority of work performed on and coordinated with the Army Military Base – Fort Belvoir. — Fairfax County, VA

Milwaukee Metropolitan Sewer District | South 43rd Street Relief Sewer; Installation of 4500 LF of RCP using both a Akkerman MTBM slurry machine and Iseki MTBM slurry machine and 2000 LF of RCP using a Decker TBM with Direct Pipe Jacking. Job alsoconsisted of sheet pile shafts and rib and lagging/liner plate shafts at 15 structure locations. — Milwaukee, WI

Milwaukee Metropolitan Sewer District | Canal St. Wet Weather Relief Sewer; Installation of 6,000 LF RCP of Direct Pipe Jack using a 105” Lovat EPB TBM with Direct Pipe Jacking. Job also consisted of sheet pile shafts and rib and lagging/liner plate shafts at 18 structure locations. — Milwaukee, WI

Sacramento Regional County Sanitation District | Upper Northwest Interceptor Sewer 3 & 4; Installation of 3,000 LF of RCP using an 84” Akkerman MTBM slurry machine, 8,000 LF RCP Two-Pass Tunnel using a 130” Lovat TBM, and 6,000 LF RCP of Direct Pipe Jack using a 105” Lovat EPB TBM. Job also consisted of 12 sheet pile shafts and 6 drilled manhole shafts. — Sacramento, CA

TRAINING & CERTIFICATIONS

- OSHA 30-Hour
- OSHA 10-Hour
- OSHA 500 – Trainer Course for Construction (Qualified To train 10 to 30 Hour Classes)

TRAINING & CERTIFICATIONS (continued)

- BioMarine BioPak Re-breather Training and Certification
- Cal/OSHA Certified Gas Tester
- Cal/OSHA Licensed Tunnel Safety Representative
- Certified Associate Constructor - American Institute of Constructors (AIC)
- American HealthCare Assoc. Healthcare Provider Certification
- American HealthCare Assoc. Heartsaver First Aid Certification
- Rigging and Fall Protection Inspection Training (Competent Person)
- Medic First Aid Certification Renewal (CPR, AED, & First Aid)
- Qualified Rigger and Signal Person
- Confined Space Entry Awareness Training (Competent Person)
- Open Trench Safety Awareness Training (Competent Person)
- Wisconsin Lift Truck Operator Training
- Commercial Driver's License (Class ABC)
- 32-Hour Supported Scaffold Certified (NYC-DOB)
- Louisiana State Licensing Board for Contractors -- Pipe Work: 7-43 (Sewer Lines) 7-44 (Storm Drains) 7-45 (Water Lines) #25444
- Louisiana State Licensing Board for Contractors -- Specialty: 7-590 Telecommunications #25444
- North Carolina Licensing Board for General Contractors -- S (Boring & Tunneling) #29269
- State of Rhode Island: Contractors' Registration and Licensing Board -- Commercial & Residential Contractor Registration #40432
- South Carolina Department of Labor, Licensing and Regulation -- Class WL5 (water lines) & BT5 (bore & tunnel) #G10861

INDUSTRY INVOLVEMENT

- 2009 National AGG/ASC Heavy Civil Construction Competition – 4th Place
- 2008 Great Lakes Region AGG/ASC Heavy Civil Construction Competition – 1st Place
- 2007 Great Lakes Region AGG/ASC Heavy Civil Construction Competition – 3rd Place
- 2006 Lynn E. Legault Undergraduate Scholarship (AGC Education Research Foundation)

EDUCATION

University of Wisconsin–Stout | Menomonie, WI

Bachelors of Science – Construction; Minor – Risk Control & Business

University of Wisconsin–Fond du Lac | Fond du Lac, WI

Associates of Arts & Science Degree

MICHELS®

Richard Zavitz

Drilling Fluids Specialist/Project Manager

PROFESSIONAL EXPERIENCE

2012 – Present: Drilling Fluids Specialist/Project Manager | Michels Directional Crossings | Brownsville, WI

Develop detailed drilling fluid plans and contingencies based upon geotechnical reports, equipment and scope of project. Measure and testing of drilling fluids and supervising the mixing and pumping operations. Perform technical analysis and interpret geotechnical reports. Control and maintain drilling fluids parameters and provide technical recommendations. More notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	7402'	Susquehanna River, PA	2019
20"	1720'	Everett Railroad & Juniata River, PA	2018
42"	3980'	Susquehanna River MP 99.6, PA	2018
36"	2792'	Middle Island Creek, WV	2017
36"	5841'	Ohio River MP 33.8, OH/WV	2017
10"	5697'	Mississippi River, LA	2017
8"	1530'	SPL Yellowstone River, MT	2017
8"	1542'	YPL Yellowstone River, MT	2017
12"	1285'	XOM Yellowstone River, MT	2017
30"	7531'	Lake Oahe & Missouri River, ND	2017
16"	11,397'	Lake Sacagawea South, ND	2016
30"	3352'	Cliff Crossing, ND	2016
16"	11,229'	Lake Sacagawea North, ND	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
24"	3716'	Barbour's Cut, TX	2015
24"	7432'	Houston Ship Channel, TX	2015
24"	5908'	Tabbs Bay, TX	2015
12"	11,563	Holland Bottoms Wetlands, AK	2015
48"	4039'	Dow Barge Channel, TX (Direct Pipe)	2015
36"	3461'	Kennedy Ave/Griffith Terminal, IN	2015
36"	3011'	Highway 41 & RR, IN	2015
36"	5128'	Lake Ave & RR, IL	2015
36"	1002'	Highway 255, TX (Direct Pipe)	2015
36"	1092'	Lubrizol Drainage, TX (Direct Pipe)	2015
18"	12,459'	Rio Grande River, TX	2014
48"	2400'	Rio Grande River, TX (Direct Pipe)	2014

PROFESSIONAL EXPERIENCE (continued)

42"	1200'	RR Crossing, TX (Direct Pipe)	2014
36"	9040'	Mississippi River, IL/MO	2014
30" & 24"	2,850',1,991', 2,732',2,983'	SE Market Expansion Project MS & AL	2014
36"	3544'	Illinois River, IL	2013
36"	4304'	Bois D' Arc, TX	2013
36"	3892'	Red River, OK/TX	2013
36"	3077'	UP RR & Jefferson St, OK	2013
36"	4213'	Menard Creek, TX	2013
36"	3239'	Clear Boggy Creek, OK	2013

2011 – 2012: **Drilling Fluid Specialist | Mears Group, Inc. | Billings, MT**

Developed detailed drilling fluid plans and contingencies based upon geotechnical reports, available equipment and scope of project. Selected bentonite and polymers based on characteristics required by the project. Trained field personnel on mud testing concepts and drilling fluid theology. Liaised with environmental regulators to obtain approval for drilling fluid products for projects.

2010 – 2011: **Territory Manager | Akkerman, Inc. | Billings, MT**

Sold tunneling and pipe jacking equipment. Analyzed and interpreted geotechnical reports to provide equipment recommendations.

2000 – 2010: **Technical Sales Engineer | Wyo-Ben, Inc. | Billings, MT**

Engineered fluids on HDD, microtunneling, pipe ramming, pipe jacking and auger boring projects. Analyzed geotechnical reports and developed mud/lubrication programs.

1998 – 2000: **Sales Representative | Surface to Surface | London, Ontario, Canada**

Trained new HDD operators. Sold pipe and cable locating equipment.

Colorado School of Mines

Taught bentonite and polymer course at Microtunneling Short Course.

TRAINING & CERTIFICATIONS

- OSHA 510 - OSHA Standards for Construction
- Apprenticed under oil field qualified mud engineer working on HDD projects
- OSHA 10-Hour
- Multiple OQ courses for various energy companies
- Multiple safety courses required by various energy companies
- OFITE trained in repair and calibration of OFITE Model 900 viscometer

EDUCATION

1988 **University of Western Ontario**

Bachelor of Arts, Kinesiology

2000 **Wyo-Ben, Inc. Intensive Mud School**

Graduated

MICHELS®

Wendell Long

Project Manager

PROFESSIONAL EXPERIENCE

2002 – Present: **Project Manager**

Michels Directional Crossings | Brownsville, WI

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production record-keeping, and overall on-site management. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
36"	6238'	Ohio River, OH/WV	2017
30"	2278'	Chattahoochee River, GA	2017
30"	2757'	Little Rock River, IA	2016
30"	6328'	Big Sioux River, SD/IA	2016
30"	1614'	Mill Creek, IA	2016
30"	6119'	Lake Whitney, TX	2016
16"	11,563	Holland Bottoms Wetlands, AK	2015
22"	2538'	Barrington Rd, IL	2015
36"	1147'	E. 138th Street, IL	2015
36"	2697'	Barrington Rd, IL	2015
48"	2060'	Tres Palacios River, TX	2014
48"	1692'	Navidad River, TX	2014
24"	2750'	Escatawpa River, MS	2014
24"	3030'	Big Creek Lake, AL	2014
30"	2774'	South Canadian River, OK	2013
28"	4270'	Saline Creek, Alberta, Canada	2013
12"	4272'	Saline Creek, Alberta, Canada	2013
36"	3618'	Johnson Creek, TX	2013
36"	3314'	East Fork Angelina River, TX	2013
36"	3130'	Cypress, TX	2012
16"	1664'	Morales, TX	2012
42"	1657'	Morales, TX	2012
20"	2108'	Bayonne, NJ	2012
24"	6091'	Homestead, FL	2011
36"	2373'	Ravenswood, LA	2011

PROFESSIONAL EXPERIENCE (continued)

10'	778'	Ft. Lauderdale, FL	2011
10"	964'	Ft. Lauderdale, FL	2011
16"	9931'	Cooper River, SC	2010
42"	1998'	I-49, LA	2010
16"	2566'	Hitchcock Plaza, SC	2010
30"	2176'	I-285, Atlanta, GA	2010

1994 – 2002: **Project Manager**

Michels Mid-America Line and Cable | Brownsville, WI

Job estimating, profit and loss coordination of materials and equipment. Labor and production jobs varying in size up to $25 million. Projects include aerial, buried, underground, cooper and fiber routes.

1987 – 1991: **Project Manager**

U.S. Sprint | Midwest and Eastern U.S.A.

Responsible for construction management, permits, schedules and daily work operation to meet completion dates. Jobs varying in size to $20 million.

1985 – 1986: **Senior Engineer**

U.S. Sprint | Midwest and Eastern U.S.A.

In charge of engineering and fiber construction for several miles.

1981 – 1984: **Construction and Maintenance Supervisor**

United Telephone of Florida | Fort Meyers, FL

Responsibilities include new construction, maintenance, splicing and cutover of offices in eight exchanges. Responsible for daily operation of 35 splicers.

1964 – 1980: **Cable Splicer**

United Telephone of Florida | Fort Meyers, FL

Spliced paper and plastic cable, exchange cutover and maintenance of all types of cable.

1962 – 1963: **Lineman**

United Telephone of Florida | Fort Meyers, FL

Worked on open wire circuits including toll circuits and placements of cable.

EDUCATION

1956 **Hardee High School | Wauchula, FL**

High School Diploma

MICHELS®

Jeremiah Yliniemi

Project Manager

PROFESSIONAL EXPERIENCE

2020 – Present: **Project Manager | Michels Directional Crossings | Brownsville, Wisconsin**

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production record-keeping, and overall on-site management. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	4813'	Raystown Lake, PA	2020

2006 – 2020: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	7402'	Susquehanna River, PA	2019
20"	2236'	Lower Piney Creek, PA	2018
20"	1720'	Everett RR-Juniata River, PA	2018
16"	2346'	Frankstown Branch-Juniata River, PA	2018
16"	1275'	Hollow Road, PA	2017
20"	1260'	Hollow Road, PA	2017
20"	4771'	Raystown Lake, PA	2017
36"	7194'	Ohio River MP 16.07, OH/MV	2017
30"	7531'	Lake Oahe & Missouri River, ND	2017
16"	11,397'	Lake Sacagawea, ND	2016
30"	3352'	Cliff Crossing, ND	2016
16"	1112'	Palermo Railroad, ND	2016
12"	7228'	Athabasca River, Alberta, Canada	2016

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Crossing/Location	Year
42"	3885'	Dover River, Alberta, Canada	2016
24"	1230'	Christina River, Wood Buffalo, Canada	2015
42"	7205'	Athabasca River, Alberta, Canada	2015
42"	1008'	Highway 63, Canada - Direct Pipe Installation	2015
42"	2510'	Ruth Lake, Fort McMurray, Canada	2015
12" and 6"	3173'	Beaver Lake, Alberta, Canada	2015
42"	3114'	Beaver Lake, Fort Mc Murray, Canada	2015
42"	3776'	MacKay River, Fort McMurray, Canada	2015
30"	2667'	South Fork Ten Mile Creek, PA	2014
20"	1193'	SR-265/Leatherwood Rd, OH	2014
24"	3269'	Transfer Line 2, IN	2014
36"	1874'	Wetland S-517C, IN	2014
42"	4284'	Vermillion River, Canada	2013
42"	3392'	N. Saskatchewan River, Canada	2013
42"	4441'	Goethals Bridge, NY	2013
30"	8101'	Kill Van Kull River, NY/NJ	2013
36"	2133'	Little River, OK	2013
36"	4342'	Deep Fork river, OK	2013
36"	4505'	Medicine Hat Alberta Canada	2012
36"	4993'	Atchafalaya River, LA	2011
20"	3080'	Rock Creek, OR	2011
42"	4272'	St. John's River, BC	2011
14"	1633'	Ocean Sciences, Newfoundland	2011
42"	2204'	Bayou Comitte, LA	2010
36"	1873'	Petitcodic River, Canada	2009

2004 – 2006: **Nick's Conoco | Park Rapids, MN**

EDUCATION

2002 **Park Rapids Area High School**

High School Diploma

MICHELS®

Doug Houska

Project Manager

PROFESSIONAL EXPERIENCE

2019 – Present: Project Manager | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production record-keeping, and overall on-site management.

1991 – 2019: Drilling Survey Technician | Michels Directional Crossings | Brownsville, WI

Responsible for surveying, staking and design of directional drill path and curve, drilling the pilot hole, tracking and monitoring the drill path and calculating and interpreting the ground elevations and contours. Computer literate with knowledge and experience operating various software including: 1) Magnetic Guidance System, 2) Survey, 3) Tru-Tracker and 4) Microsoft applications. Applied working knowledge of advanced mathematics including: 1) Fluid Dynamics, 2) Advanced Algebra, 3) Trigonometry, 4) Calculus, 5) Statistics and 6) Stress Engineering. Complete surveying skills and experience utilizing a Total Station (Theodolite with built-in EDM) for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points (benchmarks). Additional duties include on-site maintenance of technical equipment, and necessary record-keeping of plots and drilling logs. Performed the above operations for crossings which include, but not limited to:

Diameter	Length	Location	Year
20"	13,247'	Lake Sakakawea River, ND	2019
8"	3768'	MP 50.8 Landslide, MT	2018
36"	1805'	Portage River MP 162.5, OH	2018
36"	2974'	Wetland MP 8.1, OH	2018
42"	3980'	Susquehanna River MP 99.6, PA	2018
42"	1810'	Interstate 80, PA	2018
48"	3649'	IBWC North Floodway, TX	2017
48"	3595'	Road 771 Canal, TX	2017
48"	2222'	Hwy 803, CA Rd & Supply Canal, TX	2017
48"	2033'	Resaca De Los Cuates Canal, TX	2017
30"	2555'	Resaca De Los Fresnos Canal #1, TX	2017
48"	2126'	Pinson Rd Canal, TX	2017
30"	3483'	Ford Island to Landing C, HI	2017
48"	2042'	County Rd 300 Canal, TX	2017
48"	2349'	Chiltipan Creek, TX	2017

PROFESSIONAL EXPERIENCE (continued)

30"	7531'	Lake Oahe & Missouri River, ND	2017
16"	6693'	Wapsipinicon River, IA	2016
30"	2757'	Little Rock River, IA	2016
12"	1114'	Sunflower Field, VT	2016
30"	5714'	James River, SD	2016
30"	2069'	Floyd River/RR/HWY 60, IA	2016
30"	2991'	PCN3/Wetland, SD	2016
30"	1791'	200th St, SD	2016
30"	1372'	183rd St & Wetland MP 331, SD	2016
30"	5154'	House River, Alberta, Canada	2016
42"	3885'	Dover River, Alberta, Canada	2016
42"	3399'	McKay River, Alberta, Canada	2016
24"	1230'	Christina River, Wood Buffalo, Canada	2015
42"	7205'	Athabasca River, Alberta, Canada	2015
36"	5128'	Lake Ave & RR, IL	2015
12" and 6"	3173'	Beaver Lake, Alberta, Canada	2015
42"	3776'	MacKay River, Fort McMurray, Canada	2015

1988 – 1991: **Project Coordinator | Mid America Line and Cable, Division of Michels Pipeline | Brownsville, WI**

Assisted Project Manager with coordinating field personnel for large scale telephone cable installation projects. Recorded and prepared field reports for project, office and customer needs. Acting liaison between project managers, public, existing utility representatives and customer representatives. Coordinated project between existing utilities and placement of new installation. Maintain material inventory required for projects.

1980 – 1988: **Project Assistant/Bookkeeper | Michels Pipeline Construction | Brownsville, WI**

Purchasing agent responsible for coordinating all materials to various locations along project routes for water line and telephone installations . Inventory control of materials. Prepared field reports to keep record of labor and production. Liaison between existing utility representatives and Michels.

EDUCATION

1980 **Mitchell Area Vocational Technical College | Mitchell, SD**

Two year Associate Degree Accounting

1978 **Kimball High School | Kimball, SD**

High School Diploma

MICHELS®

Chad R. Johnson

Project Manager

PROFESSIONAL EXPERIENCE

2019 – Present: Project Manager | Michels Directional Crossings | Brownsville, Wisconsin

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production record-keeping, and overall on-site management. Some more notable crossings include, but are not limited to:

2019: HDD Operator | Michels Directional Crossings | Brownsville, Wisconsin

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production.

2017 – 2019: Skilled Laborer | Michels Directional Crossings | Brownsville, Wisconsin

Integral member of a specialized team working on and around directional drilling rigs. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs, hydraulics, fluids, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation.

2004 – 2017: Bore Coordinator, Project Manager, Construction Inspection & Water Treatment Operator | Xenia Rural Water District | Bouton, IA

Coordinated the projects from mapping the project to scheduling of utility locations and equipment. Worked with the state, county and local officials for the projects and acquired DOT permits. Attended landowners meetings/conflict management, completed daily project reports and reported to the executive director. Installation of water lines 1" to 24" PVC, fusible PVC and HDPE and 8" to 36" steel. Operation of multiple pieces of equipment (bore machines, ditch witch, backhoes, track hoes and dozers).

TRAINING & CERTIFICATIONS

- Water Treatment and Distribution Grade II Certification
- Vocational Auto Mechanics

EDUCATION

Boone High School | Boone, IA

High School Graduate

MICHELS®

Karl Kornkven

Project Manager

PROFESSIONAL EXPERIENCE

2020 – Present: **Project Manager | Michels Directional Crossings | Brownsville, Wisconsin**

Responsible for coordinating directional boring projects for various size gas, water, sewer, electrical and communication lines throughout the United States and Canada. Complete knowledge of directional drilling technology and procedures. Duties include project coordination from start-up to completion, union relations, subcontractor coordination, production record-keeping, and overall on-site management.

2002 – 2020: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	7595'	Houston Ship Channel, TX	2019
16"	6053'	Tabbs Bay, TX	2019
16"	3846'	Barbour's Cut, TX	2019
30"	3746'	Dix River, KY	2019
20"	2355'	Joanna Rd, PA	2018
36"	1886'	Nimisila Reservoir MP 40.9, OH	2018
20"	7354'	Susquehanna River, PA	2018
30"	7531'	Lake Oahe & Missouri river, ND	2017
30"	2991'	PCN3/Wetland, SD	2016
12"	7228'	Athabasca River, Alberta, Canada	2016
30"	5154'	House River, Alberta, Canada	2016
42"	3399'	McKay River, Fort McMurray, Cananda	2016
24"	1230'	Christina River, Wood Buffalo, Canada	2015

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Crossing/Location	Year
42"	7205'	Athabasca River, Alberta, Canada	2015
42"	2510'	Ruth Lake, Fort McMurray, Canada	2015
42"	3114'	Beaver Lake, Fort McMurray, Canada	2015
42"	3776'	MacKay River, Fort McMurray, Canada	2015
36"	1613'	Fish Pond, Alberta, Canada	2014
36"	1359'	Wetland Crossing #2, Alberta, Canada	2014
36"	9040'	Mississippi River, IL/MO	2014
42"	4284'	Vermillion River, Canada	2013
30"	4905'	Merseles, NJ	2013
30"	5378'	Hudson River, NJ/NY	2012
30"	4850'	Red River, TX/OK	2012
16"	1649'	Cordele, TX	2012
42"	1661'	Cordele, TX	2012
16"	3214'	Dewitt, TX	2012
42"	3205'	Dewitt, TX	2012
36"	4505'	Medicine Hat, Alberta, Canada	2012
36"	4993'	Atchafalaya River, LA	2011
42"	4272'	St. John's River, BC	2011
36"	4495'	Saskatchewan River, AB	2011
14"	1554'	St. John's Newfoundland	2010
42"	4322'	Cache River, AR	2010
42"	5084'	Mississippi River, AR	2010

2000 – 2002: **Drill Rig Operator | Michels Directional Crossings | Brownsville, WI**

Experience in working on and around directional drilling rigs as an integral member of a specialized team. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs; hydraulics; fluids; set-up and operation of drill motors; power generators; mud pumps; bentonite mixers; drill pipe; reamers; couplings; and overall equipment maintenance and operation.

1998 – 2000: **Drilling Fluid Technician | Michels Directional Crossings | Brownsville, WI**

Solely responsible for mixing bentonite to the right consistency with an emphasis in directional drilling. Proficient working in and around drilling rigs and overall operation as an integral member of the specialized team. Multi-capable to assist with all types of drilling tasks and familiar with repair, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, steer tool wireline connections, couplings, etc. Involved in various types of directional drilling projects, line and cable, water and setting manholes.

PROFESSIONAL EXPERIENCE (continued)

1991 – 1997: **Machinist | Nissen Manufacturing | Larimore, ND**

Machinist performing welding, drilling and assembly

1988 – 1991: **Air Traffic Controller | United States Air Force | Grand Forks, ND**

EDUCATION

University of North Dakota

Bottineau High School | Bottineau, ND

High School Diploma

MICHELS®

Dan Kriesel

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2006 – Present: Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	3653'	Ship Road/King Road, PA	2019
16"	4358'	Phoenixville Pike Road, PA	2019
22"	4986'	Atchafalaya River, LA	2019
8"	3768'	MP 50.8 Landslide, MT	2018
42"	3980'	Susquehanna River MP 99.6, PA	2018
36"	5841'	Ohio River MP 33.8, OH/WV	2017
14"	9154'	Nansemond River, VA	2017
10"	5697'	Mississippi River, LA	2017
30"	3483'	Ford Island to Landing C, HI	2017
30"	7531'	Lake Oahe & Missouri River, ND	2017
16"	6693'	Wapsipinicon River, IA	2016
30"	6328'	Big Sioux River, SD/IA	2016
24"	4531'	Athabasca River, Alberta, Canada	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
24"	3716'	Barbour's Cut, TX	2015
24"	7432'	Houston Ship Channel, TX	2015
30"	1418'	Highway 250, OH	2015
16"	1402'	Deer Lake, ND	2015
36"	3461'	Kennedy Ave/Griffith Terminal, IN	2015
36"	3011'	Highway 41 & RR, IN	2015
10"	4654'	Allegheny River, PA	2015
8"	3320'	Yellowstone River, MT	2015

24" HDPE	1061'	Lake Sakakawea, ND	2014
8"	7321'	MP 49.3 Landslide, MT	2014
8"	4159'	MP 54.8 Landslide, MT	2014
20"	2364'	Missouri River, NE/IA	2014
16"	2951'	Line 82, ND	2014
36"	2264'	Otter Creek, IL	2013
36"	1611'	Mackinaw River, IL	2013
48"	1943'	West Neck Creek, VA	2013
48"	819'	Hunt Club Creek, VA	2013
8"	7177'	115 KV Power Duct, SC	2013
8"	7304'	115 KV Power Duct, SC	2013
8"	3503'	Hamlin Creek, Charelston, SC	2013
8"	4911'	115 KV Power Duct, SC	2013
8"	12,902'	MP66, Wyola, MT	2012
8"	4475'	MP57, Lodge Grass, MT	2012
8"	2645'	Tioga Junction, PA	2012
16"	3894'	Roaring Branch, PA	2012
10"	1819'	Texas Creek, Tioga, PA	2011
16"	1818'	Texas Creek, Tioga, PA	2011
30"	5786'	Lake Conway, Vernon, NJ	2011
42"	992'	Bayou Rapids, Bunkie, LA	2011
42"	1223'	Bayou Robert, Bunkie, LA	2011
36"	3030'	Black Bear Forest, Bunkie, LA	2011
3"	1879'	Coquille River, Bandon, OR	2010
3"	1895'	Coquille River, Bandon, OR	2010
30"	1275'	Little Powder River, WY	2010

2006: **Operator | InterCon Construction | Madison, WI**

Duties include rig set-up, operation, maintenance, and mud technician for water lines.

2004 – 2006: **Foreman/Operator | Blue Badger, Inc. | Rosebush, MI**

Duties include walk over locating and operating of 80x100 rig for water, gas, fiber optic and sewer line installation.

2002 – 2004: **Operator/Laborer | Mears/HDD, LLC | Rosebush, MI**

Duties include wire line splice technician, mud technician, operate track hoe/back hoe and laborer for water, gas and sewer line installation.

EDUCATION

1994 **Mason County Central High School | Scottville, MI**

High School Diploma

MICHELS®

Marcus Carratt

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2000 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
16"	12,769'	Houston Ship Channel, TX	2019
16"	6053'	Tabbs Bay, TX	2019
8"	12,769'	Montezeuma Slough, CA	2019
24"	3341'	Hwy 367/Coldwater Creek, MO	2019
24"	3817'	Missouri River, MO	2019
36"	2611'	Tuscarawas River MP 47.8, OH	2018
16"	5869'	Conrail RR, NJ	2018
36"	5841'	Ohio River MP 33.8, OH/WV	2017
20"	4771'	Raystown Lake, PA	2017
48"	2349'	Chiltipan Creek, TX	2017
48"	3291'	Meter to LNG Facility, TX	2017
30"	5714'	James River, SD	2016
30"	1516'	408th & Wetland MP 360, SD	2016
30"	1519'	Turtle Creek, SD	2016
42"	3885'	Dover River, Alberta, Canada	2016
4-4" HDPE	764'	Fox River, WI	2015
48"	4039'	Dow Barge Channel, Clute TX - Direct Pipe	2015
36"	9040'	Mississippi River, IL/MO	2014
42"	1153'	Railroad Crossing, TX - Direct Pipe	2014
42"	3392'	N. Saskatchewan River, Canada	2013
42"	4441'	Goethals Bridge, NY	2013

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
42"	3186'	Arthur Kill, Staten Island, NJ/NY	2013
16"	1656'	Chicolete River, TX	2012
42"	1650'	Chicolete River, TX	2012
16"	1717'	Morales, TX	2012
42"	1670'	Morales, TX	2012
36"	4505'	Medicine Hat, Alberta, Canada	2012
24"	2458'	Jonestown, PA	2012
36"	4519'	Freeman Road, LA	2011
42"	5117'	Nature Conservatory, LA	2011
36"	4992'	Atchafalaya River, LA	2011
16"	9931'	Cooper River, SC	2010
42"	3485'	Quachita River, LA	2010
42"	4067'	LA State Hey 34, LA	2010

1999 – 2000: **Foreman | Schatz Underground Cable | Villa Ridge, MO**

Working foreman responsibilities included locating, operating Ditch Witch, directional boring rig, trencher, plow, back hoe, and small back hoe.

1997 – 1999: **Laborer | Michels Pipe Line Construction | Brownsville, WI**

Experience in working on and around directional drilling rigs as an integral member of a specialized team. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs; hydraulics; fluids; set-up and operation of drill motors; power generators; mud pumps; bentonite mixers; drill pipe; reamers; couplings; and overall equipment maintenance and operation.

1993 – 1997: **Beginning Manager | Driver, United States Marine Corps | Camp LeJeune, NC**

sgssg

TRAINING & CERTIFICATIONS

- PCST Certificate Renewal Course (2014)

EDUCATION

1986 **Waupun High School | Waupun, WI**

High School Diploma

MICHELS®

Steve Sanders

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2003 – Present: Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation.

Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	2518'	Herman O.W. Drive, PA	2019
16"	6601'	Arch Bishp/S Chester Rd, PA	2019
42"	4687'	Lake Scranton Finished H2O Tunnel, PA	2018
36"	2974'	Wetland MP 8.1, OH	2018
30"	2273'	Susquehanna River @ MP 35, PA	2018
42"	2826'	San Joaquin River, CA	2017
12"	5741'	Rum River & Wetland, MN	2017
12"	5170'	Larch Dr & Wetland, MN	2017
6"	3309'	Hauser Lake, MT	2017
8"	1980'	CHS Yellowstone River, MT	2017
8"	1530'	SPL Yellowstone River, MT	2017
8"	1542'	YPL Yellowstone River, MT	2017
12"	1285'	XOM Yellowstone River, MT	2017
24"	1898'	Vermillion River, IL	2016
12"	3144'	Monkton Swamp, VT	2016
12"	1491'	Drinkwater Rd, VT	2016
20"	1904'	North St Mary's River, IN	2016
20"	1076'	South St Mary's River, IN	2016
30"	6119'	Lake Whitney, TX	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
24"	3716'	Barbour's Cut, TX	2015
24"	7432'	Houston Ship Channel, TX	2015

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Crossing/Location	Year
24"	5908'	Tabbs Bay, TX	2015
36"	1862'	State Highway 50, IL	2015
36"	1813'	Calumet Ave, IN	2015
36"	1803'	Dyer Ditch, IN	2015
36"	1812'	Highway 394, IL	2015
30"	1376'	Tom's Creek, MS	2014
24"	2750'	Escatawpa River, MS	2014
24"	3030'	Big Creek Lake, AL	2014
24"	2020'	Unnamed Creek, AL	2014
30"	2774'	South Canadian River, OK	2013
30"	4987'	Monksville Reservoir, NJ	2013
30"	1707'	Bayonne Inlet, NJ	2013
30"	8101'	Kill Van Kull River, NY/NJ	2013
20"	869'	Centerview, MO	2012
20"	2458'	Centerview, MO	2012
16"	3894'	Roaring Branch, PA	2012
20"	2513'	Tioga Junction, PA	2012
30"	5786'	Lake Conway, NJ	2011
42"	3008'	White River, AR	2010
42"	1851'	Siphon Creek, LA	2010
20"	5222'	Pokegama Carnegie, WI	2009
36"	2096'	Prairie River, MN	2009
20"	1130'	Wilson Bay, NC	2009

1995 – 2002: **HDD Rig Operator | Michels Directional Crossings | Brownsville, WI**

Experience in working on and around directional drilling rigs as an integral member of a specialized team. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs; hydraulics; fluids; set-up and operation of drill motors; power generators; mud pumps; bentonite mixers; drill pipe; reamers; couplings; and overall equipment maintenance and operation.

EDUCATION

1994 **University of Wisconsin–Stout | Menomonie, WI**

1990 **Berlin High School | Berlin , WI**

High School Diploma

MICHELS®

Jack Edmunds

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

1998 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record-keeping of plots and production.

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down-hole survey along with surveying and surveying instrumentation.

Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
16"	4145'	Loyalhanna Lake, PA	2020
20"	13,247'	Lake Sakakawea, ND	2019
20"	6429'	Badlands Canyon, MT	2019
8"	12,769'	Montezeuma Slough, CA	2019
16"	2734'	Yellowstone River, MT	2019
22"	4986'	Atchafalaya River, LA	2019
42"	4687'	Lake Scranton Finished H2O tunnel, PA	2018
42"	1861'	San Martin Lake Channel, TX	2018
42"	3717'	Bahia Grande Channel #2, TX	2018
42"	4869'	Bahia Grande Channel #1, TX	2018
48"	3235'	Arroyo Colorado Canal, TX	2017
48"	3649'	IBWC North Floodway, TX	2017
48"	2222'	Hwy 803, CA Rd & Supply Canal, TX	2017
48"	2183'	Resaca De Los Fresnos Canal #2, TX	2017
48"	2555'	Resaca De Los Fresnos Canal #1, TX	2017
48"	2398'	CR2340 & Los Olmos Creek, TX	2017
48"	2807'	Oliver Creek & SH 188, TX	2017
48"	2263'	US Hwy 181/Hwy 35, TX	2017
30"	2782'	Mississippi River, IA/IL	2016
42" Steel with 36" HDPE	3983'	St John's River, FL	2016
27" HDPE Bundle	3737'	Little Creek, VA	2016
8"	1957'	Grand River, MI	2016

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
16"	1508'	Beverly Harbor, MA	2015
16"	3827'	Collins Cove, MA	2015
36"	2303'	Liberty Street, IL	2015
18"	12,459	Houston Ship Channel, TX	2015
36"	9040'	Mississippi River, IL/MO	2014
24"	3269'	Transfer Line 2, IN	2014
24"	3275'	Transfer Line 1, IN	2014
30"	2344'	Delaware River, PA/NJ	2013
42"	3008'	I-95 & Tidal Wetlands, NJ	2013
30"	4831'	18th Street, NJ	2013
16"	1664'	Morales, TX	2012
42"	1657'	Morales, TX	2012
10"	1495'	Missoula, MT	2012
24"	1546'	Colorado River, CO	2011
12"	1612'	WBC62 (Offshore), LA	2011

1981 – 1998: **Trenchless Technology Operator/Supervisor & Journeyman Welder | Michels Pipeline Construction | Brownsville, WI**

As Operator/Supervisor he completed profit and loss responsibility for performing trenchless casing installations for civil, pipeline, communications and power at roads, railroads and rivers. Coordinated and executed entire boring operation from mobilization to demobilization.

1977 – 1981: **Skilled Laborer/Operator | Beloit Pipe and Dredge Company | Beloit , WI**

Performed various duties in the construction of natural gas and petroleum product pipeline. Multi-capable to assist with all facets of product pipeline installation including conventional and trenchless methods of construction.

TRAINING & CERTIFICATIONS

- Certified for fusion of plastic natural gas pipe and fittings.
- Certified for butt, sidewall and/or socket fusion of Driscopipe polyethylene pipe and fittings.

INDUSTRY INVOLVEMENT

- Member of Local 601 of United Association of Journeyman and Apprentices for the Plumbing and Pipe Fitting Industry of the United States and Canada (Steamfitters).

EDUCATION

1995 **Moraine Park Technical College**

Welding Courses

1976 **Waupun High School | Waupun , WI**

High School Diploma

MICHELS®

Brian Guelig

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2006 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
20"	2740'	West Branch Escanaba River, MI	2019
20"	13,247'	Lake Sakakawea River, ND	2019
24"	6336'	Mississippi River, IL/MO	2019
42"	4687'	Lake Scranton Finished H2O Tunnel, PA	2018
20"	2355'	Joanna Rd, PA	2018
42"	1501'	Platte River, NE	2018
42"	1861'	San Martin Lake Channel, TX	2018
42"	3717'	Bahia Grande Channel #2, TX	2018
42"	4869'	Bahia Grande Channel #1, TX	2018
48"	3085'	Rancho Viejo Floodway, TX	2017
48"	3649'	IBWC North Floodway, TX	2017
48"	3595'	Road 771 Canal, TX	2017
48"	2033'	Resaca De Los Cuates Canal, TX	2017
48"	2555'	Resaca De Los Fresnos Canal #1, TX	2017
36"	7194'	Ohio River MP 16.07, OH/WV	2017
24"	2026'	Highway 20, GA	2017
36"	1606'	Hannahatchee Creek, GA	2017
36"	1907'	Earthen Dam, GA	2016
36"	3829'	Flint River, GA	2016
36"	4311'	Major Mackenzie Rd, Ontario, Canada	2016
36"	3901'	Rutherford Rd, Ontario, Canada	2016

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
36"	3160'	Christina River, Alberta, Canada	2016
42"	1411'	Torbram Rd, Ontario, Canada	2015
36"	3133'	Pamona Creek, Ontario, Canada	2015
36"	1559'	West Don River, Ontario, Canada	2015
36"	1352'	Bayview Road, Ontario, Canada	2015
36"	2992'	Alden Road, Ontario, Canada	2015
36"	3363'	Steeles Ave, Ontario, Canada	2015
36"	1588'	Hwy 404, Ontario, Canada	2015
36"	1355'	Beaver Creek, Ontario, Canada	2015
36"	3805'	Williamette River, OR	2014
16"	2951'	Line 82, ND	2014
36"	1874'	Wetland S-517C, IN	2014
8"	2545'	MP266, Mountain Green, UT	2013
30"	1881'	Bennekill Stream, NJ	2013
30"	6544'	1st Street, NJ	2013

2002 – 2006: **Operator | Michels Directional Crossings | Brownsville, WI**

Experience in working on and around directional drilling rigs as an integral member of a specialized team. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs; hydraulics; fluids; set-up and operation of drill motors; power generators; mud pumps; bentonite mixers; drill pipe; reamers; couplings; and overall equipment maintenance and operation.

1999 – 2002: **Laborer | Northeast Asphalt | Fond du Lac, WI**

EDUCATION

1999 **New Holstein High School | New Holstein, WI**

High School Diploma

MICHELS®

Nick LeBlanc

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2004 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, wi**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	6601'	Arch Bishop/S Chester Rd, PA	2019
42"	2007'	Las Moras Creek, TX	2019
20"	2355'	Joanna Rd, PA	2018
36"	4034'	Maumee River MP 181.7, OH	2018
16"	5869'	Conrail RR, NJ	2018
16"	2766'	Hall Street, NJ	2018
16"	1999'	Route-35, NJ	2018
30"	2278'	Chattahoochee River, GA	2017
16"	11,397'	Lake Sacagawea South, ND	2016
30"	3352'	Cliff Crossing, ND	2016
16"	11,229'	Lake Sacagawea North, ND	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
4-4" HDPE	764'	Fox River, WI	2015
12"	11,563	Holland Bottoms Wetlands, AK	2015
36"	2510'	Deep Creek, IL	2015
36"	5128'	Lake Ave & RR, IL	2015
18"	12,459	Houston Ship Channel, TX	2015
28"	1741'	Lafayette River, VA	2014
48"	2060'	Tres Palacios River, TX	2014
48"	1692'	Navidad River, TX	2014
36"	1311'	Fraizer Creek, IL	2013

36"	3544'	Illinois River, IL	2013
36"	3077'	UP RR & Jefferson St, Tushka, OK	2013
36"	1499'	60" Water Main, OK	2013
36"	2133'	Little River, OK	2013
36"	2610'	Stroud, OK	2013
30"	4850'	Red River, Thackerville, TX/OK	2012
24"	1386'	Jonestown, PA	2012
8"	6669'	Wilmington, NC	2012
24"	1701'	Howard, MD	2011
36"	2496'	Taterville, LA	2011
36"	5325'	Kingston, LA	2011
16"	9931'	Cooper River, SC	2010
42"	3485'	Quachita River, LA	2010
42"	4067'	LA State Hey 34, LA	2010
36"	5240'	Pokegama Carnegie, WI	2009
42"	3800'	Mississippi River, MO	2009

EDUCATION

1999 **Carencro High**

High School Diploma

MICHELS®

Dave Williams

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2015 – Present: Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
16"	6976'	Matlock/W Chester Rd, PA	2020
36"	1321'	Saline River MP 237.4, MI	2018
36"	1863'	E. Branch Black River MP 86.7, OH	2018
20"	2355'	Joanna Rd, PA	2018
36"	1430'	Interstate 80 MP 110.3, OH	2018
36"	1810'	Interstate 80, PA	2018
36"	2836'	Nemadji Golf Course, WI	2017
42"	2826'	San Joaquin River, CA	2017
36"	1725'	Tower Ave/Hwy 35, WI	2017
42"	2431'	Maumee River & State Hwy 24, OH	2017
16"	3065'	Rock Creek & US HWY 67, IA	2016
30"	2757'	Little Rock River, IA	2016
30"	2069'	Floyd River/RR/HWY 60, IA	2016
30"	1791'	200th St, SD	2016
30"	1372'	183rd St & Wetland MP 331, SD	2016
30"	1278'	Wetland MP 311, SD	2016
30"	5154'	House River, Alberta, Canada	2016
36"	3160'	Christina River, Alberta, Canada	2016
36"	2215'	Bathurst Rd, Ontario, Canada	2015
36"	3363'	Steeles Ave, Ontario, Canada	2015
36"	1588'	Hwy 404, Ontario, Canada	2015

PROFESSIONAL EXPERIENCE (continued)

2008 – 2015: **HDD Operator | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
36"	3805'	Williamette River, OR	2014
24"	1961'	County Road 2, AL	2014
24"	2884'	Hatchett Creek, AL	2014
36"	1874'	Wetland S-517C, IN	2014

8"	2545'	MP266, UT	2013
30"	1881'	Bennekill Stream, NJ	2013
42"	3392'	N. Saskatchewan River, Canada	2013
30"	6544'	1st Street, NJ	2013
30"	1633'	Brooklyn, NY	2012
30"	5786'	Vernon, NJ	2011
42"	1851'	Siphin Creek,LA	2010
36"	2096'	Prairie River, MN	2009
36"	5237'	Pokegema Carnegie, WI	2009

1994 – 2008: **Operator | PTS Contractors | Green Bay, WI**

Sewer and water utility contractor.

EDUCATION

1986 **Amber Pocasset High School | Amber, OK**

High School Diploma

MICHELS®

Ryan Jackson

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2012 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, Wisconsin**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	2734'	Yellowstone River, MT	2019
22"	4986'	Atchafalaya River, LA	2019
42"	3717'	Bahia Grande Channel #2, TX	2018
42"	4869'	Bahia Grande Channel #1, TX	2018
48"	3235'	Arroyo Colorado Canal, TX	2017
48"	3649'	IBWC North Floodway, TX	2017
42"	3983'	42" Steel with 36" HDPE, St John's River, FL	2016
27"	3737'	27" HDPE Bundle, Little Creek, VA	2016
8"	1957'	Grand River, MI	2016
8"	4022'	Lake Macatawa, MI	2016
16"	1508'	Beverly Harbor, MA	2015
16"	3827'	Collins Cove, MA	2015
18"	12,459'	Houston Ship Channel, TX	2015
36"	3805'	Williamette River, OR	2014
30"	1701'	Red River, OK	2013
30"	2344'	Delaware River, PA/NJ	2013
30"	1246'	OK City Water Main, OK	2013
30"	4987'	Monksville Reservoir, NJ	2013
42"	4441'	Goethels Bridge, NY	2013
30"	4801'	18th Street, NJ	2013
30"	5378'	Hudson River, NY/NJ	2012

PROFESSIONAL EXPERIENCE (continued)

2007 – 2012: **HDD Operator | Michels Directional Crossings | Brownsville, Wisconsin**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation.

TRAINING & CERTIFICATIONS

- Safety Trained with Forklift & Excavator - Competent Person
- OSHA 30 Hour

EDUCATION

2004 **Winnebago Lutheran Academy | Fond du Lac, Wisconsin**

High School Graduate

MICHELS®

Mark Matthews

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2017 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. More notable crossings include, but are not limited to:

Diameter	Length	Location	Year
42"	34551'	Bow River, Canada	2019
42"	2264'	Springbank Reservoir, Canada	2019
36"	6135'	Kakwa River 36" Bundle, Canada	2019
42"	3773'	Permanent Creek 42" Bundle, Canada	2019
42"	1640'	Pouce Coupe River, Canada	2019
36"	1749'	Deadhorse Creek, Canada	2018
12"	6986'	Mackenzie River, Canada	2018
42"	3087'	Victoria Harbor, Canada	2018
36"	1511'	Hwy #1, Canada	2017
48"	1112'	134 Street & 92nd Avenue, Canada	2017
36"	1116'	United Blvd & Mundy Creek, Canada	2017
36"	1076'	Hwy 7 & CP Rail, Canada	2017
48"	2349'	Chiltipan Creek, TX	2017

2011 – 2017: **HDD Operator | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
48"	2263'	US Hwy 181/Hwy 35, TX	2017
48"	2807'	Oliver Creek & SH 188, TX	2017
12"	7228'	Athabasca River, Alberta, Canada	2016
42"	3885'	Dover River, Alberta, Canada	2016

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
24"	1230'	Christina River, Wood Buffalo, Canada	2015
42"	7205'	Athabasca River, Alberta, Canada	2015
12"	3472'	Gilmore Lane, OR	2014
36"	1640'	LaMoine River, IL	2013
36"	5313'	Kansas City RR, LA	2011
42"	4952'	Rambling Bayou, LA	2011
36"	4993'	Atchafalaya Rivre, LA	2011
36"	1518'	Vermillion River, IL	2013
36"	4304'	Bois D' Arc, TX	2013
36"	3239'	Clear Boggy Creek, OK	2013
36"	1792'	North Canadian River, OK	2013
36"	1444'	Hwy 155 & UP RR, Big Sandy, TX	2012
36"	1761'	Private Lake, Maple Springs, TX	2012
36"	4505'	Medicine Hat Alberta, Canada	2012

2009 – 2011: **Operator | Michels Pipeline | Brownsville, WI**

Responsibilities included locating, operating Ditch Witch, directional boring rig, trencher, plow, back hoe, and small back hoe.

2006 – 2009: **Operator/Driller | Laney Directional Drilling | Humble, TX**

Operated Drill Rig, Trackhoe and Crane. Currently hold world record for drilling 6700' of 42" in Sulphur, LA (7/2008).

EDUCATION

1987 **Linville High School | Linville , LA**

High School Diploma

MICHELS®

Richard Wulff

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2015 – Present: Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Some more notable crossings, but not limited to:

Diameter	Length	Location	Year
16"	2997'	Paoli Pike/E Boot Road, PA	2019
16"	3419'	Greenhill Road, PA	2019
12"	1070'	Indiana Harbor Canal - 12" & 10" Bundle, IN	2018
20"	1665'	Aughwick Creek, PA	2018
20"	2209'	Horse Valley Road, PA	2018
20"	1507'	Trough Creek Valley Pike/SR 829, PA	2018
16"	1999'	Route-35, NJ	2018
16"	1198'	Harrisburg Pike, PA	2017
20"	2005'	Hwy 15, PA	2017
36"	1545'	Van Dyke Road, IL	2017
24"	3166'	N Saskatchewan River, Alberta, Canada	2016
24"	4531'	Athabasca River, Alberta, Canada	2016
30"	2461'	Highway 63, Alberta, Canada	2015
24"	1956'	Clearwater River, Alberta, Canada	2015

1998 – 2015: HDD Operator | Michels Directional Crossings | Brownsville, WI

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
36"	1613'	Fish Pond, Alberta, Canada	2014
36"	2274'	Highway 13, Alberta, Canada	2014
36"	2133'	Wetland Crossing, Alberta, Canada	2014
12"	4272'	Saline Creek, Alberta, Canada	2013
36"	3618'	Johnson Creek, TX	2013

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
36"	3314'	East Fork Angelina River, TX	2013
36"	1867'	Flora, TX	2012
20"	869'	Centerview, MO	2012
20"	2458'	Centerview, MO	2012
16"	3894'	Roaring Branch, PA	2012
30"	3455'	Marysville, MI-Searnia, Ontario	2011
16"	1413'	Mill Ln, NJ	2010
30"	1422'	Mill Ln/Hedding Ave, NJ	2010
36"	3999'	Mississippi River, MN	2009
42"	2429'	Scioto River, OH	2009
42"	3800'	Mississippi River, MO	2009
42"	3043'	Little Miami River, OH	2009
36"	2190'	Souris River, Manitoba	2009

1996 – 1998: **Operator | Haug Roofing | West Bend, WI**

Operate crane and skid loader. Knowledgeable on every aspect of the roofing business; design techniques, blueprints, drawings and structure.

EDUCATION

2003 **Fond du Lac High School | Fond du Lac, WI**

High School Diploma

MICHELS®

Seth Matheny

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2017 – Present: Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	1933'	W Baltimore/Glenwood Rd, PA	2020
16"	4399'	Valley Rd/Darlington Rd, PA	2019
20"	1720'	Everett Railroad-Juniata River, PA	2018
20"	2209'	Horse Valley Road, PA	2018
20"	1416'	Blacklog Creek, PA	2018
16"	2766'	Hall Street, NJ	2018
36"	6238'	Ohio River, OH/WV	2017
16"	1260'	Hollow Road, PA	2017

2014 – 2016: Foreman | Kirk Excavating | Columbus, OH

Oversee day to day operations. Met with contractors. Operated various horizontal directional drills. Set-up and created bore profiles. Steered and/or located pilot bore. Mandated OSHA Regulations.

2011 – 2014: Operator | Precise Boring of Ohio | Lancaster, OH

Operated various horizontal directional drills. Operated and maintained mud cleaning systems. Set-up and created bore profiles. Steered and/or located pilot bore. Completed all necessary paperwork pertaing to the job. Mandated OSHA Regulations.

2007 – 2011: Foreman | Sureshot Directional Drilling | Lancaster, OH

Maintained inventory for all drilling needs. Fostered communication and relations with contractors and utility companies. Prepared job estimates and bids and trained new employees. Operated various horizontal directional drills. Set-up and created bore profiles. Steered and/or located pilot bore. Mandated OSHA Regulations.

2002 – 2007: Operator | Tob Gobel Excavating and Well Drilling | Amanda, OH

Operated backhoe, trackhoe, bulldozer and skid steer. Well driller assistant, grade checker and other duties as needed.

TRAINING & CERTIFICATIONS

- Class A CDL with Tanker Endorsement
- OSHA 10 Training
- Safeland and Safegulf Training
- HDPE Columbia Gas Fusion Certification

EDUCATION

2005 **Amanda-Clearcreek High School | Amanda, OH**

High School Graduate

MICHELS®

Jamie Hollenbeck

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2018 – Present: Field Operations Superintendent | Michels Directional Crossings | Brownsville, Wisconsin

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Some more notable crossings, but not limited to:

Diameter	Length	Crossing/Location	Year
20"	13,247'	Lake Sakakawea, ND	2019
20"	6429'	Badlands Canyon, MT	2019
8"	12,769'	Montezeuma Slough, CA	2019
24"	2100'	Spanish Lake, MO	2019
22"	4986'	Atchafalaya River, LA	2019
20"	1068'	Rahway River, NJ	2018
42"	3980'	Susquehanna River MP 99.6, PA	2018

2008 – 2018: HDD Operator | Michels Directional Crossings | Brownsville, WI

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
36"	5841'	Ohio River MP 33.8, OH/WV	2017
10"	5697'	Mississippi River, LA	2017
30"	3483'	Ford Island to Landing C, HI	2017
30"	7531'	Lake Oahe & Missouri River, ND	2017
16"	6693'	Wapsipinicon River, IA	2016
30"	6328'	Big Sioux River, SD/IA	2016
24"	4531'	Athabasca River, Alberta, Canada	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
24"	3716'	Barbour's Cut, TX	2015
24"	7432'	Houston Ship Channel, TX	2015
36"	3461'	Kennedy Ave/Griffith Terminal, IN	2015
36"	3011'	Highway 41 & RR, IN	2015

PROFESSIONAL EXPERIENCE (continued)

10"	4654'	Allegheny River, PA	2015
8"	3320'	Yellowstone River, MT	2015
24" HDPE	1061'	Lake Sakakawea, ND	2014
8"	7321'	MP 49.3 Landslide, MT	2014
8"	4159'	MP 54.8 Landslide, MT	2014
20"	2364'	Missouri River, NE/IA	2014
16"	2951'	Line 82, ND	2014
36"	2264'	Otter Creek, IL	2013
48"	1943'	West Neck Creek, VA	2013
8"	7177'	115 KV Power Duct, SC	2013
8"	7304'	115 KV Power Duct, SC	2013
8"	4911'	115 KV Power Duct, SC	2013
8"	12,902'	MP66, Wyola, MT	2012
8"	4475'	MP57, Lodge Grass, MT	2012
16"	3894'	Roaring Branch, PA	2012
16"	1818'	Texas Creek, Tioga, PA	2011
30"	5786'	Lake Conway, Vernon, NJ	2011
42"	992'	Bayou Rapids, Bunkie, LA	2011
42"	1223'	Bayou Robert, Bunkie, LA	2011
36"	3030'	Black Bear Forest, Bunkie, LA	2011

2005 – 2008: **Laborer | Ballard Utility**

Run Directional Drills

2001 – 2005: **Laborer | NPL**

Installed gas services and mains by Directional Drilling

1994 – 2000: **Operator | Mears Directional Drilling**

Worked as a laborer, became an operator for an excavator and final advancement operating a 24-40 drill rig.

MICHELS®

Doug Stebbins

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2018 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, Wisconsin**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. More notable crossings include, but are not limited to:

Diameter	Length	Location	Year
42"	3451'	Bow River, Cananda	2019
24"	3183'	Crow River, MN	2019
20"	1010'	East Branch Escanaba River, MI	2019
20"	6429'	Badlands Canyon, MT	2019
20"	1421'	Middle Branch Escanaba River, MI	2019
24"	6336'	Mississippi River, IL/MO	2019
20"	2355'	Joanna Rd, PA	2018
36"	2611'	Tuscarawas River MP 47.8, OH	2018
42"	3980'	Susquehanna River MP 99.6, PA	2018
42"	1810'	Interstate 80, PA	2018

2007 – 2017: **HDD Operator | Michels Corporation | Brownsville, wi**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation. Responsible for surveying, staking and design of directional drill path and curve, drilling the pilot hole, monitoring the drill path and calculating and interpreting the ground elevations and contours. Complete surveying skills and experience utilizing a Total Station (Theodolite with built-in EDM) for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points (benchmarks). On-site maintenance of technical equipment, and necessary record-keeping of plots and drilling logs. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
36"	1511'	Hwy #1, Canada	2017
36"	1116'	United Blvd & Mundy Creek, Canada	2017
36"	1076'	Hwy 7 & CP Rail, Canada	2017
16"	11,397'	Lake Sacagawea South, ND	2016
16"	11,229'	Lake Sacagawea North, ND	2016

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
12"	7228'	Athabasca River, Alberta, Canada	2016
42"	3399'	McKay River, Alberta, Canada	2016
42"	7205'	Athabasca River, Alberta, Canada	2015
8"	7321'	MP 49.3 Landslide, MT	2014
36"	4005'	Canadian River, OK	2013
36"	1792'	North Canadian River, OK	2013
36"	1366'	Big Sandy, Maple Springs, TX	2012
30"	3042'	Wyalusing, PA	2012
20"	2513'	Tioga Junction, PA	2012

2002 – 2007: **Operator/Foreman | InterCon Construction | Madison, WI**

Skilled in the operation of technical, lifting and heavy equipment for directional drilling operation. Working knowledge of hydraulic engineering and applied mechanical engineering. Experience in working on and around directional drilling rigs as an integral member of a specialized team. Familiar with mechanical repairs, hydraulics, fluids, set-up and operation of drill morors, power generators mud pmps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation.

EDUCATION

1995 **Wakefield High School | Michigan**

High School Diploma

MICHELS®

Curt Rischmueller

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2006 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville , WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	1933'	W Baltimore Pike/Glenwood Rd, PA	2020
20"	2236'	Lower Piney Creek, PA	2018
36"	2730'	Sanddusky River MP 145.8, OH	2018
20"	3874'	Waltonville Rd, PA	2018
36"	1525'	Dupage River #1, IL	2017
12"	1178'	Howard Cove, ME	2016
12"	1023'	Cutler Site, ME	2016
12"	2765'	Lewis Creek, VT	2016
12"	2856'	Wetland Replacement, OH	2016
20"	845'	Patterson Rd/RR, IL	2016
20"	1335'	Laraway Rd, IL	2016
12"	11,563	Holland Bottoms Wetlands, AK	2015
24"	1405'	Platte River, MO	2015
16"	2249'	Ohio River, OH/KY	2015
22"	2538'	Barrington Rd, IL	2015
36"	1147'	E. 138th Street, IL	2015
36"	2697'	Barrington Rd, IL	2015
36"	3031'	BNSF RR & Aurora Rd, IL	2015
12"	2557'	Arkansas River, AR	2014
36"	2355'	Salt Fork River, MO	2013
36"	2077'	Chariton River, MO	2013

PROFESSIONAL EXPERIENCE
(continued)

Diameter	Length	Crossing/Location	Year
36"	3892'	Red River, OK	2013
36"	4213'	Menard Creek, TX	2013
36"	3571'	Angelina River, TX	2013
36"	2908'	Neches River & RR, TX	2013
36"	4505'	S. Saskatchewan River, Alberta	2012
36"	2567'	S. Sulpher, Sandhill, TX	2012
36"	1640'	Sabine River, Pine Hurst Farm, TX	2012
30"	2133'	Alberta, Canada	2012
42"	3443'	Wetland R2, Bienville Parish, LA	2011
30"	5786'	Lake Conway, Vernon, NJ	2011
42"	1223'	Bunkie, LA	2011
20"	2855'	Suwannee River, FL	2010
42"	1786'	Big Creek, LA	2010

2000 – 2006: **HDD Foreman | InterCon Construction | Madison, WI**

Set up drill site location. Maintain daily operations of Directional Drill. Direct correspondence with contractors, landowners and other personnel dealing with drill operations.

1995 – 2000: **Fuser/Welder | InterCon Construction | Madison, WI**

Ran house service and mainline extension for MG&E and Wisconsin Power and Light.

EDUCATION

1980 **Sauk Prairie High School | Sauk City, WI**

High School Diploma

MICHELS®

Bobby Skipworth

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2017 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Some more notable crossings, but not limited to:

Diameter	Length	Location	Year
16"	2997'	Paoli Pike/E boot Road, PA	2019
16"	707'	Eagle View Blvd, PA	2019
16"	1152'	Meadow Ln & Shepard Ln, PA	2019
16"	1888'	West Baltimore Pike Rd, PA	2019
4"	1495'	Des Moines River, IA	2018
12"	1070'	Indiana Harbor Canal - 12" & 10" Bundle, IN	2018
12"	1369'	Rocky Point Landing, Jamaica	2018
16"	1999'	Route-35, NJ	2018
16"	1198'	Harrisburg Pike, PA	2017
10"	5697'	Mississippi River, LA	2017
30"	2278'	Chattahoochee River, GA	2017

2014 – 2016: **HDD Operator | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation.

Diameter	Length	Location	Year
12"	1178'	Howard Cove, ME	2016
12"	1023'	Cutler Site, ME	2016
12"	2765'	Lewis Creek, VT	2016
12"	2856'	Wetland Replacement, OH	2016
20"	845'	Patterson Rd/RR, IL	2016
20"	1335'	Laraway Rd, IL	2016
12"	11,563	Holland Bottoms Wetlands, AK	2015
24"	1405'	Platte River, MO	2015

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
16"	2249'	Ohio River, OH/KY	2015
22"	2538'	Barrington Rd, IL	2015
36"	1147'	E. 138th Street, IL	2015
36"	2697'	Barrington Rd, IL	2015
36"	3031'	BNSF RR & Aurora Rd, IL	2015
12"	2557'	Arkansas River, AR	2014
24"	3030'	Big Creek Lake, AL	2014

MICHELS®

Tim Monroe

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2016 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Some more notable crossings, but not limited to:

Diameter	Length	Location	Year
16"	3628'	Eagleview Blvd, PA	2019
16"	1888'	West Baltimore Pike Rd, PA	2019
16"	3981'	Glendale Rd & Concord Ave, PA	2019
36"	3199'	Vermillion River MP 104.4, OH	2018
36"	1522'	Findlay Road MP 179.9, OH	2018
16"	5869'	Conrail RR, NJ	2018
36"	2377'	Hydro Park MP 250.7, MI	2018
36"	6238'	Ohio River, OH/WV	2017
24"	983'	Mystic River, MA	2017
24"	2293'	Interstate 20, GA	2017
36"	3829'	Flint River, GA	2016
30"	5714'	James River, SD	2016
42" Steel w/ 36" HDPE	3983'	St John's River, FL	2016

2008 – 2016: **Drilling Fluids Technician/Laborer | Michels Directional Crossings | Brownsville, WI**

Integral member of a specialized team working on and around directional drilling rigs. Provide onsite services by measuring and testing of fluid mixing and pumping, including technical analysis and practical recommendations for controlling fluid properties. Maintain fluid properties on rig sites by testing fluid properties accurately. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs, hydraulics, fluids, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
16"	1508'	Beverly Harbor, MA	2015
16"	3827'	Collins Cove, MA	2015
36"	2303'	Liberty Street, IL	2015
18"	12,459	Houston Ship Channel, TX	2015

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
36"	9040'	Mississippi River, IL/MO	2014
24"	3269'	Transfer Line 2, IN	2014
24"	3275'	Transfer Line 1, IN	2014
20"	1193'	SR-265/Leatherwood Rd, OH	2014
30"	2344'	Delaware River, PA/NJ	2013
42"	3008'	I-95 & Tidal Wetlands, NJ	2013
16"	1664'	Morales, TX	2012
42"	1657'	Morales, TX	2012
10"	1495'	Missoula, MT	2012
24"	1546'	Colorado River, CO	2011
12"	1612'	WBC62 (Offshore), LA	2011
10"	3447'	Grand Lake, OK	2011

EDUCATION

2003 **Fond du Lac High School | Fond du Lac, WI**

High School Diploma

MICHELS®

James Day

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2017 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
36"	2717'	N Saskatchewan River, Canada	2019
16"	7402'	Susquehanna River, PA	2019
20"	2236'	Lower Piney Creek, PA	2018
20"	1720'	Everett RR-Juniata River, PA	2018
20"	2209'	Horse Valley Road, PA	2018
20"	7354'	Susquehanna River, PA	2018
36"	5841'	Ohio River MP 33.8, OH/WV	2017
42"	2431'	Maumee River/State Hwy 24, OH	2017

2008 – 2017: **HDD Operator | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation. Some notable crossings include, but are not limited to:

Diameter	Length	Location	Year
30"	7531'	Lake Oahe & Missouri River, ND	2017
16"	6693'	Wapsipinicon River, IA	2016
30"	6328'	Big Sioux River, SD/IA	2016
12"	7228'	Athabasca River, Alberta, Canada	2016
42"	7205'	Athabasca River, Alberta, Canada	2015
36"	2510'	Deer Creek, IL	2015
42"	3776	Mackay River, Alberta, Canada	2015

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
6"	6999'	Navajo Reservoir/San Juan river, NM	2014
36"	9040'	Mississippi River & Levees, IL/MO	2014
24"	2020'	Unnamed Creek, AL	2014
42"	1252'	Battle River, Alberta, Canada	2013
30"	6544'	East 1st Street, NJ	2013
30"	4905'	Merseles Streer, NJ	2013
12"	4272'	Saline Creek, Alberta, Canada	2013
30"	5378'	Hudson River, NJ/NY	2012
30"	4850'	Red River, TX/OK	2012
42"	3205'	Dewitt, TX	2012
36"	4505'	Medicine Hat, Alberta, Canada	2012
36"	4993'	Atchafalaya River, LA	2011
42"	4272'	St. John's River, BC	2011
42"	2204'	Bayou Comitte, LA	2010
36"	1873'	Petitcodic River, Canada	2009
24"	3009'	Middle Salinas River, CA	2008
30"	1657'	St. Lucie Canal, FL	2008
30"	2739'	Couse Midden, FL	2008

2007 – 2008: **Laborer | Intercom Construction | Madison, WI**

Directional Drilling, Fusing and hand digging for services

EDUCATION

2002 **Boone High School | Boone, IA**

High School Graduate

817 Main Street, PO Box 128 • Brownsville, WI 53006 | 920-583-3132

MICHELS®

Cliff Mclain

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2006 – Present: **Field Operations Superintendent | Michels Corporation | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
20"	6429'	Badlands Canyon, MT	2019
30"	3746'	Dix River, KY	2019
36"	2974'	Wetland MP 8.1, OH	2018
36"	1886'	Nimisila Reservoir MP 40.9, OH	2018
36"	2611'	Tuscarawas River MP 47.8, OH	2018
30"	2273'	Susquehanna River @ MP 35, PA	2018
12"	5741'	Rum River & Wetland, MN	2017
12"	5170'	Larch Dr & Wetland, MN	2017
36"	1594'	Dupage River #2, IL	2017
30"	7282'	Mississippi River, IA/IL	2016
42"	3885'	Dover River, Alberta, Canada	2016
42"	7205'	Athabasca River, Alberta, Canada	2015
42"	2510'	Ruth Lake, Fort McMurray, Canada	2015
12"	3472'	Gilmore Lane, OR	2014
36"	1640'	LaMoine River, IL	2013
36"	4304'	Bois D' Arc, TX	2013
36"	4005'	Canadian River, OK	2013
36"	1792'	North Canadian River, OK	2013
30"	3042'	Wyalusing, PA	2012
16"	3894'	Roaring Branch, PA	2012
20"	2513'	Tioga Junction, PA	2012

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
12"	2530'	Cornwall, ONT, Canada	2011
10"	964'	US Route 1, Fort Lauderdale, FL	2011
30"	3455'	Marysville, MI-Searnia, Ontario	2011
42"	3008'	White River, Russell, AR	2010
42"	5084'	Mississippi River, Helena, AR	2010
42"	3497'	Little Red River, AR	2010
20"	5022'	Pokegama Carnegie, WI	2009
20"	5087'	Mississippi River, Empire, LA	2009

1995 – 2006: **Drill Operator | InterCon Construction | Madison, WI**

Crane operator responsible for safe operation and timely placement of drill stem and equipment. Integral link in the drilling operation, from drill rig set-up, pipe pull back and rig-down of equipment. Also conducted pipe support operations at the exit side during pipeline pullback. Responsible for permitting and mobilization/demobilization of heavy and non-dimensional equipment to drill sites.

EDUCATION

Florence High School | Florence, WI

High School Diploma

MICHELS®

Josh Bush

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2017 – Present: **Field Operations Superintendent | Michels Directional Crossings**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production. Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	6976'	Matlock/W Chester Rd, PA	2020
16"	3728'	Village Square Dr, PA	2019
36"	1487'	River Raisin, MI	2018
36"	1805'	Portage River, OH	2018
16"	2346'	Frankstown Branch-Juniata River, PA	2018
20"	2307'	Frankstown Branch-Juniata River, PA	2017

2016 – 2017: **HDD Operator | Michels Directional Crossings**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation.

2013 – 2016: **Skilled Laborer | Michels Directional Crossings**

Integral member of a specialized team working on and around directional drilling rigs. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs, hydraulics, fluids, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation.

2009 – 2013: **Diesel Mechanic | McCartney Produce | Paris, TN**

TRAINING & CERTIFICATIONS

- Respiratory Protection
- Respirable Crystalline Silica
- First Aid/CPR/AED Certification
- Confined Space Rescue Certification

EDUCATION

2011 **Gateway School | Paris, TN**

High School Graduate

MICHELS®

Jason Freund

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2020 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

2009 – 2020: **HDD Operator | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings, but not limited to:

Diameter	Length	Crossing/Location	Year
12"	1369'	Rocky Point Landing, Jamaica	2018
36"	2974'	Wetland MP 8.1, OH	2018
30"	2273'	Susquehanna River @ MP 35, PA	2018
42"	2826'	San Joaquin River, CA	2017
12"	5741'	Rum River & Wetland, MN	2017
12"	5170'	Larch Dr & Wetland, MN	2017
6"	3309'	Hauser Lake, MT	2017
8"	1980'	CHS Yellowstone River, MT	2017
8"	1530'	SPL Yellowstone River, MT	2017
8"	1542'	YPL Yellowstone River, MT	2017
12"	1285'	XOM Yellowstone River, MT	2017
24"	1898'	Vermillion River, IL	2016
12"	3144'	Monkton Swamp, VT	2016
12"	1491'	Drinkwater Rd, VT	2016
20"	1904'	North St Mary's River, IN	2016
20"	1076'	South St Mary's River, IN	2016
30"	6119'	Lake Whitney, TX	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Crossing/Location	Year
24"	3716'	Barbour's Cut, TX	2015
24"	7432'	Houston Ship Channel, TX	2015
24"	5908'	Tabbs Bay, TX	2015
36"	1862'	State Highway 50, IL	2015
36"	1813'	Calumet Ave, IN	2015
36"	1803'	Dyer Ditch, IN	2015
36"	1812'	Highway 394, IL	2015

2000 – 2008: **Skilled Laborer | Michels Directional Crossings | Brownsville, WI**

Integral member of a specialized team working on and around directional drilling rigs. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs, hydraulics, fluids, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation.

MICHELS®

Mike Brever

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2018 – Present: Field Operations Superintendent | Michels Directional Crossings | Brownsville, Wisconsin

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Some more notable crossings, but not limited to:

Diameter	Length	Crossing/Location	Year
36"	3199'	Vermillion River MP 104.4, OH	2018
36"	2974'	Wetland MP 8.1, OH	2018

2009 – 2018: HDD Operator | Michels Directional Crossings | Brownsville, WI

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
30"	3483'	Ford Island to Landing C, HI	2017
20"	2005'	Highway 15, PA	2017
36"	1535'	Calumet River, IL Direct Pipe	2017
36"	3901'	Rutherford Rd, Ontario, Canada	2016
42"	3885'	Dover River, Alberta, Canada	2016
36"	3160'	Christina River, Alberta, Canada	2016
30"	5154'	House River, Alberta, Canada	2015
12'	11,563'	Holland Bottoms Wetland, AR	2015
48"	4039'	Dow Barge Channel, TX Direct Pipe	2015
10"	4654'	Allegheny River, PA	2015
36"	3805'	Williamette River, OR	2014
24"	2884'	Hatchett Creek, AL	2014
16"	2951'	Line 82, ND	2014
8"	2545'	MP266, Mountain Green, UT	2013
30"	1881'	Bennekill Stream, NJ	2013
30"	6544'	1st Street, NJ	2013
42"	1670'	Lavaca River, TX	2012

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
42"	1650'	Chicolete River, TX	2017
30"	1633'	Paerdegat Basin, NY	2017
36"	1392'	Hackensack River, NJ	2017
24"	2645'	Chemung River, NY	2016
30"	5786'	Lake Coneay, NJ	2016

2005 – 2009: **Heavy Truck/Diesel Mechanic | Mike's Truck and Trailer Repair | New Brighton, MN**

EDUCATION

2006 **Henippen Technician College | Brooklyn Center, MN**

Heavy Truck Degree

2003 **Columbia Heights High School | Columbia Heights, MN**

High School Diploma

MICHELS®

Tim Bunkelman

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2018 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production.

Diameter	Length	Location	Year
16"	983'	N Chester Rd/Bancroft, PA	2019
16"	1888'	West Baltimore Pike Rd, PA	2019
20"	1665'	Aughwick Creek, PA	2018
20"	2209'	Horse Valley Road, PA	2018

1992 – 2018: **HDD Operator | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
20"	1507'	Trough Creek Valley Pike/SR 829, PA	2018
16"	1999'	Route-35, NJ	2018
16"	1198'	Harrisburg Pike, PA	2017
20"	2005'	Hwy 15, PA	2017
36"	1545'	Van Dyke Road, IL	2017
24"	3166'	N Saskatchewan River, Alberta, Canada	2016
24"	4531'	Athabasca River, Alberta, Canada	2016
30"	2461'	Highway 63, Alberta, Canada	2015
24"	1956'	Clearwater River, Alberta, Canada	2015
36"	1613'	Fish Pond, Alberta, Canada	2014
36"	1359'	Wetland Crossing #2, Alberta, Canada	2014
36"	9040'	Mississippi River, IL/MO	2014
42"	4284'	Vermillion River, Canada	2013
30"	4905'	Merseles, NJ	2013
30"	5378'	Hudson River, NJ/NY	2012

PROFESSIONAL EXPERIENCE (continued)

1989 – 1992: **Skilled Laborer | Michels Directional Crossings | Brownsville, WI**

Integral member of a specialized team working on and around directional drilling rigs. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs, hydraulics, fluids, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation.

1987 – 1989: **Construction of Pole Buildings | Pro Builders | Lomira , WI**

1979 – 1986: **Heavy Equipment Diesel Mechanic | US Army**

EDUCATION

1979 **Campbellsport High School | Campbellsport, WI**

MICHELS®

Seth Strean

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2020 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

2012 – 2019: **HDD Operator | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings, but not limited to:

Diameter	Length	Crossing/Location	Year
20"	2236'	Lower Piney Creek, PA	2018
36"	2730'	Sanddusky River MP 145.8, OH	2018
20"	3874'	Waltonville Rd, PA	2018
36"	1525'	Dupage River #1, IL	2017
12"	1178'	Howard Cove, ME	2016
12"	1023'	Cutler Site, ME	2016
12"	2765'	Lewis Creek, VT	2016
12"	2856'	Wetland Replacement, OH	2016
20"	845'	Patterson Rd/RR, IL	2016
20"	1335'	Laraway Rd, IL	2016
12"	11,563	Holland Bottoms Wetlands, AK	2015
24"	1405'	Platte River, MO	2015
16"	2249'	Ohio River, OH/KY	2015
22"	2538'	Barrington Rd, IL	2015
36"	1147'	E. 138th Street, IL	2015
36"	2697'	Barrington Rd, IL	2015
36"	3031'	BNSF RR & Aurora Rd, IL	2015
12"	2557'	Arkansas River, AR	2014
36"	2355'	Salt Fork River, MO	2013
36"	2077'	Chariton River, MO	2013

PROFESSIONAL EXPERIENCE (continued)

2000 – 2012: **Skilled Laborer | Michels Directional Crossings | Brownsville , WI**

Integral member of a specialized team working on and around directional drilling rigs. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs, hydraulics, fluids, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation.

EDUCATION

1999 **Goodrich High School | Fond du Lac, WI**

MICHELS®

Matt Rohwer

Field Superintendent

PROFESSIONAL EXPERIENCE

2007 – Present: **Field Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical, and communication lines. Complete knowledge of directional drilling technology and procedures. Duties include mobilization of all equipment and personnel to job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; necessary record keeping of production and overall on-site management.

2005 – 2007: **Laborer | NPL | Lakeville, MN**

General labor installing utilities.

PROJECT PROFILES

2018 | CHS | Wastewater Force Main Project; HDD 24" pipe under BSF Railroad Tracks – Laurel, MT

2018 | MERC | Rochester Lateral; HDD 16" pipe under CP Railroad Tracks – Rocxhester, MN

2007-2017 | CPE | Multiple Pipe Sizes | Miscellaneus Railroad Tracks around Twin Cities; MN

TRAINING & CERTIFICATIONS

- ERail Safe

EQUIPMENT EXPERIENCE

- Drill Rig
- Excavator
- Mud Rig

EDUCATION

Triton High School | Dodge Center, MN

MICHELS®

Brady Hickey

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2010 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites, set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Oversees drilling survey during crossing.

Diameter	Length	Location	Year
16"	4,100'	Hummelstown, PA	2020
10"	1,200'	Linn, MO	2019
24"	2,000'	Cologne, MN	2019
24"	1,000'	Cologne, MN	2019
8"	4,800'	Little Falls, MN	2019
8"	600'	Spokane, WA	2019

TRAINING & CERTIFICATIONS

- Safety training
- Veriforce training
- TWIC Card

EQUIPMENT EXPERIENCE

- Excavator
- Mud Rig
- Drill Rig

EDUCATION

Triton High School | Dodge Center, MN

MICHELS®

Branden Cole

Field Superintendent

PROFESSIONAL EXPERIENCE

2019 – Present: Field Superintendent | Michels Directional Crossings | Brownsville, WI

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines as well as environmental wells. Duties include mobilization of all equipment and personnel to remote job sites, set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary recordkeeping of plots and production. Oversees drilling survey during crossing.

2015 – 2019: Foreman | Precision Pipeline | Eau Claire, WI

Horizontal Directional Drilling of steel natural gas and petroleum pipelines. Ordered tooling for drills, supervised crew, interpreted blueprints and profiles, performed daily progress reports and time sheets, and tracking of expenditures on the job.

2009 – 2015: Laborer | Roese Contracting/Pipeline LLC | Kawkawlin, MI

Responsibilities included location utilities, installing fiber optic cable, plastic pipeline for gas distribution, gas service and meter sets to customer homes.

1994 – 2009: Crew Member | Ironworkers Local 25 | Novi, MI

Erected steel buildings, tied reinforcing steel for concrete placement, made connections on structural steel, steel welding, bolting up steel, setting beams on bridges, steel roofing, sheeting on buildings, and ornamental work.

PROJECT PROFILES

NPL | HDD; Rochester, MN

Sunoco | Manor East II HDD; Harrisburg, PA

DTE | HDD and Open Trench; Detroit, MI

Michigan DOT | Erected Bridges; Detroit, MI

DOW | Erected Buildings; Midland, MI

Michigan DOT | Welding on Bridges; Pontiac, MI

TRAINING & CERTIFICATIONS

- Class A Commercial Driver's License
- ASE Certified Mechanic
- Certified Welder
- First Aid/CPR/AED Certification
- Trenching/Excavation Safety Training
- OSHA 20-Hour

INDUSTRY INVOLVEMENT

- Operating Engineers Local 49
- Laborer's Union 1098
- Ironworkers Local 25

EQUIPMENT EXPERIENCE

- Track/Excavator

EQUIPMENT EXPERIENCE (continued)

- Front end loader
- Skytrac
- Roller
- Skid Steer
- Reclaimer
- Drill Rig

EDUCATION

1998 **Mott Community College | Flint, MI**

Construction Management

MICHELS®

Steve Case

Field Operations Superintendent

PROFESSIONAL EXPERIENCE

2008 – Present: **Field Operations Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation.

Some more notable crossings include, but are not limited to:

Diameter	Length	Location	Year
10"	2100'	Blue Line Replacvement, MO	2019
8"	3100'	Elkhorn River, NE	2019
20"	1800'	County Road B, MN	2019
16"	1400'	Rochester Greenfield Lateral, MN	2019
16"	2300'	Teton River, MT	2019

2006 – 2008: **Forman | Telecom Construction | Clearwater, MN**

Conduct daily tasks, install fiber optic cables, install phone and power cables using HDD methods. Read prints/alignment sheets, locate utility lines using electronic locating devices, set vaults for utilities

2004 – 2006: **Automotive Technician | Nokomis Auto Service | Alexandria, MN**

Perform inspections on automobiles and diagnose problem. Use of electronic scan tools to perform repairs on automobiles. Repair faulty part(s), replace, test vehicle.

INDUSTRY INVOLVEMENT

- Member of Operating Engineers Local 49

EQUIPMENT EXPERIENCE

- Drill Rig, Trackhoe, Dozer and Backhoe

EDUCATION

Park High School | Livingston , MT

High School Diploma

MICHELS®

Garrett Derrer

Assistant Superintendent

PROFESSIONAL EXPERIENCE

2020 – Present: **Assistant Superintendent | Michels Directional Crossings | Brownsville, WI**

Responsible for coordinating and drilling directional boring projects for various size gas, water, sewer, electrical and communication lines. Duties include mobilization of all equipment and personnel to remote job sites throughout the United States; the set-up and drilling of crossings; on-site maintenance of mechanical and technical equipment; and necessary record keeping of plots and production.

2016 – 2020: **HDD Operator | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation. Some more notable crossings, but not limited to:

Diameter	Length	Location	Year
16"	2518'	Herman O.W. Drive, PA	2019
16"	4381'	Pennsylvania Drive, PA	2019
16"	1888'	West Baltimore Pike Rd, PA	2019
16"	3981'	Glendale Rd & Concord Ave, PA	2019
36"	3199'	Vermillion River MP 104.4, OH	2018
16"	5869'	Conrail RR, NJ	2018
36"	2377'	Hydro Park MP 250.7, MI	2018
36"	6238'	Ohio River, OH/WV	2017
24"	983'	Mystic River, MA	2017
24"	2293'	Interstate 20, GA	2017
36"	3829'	Flint River, GA	2016
30"	5714'	James River, SD	2016

2016: **Welder | Whitehead Construction | Elizabethton, TN**

Welding and repairing electrostatic precipitator cleaning systems in power plants and coal burners

2015: **Pipe Fitter | Fagen Inc | Granite Falls, MN**

Installing piping systems and hydro testing product pipe for an ethanol plant

TRAINING & CERTIFICATIONS

- OSHA 30
- NCCER Level 4 Certifiation
- Pipe Fitting Diploma
- Professional Welding Diploma

EDUCATION

Tulsa Welding School | Tulsa , OK

Professional Welding and Pipe Fitting Diploma

TBAISD CTC | Traverse City, MI

Pre Trade Welding

Mancelona High School | Mancelona , MI

High School Diploma

MICHELS®

Jeff Nehmer

Drilling Survey Technician

PROFESSIONAL EXPERIENCE

1997 – Present: **Drilling Survey Technician | Michels Directional Crossings | Brownsville, WI**

Responsible for surveying, staking and design of directional drill path and curve, drilling the pilot hole, tracking and monitoring the drill path and calculating and interpreting the ground elevations and contours. Computer literate with knowledge and experience operating various software including: 1) Magnetic Guidance System, 2) Survey, 3) Tru-Tracker and 4) Microsoft applications. Applied working knowledge of advanced mathematics including: 1) Fluid Dynamics, 2) Advanced Algebra, 3) Trigonometry, 4) Calculus, 5) Statistics and 6) Stress Engineering. Complete surveying skills and experience utilizing a Total Station (Theodolite with built-in EDM) for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points (benchmarks). Additional duties include on-site maintenance of technical equipment, and necessary record-keeping of plots and drilling logs. Performed the above operations to crossings which include, but not limited to:

Diameter	Length	Crossing/Location	Year
20"	2740'	West Branch Escanaba River, MI	2019
20"	6429'	Badlands Canyon, MT	2019
24"	3341'	Hwy 367/Coldwater Creek, MO	2019
24"	2100'	Spanish Lake, MO	2019
22"	4986'	Atchafalaya River, LA	2019
24"	3817'	Missouri River, MO	2019
24"	6336'	Mississippi River, IL/MO	2019
42"	4687'	Lake Scranton Finished H2O Tunnel, PA	2018
20"	2355'	Joanna Rd, PA	2018
20"	1720'	Everett RR-Juniata River, PA	2018
20"	1068'	Rahway River, NJ	2018
30"	2273'	Susquehanna River @ MP 35, PA	2018
36"	2836'	Nemadji Golf Course, WI	2017
20"	2005'	Hwy 15, PA	2017
12"	5741'	Rum River & Wetland, WI	2017
12"	5171'	Larch Dr & Wetland, MN	2017
36"	7194'	Ohio River MP 16.07, OH/WV	2017
24"	5788'	Hwy 41/45, WI	2017
36"	1545'	Van Dyke Road, IL	2017
24"	2293'	Interstate 20, GA	2017
12"	1285'	XOM Yellowstone River, MT	2017

12"	1178'	Howard Cove, ME	2016
12"	1023'	Cutler Site, ME	2016
12"	3144'	Monkton Swamp, VT	2016
12"	2765'	Lewis Creek, VT	2016
12"	1491'	Drinkwater Rd, VT	2016
12"	922'	Arch Site & Monkton Rd, VT	2016
42" Steel with 36" HDPE	3983'	St John's River, FL	2016
20"	983'	Schweitzer Rd, IL	2016
8"	1957'	Grand River, MI	2016
12"	11,548	Union Canal & Martin Barge Canal, TX	2015
16"	3827'	Collins Cove, MA	2015
36"	1147'	E. 138th Street, IL	2015
16"	2249'	Ohio River, OH/KY	2015
10"	4654'	Allegheny River, PA	2015
36"	3805'	Williamette River, OR	2014
24"	1935'	Coosa River, AL	2014
24"	2884'	Hatchett Creek, AL	2014
24"	3269'	Transfer Line 2, IN	2014
24"	3275'	Transfer Line 1, IN	2014
36"	1874'	Wetland S-517C, IN	2014
36"	3544'	Illinois River, IL	2013
8"	2545'	MP266, Mountain Green, UT	2013
30"	4987'	Monksville Reservoir, NJ	2013
30"	4905'	Merseles St, NJ	2013
30"	6544'	1st Street, NJ	2013
42"	4441'	Goethals Bridge, NY	2013
30"	8101'	Kill Van Kull River NY/NJ	2013

1995 – 1996: **Subsurface Exploration | Wisconsin Dept. of Transportation | Madison, WI**

Took core samples vertically from the ground and ran tests on soil conditions for roadways.

EDUCATION

1997 **MATC**

Degree as Civil Engineering Technician

1994 **Columbus High School | Columbus , WI**

High School Diploma

MICHELS®

Cale Mullenix

Drilling Survey Technician

PROFESSIONAL EXPERIENCE

1997 – Present: **Drilling Survey Technician | Michels Directional Crossings | Brownsville, WI**

Responsible for surveying, staking and design of directional drill path and curve, drilling the pilot hole, tracking and monitoring the drill path and calculating and interpreting the ground elevations and contours. Computer literate with knowledge and experience operating various software including: 1) Magnetic Guidance System, 2) Survey, 3) Tru-Tracker and 4) Microsoft applications. Applied working knowledge of advanced mathematics including: 1) Fluid Dynamics, 2) Advanced Algebra, 3) Trigonometry, 4) Calculus, 5) Statistics and 6) Stress Engineering. Complete surveying skills and experience utilizing a Total Station (Theodolite with built-in EDM) for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points (benchmarks). Additional duties include on-site maintenance of technical equipment, and necessary record-keeping of plots and drilling logs. Performed the above operations for crossings which include, but not limited to:

Diameter	Length	Crossing/Location	Year
20"	13,247'	Lake Sakakawea, ND	2019
20"	6429'	Badlands Canyon, MT	2019
8"	12,769'	Montezeuma Slough, CA	2019
16"	1888'	West Baltimore Pike Rd, PA	2019
16"	3981'	Glendale Rd & Concord Ave, PA	2019
4"	1495'	Des Moines River, IA	2018
12"	1369'	Rocky Point Landing, Jamaica	2018
36"	2974'	Wetland MP 8.1, OH	2018
36"	2611'	Tuscarawas River, OH	2018
20"	7354'	Susquehanna River, PA	2018
42"	1501'	Platte River, NE	2018
36"	1370'	Interstate-80 MP 251.5, MI	2018
36"	2377'	Hydro Park MP 250.17, MI	2018
42"	4869'	Bahia Grande Channel #1, TX	2018
42"	2826'	San Joaquin River, CA	2017
14"	9154'	Nansemond River, VA	2017
10"	5697'	Mississippi River, LA	2017
12"	5171'	Larch Dr & Wetland, MN	2017
36"	7194'	Ohio River MP 16.07, OH/WV	2017
30"	3483'	Ford Island to Landing C, HI	2017
6"	3309'	Hauser Lake, MT	2017

36"	1545'	Van Dyke Road, IL	2017
30"	7531'	Lake Oahe & Missouri River, ND	2017
30"	2278'	Chattahoochee River, GA	2017
24"	2026'	Highway 120, GA	2017
30"	7282'	Mississippi River, IA/IL	2016
16"	11,397'	Lake Sacagawea South, ND	2016
30"	3352'	Cliff Crossing, ND	2016
16"	11,229'	Lake Sacagawea North, ND	2016
16"	1112'	Palermo Railroad, ND	2016
20"	1904'	North St Mary's River, IN	2016
20"	845'	Patterson Rd/RR, IL	2016
20"	871'	Wetlands #2, IL	2016
8"	1957'	Grand River, MI	2016
24"	7432'	Houston Ship Channel, TX	2015
16"	1508'	Beverly Harbor, MA	2015
16"	3827'	Collins Cove, MA	2015
36"	2510'	Deep Creek, IL	2015
36"	3011'	Highway 41 & RR, IN	2015
36"	2697'	Barrington Rd, IL	2015
36"	1755'	New York St, IL	2015
36"	2303'	Liberty Street, IL	2015
36"	3805'	Williamette River, OR	2014
2 x 4" Bundle	1809'	Hwy 550, Nageezi, NM	2014
6"	6999'	Lake Navajo/San Juan River, NM	2014
8"	7321'	MP 49.3 Landslide, MT	2014
8"	4159'	MP 54.8 Landslide, MT	2014
24"	1935'	Coosa River, AL	2014
16"	2951'	Line 82, ND	2014
36"	5687'	Missouri River, MO	2013
30"	1246'	OK City Water Main, OK	2013
30"	4987'	Monksville Reservoir, NJ	2013
12"	6209'	Jamacian Bay, NY	2013
42"	3008'	I-95 & Tidal Wetlands, NJ	2013
30"	4905'	Merseles St, NJ	2013
30"	6544'	1st Street, NJ	2013

Cale Mullenix

PROFESSIONAL EXPERIENCE (continued)

1996 – 1997: **Fluid Dynamics Technician | Michels Directional Crossings | Brownsville, WI**

Accountable for mixing bentonite solution used throughout directional drilling and reaming operations. Trained to monitor viscosity of mixture and manipulate ratios of solids and fluid to maintain specific viscosities which continually change based on the environment and which vary by operation phases and subterrain. Experience in operation, maintenance and repair of bentonite mixing equipment.

EDUCATION

1996 **University of Wisconsin-Madison | Madison, WI**

1995 **Goodrich High School | Fond du Lac, WI**

High School Diploma

MICHELS®

Lorenzo Rivera Jr

Drilling Survey Technician

PROFESSIONAL EXPERIENCE

2017 – Present: **Drilling Survey Technician | Michels Directional Crossings | Brownsville, Wisconsin**

Responsible for surveying, staking and design of directional drill/Direct Pipe path and curve, drilling the pilot hole, tracking and monitoring the drill path and calculating and interpreting the ground elevations and contours. Computer literate with knowledge and experience operating various software including: 1) Magnetic Guidance System, 2) Survey, 3) Tru-Tracker and 4) Microsoft applications. Applied working knowledge of advanced mathematics including: 1) Fluid Dynamics, 2) Advanced Algebra, 3) Trigonometry, 4) Calculus, 5) Statistics and 6) Stress Engineering. Complete surveying skills and experience utilizing a Total Station (Theodolite with built-in EDM) for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points (benchmarks). Additional duties include on-site maintenance of technical equipment, and necessary record-keeping of plots and drilling logs. Performed the above operations for crossings which include, but not limited to:

Diameter	Length	Crossing/Location	Year
16"	7595'	Houston Ship Channel, TX	2019
24"	3183'	Crow River, MN	2019
20"	1421'	Middle Branch Escanaba River, MI	2019
16"	3628'	Eagleview Blvd, PA	2019
42"	2007'	Las Moras Creek, TX	2019
20"	2236'	Lower Piney Creek, PA	2018
42"	4687'	Lake Scranton Finished H2O Tunnel, PA	2018
36"	1863'	E Branch Black River MP 86.7, OH	2018
48"	651'	Juniata River, PA - HK750PT Installation	2018
36"	1682'	W Branch Black River MP 92.3, OH	2018
42"	1861'	San Martin Lake Channel, TX	2018
42"	899'	Highway 50, West Virginia - HK500PT Installation	2018
36"	1535'	Calumet River, IL - HK300PT Installation	2017
48"	2183'	Resaca De Los Fresnos Canal #2, TX	2017
48"	2555'	Resaca De Los Fresnos Canal #1, TX	2017
48"	2126'	Pinson Rd Canal, TX	2017
48"	2042'	County Rd 300 Canal, TX	2017
48"	2398'	CR2340 & Los Olmos Creek, TX	2017
48"	2349'	Chiltipan Creek, TX	2017

PROFESSIONAL EXPERIENCE (continued)

2013 – 2017: **Operaor/Direct Pipe | Michels Directional Crossings | Brownsville, WI**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for direct pipe & directional micro-tunnel operations as well as directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and downhole survey along with surveying and surveying instrumentation. Some more notable crossings include, but are not limited to:

DIRECT PIPE INSTALLATIONS/PIPE ASSISTS

Diameter	Length	Crossing/Location	Year
36"	827'	Leslie Street, Ontario, Canada - HK 300PT Installation	2015
48"	4,039'	Dow Barge Channel, Clute TX - HK750PT Installation	2015
36"	1,002'	Hwy 225, Deer Park, TX - HK300PT Installation	2015
36"	1,092'	Lubrizol Drainage, LaPorte, TX-HK300PT Installation	2015
48"	2,455	Rio Grande River, El Refugio, TX-HK750PT Installation	2014
42"	1,200'	Railroad Crossing, Groves, TX-HK750PT Installation	2014

HDD PROJECTS

Diameter	Length	Crossing/Location	Year
30"	11,229'	Lake Sacagawea North, SD	2016
30"	6119'	Lake Whitney, TX	2016
12"	11,563	Holland Bottoms Wetlands, AK	2015
36"	2510'	Deep Creek, IL	2015
36"	5128'	Lake Ave & RR, IL	2015
18"	12,459	Houston Ship Channel, TX	2015
28"	1741'	Lafayette River, VA	2014
48"	2060'	Tres Palacios River, TX	2014
48"	1692'	Navidad River, TX	2014

2013: **Truck Driver | Billy Cummings | TX**

2012 – 2013: **Bank Teller | City National Bank | TX**

EDUCATION

2013 **Texas Technical College | TX**

Engineering Prerequisite Classes

2010 **PJC Junior College | TX**

MICHELS®

Eric Riha

Drilling Survey Technician

PROFESSIONAL EXPERIENCE

2019 – Present: **Drilling Survey Technician | Michels Directional Crossings | Brownsville, Wisconsin**

Responsible for surveying, staking and design of directional drill path and curve, drilling the pilot hole, tracking and monitoring the drill path and calculating and interpreting the ground elevations and contours. Computer literate with knowledge and experience operating various software including: 1) Magnetic Guidance System, 2) Survey, 3) Tru-Tracker and 4) Microsoft applications. Applied working knowledge of advanced mathematics including: 1) Fluid Dynamics, 2) Advanced Algebra, 3) Trigonometry, 4) Calculus, 5) Statistics and 6) Stress Engineering. Complete surveying skills and experience utilizing a Total Station (Theodolite with built-in EDM) for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points (benchmarks). Additional duties include on-site maintenance of technical equipment, and necessary record-keeping of plots and drilling logs.

Some more notable crossings include, but are not limited to:

Diameter	Length	Crossing/Location	Year
16"	2518'	Herman O.W. Drive, PA, PA	2019

2018 – 2019: **HDD Operator | Michels Directional Crossings | Brownsville, Wisconsin**

Skilled equipment operator with the operation of technical, lifting and heavy equipment for directional drilling operations. Working knowledge of hydraulic engineering and applied mechanical engineering. Skilled in hydraulics repair, electrical repair, welding and troubleshooting. Working knowledge of computers and down hole survey along with surveying and surveying instrumentation.

2017 – 2018: **Skilled Laborer | Michels Directional Crossings | Brownsville, Wisconsin**

Integral member of a specialized team working on and around directional drilling rigs. Multi-capable to assist with all facets of drilling operations. Familiar with mechanical repairs, hydraulics, fluids, set-up and operation of drill motors, power generators, mud pumps, bentonite mixers, drill pipe, reamers, couplings and overall equipment maintenance and operation.

2013 – 2015: **CNC Lathe Operator | D&S Machine Service Inc. | Luxemburg**

Operated a CNC lathe machine to precise dimensions per interpretation of blue prints, prioritize the tasks at hand for the day & operated a forklift.

EDUCATION

2015 **Northeast Wisconsin Technical College | Green Bay, WI**

Natural Gas Utility Construction

2012 **Kewaunee High School | Kewaunee , WI**

High School Graduate

MICHELS®

Jeremiah Erickson

Drilling Survey Technician

PROFESSIONAL EXPERIENCE

2008 – Present: Drilling Survey Technician | Michels Directional Crossings | Brownsville, WI

Responsible for surveying, staking and design of directional drill/Direct Pipe path and curve, drilling the pilot hole, tracking and monitoring the drill path and calculating and interpreting the ground elevations and contours. Computer literate with knowledge and experience operating various software including: 1) Magnetic Guidance System, 2) Survey, 3) Tru-Tracker and 4) Microsoft applications. Applied working knowledge of advanced mathematics including: 1) Fluid Dynamics, 2) Advanced Algebra, 3) Trigonometry, 4) Calculus, 5) Statistics and 6) Stress Engineering. Complete surveying skills and experience utilizing a Total Station (Theodolite with built-in EDM) for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points (benchmarks). Additional duties include on-site maintenance of technical equipment, and necessary record-keeping of plots and drilling logs. Performed the above operations for crossings which include, but not limited to:

Diameter	Length	Location	Year
16"	3628'	Eagleview Blvd, PA	2019
16"	1888'	West Baltimore Pike Rd, PA	2019
16"	3981'	Glendale Rd & Concord Ave, PA	2019
36"	856'	Qu'Appelle River, Canada - HK750PT Installation	2017
42"	1861'	San Martin Lake Channel, TX	2017
36"	1535'	Calumet River, IL - HK300PT Installation	2017
20"	2005'	Highway 15, PA	2017
36"	1606'	Hannahatchee Creek, GA	2017
36"	3829'	Flint River, GA	2016
42"	7200'	Athabasca River, Canada - HK750PT Installation	2016
48"	4039'	Dow Barge Channel, Clute TX - HK750PT Installation	2015
36"	1002'	Hwy 225, Deer Park, TX - HK300PT Installation	2015
36"	1092'	Lubrizol Drainage, LaPorte, TX-HK300PT Installation	2015
48"	2455	Rio Grande River, El Refugio, TX-HK750PT Installation	2014
42"	1200'	Railroad Crossing, Groves, TX-HK750PT Installation	2014
8"	7321'	MP 9.3 Landslide, MT	2014
42"	1050'	Beaver River, Alberta, Canada-HK750PT Installation	2013
42"	470'	I-84, Westfall, PA - HK750PT Installation	2013
42"	4441'	Goethals Bridge, NY	2013
36"	5687'	Missouri River, MO	2013

PROFESSIONAL EXPERIENCE (continued)

Diameter	Length	Location	Year
36"	2958'	North Sulpher, Mount Joy, TX	2012
30"	4850'	Red River, Thackerville, TX/OK	2012
42"	1670'	Morales, TX	2012
42"	1658'	Dewitt, TX	2012
16"	5754'	New Berlin, WI	2012
20"	3075'	Rock Creek, OR	2011
42"	1826'	Interstate 49 and RR, LA	2011
42"	3443'	Wetland R2, LA	2011
42"	1704'	Willow Creek, LA	2010
42"	2015'	Flat Creek, LA	2010
42"	2129'	Ceasars Creek, OH	2009
36"	3031'	Four Legged Lake, MN	2009
42"	4068'	Illinois River, IL	2009
42"	2691'	200th Ave, IL	2009
42"	3627'	Salt River, MO	2009
42"	1992'	Hwy 67, TX	2008
42"	3705'	Neches River, TX	2008
42"	6004'	Old River, TX	2008

EDUCATION

2003 High School Graduate

MICHELS®

Dan Reynolds

Drilling Survey Technician

PROFESSIONAL EXPERIENCE

2006 – Present: **Drilling Survey Technician | Michels Directional Crossings | Brownsville, WI**

Responsible for surveying, staking and design of directional drill path and curve, drilling the pilot hole, tracking and monitoring the drill path and calculating and interpreting the ground elevations and contours. Computer literate with knowledge and experience operating various software including: 1) Magnetic Guidance System, 2) Survey, 3) Tru-Tracker and 4) Microsoft applications. Applied working knowledge of advanced mathematics including: 1) Fluid Dynamics, 2) Advanced Algebra, 3) Trigonometry, 4) Calculus, 5) Statistics and 6) Stress Engineering. Complete surveying skills and experience utilizing a Total Station (Theodolite with built-in EDM) for lay out of grade elevations over all types of topography in establishing alignment tying into existing surveyed points (benchmarks). Additional duties include on-site maintenance of technical equipment, and necessary record-keeping of plots and drilling logs. Performed the above operations for crossings which include, but not limited to:

Diameter	Length	Crossing/Location	Year
30"	3746'	Dix River, KY	2019
22"	4986'	Atchafalaya River, LA	2019
20"	2236'	Lower Piney Creek, PA	2018
20"	2209'	Horse Valley Road, PA	2018
20"	1416'	Blacklog Creek, PA	2018
16"	2346'	Frankstown Branch-Juniata River, PA	2018
20"	1337'	Berry Ridge & Old Mill Rd, PA	2018
16"	5869'	Conrail RR, NJ	2018
20"	2307'	Frankstown Branch-Juniata River, PA	2017
36"	6238'	Ohio River, OH/WV	2017
12"	5741'	Rum River & Wetland, MN	2017
42"	2431'	Maumee River & State Hwy 24, OH	2017
48"	2807'	Oliver Creek & SH 188, TX	2017
48"	2263'	US Hwy 181/Hwy 35, TX	2017
36"	3829'	Flint River, GA	2016
30"	7282'	Mississippi River, IA/IL	2016
12"	2765'	Lewis Creek, VT	2016
12"	2856'	Wetland Replacement, OH	2016
42"	3885'	Dover River, Alberta, Canada	2016

"27" HDPE

Bundle"	3737'	Little Creek, VA	2016

12"	11,563	Holland Bottoms Wetlands, AK	2015
30"	1418'	Highway 250, OH	2015
24"	1405'	Platte River, MO	2015
22"	2538'	Barrington Road, IL	2015
12" and 6"	3173'	Beaver Lake, Alberta, Canada	2015
10"	1971'	Tank Farm/Central Ave, PA	2015
42"	3776'	MacKay River, Fort McMurray, Canada	2015
36"	1613'	Fish Pond, Alberta, Canada	2014
36"	1359'	Wetland Crossing #2, Alberta, Canada	2014
36"	2274'	Highway 13, Alberta, Canada	2014
36"	2133'	Wetland Crossing, Aberta, Canada	2014
30"	2667'	South Fork Ten Mile Creek, PA	2014
24"	2750'	Escatawpa River, MS	2014
20"	1193'	SR-265/Leatherwood Rd, OH	2014
36"	2355'	Salt Fork River, MO	2013
30"	2774'	South Canadian River, OK	2013
30"	4400'	Saline Creek, Alberta, Canada	2013
42"	4284'	Vermillion River, Alberta, Canada	2013
28"	4270'	Saline Creek, Alberta, Canada	2013
36"	4304'	Bois D' Arc, TX	2013
30"	1707'	Bayonne Inlet, NJ	2013
36"	2908'	Neches River & RR, TX	2013
8"	10,053'	Potomac River, VA/MD	2012
20"	3048'	St. Clair, Marysville, MI	2012
8"	12,885'	MP66, Big Horn County, MT	2012
8"	4400'	MP57, Big Horn County, MT	2012
30"	2906'	Hickory Creek, Marietta, OK	2012
36"	4505'	Medicine Hat, Alberta, Canada	2012
30"	2133'	Alberta, Canada	2012
8"	6669'	Wilmington, NC	2012

PROFESSIONAL EXPERIENCE (continued)

2003 – 2006: **Drilling Survey Technician | Southeast Pipeline Construction | Casa Grande, AZ**

All aspects of drilling and design utilizing Tru-Tracker software for contractor. Larger projects include:

Diameter	Length	Location/Customer
56" (3)	2100'-2520'	Bechtel/API
16" (9)	800'-3400'	Williston Basin
36"	1185'	Snelson Hoen Rd
24"	3385'	Carbon Mountain

2003: **Drilling Survey Technician | H.M.S. Construction | Rio Vista, CA**

All aspects of drilling and design utilizing Tru-Tracker software for contractor. Larger projects include:

Diameter	Length	Location/Customer
8" & 12"	450'	City of Waikiki, HI
HDPE	615'-1005' (6)	U.S. Navey Aloha-Aina Park
32"	2900'	AP & T Tidal Inlet

2002 – 2003: **Drilling Survey Technician | Thunderbird Exploration | Gilbert, AZ**

Steering hand working on communication projects. Larger projects include:

Diameter	Length	Location/Customer
8"	Various	Telecommunications
8" & 10"	600'-2400'	U.W. I.
24"	800'-1200'	Questar

1998 – 2002: **Drilling Survey Technician | Ozzie's Directional Drilling | Scottsdale, AZ**

EDUCATION

1980 **Soper High School | Soper, OK**

High School Diploma

ATTACHMENT

SAFETY AND JSA INFORMATION

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2019

MICHELS®

Performance Indicators

Performance Measure	Target/Achievements
Lagging Indicators:	
Total # of Incidents	Should demonstrate that employees understand what is considered an incident and are appropriately reporting with an emphasis on **Near-Hit reporting**
Incident Severity Totals (near hit, minor, serious, major, critical)	1 Near Hit/Learning Event : 2,500 hours worked
Recordable Injury Related Incidents	No medical aid incidents
Total Exposure Hours	Contractor and Subcontractor total hours.
Total Spills/Releases	Demonstrates employee's knowledge of spill/release definition and the proper methods to use clean-up kits that are provided to all employees/jobs
Recordable Vehicle Incidents	No reportable vehicle incidents
Total Exposure Miles	For contractor and subcontractor
Leading Indicators	
Total # of Tailgate Meetings	Held Daily
Total # of Weekly Safety Meetings	Held Weekly
Total # Monthly Safety Meetings (Project Team)	Held Monthly
Total # of JSAs reviewed for quality assurance	# of JSAs developed and # reviewed
Total # of Safety Stand downs	List and Why they were held
Total # of Formal Inspections	When and Conducted by Whom
Total # Safety Meetings (Michels)	(as per Michels Site Specific Safety Plan (SSSP) • Monthly Safety meeting • Weekly / Shift Safety Meeting • Daily Tailgate Meeting • Total # of Safety Meetings per month
Work Site Inspection – formalized / documented (as per Contractor)	**(**Daily – Safety Inspector) (1 with Project Manager / construction manager) (2 with HSE Representative)
Michels Response to audit/inspection findings or any HSE related issues	Demonstration that Michels takes safety related issues seriously and implements effective controls in a timely manner to ensure a safe work site

STEP BACK FOR SAFETY

MICHELS
HSE
Health • Safety • Environment

CREW TYPE:	JOB#:
DATE:	TIME:

Top Three Hazards?

Controls in Place (PPE, Spotter, etc.)?

PRINT NAME	SIGNATURE	PRINT NAME	SIGNATURE
1.		7.	
2.		8.	
3.		9.	
4.		10.	
5.		11.	
6.		12.	

SUBMIT COMPLETED CARDS WITH YOUR DAILY JSA

JOB SAFETY ANALYSIS

PURPOSE:

A Job Safety Analysis (JSA) is a tool used to identify/recognize potential hazards at your work location, and to help implement solutions or correct actions to reduce or eliminate the hazard prior to the start of work to allow for a safe working environment.

ASSESS ***IDENTIFY*** ***CONTROL***

HAZARDS IDENTIFIED MAY INCLUDE BUT ARE NOT LIMITED TO:

1. Trip Hazards—Timber mats, rough terrain, etc.
2. Existing Utilities—Overhead/Underground
3. Pinch Points—Moving equipment/material
4. Slips & Trips—Slippery /obstructed work surfaces
5. Falls—Working at heights (6ft. or greater)
6. Excavations—Soil failure
7. Environmental—Excessive mud, water, dust, etc.
8. Chemicals—Hazardous substances
9. Wildlife—Venomous snakes & spiders
10. Plants—Poisonous plants

IF YOU HAVE A QUESTIONS…..ASK!!!

MICHELS CORPORATION

Project Name: ____________ Project Location: ____________

Inspected by: ____________ Date of Inspection: ____________

Equipment Name: ____________ Number: ____________

Hours/Mileage ____________

CONSTRUCTION EQUIPMENT INSPECTION

*** Verbally report to supervisor and turn sheets in daily

CONSTRUCTION EQUIPMENT INSPECTION

		N/A	Remarks			N/A	Remarks
Tracks, tires, wheels	☐	☐		Motor (wiring)	☐	☐	
Brakes	☐	☐		Radiator	☐	☐	
Horn	☐	☐		Belts	☐	☐	
Lights	☐	☐		Hoses	☐	☐	
Clutch	☐	☐		Lubrication Points	☐	☐	
Windshield Wiper	☐	☐		Loose Bearings	☐	☐	
Glass	☐	☐		Guards	☐	☐	
Rear View Mirror	☐	☐		Belt Tension	☐	☐	
Body	☐	☐		Loose Gears	☐	☐	
Cover	☐	☐		Brakes	☐	☐	
Frame	☐	☐		Vibration	☐	☐	
Dump Mechanism	☐	☐		Pneu. Interlocks	☐	☐	
Steering	☐	☐		Exhaust System	☐	☐	
Fire Extinguisher	☐	☐		Proper RPM	☐	☐	
Signal System	☐	☐		Overload Protect	☐	☐	
Fuel & Gas Lines	☐	☐		Mech. Switch	☐	☐	
Fuel Tank	☐	☐		Ground Continuity	☐	☐	
Exhaust System	☐	☐		Limit Switches	☐	☐	
Boom	☐	☐		Cords	☐	☐	
Boom Hoist	☐	☐		Plugs/Receptacles	☐	☐	
Sheaves	☐	☐		Fan Shroud	☐	☐	
Hooks,	☐	☐		Back Up Alarm	☐	☐	
Grab Bars, Steps	☐	☐		Pins-Bushings	☐	☐	
Warning Lights	☐	☐		Pins-Keepers	☐	☐	
Cables	☐	☐					

Operator/Print Name ____________ Operator/Signature ____________

Foreman/Print Name ____________ Foreman/Signature ____________

Comments:

MICHELS®

DIRECTIONAL CROSSINGS
TAILGATE SAFETY MEETING MINUTES

Date: ______________ **Job #** ____________ **Location:** ________________

Company: ______________ **Foreman/Supervisor:** ________________

First Aid Personnel: ______________________________

	Name	Address	Phone #
NEAREST CLINIC:			
CLOSEST MAJOR INTERSECTION:			

FOR LIFE THREATENING INJURIES OR EMERGENCIES – DIAL 911 or:

 # In Crew: ______ **# Attending:** ______ **Current Weather:** ______________

Competent Person(s) (if applicable): ______________________

Who Will Transport Injured Personnel? ______________________

Work To Be Performed: ______________________

Topics Discussed: ______________________

Potential Site Hazards: ______________________

Safety Recommendations: ______________________

Attendance (use additional paper if necessary)

Print	Sign	Print	Sign

JOB SAFETY ANALYSIS WORK SHEET

Tasks to be performed/critical steps to be taken (Check all that apply to job)	Potential Hazard (Check all that apply to tasks/steps from column 1)	Recommended Safe Job Procedures (Check all protective measures that apply to what was identified in column 2)	
☐ Driving	☐ Traffic hazards (vehicular & pedestrian)	☐ Designate a person for a specific task such as confined space attendant, fire watch, etc.	☐ Keep guards in place at all times – no modifications to tools or equipment
☐ Walking	☐ Working on rough/challenging/uneven terrain	☐ Hold a pre job meeting with all involved	☐ Use hearing protection
☐ Manual Digging	☐ Exposure to loud noise	☐ Utilize one call and pothole/daylight existing utilities BEFORE excavating	☐ Know the depth of water and stay out of it
☐ Mechanical Digging	☐ Overhead Utilities / Underground Utilities	☐ Inspect excavations & complete report	☐ Yield for pedestrians & equipment
☐ Manual Lifting	☐ Suspended Loads / Swinging Loads	☐ Barricade or mark areas of excavation	☐ Reduce speed and drive defensively
☐ Mechanical Lifting (Crane)	☐ Heavy Objects/ Back Injuries	☐ Utilize protective systems (shoring/sloping)	☐ Use of additional PPE (face shield, goggles, chaps etc.)
☐ Welding /Cutting/Grinding	☐ Heavy Lifting Equipment	☐ Nobody permitted to enter unsafe excavations (ensure access/egress is provided)	☐ Inspection and color coding of electrical tools
☐ Hauling Equipment/Materials	☐ Heavy Earthmoving Equipment	☐ Walk with small steps, take time & watch footing	☐ Inspect tools for signs of excessive wear/damage & replace if necessary
☐ Setting/Moving Timbers/Mats	☐ Trenches/Excavations (Engulfment/collapse)	☐ Never park a vehicle next to heavy equipment	☐ Stay clear of x-ray operations
☐ Coating	☐ Asphyxiation / confined space hazards	☐ Wear appropriate PPE at all times	☐ Install portable lighting in dark areas
☐ Sandblasting	☐ Slips, trips & falls – rough/slippery working surfaces	☐ Use taglines where appropriate	☐ Use bug spray or other means of pest control
☐ Rigging	☐ Possible hit/struck/crushed by moving trucks or equipment	☐ Stay a minimum of 25 ft. from loads and equipment	☐ Store cylinders upright, secured with the caps on and transport properly
☐ Line-ups	☐ Slings, Cables, Chains could break/fail	☐ Use proper lifting techniques (lift with legs)	☐ Identify and avoid poisonous plants
☐ End-facing/Beveling	☐ Exposure to gamma emitting sources & x-ray	☐ Stay clear of equipment when in operation	☐ Use spotter with warning device (air horn)
☐ Climbing to Lower Levels	☐ Abrasive materials (eye injuries/skin abrasions)	☐ Never stand/walk between two pieces of working equipment	☐ Drink plenty of water, take cool down/warm-up breaks
☐ Climbing to Higher Levels	☐ Multiple pinch/crush points	☐ Stay a minimum of 10 ft. from all power lines	☐ Install pressure relief valve (PRV)
☐ X-Raying	☐ Compressed Gases	☐ Utilize goal post system and spotters	☐ Test the atmospheres for hazards
☐ Cell Phone use	☐ Heat Stress/Hypothermia (Hot/Cold weather)	☐ Flashback arrestors must be in place	☐ Ensure proper ventilation
☐ Run cords, hydraulic lines and Kelley hose	☐ Inclement Weather (Lightning/Rain/Snow/Fog/Icy conditions)	☐ Ensure certifications are in place on all lifting equipment, devices and rigging	☐ Wear sunscreen and appropriate clothing
☐ Road Crossing	☐ Falls from an upper level	☐ Inspect pins and cables daily for problems	☐ Never lift with the teeth of buckets
☐ Loading/Offloading equipment/Materials	☐ Without proper communication drill string can turn inadvertently causing pinched by/ struck by	☐ Establish eye contact and intent with the operator of the equipment before approaching	☐ Visually inspect the leads as they are being run out
☐ Installing shoring/trench box	☐ Poisonous plants (Contact Dermatitis)	☐ Stay on designated ROW	☐ Ensure spill kit is readily available
☐ Break connections apart to install or remove rods or tooling	☐ Worn or damaged leads could cause shock or property damage	☐ Establish good communication between workers and drill operator before any operations start	☐ Ensure hoses are properly connected and whip-checks are in place
☐ Pumping	☐ Uneven/unsecured or bulky loads	☐ Only one person directing operator/driller	☐ Inspect wear points on hoses/HDPE and replace damaged/worn sections
☐ Lowering-in product	☐ Components/drill stem potentially remaining under pressure even after "ALL STOP"	☐ Stop work and take cover in inclement weather	
☐ Backfilling	☐ Overloading equipment – equipment failure	☐ Secure ladders, & ensure they are not damaged	☐ Ensure fall protection (tied-off/guard rails/hand rails) are in place
☐ Boring/Directional Drilling	☐ Welding, cutting, burning tools (Fire Hazard)	☐ Road/traffic signs must be up while working.	
☐ Pipe Entry	☐ Pipe falling off rollers or out of calipers	☐ Use flaggers to control vehicle/pedestrian traffic	☐ Inspect calipers for correct size before use
☐ Ballast operations/buoyancy	☐ Rotating tooling, pinched by, struck by	☐ Ensure adequate number of fire extinguishers on site and in vehicles	☐ Do not place hands in the box or on the ends of the drill stem/pipe
☐ Pre-heating	☐ Grinding tools - Flying Sparks and Debris	☐ Close observation of pipe rollers and cradles	☐ Use GFCI's and proper grounding
☐ Refueling	☐ Water Exposure/Drowning	☐ Install back-up alarms/ensure alarms are working	☐ Communicate with the railroad and ensure flagger protection is provided if necessary – don't work within 25 feet without flagger protection!
☐ Making wire connections	☐ Electrical Shock Hazards	☐ Never step or reach over rotating stems/pipe	
☐ Changing out hydraulic components	☐ Safety Latch on rigging inoperable/missing	☐ Position trailer on level terrain if possible	☐ Erect barricades and ensure personnel are kept clear of test area
☐ Break connections apart – EXIT SIDE	☐ Working near live railroad tracks (train traffic)	☐ Set parking brake on vehicles & equipment when not in use	
☐ Hydrotest product line	☐ Environmental release/spill		☐

ATTACHMENT

SPCC PLAN

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2019

SPILL PREVENTION/CONTROL/ COUNTERMEASURE PLAN (SPCC)

For
HDD - Crossings

A DIVISION OF MICHELS CORPORATION

MICHELS®

DIRECTIONAL DRILLED CROSSINGS

Revision 0
March 18, 2020

MICHELS DIRECTIONAL CROSSINGS
A DIVISION OF MICHELS CORPORATION

SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN (SPCC)

HORIZONTAL DIRECTIONAL DRILLING

Table of Contents

TABLE OF CONTENTS

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

I. Introduction

This Spill Prevention Control and Countermeasure Plans (SPCC) have been developed by Michels Corporation (Michels) to serve as a guideline for horizontal directional drilling (HDD) operations. This plan is intended to ensure that the equipment utilized to perform the work and the fuel, oil, and lubricant products used in the day to day operation of the equipment will have no long-term adverse environmental impact on the staging areas required for construction. The guidelines contained in this plan will be implemented by field personnel to prevent accidental releases of hazardous material to the environment and to outline measures taken should an accidental release occur. The drilling project manager for the project is experienced in these matters and is typically the designated Spill Coordinator for Michels.

This SPCC plan was developed using Federal Energy Regulatory Commission (FERC) guidelines for construction activities along a pipeline right-of-way. This plan is intended to comply with all applicable requirements of FERC and local State and County authorities. Since HDD operations are generally confined to two distinct locations, the rig (entry) side and pipe (exit) side, this SPCC plan addresses construction operations at these specific locations only for hazardous materials. This SPCC plan consists of three sections:

- Preventative measures to be taken prior to initiating construction with hazardous materials;
- Preventative procedures to be followed while using hazardous materials during construction;
- Procedures to be implemented should an accidental spill of hazardous material occur;

II. Pre-Construction Hazardous Material Spill Prevention

Prior to construction, all Michels' personnel who will be performing work on site will have attended a FERC-approved environmental training program within the last year. This training program will serve to indoctrinate the personnel and make them aware of the pollution control laws, rules, and regulations applicable to the pipeline right-of-ways. Michels' personnel are highly experienced with the equipment to be used in HDD operations and have worked on numerous FERC governed projects in the past. However all personnel will be refreshed by the project manager and drill superintendent in the operation and maintenance of construction equipment to prevent the accidental discharge or spill of fuel, oil, or lubricants.

Through the environmental training program and the project manager's guidance along with knowledge obtained from past experience, all Michels' personnel will be thoroughly educated on the following topics:

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

- Precautionary measures to prevent spills;
- Potential sources of spills, such as equipment failure or malfunction and re-fueling procedures;
- Standard operating procedures in case of a spill, including applicable notification requirements;
- Equipment, Materials, and Supplies available for clean-up of a spill;
- Review of known spill events, if any.

Prior to mobilizing equipment to the proposed alignment R.O.W., Michels will thoroughly inspect and if necessary repair or replace equipment components that could potentially leak hazardous material. The equipment will be cleaned of any debris or material observed to be hazardous. All hazardous material storage containers and secondary containment devices will be inspected and if necessary repaired or replaced.

The spill containment and clean-up materials used by Michels will be inventoried and if necessary re-stocked prior to initiating construction operations. At a minimum, the following spill containment and clean-up materials will be located in a central location at each side of the HDD crossings where equipment is in use or hazardous materials are stored in sufficient quantities to contain and clean-up a spill or release should one occur:

- Spill containment kits typically consisting of the following items
  - 1 x 55 gal poly drum
  - 50 x 18" x 18" absorbent pads
  - 8 x 3" x 4' absorbent socks
  - 6 x 18" x 18" absorbent pillows
  - 3 x 5" x 10' absorbent booms
  - 4 Disposable plastic bags with ties
  - 4 pair nitrile gloves
- Plastic sheeting
- Floor Dry absorbent material (50 pound bag-typical)
- Personal protective equipment (i.e. gloves and safety glasses)
- Replacement parts and equipment for repair of tanks, hoses, nozzles, etc.
- Equipment and tools to divert spilled fluids and create earthen barriers

III. HDD Construction Operations Hazardous Material Spill Prevention

Once construction activities for the HDD are underway, hazardous material spill prevention will be a continuous element of the operations. During equipment set up, potential sources of hazardous material releases, i.e. fuel tanks, hydraulic oil tanks and hoses, antifreeze tanks, and lubricant storage bins will be located as far away as practicably possible from streams, wetlands, and drainage ways. If necessary, and if practicable, temporary barriers may be constructed or placed between the potential sources of spills and areas identified as extremely sensitive to accidental

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

spills. Spill containment and clean-up materials/kits will be located in a central location at each side of the drill site location where equipment is in operation or hazardous materials are stored and all personnel will be made aware of the location.

Secondary containment devices will be placed to enclose major sources of potential hazardous spill locations (i.e. fuel storage tanks and hazardous materials storage areas). A site layout drawing for entry locations and exit locations showing the placement of significant sources of hazardous material releases and secondary containment measures are attached in **Appendix A** of this plan. The exact location of the equipment will vary to address specific site conditions after the temporary work space has been prepared for equipment set-up. Access to the sites will be limited by the Project Manager to only authorized personnel and visitors.

During construction, spill refresher briefings will be scheduled quarterly and conducted by Michels. The briefings will refresh Michels' personnel on the topics covered during the pre-construction environmental training as well as review operations to date, including any accidental spills that may have occurred and measures taken for prevention of future spills.

Michels will store, handle and transfer hazardous materials used during HDD operations in a manner to prevent accidental releases or spills of these materials. **Table-1** attached in **Appendix-A** to this plan summarizes the hazardous materials, combined expected volumes, and storage methods for both the entry and exit locations. The Material Safety Data Sheets (MSDS) for every product used by Michels are maintained on file in the drilling survey trailer on site should they be required to assess the hazard potential of a spill. The list of primary hazardous materials (petroleum-based products) to be used by Michels over the course of each HDD crossing is as follows:

- Gasoline
- Diesel Fuel
- Hydraulic Oil
- Lubricants
- Penetrating Oils
- Antifreeze

Michels' personnel will follow specific guidelines set forth in this plan during operation and maintenance of equipment and vehicles used in support of the HDD operations. All waste oil or fuel collected during routine maintenance of the equipment will be contained and disposed of in accordance with state and federal requirements.

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

IV. Potential Sources of Hazardous Spill-Preventative Measures to be Implemented

For day to day operations, Michels' personnel will follow these guidelines to prevent the accidental release or spill of hazardous materials:

Potential Source of Hazardous Spill	Preventative Measures To be Implemented
Fuel stored in a storage tank	• Except as specified in **Attachment-A** of Appendix-B, locate storage tank at least 100 feet from wetlands or surface waters, at least 200 feet from private water supplies, and at least 400 feet from public water supplies. • Install secondary containment devices around tank in excess of 150% of the maximum volume to be stored. • Inspect tank and secondary containment daily and before filling, implement corrective action upon discovery of deterioration that could cause a spill or result in a leak. Record inspection results weekly on log attached in the appendix to this plan. • Remove any precipitation found within the secondary containment. Prior to removing the precipitation, inspect for film, sheen, discoloration, sludge, emulsion or tarry residue, if present then collect the liquid for disposal. Do not discharge to land or surface waters. • Plug or close all tank openings when not in use. • Maintain sufficient quantities of spill control and clean-up materials in a central location near the storage tank, inspect supply daily. • Provide security measures to protect against vandalism of stored materials
Liquid material stored in a container	• Except as specified in **Attachment-A** of Appendix-B, store container at least 100 feet from wetlands or surface waters, at least 200 feet from private water supplies, and at least 400 feet from public water supplies. • If practicable and if room allows, store containers in a central location within a common secondary containment device. All significant container storage (i.e. greater than 5 gallon) will have secondary containment in excess of 150% of the maximum volume proposed to be stored. • Use small containers which are in good condition (maximum 55 gallon drum). • Take measures to protect the containers from the elements or physical damage. • Inspect containers daily, replace immediately if damaged or leaking. Record inspection results weekly on log attached in **Attachment-B** of Appendix-B to this plan • Close containers when not in use. • Maintain sufficient quantities of spill control and clean-up materials in a central location where the containers are regularly used, inspect supply daily. • Provide security measures to protect against vandalism of stored materials

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Liquid material transferred from a storage tank or container to vehicles or equipment	• Except as specified in **Attachment-A** of Appendix-B**,** transfer materials at least 100 feet from wetlands or surface waters, at least 200 feet from private water supplies, and at least 400 feet from public water supplies. Exercise extreme caution for transfers in areas where set-back distances from sensitive areas cannot be met such as placement of absorbent pads or drip pans beneath transfer points, creating temporary earthen berms, or other similar precautionary spill measures. • Transfer during daylight hours or where lighting is adequate to illuminate the area. • Monitor transfer operations at all times. • Maintain sufficient quantities of spill control and clean-up materials in a central location where transfers regularly occur, inspect supply daily. • Provide security measures to protect against vandalism of stored materials

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Liquid material used in vehicles and equipment	• Except as specified in **Attachment-A** of Appendix-B, park at least 100 feet from wetlands or surface waters, at least 200 feet from private water supplies, and at least 400 feet from public water supplies. • Inspect daily for leaks or signs of deterioration that could result in a leak. • Repair or replace defective tanks, hoses, fittings, etc. • Maintain sufficient quantities of spill control and clean-up materials in a central location where equipment or vehicles are in use, inspect supply daily. • Provide security measures to protect against vandalism of stored materials

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Liquid material transferred from tank vehicle to vehicles & equipment	• Except as specified in **Attachment A** of Appendix-B, tank vehicle used during re-fueling operations shall be specifically designed for supplying fuel to vehicle or equipment tanks and will comply with the requirements of NFPA 385 and other applicable state and federal requirements. • Tank vehicle and its equipment shall be maintained in good repair. • Drivers to be thoroughly trained in the proper method and operation of tank vehicles and in acceptable unloading procedures. • The driver or operator will not leave vehicle unattended during re-fueling operations • All engines to be shut off and operators not on the equipment during refueling operations. • Smoking is to be forbidden on or near any vehicle involved in re-fueling operations. Extreme precaution shall be exercised to prevent people in the vicinity from smoking, lighting matches, or carrying any flame or lighted device. Signs prohibiting smoking or open flames to be prominently displayed in open view on the tank vehicle. • Re-fueling procedures will not be initiated until precautions have been taken to prevent the motion of vehicles involved. Parking brakes to be utilized if available. • Length of refueling hose is typically limited to 50-feet from the hose reel. Tank vehicle to be positioned with respect to vehicles being fueled in order to prevent unwanted traffic between the tank vehicle and vehicle/equipment being fueled. • Each vehicle must contain one portable fire extinguisher that has a minimum rating of 4A, or 4-B,C. Ratings to be in accordance with NFPA-10. Signage on vehicles shall clearly indicate location of fire extinguisher. • Fueling/Re-fueling operations should typically take place during daylight hours. Nighttime fueling operations conducted in adequately lighted areas. • Documentation of training to be made available upon request. • Provide security measures to protect against vandalism of stored materials

Should these guidelines prove to be inadequate to prevent the accidental release or spill of hazardous material, they will be revised and implemented as required to ensure that every possible preventative effort is being taken. All personnel will be made aware of any such revisions at the time of the revision and at the environmental refresher meetings.

V. HDD Construction Operations Hazardous Material Spill Procedures

A spill is an unintentional release of hazardous material to the environment. In the unlikely event that an inadvertent spill of a hazardous material occurs the following steps will be followed at a minimum:

- Step 1 - Containment: Assess the situation prior to attempting to control the spill. Secure the spill scene and attempt to identify and stop the source of spill and

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

contain at source. Limit access to the site in order to prevent/limit personal and/or property damage. Responders must have knowledge of the spilled material and immediately utilize all available resources (i.e. equipment, personnel, and materials), to contain spill. If adequate resources are not available, expedite mobilization of additional resources from other construction activities as required to fully contain the spill. If the spill cannot be adequately handled by additional resources, Michels will arrange for an approved spill response contractor to mobilize to the site and contain, clean up, and perform required sampling and disposal of spilled materials and residual contaminated debris.

- Step 2 - Remediation: Properly trained personnel shall clean up hazardous material immediately after spill is contained to prevent further migration of hazardous materials into the environment. Responders should consult with proper governmental resource agencies as required. In no case shall containment equipment be used to permanently store contaminated material. Containerize in DOT-approved containers, label, and remove all contaminated material from the construction area and dispose of material in accordance with applicable regulatory guidelines (i.e. transport to hazardous waste disposal facility by licensed waste hauler). The Owner will be provided with proper documentation showing that material was disposed of in a proper manner.

- Step 3 - Notification: Reporting requirements will depend on the quantity of spill. A spill constituting less than a significant spill event will be reported to Owner and/or Owner's representative Chief Inspector **(CI)-_____________: ( ) - (office), or ( ) - (cell).**

  Significant spills are defined as: any amount of petroleum, oils, or lubricants discharged to a receiving stream that causes a film, sheen, or discoloration of surface water or adjoining shoreline; or any reportable quantity of hazardous material as defined by 40CFR320. If a significant spill should take place, Michels' Project Manager (PM), will notify the Prime Contractors' Project Manager and Owner's representative Chief Inspector **(CI)-__________( ) - (office), or ( ) - (cell)** of the spill as soon as he has confirmed that the spill has been completely contained. Michels' PM will assist the Owner's representative in submitting the regulatory-required information for hazardous spill notification in accordance with Governing Agency procedures. At the very minimum the project superintendent will provide the CI with the information required on the "Spill Report" included as **Attachment C** in Appendix C.

- Step 4 – Michels' Project Manager will be responsible for any applicable agency reporting requirements. The notification requirements for petroleum and hazardous materials spills are as follows:

  - Federal Contacts:
    National Spill Response Center 1-800-424-8802

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

- State Contacts:
  State Department of Environmental
  Quality - Spill Notification ( ) - (Business Hours)
  ( ) - (After Hours)

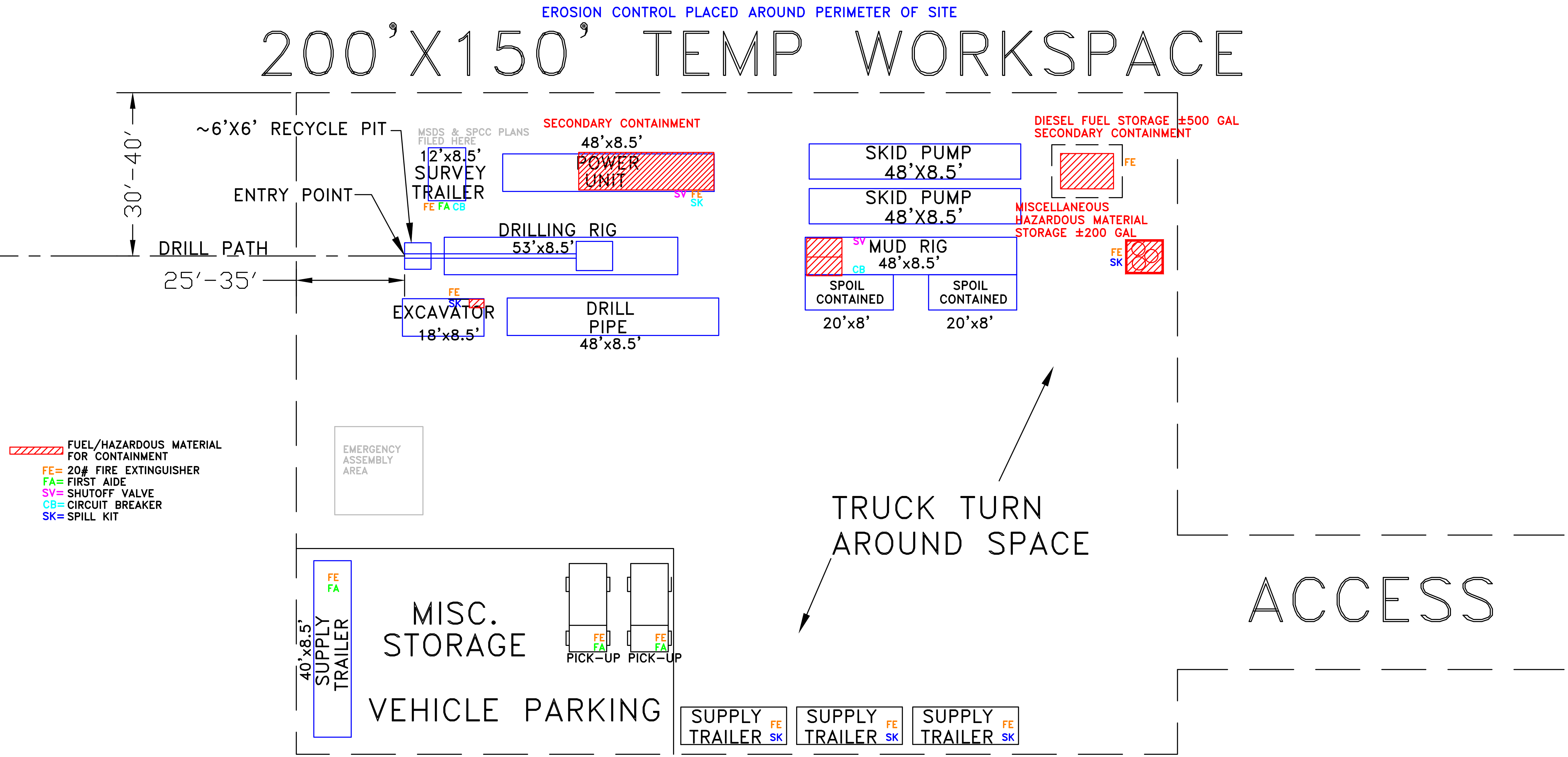
- Local Contacts:
  Local Fire Department ________

- A completed Petroleum and Hazardous Materials Spill Report must be submitted to OWNER & Governmental Agencies within 48 hours.
- Prior to continuing work, Michels will determine the cause of the spill and implement measures to ensure that further spills will not occur.

A More detailed list of Local Emergency Response Personnel and Hospital Location will be attached and filled out as **Attachment D** in Appendix C.

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

APPENDIX-A



NOTE: THIS IS A TYPICAL SITE SET-UP. THERE ARE VARIOUS CONFIGURATIONS USED DEPENDING UPON SITE RESTRICTIONS. FIELD MODIFICATIONS TO SUIT SITE.

NOTE: BENTONITE SLURRY PUMPED FROM PIT, COLLECTED & RECYCLED OR DISPOSED OF AT AN APPROVED LOCATION

PLAN VIEW

REVISIONS

NO.	DATE	REVISION DESCRIPTION	SOURCE DRAWING
0			

MICHELS®

817 W. MAIN ST., P.O. BOX 128 BROWNSVILLE, WISCONSIN 53006
PHONE: (920) 583-3132 FAX: (920) 924-4323

DIRECTIONAL BORE FOR: OWNER

PROJECT: PROJECT NAME

DRAWING: ANTICIPATED ENTRY SITE LAYOUT

SCALE: NTS

LOCATION: CROSSING NAME

DRAWN BY: B.J.E.

MDC JOB #: xxx

DATE: 3 / 18 / 20

TABLE I

HAZARDOUS SUBSTANCE INVENTORY

Material	Quantity (gallons)	Storage Location	Reportable Quantity (include reference)
Oil/Fuel:			
Unleaded Gasoline	10 Gallons	5 Gallon DOT-Approved Re-fill able Cans - Storage Trailer	
	80 Gallons	Fuel Tank in Bed of Pick-Up Truck	
Diesel Fuel	120 Gallons	Fuel Tank in Bed of Pick-Up Truck	
	500 Gallons	Fuel Tank w/Secondary Containment on Site in excess of 150% of maximum volume	
Motor Oil	1 or 5 Gallons	Reinforced Plastic Container - Storage Trailer	
Hydraulic Oil	110-Gallons	Two 55-gallon drums w/Secondary Containment on Site in excess of 150% of maximum volume	
Commercial Chemicals:			
Ethylene Glycol	40-Gallons	1 or 5 Gallon Reinforced Plastic Containers - Storage Trailer	
Hazardous Wastes:			

APPENDIX-B

Attachment A

The setbacks specified for refueling, fuel storage, and parking of equipment may not be practicable for certain construction activities, including horizontal directional drilling. Exceptions to the setback requirements may be allowed for:

- Areas where removing equipment from a wetland for servicing or overnight parking would increase adverse impacts to the wetland and/or result in significant construction delays;
- Construction sites where moving equipment to refueling stations from pre-fabricated equipment pads is impracticable or where there is a natural barrier from the water-body or wetland (i.e., dike, road or railroad);
- Locations where the water-body or wetland is located adjacent to a road crossing (from which the equipment can be serviced);
- Refueling and fuel storage for immobile equipment including, but not limited to, bending and boring machines, air compressors, padding machines, and hydro-test fill pumps.

ATTACHMENT B
WEEKLY HAZARDOUS MATERIALS/WASTE INSPECTION LOG

For each item listed below, Contractor will indicate whether existing conditions are acceptable (A) or unacceptable (U). Resolution of all unacceptable conditions must be documented. Contractor will inspect all storage facilities on a regular basis, but not less than weekly. Contractor will keep records of all inspections on file. Contractor will provide a coy of the completed form to the Chief Inspector and Environmental Inspector on a weekly basis.

I. STORAGE AREAS FOR FUELS, LUBRICANTS AND CHEMICALS

General

A/U

______ Construction yard or storage areas secured

______ National Fire Protection Association symbol posted in storage area or at yard entrance

______ Storage areas properly prepared and signed

______ Material Safety Data Sheets available

______ Hazardous Materials Management Plan/Spill Prevention and Countermeasure Plan available

Hazardous Materials Management

A/U

______ No evidence of spilled or leaking materials

______ Incompatible materials separated

______ All containers labeled properly

______ All containers securely closed

______ All containers upright

______ No evidence of container bulging, damage, rust or corrosion

Secondary Containment Areas

A/U

______ Containment berm intact and capable of holding 110% of material stored plus precipitation

______ Lining intact

______ No materials overhanging berms

______ No materials stored on berms

______ No flammable materials used for berms

Compressed Gases

A/U

______ Cylinders labeled with contents

______ Cylinders secured from falling

______ Oxygen stored at least 25 feet away from fuel

______ Cylinders in bulk storage are separated from incompatible materials by fire barriers or by appropriate distance

II. HAZARDOUS WASTE MANAGEMENT

Waste Container Storage

A/U

______ No evidence of spilled or leaking wastes

______ Adequate secondary containment for all wastes

______ Separate containers for each waste stream—no piles

______ Waste area not adjacent to combustibles or compressed gases

______ All containers securely closed

______ Bungs secured tightly

______ Open-top drum hoops secured

______ All containers upright

______ No evidence of container bulging, corrosion

______ No severe container damage or rust

______ Containers are compatible with waste (e.g. plastic liner for corrosives, metal liner for solvents)

______ No smoking and general danger/warning signs posted

Waste Container Labeling

A/U

______ Containers properly labeled

______ Name, address and EPA ID number or ID Number of generator listed (Not required if Contractor is an exempt small quantity generator.)

______ Accumulation start date listed

______ Storage start date listed

______ Chemical and physical composition of waste listed

______ Hazardous property listed

Nonhazardous Waste Areas

A/U

______ No litter in yard

______ No hazardous wastes or used oil mixed with trash (e.g., contaminated soil, oily rags, diapers, or other oily materials)

______ Empty oil and aerosol containers for disposal are completely emptied

III. EMERGENCY RESPONSE EQUIPMENT

A/U

________ Shovels

________ Absorbent materials (booms, pads, pillows, socks, “Speedy Dry”

________ Personal protective equipment (goggles, gloves)

________ Fire-fighting equipment

________ First aid supplies (e.g. medical supplies, squeeze bottle eye wash)

________ DOT-approved containers

________ Plastic sheeting, bags and ties

________ Communication equipment

________ Bung wrench (non-sparking)

IV. CORRECTIVE ACTIONS TAKEN (Required for all unacceptable conditions)

____

____

____

____

____

____

____

____

____

Date: ______________________________ **Contractor Name :** ____________________

Inspected by (Contractor’s Inspector): ____

Signature: ____

APPENDIX-C

ATTACHMENT C

Petroleum and Hazardous Material Spill Report

Date of spill: ______________________ Incident No: ______________ Date of spill discovery: ______________

Time of spill: ______________________ Time of spill recovery: ______________

Location Name: __________________________ Spread: _______ County: ______________________________

Section: _______ Township: _______ Range: _______

Name and Title of Discoverer: ____

Type of material spilled and product name: ____

Manufacturer's Name: ____

Legal description of spill location: ____

Directions from nearest community: ____

____

____

Estimated volume of spill: ______________________ Estimated material recovered: ______________

Weather Conditions: ____

Topography and surface conditions of spill site: ____

Spill medium (pavement, sandy soil, water, etc.): ____

Proximity of spill to surface waters or wetland: ____

Did the spill reach a water body? __________ Yes __________ No

If so, was a sheen present? __________ Yes __________ No

Direction and time of travel (if in stream): ____

Responsible party (name, phone number): ____

Describe the causes and circumstances resulting in the spill: ____

____

____

Describe the extent of observed contamination, both horizontal and vertical (i.e., spill-stained soil in a 5'' radius to a depth of 1"):

____

____

Resources and installations that may be affected: ____

____

____

Potential impact on human health: ______________________________

____

____

Describe immediate spill control and/or cleanup methods used and implementation schedule: ______________

____

____

Current status of cleanup actions: ______________________________

____

____

Name/Company/Address/Phone Number for the following:

Construction Superintendent: ______________________________

____

OWNER
Representative: ______________________________

____

Environmental Director: ______________________________

____

Person Who Reported the Spill: ______________________________

____

Environmental Inspector: ______________________________

____

On-Scene Agency Coordinator (where applicable): ______________________________

____

Form completed by: ______________________ Date: ______________

The Contractor must complete this for any petroleum or hazardous material spill regardless of size, and submit the form to OWNER or OWNER's designated representative for construction observation within 48 hours of the occurrence.

ATTACHMENT D
LOCAL Emergency RESPONSE PERSONNEL-HOSPITAL LOCATION

The contractor should provide a listing by municipality of the local emergency response organizations near the HDD project site, and the name and phone number of a contact person for each. For example, list fire and police departments, emergency management organizations, etc. The contractor should update and complete this information as required for his/her work locations. Additions will be made by the Project Manager once they become available prior to drilling operations.

Local Emergency Contacts

- Federal Contacts:
  National Spill Response Center 1-800-424-8802

- State Contacts:
-
-
- Local Contacts:
  Emergency Response -
  Emergency Response -
  Local Fire Department 911
  Local Police Department 911

- Nearest Hospital:

Other Phone Numbers to be added to this form if necessary.

ATTACHMENT

DRILL RIG SPECIFICATIONS

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2019

MICHELS®
817 W. Main Street, P.O. Box 128
Brownsville, WI 53006
Telephone: (920) 583-3132
Fax: (920) 583-3429
www.michels.us

HERCULES
(11) RIGS OWNED & OPERATED

DRILL RIG SPECIFICATIONS

Weight:	100,000 – 103,000 Pounds
Height:	13' 6"
Length:	53'
Width:	8' 6"
Horsepower:	1500+ HP (750 HP ea)

DRILL RIG CAPACITY

Torque Capacity:	164,500 Ft/Lbs
Max Spindle Speed:	90 RPM
Thrust/Pull:	1,260,000 Lbs

DRILLING SPECIFICATIONS (DIRT)

MAXIMUM RECOMMENDED

Back Ream:	96"
Drilling Distance:	8,000'

DRILLING SPECIFICATIONS (ROCK)

MAXIMUM RECOMMENDED

Back Ream:	60"
Drilling Distance:	8,000'

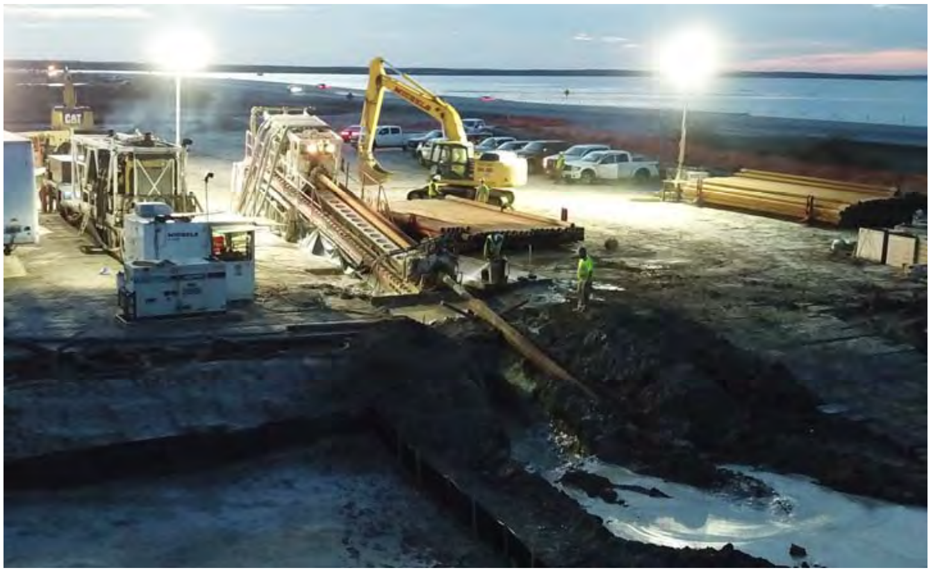
SURVEY SYSTEM SPECIFICATIONS

Type:	**Downhole probe** transmits tool face, 3 dimensional coordinate data	
Accuracy:	+/-0.1° All Angles	
Max Locating Depth:	Unlimited	
	Tool face	±0.5°
Type:	**Gyro-Steering Tool**	
Accuracy:	Inclination	±0.01°
	Azimuth	±0.04°
	Tool face	±0.02°

SECONDARY SURVEY SYSTEM SPECIFICATIONS

Type:	**ParaTrack**	
Accuracy:	Inclination	±0.1°
	Azimuth	±0.4°
	Tool face	±0.5°

817 W. Main Street, P.O. Box 128
Brownsville, WI 53006
Telephone: (920) 583-3132
Fax: (920) 583-3429
www.michels.us



ATLAS 840
(7) RIGS OWNED & OPERATED

Drill Rig Specifications

Weight:	88,000 – 93,000Lbs Varies
Height:	13' 6"
Length:	54'
Width:	8' 6"
Engine:	Dsl Cat Model 3456 or 3412
Horsepower:	660 HP or 750 HP

Drill Rig Capacity

Torque Capacity:	164,500 Ft/Lbs
Max Spindle Speed:	100 RPM
Thrust/Pull:	840,000 Lbs

Drilling Specifications (Dirt)

MAXIMUM RECOMMENDED

Back Ream:	60"
Drilling Distance:	6,500'

Drilling Specifications (Rock)

MAXIMUM RECOMMENDED

Back Ream:	52"
Drilling Distance:	6,500'

Survey System Specifications

Type:	**Downhole probe** transmits tool face, 3 dimensional coordinate data	
Accuracy:	+/-0.1º All Angles	
Max Locating Depth:	Unlimited	
	Tool face	±0.5º
Type:	**Gyro-Steering Tool**	
Accuracy:	Inclination	±0.01°
	Azimuth	±0.04°
	Tool face	±0.02°

Secondary Survey System Specifications

Type:	**ParaTrack**	
Accuracy:	Inclination	±0.1º
	Azimuth	±0.4º
	Tool face	±0.5º

ATTACHMENT

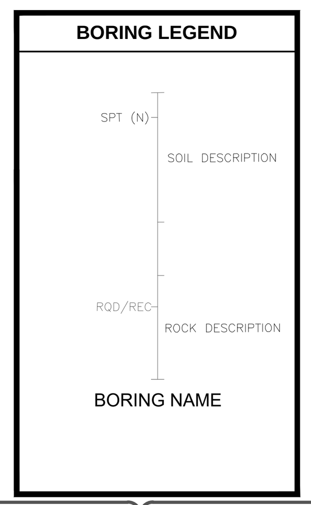
HDD PLAN AND PROFILE DRAWING

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2019

PLAN VIEW
SCALE 1-in:600-ft

PROFILE ALONG CENTRELINE OF PROPOSED PIPE
SCALE 1:600 HORIZONTAL
SCALE 1:300 VERTICAL

TOTAL DRILL PIPE LENGTH 15,441'



HORIZONTAL DIRECTIONAL DRILL DATA
MISSOURI RIVER

DESCRIPTION	STATION (ft)	ELEVATION (ft)
ENTRY @ 12°	−0+019	1908.07
PC1 = 5000' RADIUS	1+293.20	1629.26
PT1 =	2+332.76	1520.00
PC2 = 5000' RADIUS	13+170.24	1520.00
PT2 =	14+210.00	1629.26
EXIT @ 12°	15+353.00	1872.17
HORIZONTAL DISTANCE (ft) = 15371		
DIRECTIONAL DRILL PIPE LENGTH (ft) = 15441.16		

REFERENCE DOCUMENT NO.	DATE
1.	

ENGINEER AND PERMIT STAMPS

ISSUED FOR REVIEW NOT FOR CONSTRUCTION

PIPELINE SPECIFICATIONS

OUTSIDE DIAMETER (OD)(in)	24
WALL THICKNESS (WT)(in)	1.219
GRADE (psi)	52,000
PRODUCT	NATURAL GAS
MATERIAL	STEEL
SPECIFICATIONS	API 5L
INTERNAL COATING	N/A
OUTER COATING	DUAL FBE
MAX. OPER. PRESSURE (psi)	1,480
MIN. TEST PRESSURE (psi)	1,850
MAX. OPER. TEMP (°F)	100
MIN. INSTALLATION TEMP (°F)	23

STEERING TOLERANCES

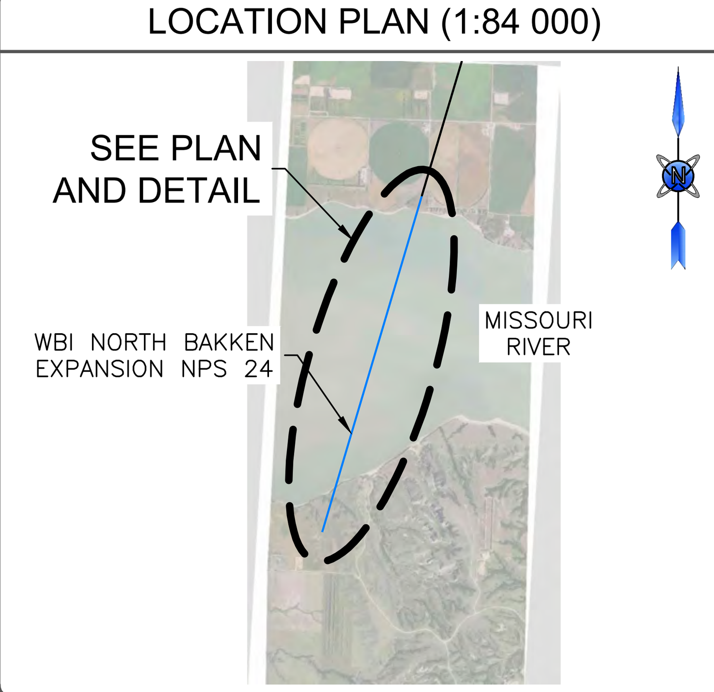
	30ft	100ft	330ft
MINIMUM RADIUS (ft)	1000	1450	4500

PULL FORCE / RIG SIZE / STRESS

PULL FORCE (w/ BUOYANCY CONTROL):	863,000 lbs (w/sf)
MINIMUM RECOMMENDED RIG SIZE:	1,000,000 lbs
COMBINED STRESS UNITY CHECK:	0.44
OPERATING STRESS	65.7%

DRAWING STATUS	DATE	DRN	CHK	DES	GEO	APR	CR
ISSUED FOR REVIEW	2019-12-19	MS		KP		KP	
PRELIMINARY	2019-10-23	MS		KP		KP	
PRELIMINARY	2019-07-25	TL	MAL	KP		KP	
PRELIMINARY	2019-06-14	RL		KP		KP	
PRELIMINARY	2019-06-11	RL		KP		KP	
PRELIMINARY	2019-03-11	AN		CG		KP	

LOCATION PLAN (1:84 000)



CCI & Associates Inc.
20333 State Highway 249, Suite 480
Houston, TX 77070
COR F-18518

ND83-NF

WBI NORTH BAKKEN EXPANSION PROJECT
MISSOURI RIVER HDD CROSSING
PLAN AND PROFILE
WATFORD CITY / TIOGA, NORTH DAKOTA

SCALE	DWG. #	REVISION	SHEET
AS SHOWN	2386-EG-0101	A	1 OF 2

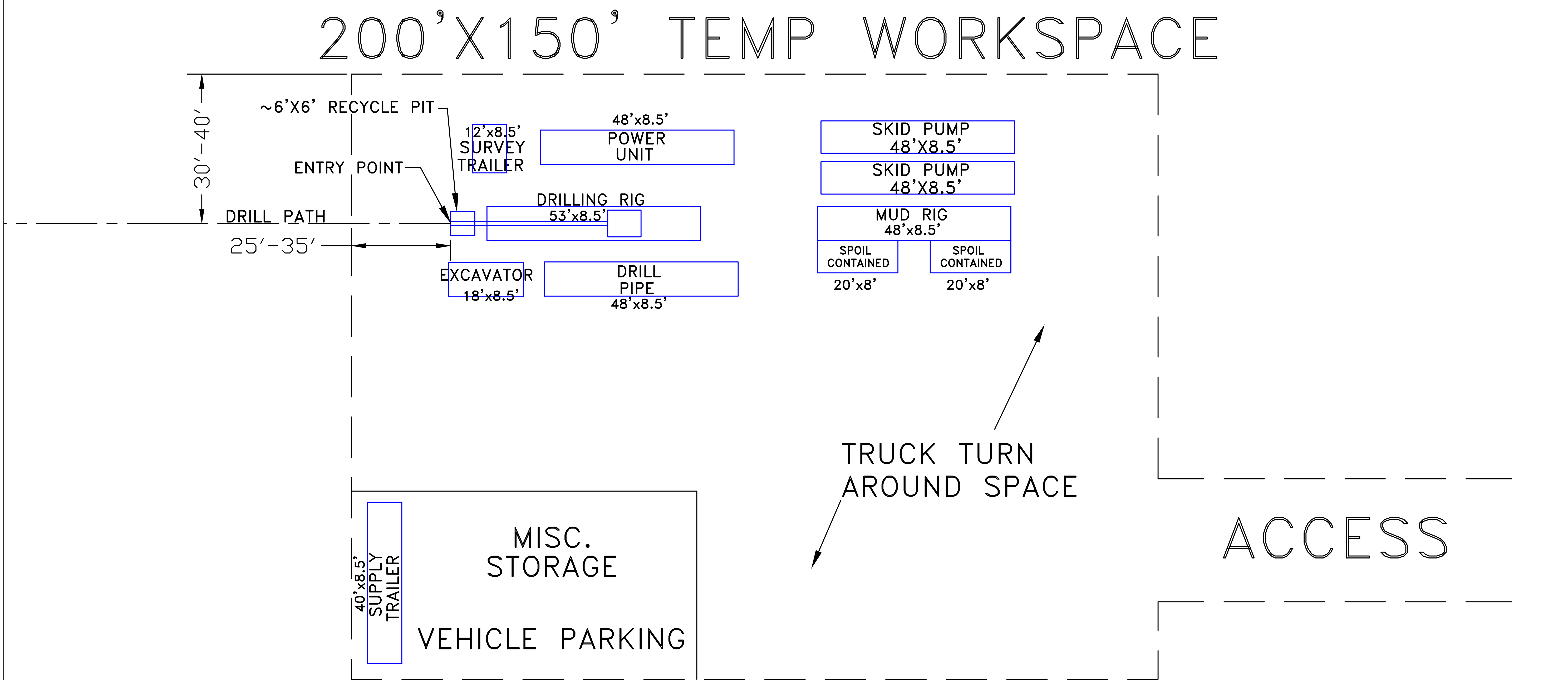
File Name: S:\Current Jobs\2386-WBI-N.Bakken Expansion\Eng\Drawings\01-Lake Sakakawea Missouri River\Preliminary\2386-EG-0101-F.dwg Date/Time: 11-Dec-19 / 3:48:23 PM Last Saved By: Matthew.Smith

MICHELS®

ATTACHMENT

ANTICIPATED ENTRY/EXIT EQUIPMENT

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2019



PLAN VIEW

NOTE: THIS IS A TYPICAL SITE SET-UP. THERE ARE VARIOUS CONFIGURATIONS USED DEPENDING UPON SITE RESTRICTIONS. FIELD MODIFICATIONS TO SUIT SITE.

NOTE: BENTONITE SLURRY PUMPED FROM PIT, COLLECTED & RECYCLED OR DISPOSED OF AT AN APPROVED LOCATION

REVISIONS

NO.	DATE	REVISION DESCRIPTION	SOURCE DRAWING
0			

MICHELS®

817 W. MAIN ST., P.O. BOX 128 BROWNSVILLE, WISCONSIN 53006
PHONE: (920) 583-3132 FAX: (920) 924-4323

DIRECTIONAL BORE FOR: OWNER

PROJECT: PROJECT NAME

DRAWING: ANTICIPATED ENTRY SITE LAYOUT

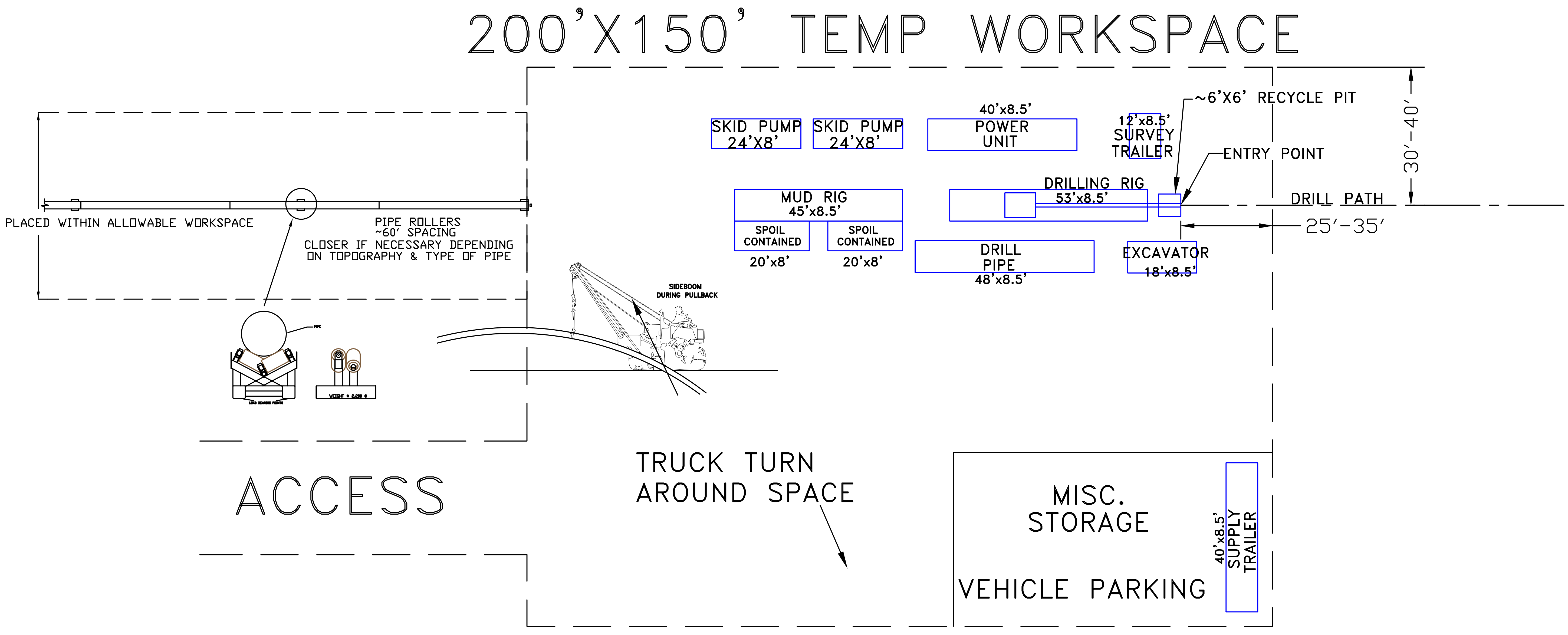
SCALE: NTS

LOCATION: CROSSING NAME

DRAWN BY: B.J.E.

MDC JOB #: xxx

DATE: 1 / 6 / 18



PLAN VIEW

NOTE: RIG AND SUPPORT EQUIPMENT SHOWN MAY OR MAY NOT BE REQUIRED BUT SHALL BE PLANNED FOR IN CASE A HOLE INTERSECT IS REQUIRED AND/OR AS A HDD CONTINGENCY MEASURE

NOTE: THIS IS A TYPICAL SITE SET-UP. THERE ARE VARIOUS CONFIGURATIONS USED DEPENDING UPON SITE RESTRICTIONS. FIELD MODIFICATIONS TO SUIT SITE.

NOTE: BENTONITE SLURRY PUMPED FROM PIT, COLLECTED & RECYCLED OR DISPOSED OF AT AN APPROVED LOCATION

REVISIONS

NO.	DATE	REVISION DESCRIPTION	SOURCE DRAWING
0			

MICHELS®

817 W. MAIN ST., P.O. BOX 128 BROWNSVILLE, WISCONSIN 53006
PHONE: (920) 583-3132 FAX: (920) 924-4323

DIRECTIONAL BORE FOR: OWNER

PROJECT: PROJECT NAME

DRAWING: ANTICIPATED EXIT SITE LAYOUT

SCALE: NTS | LOCATION: CROSSING NAME

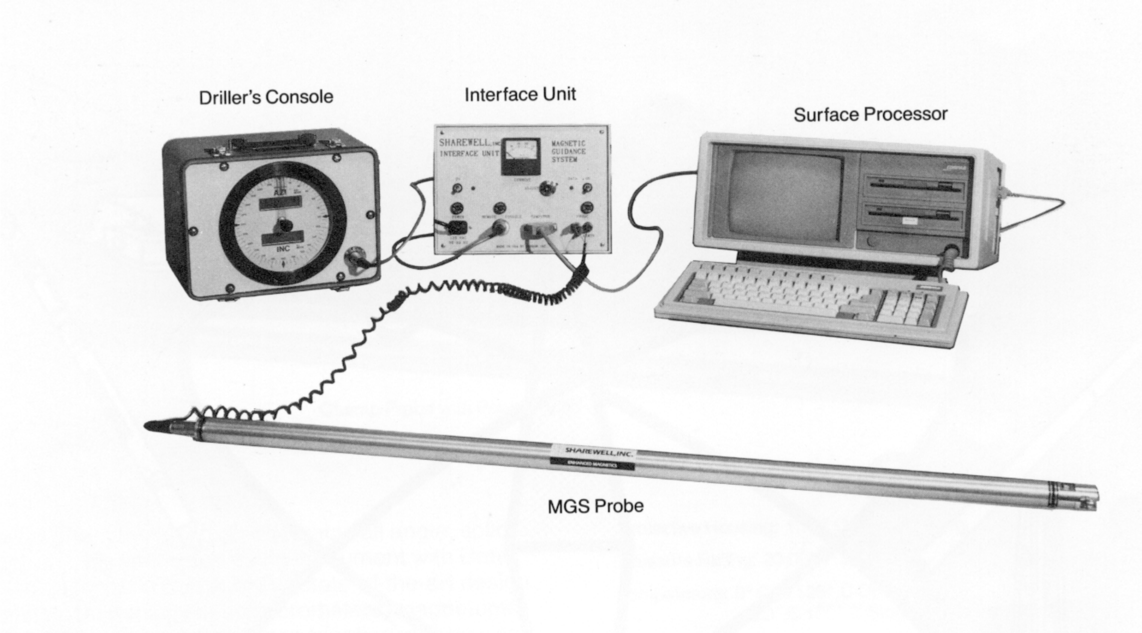
DRAWN BY: B.J.E. | MDC JOB #: xxx | DATE: 1 / 6 / 18

ATTACHMENT

MGS STEER TOOL SYSTEM

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

MAGNETIC GUIDANCE SYSTEM



The Magnetic Guidance System (M.G.S.) is designed to address a wide range of applications from normal oil and gas drilling to drainhole and pipeline river crossing drilling.

While directional drilling with either a downhole motor or jetting operation, the system permits you to guide the bit with utmost accuracy. Data is transmitted to surface via a single-conductor wireline.

The system comprises three main sub-sections: the downhole probe, the surface processing unit, and the driller's remote display.

Useful features include the ability to monitor the magnetic moments during drilling operations and to perform probe operational diagnostics while downhole as well as to verify probe calibration at the drilling location.

The directional engineer has the option to drill using either magnetic tool face or gravity tool face, along with having the magnetic hole direction and hole inclination displayed on a continuous basis from the remote readout. The surface processing unit provides duplicate output as the remote display, as well as the magnetic parameters including voltage temperature. A printed record of the data is available at selected intervals by the operator. The M.G.S. downhole probe incorporates the latest technology in accelerometers, magnetometers, calibration and modeling techniques to provide a rugged and reliable tool.

PROBE SPECIFICATIONS

SENSORS:

3 Axis Accelerometers → All Angle Capability
3 Axis Magnetometers → All Angle Capability

DIMENSION & RATING:

Probe Length …… 47.25"
Probe Diameter …… 1.38"
Protective Housing …… 1.75" x 6'
Protective Housing Pressure Rating …… 20,000 P.S.I.
Maximum Operating Temperature …… 125°C
Repeatability …… 0.2° at Horizontal
0.5° at 4° or Less
Accuracy …… ± 1%

DRILLER'S CONSOLE:

Two 4-character L.C.D. displays for Inclination, Azimuth and Tool Face Mode
360° Rotating Pointer for Tool Face Position
Hermetically Sealed Unit
12 Vac Operation
Electronics Isolated From Case
Easily Positioned Near Driller

SOFTWARE:

Displays Individual Sensor Values
Display of All Magnetic Parameters
Tool Face Offset Option
Complete Diagnostic Check
Automatic Tool Face Switching Mode Option
Data Printout on Request
Menu Driven
Borehole Survey Calculations

SURFACE PROCESSOR:

COMPAQ Portable or IBM Compatible with Printer

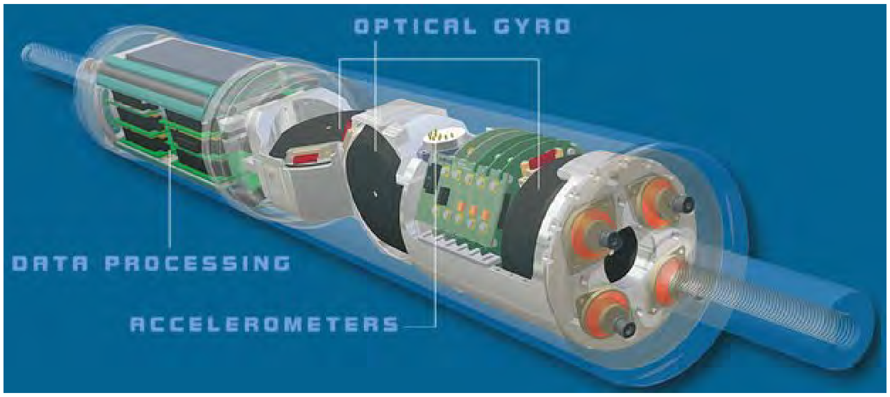
MICHELS®

ATTACHMENT

GYROSCOPIC
STEER TOOL SYSTEM

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

DRILLGUIDE GYRO STEERING TOOL



Technical Specifications –

Electric Power (Input on surface)	110-Volts AC / 50 Hz
Electric Power (Output to Downhole Tool)	48-Volts AC
Tool OD	6-5/8-inches
Tool Length	9-ft
Tool Joint Connection (Box Up x Pin Down)	4-1/2 IF
Maximum Allowed Torque (on Tool Housing)	18,000-foot pounds
Maximum Allowed Push/Pull (on Tool Housing)	75,000-pounds
Maximum Allowed Temperature (on Tool)	120-f
Maximum Allowed Shock (on Tool)	50-g (half sine wave)
Maximum Allowed Vibration (on Tool)	20-g up to 200-Hz
Maximum Allowed Mud Pressure (on Tool)	650-psi
Maximum Allowed Side Load (on Tool Housing)	33,000-pounds

Accuracy –

Azimuth	0.04°
Inclination	0.01°
Tool Face	0.02°

For additional information - http://www.drillguide.com

ATTACHMENT

PARA TRACKER SYSTEM

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

Vector Magnetics LLC
236 Cherry Street
Ithaca, New York 14850
607-273-8351 Fax: 607-273-6137

ParaTrack2 Survey and Guidance System Specifications

Downhole Survey Probe
Shock mounted triaxial accelerometers and magnetometers, temperature sensor and digitizing circuitry contained in 1.750 in. dia. x 55.3 in. long beryllium copper pressure barrel. Telemetry and power via wireline.

Temperature Rating:	85°C
Pressure Rating:	1200 bar
Survey Accuracy:	
Inclination:	±0.1°
Azimuth:	±0.4°
Toolface:	±0.5°
Maximum wireline length:	5000 meters

Interface Unit

Input:	85-265 VAC 50-60 HZ
Output:	48VDC, 50 mA

Guidance System
A single signal wire earthed at each end or with a return wire to close the loop.

Guidance Unit Input:	85-265 VAC 50-60 HZ
Guidance Unit Output:	34 VRMS, 6 Amps p-p max.
Position Accuracy:	±2% of separation from signal wire

Drillpipe and Borehole Pressure Module
(requires compatible survey probe)
Borehole gauge, 0-500 psi Full Scale, 1200 psi survival, 2400 psi burst
Drillpipe gauge, 0-2000 psi Full Scale, 6000 psi survival, 10000 psi burst
Non-linearity +/-0.1 %FS
Hysteresis +/-0.015 %FS
Repeatability +/-0.01 %FS

ATTACHMENT

PARA TRACK GYRO MODULE

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

PGM

PARATRACK GYRO MODULE

IMMUNE TO MAGNETIC INTERFERENCE

The ParaTrack Gyro Module (PGM) is the latest in a long line of Vector Magnetics innovations for the HDD market. With no concern of magnetic interference from nearby active utility lines, shorepiles, ship traffic or other transportation activity, drilling may be carried out confidently, regardless of surrounding conditions.

The PGM runs in conjunction with the ParaTrack Steering Tool, providing the ability to tie in with the entire ParaTrack System of tools and software. The PGM is especially effective for initial surface entry, while absolute position may then be verified via the ParaTrack2 Guide Wire or Beacon Tracker, providing confidence that the bore is placed properly relative to the planned exit location prior to punch out.

Features

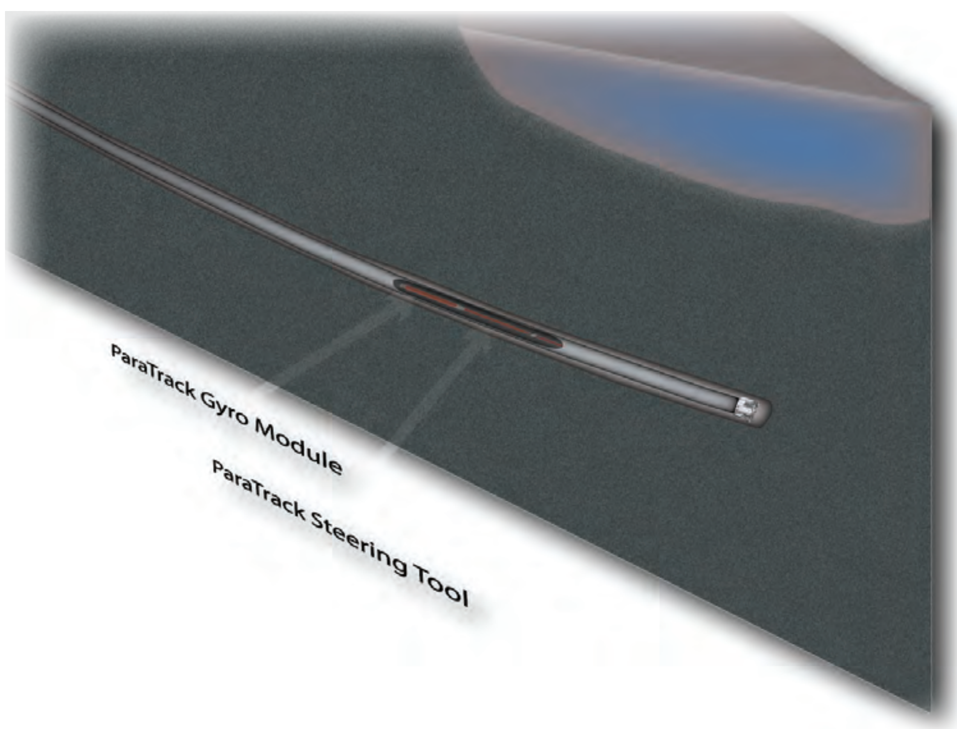
- Fiber optic north seeking gyro system
- Compatible with the entire ParaTrack line of Steering, Tracking and Surveying tools

Benefits

- Accurate surveying in cases of severe magnetic interference
- No specialized handling or personnel required
- Surveys immune from drillstring vibration

Applications

- Surveying in densely developed urban areas
- Verification and correction of magnetic azimuth in long unguided sections



Specifications

Outside Diameter: 2.75" (requires 3.5" collar)

Length: Head to foot - 48"

Internal Operating Temperature: 0-70C

Electrical Connection: 1-3/16", 12 tpi (standard wet connect)

Copyright © 2017 Vector Magnetics LLC

ATTACHMENT

TENSTEER TOOL

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2016

TENSTEER DRILLER'S CONSOLE

- Features a 10.4" TFT color LCD with backlight that is sunlight readable
- Physical dimensions are 12.3" X 10.3" X 4.0"
- Weight is less than 12 lbs
- Operating temperature is –10° C to 70° C
- Internally protected against shock and vibration
- Sealed, metal construction that is resistant to dust, dirt and liquids
- 24V DC input power provided by Tensteer Steering Tool Receiver (STR)
- Inclination: Digital Display, ±90° range with 0.1° resolution
- Azimuth: Digital Display, 360° range with 0.1° resolution
- Tool Face: Digital Display, 360° range with 2.0° resolution
- Tool Face has magnetic and high side indicators
- Values for HTOT and GTOT are displayed
- Pipe and Annulus Pressure are capable of being displayed

For more information, contact Tensteer LLC at the following:

4245 Gattis School Rd Round Rock, TX 78664
Phone: 512-670-0447
Fax: 512-670-1070
Email: fred@tensteer.com
Website: www.tensteer.com

TENSTEER HIGH RESOLUTION STEERING TOOL PROBE

- Probe size: 1.75” diameter x 49” long
- Operating temperature: -20°C to 75°C
- Pressure rating: 12,000 psi
- Shock: 1000g, 0.5 msec, half sine
- Vibration: 30g peak, 30 to 500 Hz
- Maximum lateral displacement error: 2.6 ft. per 1000 ft. or a conical uncertainty of ±0.15°
- Survey resolution: 0.02°
- Magnetic resolution: <0.5 nT
- Power: 36 - 42 VDC, 70 mA
- Can track with DC power supply or welder
- Pressure and gamma upgradable
- Compatible with TrueGyde Software
- Can upgrade Tensor Probes

For more information, contact Tensteer LLC at the following:

4245 Gattis School Rd Round Rock, TX 78664
Phone: 512-670-0447
Fax: 512-670-1070
Email: fred@tensteer.com
Website: www.tensteer.com

TENSTEER STEERING TOOL RECEIVER (STR)

- Physical dimensions: 8.2″ X 8.3″ X 11″
- Weight: under 10 lbs
- Operating temperature: -20°C to 70°C
- Internal shock and vibration protection
- Powered by 110 VAC, 60Hz or 220 VAC 50 Hz, 60W max
- Three communication ports – USB, 9 Pin RS232, 25 Pin RS232
- Compatible with Tensor STDC and future Tensteer Driller's Consoles
- Wireline current shown on analog meter
- Power and data status shown on LED lamps

For more information, contact Tensteer LLC at the following:

4245 Gattis School Rd Round Rock, TX 78664
Phone: 512-670-0447
Fax: 512-670-1070
Email: fred@tensteer.com
Website: www.tensteer.com

ATTACHMENT

DAILY TRACKING FORMS

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2019

Date:
Location:
Superintendent:

MICHELS

Tester Name
Michels Directional Crossings
817 W. Main Street, Brownsville, WI 53006
E-mail address

FIELD REPORT

TIME	DENSITY "MUD WEIGHT" (lbs/gal)	FUNNEL VISCOSITY use Marsh funnel (sec/qt)	Solids/Sand Content (% by Vol)	pH	Comments

DRILL FLUID PRODUCT USED		DRILL FLUID HAULED OFF
Bentonite Type:	**Additives:**	
Drill-Terge:		

MICHELS DIRECTIONAL CROSSINGS
DAILY PROGRESS REPORT

MICHELS JOB #

MICHELS®

DATE:
WEATHER:
PREPARED BY:
LOCATION: *ENTRY:* *EXIT:*

	EMPLOYEE	CLASS	HOURS	
ENTRY SIDE				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.

	EMPLOYEE	CLASS	HOURS	
EXIT SIDE				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.
				Hrs.

OPERATIONAL INFORMATION

CONDUCTOR CASING:	*Entry:*		
	Exit:		
HOLE SIZE / OPERATION:	*Entry Side*		
TOOL USED:			
TODAY's FOOTAGE:			
TOTAL FOOTAGE:			
% COMPLETED:			
COMPLETED PILOT HOLE:			

DRILLING FLUIDS INFORMATION

	ENTRY		EXIT	
BENTONITE TODAY:				Pallets
BENTONITE TO DATE:		Pallets		Pallets
WATER USED TODAY:				Gal.
WATER USED TOTAL:		Gal.		Gal.
LOSE CIRCULATION TODAY:				
VAC TRUCKS HAULED TODAY:		Ea.		Ea.
DISPOSAL VOLUME TODAY:		Gal.		
DISPOSAL VOLUME TOTAL:		Gal.		Gal.
DUMP TRUCKS TODAY:		Ea.		Ea.
SOLIDS DISPOSED TODAY:		Yds.		Yds.
SOLIDS DISPOSED TOTAL:		Yds.		Yds.

SUMMARY OF DAILY ACTIVITIES AND PROGRESS:

MICHELS®

PROJECT:
LOCATION:
JOB #:
SHEET #:

DATE	SURVEY #	MD	INC	FINAL AZI	HTOTAL	DIP	P2 ELEV	P2 RT	CALC STATION	CALC ELEV	CALC RIGHT	3 JOINT INC RADIUS	3 JOINT AZI RADIUS

MICHELS®

ATTACHMENT

BENTONITE BRANDS
PRODUCT DATA SHEETS

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

Product Bulletin

Certified to
ANSI/NSF 60

MAX GEL ™

MAX GEL viscosifier is a premium Wyoming bentonite blended with special extenders producing a viscosifier that will yield more than twice as much viscosity as regular Wyoming bentonite. MAX GEL is a high-yielding, easily mixed, superior mud making bentonite in fresh water.

APPLICATIONS

MAX GEL is used in the following applications to rapidly build mud viscosity and provide superior hole cleaning, as well as to help control lost circulation, formation sloughing and promote hole stability in unconsolidated formations.

- Potable water wells
- Mineral exploration (coring and rotary drilling)
- Horizontal directional drilling
- Blast holes
- Shaft drilling
- Monitor / observation wells
- Gel-foam air drilling applications

ADVANTAGES

- Yields more quickly than API-standard bentonite
- Non-toxic and proven suitable for use in drilling potable water wells
- Increased penetration rates are exhibited due to lower solids content than regular bentonite systems
- Transportation and storage costs are reduced due to lower treatment requirements as compared to bentonite

TYPICAL AMOUNTS OF MAX GEL ADDITIONS ADDED TO FRESH WATER

Drilling Application/Desired Results	lb/100gal	lb/bbl	kg/m3
Normal drilling	15 - 25	6 - 11	15 - 30
In gravel or other poorly consolidated formation	25 - 40	12 - 18	35 - 50
Lost circulation control	35 - 45	15 - 20	40 - 45
Added to freshwater mud to improve hole cleaning properties, increase hole stability and develop filter cakes	5 - 10	2 - 5	6 - 14

LIMITATIONS

- Loses effectiveness in water containing >7500 mg/l sodium chloride / 240 mg/l calcium
- If dispersants or thinners are to be used, they should be added sparingly, using 50% or less of the normal treatment

TYPICAL PHYSICAL PROPERTIES

Physical appearance.............. Light tan / gray – green powder
Specific gravity .... 2.3 - 2.5
Approximate yield................ 220 bbl/ton

TOXICITY AND HANDLING

Bioassay information available upon request. No special requirements are necessary for handling and storage. Avoid inhalation of dust. A dust respirator and goggles are recommended if mixing in an enclosed area.

PACKAGING AND STORAGE

MAX GEL is packaged in 50 lb. (22.7-kg), multi-wall, paper sacks and is available in bulk. Store in a dry location (slip hazard when wet) and minimize dust (use dust-less systems for handling, storage and cleanup).

This material is supplied solely for informational purposes and M-I L.L.C. makes no guarantees or warranties, either expressed or implied, with respect to the accuracy or use of this data. All product warranties and guarantees shall be governed by the Standard Terms of Sale.

MATERIAL SAFETY DATA SHEET
MAX GEL

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: MAX GEL

OTHER NAME: Bentonite

CHEMICAL CLASS: Naturally occuring mineral.

APPLICATIONS: Oil well drilling fluid additive. Viscosifier.

EMERGENCY TELEPHONE: 281-561-1600

SUPPLIER: Supplied by a Business Unit of
M-I L.L.C.
P.O. Box 42842, Houston, Texas 77242-2842
See cover sheet for local supplier.
TELEPHONE: 281-561-1509
FAX: 281-561-7240

CONTACT PERSON: Sam Hoskin - Manager, Occupational Health

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Silica, crystalline, quartz	14808-60-7	2-15 %		
Bentonite	1302-78-9	70-95 %		
Silica, crystalline, Cristobalite	14464-46-1	2-12 %		
Silica, crystalline, Tridymite	15468-32-3	1-5 %		
Gypsum	13397-24-5	0-1 %		

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

CAUTION! MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION. Avoid contact with eyes, skin and clothing. Avoid breathing airborne product. Keep container closed. Use with adequate ventilation. Wash thoroughly after handling.

This product is a/an gray to tan powder. Slippery when wet. No significant immediate hazards for emergency response personnel are known.

ACUTE EFFECTS:
HEALTH HAZARDS, GENERAL:

Particulates may cause mechanical irritation to the eyes, nose, throat and lungs. Particulate inhalation may lead to pulmonary fibrosis, chronic bronchitis, emphysema and bronchial asthma. Dermatitis and asthma may result from short contact periods.

INHALATION: May be irritating to the respiratory tract if inhaled.

INGESTION: May cause gastric distress, nausea and vomiting if ingested.

SKIN: May be irritating to the skin.

EYES: May be irritating to the eyes.

CHRONIC EFFECTS:
CARCINOGENICITY:
IARC: Not listed. NTP: Not listed. OSHA: Not regulated.

ATTENTION! CANCER HAZARD. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

IARC Monographs, Vol. 68, 1997, concludes that there is sufficient evidence that inhaled crystalline silica in the form of quartz or cristobalite from occupational sources causes cancer in humans. IARC classification Group 1.

ROUTE OF ENTRY:
Inhalation. Skin and/or eye contact.

TARGET ORGANS:
Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this SDS with them.

INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.

INGESTION: Drink a couple of glasses water or milk. Do not give victim anything to drink of he is unconscious. Get medical attention.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (?F): N/D
FLAMMABILITY LIMIT - LOWER(%): N/D
FLAMMABILITY LIMIT - UPPER(%): N/D

EXTINGUISHING MEDIA:
This material is not combustible. Use extinguishing media appropriate for surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES:
No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:
No unusual fire or explosion hazards noted.

HAZARDOUS COMBUSTION PRODUCTS:
Not relevant.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:
Wear proper personal protective equipment (see SDS Section 8).

SPILL CLEAN-UP PROCEDURES:

Avoid generating and spreading of dust. Shovel into dry containers. Cover and move the containers. Flush the area with water. Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:

Avoid handling causing generation of dust. Wear full protective clothing for prolonged exposure and/or high concentrations. Eye wash and emergency shower must be available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Mechanical ventilation or local exhaust ventilation is required.

STORAGE PRECAUTIONS:

Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:		ACGIH TLV:		OTHER:		
INGREDIENT NAME:	**CAS No.:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**TWA:**	**STEL:**	**UNITS:**
Silica, crystalline, quartz	14808-60-7	*		0.1				mg/m3 resp.dust
Bentonite	1302-78-9	5		3				mg/m3 resp.dust
Silica, crystalline, Cristobalite	14464-46-1	*		0.05				mg/m3 resp.dust
Silica, crystalline, Tridymite	15468-32-3	*		0.05				mg/m3 resp.dust
Gypsum	13397-24-5	15						mg/m3 total dust

INGREDIENT COMMENTS:

* OSHA PELs for Mineral Dusts containing crystalline silica are 10 mg/m3 / (%SiO2+2) for quartz and 1/2 the calculated quartz value for cristobalite and tridymite.

PROTECTIVE EQUIPMENT:

ENGINEERING CONTROLS:

Use appropriate engineering controls such as, exhaust ventilation and process enclosure, to reduce air contamination and keep worker exposure below the applicable limits.

VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.

RESPIRATORS: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator. For exposures exceeding 10 x PEL use a NIOSH-approved N100 Particulate Respirator.

PROTECTIVE GLOVES:

Use suitable protective gloves if risk of skin contact.

EYE PROTECTION:

Wear dust resistant safety goggles where there is danger of eye contact.

PROTECTIVE CLOTHING:

Wear appropriate clothing to prevent repeated or prolonged skin contact.

HYGIENIC WORK PRACTICES:
Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE:	Powder, dust.	
COLOR:	Grey. to Tan.	
ODOR:	Odorless or no characteristic odor.	
SOLUBILITY DESCRIPTION:	Insoluble in water.	
DENSITY/SPECIFIC GRAVITY (g/ml):	2.3-2.6	TEMPERATURE (?F): 68
BULK DENSITY:	67 lb/ft3; 1068 kg/m3	
VAPOR DENSITY (air=1):	N/A	
VAPOR PRESSURE:	N/A	TEMPERATURE (?F):

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.

CONDITIONS TO AVOID:
N/A.

HAZARDOUS POLYMERIZATION:
Will not polymerize.

POLYMERIZATION DESCRIPTION:
Not relevant.

MATERIALS TO AVOID:
N/A

HAZARDOUS DECOMPOSITION PRODUCTS:
No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION:
No toxicological data is available for this product.

12. ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION:
Contact M-I Environmental Affairs for ecological information.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:
This product does not meet the criteria of a hazardous waste if discarded in its purchased form. Under RCRA, it is the responsibility of the user of the product to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because product uses, transformations, mixtures, processes, etc, may render the resulting materials hazardous. Empty containers retain residues. All labeled precautions must be observed.

DISPOSAL METHODS:

Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria prior to disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

PRODUCT RQ: N/A

U.S. DOT:
U.S. DOT CLASS: Not regulated.

CANADIAN TRANSPORT:
TDGR CLASS: Not regulated.

SEA TRANSPORT:
IMDG CLASS: Not regulated.

AIR TRANSPORT:
ICAO CLASS: Not regulated.

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:

NAME:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL(CAN):
Silica, crystalline, quartz	14808-60-7	Yes	No	No	No	Yes
Bentonite	1302-78-9	Yes	No	No	No	Yes
Silica, crystalline, Cristobalite	14464-46-1	Yes	No	No	No	Yes
Silica, crystalline, Tridymite	15468-32-3	Yes	No	No	No	Yes
Gypsum	13397-24-5	Yes	No	No	No	Yes

US FEDERAL REGULATIONS:
WASTE CLASSIFICATION: Not a hazardous waste by U.S. RCRA criteria. See Section 13.

REGULATORY STATUS: This Product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.

SARA 311 Categories:
1: Immediate (Acute) Health Effects.
2. Delayed (Chronic) Health Effects.

The components of this product are listed on or are exempt from the following international chemical registries:
TSCA (U.S.)
DSL (Canada)
EINECS (Europe)

STATE REGULATIONS:

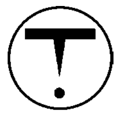
STATE REGULATORY STATUS:

This product or its components, if a mixture, is subject to following regulations (Not meant to be all inclusive - selected regulations represented):.

None.

PROPOSITION 65: This product contains the following chemical(s) considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 as causing cancer or reproductive toxicity, and for which warnings are now required: Silica, crystalline

CANADIAN REGULATIONS:
LABELS FOR SUPPLY:



REGULATORY STATUS:

This Material Safety Data Sheet has been prepared in compilance with the Controled Product Regulations.

Canadian WHMIS Classification: D2A - Other Toxic Effects: Very Toxic Material

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX: * 1 Slight Hazard
FLAMMABILITY: 0 Minimal Hazard
REACTIVITY: 0 Minimal Hazard
NPCA HMIS PERS. PROTECT. INDEX: E - Safety Glasses, Gloves, Dust Respirator

USER NOTES: N/A = Not applicable N/D = Not determined

INFORMATION SOURCES:

OSHA Permissible Exposure Limits, 29 CFR 1910, Subpart Z, Section 1910.1000, Air Contaminants.

ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (latest edition).

Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997).

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Silica, Some Silicates, Coal Dust, and para-Aramid Fibrils, Vol. 68, World Health Organization, Lyon, France, 1997.
Product information provided by the commercial vendor(s).

PREPARED BY: Sam Hoskin/bb

REVISION No.: 0

SDS STATUS: Approved.

DATE: June 1, 1999

DISCLAIMER:

SDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditiions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

**Water Well Drilling &
Mineral Exploration Products**

AMERICAN Colloid Company
Water/Mineral Division

Super Gel-X

High Yield Bentonite

DESCRIPTION:

- Super Gel-X is a 200 mesh, high viscosity 200-bbl yield, sodium bentonite for use in all freshwater drilling conditions.

RECOMMENDED USE:

- May be used for all types of freshwater mud rotary drilling.

CHARACTERISTICS:

- Highly concentrated for maximum yield.
- Fast and easy mixing.
- Reduces solids and increases lifting power.
- Removes cuttings.
- Cools and lubricates bit.
- Stabilizes bore holes.

MIXING AND APPLICATION:

- Mixing ratios are based on 200-bbl yield material using freshwater. Level of water purity will affect bentonite performance.

- Super Gel-X mixing ratio in lbs. per 100 gallons of water:

  Normal conditions .... 15 to 25 lbs.
  Sand and gravel .... 25 to 35 lbs.
  Fluid loss controls .... 35 to 40 lbs.

PACKAGING:

- 50 pound, multi-wall, non-tear, waterproof bags, 48 bags per pallet, and all pallets are stretch-wrapped.

1500 W. Shure Drive   Arlington Heights, IL 60004   1434-(3112) 392-4600

The information and data contained herein are believed to be accurate and reliable. American Colloid Company makes no warranty of any kind and accepts no responsibility for the results obtained through this application of this information.

MATERIAL SAFETY DATA SHEET — May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

PRODUCT NAME: SUPER GEL-X™

Section I MANUFACTURER'S INFORMATION

MANUFACTURER'S NAME & ADDRESS: **Date Prepared: June 1, 2002**

CETCO – *Drilling Products Group*
1500 West Shure Drive
Arlington Heights, IL 60004

Telephone Number: 847-392-5800 Fax 847-506.6150
EMERGENCY CONTACT: CHEMTREC 800-424-9300
E-mail: www.cetco.com

Section II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

HAZARDOUS COMPONENTS: (Specific Chemical Identity: Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
Crystalline Quartz: CAS# 14808-60-7			*	< 6%
Respirable Crystalline Quartz:			NIOSH	< 2%
Present (TWA)	0.1 mg/m^3	0.1 mg/m^3	50 ug/m^3	
Proposed (TWA)		50.0 ug/m^3		
Nuisance Dust:				
Respirable	5 mg/m^3	5 mg/m^3		
Total Dust	15 mg/m^3	10 mg/m^3		

*** WARNING:** This product contains a small amount of crystalline silica, which may cause delayed respiratory disease if inhaled over a prolonged period of time. Avoid breathing dust. Use NIOSH/MSHA approved respirator where TLV for crystalline silica (Quartz) may be exceeded. IARC Monographs on the evaluation of the Carcinogenic Risk of Chemicals to Humans (volume 68, 1997) concludes that crystalline silica is carcinogenic to humans in the form of quartz. IARC classification 1.

The small quantities of crystalline silica (quartz) found in this product are, under normal conditions, naturally coated with an unremovable layer of amorphous silica and/or bentonite clay. IARC (vol. 68, 1997, pg. 191-192) has stated that crystalline silica (quartz) can differ in toxicity depending on the minerals with which it is combined, citing studies in IARC (vol. 42, 1987, p. 86) which stated that the toxic effect of crystalline silica (quartz) is reduced by the "protective effect...due mainly to clay minerals..."

National Institute for Occupational Safety and Health (NIOSH) has recommended that the permissible exposure limit be changed to 50 micrograms respirable free silica per cubic meter of air (0.05 mg/ m^3) as determined by a full shift sample up to a 10 hour working day, 40 hours per week. *See*: 1974 NIOSH criteria for a recommended Standard for Occupational Exposure to Crystalline Silica should be consulted for more detailed information.

PEL - OSHA Permissible Exposure Limit.
TLV - American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value.
TWA - 8 hour time weighted average
Note: The Permissible Exposure Limits (PEL) reported above are the pre - 1989 limits that were reinstated by OSHA June 30, 1993 following a decision by the United States Circuit Court of Appeals for the 11th Circuit. Federal OSHA is now enforcing these PELs. More restrictive exposure limits may be enforced by some other jurisdictions.

PRODUCT IDENTIFICATION:
Chemical Name: Dry Mixture of Inorganic Mineral Compounds.
NFPA/HMIS: Health - 2, Fire - 0, Reactivity - 0, Specific Hazard - *See Section VI.*
Shipping Class: Not Regulated (DOT / 49CFR, IMDG, ICAO / IATA).

Section III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point: Not Applicable.
Vapor Pressure (mm Hg.)**:** Not Applicable.
Vapor Density (AIR = 1)**:** Not Applicable.
Solubility in Water: Negligible.
Specific Gravity (H_2O = 1)**:** 2.5
Melting Point: 1400°F
Evaporation Rate (Butyl Acetate = 1)**:** Not Applicable.
Appearance and Odor: Tan or beige to light gray colored powder to fine granules, odorless.

Copyright 2002 CETCO All rights reserved.
CETCO is a wholly owned subsidiary of AMCOL International Corp.

PRODUCT NAME: SUPER GEL-X™

Section IV FIRE AND EXPLOSION HAZARD DATA

Flash Point (*Method Used*)**:** Not Available. **Flammable Limits:** Not Available. **LEL** - NA. **UEL** - NA.
Extinguishing Media: Not Applicable. **Special Fire Fighting Procedure:** Not Applicable.
Unusual Fire/Explosion Hazards: Product may pose possible dust explosion under *extremely rare* circumstances or conditions.

Section V REACTIVITY DATA

Stability: Stable **Conditions to Avoid** - None Known.
Incompatibility (*Materials to Avoid*)**:** Powerful oxidizing agents such as fluorine, chlorine trifluoride, manganese trioxide, etc.
Hazardous Decomposition or By-products: Silica will dissolve in hydrofluoric acid producing a corrosive gas, silicon tetrafluoride.
Hazardous Polymerization: Will Not Occur **Conditions to Avoid** - None Known.

Section VI HEALTH HAZARD DATA

Route(s) of Entry: Inhalation? Yes Skin? No Ingestion? No
Health Hazards (Acute and Chronic):

Inhalation: Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may have the following serious chronic health effects:
Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness and reduced pulmonary function. Smoking exacerbates this disease. Individuals with silicosis are predisposed to develop tuberculosis.
Cancer Status: The International Agency for Research on Cancer has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1 - carcinogenic to humans). Refer to *IARC Monograph 68, Silica, Some Silicates and Organic Fibers* (published in June 1997) in conjunction with the use of these
materials. The National Toxicology Program classifies respirable crystalline silica as "reasonably anticipated to be a carcinogen". For further information *See*: "Adverse effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, page 761-765, 1997.

Other Data with Possible Relevance to Human Health: The small quantities of crystalline silica (quartz) found in this product are, under normal conditions, naturally coated with an unremovable layer of amorphous silica and/or bentonite clay. IARC (Vol. 68, 1997, pg. 191-192) has stated that crystalline silica (quartz) can differ in toxicity depending on the minerals with which it is combined, citing studies in IARC (Vol. 42, 1987 pg. 86) which stated that the toxic effect of crystalline silica (quartz) is reduced by the "protective effect....due mainly to clay minerals..."

Carcinogenicity: NTP? No IARC Monographs? Yes OSHA Regulated? No

Signs and Symptoms of Exposure: Excessive inhalation of generated dust may result in shortness of breath and reduced pulmonary function.

Medical Conditions Generally Aggravated by Exposure: Individuals with respiratory disease, including but not limited to, asthma and bronchitis, or subject to eye irritation should not be exposed to respirable crystalline silica (quartz) dust.

Emergency and First Aid Procedures:
Eyes & Skin: Flush with water.
Gross Inhalation of Dust: Remove to fresh air; give oxygen or artificial respiration if necessary; seek medical attention.
Ingestion: If large amounts are swallowed, get immediate medical attention.

Section VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case Material is Released or Spilled: Vacuum if possible to avoid generating airborne dust. Avoid breathing dust. Wear an approved respirator. Avoid adding water; product will become slippery when wet.
Waste Disposal Method: Bury in an approved sanitary landfill, in accordance with federal, state and local regulations.
Precautions to Be Taken in Handling and Storing: Avoid breathing dust, use NIOSH/MSHA approved respirator where TLV limits for Crystalline Silica may be exceeded.
Other Precautions: Slippery when wet.

1500 W. Shure Dr., Arlington Heights, Illinois 60004 USA / +1 800.527.9948 / tel +1 847.392.5800 / fax +1 847.577.5571
Copyright 2002 CETCO All rights reserved.
CETCO is a wholly owned subsidiary of AMCOL International Corp.

PRODUCT NAME: SUPER GEL-X™

Section VIII CONTROL MEASURES

Respiratory Protection: Use appropriate respiratory protection for respirable particulate based on consideration of airborne workplace concentration and duration of exposure arising from intended end use. Refer to the most recent standards of ANSI (z88.2) OSHA (29 CFR 1910.134), MSHA (30 CFR Parts 56 and 57) and NIOSH Respirator Decision Logic.

Ventilation: Use local exhaust as required to maintain exposures below applicable occupational exposure limits (*See Section II*). See also ACGIH "Industrial Ventilation – A Manual for Recommend Practice", (*current edition*).

Protective Gloves: Not Required. **Eye Protection:** Recommended.

Other Protective Clothing or Equipment: None. **Work/Hygienic Practices:** Use good housekeeping practices.

Section IX REGULATORY INFORMATION

SARA 311/312: Hazard Categories for SARA Section 311/312 Reporting: Chronic Health
SARA 313: This product contains the following chemicals subject to annual release reporting requirements under the SARA section 313 (40 CFR 372): None

CERCLA section 103 Reportable Quantity: None

California Proposition 65: *This product contains the following substances known to the state of California to cause cancer and/or reproductive harm: This product contains crystalline silica (respirable); however, the user should note that the small quantities of crystalline silica (quartz) found in this product are, under normal conditions, naturally coated with an unremovable layer of amorphous silica and/or bentonite clay. IARC (Vol. 68, 1997, pg. 191-192) has stated that crystalline silica (quartz) can differ in toxicity depending on the minerals with which it is combined. Citing studies in IARC (Vol. 42, 1987, p. 86) which stated that the toxic effect of crystalline silica (quartz) is reduced by the "protective effect....due mainly to clay minerals...".*

Toxic Substances Control Act: All of the components of this product are listed on the EPA TSCA Inventory or are exempt from notification requirements.

Canadian Environmental Protection Act: All the components of this product are listed on the Canadian Domestic Substances List or exempt from notification requirements.

European Inventory of Commercial Chemical Substances: All the components of this product are listed on the EINECS Inventory or exempt from notification requirements. (The EINECS number for Quartz: 231-545-5)
European Community Labeling Classification: Harmful (Xn)
European Community Risk and Safety Phrases: R40, R48, S22

Japan MITI: All the components of this product are existing chemical substances as defined in the Chemical Substance Control Law.

Australian Inventory of Chemical Substances: All the components of this product are listed on the AICS Inventory or exempt from notification requirements.

Canadian WHMIS Classification: Class D, Division 2, Subdivision A (Very Toxic Material causing other Toxic Effects)

NF-+PA Hazard Rating:	Health: 2	Fire: 0	Reactivity: 0
HMIS Hazard Rating:	Health: *	Fire: 0	Reactivity: 0

***Warning** - Chronic health effect possible - inhalation of silica dust may cause lung injury/disease (silicosis). Take appropriate measures to avoid breathing dust. *See Section II*.

REFERENCES:

Registry for Toxic Effects of Chemical Substances (RTECS), 1995.

Patty's Industrial Hygiene and Toxicology.

NTP Seventh Annual Report on Carcinogens, 1994.

IARC Monograph Volume 68, Silica, Some Silicates and Organic Fibers, 1997.

The information herein has been compiled from sources believed to be reliable and is accurate to the best of our knowledge. However, CETCO cannot give any guarantees regarding information from other sources, and expressly does not make any warranties, nor assumes any liability, for its use.

1500 W. Shure Dr., Arlington Heights, Illinois 60004 USA / +1 800.527.9948 / tel +1 847.392.5800 / fax +1 847.577.5571
Copyright 2002 CETCO All rights reserved.
CETCO is a wholly owned subsidiary of AMCOL International Corp.

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BARA-KADE® BENTONITE**

Revision Date: 31-Mar-2005

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BARA-KADE® BENTONITE
Synonyms: None
Chemical Family: Mineral
Application: Additive

Manufacturer/Supplier
BPM Minerals LLC
3000 N Sam Houston Parkway East
Houston, TX 77032

Telephone: (281) 871-7900
Fax: (281) 871-7940
Emergency Telephone: (800) 666-9260 or (713) 753-3000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Crystalline silica, cristobalite	14464-46-1	0 - 1%	0.05 mg/m^3	$1/2 \times \frac{10\ mg/m^3}{\%SiO_2 + 2}$
Crystalline silica, tridymite	15468-32-3	0 - 1%	0.05 mg/m^3	$1/2 \times \frac{10\ mg/m^3}{\%SiO_2 + 2}$
Crystalline silica, quartz	14808-60-7	1 - 5%	0.05 mg/m^3	$\frac{10\ mg/m^3}{\%SiO_2 + 2}$
Bentonite	1302-78-9	60 - 100%	Not applicable	Not applicable

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

3. HAZARDS IDENTIFICATION

Hazard Overview	**CAUTION! - ACUTE HEALTH HAZARD** May cause eye and respiratory irritation. **DANGER! - CHRONIC HEALTH HAZARD** Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (SDS) for this product, which has been provided to your employer.

4. FIRST AID MEASURES

Inhalation	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	All standard firefighting media.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.
NFPA Ratings:	Health 0, Flammability 0, Reactivity 0
HMIS Ratings:	Flammability 0, Reactivity 0, Health 0*

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions	This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Storage Information	Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Various
Odor:	Odorless
pH:	8-10
Specific Gravity @ 20 C (Water=1):	2.65
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	50-70
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur

Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure Eye or skin contact, inhalation.

Inhalation

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Skin Contact May cause mechanical skin irritation.

Eye Contact May cause eye irritation.

Ingestion None known

Aggravated Medical Conditions Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: TLM96: 10000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard Chronic Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity For This Product	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	D2A Very Toxic Materials (Crystalline silica)

16. OTHER INFORMATION

The following sections have been revised since the last issue of this SDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF SDS*****

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BARA-KADE® BENTONITE**

Revision Date: 31-Mar-2005

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BARA-KADE® BENTONITE
Synonyms: None
Chemical Family: Mineral
Application: Additive

Manufacturer/Supplier
BPM Minerals LLC
3000 N Sam Houston Parkway East
Houston, TX 77032

Telephone: (281) 871-7900
Fax: (281) 871-7940
Emergency Telephone: (800) 666-9260 or (713) 753-3000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Crystalline silica, cristobalite	14464-46-1	0 - 1%	0.05 mg/m^3	$1/2 \times \frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, tridymite	15468-32-3	0 - 1%	0.05 mg/m^3	$1/2 \times \frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, quartz	14808-60-7	1 - 5%	0.05 mg/m^3	$\frac{10\ mg/m^3}{\%SiO2 + 2}$
Bentonite	1302-78-9	60 - 100%	Not applicable	Not applicable

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

3. HAZARDS IDENTIFICATION

Hazard Overview	**CAUTION! - ACUTE HEALTH HAZARD** May cause eye and respiratory irritation. **DANGER! - CHRONIC HEALTH HAZARD** Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (SDS) for this product, which has been provided to your employer.

4. FIRST AID MEASURES

Inhalation	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	All standard firefighting media.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.
NFPA Ratings:	Health 0, Flammability 0, Reactivity 0
HMIS Ratings:	Flammability 0, Reactivity 0, Health 0*

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions	This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Storage Information	Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Various
Odor:	Odorless
pH:	8-10
Specific Gravity @ 20 C (Water=1):	2.65
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	50-70
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur

Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure Eye or skin contact, inhalation.

Inhalation Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Skin Contact May cause mechanical skin irritation.

Eye Contact May cause eye irritation.

Ingestion None known

Aggravated Medical Conditions Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: TLM96: 10000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard Chronic Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity For This Product	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	D2A Very Toxic Materials (Crystalline silica)

16. OTHER INFORMATION

The following sections have been revised since the last issue of this SDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF SDS*****

ATTACHMENT

DRILLING ADDITIVES / LCMs FOR APPROVAL

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Product Name	Manufacturer	Generic Name	Intended Use	NSF 60 APPROVED?
Platinum PAC	M I Swaco	PAC	Fluid Loss Inhibitor	YES
Platinum PAC UL	M I Swaco	PAC	Fluid Loss Inhibitor	YES
Ringfree	M I Swaco	Thinner	Drill Mud Thinner	YES
Torqmaster	WyoBen, Inc.	Surfactant	Torque reduction / reduce bit balling	NO
Plugz It	WyoBen, Inc.	Proprietary bentonite blend	Lost Circulation Material	YES
Clay Cutter	Cetco	Clay Inhibitor	Inhibit swelling of clay formations	NO
Clay Breaker	DCS Fluids	Clay Inhibitor	Inhibit swelling of clay formations	NO
Torque Breaker	DCS Fluids	Surfactant	Torque reduction / reduce bit balling	NO
Ball Buster	DCS Fluids	SAPP	Reduce bit / reamer balling	YES
Soda Ash	Various	pH Enhancement	Increase pH and reduce hardness of make up water	YES
Sodium Bicarbonate	Various	Calcium Control	Reduce calcium contamination of mud from drilling grout	YES
Citric Acid	Various	pH Reducer	Reduce pH when drilling grout	YES

POTENTIAL ADDITIVIVE

PLATINUM PAC

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

SDS no. 12391
Version 7
Revision date 21/Jul/2014
Supersedes date 20/Dec/2013

Safety Data Sheet
PLATINUM PAC†

1. Identification of the substance/preparation and of the Company/undertaking

1.1 Product identifier

Product name	PLATINUM PAC†
Product code	12391

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended Use	Drilling fluid additive Fluid loss reducer.
Uses advised against	Consumer use

1.3 Details of the supplier of the safety data sheet

Supplier
M-I L.L.C.
P.O.Box 42842
Houston, TX 77242
www.miswaco.slb.com

Prepared by
Global Chemical Regulatory Compliance (GCRC) , Bethicia Prasek

1.4 Emergency Telephone Number

Emergency telephone - (24 Hour) Australia +61 2801 44558, Asia Pacific +65 3158 1074, China +86 10 5100 3039, Europe +44 (0) 1235 239 670, Middle East and Africa +44 (0) 1235 239 671, New Zealand +64 9929 1483, USA 001 281 561 1600
Telephone Number - 281-561-1512

2. Hazards identification

2.1 Classification of the substance or mixture

GHS - Classification

Health hazards	Not classified
Environmental hazards	Not classified

Physical Hazards

Combustible dust	-

2.2 Label elements

Signal word
WARNING

May form combustible dust concentrations in air

Precautionary statements
P240 - Ground/bond container and receiving equipment
P243 - Take precautionary measures against static discharge

P241 - Use explosion-proof electrical/ ventilating/ lighting/ equipment

3. Composition/information on Ingredients

3.1 Substances

Component	CAS-No	Weight % - range
Carboxymethylcellulose sodium salt	9004-32-4	99

3.2 Mixtures

Not Applicable

4. First aid measures

4.1 Description of first-aid measures

Inhalation
If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Ingestion
Rinse mouth. Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Seek medical attention if irritation occurs.

Skin contact
Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes. Get medical attention immediately if symptoms occur.

Eye contact
Promptly wash eyes with lots of water while lifting eye lids. Remove contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

4.2 Most important symptoms and effects, both acute and delayed

General advice
The severity of the symptoms described will vary dependant of the concentration and the length of exposure. If adverse symptoms develop, the casualty should be transferred to hospital as soon as possible.

Main symptoms

Inhalation	Please see Section 11. Toxicological Information for further information.
Ingestion	Please see Section 11. Toxicological Information for further information.
Skin contact	Please see Section 11. Toxicological Information for further information.
Eye contact	Please see Section 11. Toxicological Information for further information.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician Treat symptomatically.

5. Fire-fighting measures

5.1 Extinguishing media

Suitable extinguishing media
Water Fog, Alcohol Foam, CO_2, Dry Chemical.

Extinguishing media which shall not be used for safety reasons
None known.

5.2 Special hazards arising from the substance or mixture

Unusual fire and explosion hazards
Suspended dust may present a dust explosion hazard.

Hazardous combustion products
Carbon oxides (COx).

5.3 Advice for firefighters

Special protective equipment for fire-fighters
As in any fire, wear self-contained breathing apparatus and full protective gear.

Special Fire-Fighting Procedures
Containers close to fire should be removed immediately or cooled with water.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Evacuate personnel to safe areas. Use personal protective equipment. See also section 8. If spilled, take caution, as material can cause surfaces to become very slippery.

6.2 Environmental precautions

The product should not be allowed to enter drains, water courses or the soil.

Environmental exposure controls
Avoid release to the environment.

6.3 Methods and materials for containment and cleaning up

Methods for containment
Prevent further leakage or spillage if safe to do so.

Methods for cleaning up
Sweep up and shovel into suitable containers for disposal. After cleaning, flush away traces with water. Material becomes slippery when wet. Use caution if wet.

6.4 Reference to other sections

See section 13 for more information.

7. Handling and storage

7.1 Precautions for safe handling

Handling
Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin and eyes. Avoid dust formation.

Hygiene measures
Use good work and personal hygiene practices to avoid exposure. Do not eat, drink or smoke when using this product.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/precautions Ensure adequate ventilation. Provide appropriate exhaust ventilation at places where dust is formed. Keep airborne concentrations below exposure limits.

Storage precautions Keep away from open flames, hot surfaces and sources of ignition. Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls/personal protection

8.1 Control parameters

Exposure limits Control as an ACGIH particulate not otherwise specified (PNOS): 10 mg/m^3 (Inhalable); 3 mg/m^3 (Respirable) and an OSHA particulate not otherwise regulated (PNOR): 15 mg/m^3 (Total); 5 mg/m^3 (Respirable).

Component	ACGIH TLV	OSHA PEL
Carboxymethylcellulose sodium salt 9004-32-4 (99)	Not Determined	Not Determined

8.2 Exposure controls

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazard present and the risk of exposure to those hazards. The PPE recommendations below are based on an assessment of the chemical hazards associated with this product. Where this product is used in a mixture with other products or fluids, additional hazards may be created and as such further assessment of risk may be required. The risk of exposure and need of respiratory protection will vary from workplace to workplace and should be assessed by the user in each situation.

Engineering measures to reduce exposure
Ensure adequate ventilation.

Personal protective equipment

Eye protection It is good practice to wear goggles when handling any chemical. Tightly fitting safety goggles.

Hand protection Wear chemical resistant gloves such as nitrile or neoprene.

Respiratory protection	All respiratory protection equipment should be used within a comprehensive respiratory protection program that meets the requirements of 29 CFR 1910.134 (U.S. OSHA Respiratory Protection Standard) or local equivalent. If exposed to airborne mist/aerosol of this product, use at least a NIOSH-approved N95 half-mask disposable or re-usable particulate respirator. In work environments containing oil mist/aerosol, use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator. If exposed to vapors from this product use a NIOSH/MSHA-approved respirator with an Organic Vapor cartridge.
Skin and body protection	Wear suitable protective clothing.
Hygiene measures	Wash hands before eating, drinking or smoking, Remove and wash contaminated clothing before re-use.

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	Solid powder
Appearance	Opaque
Odor	Mild Odorless
Color	Off-white - Tan
Odor threshold	Not applicable

Property	Values	Remarks
pH	No information available	
pH @ dilution	6.5-8.0 @ 1% in H2O	
Melting/freezing point		
Boiling point/range	No information available	
Flash point	Does not flash	
Evaporation rate (BuAc =1)		
Flammability (solid, gas)	Not Applicable	
Flammability Limits in Air		
Upper flammability limit	Not applicable	
Lower flammability limit	Not applicable	
Vapor pressure	0 mmHg	
Vapor density	Not applicable	
Specific gravity	1.5 - 1.6	
Bulk density	No information available	
Relative density	No information available	
Water solubility	Gels on contact with water	
Solubility in other solvents	No information available	
Autoignition temperature	No information available	
Decomposition temperature	No information available	
Kinematic viscosity	No information available	
Dynamic viscosity	No information available	
Log Pow	Not determined	
Explosive properties	Not Applicable	
Oxidizing properties	None known.	

9.2 Other information

Pour point	No information available
Molecular weight	No information available
VOC content(%)	None
Density	No information available

10. Stability and reactivity

10.1 Reactivity

No specific reactivity hazards associated with this product.

10.2 Chemical stability

Stable under normal temperature conditions and recommended use.

10.3 Possibility of Hazardous Reactions

Hazardous polymerization
Hazardous polymerization does not occur.

Hazardous Reactions
None known.

10.4 Conditions to avoid

Heat, flames and sparks.

10.5 Incompatible materials

Strong oxidizing agents.

10.6 Hazardous decomposition products

Carbon oxides (COx).

11. Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Inhalation Inhalation of dust may cause shortness of breath, tightness of the chest, a sore throat and cough.

Eye contact Dust may cause mechanical irritation.

Skin contact Repeated exposure may cause skin dryness or cracking.

Ingestion Irritant; may cause pain or discomfort to mouth, throat and stomach.

Acute toxicity 0% of the mixture consists of ingredient(s) of unknown toxicity.

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Carboxymethylcellulose sodium salt	= 27000 mg/kg (Rat)	> 2 g/kg (Rabbit)	> 5800 mg/m³ (Rat) 4 h

Sensitization This product does not contain any components suspected to be sensitizing.

Mutagenic effects This substance has no evidence of mutagenic properties.

Carcinogenicity This substance has no evidence of carcinogenic properties.

Reproductive toxicity	None known.
Developmental toxicity	Not known to cause birth defects or have a deleterious effect on a developing fetus.
Routes of exposure	Inhalation. Skin contact. Eye contact.
Routes of entry	None known.
Specific target organ toxicity (single exposure)	Not classified
Specific target organ toxicity (repeated exposure)	Not classified.
Aspiration hazard	Not Applicable.

12. Ecological information

12.1 Toxicity

Toxicity to algae
See component information below.

Toxicity to fish
See component information below.

Toxicity to daphnia and other aquatic invertebrates
See component information below.

Component	Toxicity to fish	Toxicity to algae	Toxicity to daphnia and other aquatic invertebrates
Carboxymethylcellulose sodium salt	No information available	No information available	No information available

12.2 Persistence and degradability

No product level data available.

12.3 Bioaccumulative potential

No data available.

12.4 Mobility in soil

No information available.

12.5 Results of PBT and vPvB assessment

This substance is not considered to be persistent, bioaccumulating or toxic (PBT)
This substance is not considered to be very persistent nor very bioaccumulating (vPvB)

12.6 Other adverse effects.

None known. Check for additional information in sect. 7.

13. Disposal considerations

13.1 Waste treatment methods

Waste from residues / unused products	Dispose of in accordance with local regulations.
Contaminated packaging	Empty containers should be taken for local recycling, recovery or waste disposal.

14. Transport information

14.1 UN Number

UN/ID No. (ADR/RID/ADN/ADG)	Not regulated
UN No. (IMDG)	Not regulated
UN No. (ICAO)	Not regulated
UN No. (DOT)	Not regulated

14.2 Proper shipping name

Not regulated for transportation by DOT, TDG, IMDG and ICAO/IATA.

14.3 Hazard class(es)

ADR/RID/ADN Hazard class	Not regulated
IMDG Hazard class	Not regulated
ICAO Hazard class/division	Not regulated
DOT Hazard class	Not regulated

14.4 Packing group

ADR/RID/ADN Packing Group	Not regulated
IMDG Packing group	Not regulated
ICAO Packing group	Not regulated
DOT Packing group	Not regulated

14.5 Environmental hazard

No

14.6 Special precautions

Not Applicable

15. Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

International inventories

USA (TSCA)	Complies
European Union (EINECS and ELINCS)	Complies
Canada (DSL)	Complies
Philippines (PICCS)	Complies
Japan (ENCS)	Complies
China (IECSC)	Complies
Australia (AICS)	Complies
Korean (KECL)	Complies
New Zealand (NZIoC)	Complies

U.S. Federal and State Regulations

SARA 311/312 Hazard Catagories Not a SARA 311/312 hazard.

SARA 302/304, 313, CERCLA RQ, California Proposition 65
Note: If no components are listed below, this product is not subject to the referenced SARA and CERCLA regulations and is not known to contain a Proposition 65 listed chemical at a level that is expected to pose a significant risk under anticipated use conditions.

This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class Not a controlled product.

16. Other information

Supersedes date	20/Dec/2013
Revision date	21/Jul/2014
Version	7
The following sections have been revised	All sections.

HMIS classification

Health	0
Flammability	1
Physical hazard	0
PPE	E

N/A - Not Applicable, N/D - Not Determined.

†A mark of M-I L.L.C.

Disclaimer
The information provided in this Material Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

MICHELS®

POTENTIAL ADDITIVIVE

PLATINUM PAC UL

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

SDS no. 12481
Version 4
Revision date 08/Jan/2015
Supersedes date 14/Feb/2012

Safety Data Sheet
PLATINUM PAC† UL

1. Identification

1.1 Product identifier

Product name PLATINUM PAC† UL

Product code 12481

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Drilling fluid additive.

Uses advised against Consumer use

1.3 Details of the supplier of the safety data sheet

Supplier
M-I L.L.C.
P.O.Box 42842
Houston, TX 77242
www.miswaco.slb.com

Prepared by
Global Chemical Regulatory Compliance (GCRC) , Bethicia Prasek

1.4 Emergency Telephone Number

Emergency telephone (24 Hour) Australia +61 2801 44558, Asia Pacific +65 3158 1074, China +86 10 5100 3039, Europe +44 (0) 1235 239 670, Middle East and Africa +44 (0) 1235 239 671, New Zealand +64 9929 1483, USA 001 281 561 1600
Telephone Number - 281-561-1511

2. Hazards identification

2.1 Classification of the substance or mixture

GHS - Classification

Health hazards Not classified

Environmental hazards Not classified

Physical Hazards

Combustible dust	-

2.2 Label elements

Signal word
WARNING

May form combustible dust concentrations in air

Precautionary statements
P240 - Ground/bond container and receiving equipment
P243 - Take precautionary measures against static discharge

P241 - Use explosion-proof electrical/ ventilating/ lighting/ equipment

Unknown acute toxicity 0% of the mixture consists of ingredient(s) of unknown toxicity.

3. Composition/information on Ingredients

3.1 Substances

Not Applicable

3.2 Mixtures

Component	CAS-No	Weight % - range
Carbohydrate	Proprietary	60 - 100

Comments
The exact percentage (concentration) of composition has been withheld as a trade secret

4. First aid measures

4.1 First-Aid Measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Ingestion Rinse mouth. Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Seek medical attention if irritation occurs.

Skin contact Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes. Get medical attention immediately if symptoms occur.

Eye contact Promptly wash eyes with lots of water while lifting eye lids. Remove contact lenses. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

4.2 Most important symptoms and effects, both acute and delayed

General advice The severity of the symptoms described will vary dependant of the concentration and the length of exposure. If adverse symptoms develop, the casualty should be transferred to hospital as soon as possible.

Main symptoms

Inhalation Please see Section 11. Toxicological Information for further information.

Ingestion Please see Section 11. Toxicological Information for further information.

Skin contact Please see Section 11. Toxicological Information for further information.

Eye contact Please see Section 11. Toxicological Information for further information.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician Treat symptomatically

5. Fire-fighting measures

5.1 Extinguishing media

Suitable extinguishing media
Water Fog, Alcohol Foam, CO_2, Dry Chemical.

Extinguishing media which shall not be used for safety reasons
None known.

5.2 Special hazards arising from the substance or mixture

Unusual fire and explosion hazards
Suspended dust may present a dust explosion hazard.

Hazardous combustion products
Carbon oxides (COx).

5.3 Advice for firefighters

Special protective equipment for fire-fighters
As in any fire, wear self-contained breathing apparatus and full protective gear.

Special Fire-Fighting Procedures
Containers close to fire should be removed immediately or cooled with water.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Evacuate personnel to safe areas. Use personal protective equipment. See also section 8. If spilled, take caution, as material can cause surfaces to become very slippery.

6.2 Environmental precautions

As local regulations may vary; all waste must be disposed/recycled/reclaimed in accordance with federal, state, and local environmental control regulations.

Environmental exposure controls
Avoid dust formation.

6.3 Methods and materials for containment and cleaning up

Methods for containment
Prevent further leakage or spillage if safe to do so.

Methods for cleaning up
Sweep up and shovel into suitable containers for disposal. After cleaning, flush away traces with water. Material becomes slippery when wet. Use caution if wet.

6.4 Reference to other sections

See section 13 for more information.

7. Handling and storage

7.1 Precautions for safe handling

Handling
Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin and eyes. Avoid dust formation.

Hygiene measures
Use good work and personal hygiene practices to avoid exposure. Do not eat, drink or smoke when using this product.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/precautions
Ensure adequate ventilation. Provide appropriate exhaust ventilation at places where dust is formed. Keep airborne concentrations below exposure limits.

Storage precautions
Keep away from open flames, hot surfaces and sources of ignition. Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls/personal protection

8.1 Control parameters

Exposure limits
Control as an ACGIH particulate not otherwise specified (PNOS): 10 mg/m³ (Inhalable); 3 mg/m³ (Respirable) and an OSHA particulate not otherwise regulated (PNOR): 15 mg/m³ (Total); 5 mg/m³ (Respirable).

Component	ACGIH TLV	OSHA PEL
Carbohydrate	Not Determined	Not Determined

8.2 Exposure controls

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazard present and the risk of exposure to those hazards. The PPE recommendations below are based on an assessment of the chemical hazards associated with this product. Where this product is used in a mixture with other products or fluids, additional hazards may be created and as such further assessment of risk may be required. The risk of exposure and need of respiratory protection will vary from workplace to workplace and should be assessed by the user in each situation.

Engineering measures to reduce exposure
Ensure adequate ventilation.

Personal protective equipment

Eye protection	Tightly fitting safety goggles.
Hand protection	Wear chemical resistant gloves such as nitrile or neoprene.
Respiratory protection	All respiratory protection equipment should be used within a comprehensive respiratory protection program that meets the requirements of 29 CFR 1910.134 (U.S. OSHA Respiratory Protection Standard) or local equivalent. If exposed to airborne mist/aerosol of this product, use at least a NIOSH-approved N95 half-mask disposable or re-usable particulate respirator. In work environments containing oil mist/aerosol, use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator. If exposed to vapors from this product use a NIOSH/MSHA-approved respirator with an Organic Vapor cartridge.
Skin and body protection	Wear suitable protective clothing.
Hygiene measures	Wash hands before eating, drinking or smoking, Remove and wash contaminated clothing before re-use.

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	Solid powder
Appearance	Opaque
Odor	Mild Odorless
Color	White - Yellow
Odor threshold	Not applicable

Property	Values	Remarks
pH		
pH @ dilution	6.5-8.5 @ 1% in H2O	
Melting/freezing point		
Boiling point/range	No information available	
Flash point	Does not flash	
Evaporation rate (BuAc =1)	No information available	
Flammability (solid, gas)	Not Applicable	
Flammability Limits in Air		
Upper flammability limit	No information available	
Lower flammability limit	No information available	
Vapor pressure	0 mmHg	
Vapor density	Not applicable	
Specific gravity	0.3 - 0.5	
Bulk density	No information available	
Water solubility	Soluble in water	
Solubility in other solvents	No information available	
Autoignition temperature	No information available	
Decomposition temperature	No information available	
Kinematic viscosity	No information available	
Dynamic viscosity	No information available	
Log Pow	Not determined	
Explosive properties	Not Applicable	
Oxidizing properties	None known.	

9.2 Other information

Pour point	No information available
Molecular weight	No information available

VOC content(%) None
Density No information available

10. Stability and reactivity

10.1 Reactivity

No specific reactivity hazards associated with this product.

10.2 Chemical stability

Stable under normal temperature conditions and recommended use.

10.3 Possibility of Hazardous Reactions

Hazardous polymerization
Hazardous polymerization does not occur.

Hazardous Reactions
None known.

10.4 Conditions to avoid

Heat, flames and sparks.

10.5 Incompatible materials

Strong oxidizing agents.

10.6 Hazardous decomposition products

Carbon oxides (COx).

11. Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Inhalation Inhalation of dust may cause shortness of breath, tightness of the chest, a sore throat and cough.

Eye contact Dust may cause mechanical irritation.

Skin contact Repeated exposure may cause skin dryness or cracking.

Ingestion Irritant; may cause pain or discomfort to mouth, throat and stomach.

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Carbohydrate	= 27000 mg/kg (Rat)	> 2 g/kg (Rabbit)	> 5800 mg/m³ (Rat) 4 h

Component	IARC Group 1 or 2	ACGIH - Carcinogens	OSHA listed carcinogens	NTP
Carbohydrate	No data available	No data available	No data available	No data available

Sensitization This product does not contain any components suspected to be sensitizing.

Mutagenic effects This substance has no evidence of mutagenic properties.

Carcinogenicity	This substance has no evidence of carcinogenic properties.
Reproductive toxicity	None known.
Developmental toxicity	Not known to cause birth defects or have a deleterious effect on a developing fetus.
Routes of exposure	Inhalation. Skin contact. Eye contact.
Routes of entry	None known.
Specific target organ toxicity (single exposure)	Not classified
Specific target organ toxicity (repeated exposure)	Not classified.
Aspiration hazard	Not Applicable.

12. Ecological information

12.1 Toxicity

Toxicity to algae
See component information below.

Toxicity to fish
See component information below.

Toxicity to daphnia and other aquatic invertebrates
See component information below.

Component	Toxicity to fish	Toxicity to algae	Toxicity to daphnia and other aquatic invertebrates
Carbohydrate (60 - 100)	No information available	No information available	No information available

12.2 Persistence and degradability

No product level data available.

12.3 Bioaccumulative potential

No data available.

12.4 Mobility in soil

No information available.

12.5 Results of PBT and vPvB assessment

This substance is not considered to be persistent, bioaccumulating or toxic (PBT)
This substance is not considered to be very persistent nor very bioaccumulating (vPvB)

12.6 Other adverse effects.

None known.

13. Disposal considerations

13.1 Waste treatment methods

Disposal Method	Disposal should be made in accordance with federal, state and local regulations.
Contaminated packaging	Empty containers should be taken for local recycling, recovery or waste disposal.

14. Transport information

14.1 UN Number

UN/ID No. (ADR/RID/ADN/ADG)	Not regulated
UN No. (IMDG)	Not regulated
UN No. (ICAO)	Not regulated
UN No. (DOT)	Not regulated

14.2 Proper shipping name

Not regulated for transportation by DOT, TDG, IMDG and ICAO/IATA.

14.3 Hazard class(es)

ADR/RID/ADN Hazard class	Not regulated
IMDG Hazard class	Not regulated
ICAO Hazard class/division	Not regulated
DOT Hazard class	Not regulated

14.4 Packing group

ADR/RID/ADN Packing Group	Not regulated
IMDG Packing group	Not regulated
ICAO Packing group	Not regulated
DOT Packing group	Not regulated

Marine pollutant
No

14.6 Special precautions

Not Applicable

15. Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

International inventories

USA (TSCA)	Complies
European Union (EINECS and ELINCS)	Complies
Canada (DSL)	Complies
Philippines (PICCS)	Complies
Japan (ENCS)	Complies

China (IECSC)	Complies
Australia (AICS)	Complies
Korean (KECL)	Complies
New Zealand (NZIoC)	Complies

U.S. Federal and State Regulations

SARA 311/312 Hazard Categories
Not a SARA 311/312 hazard.

SARA 302/304, 313, CERCLA RQ, California Proposition 65
Note: If no components are listed below, this product is not subject to the referenced SARA and CERCLA regulations and is not known to contain a Proposition 65 listed chemical at a level that is expected to pose a significant risk under anticipated use conditions.

Component	SARA 302 / TPQs	SARA 313	CERCLA RQ
Carbohydrate	N/A	N/A	N/A

State Comments
Proposition 65: This product is not known to contain chemicals considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 as causing cancer and/or reproductive toxicity at levels that are expected to pose a significant risk under anticipated use conditions.

Canadian Classification

This product has been classified in accordance with the hazard criteria of the CPR and the SDS contains all the information required by the CPR.

WHMIS Hazard Class Not a controlled product.

16. Other information

Supersedes date 14/Feb/2012

Revision date 08/Jan/2015

Version 4

The following sections have been revised All sections. Updated according to GHS/CLP.

HMIS classification

Health	0
Flammability	1
Physical hazard	0
PPE	E

N/A - Not Applicable, N/D - Not Determined.

†A mark of M-I L.L.C.

Disclaimer

The information contained herein is considered in good faith as reliable of the date issued and is based upon on measurements, tests or data derived from supplier's own study or furnished by others. In providing this SDS information, Supplier makes no express or implied warranties as to the information or product; merchantability or fitness of purpose; any express or implied warranty; or non-infringement of intellectual property rights; and supplier assumes no responsibility for any direct, special or consequential damages, results obtained, or the activities of others. To the maximum extent permitted by law, supplier's warranty obligations and buyer's sole remedies are as stated in separate agreement between the parties.

POTENTIAL ADDITIVIVE

RING FREE

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

SDS no. 12003
Version 3
Revision date 24/Jul/2014
Supersedes date 27/Dec/2013

Safety Data Sheet
RINGFREE†

1. Identification of the substance/preparation and of the Company/undertaking

1.1 Product identifier

Product name RINGFREE†
Product code 12003

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Drilling fluid additive

Uses advised against Consumer use

1.3 Details of the supplier of the safety data sheet

Supplier
M-I L.L.C.
P.O.Box 42842
Houston, TX 77242
www.miswaco.slb.com

Prepared by
Global Chemical Regulatory Compliance (GCRC) , Mike McDowell

1.4 Emergency Telephone Number

Emergency telephone - (24 Hour) Australia +61 2801 44558, Asia Pacific +65 3158 1074, China +86 10 5100 3039, Europe +44 (0) 1235 239 670, Middle East and Africa +44 (0) 1235 239 671, New Zealand +64 9929 1483, USA 001 281 561 1600
Telephone Number - 281-561-1512

2. Hazards identification

2.1 Classification of the substance or mixture

GHS - Classification

Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Health hazards Not classified

Environmental hazards Not classified

Physical Hazards Not classified

2.2 Label elements

Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)
Hazard statements
None

Precautionary statements
None

-

3. Composition/information on Ingredients

3.1 Substances

Not Applicable

3.2 Mixtures

Not Applicable

Comments
No classified ingredients, or those having occupational exposure limits, present above the level of disclosure.

4. First aid measures

4.1 Description of first-aid measures

Inhalation	If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
Ingestion	Rinse mouth. Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person. Get medical attention if symptoms occur.
Skin contact	Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes. Get medical attention immediately if symptoms occur.
Eye contact	Remove contact lenses. Promptly wash eyes with lots of water while lifting eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

4.2 Most important symptoms and effects, both acute and delayed

General advice	The severity of the symptoms described will vary dependant of the concentration and the length of exposure. If adverse symptoms develop, the casualty should be transferred to hospital as soon as possible.
Main symptoms	
Inhalation	Please see Section 11. Toxicological Information for further information.
Ingestion	Please see Section 11. Toxicological Information for further information.
Skin contact	Please see Section 11. Toxicological Information for further information.
Eye contact	Please see Section 11. Toxicological Information for further information.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician Treat symptomatically.

5. Fire-fighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use extinguishing media appropriate for surrounding material.

Extinguishing media which shall not be used for safety reasons
None known.

5.2 Special hazards arising from the substance or mixture

Unusual fire and explosion hazards
None known.

Hazardous combustion products
Carbon oxides (COx).

5.3 Advice for firefighters

Special protective equipment for fire-fighters
As in any fire, wear self-contained breathing apparatus and full protective gear.

Special Fire-Fighting Procedures
Containers close to fire should be removed immediately or cooled with water.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. See also section 8.

6.2 Environmental precautions

The product should not be allowed to enter drains, water courses or the soil.

Environmental exposure controls
Avoid release to the environment.

6.3 Methods and materials for containment and cleaning up

Methods for containment
Prevent further leakage or spillage if safe to do so. Dike far ahead of liquid spill for later disposal.

Methods for cleaning up
Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. After cleaning, flush away traces with water.

6.4 Reference to other sections

See section 13 for more information.

7. Handling and storage

7.1 Precautions for safe handling

Handling
Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin and eyes. Do not breathe vapors or spray mist. Avoid spills and splashing during use.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/precautions	Ensure adequate ventilation. Keep airborne concentrations below exposure limits.
Storage precautions	Keep containers tightly closed in a dry, cool and well-ventilated place.
Packaging material	Use specially constructed containers only

8. Exposure controls/personal protection

8.1 Control parameters

Exposure limits The product does not contain any hazardous materials with occupational exposure limits established.

8.2 Exposure controls

All chemical Personal Protective Equipment (PPE) should be selected based on an assessment of both the chemical hazard present and the risk of exposure to those hazards. The PPE recommendations below are based on an assessment of the chemical hazards associated with this product. Where this product is used in a mixture with other products or fluids, additional hazards may be created and as such further assessment of risk may be required. The risk of exposure and need of respiratory protection will vary from workplace to workplace and should be assessed by the user in each situation.

Engineering measures to reduce exposure
Ensure adequate ventilation.

Personal protective equipment

Eye protection	It is good practice to wear goggles when handling any chemical. Tightly fitting safety goggles.
Hand protection	Wear chemical resistant gloves such as nitrile or neoprene.
Respiratory protection	No personal respiratory protective equipment normally required, In case of insufficient ventilation wear suitable respiratory equipment.
Skin and body protection	Wear suitable protective clothing, Provide eyewash station.
Hygiene measures	Wash hands before eating, drinking or smoking, Remove and wash contaminated clothing before re-use.

9. Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	Liquid
Appearance	Transparent
Odor	Mild
Color	Light yellow
Odor threshold	Not applicable

Property	Values	Remarks
pH	6 - 8	

pH @ dilution	
Melting/freezing point	
Boiling point/range	90 °C / 194 °F
Flash point	No information available
Evaporation rate (BuAc =1)	
Flammability (solid, gas)	Not Applicable
Flammability Limits in Air	
Upper flammability limit	Not applicable
Lower flammability limit	Not applicable
Vapor pressure	No information available
Vapor density	No information available
Specific gravity	1.27
Bulk density	No information available
Relative density	No information available
Water solubility	Slightly soluble in water.
Solubility in other solvents	No information available
Autoignition temperature	No information available
Decomposition temperature	No information available
Kinematic viscosity	No information available
Dynamic viscosity	No information available
Log Pow	Does not bioaccumulate
Explosive properties	No information available
Oxidizing properties	No information available

9.2 Other information

Pour point	No information available
Molecular weight	No information available
VOC content(%)	No information available
Density	No information available

10. Stability and reactivity

10.1 Reactivity

No specific reactivity hazards associated with this product.

10.2 Chemical stability

Stable under normal temperature conditions and recommended use.

10.3 Possibility of Hazardous Reactions

Hazardous polymerization
Hazardous polymerization does not occur.

10.4 Conditions to avoid

None known.

10.5 Incompatible materials

Strong oxidizing agents.

10.6 Hazardous decomposition products

Carbon oxides (COx).

11. Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Inhalation	Inhalation of vapors in high concentration may cause irritation of respiratory system.
Eye contact	May cause slight irritation.
Skin contact	Prolonged contact may cause redness and irritation.
Ingestion	Ingestion may cause stomach discomfort.
Acute toxicity	0% of the mixture consists of ingredient(s) of unknown toxicity.

Sensitization	This product does not contain any components suspected to be sensitizing.
Mutagenic effects	No evidence of mutagenic properties.
Carcinogenicity	No evidence of carcinogenic properties.
Reproductive toxicity	No evidence of toxicity to reproduction.
Developmental toxicity	Not known to cause birth defects or have a deleterious effect on a developing fetus.
Routes of exposure	Eye contact. Skin contact. Inhalation.
Routes of entry	No route of entry noted.
Specific target organ toxicity (single exposure)	Not classified
Specific target organ toxicity (repeated exposure)	Not classified.
Aspiration hazard	Not Applicable.

12. Ecological information

12.1 Toxicity

Toxicity to algae
See component information below.

Toxicity to fish
See component information below.

Toxicity to daphnia and other aquatic invertebrates
See component information below.

12.2 Persistence and degradability

No product level data available.

12.3 Bioaccumulative potential

No data available.

12.4 Mobility in soil

No information available.

12.5 Results of PBT and vPvB assessment

This preparation contains no substance considered to be persistent, bioaccumulating nor toxic (PBT)
This preparation contains no substance considered to be very persistent nor very bioaccumulating (vPvB)

12.6 Other adverse effects.

None known.

13. Disposal considerations

13.1 Waste treatment methods

Waste from residues / unused products	Dispose of in accordance with local regulations.
Contaminated packaging	Empty containers should be taken for local recycling, recovery or waste disposal.

14. Transport information

14.1 UN Number

UN/ID No. (ADR/RID/ADN/ADG)	Not regulated
UN No. (IMDG)	Not regulated
UN No. (ICAO)	Not regulated
UN No. (DOT)	Not regulated

14.2 Proper shipping name

Not regulated for transportation by DOT, TDG, IMDG and ICAO/IATA.

14.3 Hazard class(es)

ADR/RID/ADN Hazard class	Not regulated
IMDG Hazard class	Not regulated
ICAO Hazard class/division	Not regulated
DOT Hazard class	Not regulated

14.4 Packing group

ADR/RID/ADN Packing Group	Not regulated
IMDG Packing group	Not regulated
ICAO Packing group	Not regulated
DOT Packing group	Not regulated

14.5 Environmental hazard

No

14.6 Special precautions
Not Applicable

15. Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

International inventories

USA (TSCA)	Complies
European Union (EINECS and ELINCS)	Does not Comply
Canada (DSL)	Complies
Philippines (PICCS)	Complies
Japan (ENCS)	Complies
China (IECSC)	Complies
Australia (AICS)	Complies
Korean (KECL)	Complies
New Zealand (NZIoC)	Complies

IMPORTS, Canada
No import volume restrictions.

U.S. Federal and State Regulations

SARA 311/312 Hazard Catagories Not a SARA 311/312 hazard.

State Comments
Proposition 65: This product is not known to contain chemicals considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 as causing cancer and/or reproductive toxicity at levels that are expected to pose a significant risk under anticipated use conditions.

This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class Not a controlled product.

16. Other information

Supersedes date	27/Dec/2013
Revision date	24/Jul/2014
Version	3
The following sections have been revised	All sections. Updated according to GHS.

Health	0
Flammability	1
Physical hazard	0
PPE	E

Disclaimer

The information provided in this Material Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

POTENTIAL ADDITIVIVE

TORQMASTER

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

WYO-BEN, INC.

SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product identifier

Product Code	25392
Product Name	**TORQMASTER®**

Other means of identification

Recommended use of the chemical and restrictions on use
Use only for the purpose on the product label.

Details of the supplier of the safety data sheet

Manufacturer / Manufactured For
WYO-BEN
1345 Discovery Dr
Billings, Montana 59102
Phone: 406-652-6351
Emergency telephone number
24 Hour Emergency Phone Number: 1-800-535-5053

2. HAZARDS IDENTIFICATION

This product is not classified according to paragraph (d) of 29 CFR 1910.1200 and does not require a hazard warning label.

Hazard Classification

Acute aquatic toxicity	Category 3
Chronic aquatic toxicity	Category 3

Signal Word
None

Hazard Statements
Harmful to aquatic life with long lasting effects

Hazard Symbol
None

Precautionary Statements - Prevention
Avoid release to the environment.

Precautionary Statements - Response
Specific Treatment (See Section 4 on the SDS).
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.
IF ON SKIN: Wash with plenty of soap and water. Wash contaminated clothing before reuse.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting. Drink plenty of water.

Precautionary Statements – Storage
Keep out of reach of children.

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant.

Hazards not otherwise classified (HNOC)
Other Information

Unknown Acute Toxicity — 0.06% of the mixture consists of ingredient(s) of unknown toxicity.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Weight-%	Trade Secret
PROPRIETARY	Proprietary	1-5	*
Sodium Carbonate	497-19-8	1-5	*

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

First aid measures

Skin Contact — Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Wash contaminated clothing before reuse. If skin irritation persists, call a physician.

Eye contact — Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. If irritation persists, call a physician.

Inhalation — If mists/vapors are formed or irritation occurs, leave area and do not return until mists/vapors have dissipated. If irritation persists, see a physician.

Ingestion — Rinse mouth. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Drink plenty of water. If irritation persists, see a physician.

Most important symptoms and effects, both acute and delayed

Symptoms — No Information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians — Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media
Caution: Use of water spray when fighting fire may be inefficient.

Specific hazards arising from the chemical
No Information available.

Explosion data
Sensitivity to Mechanical Impact None
Sensitivity to Static Discharge None

Protective equipment and precautions for firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA **Health Hazard 0** **Fire Hazard 0** **Reactivity 0**

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions	Ensure adequate ventilation, especially in confined areas.

Environmental precautions

Environmental precautions	See Section 12 for additional ecological information.

Methods and material for containment and cleaning up

Methods for containment	Prevent further leakage or spillage if safe to do so.
Methods for cleaning up	Soak up with inert absorbent material. Pick up and transfer to properly labeled containers.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling	Handle in accordance with good industrial hygiene and safety practice.

Conditions for safe storage, including any incompatibilities

Storage Conditions	Keep containers tightly closed in a dry, cool and well-ventilated place.
Incompatible materials	None known based on information supplied.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines	This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Appropriate engineering controls

Engineering Controls	Showers, Eyewash stations & Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin and body protection	Wear chemical resistant gloves.
Respiratory protection	If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators or air purifying respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.
General Hygiene	Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Viscous Liquid
Appearance	Pink, Dark
Odor	Mild
Odor threshold	No Information available

Property	Values
pH	9.5 - 11.5
Specific Gravity	1.01
Viscosity	No Information available
Melting point/freezing point	No Information available
Boiling point / boiling range	> 212 / ° F Degrees
Flash point	> 212 / ° F Degrees
Evaporation rate	No Information available
Flammability (solid, gas)	No Information available
Upper flammability limit:	No Information available
Lower flammability limit:	No Information available
Vapor pressure	No Information available
Vapor density	No Information available
Bulk Density Lbs/Gal	No Information available
Water solubility	Complete
Partition Coefficient (n-octanol/water)	No Information available
Autoignition temperature	No Information available
Decomposition temperature	No Information available
VOC Content (%)	No Information available

10. STABILITY AND REACTIVITY

Reactivity
No data available

Chemical stability
Stable under recommended storage conditions.

Possibility of Hazardous Reactions
None under normal processing.

Conditions to avoid
Extremes of temperature and direct sunlight.

Incompatible materials
None known based on information supplied.

Hazardous Decomposition Products
None known based on information supplied.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information No data available

Inhalation No data available.

Eye contact No data available.

Skin Contact No data available.

Ingestion No data available.

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Sodium Carbonate 497-19-8	= 4090 mg/kg (Rat)	-	= 2300 mg/m^3 (Rat) 2 h

Information on toxicological effects

Symptoms No Information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization	No Information available.
Germ cell mutagenicity	No Information available.
Carcinogenicity	No Information available.
Reproductive toxicity	No Information available.
STOT - single exposure	No Information available.
STOT - repeated exposure	No Information available.
Aspiration hazard	No Information available.

Numerical measures of toxicity - Product Information

Unknown Acute Toxicity 0.05% of the mixture consists of ingredient(s) of unknown toxicity.
This is based upon values calculated per chapter 3.1 of the GHS document.

12. ECOLOGICAL INFORMATION

Ecotoxicity

0.05% of the mixture consists of components(s) of unknown hazards to the aquatic environment

Chemical Name	Algae/aquatic plants	Fish	Crustacea
PROPRIETARY	-	LC50 Oncorhynchus mykiss, 96 hr.,1.2 mg/L:	LC50 Daphnia sp., 48 hr., 5.3 mg/L
Sodium Carbonate 497-19-8	EC 50 Nitzschia sp.,120 hr.,242 mg/L	LC 50 Lepomis macrochirus, 96 hr., 300 mg/L static LC50 Pimephales promelas, 96 hr., 310 - 1220 mg/L., static	EC50 Daphnia magna, 48 hr., 265 mg/L

Persistence and degradability
No Information available.

Bioaccumulation
No Information available.

Other adverse effects No Information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes Disposal should be in accordance with applicable regional, national and local laws and regulations.

Contaminated packaging Do not reuse container.

This product contains one or more substances that are listed with the State of California as a hazardous waste.

Chemical Name	California Hazardous Waste Status
Sodium Carbonate 497-19-8	Corrosive

14. TRANSPORT INFORMATION

The shipping classification information in this section (Section 14) is meant as a guide to the overall classification of the product. However, transportation classifications may be subject to change with changes in package size. Consult shipper requirements under 49 CFR, IATA and IMDG to assure regulatory compliance.

DOT Not regulated

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Does not comply
ENCS	Does not comply
IECSC	Does not comply
KECL	Does not comply
PICCS	Does not comply
AICS	Does not comply

Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory.
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List.
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances.
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

US Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Acute health hazard	No
Chronic Health Hazard	No
Fire hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

CWA (Clean Water Act)
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations
This product does not contain chemicals subject to Right-To-Know regulations in other states.

U.S. EPA Label Information
EPA Pesticide Registration Number Not Applicable

16. OTHER INFORMATION

Prepared	12/17/2019
Last Revision	01/17/2020

DISCLAMER

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. No warranty or guarantee, expressed or implied is made by WYO-BEN, INC. as to this information, or as to the safety, toxicity or effect of the use of this product.

POTENTIAL ADDITIVIVE

PLUGZ IT

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

WYO-BEN, INC.

SAFETY DATA SHEET

SECTION 1 — CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: **PLUGZ-IT™ MAX**
Chemical Family: Mineral
Application: Sealing

Manufacturer/Supplier: Wyo-Ben, Inc.
1345 Discovery Drive
Billings, MT 59102 USA
Telephone: 800.548.7055
Facsimile: 406.656.0748
Emergency Phone Number CHEMTREC® 800.424.9300

SECTION 2 — HAZARD IDENTIFICATION

Hazard Symbol: Health Hazard

Signal Word: Warning

Hazard Overview: ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer.

SECTION 3 — COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	Percent	ACGIH TLV-TWA	OSHA PEL-TWA*
Crystalline Silica, quartz	14808-60-7	1 – 6%	0.025 mg/m^3	$\frac{10\ mg/m^3}{\%SiO_2 + 2}$

*More restrictive exposure limits may be enforced by some states, agencies, or other authorities.
Non-hazardous components > 94%

SECTION 4 — FIRST AID MEASURES

Inhalation: If inhaled, remove to a dust free area. Get medical attention if respiratory irritation develops or if breathing becomes difficult. Inhalation may aggravate existing respiratory illness.

Skin: Wash with soap and water until clear. Seek medical attention if irritation persists.

Eyes: In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion: No adverse effects.

Notes to Physician: Treat Symptomatically.

SECTION 5 — FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not applicable
Flash Point/Range (C):	Not applicable
Flash Point Method:	Not applicable
Autoignition Temperature (F):	Not applicable
Autoignition Temperature (C):	Not applicable
Flammability Limits in Air – Lower (%):	Not applicable
Flammability Limits in Air – Upper (%):	Not applicable
Fire Extinguishing Media:	All standard firefighting media. (Caution slippery when wet.)
Special Exposure Hazards:	Not applicable
Special Protective Equipment for Firefighters:	Not applicable
NFPA Ratings:	Health 0, Flammability 0, Reactivity 0

SECTION 6 — ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures:	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures:	None known.
Procedure for Cleaning/Absorption:	Collect using appropriate dustless method and hold for appropriate disposal.

SECTION 7 — HANDLING AND STORAGE

Handling Precautions:	This product contains quartz which may become airborne. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH/MSHA European Standard En 149, or equivalent certified for silica bearing dust, respirator when using this product. Material is slippery when wet. Promptly clean up spills to avoid breathing airborne dust.
Storage Information:	Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

SECTION 8 — EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls:	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.
Personal Protective Equipment:	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection:	Not normally needed. If significant exposures are possible use NIOSH/MSH respirator approved for silica bearing dust.
Hand Protection:	Normal work gloves.
Skin Protection:	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection:	Wear safety glasses or goggles to protect against exposure.
Other Precautions:	None known.

SECTION 9 — PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Light tan to gray as dry powder
Odor:	Odorless
pH:	8 – 10 (5% aqueous solution)
Specific Gravity @ 20 C (Water=1):	2.45 – 2.55
Density @ 20 C (lbs/gallon):	Not determined
Bulk Density @ 20 C (lbs/ft^3):	60 – 66
Boiling Point/Range (F):	Not applicable
Boiling Point/Range (C):	Not applicable
Freezing Point/Range (F):	Not applicable
Freezing Point/Range (C):	Not applicable
Vapor Pressure @ 20 C (mmHg):	Not applicable
Vapor Density (Air=1):	Not applicable
Percent Volatiles:	Not applicable
Evaporation Rate (Butyl Acetate=1):	Not applicable
Solubility in Water (g/100ml):	Insoluble, forms colloidal suspension
Solubility in Solvents (g/100ml):	Not applicable
VOCs (lbs/gallon):	Not applicable
Viscosity, Dynamic @ 20 C (centipoise):	240
Viscosity, Kinematic @ 20 C (centistrokes):	Not applicable
Partition Coefficient/n-Octanol/Water:	Not applicable
Molecular Weight (g/mole):	Not applicable

SECTION 10 — STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid:	None anticipated
Incompatibility (Materials to Avoid):	Hydrofluoric Acid
Hazardous Decomposition Products:	None
Additional Guidelines:	Not applicable

SECTION 11 — TOXICOLOGICAL INFORMATION

Principle Route of Exposure:	Eye or skin contact, inhalation.
Inhalation:	Inhaled crystalline silica in the form or quartz from occupational sources is carcinogenic to humans (IARC, Group 1).
Skin Contact:	May cause mechanical skin irritation.
Eye Contact:	May cause eye irritation.
Ingestion:	None known
Aggravated Medical Conditions:	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to respirable quartz-bearing dust.
Chronic Effects/Carcinogenicity:	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC, 1997) concludes that there is sufficient evidence in humans for carcinogenicity of inhaled crystalline silica from occupational sources (IARC Group 1), that carcinogenicity was not detected in all industrial circumstances studied and that carcinogenicity may depend on characteristics of the crystalline silica or on external factors affecting its biological activity. See IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997). The National Toxicology Program (NTP) classifies respirable crystalline silica as "Known to be a human carcinogen" (NTP 9th Report on Carcinogens, 2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).
Other Information:	See "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).
Toxicity Tests	
Oral Toxicity:	Not determined (on FDA GRAS list; used as a food additive)
Dermal Toxicity:	Not determined (on FDA GRAS list; used in cosmetic preparations)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity:	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive/Developmental Toxicity:	Not determined

SECTION 12 — ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air):	Not determined
Persistence/Degradability:	Not determined
Bio-accumulation:	Not determined
Ecotoxicological Information	
Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information:	Not determined
Other Information:	Not applicable

SECTION 13 — DISPOSAL CONSIDERATIONS

Disposal Method:	Bury in a licensed landfill according to federal, state and local regulations.
Contaminated Packaging:	Follow all applicable national or local regulations.

SECTION 14 — TRANSPORT INFORMATION

Land Transportation

DOT – Not Restricted
Canadian TDG – Not Restricted
ADR – Not Restricted

Air Transportation

ICAO/IATA – Not Restricted

Sea Transportation

IMDG – Not Restricted

Other Transportation Information

Labels: None

SECTION 15 — REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311, 312) Hazard Class	Acute Health Hazard Chronic Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual “Toxic Chemical Release Reporting” under Section 313 (40 CFR 372).

EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	This product contains crystalline silica (respirable) which is a substance known to the State of California to cause cancer.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory are exempt.
WHMIS Hazard Class	This product contains crystalline silica (respirable) and is classified as a Class D, Division 2, Subdivision A substance.

SECTION 16 — OTHER INFORMATION

Prepared 03/18/2015

Last Revision 07/23/2015

DISCLAIMER

All information presented herein is believed to be accurate; however, it is the user's responsibility to determine in advance of need that the information is current and suitable for their circumstances. No warranty or guarantee, expressed or implied is made by WYO-BEN, INC. as to this information, or as to the safety, toxicity or effect of the use of this product.

MICHELS®

POTENTIAL ADDITIVIVE

CLAY CUTTER

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Material name	CLAY CUTTER™
Version #	05
Revision date	19-December-2008
Chemical name	Formation Inhibitor
Chemical description	Liquid
CAS #	Mixture
Manufacturer	CETCO Drilling Products Group 2870 Forbs Avenue Hoffman Estates, IL 60192 US safetydata@amcol.com http://www.cetco.com/ General Information (800) 527-9948 CHEMTREC® (800) 424-9300

2. Hazards Identification

Emergency overview No hazards resulting from the material as supplied. Health injuries are not known or expected under normal use.

OSHA regulatory status While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this MSDS contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product.

Potential health effects

- **Eyes** Contact with eyes may cause irritation.
- **Skin** May cause skin irritation in susceptible persons.
- **Inhalation** Health injuries are not known or expected under normal use.
- **Ingestion** Ingestion of this product may cause nausea, vomiting and diarrhea.

3. Composition / Information on Ingredients

The manufacturer lists no ingredients as hazardous according to OSHA 29 CFR 1910.1200.

Composition comments This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

4. First Aid Measures

First aid procedures

- **Eye contact** Immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists.
- **Skin contact** Wash off with soap and water. Remove contaminated clothing. Get medical attention if irritation develops or persists.
- **Inhalation** Remove to fresh air. If the affected person is not breathing, apply artificial respiration. If breathing is difficult, give oxygen. Get medical attention, if needed.
- **Ingestion** Give victim water or milk. If swallowed, do NOT induce vomiting. Never give anything by mouth to an unconscious person. Obtain medical attention.

General advice If you feel unwell, seek medical advice (show the label where possible).

5. Fire Fighting Measures

Flammable properties Not a fire hazard.

Extinguishing media

- **Suitable extinguishing media** Use any media suitable for the surrounding fires.

Protection of firefighters

Protective equipment and precautions for firefighters	Move containers from fire area if you can do it without risk. Cool containers with flooding quantities of water until well after fire is out.
Hazardous combustion products	None known.

6. Accidental Release Measures

Environmental precautions	Prevent spreading over a wide area (e.g. by containment or oil barriers). Prevent further leakage or spillage if safe to do so. Do not flush into surface water or sanitary sewer system.
Methods for containment	Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible.
Methods for cleaning up	Absorb spill with inert material (e.g., dry sand or earth), then place in a chemical waste container. Do not allow the spilled product to enter public drainage system or open water courses. Wear appropriate protective equipment and clothing during clean-up.

7. Handling and Storage

Handling	Use only in well-ventilated areas. Provide sufficient air exchange and/or exhaust in work rooms. In case of insufficient ventilation, wear suitable respiratory equipment.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Store in original container.

8. Exposure Controls / Personal Protection

Engineering controls	Good general ventilation should be sufficient to control airborne levels. Local exhaust is suggested for use, where possible, in enclosed or confined spaces. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.

Personal protective equipment

Eye / face protection	Wear safety glasses; chemical goggles (if splashing is possible).
Skin protection	Wear appropriate chemical resistant gloves. Use of an impervious apron is recommended.
Respiratory protection	None required where adequate ventilation conditions exist.
General hygeine considerations	Use good industrial hygiene practices in handling this material. Wash hands before breaks and immediately after handling the product.

9. Physical & Chemical Properties

Appearance	Not available.
Color	Not available.
Odor	Not available.
Odor threshold	Not available.
Physical state	Liquid.
Form	Liquid.
pH	Not available.
Melting point	Not available.
Freezing point	Not available.
Boiling point	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability	Not available.
Flammability limits in air, upper, % by volume	Not available.
Flammability limits in air, lower, % by volume	Not available.
Vapor pressure	Not available.
Vapor density	Not Determined
Specific gravity	Not available.
Relative density	Not available.
Solubility (water)	Not available.

Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Percent volatile	50 % v/v

10. Chemical Stability & Reactivity Information

Chemical stability	No hazards to be especially mentioned. Stable at normal conditions.
Conditions to avoid	None known.
Incompatible materials	None known.
Hazardous decomposition products	Upon decomposition, this product may yield gaseous nitrogen oxides, carbon monoxide, carbon dioxide and/or low molecular weight hydrocarbons.
Possibility of hazardous reactions	Will not occur.

11. Toxicological Information

Component analysis - LD50	This product is judged to have an acute oral LD50 (rat) greater than 5 g/kg of body weight, and ar acute dermal LD50 (rabbit) greater than 3.16 g/kg of body weight.
Further information	This product has no known adverse effect on human health.

12. Ecological Information

Ecotoxicity	This material is not expected to be harmful to aquatic life. This material has a biodegradatior percentage of 85.2% and is considered to have ready biodegradability. This material exceeds the OECD Guideline 301B for environmental friendliness
Environmental effects	Ecological injuries are not known or expected under normal use.
Persistence and degradability	Not available.

13. Disposal Considerations

Disposal instructions	Dispose in accordance with all applicable regulations.

14. Transport Information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

US federal regulations	OSHA Process Safety Standard: This material is not known to be hazardous by the OSHA Highly Hazardous Process Safety Standard, 29 CFR 1910.119.

CERCLA (Superfund) reportable quantity

None

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - No Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No
Section 302 extremely hazardous substance	No
Section 311 hazardous chemical	No

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of New and Existing Chemicals (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

State regulations

This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

16. Other Information

Further information

This safety datasheet only contains information relating to safety and does not replace any product information or product specification.

HMIS ratings

NFPA ratings

Health: 0
Flammability: 0
Instability: 0

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The manufacturer expressly does not make any representations, warranties, or guarantees as to its accuracy, reliability or completeness nor assumes any liability, for its use. It is the user's responsibility to verify the suitability and completeness of such information for each particular use.

Third party materials: Insofar as materials not manufactured or supplied by this manufacturer are used in conjunction with, or instead of this product, it is the responsibility of the customer to obtain, from the manufacturer or supplier, all technical data and other properties relating to these and other materials and to obtain all necessary information relating to them. No liability can be accepted in respect of the use of this product in conjunction with materials from another supplier.

Issue date

19-December-2008

This data sheet contains changes from the previous version in section(s):

Composition / Information on Ingredients: Component information

POTENTIAL ADDITIVIVE

CLAY BREAKER

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME:	ClayBreaker
24-HOUR EMERGENCY TELEPHONE:	1-800-535-5053 (Infotrac)
SUPPLIER:	DCS Fluids Solutions LP P.O. Box 1027 Graham, TX 76450 (940) 521-0400

Product Use: Well Stimulation Additive, Clay Stabilizer
CAS #: Mixture

2. COMPOSITION, INFORMATION ON INGREDIENTS

No hazardous ingredients as defined by OSHA 29 CFR 1910.1200

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Colorless to amber liquid with a strong odor. May be irritating to eyes, skin and respiratory tract. May be harmful if swallowed. Avoid contact with skin, eyes and clothing.

POTENTIAL HEALTH HAZARDS:

- **INHALATION:** May cause irritation of respiratory tract.
- **INGESTION:** May cause irritation of the gastrointestinal tract including nausea, vomiting and diarrhea.
- **SKIN:** May cause skin irritation.
- **EYES:** May cause eye irritation.

CHRONIC EFFECTS: None known

Ingredients found on one of the OSHA designated carcinogen lists are listed below.

No ingredients listed in this section.

4. FIRST AID MEASURES

INHALATION: If breathing is difficult, remove to fresh air and keep at rest in a comfortable position for breathing. Obtain immediate medical attention.

INGESTION: If swallowed, seek immediate medical attention and show this container or label. Do not induce vomiting without medical advice.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any irritation continues.

EYES: Immediately flush eyes with large quantities of water for at least 15 minutes. Hold eyelids apart to ensure complete irrigation of all eye and lid tissue. Get medical attention if irritation develops.

ADVICE TO PHYSICIANS: No specific treatment. Treat according to symptoms present.

5. FIRE FIGHTING MEASURES

FLASH POINT: >200° F (>93.3° C)
FLAMMABLE LIMITS: LEL: N/A
UEL: N/A

EXTINGUISHING AGENTS:
Water, dry chemical, CO_2, water spray or regular foam.
Do not use a solid water stream as it may scatter and spread fire.

SPECIAL FIRE FIGHTING PROCEDURES:
Wear positive-pressure, self-contained breathing apparatus (SCBA) and protective fire fighting clothing (including fire fighting helmet, coat, pants, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.

UNUSUAL FIRE & EXPLOSION HAZARDS:
Always stay away from tanks engulfed in flame. Withdraw immediately in case of rising sound from venting safety devices of any discoloration of tanks due to fire. Move containers from fire area if you can do it without risk. Do not scatter spilled material with high pressure water streams. Use water spray to cool unopened containers. Cool containers with flooding quantities of water until well after fire is out.

6. ACCIDENTAL RELEASE MEASURE

PERSONAL PROTECTION:
Don appropriate personal protective equipment prior to entering spill/leak area.
(See Section 8)

SPILL CLEAN-UP PROCEDURES:
Limit access to area, as necessary. Shut off leak if it can be done safely. Contain spill with dike. Prevent run-off into sewers or waterways. Pump large spills into salvage containers. Soak up residue and small spills with vermiculite, paper, clay or other absorbent material. Remove affected soils. Place in salvage containers. Continue to observe handling precautions.

WASTE DISPOSAL METHOD:
Follow approved local beneficial reuse guidelines for uncontaminated spent drilling fluids. If contaminated, dispose of in a licensed industrial landfill according to local, state and federal regulations. If released to the environment for other than its intended purpose, this product, in its current state, does not meet the definition of a hazardous waste under 40 CFR 261.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:
Always wear recommended personal protection equipment. Do not get in eyes, on skin or clothing. Avoid breathing mist or vapor. Use only with adequate ventilation or wear respiratory protection.

STORAGE PRECAUTIONS:

Keep containers tightly closed and properly labeled. Store at moderate temperatures in dry, well-ventilated area. Keep container closed when not in use. Keep in original container. Store containers in upright position. Since emptied containers retain product residue, follow hazard precautions even when empty.

HYGIENIC WORK PRACTICES:

Use good personal hygiene practices. Wash hands and skin thoroughly after handling. Promptly remove contaminated clothing and wash before reuse. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

ENGINEERING CONTROLS:

There are no occupational exposure limits established at this time. Since this material may be irritating to skin and mucous membranes, general room ventilation plus local exhaust at points of emission should be used to maintain levels of airborne contaminants as low as feasibly possible.

PERSONAL PROTECTION EQUIPMENT

RESPIRATORY:

Respiratory protection is not required under normal use. Wear a NIOSH/MSHA approved respirator following manufacturer's recommendations where airborne contaminants may occur.

EYE / FACE PROTECTION:

Wear chemical safety goggles or face shield to protect against splashing.

SKIN PROTECTION:

Chemical resistant gloves and splash aprons made of impermeable material should be worn.

9. PHYSICAL AND CHEMICAL PROPERTIES

- **Appearance and Odor:** Colorless to amber liquid with strong odor.
- **Physical State:** Liquid
- **pH:** 6.5 – 9
- **Vapor Pressure:** Not determined
- **Vapor Density:** Not determined
- **Boiling Point:** Not determined
- **Melting Point:** 469.4° F estimated
- **Solubility in Water:** Complete
- **Specific Gravity:** 1.01 – 1.03

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable at normal conditions**.**

CONDITIONS TO AVOID: Heat, flames and sparks.

MATERIALS TO AVOID: Strong acids.

HAZARDOUS DECOMPOSITION PRODUCTS: None expected.

HAZARDOUS POLYMERIZATION: Does not occur.

11. TOXICOLOGICAL INFORMATION

ACUTE EFFECTS:

Acute LD50: 400 – 4000 mg/kg, Rat, Oral
Acute LC50: > 4000 mg/kg, Rat, Dermal

Not expected to be hazardous by OSHA criteria.

CHRONIC EFFECTS:

None known. Not expected to be hazardous by OSHA criteria.
This product has no known adverse effect on human health.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL INFORMATION:

ClayBreaker has a biodegradation percentage of 85.2% and is considered to have ready biodegradability. Test of ready biodegradability are stringent tests that provide limited opportunity for acclimation and biodegradation to occur. A positive result in a test of ready biodegradability is an indication that the test substance will undergo rapid and ultimate biodegradation in the environment. OECD Guideline 301B has set the standard for ready biodegradability at 60%. ClayBreaker exceeds this standard for environmental friendliness.

13. DISPOSAL CONSIDERATIONS

Follow approved local beneficial reuse guidelines for uncontaminated spent drilling fluids. If contaminated, dispose of in a licensed industrial landfill according to local, state and federal regulations. If released to the environment for other than its intended purpose, this product does not meet, in its present state, the definition of a hazardous waste under 40 CFR 261. Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for a hazardous waste. Dispose in accordance with all applicable regulations.

14. TRANSPORTATION INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT):

Not regulated as dangerous goods.

CANADIAN TRANSPORTATION OF DANGEROUS GOODS (TDG):

Not regulated as dangerous goods.

IMDG:

Not regulated as dangerous goods.

IATA:

Not regulated as dangerous goods.

15. REGULATORY INFORMATION

OSHA: This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200. We request that you make all information in the Material Safety Data Sheet available to your employees.

TSCA: Not on inventory.

SARA TITLE III/CERCLA:
To aid our customers in complying with regulatory requirements, SARA Title III Hazard Categories for this product are indicated below. If the word "YES" appears next to any category, this product may be reportable by you under the requirements of 40 CFR Part 370. Please consult those regulations for details.

Immediate (Acute) Health:	YES
Delayed (Chronic) Health:	NO
Fire Hazard:	NO
Reactive Hazard:	NO
Sudden Release of Pressure:	NO

Reportable Quantity: Not reportable

Spills/release resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center (1-800-424-8802) and to your Local Emergency Planning Committee.

16. OTHER INFORMATION

HMIS RATINGS: HEALTH (1) FLAMMABILITY (0) PHYSICAL HAZARD (0)
Based on the NPCA HMIS III rating system.

CURRENT ISSUE DATE: August 1, 2014
Updated information on LD50 and LC50.

DCS Fluid Solutions LP believes the information contained in this material safety data sheet is accurate based on the information supplied by reputable suppliers of our raw materials. We cannot make any assertions as to its reliability or completeness; therefore, the user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Neither warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

POTENTIAL ADDITIVIVE

TORQUE BREAKER

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

MATERIAL SAFETY DATA SHEET

5/04/04

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: TorqBreaker™
Chemical Family: Surfactant
Supplier: DCS Fluid Solutions.
PO Box1027
Graham TX 76450
940-521-0500

2. COMPOSITION/INFORMATION ON INGREDIENTS

OSHA Regulated Components: None

3. HAZARDS IDENTIFICATION

Acute Health Effects: None
Chronic Health Effects: None
Carcinogen: No

PRIMARY ENTRY ROUTES:

1) Skin and Eyes: Repeated contact with the skin may be irritating. Eye contact may be irritating.
2) Ingestion: May be harmful.
3) Inhalation: Not considered a hazard.

4. FIRST AID MEASURES

SKIN CONTACT:	Remove contaminated clothing without delay. Wash skin thoroughly with water. If irritation persists, get medical attention.
EYE CONTACT:	Rinse thoroughly with plenty of water for 15 minutes. In case of persistent eye irritation, consult a physician.
INGESTION:	Give large volumes of water. Do not induce vomiting. Get medical attention.
INHALATION:	N/A

5. FIRE FIGHTING MEASURES

FLASH POINT: None (will not burn)
EXTINGUISHING MEDIA: N/A
FIRE FIGHTING PROCEDURES: N/A

UNUSUAL FIRE AND EXPLOSION HAZARD: Fire fighters should observe all precautions that apply to any fire where chemicals are stored.

6. ACCIDENTAL RELEASE MEASURES

If product leaks or spills, flood area with water. Mop up and dispose to sanitary sewer. Adhere to all Federal, State and Local Regulations.

7. HANDLING AND STORAGE

Store containers tightly closed and in an upright position.
Do not destroy or deface the label.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Food, beverages and tobacco products should not be carried, stored or consumed where this material is in use. Before eating, drinking or smoking, wash face and hands with soap and water. Avoid skin contact. Protective clothing such as impervious gloves are recommended to prevent skin contact. For operations where eye or face contact can occur, wear eye protection such as chemical splash proof goggles or face shield.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Viscous Liquid
Color:	Red
Odor:	Slight Citrus
Solubility:	Completely soluble in water
Specific Gravity:	1.035
pH	10.0
Freezing Point:	N/A
Flash Point:	None (will not burn)
Vapor Pressure	N/A

10. STABILITY AND REACTIVITY

STABILITY: Stable Conditions to Avoid: None known
POLYMERIZATION: Will not occur. Conditions to Avoid: None known

11. TOXICOLOGICAL INFORMATION

None Available

12. ECOLOGICAL INFORMATION

None Available

13. DISPOSAL INFORMATION

If released into the environment for other than its intended purpose, this product does not meet the definition of a hazardous waste under 40 CFR 261. Follow approved local beneficial reuse guidelines for uncontaminated spent drilling fluids. If contaminated, dispose of in a licensed industrial landfill according to local, state and federal regulations..Recover and reuse if possible.

14. TRANSPORT INFORMATION

SHIPPING NAME: Not applicable/Not Regulated
HAZARD CLASS: Not applicable
UN NUMBER: Not applicable
DOT HAZARDOUS SUBSTANCES: Not applicable
TRANSPORT LABEL: None Required

15. REGULATORY INFORMATION

US TSCA: All components of this product are included on the TSCA Inventory in compliance with the Toxic Substances Control Act, 15 U.S.C. 2601

SECTION 313 SUPPLIER NOTIFICATION (SARA): This product contains the following toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right to Know Act of 1986 and of 40 CFR 372: None.

16. OTHER INFORMATION – NFPA Hazard Rating

Fire
0
Health 0 0 Reactivity
2
PPE

Health: 0=minimal	Fire: 0=will not burn
1=slightly hazardous	1=FP>141F
2=hazardous	2=FP>73=<141F
3=serious hazard	3=FP<73F
4=severe hazard	4=BP<95F FP by Pensky Marten closed cup
Reactivity: 0=None	PPE 0=not necessary

1=mild	1=goggles
2=strong	2=goggles, gloves
	3=goggles, gloves, protective clothes
	4=goggles, gloves, respirator

POTENTIAL ADDITIVIVE

BALL BUSTER

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

BHS Marketing

Western Briquette

BALLBUSTER

MATERIAL SAFETY DATA SHEET

Sodium Acid Pyrophosphate

Date: June 20, 2001

I Company Identification

Company Name:	BHS Marketing / Western Briquette
Mailing Address:	P.O. Box 27955 SLC, UT 84127-0955
Physical Address:	2320 West Indiana Ave. SLC, UT 84104
Telephone:	(801) 973-8232
Fax:	(801) 973-8838
Emergency Number:	Chemtrec (800) 424-9300

II Product Identification

Product Name:	Sodium Acid Pyrophosphate, SAPP, Disodium pyrophosphate
Chemical Formula:	$Na_2H_2P_2O_7$
Molecular Weight:	221.96
CAS Number:	7758-16-9

III Typical Physical Properties

Physical Appearance:	White powder
Odor:	Odorless
Bulk Density:	0.9 kg/l approx.
pH (1% aqueous solution):	3.7-4.4
Melting Point:	Decomposes at 220°C
Solubility in Water:	approx. 13g in 100g water, room temperature
Vapor Pressure:	Negligible

IV Reactivity Data

Chemical Stability:	Stable
Materials to Avoid:	Avoid contact with strong bases

V Toxicological Information

Toxicity:	Oral-rat LD-50: > 1000 mg/kg

VI Hazard Data

Acute	
Eye Contact:	Causes irritation
Skin Contact:	Causes irritation
Ingestion:	Causes irritation
Inhalation:	Causes irritation
Symptoms of Overexposure:	Irritant to eyes, skin and respiratory systems. Ingestion can cause vomiting and diarrhea

VII Recommended First Aid Measures

General First Aid:	Remove the person from source of exposure. Wash with plenty of water. Upon ingestion, if the person is conscious, cause him/her to vomit. Get medical attention

VIII Fire Fighting Measures

Flash Point:	Not flammable
Extinguishing Media:	Not combustible
Special Firefighting Procedures:	Protective clothing and self contained breathing apparatus

IX Accidental Release Measures

Clean up & Disposal of Spills:	Spillage or leakages are cleaned up by mechanical removal, if possible. Flushing with plenty of water

X Handling & Storage

Handling:	Avoid inhalation, contact with eyes, skin or clothing. Do not ingest
Storage:	Store in a cool, well ventilated, dry place, in tightly closed containers

XI Exposure Controls/ Personal Protection

Appropriate Hygienic Practices:	As part of good industrial, personal hygiene and safety procedure, avoid all unnecessary exposure to the product and ensure prompt removal from eyes, skin and clothing. Maintain good housekeeping to control dust accumulations.

Personal Protection Equipment

Eye Protection:	Use safety glasses
Skin Protection:	Wear protective clothing, gloves and dust respirator if necessary
Ventilation Protection:	Adequate ventilation

XII Additional Information

The information in this MSDS was obtained from sources, which we believe are reliable. However, the information is provided without any warranty, expressed or implied, regarding its correctness.

The conditions or methods of handling, storage, use and disposal are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage, or expense arising out of or in any way connected with handling, storage, use or disposal of the product.

*n/a= Not Applicable

POTENTIAL ADDITIVIVE

SODA ASH

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Soda Ash / Sodium Carbonate

Revision Date: 1/18/2016

SAFETY DATA SHEET

1 PRODUCT AND COMPANY IDENTIFICATION

1.1 PRODUCT IDENTIFIERS

Product Name:	Soda Ash or Sodium Carbonate
Chemical Name:	Sodium Carbonate
Synonyms / Common Names:	Carbonic Acid Sodium Salt
Registration Number REACH:	01-2119485498-19-0011
Product Type REACH:	Substance/mono-constituent
CAS Number:	497-19-8
EC Index Number:	011-005-00-2
EC Number:	207-838-8
RTECS Number:	VZ4050000

1.2 RELEVANT IDENTIFIED USES

Glass production	Paper production	Manufacture of substances
Detergent component	Laboratory chemicals	Acidity regulator

1.3 MANUFACTURER

Ciner Wyoming LLC
254 County Road 4-6
Green River, Wyoming 82935
United States
Telephone Number: (307) 875-2600
www.ciner.us.com

1.4 EMERGENCY TELEPHONE NUMBER

Emergency Response Information Provider: CHEMTREC

Within the United States Emergency Telephone Number: 1-800-424-9300

Outside the United States / International Emergency Telephone Number: +1-703-527-3887

2 HAZARD(S) IDENTIFICATION

2.1 CLASSIFICATION OF THE SUBSTANCE OR MIXTURE

GHS Classification in accordance with 29 CFR 1910 (OSHA HazCom Standard):

Eye Irritation (Category 2A), H319

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS LABEL ELEMENTS, INCLUDING PRECAUTIONARY STATEMENTS

Pictograms:

Irritant

Signal Word: Warning

Hazard Statement(s):

H319 Causes serious eye irritation.

Precautionary Statement(s):

P264 Wash skin thoroughly after handling.

P280 Wear eye protection / face protection.

P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P337 + P313 If eye irritation persists: Get medical advice / attention.

2.3 HAZARDS NOT OTHERWISE CLASSIFIED OR NOT COVERED BY GHS

None

3 COMPOSITION / INFORMATION ON INGREDIENTS

3.1 SUBSTANCES

Synonyms: Soda Ash, Sodium Carbonate, Carbonic Acid Sodium Salt

Formula: Na_2CO_3

Molecular Weight: 105.99 g/mol

Component (REACH Registration)	CAS # / EC #	Concentration	Classifications	Remark
Sodium carbonate (01-2119485498-19-0011)	CAS #: 497-19-8 EC #: 207-838-8	≥ 99%	Eye Irrit. 2A, H319	Mono-constituent

* For the full text of the H-Statements mentioned in this Section, see Section 16.

4 First-Aid Measures

4.1 Description of First-Aid Measures

General - Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with labored breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital.

After inhalation - Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

After skin contact - Rinse with water. Soap may be used. Do not apply (chemical) neutralizing agents. Take victim to a doctor if irritation persists.

After eye contact - Rinse immediately with plenty of water for at least 15 minutes. Do not apply neutralizing agents. Take victim to an ophthalmologist if irritation persists.

After ingestion - Rinse mouth with water. Immediately after ingestion: give lots of water to drink. Do not induce vomiting. Consult a doctor/medical service if victim is unwell.

4.2 Most important symptoms and effects, both acute and delayed

4.2.1 Acute Symptoms

If inhaled - Dry/sore throat. Coughing. Slight irritation. Exposure to high concentrations: Irritation of the respiratory tract. Irritation of the nasal mucous membranes. Respiratory difficulties.

In case of skin contact - Not irritating

In case of eye contact - Inflammation/damage of the eye tissue. Corrosion of the eye tissue. Lacrimation.

If swallowed – After absorption of high quantities: Nausea. Vomiting. Abdominal pain. Irritation of the gastric/intestinal mucosa.

4.2.2 Delayed Symptoms

No effects known.

4.3 Indication of any immediate medical attention and special treatment needed

No data available.

5 FIRE-FIGHTING MEASURES

5.1 EXTINGUISHING MEDIA

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 SPECIAL HAZARDS ARISING FROM THE SUBSTANCE OR MIXTURE

Upon combustion CO and CO2 are formed. Reacts on exposure to water with some metals. CO2 generation occurs when mixed with acidic materials.

5.3 ADVICE FOR FIREFIGHTERS

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 SPECIAL PROTECTIVE EQUIPMENT FOR FIREFIGHTERS

Gloves. Safety glasses. Protective clothing. Dust cloud protection and heat/fire exposure: Compressed air respirator.

6 ACCIDENTAL RELEASE MEASURES

6.1 PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES

Use personal protective equipment. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust. For personal protection see section 8.

6.2 ENVIRONMENTAL PRECAUTIONS

Contain released substance, pump into suitable containers. Plug the leak, cut off the supply. Knock down/dilute dust cloud with water spray. Violent exothermic reaction with some acids; release of harmful gases/vapors (carbon dioxide). Carbon dioxide is heavier than air and will collect in ducts, drains and low lying areas. Prevent spreading in sewers.

6.3 METHODS AND MATERIAL FOR CONTAINMENT AND CLEANING UP

Prevent dust cloud formation. Scoop solid spill material into closed containers. Carefully collect the spill. Clean contaminated surfaces with an excess of water. Wash clothing and equipment after handling.

6.4 REFERENCE TO OTHER SECTIONS

For disposal see section 13.

7 Handling and Storage

7.1 Precautions for Safe Handling

Avoid contact with skin and eyes. Use air conveying/mechanical systems for bulk transfer to storage. Provide appropriate exhaust ventilation at places where dust is formed. In case of insufficient ventilation, wear suitable respiratory equipment if release of airborne dust is expected.

7.2 Conditions for safe storage, including any incompatibilities

Store in original container. Keep in properly labeled containers. Keep container tightly closed.

7.3 Suitable packaging material

No data available

7.4 Incompatible Products

Aluminum, powdered aluminum, and acids.

8 Exposure Controls / Personal Protection

8.1 Components with workplace control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls – Avoid formation of dust. Keep away from ignition sources. Keep container tightly closed. Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

8.3 Personal protective equipment

Eye / Face Protection - Safety glasses with side shields or protective goggles. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection - Handle with gloves, butyl rubber or PVC, which have good resistance. Gloves must be inspected prior to use. Use proper glove removal technique to avoid skin contact with product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection – Protective clothing. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection – For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

8.4 CONTROL OF ENVIRONMENTAL EXPOSURE

Prevent leakage or spillage if safe to do so. Do not let product enter drains. See section 6.2, 6.3, and 13.

9 PHYSICAL AND CHEMICAL PROPERTIES

9.1 INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES

Appearance Form:	Crystalline Solid / Crystalline Powder / Grains / Lumps
Color:	Colorless
Odor:	Odorless
Odor Threshold:	No data available
Particle Size:	694 µm
pH:	11.6; 5.0%
Melting Point / Freezing Point:	851 °C / 1,564 °F
Boiling Point	1,600 °C / 2,912 °F
Flash Point:	No data available
Explosion Limits:	No data available
Evaporation Rate:	No data available
Flammability:	Non Combustible
Log Kow:	-6.19 Estimated value
Viscosity:	No data available
Vapor Pressure:	No data available
Vapor Density:	No data available
Solubility water:	212.5 g/l; 20 °C / 68 °F
Relative Density:	2.52 -253; 20 °C / 68 °F
Absolute Density:	2,530 kg/m^3
Decomposition temperature:	>1600 °C / >2912 °F
Auto-ignition temperature:	>400 °C / >752 °F
Explosive Properties:	No data available
Oxidizing Properties:	No data available

9.2 PHYSICAL HAZARDS

No data available

10 STABILITY AND REACTIVITY

10.1 REACTIVITY

None under normal use conditions.

10.2 CHEMICAL STABILITY

Stable. Decomposes by reaction with strong acid.

10.3 POSSIBILITY OF HAZARDOUS REACTIONS

None under normal processing.

10.4 Conditions to Avoid

Exposure to air or moisture over prolonged periods.

10.5 Incompatible Materials

Aluminum, powdered aluminum, and acids.

10.6 Hazardous Polymerization

Hazardous polymerization does not occur.

---

11 Toxicological Information

11.1 Information on Toxicological Effects

11.1.1 Acute toxicity

LD50 Oral - rat – 2,800 mg/kg
LD50 Dermal – rabbit >2,000 mg/kg
LD50 Inhalation - rat – 2.30 mg/l, 2 hour exposure time

11.1.2 Corrosion / irritation

Skin - rabbit
Result: Mild skin irritation – 24 hours

11.1.3 Serious eye damage / eye irritation

Eyes - rabbit
Result: Severe eye irritation – 24 hours

11.1.4 Respiratory or skin sensitization

Inhalation - no data available
Skin Sensitization: no data available

11.1.5 Germ cell mutagenicity

No data available

11.1.6 Carcinogenicity

No data available

11.1.7 Reproductive toxicity

No data available

11.1.8 Specific target organ toxicity - single exposure

No data available

11.1.9 Specific target organ toxicity - repeated exposure

No data available

11.1.10 Chronic effects from short and long-term exposure

On continuous / repeated exposure / contact: Red skin. Dry skin. Tingling / irritation of the skin. Affection of the nasal septum.

12 Ecological Information

12.1 Toxicity

	Parameter	Method	Value	Duration	Species	Test design	Fresh / salt water	Value determination
Acute toxicity fishes	LC50	Other	300 mg/l	96 h	Lepomis macrohirus	Static system	Fresh water	Experimental value
Acute toxicity invertebrates	EC50	Other	200 - 227 mg/l	48 h	Ceriodaphnia sp.	Semi-static	Fresh water	Experimental value
Toxicity algae and other aquatic plants	EC50		242 mg/l	5 days	Algae			Experimental value

12.2 Persistence and Degradability:

Biodegradability: not applicable

12.3 Bioaccumulative Potential:

Low potential for bioaccumulation (Log Know <4)

12.4 Mobility in Soil:

Low potential for absorption in soil.

12.5 Results of PBT and vPvB Assessment:

PBT/vPvB assessment not available as chemical safety assessment is not required/not conducted.

12.6 Other Adverse Effects:

No data available

13 Disposal Considerations

13.1 Waste disposal

Remove waste in accordance with local and/or national regulations. Contact a licensed professional waste disposal service to dispose of this material. Different types of hazardous waste should not be mixed together if it will entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. Do not discharge into drains.

14 Transport Information

14.1 United States Department of Transportation (DOT)

Non-regulated

14.2 International Maritime Dangerous Goods (IMDG)

Non-regulated

14.3 International Air Transport Association (IATA)

Non-regulated

14.4 TDG / ADN / RID / ADR

Non-regulated

15 Regulatory Information

15.1 SARA 302 Components

SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

15.2 SARA 313 Components

SARA 313: This material does not contain any chemical with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

15.3 SARA 311/312 Hazards

Acute Health Hazard

15.4 Pennsylvania Right To Know Components

Sodium carbonate, CAS-No: 497-19-8

15.5 New Jersey Right To Know Components

Sodium carbonate, CAS-No: 497-19-8

15.6 WHMIS CLASSIFICATION: C, D2

Note: The product listed on this SDS has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations.

16 OTHER INFORMATION

16.1 FULL TEXT OF H-STATEMENTS REFERRED TO UNDER SECTION 2 AND 3.

Eye Irrit.	Eye Irritation
H319	Causes serious eye irritation

16.2 HMIS RATING

Health Hazard:	2
Flammability:	0
Physical Hazard:	0

16.3 NFPA RATING

Health Hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

16.4 NOTICE

The above information is believed to be correct but is not intended to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Ciner and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product.

POTENTIAL ADDITIVIVE

SODIUM BICARBONATE

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Soda Ash / Sodium Carbonate
Revision Date: 7/27/2018

SAFETY DATA SHEET

1 PRODUCT AND COMPANY IDENTIFICATION

1.1 PRODUCT IDENTIFIERS

Product Name:	Soda Ash or Sodium Carbonate
Chemical Name:	Sodium Carbonate
Synonyms / Common Names:	Carbonic Acid Sodium Salt
Product Type REACH:	Substance/mono-constituent
CAS Number:	497-19-8
EC Index Number:	011-005-00-2
EC Number:	207-838-8
RTECS Number:	VZ4050000

1.2 RELEVANT IDENTIFIED USES

Glass Production	Paper Production	Manufacture of Substances
Detergent Component	Laboratory Chemicals	Acidity Regulator

1.3 MANUFACTURER

Ciner Wyoming LLC
254 County Road 4-6
Green River, Wyoming 82935
United States
Telephone Number: (307) 875-2600
www.ciner.us.com

1.4 EMERGENCY TELEPHONE NUMBER

Emergency Response Information Provider: CHEMTREC
Within the United States Emergency Telephone Number: 1-800-424-9300
Outside the United States / International Emergency Telephone Number: +1-703-527-3887

2 HAZARD(S) IDENTIIFICATION

2.1 CLASSIFICATION OF THE SUBSTANCE OR MIXTURE

GHS Classification in accordance with 29 CFR 1910 (OSHA HazCom Standard):
Eye Irritation (Category 2A), H319
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS LABEL ELEMENTS, INCLUDING PRECAUTIONARY STATEMENTS

Pictograms:

Irritant

Signal Word: Warning

Hazard Statement(s):
H319 Causes serious eye irritation.

Precautionary Statement(s):
P264 Wash skin thoroughly after handling.

P280 Wear eye protection / face protection.

P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P337 + P313 If eye irritation persists: Get medical advice / attention.

2.3 HAZARDS NOT OTHERWISE CLASSIFIED OR NOT COVERED BY GHS

None

3 COMPOSITION / INFORMATION ON INGREDIENTS

3.1 SUBSTANCES

Synonyms: Soda Ash, Sodium Carbonate, Carbonic Acid Sodium Salt
Formula: Na_2CO_3
Molecular Weight: 105.99 g/mol

Component (REACH Registration)	CAS #	Concentration	Classifications	Remark
Sodium Carbonate (01-2119485498-19-0011)	CAS #: 497-19-8	≥ 99%	Eye Irrit. 2A, H319	Monoconstituent

* For the full text of the H-Statements mentioned in this Section, see Section 16.

4 FIRST-AID MEASURES

4.1 DESCRIPTION OF FIRST-AID MEASURES

General - Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with labored breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital.

After inhalation - Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

After skin contact - Rinse with water. Soap may be used. Do not apply (chemical) neutralizing agents. Take victim to a doctor if irritation persists.

After eye contact - Rinse immediately with plenty of water for at least 15 minutes. Do not apply neutralizing agents. Take victim to an ophthalmologist if irritation persists.

After ingestion - Rinse mouth with water. Immediately after ingestion: give lots of water to drink. Do not induce vomiting. Consult a doctor/medical service if victim is unwell.

4.2 MOST IMPORTANT SYMPTOMS AND EFFECTS, BOTH ACUTE AND DELAYED

4.2.1 Acute Symptoms

If inhaled - Dry/sore throat. Coughing. Slight irritation. Exposure to high concentrations: Irritation of the respiratory tract. Irritation of the nasal mucous membranes. Respiratory difficulties.

In case of skin contact - Not irritating

In case of eye contact - Inflammation/damage of the eye tissue. Corrosion of the eye tissue. Lacrimation.
If swallowed – After absorption of high quantities: Nausea. Vomiting. Abdominal pain. Irritation of the gastric/intestinal mucosa.

4.2.2 Delayed Symptoms

No effects known.

4.3 INDICATION OF ANY IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT NEEDED

No data available.

5 FIRE-FIGHTING MEASURES

5.1 EXTINGUISHING MEDIA

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 SPECIAL HAZARDS ARISING FROM THE SUBSTANCE OR MIXTURE

Upon combustion CO and CO2 are formed. Reacts on exposure to water with some metals. CO2 generation occurs when mixed with acidic materials.

5.3 ADVICE FOR FIREFIGHTERS

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 SPECIAL PROTECTIVE EQUIPMENT FOR FIREFIGHTERS

Gloves. Safety glasses. Protective clothing. Dust cloud protection and heat/fire exposure: Compressed air respirator.

6 ACCIDENTAL RELEASE MEASURES

6.1 PERSONAL PRECAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES
Use personal protective equipment. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust. For personal protection see section 8.

6.2 ENVIRONMENTAL PRECAUTIONS
Contain released substance, pump into suitable containers. Plug the leak, cut off the supply. Knock down/dilute dust cloud with water spray. Violent exothermic reaction with some acids; release of harmful gases/vapors (carbon dioxide). Carbon dioxide is heavier than air and will collect in ducts, drains and low-lying areas. Prevent spreading in sewers.

6.3 METHODS AND MATERIAL FOR CONTAINMENT AND CLEANING UP
Prevent dust cloud formation. Scoop solid spill material into closed containers. Carefully collect the spill. Clean contaminated surfaces with an excess of water. Wash clothing and equipment after handling.

6.4 REFERENCE TO OTHER SECTIONS
For disposal see section 13.

7 HANDLING AND STORAGE

7.1 PRECAUTIONS FOR SAFE HANDLING
Avoid contact with skin and eyes. Use air conveying/mechanical systems for bulk transfer to storage. Provide appropriate exhaust ventilation at places where dust is formed. In case of insufficient ventilation, wear suitable respiratory equipment if release of airborne dust is expected.

7.2 CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES
Store in original container. Keep in properly labeled containers. Keep container tightly closed.

7.3. SUITABLE PACKAGING MATERIAL
No data available.

7.4 INCOMPATIBLE PRODUCTS
Aluminum, powdered aluminum, and acids.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 COMPONENTS WITH WORKPLACE CONTROL PARAMETERS
Contains no substances with occupational exposure limit values.

8.2 EXPOSURE CONTROLS
Appropriate engineering controls – Avoid formation of dust. Keep away from ignition sources. Keep container tightly closed. Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

8.3 PERSONAL PROTECTIVE EQUIPMENT
Eye / Face Protection - Safety glasses with side shields or protective goggles. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin Protection - Handle with gloves, butyl rubber or PVC, which have good resistance. Gloves must be inspected prior to use. Use proper glove removal technique to avoid skin contact with product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection – Protective clothing. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory Protection – For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

8.4 CONTROL OF ENVIRONMENTAL EXPOSURE

Prevent leakage or spillage if safe to do so. Do not let product enter drains. See section 6.2, 6.3, and 13.

9 PHYSICAL AND CHEMICAL PROPERTIES

9.1 INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES

Appearance Form:	Crystalline Solid / Crystalline Powder / Grains / Lumps
Color:	Colorless
Odor:	Odorless
Odor Threshold:	No data available
Particle Size:	694 µm
pH:	11.6; 5.0%
Melting Point / Freezing Point:	851°C / 1,564°F
Boiling Point:	1,600°C / 2,912°F
Flash Point:	No data available
Explosion Limits:	No data available
Evaporation Rate:	No data available
Flammability:	Non-Combustible
Log Kow:	-6.19 Estimated Value
Viscosity:	No data available
Vapor Pressure:	No data available
Vapor Density:	No data available
Solubility Water:	212.5 g/l; 20°C / 68°F
Relative Density:	2.52 – 2.53; 20°C / 68°F
Absolute Density:	2,530 kg/m^3
Decomposition Temperature:	>1600°C / >2912°F
Auto-Ignition Temperature:	>400°C / >752°F
Explosive Properties:	No data available
Oxidizing Properties:	No data available

9.2 PHYSICAL HAZARDS
No data available.

10 STABILITY AND REACTIVITY

10.1 REACTIVITY
None under normal use conditions.

10.2 CHEMICAL STABILITY
Stable. Decomposes by reaction with strong acid.

10.3 POSSIBILITY OF HAZARDOUS REACTIONS
None under normal processing.

10.4 CONDITIONS TO AVOID
Exposure to air or moisture over prolonged periods.

10.5 INCOMPATIBLE MATERIALS
Aluminum, powdered aluminum, and acids.

10.6 HAZARDOUS POLYMERIZATION
Hazardous polymerization does not occur.

11 TOXICOLOGICAL INFORMATION

11.1 INFORMATION ON TOXICOLOGICAL EFFECTS

11.1.1 Acute toxicity
LD50 Oral - rat – 2,800 mg/kg
LD50 Dermal - rabbit >2,000 mg/kg
LD50 Inhalation - rat – 2.30 mg/l, 2-hour exposure time

11.1.2 Corrosion/irritation
Skin - rabbit
Result: Mild skin irritation – 24 hours

11.1.3 Serious eye damage/eye irritation
Eyes - rabbit
Result: Severe eye irritation – 24 hours

11.1.4 Respiratory or skin sensitization
Inhalation - no data available
Skin Sensitization: no data available

11.1.5 Germ cell mutagenicity
No data available

11.1.6 Carcinogenicity
No data available

11.1.7 Reproductive toxicity
No data available

11.1.8 Specific target organ toxicity - single exposure
No data available

11.1.9 Specific target organ toxicity - repeated exposure
No data available

11.1.10 Chronic effects from short and long-term exposure
On continuous / repeated exposure / contact: Red skin. Dry skin. Tingling / irritation of the skin. Affection of the nasal septum.

12 ECOLOGOCAL INFORMATION

12.1 TOXICITY

	Parameter	Method	Value	Duration	Species	Test Design	Fresh/Salt Water	Value Determination
Acute toxicity fishes	LC50 Other	Other	300 mg/l	96 h	Lepomis macronhirus	Static system	Fresh water	Experimental value
Acute toxicity invertebrates	EC50	Other	200-227 mg/l	48 h	Ceriodaphnia sp.	Semi-static	Fresh water	Experimental value
Toxicity algae and other aquatic plants	EC50		242 mg/l	5 days	Algae			Experimental value

12.2 PERSISTENCE AND DEGRADABILITY:
Biodegradability: not applicable

12.3 BIOACCUMULATIVE POTENTIAL:
Low potential for bioaccumulation (Log Kow <4)

12.4 MOBILITY IN SOIL:
Low potential for absorption in soil.

12.5 RESULTS OF PBT AND VPVB ASSESSMENT:
PBT/vPvB assessment not available as chemical safety assessment is not required/not conducted.

12.6 OTHER ADVERSE EFFECTS:
No data available.

13 DISPOSAL CONSIDERATIONS

13.1 WASTE DISPOSAL
Remove waste in accordance with local and/or national regulations. Contact a licensed professional waste disposal service to dispose of this material. Different types of hazardous waste should not be mixed together if it will entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. Do not discharge into drains.

14 TRANSPORT INFORMATION

14.1 UNITED STATES DEPARTMENT OF TRANSPORTATION (DOT)
Non-regulated

14.2 INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)
Non-regulated

14.3 INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)
Non-regulated

14.4 TDG/ADN/RID/ADR
Non-regulated

15 REGULATORY INFORMATION

15.1 SARA 302 COMPONENTS
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

15.2 SARA 313 COMPONENTS
SARA 313: This material does not contain any chemical with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

15.3 SARA 311/312 HAZARDS
Acute Health Hazard

15.4 PENNSYLVANIA RIGHT TO KNOW COMPONENTS
Sodium carbonate, CAS-No: 497-19-8

15.5 NEW JERSEY RIGHT TO KNOW COMPONENTS
Sodium carbonate, CAS-No: 497-19-8

15.6 WHMIS CLASSIFICATION: C, D2
Note: The product listed on this SDS has been classified in accordance with the hazard criteria of the Canadian Controlled Products Regulations.

15.7 US CALIFORNIA SAFE DRINKING WATER & TOXIC ENFORCEMENT ACT (PROPOSITION 65)
This product does not contain any chemicals known to the State of California to cause cancer, birth, or any other reproductive defects.

16 OTHER INFORMATION

16.1 FULL TEXT OF H-STATEMENTS REFERRED TO UNDER SECTION 2 AND 3.

Eye Irrit.	Eye Irritation
H319	Causes serious eye irritation

16.2 HMIS RATING

Health Hazard:	2
Flammability:	0
Physical Hazard:	0

16.3 NFPA RATING

Health Hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

16.4 NOTICE

The above information is believed to be correct but is not intended to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Ciner and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product.

16.5 PRODUCT CERTIFICATIONS

This product is certified to NSF/ANSI Standard 60 for use in drinking water treatment at the specified maximum use limit. The MUL (maximum use level) for sodium carbonate anhydrous is 100 mg/L under NSF/ANSI Standard 60.

OU Kosher Certification

POTENTIAL ADDITIVIVE

CITRIC ACID

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2020

Univar USA Inc Safety Data Sheet

SDS No:

Version No: 003 2015-06-02

Order No:

3075 Highland Pkwy, Ste 200, Downers Grove, IL 60515
(425) 889 3400

Emergency Assistance

For emergency assistance involving chemicals call
Chemtrec - (800) 424-9300

Safety Data Sheet

CITRIC ACID FCC/USP PWD

SECTION 1:IDENTIFICATION OF THE SUBSTANCE/ MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 PRODUCT IDENTIFIER

- Chemical name	Citric acid - Food grade
- REACH Registration Number	01-2119457026-42-0031

1.2 RELEVANT IDENTIFIED USES OF THE SUBSTANCE AND USES ADVISED AGAINST

Citric acid can be used in food as food additives and also in technical application as clarifying agent, water softener, buffer, foam booster and stabilizer, complexing agent and as an intermediate in production of organic chemicals.

1.3 DETAILS OF THE SUPPLIER

- Company identification

US:
Tate & Lyle Ingredients Americas, LLC.
2200 E.Eldorado Street
Decatur, IL 62521

Europe:
Tate & Lyle Slovakia s.r.o.
Boleraz 114
919 08 boleraz
Slovakia

1.4 EMERGENCY PHONE NR.

CHEMTREC
Toll-Free: 1-800-424-9300 (USA and Canada)
Non Toll-Free +1-703-527-3887 (Global)

SECTION 2:HAZARDS IDENTIFICATION

2.1. CLASSIFICATION OF THE SUBSTANCE OR MIXTURE
According with the version of the Globally Harmonized system of Classification and labeling adopted in the United states and Regulation 1272/2008/EC [CLP]: Eyes irritant category 2(H319)

Safety Data Sheet

CITRIC ACID FCC/USP PWD

2.2 LABEL ELEMENTS

GHS07

Signal word:
Warning

Hazard Statement:
Causes serious eye irritation. H319

Precautionary Statement:
Wash hands thoroughly after handling. P264
Wear eye protection. P280

Precautionary Statement. IF IN EYES: P305
Response :
Rinse cautiously with water for several minutes. P351
Remove contact lenses, if present and easy to do Continue rinsing. P338
If eye irritation persists: P337
Get medical advice/attention. P313

2.3. OTHER HAZARDS
FIRE AND EXPLOSION HAZARD:
May form combustible dust concentrations in air. Possibility of dust explosion. it is recommended that all dust control equipment and material transport systems involved are engineered to prevent conditions contributing to dust explosions. Do not allow dust to accumulate on flat surfaces, on rafters or building structural components. Keep away from all ignition sources including heat, sparks and flame.

SECTION 3:COMPOSITION/INFORMATION OF INGREDIENTS

- Chemical name Citric acid - Food grade

Safety Data Sheet

CITRIC ACID FCC/USP PWD

- CAS number	77-92-9
- EINECS number	201-069-1
- Synonyms	2 - Hydroxy -1,2,3 propanetricarboxylic acid Acidulant - Citric acid - food additive E330.

SECTION 4:FIRST AID MEASURES

4.1 DESCRIPTION OF FIRST AID MEASURES

- General advise	Seek medical attention if irritation develops after first aid application
- Inhalation	Move people from the exposure to fresh air.
- Skin contact	Wash skin with soap and water.
- Eye contact	Remove particulates by irrigating with eye wash solution or clean water, holding eyelids apart.
- Ingestion	Wash mouth and flush throat upto the stomach.

4.2 MOST IMPORTANT SYMPTOMS AND EFFECTS, BOTH ACUTE AND DELAYED
ROUTE(S) OF ENTRY: Skin Contact; Eye Contact
HUMAN EFFECTS AND SYMPTOMS OF OVEREXPOSURE:
ACUTE SKIN CONTACT: This product is irritating to the skin resulting in reddening, stinging, and swelling.
ACUTE EYE CONTACT: This product is irritating to the eyes resulting in stinging, reddening, tearing, and swelling.
CHRONIC EFFECTS OF EXPOSURE: No applicable information was found concerning any adverse chronic health effects from overexposure to this product.
CARCINOGENICITY: The components of this product are not listed by NTP, IARC or regulated as a carcinogen by OSHA.
MEDICAL CONDITIONS
AGGRAVATED BY EXPOSURE: Persons with pre-existing eye or skin disorders may be more susceptible to the effects of this product.

4.3 INDICATION OF ANY IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT NEEDED.
None Anticipated

SECTION 5: FIRE-FIGHTING MEASURES

5.1 EXTINGUISHING MEDIA
Water spray, dry powder, carbon dioxide or media appropriate for surrounding fire. Use of water jet may cause explosive dust conditions.

Safety Data Sheet

CITRIC ACID FCC/USP PWD

5.2 SPECIFIC HAZARDS
FIRE AND EXPLOSION HAZARD: Possibility of dust explosion. It is recommended that all dust control equipment and material transport systems involved are engineered to prevent conditions contributing to dust explosions. Do not allow dust to accumulate on flat surfaces, on rafters or building structural components. Use of water jet may cause explosive dust conditions. SEE NFPA 61, Standard for the prevention of Fire and Dust Explosions in Agricultural and Food Processing Facilities, 2008 or later Edition, and other related standards.

5.3 SPECIFIC PROTECTIVE EQUIPMENT AND PRECAUTIONS FOR FIRE-FIGHTERS
Wear self-contained breathing apparatus and full protective gear. Use water spray to cool fire exposed containers.

FLAMMABILITY CLASS (OSHA)
Not applicable

HAZARDOUS COMBUSTION PRODUCTS
Carbon dioxide and carbon monoxide

SECTION 6:ACCIDENTAL RELEASE MEASURES

6.1 PERSONAL PRECAUTIONS
Use personal protective equipment. Wear eye protection. Avoid contact with skin and eyes.

6.2 ENVIRONMENTAL PRECAUTIONS
Prevent further leakage or spillage if safe to do so. No special environmental precautions required

6.3 METHODS FOR CLEANING UP
Vacuum or sweep spills. Minimize dust generation.
If washing down spilled area is necessary, use copious amounts of water and control runoff.
Follow local, state and federal regulations for product disposal

6.4 REFERENCE TO OTHER SECTIONS
See Section 7 for information on safe handling
See Section 8 for information on personal protection equipment
See Section 13 for disposal information

SECTION 7: HANDLING AND STORAGE

Safety Data Sheet

CITRIC ACID FCC/USP PWD

7.1 PRECAUTIONS FOR SAFE HANDLING
See NFPA 61, Standard for the Prevention of Fire and Dust Explosions in Agricultural and Food Processing Facilities, 2008 Edition, and other related standards. Use with adequate ventilation. Minimize dust generation and accumulation; dust deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are disturbed.

All dust control equipment and material transport systems involved are engineered to prevent conditions contributing to dust explosions and may require explosion relief vents or an explosion suppression system or an oxygen-deficient environment. Bonding and grounding systems may be required.

Dust-handling systems (such as exhaust ducts, dust collectors, vessels, and processing equipment) should be designed to limit or prevent leakage of dust into the work area.

Do not allow dust to accumulate on flat surfaces, on rafters or building structural components. Routine housekeeping should be instituted to reduce dust accumulation. Use Avoid dispersal of dust in the air; use vacuum or wet sweeping methods. Do not use compressed air to clean surfaces.

Keep away from all ignition sources including heat, sparks, and flame. Where dust accumulations occur use non-sparking tools.

7.2 CONDITIONS OF SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES
Store in a cool dry place. Store in a tightly closed container/bag.
The packaging material should have reasonable moisture and air barriers and comply with food regulations.
7.3 SPECIFIC END USE(S)
See overview of the exposure scenario and summary of risk management measures in Appendix 1

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 CONTROL PARAMETERS
Exposure limits: Nuisance dust (also called particulate not otherwise regulated (PNOR)).
OSHA PEL: 15 mg/ mg/m3 Total dust
5 mg/m3 Respirable dust
ACGIH TLV: 10 mg/m3 Inhalable dust
5 mg/m3 Respirable dust
15 mg/m3 Total dust

Safety Data Sheet

CITRIC ACID FCC/USP PWD

8.2 EXPOSURE CONTROLS
APPROPRIATE ENGINEERING CONTROLS:
Ventilation: See NFPA 61, Standard for the Prevention of Fire and Dust Explosions in Agricultural and Food Processing Facilities, 2008 Edition, and National Fire Protection Association 650, Standard for Pneumatic Conveying Systems for Handling Combustible Materials, 1997 Edition and other related standards. Normal industrial hygiene measures should be sufficient for protection of employees from exposure to dusts. Local and mechanical exhaust is desirable when dumping bags.

APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT:
Eye protection: Safety glasses are recommended. Safety goggles are desirable when dumping bags.
Emergency wash facilities: Eye wash is recommended for conditions where dust generation is likely.
Special protective clothing: Not normally required.
Gloves: Not normally required. Use ordinary work gloves if dust dries skin.
Respirator: NIOSH approved N-95 dust respirator if working in situations that could generate large amounts of airborne dust.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:
See section 5.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1 INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES

- Physical form	Solid
- Color	White to off-white
- Odor	Essentially odorless to very slight sugar odor
- pH (concentration)	NA
- Boiling point	104°C (219 °F)
- Flash point	345°C
- Melting/freezing point	approx. 153°C at 1,013 hPa
- Decomposition temperature	NA
- Auto-ignition temperature	NA
- Explosion properties	NA
- Oxidising properties	NA
- Vapour pressure	2.21*10-6 Pa at 25°C
- Vapor density	0.62 (Air = 1)
- Relative density	1.665at 20°C

TATE & LYLE

Safety Data Sheet

CITRIC ACID FCC/USP PWD

- Bulk density	Not Established
- Specific gravity	15 °C (1.24 at 59 °F)
- Viscosity	Not Established
- Water solubility	590 g/L at 20°C
- Solubility (non aqueous)	Methyl alcohol: completely miscible
- Partition coefficient	In OCTANOL/ WATER (log value): Log Kow: -0.2 to -1.8
- Dissociation constant	pKa: 3.13, 4.76 and 6.4 at 25°
- Evaporation rate	Less than 1 (Butyl acetate =1)

9.2 OTHER INFORMATION

SECTION 10: STABILITY AND REACTIVITY

10.1 REACTIVITY
Stable

10.2 CHEMICAL STABILITY
Stable under normal conditions.
Polymerization will not occur.

10.3 POSSIBILITY OF HAZARDOUS REACTIONS
Not applicable

10.4 CONDITIONS TO AVOID
Practices which produce dust or disperse finely divided dust in air.
See NFPA 61. Standard for the Prevention of Fire and Dust Explosions in Agricultural and Food Processing Facilities, 2008 Edition, and other related standards.

10.5 INCOMPATIBLE MATERIALS
Oxidizing agents, strong acids

10.6 Hazardous decomposition products:
Nothing unusual

SECTION 11: TOXICOLOGICAL INFORMATION

11.1 INFORMATION ON TOXICOLOGICAL EFFECTS

- Inhalation	ORAL: LD50: 5400 – 5790 mg/kg bw (mouse) / LD50: 11700 mg/kg bw (rat) DERMAL: LD50 >2000 mg/kg bw rat
- Ingestion	No effects known or anticipated.

Safety Data Sheet

CITRIC ACID FCC/USP PWD

- Skin irritation / corrosion	Sustained exposure in a dusty manufacturing environment may result in mechanical irritation in the creases of the skin, particularly at the fingers, or other drying effects. no health effects known or anticipated.
- Eye irritation	Irritating to eyes.
- Skin sensitisation	Not sensitizing
- Chronic toxicity	Not known or anticipated
- Genetic toxicity	Not known or anticipated
- Carcinogenicity	Not classifiable as Carcinogen.
- Reprotoxicity	Not known or anticipated
- Specific effects	Not applicable

SECTION 12: ECOLOGICAL INFORMATION

12.1 TOXICITY
LC50 for freshwater fish: 440 mg/l
EC50/LC50 for freshwater invertebrates: 1535 mg/l.

12.2 PERSISTENCE/DEGRADABILITY
Ready biodegradable

12.3 BIOACCUMULATIVE POTENTIAL
Log Kow <3, not bioaccumulative

12.4 MOBILITY IN SOIL
Not applicable

12.5 BPT, vPvB
The substance does not meet the criteria for PBT or vPvB.

12.6 OTHER ADVERSE EFFECTS
None known

SECTION 13: DISPOSAL CONSIDERATIONS

13.1 WASTE TREATMENT METHODS
Follow local, state and federal regulations for product disposal. Not a hazardous waste unless contaminated with hazardous products.

SECTION 14: TRANSPORTATION INFORMATION

International regulations (RID/ADR; RTMDR; IMDG; IATA/OACI): Not classified as dangerous for transport.
DOT shipping label: Non-hazardous

SECTION 15: REGULATORY INFORMATION

15.1 SAFETY, HEALTH AND ENVIRONMENTAL REGULATIONS
According with the version of the Globally Harmonized System of Classification and labeling adopted in the United States and Regulation 1272/2008/EC(CLP): Classified

15.2 CHEMICAL SAFETY ASSESSMENT
US FEDERAL REGULATIONS:
Clean Air Act:
ODS: Not applicable.
SARA (EPCRA) Section 313 (40 C.F.R. § 372.65): Not applicable.
TSCA Status: On TSCA inventory.

STATE REPORTING REQUIREMENTS:
California Proposition 65: Not applicable.

SECTION 16: OTHER INFORMATION

See Hazard Communication Guidance for Combustible Dusts, OSHA 3371-08 2009, U.S. Occupational Safety and Health Administration, https://www.osha.gov/Publications/3371combustible-dust.html (accessed 10/8/14)
And
NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, for general safe handling and design guidance.

Other classifications of the substance:
TSCA STATUS: On TSCA Inventory.
FDA STATUS: Citrus acid, Anhydrous complies with FDA Regulation 21 C.F.R. § 184.1033;
CALIFORNIA PROPOSITION 65: Not applicable.
HMIS rating:
Health: 1
Flammable: 0

Safety Data Sheet

CITRIC ACID FCC/USP PWD

Reactivity: 0
(0 = minimal ; 1 = slight ; 2 = moderate ; 3 = serious ; 4 = severe)

Safety Data Sheet according to Commission Regulation (EU) No 453/2010 of 20 May 2010 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

DISCLAIMER OF LIABILITY

The information in this SDS is collected from reliable sources. However, the information is provided without any warranty, expressed or implied. The conditions or methods of handling, storage, use or disposal of the product might be beyond our control and knowledge. For the avoidance of doubt, we shall in no such circumstances be under any liability in respect of loss, damage or expenses arising from handling, storage, use or disposal of the product by your company and/or your subcontractors. This SDS is only applicable for the product mentioned in the identification chapter and title. If the product is used as a component in another product, this SDS may not be applicable on the composite material.

Annex I

SUMMARY OF RISK MANAGEMENT MEASURES
Safe use has been demonstrated by calculation of risk characterisation ratios where appropriate, while qualitative considerations were stipulated where quantification was not possible. The risk characterisation is based on the following risk management measures:
Exposure scenario ,,Description ,,General measures ,,Specific Human Health risk management measures ,,Specific Environment risk management measures ,,
ES1 ,,Production and intermediate use on production sites ,,Good working practices, containment and safe handling in line with industry best practice. ,,(i) Local Exhaust ventilation (LEV)
(ii) Personal Protective Equipment (PPE): Working clothing, protective gloves and safety glasses. Dust masks in areas where dust may be present. In case of open handling of larger quantities or accidental release, a particle mask or respirator with independent air supply is recommended. ,,(i) Treatment of effluent in waste water treatment plant. ,,
ES2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17 ,,Industrial use ,,
Good working practices, containment and safe handling in line with industry best practice. ,,(i) Local Exhaust ventilation (LEV) if
aerosol mists or dusts are present.
(ii) Personal Protective Equipment (PPE): Working clothing, protective gloves and safety glasses. Dust masks in areas where dust may be present. In case of open handling of larger quantities or accidental release, a particle mask or respirator with independent air supply is

Safety Data Sheet

CITRIC ACID FCC/USP PWD

recommended. ,,(i) Treatment of effluent in waste water treatment plant. ,,
ES10 ,,Textile industry ,,Good working practices, containment and safe handling in line with industry best practice. ,,(i) Local Exhaust ventilation (LEV) if aerosol mists or dusts are present.
(ii) Personal Protective Equipment (PPE): Working clothing, ,,(i) Treatment of effluent in waste water treatment plant.
(ii) No direct discharge into the marine environment ,,

Univar USA Inc Safety Data Sheet

For Additional Information contact SDS Coordinator during business hours, Pacific time: (425) 889-3400

Notice

Univar USA Inc. (”Univar”) expressly disclaims all express or implied warranties of merchantability and fitness for a particular purpose, with respect to the product or information provided herein, and shall under no circumstances be liable for incidental or consequential damages.

Do not use ingredient information and/or ingredient percentages in this SDS as a product specification. For product specification information refer to a product specification sheet and/or a certificate of analysis. These can be obtained from your local Univar sales office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Univar makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Univar's control and therefore users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product, or from the publication or use of, or reliance upon, information contained herein.

This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process

ATTACHMENT

DOWNHOLE TOOLS/REAMERS

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

Reaming Tools/Equipment

The reamers utilized for hole-opening operations are custom fabricated by Michels Corporation, however equivalent or better tools may be substituted depending on availability of other suppliers' products, or, if changes in anticipated drilling conditions are encountered. Michels R&D program for downhole tools includes monitoring of performance & longevity of reaming equipment in differing soil conditions throughout North America as well as foreign destinations. Utilizing the latest technology, tooling and materials available to the industry is a continuing goal of Michels.

There is essentially no limit to the length of time these tools can be run since simple repairs can be made in the field to keep the reamers in good working condition. The condition of the reamers will depend on the type of ground encountered; typically these reamers are discarded when they are observed to be beyond field repair. Initial maximum run time for specific reamers recommended by Michels is 50-100 hours.

TELECOMMUNICATIONS • GAS PIPELINE • DIRECTIONAL DRILLING • ELECTRICAL • AGGREGATE MATERIALS
SEWER, WATER & TUNNELING • CONCRETE • ENGINEERING • DESIGN/BUILD

BROWNSVILLE, WI • SEATTLE, WA • MILWAUKEE, WI • HARRISBURG, PA • NEENAH, WI • TOPEKA, KS • GREEN BAY, WI • CALGARY, AB

"AN EQUAL OPPORTUNITY EMPLOYER"

ATTACHMENT

DRILL FLUID RECYCLING
MUD CLEANING EQUIPMENT

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

Drill Mud Cleaning and Disposal

The first phase of the mud cleaning system is displacement of solid returns at the shakers. Heavy solids are sifted out by a shaker with screens and deposited into a pit. From here they will be transported by dump truck to a site for disposal.

Drill Mud Cleaning Equipment Specifications

Volume of Mixing/Scalper Tank	54.0-Bbls
Volume of Desander Tank	72.0-Bbls
Volume of Desilter Tank	72.0-Bbls
Quantity of Scalping Shakers	1.0-Shakers
Mesh Size of Scalping Shakers	10-20 Double Stacked
Desander Capability	2 @ 500-GPM (1,000 GPM Total)
Desander Cones	2.0-Cones
Desander Mesh Size	40 to 165
Quantity of Desilter Cones	10 Ea @ 100-GPM
Desilter Mesh Size	60 to 250
Steel Mud Circulating Tank Volume	160-Bbls
Returns Tank Volume (Mud Pit)	320-Bbls
Cuttings Tank Volume (20-yd Roll-off)	150-Bbls
Mud Screening, Max Pass Size	40 Mesh

Due to the quantity and types of mud pumps owned by Michels and located on multiple drill sites Michels utilizes one of the following pumps based on availability and geographic location:

Bentonite Pump Capabilities (ENTRY/EXIT)

Name Brand	Gardner Denver OPI-350
Liner Size	6-Inches
Maximum Pressure	1,469 PSI
Maximum Flow Rate	529 GPM
Gallons Per Stroke	2.94 Gallons Per Stroke

Proprietary to Michels

Bentonite Pump Capabilities (ENTRY/EXIT SIDE)

Name Brand................................Ellis Williams W-446 Super Force Triplex Piston Model

Liner Size... 6-Inches

Maximum Pressure.. 1,027 PSI

Maximum Flow Rate..661 GPM

Gallons Per Stroke....................................2.20 Gallons Per Stroke

Bentonite Pump Capabilities (ENTRY/EXIT SIDE)

Name Brand...Gardner Denver OPI-700

Liner Size... 7-Inches

Maximum Pressure.. 1,690 PSI

Maximum Flow Rate..599 GPM

Gallons Per Stroke....................................3.99 Gallons Per Stroke

Proprietary to Michels

MICHELS®

ATTACHMENT

MICHELS ROLLERS

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

Michels Directional Crossings Pipeline Rollers

General Description: Steel tubing welded frame supporting two urethane coated rollers. Pillow block bearings are used to mount the rollers. The rollers are opposed to each other and set @ 125° to accommodate various pipe sizes.

Size: Footprint of 50”x48” with overall height of 40”

Load Capacity: 167,000 Lbs per assembly

Shafts: Material is steel 4140, 2-15/16 Diameter.

Frame: Frame weldment made of steel ASTM A-500 Grade square tubing

Rollers: 11” O.D., 20” face width, 8-5/8” core size. Coating is urethane approximately 1” thick (95 Shore-A)

Bearings: 4-required per assembly, 2 on each coated roller. Manufacturer is Linkbelt, Part Number PB22447E w/ 2-15/16” spherical roller, self aligning, contact seal.

Load Capacity for Bearings;

Basic	= 41,800 Lbs
Static	= 71,500 Lbs,
L-10 Life	= 9,410 Hours @ 300 RPM

ATTACHMENT

MICHELS CONTINGENCY PLANS

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

DIRECTIONAL DRILL CONTINGENCY PLANS

WBI

Lake Sakakawea Crossing

Proprietary - Michels

Horizontal Directional Drilling

CONTINGENCY PLANS

Michels believes contingency planning begins with the appointment of competent field personnel having the greatest amount of experience to complete a project. Michels' personnel are some of the most qualified drilling experts in the industry, as demonstrated by resumes and experience lists highlighting past projects completed. With the abundant resources at their disposal, Michels has overcome risks associated with some of the most difficult drilling projects ever attempted and has evolved into an industry leader. Michels Project Managers are some of the best in the industry utilizing the many resources available while coordinating the various facets of a productive drill site.

Michels' Drill Superintendents are highly experienced at utilizing drill rigs and ancillary equipment of every size. They have worked up though the ranks providing them a complete and comprehensive understanding of safety, environmental monitoring, manpower, equipment operations and repairs for each phase of the drilling operation. As noted on the attached resumes, each Superintendent has drilled throughout North America and has encountered varying soil conditions, from sands, gravels, clay and cobble to solid rock formation. They are well respected throughout the industry and have worked with a majority of the major Pipeline Construction Companies in North America. Michels' personnel maintain continuous certification through accredited schooling for all phases of the drilling operation.

Contingency planning is conducted in response to unforeseen events and conditions, which could occur during normal operating sequences. The following contingency plans are in place to ensure completion of the project in accordance with governing authorities. The Field Operations Superintendent oversees preventative measures before product line installation. This alleviates the probability for adverse conditions such as stuck pipe. The following are some of the more common variables, which we have developed contingency plans for. They include but are not limited to:

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

Possible Condition: *Inadvertent Drill Fluid Release Response and Control*

Contingency:

A large reduction or sudden loss in drill fluid returns is a signal to the driller and monitoring personnel that monitoring for inadvertent returns should be intensified for possible surface release. Therefore, the proposed drill R.O.W. will be inspected for inadvertent returns at a minimum of twice per shift and becoming more frequent if there is a large reduction or sudden loss. The frequency and results of R.O.W. inspections will be documented and recorded on the daily reports. Early detection and quick response is the key to controlling and/or limiting surface release. Additional information regarding access to USACE-Owned Land is addressed later in this document.

The absence of an open bore-hole conduit or the presence of a major formation fracture can lead to partial and/or potentially total loss of drilling fluid circulation. While it is impossible to determine the precise nature of this type of fluid loss, it is possible to accurately monitor for it by watching for a significant difference between the rate fluid is being pumped down-hole and the rate it returns to the surface. The drilling fluid pumping rate and the rate of drilling fluid return to the surface is constantly monitored by the mud technician and relayed to the driller while the HDD operation is progressing. The driller will know immediately if an unusually high volume of drilling fluid is being lost down-hole, depending on the ground conditions encountered in the crossing and taking into account the volume used to fill the bore-hole. Should the driller believe that circulation is being completely lost he will implement the following procedures:

1) Temporarily cease drilling operations, including pump shut down;
2) Dispatch experienced observers as required to monitor the area in the vicinity of the crossing, for inadvertent returns of drilling fluid at the surface or in the river;
3) Identify the position of the drill head in relation to the point of entry
4) Re-start the pump and stroke the bore-hole up and down in stroke lengths up to 30 feet up to 6 times but no fewer than 2 in an effort to size the bore-hole annulus and re-open the circulation pathway.

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

In addition, the thixotropic properties of the drilling fluid may be thickened within the guidelines set forth by the manufacturer to aid in re-establishing circulation as required depending on bore-hole conditions. Observers will regularly monitor for inadvertent fluid returns as long as the pump remains on. Occasionally, based on the driller's discretion, it may be useful to increase the stroke length up to 90 feet or past the point at which he believes circulation was lost.

If circulation is re-established, drilling will proceed as usual and monitoring for inadvertent fluid will take place once again if the rate of drilling returns progressively decreases at the fluid entry pit. If circulation is not re-established, monitoring for inadvertent fluid returns to the ground surface and river will continue and drilling will proceed.

If the amount of inadvertent returns is not great enough to allow practical collection, the affected area will be diluted with fresh water and allowed to dry and dissipate naturally back into the earth. If the amount of returns exceeds that which can be suitably contained with hand placed containment barriers, small collection sumps (less than 3.8 cubic meters) will be used to pump fluid back to the solids control system.

When drilling fluid returns are observed to be continuously surfacing above ground at an accessible location the following procedure will be followed:

1) Immediately cease pumping of drilling fluid;
2) Contain the location such that the drilling fluid cannot migrate across the ground surface;

   On-Site Materials and equipment used for containment:

   - Straw Bales, if available;
   - Silt Fence;
   - Check Dams;
   - Backhoe for Accessible Areas;
   - Shovels;

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

- Portable Pumps;
- 100 feet of Hose.

3) Excavate a small sump pit at the location and provide a means for the fluid to be returned to either the drilling operations or a disposal site (i.e. pump through hose or into tanker);
4) Notify on-site contractor supervisor and Owner's representative as required by the communication plan;
5) Continue drilling operations, maintain the integrity of the containment measures, and monitor the fluid returns as required to ensure that no surface migration occurs;
6) Clean-up is carried out once inadvertent returns are contained/controlled;
7) Fluid pumped to a secure containment vessel;
8) Area is diluted with water;
9) Area is restored to original condition.

If inadvertent drilling fluid returns are observed to be surfacing above-ground at a location that is inaccessible, i.e. along the bed of a water body, or, into the water, the following procedures will be followed:

Ensure that all reasonable measures within the limitations of the technology have been taken to re-establish circulation;

Continue drilling with the minimum amount of drilling fluid required to penetrate the formation and successfully install the product line.

Typically lost circulation has the highest probability of occurring while the pilot hole is being drilled due to the smaller bore-hole annulus and the relatively large volume of solids being displaced and carried out in the drilling fluid. In the course of drilling the pilot hole, circulation will often be temporarily lost as the pilot bit is advanced through more permeable or less

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

competent sections of the ground formation when fluid pressures are at a maximum. As the pilot bit advances beyond these sections of the bore-hole fluid pressure will fall and circulation within the bore-hole will naturally be re-established. Much of the fluid lost to the formation under the greater pressures will return back to the bore-hole as the pressures fall, in which case the drilling fluid is not likely to migrate to the surface or the river. It is also possible for the drilling fluid to leave the bore-hole and migrate in a direction other than the ground surface or the wetland, in which case it may never be observed even if circulation is lost for long periods of time.

It should be noted that frequently drill cuttings generated as a result of the drilling process will naturally bridge and subsequently seal fractures or voids as drilling progresses, thus providing another means of re-establishing circulation. This is especially likely during the reaming process as higher volumes of larger cuttings are typically generated. Therefore it is usually beneficial to proceed with the pilot hole even if circulation has not been re-established since it will likely be re-established at some point during the reaming process.

The use of an environmentally safe drilling fluid ensures that even in the unlikely event of fluid loss at sensitive areas, there will be no adverse environmental impact other than a temporary minor increase in turbidity until the drilling fluid dissipates. It is important to note that any temporary increase in turbidity as a result of inadvertent drilling fluid loss while directional drilling the crossing will be several orders of magnitude less than that of an open-cut crossing.

Contingency Access Plan for USACE-Owned Lands in Event of Unanticipated Return

In event of an unanticipated return of drilling fluid on U.S. Army Corps of Engineer (USACE) owned lands, WBI Energy, Inc. (WBI) and its contractors would mobilize clean-up crews as soon as practicable. Crews would utilize access points and routes identified on Figures 1 and 2 (North Side and South Side of the Lake Sakakawea horizontal directional drill). To the extent practicable WBI Energy will use publically available access roads to reach inadvertent return cleanup areas. WBI and its contractors will notify landowners prior to the commencement of HDD drilling activities and will work expediently to contact landowners in event of an inadvertent return.

If necessary, equipment used to access and clean-up inadvertent returns of drilling fluid on the ground surface of USACE owned property would include rubber tired vehicles, such as pick-ups

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

and vacuum trucks (vac-trucks). It is anticipated that for an inadvertent return of drilling fluid to the ground surface, access to USACE owned property would follow the paths illustrated on Figures 1 and 2, the primary route on both sides of the Lake Sakakawea HDD would be along the permanent right-of-way leading from the drill box to the banks above the shoreline. From the permanent right-of-way, a direct perpendicular route would be taken to reach the site of the inadvertent return with the shortest path. To the maximum extent practicable, woody vegetation (trees and shrubs) will not be cleared; access paths would avoid trees and general vegetation disturbance to the maximum extent practicable. Where necessary crews will travel around persistent, live, woody vegetation.

If access is necessary along the beach on either the north side of Lake Sakakawea, as shown in Figure 1, or the south side of Lake Sakakawea, as shown in Figure 2, crews will either access the clean-up location by walking in, or utilizing small, low ground pressure equipment, such as UTVs or ATVs. A secondary option for beach access would be to mobilize a small boat from a public dock to bring personnel and cleanup equipment to the beach. Every effort will be made to access clean-up sites, if necessary, from the higher ground along the permanent right-of-way. After clean-up of drilling fluid is complete, crews will follow the same path out that was taken in to the inadvertent return, to minimize additional disturbance. Calls will be made to the appropriate USACE point of contact as soon as feasible, but not greater than 24 hours from the time crews are mobilized to clean-up the inadvertent return.

Attachment – Figure 1
Attachment – Figure 2

Possible Condition: *EQUIPMENT MALFUNCTION/FAILURE-SPARE PARTS*

Contingency: Based on past experience, Michels can reasonably estimate the average life expectancy of all major components of the drilling operation under normal operating conditions. The operating hours of the equipment are recorded prior to start of drilling operations and maintained throughout completion of the crossing. Documentation and maintenance records are maintained by the drilling superintendent so that replacement of key components can be routinely performed in a timely manner to prevent failure. Occasionally, a component of the drilling operation will fail unexpectedly even with the most stringent maintenance and replacement schedule. These types of failures have occurred in the past and

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

Michels has established a spare parts inventory with each drill rig based on the most common failures of this type. Spare parts kept on site include hydraulic pumps, flendor motors, and drive gears. In addition, odd sized or extremely high pressure hydraulic hoses that are not readily available "off the shelf" are kept on site.

Major Spare Parts kept on-site

- 1,800-Mission pump
- 2,500-Halco pump
- Mud Rig – Clutch and Transmission
- 11 – Vise Blocks
- 4 - Vise Hydraulic Rams
- 2 - Rotary Motors
- 2 – Drive Motors
- 1 – Hydraulic Pump
- 2 – Vise Travel Motors
- 1 – Circulation Pump
- 2 – Mud Swivels
- 2 – Complete Rebuilds for OPI-350
- Rebuild Parts for EW-446
- Electric Motor for Halco
- Electric Motor for Cooling Fans
- 2 – Shaker Motors

It is not feasible to maintain a complete spare parts inventory with each drilling rig on site so Michels immediately identifies local sources for commonly available spare parts and equipment upon job start up. Spare parts not readily available locally are kept in one of four Michels' permanent warehouse locations in Bothell, Washington; Adrie, Alberta Canada; Harrisburg, Pennsylvania; or Brownsville, Wisconsin, where the parts can be shipped overnight to the job site to prevent extensive down time caused as a result of equipment failure if necessary.

Possible Condition: *STUCK PIPE*

Contingency: The following are some of the preventative measures invoked by the Drilling Foreman in order to reduce the chances for complications while pulling back product pipe.

1. Utilize drilling equipment capable of supplying enough power to remove seized pipe from either entry or exit location.

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

2. Performing an extra reaming pass with the purpose of cleaning out the reamed hole (not a cutting pass) and adding proper lubrication with precise weight bentonite mixture.
3. Reduce torsional and axial loads through the use of properly spaced rollers, well maintained swivels and creating a smooth transition between downhole exit angle and pipe strung out on top of ground readied for pullback.
4. Utilize Ballasting to control the weight of the pipe by achieving negative or neutral buoyancy.

Contingencies for stuck pipe

If above preventative methods fail and the pipe become seized in the borehole we invoke Best Available Control Technology (BACT). One of the methods involves specific techniques in conjunction with ballasting, which is controlled loading with water. Past experience has shown us that if the leading end of the pipe remains too heavy during ballasting, air can be supplied to this area of pipe, displacing water back toward the middle, and in some circumstances freeing up the point of greatest friction.

If the drilling rig is unable to supply the initial thrust to release the seized pipe, side booms and or track-hoes can supply thrusting pressure from the exit side in order to start momentum. Michels drilling rigs have the potential to supply up to 1,200,000 pounds of thrust and pulling-force, add additional equipment and there is not much that cannot be dislodged.

Not only can force be applied from the drill-rig side but additional force can be applied from the pipe installation side for large diameter installations through the use of a Herrenknect pipe thruster for land to land crossings. This alternative source of power supplied from the opposite end can dramatically assist large diameter pipe pullback during significant changes in the effective weight of the pipe during pullback (buoyancy) caused by either losing circulation or re-establishing circulation unexpectedly therefore causing drastic changes in the buoyancy of the pipe. This method also reduces the risk for damage to pipe coating during pullback by reducing the tensile force needed to pull back the pipe. If the large diameter pipe becomes stuck additional control can be established to move pipe back and forth in the event gravel, cobble and/or boulder sized

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

materials fall in the hole after swabbing. This can be used as an alternative to the percussion hammer which has been used as a contingency measure on previous past projects.

(See Attachment Herrenknect Pipe Thruster)

If percussion assistance is determined to be necessary to supply the energy required to complete the pullback operation, Michels is capable of performing this operation utilizing a GrundoRam percussion hammer supplied by TT-Technologies. The work area needed for invoking hammer assist procedures is located on the pipe pullback side of the crossing. This will encompass an area of 40-feet long x 20-feet wide for staging of the "Taurus" GrundoRam percussion hammer and assist equipment. This pipe-ramming machine has a thrust of up to 2,000 tones and a ramming speed of 180-strokes/minute. A GrundoRam and 1600 CFM air compressor will be made available by Michels on-site. Additional sources for spare parts and accessories should also be identified.

(See Attachment Grundo-Ram Percussion)

A specially manufactured reinforced push ring is positioned at the back end of the product line so that equal transmission of percussion energy can be transmitted down the product pipe, and to protect the steel pipe end while in contact with the GrundoRam "Taurus". The persistent exertion of energy along the descending steel pipeline aids in aggressively sliding the pipe through suspect areas of unconsolidated formation or through areas of cave-in. Although this is not a regular occurrence due to mitigative measures taken prior to installation, Michels has successfully completed this unique form of pipeline pullback assist periodically over the past 10-years and has built a solid reputation as an innovator in this field.

Proprietary to Michels

Possible Condition: *INCLEMENT WEATHER*

Contingency: Key personnel monitor long range forecasts for the project areas to be affected. Various weather services (i.e. NOAA, Weather Channel etc) are monitored by computer for bad weather and potential hurricanes. Regular updates are given to Michels' personnel to make them aware of approaching weather conditions. Evacuation routes will be identified and reviewed with all personnel for potential hurricanes prior to beginning work and responsibilities will

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

be assigned. If electrical storms are projected to affect a drill site, approaching storms will be monitored by radar and radio and communication will be maintained between Project Manager and personnel. Electrical storms can potentially cause serious problems for a drilling operation. The Drill Superintendent must use his discretion as to the appropriate safe action to be taken for the safety of the crew and entire drilling operation. Proper grounding must be maintained throughout a drilling operation.

A safe area on the site will also be designated for response to an approaching tornado. Stream gages will also be identified and monitor for potential flooding conditions.

Possible Condition: *NOISE*

Contingency: Noise reduction can be accomplished using several methods. To begin with, a site reconnaissance or noise modeling must be completed by the Owner to determine what decibel (dB) level will be allowable at the affected locations. Some of the Noise Control Considerations include: Redirection of sound waves or deadening just by the simple positioning of drilling equipment and strategic location of frac-tanks. This option generally has little affect upon cost and may cause minor inconveniences for the drilling operation.

Another option is to utilize hospital/industrial grade mufflers to deaden sound as it leaves engines of motorized equipment. This could impede maximum operating output from equipment and also slow down the drilling operation.

More costly forms of Sound Control include; Building walls made of hay bales, sound curtain matting or plywood, or, building sound deadening enclosures constructed of wood.

Possible Condition: *DAMAGE TO EXISTING UTILITIES*

Contingency: Preventative measures include proper notification of local utilities through area one-call programs or site investigation and recording of area markers, manholes and valves. Pot-holing existing utilities is the most reliable method of exact utility location

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

Damage to existing utilities or structures may occur during drilling or reaming operations. Occasionally unknown or unmarked utilities may be hit during drilling or reaming operations. If this circumstance does occur the type of utility is first identified so that severity of response can be identified. Emergency personnel for the identified utility are then notified. Pertinent personnel for the Owner and/or Owner Representatives are then notified, following the chain of command. Decisions are then made as to appropriate action to be taken.

Possible Condition: *ENCOUNTERING SUBSURFACE OBSTRUCTION*

Contingency: Occasionally an unknown subsurface obstruction is encountered during drilling operations such as; 1) buried tanks, 2) Building foundations/piers/pilings, 3) buried junk/cars. If this situation occurs, the location of the object is first identified in relation to the drill path. If the current R.O.W. is ample and soils provide adequate steering capabilities, the drill head is pulled back to a pre-calculated point along the previously drilled path and the drill bit is rotated and steered around the obstruction.

The chance of encountering an obstruction during reaming operations is highly unlikely. But, if this should occur, the magnitude of the obstruction must first be evaluated. If the obstruction is determined to be impassible, operations will be halted until an agreeable solution can be determined.

Possible Condition: *RUNNING SANDS*

Contingency: It is possible that loose cohesionless soils, such as running sands, may not support the drilled annular space over a long directional drill length. Although this circumstance sounds serious, it may not prevent the installation of a pipeline. Mechanical agitation of the formation by the downhole tool and trailing drill string, combined with the injection of bentonite drilling fluid causes the soils to experience a decrease in shear strength. When the resulting shear strength is low enough, the soil will react in a fluid-like manner thus, allowing the pipeline to be pulled through it.

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

It would be highly unusual for soil strata to be of the same consistency from drill entry to drill exit, especially at the various depths encountered during pilot hole drilling. Prior to drilling, only general soil information is known for estimating and hypothesizing. The type of drilling fluid providing the best performance capabilities for the conditions is chosen based upon this information. Adjustments are then made in the field correlating to specific soil properties in order to improve performance.

Proprietary to Michels

Possible Condition: *PIPELINE MISALIGNMENT*

Contingency: Today's technology in the directional drilling industry provides state of the art instrumentation and tracking capabilities. The directional drill alignment is accurately known to within ± 0.01° or, ± 1.4 feet per 1,000 feet in both profile and plan view. The addition of Para Tracker as a secondary form of verification and validation for plan view orientation, left and right of center line, provides precise information which is updated regularly during drilling operations. The most frequent cause of misalignment is the inability to steer in transitional zones near the exit location. These soils may include varying degrees of overburden or formations allowing unpredictable degrees of penetration. The orientation or angle of these zones from horizontal may deflect the drill bit having a direct affect upon steering capabilities.

In any case, the steering probe maintains its tracking capabilities and allows the Survey Technician continuous feedback for locating the drill string in a three dimensional plane. Any deviation from the targeted exit is known and can be compensated for. If the target area is not large enough to accommodate the deviation, the drill string can be pulled back to a calculated point and be redirected toward the proposed exit location.

Possible Condition: *PRESSURE CONTROL*

Contingency: An important function of the drilling fluid is to prevent the uncontrolled entry into the hole of fluids from the formation penetrated by the bit. The pressure exerted by the column of drilling fluid (hydrostatic head) must be somewhat greater than the pressure exerted by the formation fluids to allow raising the drill string without any problems. Following are some mitigative measures taken to counteract pressures.

© *Copyright, Michels Directional Crossings, a Division of Michels Corporation*

1. Avoid swabbing drill string (plunging the drill string back and forth with great force)
2. Keep the hole full of drill mud while pulling the drill pipe, especially when hydrostatic head is not much greater than formation pressure.

At any given depth, the hydrostatic pressure (in psi) of the mud column is equal to mud density (in lb/gal) times depth (in feet) times 0.052

Psi	=	lb/gal	x	feet	x	0.052
(hydrostatic pressure)		(density)		(depth)		

Possible Condition: *HOLE COLLAPSE*

Contingency: Most drillable formations, whether consolidated or unconsolidated, have some form of cohesive properties allowing drilling fluid to interact and add to its bonding properties, thus avoiding hole collapse. Some soils, such as large gravel zones or cobble areas may not be capable of holding a hole. If this type of formation exists in the overburden soil (upper strata), a steel casing pipe may be washed over the drill stem into competent soil and left in place during operations. Drilling and reaming operations will then resume utilizing this conduit as a means of carrying drill cuttings back up-hole without obstruction. This reduces the chance for lost circulation. Under this circumstance, the integrity of the pipe coating **cannot** be guaranteed.

If this type of formation exists throughout the borehole, it should be known and researched prior to drilling so that an alternate route may be researched. The route that provides the best chance for success should be the route chosen. If a competent drilling contractor properly investigates a route, the chance for a hole collapse is greatly reduced.

Possible Condition: *PIPELINE COLLAPSE*

Contingency: Pipeline collapse during pulling operations is a rare occurrence caused by certain factors, which must be considered before pullback begins. Some of the main factors, which must be considered during pre-planning stages or prior to pipeline pullback operations, include:

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

1. Pre-engineered profile must reflect the minimum radius of curvature calculated for the given pipe (wall thickness, pipe size, tensile strength, X-rating)
2. Drilled profile should not exceed pipe tolerance throughout the drilled borehole.
3. Experienced directional drilling Survey Technician verifies three joint radii calculations for maximum degree of bend per 30-foot joint.
4. Industry standard safety factor should be included in the profile and calculations taking into account unknowns.
5. Exit and entry angles must be within specified tolerances so that support equipment capabilities are not exceeded in order to provide the pipeline a smooth, uninhibited transition into the opened hole.
6. Calculations performed for anticipated stresses the pipe will be subjected to during pullback (i.e. Pull loads, tensile, unconstrained buckle, hoop stress.) This way upper stress limits will be known.
7. Proper ballasting of product line through controlled loading of water to the leading end of pipeline. This procedure also provides internal pressure to the product line as a counter balance to external pressures. If water is added to the opened end of the product line and allowed to flow down toward the leading end during pullback, a vacuum may occur creating undue stress on the product line which would increase the possibility of implosion or collapse. Therefore, a conduit is positioned to carry water through the interior of the product pipe dispersing water at the leading end of the pipe filling it from the lowest portion (elevation) toward the highest elevation. Volume calculations are maintained to ensure only the lowest portion of the pipe is maintained full of water.

The appointment of highly competent personnel experienced in pipeline pullback procedures is a must. There is no substitute for experience. Experienced personnel should be placed at critical positions at both the drill entry and exit locations.

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

ATTACHMENT

FIGURE 1

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

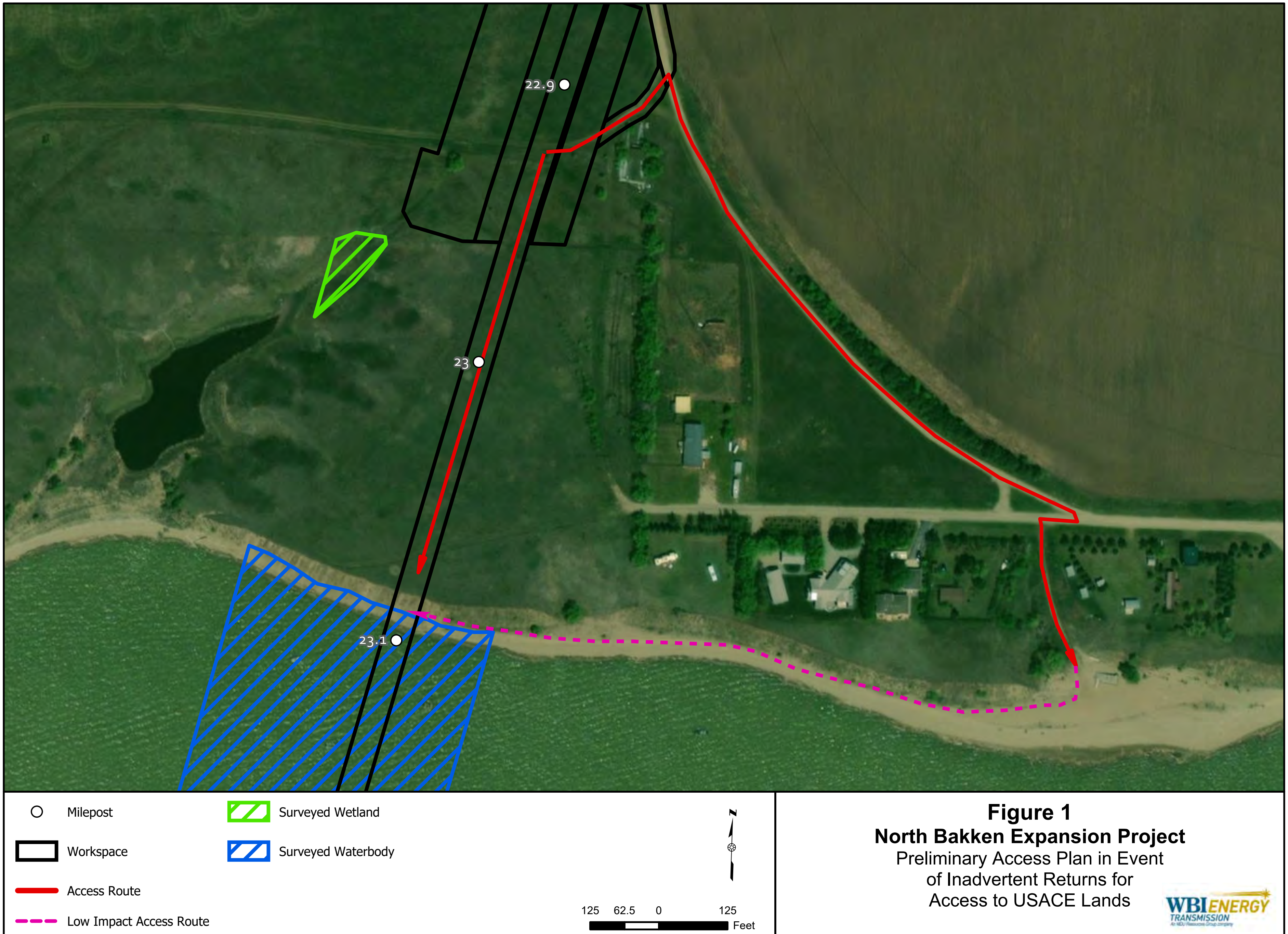


Figure 1

North Bakken Expansion Project

Preliminary Access Plan in Event of Inadvertent Returns for Access to USACE Lands

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\2020\ACE_408_Permit\ACE_408.aprx | Revised: 7/20/2020 | Scale 1:2,867

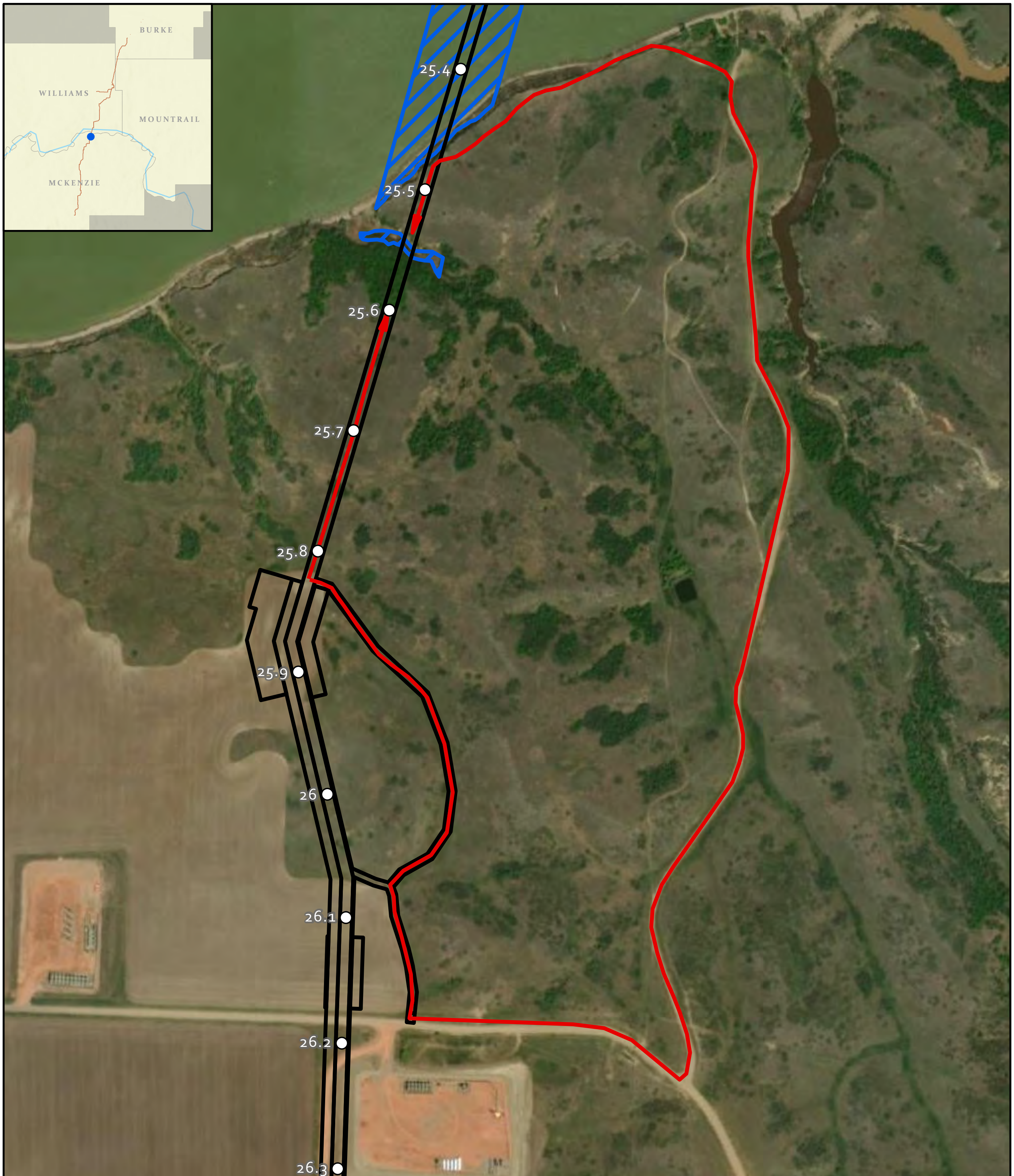
Drawn By: RJC

ATTACHMENT

FIGURE 2

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation



Milepost

Workspace

Access Route

Surveyed Waterbody

250 125 0 250
Feet

Figure 2

North Bakken Expansion Project

Preliminary Access Plan in Event of Inadvertent Returns for Access to USACE Lands

WBI ENERGY TRANSMISSION

File: M:\Clients\V-X\WBI\North_Bakken_Expansion_ArcGIS\2020\ACE_408_Permit\ACE_408.aprx | Revised: 7/20/2020 | Scale 1:7,000

Drawn By: RJC

ATTACHMENT

GRUNDO RAM
PNEUMATIC PIPE RAMMER

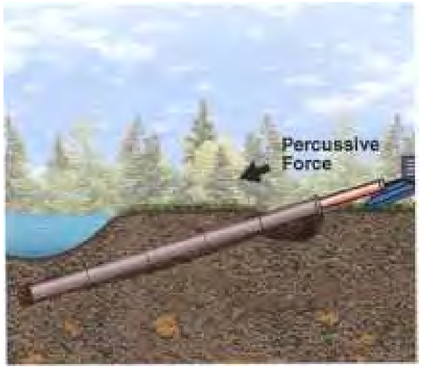
Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation

Percussive Power
for directional drilling assist

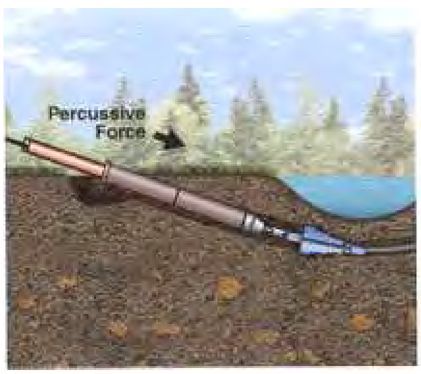
Conductor Barrel™
A sure start for your bore even in the worst soil.

- Ram casings through difficult soil conditions to more desirable drill starting points.
- Guide down-hole or mud motors to rocky soils through the conductor barrel.
- Provides friction-free section for product pullback.



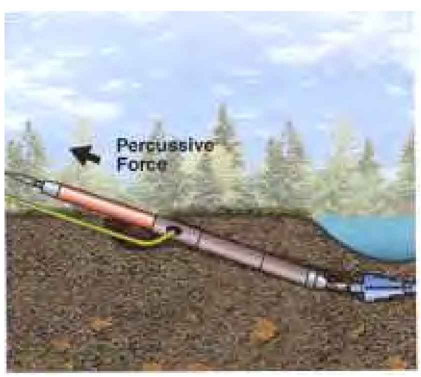
Pullback Assist
Overcome hydrolock with a pipe rammer.

- Rammer attached to product pipe during pullback.
- Percussive action keeps pipe moving and helps prevent high levels of pullback stress.
- Percussive power frees immobilized product pipes.



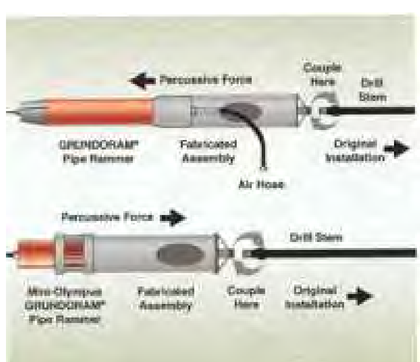
Pipe Removal
Remove stuck product pipe and bore again.

- Rammer attached to product pipe after pullback fails.
- Percussive action pulls product pipe, removing it from the bore.
- Salvage the job and bore again.

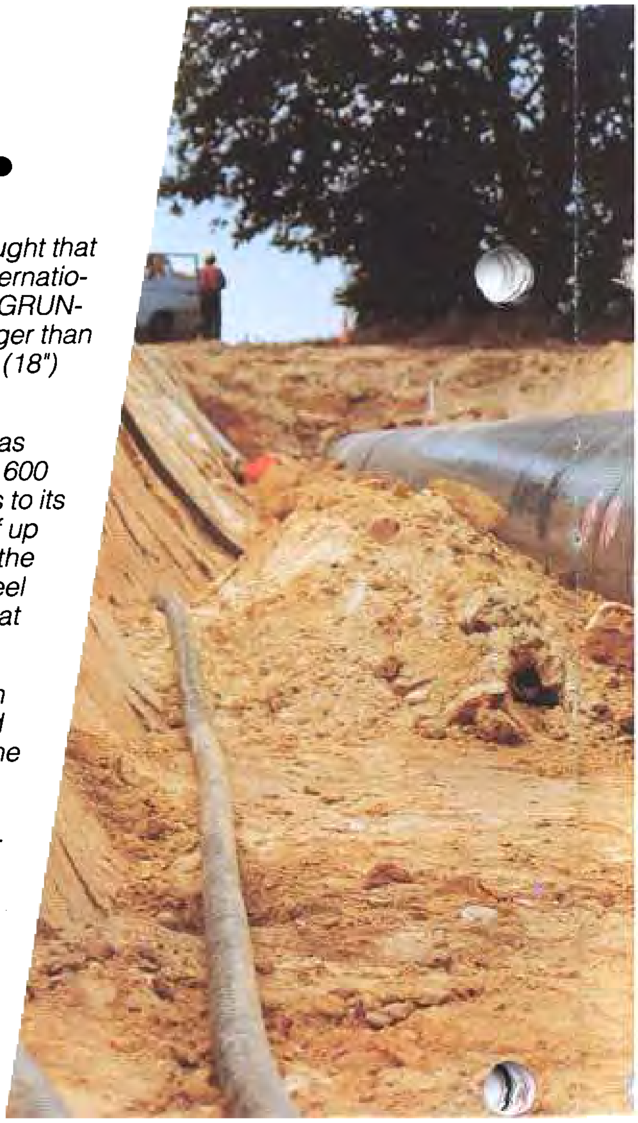


Drill Stem Recovery
Retrieve stuck drill stems.

- Pipe Rammer fitted with a special sleeve.
- Stuck drill stem welded to the back of the rammer sleeve.
- Percussive power frees drill stem, saving time and money.



The strongest in existance ...

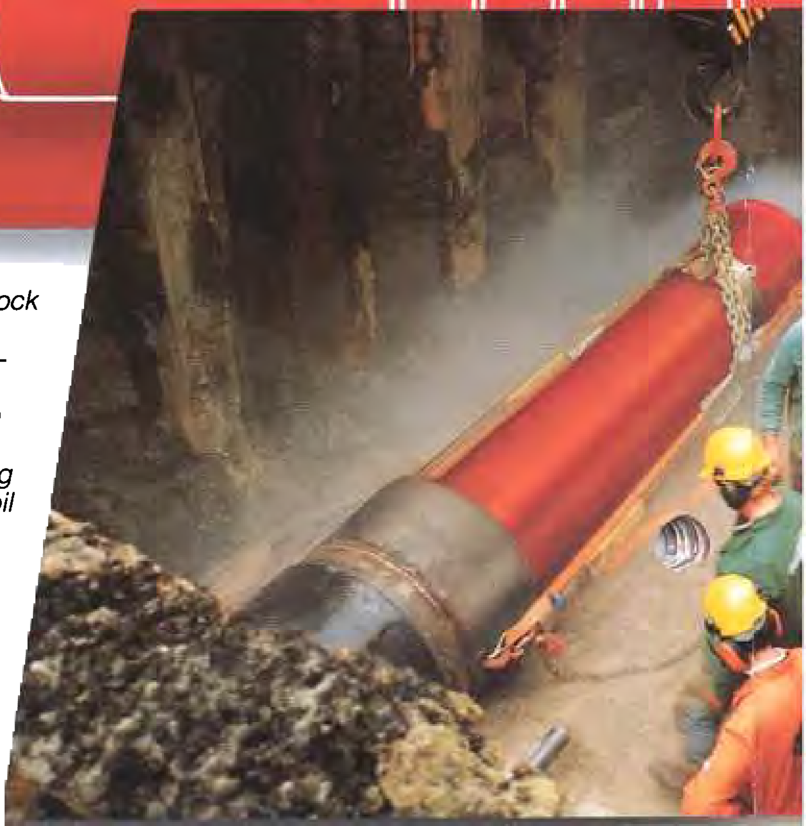


Who would have thought that there would be an international requirement for a GRUNDORAM hammer - larger than the GOLIATH 450 mm (18") machine?

International demand has made the new TAURUS 600 mm (24") a must. Thanks to its dimensions and thrust of up to 2,000 tons (4,480 lbs) the TAURUS is the largest steel pipe ramming machine that exists.

Steel pipes up to 2,000 mm (80") can now be installed with this powerful machine when installing casing or product pipes for the water, sewage, telephone, electricity and gas industries or railway authorities.

When other ramming equipment has reached its power limit the TAURUS offers that extra power to get that pipe into the ground.



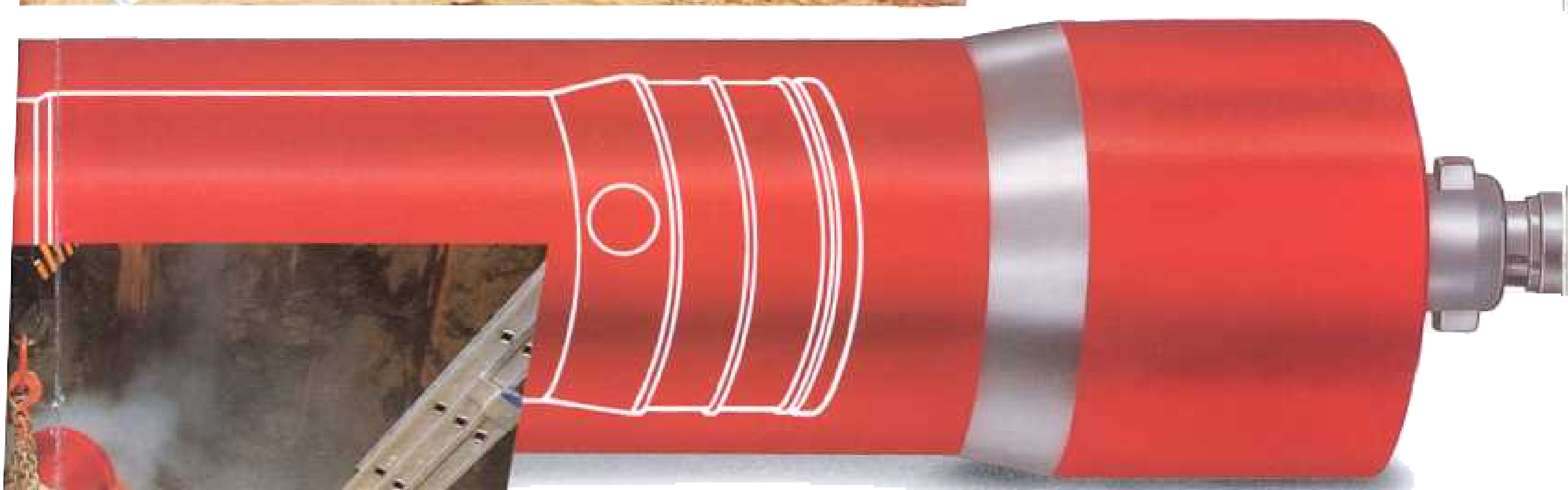
It is designed of a monoblock main casing made from a high quality alloy with a unique flexible control stud for perfect impact transmission onto the steel pipe. This makes it a reliable and lasting boring unit even in difficult soil conditions or over long stretches of steel pipe installation.

A GRUNDORAM's number of strokes has a direct influence on the forward ramming speed. However, high ground

TAURUS

Ø of rammer.....	.................24"
Length.............	..............12 ft
Weight................	.....10,580 lbs
Air consumption.	.1.766 ft³/min
Strokes per min..	180
Thrust..................	....4,400 lbs
Suitable for pipes.	.........> 380

A TAURUS used on a gas pipeline installation.



resistance and friction require a low stroke frequency with a higher single impact. The GRUNDORAM model TAURUS with 180 strokes/min and more than 2,000 tons (4,480 lbs) of dynamic thrust ensures high ramming speeds even under the most difficult conditions.

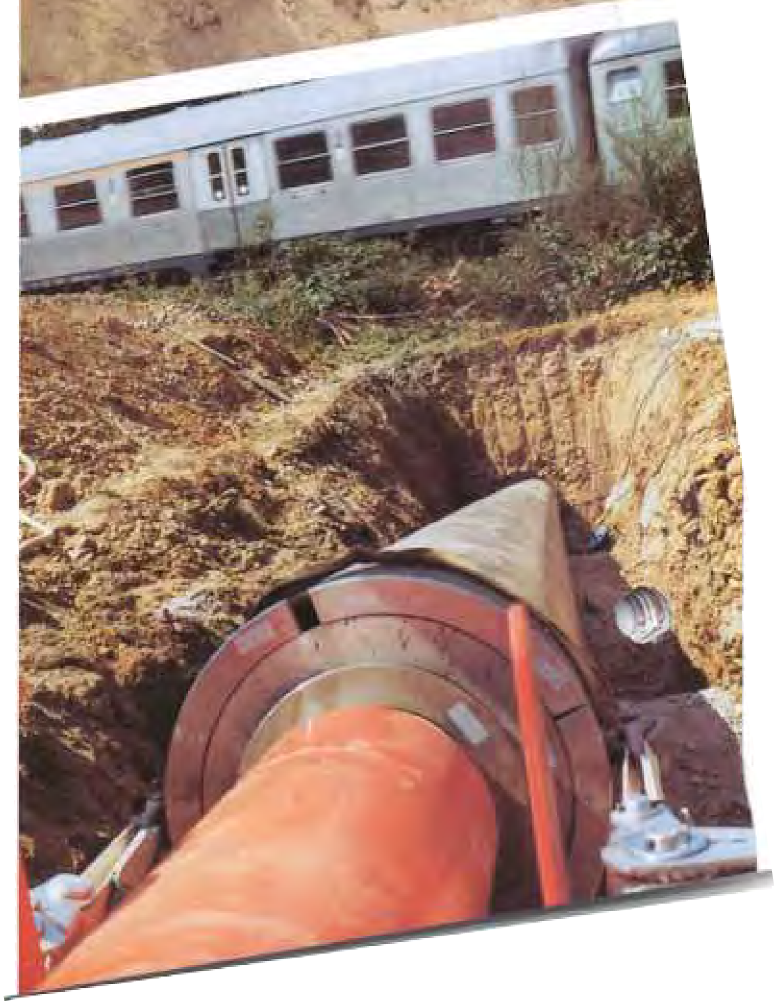
The development of the new TAURUS is the result of years of R & D in the field of trenchless pipe laying systems.

The GRUNDORAM is suitable to resist the highest stress in diffi cult soils thanks to its monoblock casing and flexible control stud.

Good examples back up our claims

Global usage is quickly leading to the general acceptance of the robust GRUNDORAM system. Contractors value the ● simple operation and ● reliability the ● enormous impact power, the ● wide range of applications, the ● quick and easy preparation and the ● sturdy accessories

● 220 ft of steel pipe, 14" diameter was rammed under a canal to accommodate 8 fibre-optic cables.
● 125 ft of 59" diameter pipe was laid under an embankment in Manchester, England, as a drainage system.
● 65 steel pipes of 28" diameter were installed parallel to each other under the main Seoul-Pusan railway line in South Korea.
● A 24" steel pipe was easily rammed along a 131 ft stretch under a railway embankment south of Cairo/Egypt.



"Typical" but also not everyday jobsite projects are excellent references, for example
● 115 ft of steel drainage pipe of 55" diameter was perfectly installed under the river Pader in the heart of the city of Paderborn/Germany
● 200 ft of 30" steel casing for gas/telecom/mains supply was installed under the A 1 motorway without traffic disruption or diversions

● 90 steel pipes of 20" diameter were driven in vertically to provide solid foundations for a noise-protection barrier in Germany.

There are many other typically good examples that could be listed. If you are interested in specific cases, contact us - we will supply you with detailed information.

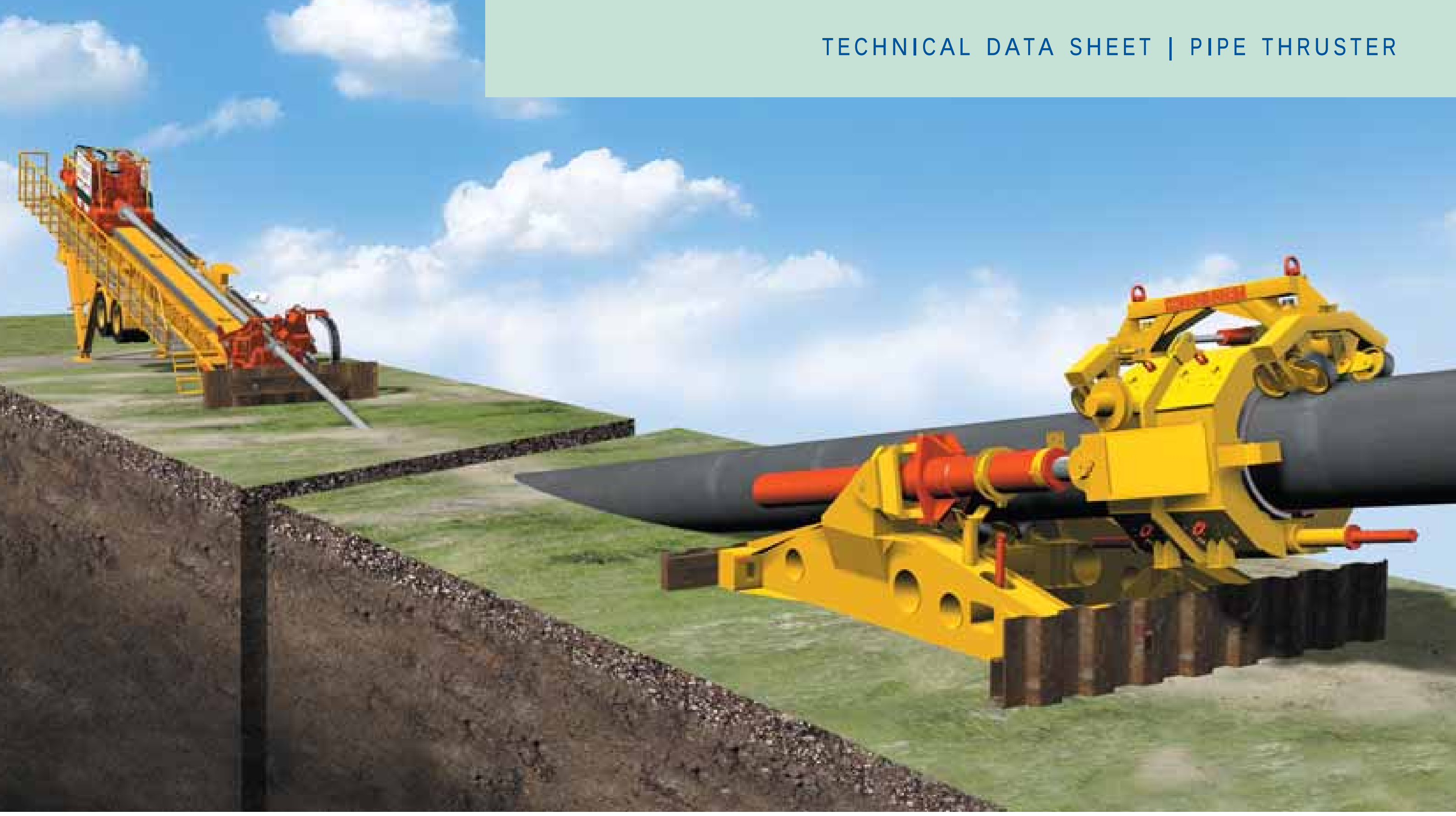
GRUNDORAM

ATTACHMENT

HERRENKNECT
PIPE THRUSTER

Proprietary to Michels

© Copyright, Michels Directional Crossings, a Division of Michels Corporation



Additional Power for Pipe Pullback.

The newly developed Herrenknecht Pipe Thruster is an auxiliary device for Horizontal Directional Drilling Technology and extends its field of application. The Thruster is mounted at the exit point and helps to push the entire pipeline into the ground. It is particularly suited for extremely long pipelines, very large diameters or difficult geological conditions. Depending on the project the Pipe Thruster can be used as a support tool, a rescue tool or as a pipe installation tool.

After finishing the pilot hole and the reaming procedures using a HDD Rig the Pipe Thruster assists during the pipe pull. The Pipe Thruster is mounted at the exit point and pushs the product pipe into the enlarged hole while the Rig is pulling the pipe. This simultaneuos process will reduce the stresses on the drillpipe and the product pipe.

Beside improved safety the Pipe Thruster allows drill lengths of more than 3,000m and makes the use of big pipe diameters more common.

Herrenknecht AG
D-77963 Schwanau
Tel +49 7824 302 0
Fax +49 7824 302 364
utility@herrenknecht.com
www.herrenknecht.com

HERRENKNECHT
Tunnelling Systems

Innovative Solution: The Pipe Thruster

Range of Application

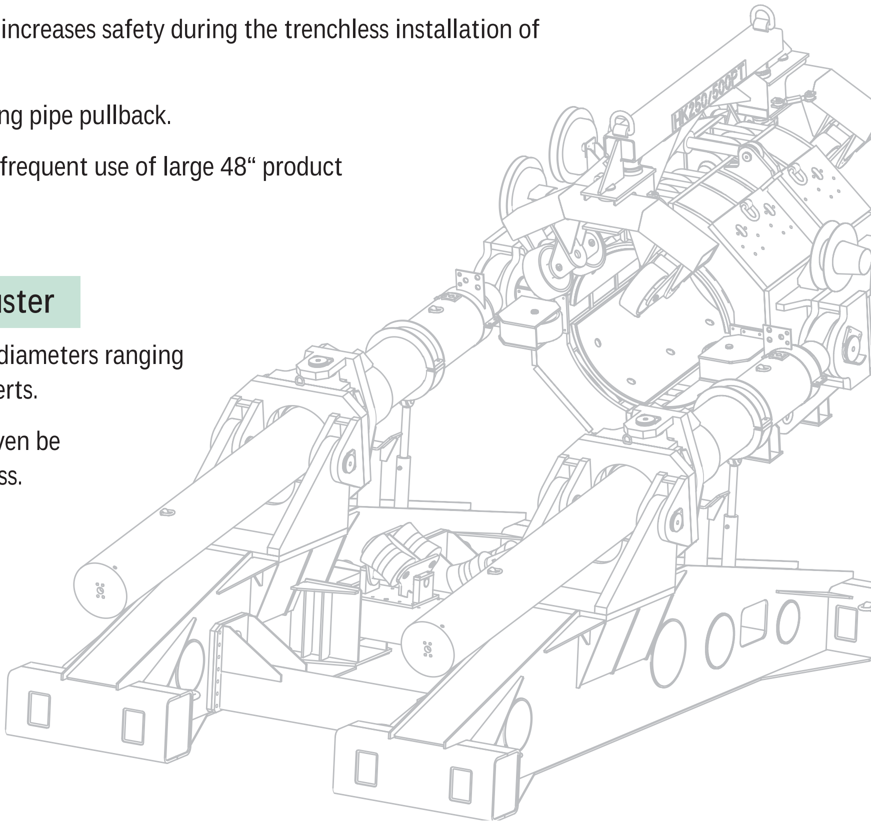
- Support of the HDD process during pipe pullback.
- Sea Outfall projects: ashore thrusting of the product pipeline.
- Rescue Tool for the recovery of stucked pipelines, e.g. in difficult geological conditions.

Advantages of the Method

- The deployment of the Pipe Thruster allows to add a push force from the exit point to the pull force of the HDD Rig.
- The flexible load distribution at the entry and exit point increases safety during the trenchless installation of pipelines considerably.
- Reduced stress for drill pipes and rigsite equipment during pipe pullback.
- Increase of drill lengths to more than 3,000m and more frequent use of large 48“ product pipe diameters.

Advantages of the Herrenknecht Pipe Thruster

- The Herrenknecht Pipe Thruster can be used for all pipe diameters ranging between 20“ and 48“ by just changing the clamping inserts.
- Due to a tilting clamping device the Pipe Thruster can even be installed when the pipeline pullback is already in progress.
- The clamping device is suitable for all types of pipelines and coatings.
- The modular design does not require special cargo transports.



Technical Data

Pipe Thruster

- Operating angle: 5° - 15°
- Push and pull force (normal): 250t (2,500kN)
- Push and pull force (maximum): 500t (5,000kN)
- Min. clamp diameter: 20“ (508mm)
- Max. clamp diameter: 48“ (1,219mm)
- Max. speed: 5m/min.
- Stroke of push/pull cylinder: 5,000mm
- Dimensions: 9 x 4.1 x 4.4m
- Weight: 45t

Power Unit

- Dimensions: 20ft container
- Installed power: 400kW
- Weight: 10t
- Remote control and hydraulic hoses to the Pipe Thruster are included.

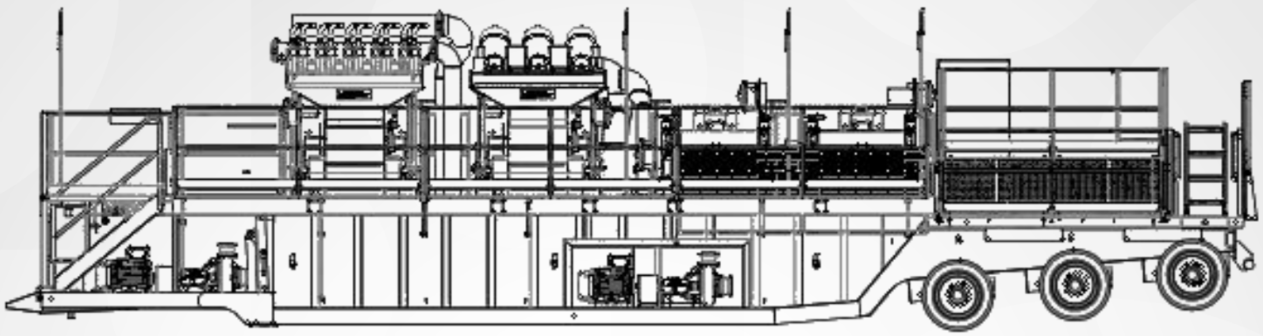
ATTACHMENT

DRILL FLUID RECYCLING FLOW CHART

© Copyright, Michels Directional Crossings, a Division of Michels Corporation, 2018

1 Drilling fluid volume is initially prepared consisting primarily of bentonite (NSF/ANSI-60 Drinking Water Additive Standard Certified) & water. Pumps are used to circulate the fluid downhole.

5 Solid laden drilling fluid returns to the recycling system where it is processed by large particle shakers, de-sanders & de-silters. It is during this stage that the suspended cuttings are removed and the desired drilling fluid rheology is restored.

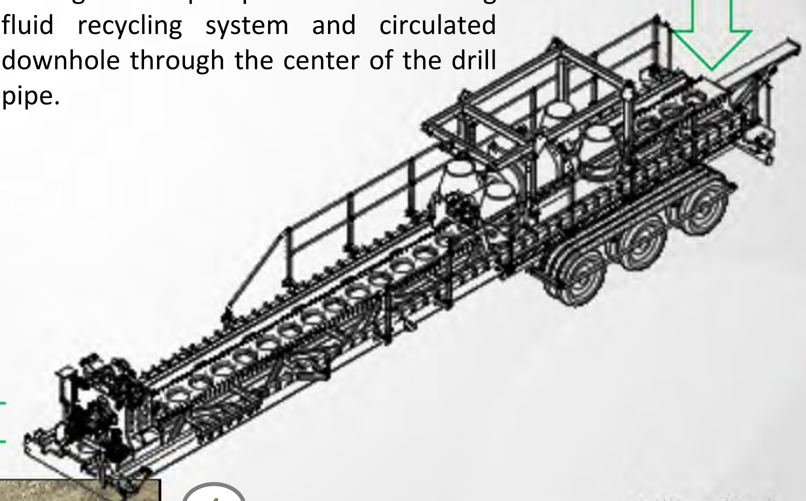


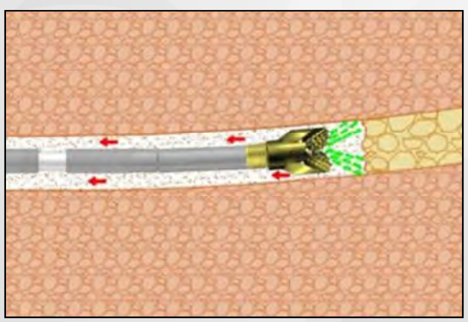
CLEAN FLUID

3 Once downhole, drilling fluid serves the following purposes;

- In alluvial formations, assists with jetting the hole
- Transports cuttings to the surface
- Aids in stabilizing formations
- Provides lubrication & tool cooling
- Provides hydrostatic fluid pressure to balance formation pressure.

2 Drilling fluid is pumped from the drilling fluid recycling system and circulated downhole through the center of the drill pipe.





4 Solids are suspended by the drilling fluid downhole and transported throughout the annular space to the entry pit at surface.

SOLIDS LADEN FLUID

MICHELS®

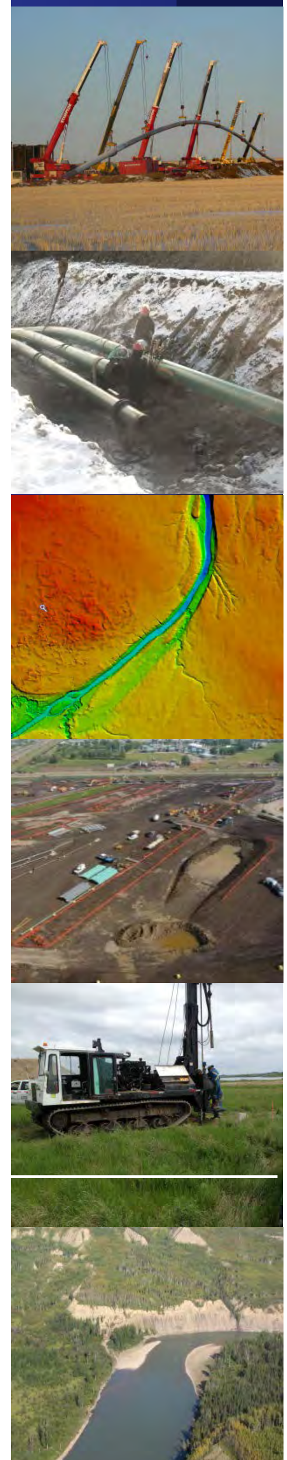
NORTH BAKKEN EXPANSION PROJECT

Horizontal Directional Drill/Guided Bore Drilling Fluid Monitoring and Operations Plan

Attachment B

North Bakken Expansion HDD Design Report Missouri River NPS 24 HDD Crossing, Prepared by CCI & Associates Inc

CCI & Associates Inc.



North Bakken Expansion

HDD Design Report

Missouri River NPS 24 HDD Crossing

Prepared for:

WBI Energy Transmission

Project No.: 2386

Document No.: 2386-01-DESIGN REPORT-00

Date: 07/31/2020

Houston Area Office
20445 State Hwy 249, Suite 250
Houston, TX 77070
P: 832-210-1030

Edmonton Area Office
17816-118 Ave NW
Edmonton, AB T5S 2W5
P: 780-784-1990

Calgary Area Office
2600, 520 – 5th Ave SW
Calgary, AB T2P 3R7
P: 403-932-0560

Revision	Prepared by	Checked by	Approved by	Date Approved
00	CG	BKP	JT	07/31/2020

North Bakken Expansion

HDD Design Report - Missouri River NPS 24 HDD Crossing

CCI & Associates Inc. – North Dakota CoCP # 27692PE

Prepared by:

Chelsea Griffiths, P.Eng.
Project Manager

Checked by:

B. Kerby Primm, P.E.
Project Manager

Approved by:

Justin Taylor, P.Eng., P.E.
VP of Engineering

TABLE OF CONTENTS

APPENDICES

1 INTRODUCTION

WBI Energy Transmission, Inc. (WBI) is planning to construct a pipeline crossing of the Missouri River (Lake Sakakawea) within North Dakota, between the cities of Tioga and Watford City as part of the North Bakken Expansion Project. The project involves approximately 60 miles of new NPS 24 (24" O.D.) natural gas pipeline that will connect WBI Energy's Tioga Compressor Station near Tioga, North Dakota, with Northern Border Pipeline Company's mainline at a new interconnection point south of Watford City, North Dakota. The pipeline is for natural gas takeaway to help reduce natural gas flaring in the area. The pipeline alignment crosses the Missouri River approximately 24 miles north of Watford City and 23 miles east of Williston, ND. At the crossing location, the Missouri River forms Lake Sakakawea, which contains a historic channel traversing the lake, and is a United States Army Corps of Engineers (USACE) monitored navigable waterway. This report will focus on the feasibility of the North Bakken Missouri River crossing utilizing the Horizontal Directional Drill (HDD) trenchless construction method. The proposed HDD crossing will cross beneath the entire width of the lake, measuring 15,393 ft in length from entry to exit.

This report is provided as a feasibility assessment of site conditions, incorporating the available geotechnical information and a geometric review of the proposed HDD alignment and design along with annular pressure analysis and pipe stress analysis. Also included are some challenges the contractor may face and some mitigation strategies that may be implemented to minimize the project risks. This assessment is also intended to provide verification that the HDD design meets USACE requirements.

2 DESIGN PARAMETERS

The parameters utilized in the design of the crossing are as follows:

a) The Pipeline Research Council International (PRCI) design guidelines (PR-277-144507-R01) and ASME B31.8 requirements, as applicable, were utilized to model the bending, external hoop, tensile, and combined stress cases for the installation and operating conditions imposed on the pipe.
b) The calculations consider the pipe material, diameter, wall thickness, grade, depth, and the geometric design of the crossing.
c) The geotechnical conditions at the site were analyzed to design the drill for progression through formations that are favorable for horizontal directional drills, where possible, with consideration given to potential borehole instability and surficial casing installation.
d) The HDD crossing was designed by completing an assessment of the annular pressure to minimize the risk of hydraulic fracture to the surface or water body during drilling of the pilot hole. The HDD crossing was designed to have a factor of safety against hydraulic fracture beneath the Missouri River (Lake Sakakawea) of greater than 2.0, as per USACE calculations. The annular pressure calculation models the potential fracture pressure of the overburden formation versus the downhole pressures created during the pilot hole phase of the construction.
e) Space limitations associated with points of inflection (PI), topographical features, and achievable temporary workspace (TWS) were considered. Temporary workspace has been selected to ensure that the required equipment can be set up on site to complete the work and to minimize grading requirements and disturbance.
f) The entry and exit positions have been identified based on the location of the pipe section lay out for installation, generally at the exit location. The drill is designed as an intersect and will have a drill rig set up at both the entry and exit locations.
g) The crossing has been designed with consideration of the pullback section and available layout. These plans will be updated (if required) to allow for multiple sections and/or contractor input.

h) All elevations and topographic survey data utilized are based off North American Vertical Datum 88 (NAVD 88) and State Plane North Dakota North coordinate system.

3 MISSOURI RIVER CROSSING LOCATION

3.1 SITE DESCRIPTION

The proposed HDD crosses the Missouri River (Lake Sakakawea) within McKenzie and Williams County, North Dakota. The proposed pipeline alignment is located approximately 24 miles north of Watford City and 23 miles east of Williston, ND, and is shown in Figure 1, below. The length of the proposed HDD measures approximately 15,393 ft.

Figure 1. Proposed HDD Alignment Location

The proposed HDD entry location is situated in a relatively level, cultivated grass field, southwest of rugged terrain along the edge of the Missouri River and east of Tobacco Garden Bay. From entry, the HDD alignment follows the proposed pipeline right-of-way down rolling, sloped terrain towards the south bank, crosses the Missouri River (Lake Sakakawea) and climbs the north bank to the location of the HDD exit. The exit location is situated within a maintained grass field, west of several houses along the lake. The pipe string staging and preparation area, shown in Figure 2, is located to the north of the exit point (pipe side) within a proposed temporary workspace area. The planned pipe string and pullback alignment continues to the north, crossing 52nd Street NW and a cultivated field before roping to parallel Highway 17A, ending at Highway 1804 (54th Street NW).

The land near the proposed HDD consists of primarily agricultural fields and grassed areas with several residential buildings in proximity of the northern work site.

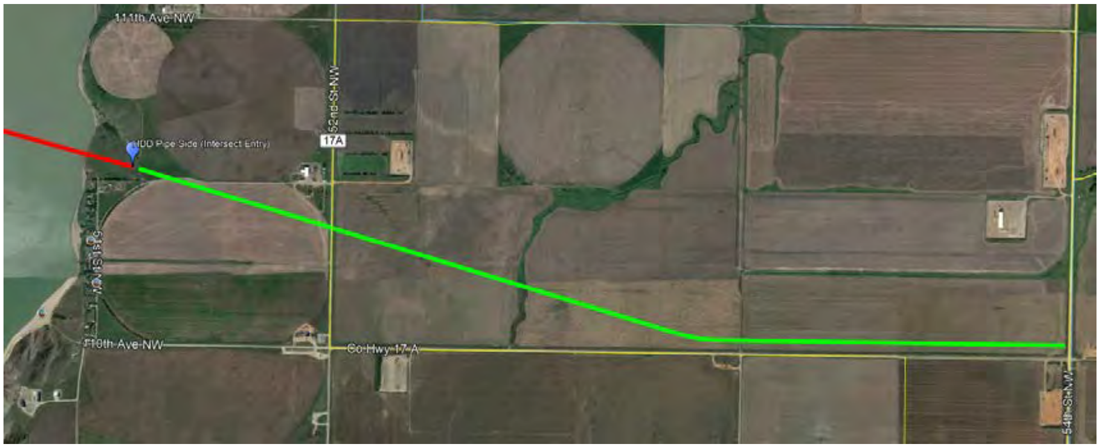


Figure 2. Proposed HDD Pipe Stringing Location

3.2 GEOLOGICAL SETTING

The geology in the area consists of glacial deposits overlying the Sentinel Butte Formation followed by the Bullion Creek Formation, both of the Paleocene Age. The Sentinel Butte Formation consists of layers of silt, clay, sand, lignite, carbonaceous shale, and mudstone. The Bullion Creek Formation comprises primarily silt, clay, sand with interbedded sandstone, lignite, baked clay, and limestone. Both formations are poorly lithified and form rolling topography over areas of Western North Dakota. It is expected that the proposed HDD bore path will be encompassed within the Sentinel Butte Formation and not encounter the Bullion Creek Formation.

3.3 GEOTECHNICAL REVIEW

To form a basis on evaluating the site specific subsurface conditions, CCI sub-contracted Groundwater & Environmental Services, Inc. (GES) to perform a subsurface exploration and laboratory testing program at the proposed HDD site to support the feasibility evaluation and design of the Lake Sakakawea crossing. As part of the geotechnical program, two investigations were completed: one (1) land-based investigation and one (1) water-based investigation. Associated subsequent geotechnical reports entitled "Geotechnical Investigation Report – WBI North Bakken Expansion Project", dated June 14, 2019 and "Geotechnical Investigation Report, Water-Based Borings – WBI North Bakken Expansion Project", dated July 9, 2020 were completed. As part of the land-based investigation, three (3) exploratory land borings, LB-1 to LB-3, were drilled/sampled to depths between 372 and 403 ft below ground surface. As part of the water-based investigation, six (6) additional water-based borings, WB-1 to WB-6, were drilled/sampled to depths between 300 and 315 ft below the Lake Sakakawea thalweg.

The locations of the nine (9) geotechnical borings relative to the HDD alignment are shown in Figure 2, below, and depicted in the design drawing attached in Appendix A.

Figure 3. Borings Location Plan

The borehole coordinates were obtained during the geotechnical investigation by GES using a handheld GPS. The borehole depths and coordinates are shown below in Table 1.

Table 1. Geotechnical Boring Locations and Depths

Borehole	Depth (ft)	Latitude	Longitude
LB -1	403	48.115647°	-103.092842°
LB-2	400	48.117656°	-103.092611°
LB-3	372	48.156139°	-103.077672°
WB-4	300	48.123139°	-103.090536°
WB-5	300	48.128400°	-103.087644°
WB-6	300	48.133994°	-103.086317°
WB-7	315	48.138314°	-103.083792°
WB-8	300	48.146003°	-103.081647°
WB-9	310	48.150150°	-103.079189°

A summary of the encountered subsurface conditions encountered during the geotechnical program, as well as some concerns regarding the geotechnical conditions as they relate to HDD construction operations is listed below in Table 2 and 3. A copy of the detailed geotechnical boring logs from GES' geotechnical investigation is located within the Geotechnical Reports provided in Appendix E.

Table 1. Generalized Summary of the Boring Logs for Missouri River

Borehole	Location	Geologic Description[1, 2]	Primary Geotechnical Concerns
LB -1	Approx. 130 ft NE of entry point, near NE corner of entry pad TWS	0 – 25 ft: Med. Dense Sand 25 – 110 ft: V. Stiff to Hard Lean/Fat Clay and Silt 110 – 211 ft: Hard Fat/Lean Clay 211 – 233 ft: Coal 233 – 288 ft: Highly Weathered, Hard Shale 288 – 403 ft: Hard Silt	Thick coal layer encountered from 211 to 233 ft. Intermittent coal layers/lenses frequently encountered below 233 ft. Fat clays/shale could contain high swell potential.
LB-2	Approx. 930 ft NE of entry point, west side of HDD CL	0 –35 ft: Loose to Med. Dense Silt/Silty Sand. 35-55 ft: V. Stiff Fat Clay 55 – 120 ft: Loose to Dense Sand 120 – 153 ft: Hard Silt and Lean Clay 153 – 215 ft: Highly Weathered Shale and Siltstone	Loose granular materials encountered poses slough risk. Thick coal layer encountered from 215 to 238 ft. Intermittent coal layers/lenses frequently

Borehole	Location	Geologic Description[1, 2]	Primary Geotechnical Concerns
		215 – 238: Coal 238 – 350 ft: Hard Silt 350 – 380 ft: Dense Sand 380 – 400 ft: Highly Weathered Shale	encountered below 238 ft. Fat clays/shale could contain high swell potential.
LB-3	Approx. 100 ft from exit point, along southern edge of exit pad TWS	0 – 115 ft: V. Loose to V. Dense Sand and Silty Sand 115 – 140 ft: Coal 140 – 202 ft: V Dense/Hard Sand, Silt and Lean Clay 202 – 252 ft: Hard Silt with coal lenses 252 – 290 ft: V. Dense Sand 290 – 336 ft: Highly Weathered, Hard Shale 347 – 372 ft: V. Dense Silty Sand	Loose granular materials encountered poses slough risk. Thick coal layer encountered from 115 to 140 ft. Intermittent coal layers/lenses frequently encountered below 140 ft. Shale contains swell potential.
WB-4	Approx. 2,900 ft from entry point, west side of HDD CL	0 – 45 ft: Soft/Loose Lean Clay and Sand 45 – 53 ft: Loose Gravelly Sand 53 – 81 ft: Hard Lean Clay 81 – 102 ft: Highly Weathered, Hard Shale 102 – 127 ft: Coal 127 – 277 ft: Highly Weathered, Hard Shale and Weakly Cemented, V. Dense Sandstone 287 – 300 ft: Highly Weathere, Hard Shale	Granular (alluvial) materials encountered poses slough risk. Thick coal layer encountered from 102 to 127 ft. Intermittent coal layers/lenses frequently encountered below 127 ft. Shale could contain high swell potential.
WB-5	Approx. 4,950 ft from entry point, east side of HDD CL	0 – 35 ft: Med. Stiff/Loose Silt and Sand 35 – 85 ft: Med. to V. Dense Sand and Gravel 85 – 140 ft: Hard/Dense Lean Clay and Sand 140 – 245 ft: Highly Weathered, Hard Shale 245 – 267 ft: Weakly Cemented, V. Dense Sand 267 – 280 ft: Coal 280 – 300 ft: Hard Lean Clay	Thick coal layer encountered from 267 to 280 ft. Intermittent coal layers/lenses frequently encountered below 140 ft. Shale could contain high swell potential.
WB-6	Approx. 7,000 ft from entry point, west side of HDD CL	0 – 70 ft: V. Loose to Med. Dense Sand 70 – 115 ft: V. Stiff Lean/Fat Clay and Silt 115 – 220 ft: Dense to V. Dense Sand 220 – 300 ft: Highly Weathered, Hard Shale	Frequent coal layers/lenses encountered below 220 ft. Fat clays/shale could contain high swell potential.
WB-7	Approx. 8,690 ft from entry point, east side of HDD CL	0 – 56 ft: V. Loose to Med. Dense Sand 56 – 120 ft: Med. Dense/V. Stiff Sand and Lean Clay 120 – 210 ft: Dense to V. Dense Sand 210 – 235 ft: Highly Weathered, Hard Shale 235 – 253 ft: Coal 253 – 315 ft: Highly Weathered, Hard Shale	Thick coal layer encountered from 235 to 253 ft. Intermittent coal layers/lenses frequently encountered below 253 ft. Shale could contain high swell potential.
WB-8	Approx. 3,840 ft from exit point, west side of HDD CL	0 – 35 ft: V. Soft to Med. Stff Lean Clay and Silt 35 – 150 ft: V. Loose to V. Dense Sand 150 – 230 ft: Highly Weathered, Hard Shale 230 – 240 ft: Coal 240 – 290 ft: Highly Weathered, Hard Shale 290 – 300 ft: Coal	Thick coal layers encountered in the bedrock. As well, thinner intermittent coal layers/lenses frequently encountered. Shale could contain high swell potential.
WB-9	Approx. 2,230 ft from exit point, west side of HDD CL	0 – 140 ft: V. Loose to V. Dense Sand and Gravelly Sand 140 – 225 ft: Highly Weathered, Hard, Shale 225 – 235 ft: Coal 235 – 290 ft: Highly Weathered, Hard, Shale 290 – 305 ft: Coal 305 – 310 : Highly Weathered, Hard, Shale	Thick coal layers encountered in the bedrock. As well, thinner intermittent coal layers/lenses frequently encountered. Shale could contain high swell potential.

Note 1: ***Soil descriptions as per United Soil Classification System (USCS)***
Note 2: ***Soil Consistency and Relative Density determined as per in-situ SPT N-Value***

Although variations exist, the subsurface conditions were similar in the nine (9) borings. In general, the subsurface conditions comprised overburden glacial and alluvial deposits to depths between 127 and 290 ft below the surface/thalweg overlying the Sentinel Butte Formation to the depth of the investgation. The glacial and alluvial deposits predominantly consisted of variable deposits of fat/lean clay, sand and silt with thin, frequent interbedded layers of gravel and coal. The consistency of the overburden material increased with depth, starting as soft/loose and becoming hard/very dense. As noted, the bedrock of the Sentinel Butte Formation consisted of primarily poorly lithified shale and sand. Within the formation, two

(2) relatively continuous coal layers were identified along the length of the drill. The coal layers varied in thickness from approximately 5 to 30 ft, with frequently encountered thinner layers/lenses.

Although not encountered in the geotechnical investigation, there is potential to encounter cobbles and/or boulders along the drill path. By definition, glacial deposits consists of a variations of all soil types, including a random distribution of cobble and boulder sized materials, and granular layers/lenses.

No standpipes were installed. Rather, groundwater conditions were inferred from seepages noted and measurements taken during drilling. For the land-based borings, water was observed at 24 ft in LB-3 whereas LB-1 and LB-2 remained dry; however, in each of these borings mud-rotary drilling commenced at a depth of 25 ft, precluding deeper measurements. No groundwater measurements were obtainable in the water-based borings since a perfect seal was not feasible on the casing through the lake. It is expected that the groundwater is situated at an elevation equivalent to the elevation of Lake Sakakawea.

The proposed HDD is anticipated to be within shale of the Sentinel Butte Formation for most of its length, passing through overburden/alluvial deposits as it nears surface at the entry and exit locations. As noted, the overburden/alluvial deposits consist of variations of fat/lean clay, sand and silt. Two relatively continuous coal layers, approximately 5 to 30 ft thick, are proximate to the bottom tangent of the bore path.

4 HDD CROSSING CONSIDERATIONS

4.1 PIPE SPECIFICATIONS

The pipeline specifications provided by WBI are summarized in Table 3. These parameters were used in the engineering design of the Missouri River HDD crossing.

Table 3. Pipe Specifications for the Missouri River HDD Crossing

Parameter	NPS 24 HDD
Outside Diameter (inch)	24
Wall Thickness (inch)	0.99
Pipe Material	Steel
Carried Product	Natural Gas
Specification	API 5L
Grade	X60
Specified Minimum Yield Strength (SMYS) (psi)	60,000
Chosen Design Radius (ft)	5,000
Minimum Allowable Design Radius (MADR) (ft)	1,500
Entry Angle	15°
Exit Angle	14°
Borehole Diameter (inch)	36
Maximum Operating Temperature (°F)	100
Minimum Installation Temperature (°F)	60
Maximum Operating Pressure (psi)	1,480

4.2 HDD ALIGNMENT

The proposed crossing follows a southwest to northeast alignment with the proposed entry and exit (pipe layout) points located approximately 2,100 ft south and 850 ft north of the Missouri River edge of water, respectively. The crossing passes beneath the lake for approximately 12,300 ft. Temporary workspace (TWS) is required at both ends of the crossing to facilitate entry and exit-side construction spreads, which are planned to have workspace dimensions of 300 ft x 300 ft (on the south) and 270 ft x 300 ft (on the north).

The proposed crossing is planned to be completed by intersect methodology, approximately 6000-9000 ft will be competed from either direction, the drill paths will intersect within a 3200 ft “intersect zone”. The details of the design are shown on the Issued for Permit (IFP) HDD design drawing [2386-EG-0101, Rev G, dated July 31, 2020] provided in Appendix A.

4.3 BOREHOLE SIZE

The final borehole diameter must be larger than pipe outer diameter to facilitate pipeline installation and reduce the drag forces acting on the pipe while allowing for proper drilling fluid circulation within the annulus. The general industry standard for pipes with diameter more than 20 inches is a final borehole diameter 12 inches larger than the pipe outer diameter. For the proposed NPS 24 HDD crossing, the minimum final borehole diameter is expected to be 36 inches.

4.4 ENTRY AND EXIT ANGLES

The entry and exit angles have been selected based on expected geologic formations and casing requirements, bending restrictions, topography and the support of the pullback section. The entry angle (south) has both been selected to be 15° for this crossing to minimize casing requirements while adhering to geometric constraints and depth. The exit angle was selected to minimize casing requirements on exit while considering the overbend support height and support equipment requirements. The exit angle has been designed to be 14° for the proposed crossing. Due to the pipe size and specification, significant equipment is still required to lift and safely support the pipe above ground during installation. The risks associated with above-ground pipe support equipment requirements on site will be discussed further in the construction risk assessment.

4.5 HDD DEPTH OF COVER

Selection of an HDD depth is based on several parameters including geological formation, casing requirements, required overburden pressure to overcome the drilling fluid annular pressure (while maintaining an adequate factor of safety), and watercourse geometric parameters. The proposed installation depth considered should maximize the length of drill advancing through favorable materials for directional drilling to maximizing borehole stability during hole opening and pipe installation. The drill path is designed to avoid the coal layers identified in the geotechnical investigation for as much of the drill path as possible.

The bottom tangent depth for the proposed NPS 24 HDD is around 250 ft below the bottom of the lake. It is expected that the majority of the drill path will be within shale of the Sentinel Butte Formation based on the 9 geotechnical borings described above. The design depth for the proposed crossing is expected to provide adequate overburden pressure to counteract the expected drilling fluid pressures while utilizing the HDD pilot hole intersect method. Further details about annular pressure modeling are discussed in Section 5.1.

4.6 DESIGN RADIUS

The standard practice in the HDD industry is to utilize 1,200 times the nominal pipe diameter (in ft) as the design radius of curvature (ROC). For example, an NPS 24 (2 ft O.D.) pipe would utilize a 2,400 ft ROC. This is a general "Rule of Thumb" for quick calculations which has been developed over the years based on constructability as opposed to pipe stress limitations. The minimum vertical curve chosen for the proposed HDD is 5,000 ft, which is much larger than the minimum based on the above criteria. This increased design radius has been chosen to assist in ease of steering for the contractor during construction. Applying the design radius, the bending stress and operational shear stress have been calculated to be 13.1% and 48.1%, of allowable, respectively.

An essential part of the design of HDD crossings is providing the contractor with minimum steering tolerances during pilot-hole based on an acceptable level of stress on the pipe. These tolerances are designed to allow the contractor to follow the designated drill path as closely as possible while avoiding any variation that may result in overstressing the product pipe. CCI has calculated the minimum allowable design radius (MADR) for the pipe based on limiting the bending stress to less than 45% of allowable (as per PRCI). For this crossing, an additional design factor has been added to this typical MADR calculation, in order to ensure major variations from the design radius which may negatively affect installation pull-forces are avoided. In addition to the calculated 3-joint minimum allowable design radius (MADR), CCI recommends the additional minimum 1-joint radius specification as shown in Table 4.

Table 4. Minimum Radius Allowances

	Radius Specification
30ft (single-joint)	Minimum ROC – 1,100 ft
100ft Average (3-joint) / MADR	Minimum ROC – 2,000 ft
Design Radius	5,000 ft

If the contractor adheres to these minimum radius specifications, the product pipe will be within allowable stress limits during installation and operation. It should be noted that a recommended single-joint minimum radius has been included, which is sometimes not specified within HDD designs. Without a single-joint radius specification, it is possible that the contractor may be able to include an excessive steer within a single joint, yet still adhere to the provided 3-joint minimum radius average. In order to avoid overstressing of the pipe that may occur in such an instance, adherence to the single-joint radius specification is recommended.

4.7 LAYDOWN AREA

The design proposes that the product pipe be laid out in one (1) continuous section. The proposed pullback workspace is 100 ft wide and crosses an unnamed road and 52nd Street NW (Highway 17A). The proposed pullback alignment also crosses an un-named creek which would likely require two (2) additional side booms to support the pipe from either side of the creek bed. The creek may need to be diverted, bridged, or infilled within the temporary workspace to support machinery traffic and equipment. From an initial desktop study, most of the designated workspace that is planned to be used during pullback will travel through cleared land, so minimal clearing will be required. Near the end of the pullback section, the workspace turns and parallels Co Highway 17A. To accommodate this curve, the pullback includes a 4000 ft radius horizontal curve.

Due to the usage of 52nd Street, it is expected that it will not be possible to close for pullback and it is expected the pipe will be lifted and supported over the road during pullback operations after final welds.

Due to the pipe size, a significant excavation length would be required if the pipe were to be strung under the road in a culvert. The culvert option could be investigated if permission to support the pipe over the road are not granted.

Based on CCI's stress analysis, the minimum allowable overbend radius of the pullback section is roughly 1,600 ft for the NPS 24 pipe. The stress analysis also yielded a maximum crane/side boom support spacing of 80 ft (based on typical roller-cradle capacities) and roller spacing of 40 ft, assuming adequately sized supports will be used. It is also recommended the maximum unsupported overhang not exceed 60 ft. The overbend radius and maximum support spacing was selected to maintain the imposed stress on the product pipe below 80% of allowable stress as per PRCI and with consideration of roller-cradle capacities.

The pullback alignment described above encounters a relatively level topography, with one geographically noticeable hill approximately 2,800 ft north along the pipe stringing alignment. The hill is gradual and should not affect pullback operations. Given the 14° exit angle, the height of the pullback overbend will reach approximately 35 ft above ground surface. This overbend results in approximately 6 cranes and 3 side booms to support the pipe within the overbend.

At the end of the existing 100 ft wide workspace, CCI has proposed an additional 40' of workspace, ending at the road surface of 54th Street NW. This additional workspace is to allow the pipe to be laid out in one section. Due to the topographical elevation changes within the layout, it is expected the pipe will not be as close to the road as is conservatively shown on the Issued for Permit (IFP) HDD design drawing [2386-EG-0102, Rev D, dated July 31, 2020] provided in Appendix A.

5 HDD ENGINEERING ANALYSES

The proposed HDD design has incorporated supplied topographical information, geotechnical information, and ROW alignment. In addition to these considerations, detailed annular pressure analysis and pipe stress analysis calculations have been completed as outlined below.

5.1 ANNULAR PRESSURE MODELING

The annular pressure (AP) was modeled to simulate the downhole pressure during the pilot hole phase of construction and compare it with the limiting pressure of the substrata above the drill path. The AP simulation was conducted with CCI's analysis tools, which have been developed with industry standard calculation models (Bingham Plastic, General Overburden, and USACE/Delft model) and additional modified safety factors based on our experience from over 15,000 completed HDD crossings. CCI developed geotechnical parameters for the crossing that are closely representative of the soil formations observed in the land boring logs and water boring logs completed by GES at the crossing.

Drilling fluid properties, used to model the downhole pressure during drilling, are dependent on construction practices of the HDD contractor, field conditions, and interpretations of the drilling fluid technician. Annular drilling fluid pressures can significantly change with changes in drilling fluid properties. Therefore, it is important to re-evaluate drilling fluid pressures based on fluid properties during HDD operations and compare them with estimated limiting pressures of the formation. Additionally, annular pressure measurement tools should be used to monitor annular pressure during the HDD installation.

The drilling parameters utilized by CCI for this analysis are based on tooling specifications provided by the drilling contractor and are as follows:

- 13 1/2" drill bit (pilot)
- 7 5/8" drill pipe

- 650 gpm (2.5 m^3/min) fluid pump rate
- 9.6 lb/gal fluid density
- 25 lb/100ft^2 yield point of fluid
- 20 cP plastic viscosity of fluid

Calculated expected annular pressure graphs for each drill direction were produced with the above drilling parameters and are modeled in Figure 3 and Figure 4. These annular pressure graphs form the basis for establishing whether a proposed HDD crossing is at risk for hydraulic fracture during the pilot hole phase. This graph shows a calculated expected downhole pressure, as well as an *Operating Zone* above the expected downhole pressure, shown as 125% of the calculated pressure. According to this model, drilling pressures that exceed the overburden fracture pressure do not necessarily indicate a fracture will occur, but rather a higher risk that hydraulic fracture may occur in those areas.

CCI has reviewed and incorporated the geotechnical program laboratory testing results from the geotechnical investigation and developed three geotechnical parameter sets for this crossing. These geotechnical parameter sets represent a “Firm CL-CI Clay” layer at surface, a variable thickness “Compact Sand” layer, and a “Shale Bedrock” layer in which the drill progresses for the majority of the crossing. The Parameters utilized by CCI are listed below.

Firm CL-CI:

- 26° Internal Angle of Friction
- 200 psf Cohesion Coefficient
- 120 pcf Unit weight of Soil
- 0.4 ksi Shear Modulus of the Soil
- Variable Radius of Plastic Zone based on soil parameters

Compact Sand:

- 32° Internal Angle of Friction
- 0 psf Cohesion Coefficient
- 125 pcf Unit weight of Soil
- 2.2 ksi Shear Modulus of the Soil
- Variable Radius of Plastic Zone based on soil parameters

Shale Bedrock:

- 26° Internal Angle of Friction
- 902 psf Cohesion Coefficient
- 131 pcf Unit weight of Bedrock
- 6.7 ksi Shear Modulus of the Bedrock
- Variable Radius of Plastic Zone based on soil parameters

Due to the length of the Missouri River HDD crossing, the crossing will be completed by intersect methodology. Figure 3 and 4 represent the annular pressure curves for the north and south portions of the HDD pilot hole. The Intersect Zone is shown on both drills, and represents the maximum length drilled from either side. The graphs shown are based on a modified CCI Delft equation. The modified Delft equation used here utilizes a smaller Radius of Plastic Zone than the standard Delft equation which results in much lower limiting pressure outputs, equating to more conservative allowable pressures in the curves shown below than would be shown in typical Delft model outputs.

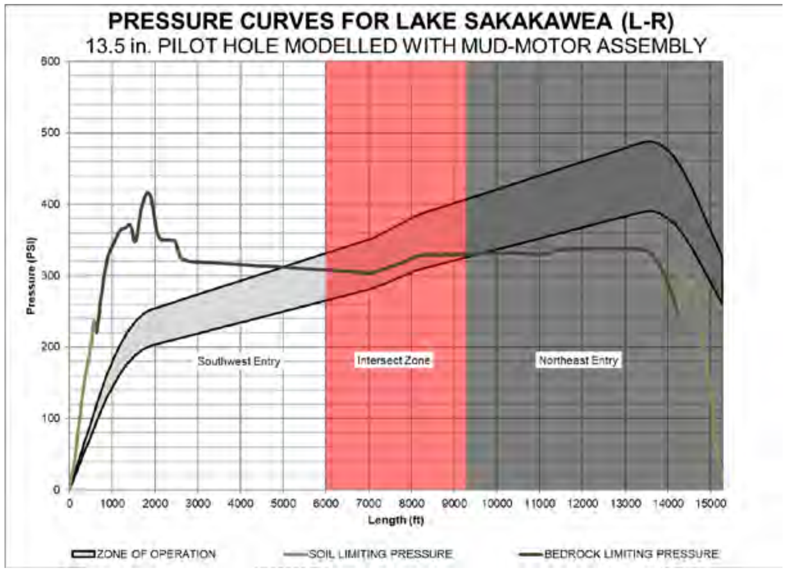


Figure 3. Modeled Annular Pressure During South Pilot Hole

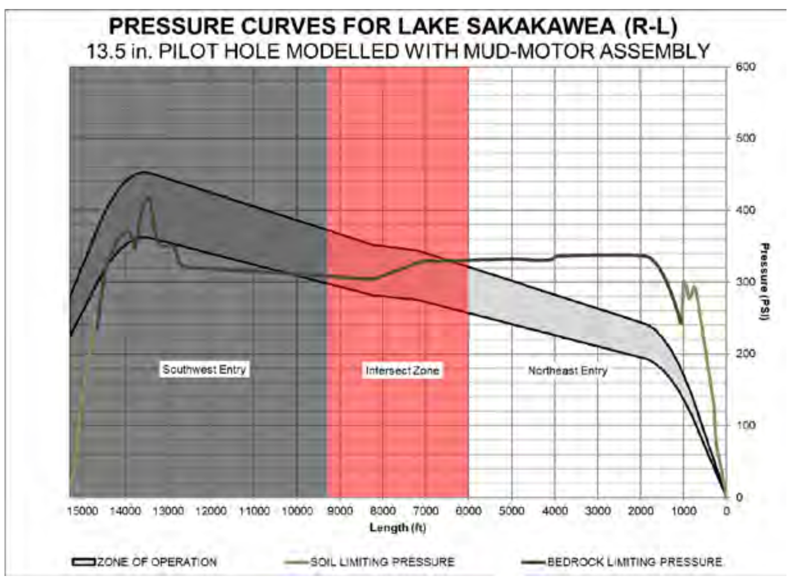


Figure 4. Modeled Annular Pressure During North Pilot Hole

The modified CCI annular pressure graphs above suggest that the drilling pressures remain below the limiting pressures of the overburden along the first 5000-6000 ft of the drill from either side. Within the 5000-8000 ft measured depth range, the lower operating pressures are below or slightly over the limiting over burden pressures. Once past the planned intersect zones, the drilling pressures greatly exceed the overburden pressure, illustrating the need for an intersect based on annular pressure considerations. Within the middle section of the drill, near the intersect zone, the risk of hydraulic fracture for the HDD is moderate.

The annular pressure graphs in Figures 5 and 6, below, have been run using the standard USACE Delft equation. These annular pressure graphs correspond to the factor of safety graphs seen in Figures 7 and 8.

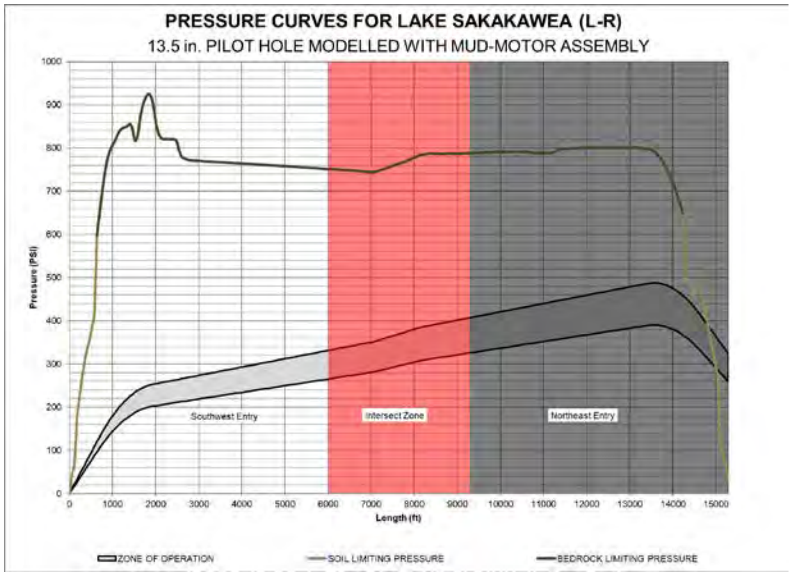


Figure 5. USACE Modeled Annular Pressure During South Pilot Hole

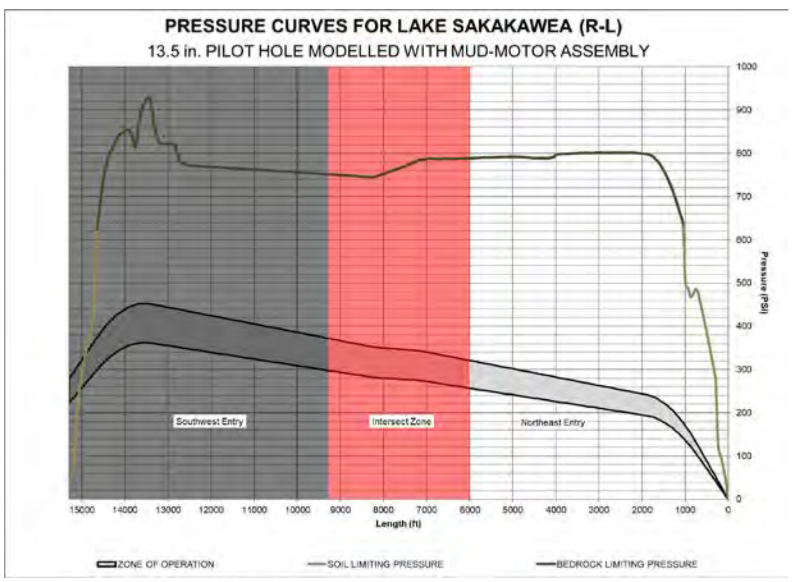


Figure 6. USACE Modeled Annular Pressure During North Pilot Hole

USACE requires a factor of safety against hydraulic fracturing, generally in the 2.0 range, for the portion of the drill passing beneath a regulated waterbody. The factor of safety is calculated by dividing the calculated limiting pressure of the formation by the expected annular pressure along the length of the drill path. Figure 7 and 8 shows the factor of safety against hydraulically fracturing the formation during pilot hole installations utilizing the standard USACE calculation models without any additional factor of safety applied to the equations at the design depth.

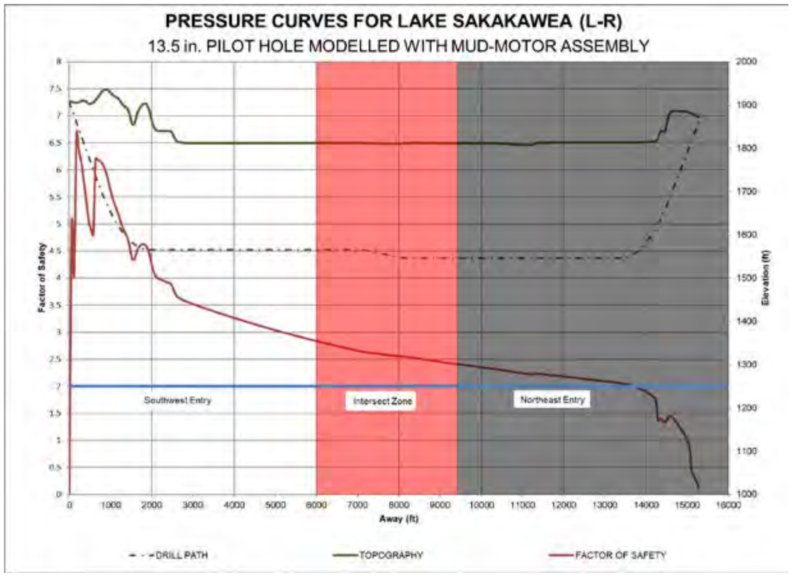


Figure 7. Factor of Safety Against Hydraulic Fracture South Pilot Hole

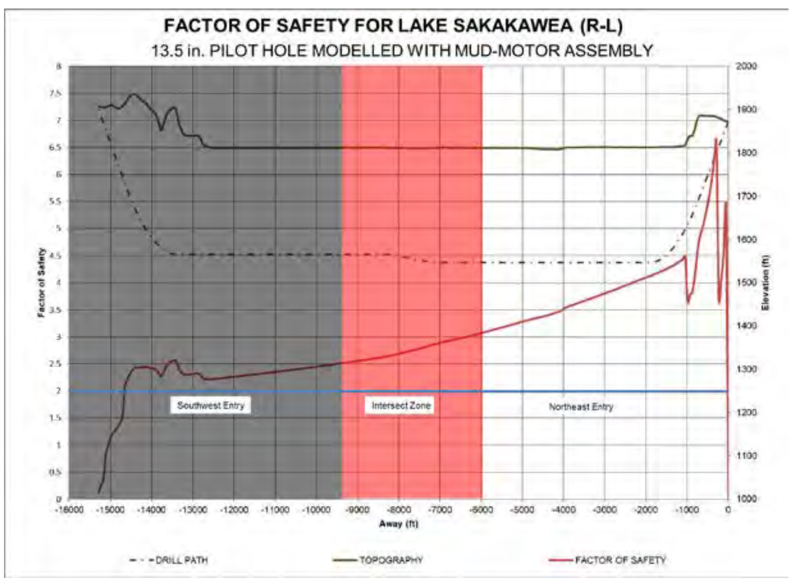


Figure 8. Factor of Safety Against Hydraulic Fracture North Pilot Hole

Figure 7 and 8 indicate that the Factor of Safety (FOS) against hydraulic fracture is above 2.0 for the entire planned pilot hole from the south and north sides. Utilizing USACE calculations, the FOS is roughly 2.5-4 below the Missouri River. Based on the results of the analysis, the HDD design meets the USACE minimum requirements for factor of safety against hydraulic fracture.

During construction, the risk and impact of hydraulic fracture and inadvertent returns (IR) to surface can be reduced by implementing preventative measures during pilot hole. It is recommended that the contractor reduce pump rates as the drills approach the intersect location. It is also recommended that contractor maintain drilling fluid densities at the low end of what is industry standard. An annular pressure tool should be used during construction to monitor pressures as the drill progresses, avoiding exceeding containment pressures under any critical locations, as required by the USACE. The contractor should review the drilling fluid parameters and tooling and ensure the proposed equipment is in alignment. It may be preferential to utilize a larger drill bit to increase the annular space and decrease the expected pressures.

5.2 HDD STRESS ANALYSIS

The installation and operating conditions imposed on the product pipe during and after installation have been modelled against the respective code requirements as laid out in Section 2. The HDD stress modeling determines if given pipe specifications are adequate for the design.

5.2.1 Pulling Load

To pull the product line inside the borehole, the pull force must overcome several resisting forces including effective weight of the pipe, fluidic drag, frictional drag between the pipe and the borehole walls and between the pipe and the rollers, drag due to length of drill string in the hole, and the reamer assembly in front of the pull section.

The pull force has been calculated with the assumption that the pipe will be installed in one continuous section with no mid-welds as it is suspected there will be sufficient, or nearly sufficient, workspace. It is expected a small section of pipe may need to be pulled into the borehole prior to a single, final weld. This portion of the pipe would be expected to be in the surface casing, and it is not anticipated increased pull forces will be experienced due to this stop near the beginning of pull. If the pipeline installation requires multiple sections beyond this short initial section, the pull forces should be reevaluated to account for the effects of downtime due to intermittent welds during pullback. The soil around the borehole could slough or swell while the pipe remains stationary downhole during the welding process which would result in increased friction on the pipe during pulling.

The calculated expected installation pull force is dependent on the geometry of the HDD, geologic formations present along the drill path, drilling mud properties, and pipe size and weight. CCI has calculated the expected range of pull forces for the product pipe installation, accounting for typical ranges of downhole mud densities. In this analysis, 9.5 ppg (pounds per gallon) drilling fluid is applicable for relatively clean drilling fluid with minimal suspended cuttings, while 12 ppg fluid would be applicable for relatively “dirty” drilling fluid containing significant suspended solids and cuttings. CCI utilizes a safety factor of 1.5 when calculating pull force to account for variations in drilling practices, geology, etc. and addition of the reamer and swivel in the pullback bottom hole assembly. CCI has calculated pull forces for the proposed HDD crossings with and without the additional factor of safety. The calculated pull forces are shown in Table 5. Due to the wall thickness of the product pipe and its associated weight, the pipe is relatively close to neutrally buoyant and therefore buoyancy control is not required for this installation.

Table 5. Pullforce Calculation Analysis

	Drilling Fluid (9.5 ppg)	Drilling Fluid (12 ppg)
Pull force	502,000 lbs	640,000 lbs
Pull force incl. 1.5 x S.F.	752,000 lbs	960,000 lbs

5.2.2 Installation & Operating Stresses

As the pipeline is installed through the final borehole, it is subjected to three primary loading conditions: tension, bending, and external (hoop) pressure. As part of the design process, the individual stresses and their combined effect on the pipe were evaluated to check the pipeline potential for failure.

During operation, the stress imposed on a pipeline installed by HDD is similar to a conventionally installed pipe with the exception of the elastic bending resulting from a continually welded pipeline pulled through a curved borehole. The operating loads including bending, net hoop stress (difference between external and internal pressures), thermal expansion, and combined stresses were checked to evaluate the risk of failure for the NPS 24 product pipe.

The stress analysis completed by CCI based on the design geometry, pipe specifications, and operating conditions for the proposed HDD installation is summarized in Table 6.

A summary of the maximum expected installation and operating stresses and their allowable limits are presented in Appendix B.

Table 6. Installation & Operating Stresses

	Missouri River HDD Crossing	
	Installation Stresses	**% of Allowable (PRCI)**
Maximum Tensile Stress (PRCI 5.1.1, 5.5)	8,935 psi	16.5%
Maximum Bending Stress (PRCI 5.2.2)	5,900 psi	13.1%
Maximum Hoop Stress (PRCI 5.2.3)	2,642 psi	11.3%
Maximum Operating Stress (PRCI 5.4.4.2)	13,000 psi	48.1%
Maximum Combined Installation Stress (tensile and bending) (PRCI 5.2.4)	0.29	29%
Maximum Combined Installation Stress (tensile, bending, and hoop) (PRCI 5.2.4)	0.10	10%

5.2.3 Pipe Lifting Stress Modeling

An analysis was completed to evaluate stresses and imposed loading on the product pipe and supporting equipment during lifting and pullback operations. Minimum support spacing was determined based on pipe specifications and capacity of expected equipment. Summaries of the maximum expected support loading and stresses on the pipe and supports are presented in Appendix B.

The lifting plan requirements including minimum allowable overbend radii, maximum support spacing and maximum allowable overhang to not overstress the pipe or supporting equipment are shown in Table 7. The stresses imposed on the pipeline and loadings on supporting equipment during pullback are also shown. The stress analysis assumes that the pipe is installed empty without buoyancy control.

Table 7. Pullback Support Stresses & Loading

Parameter	
Tensile Stress / % SMYS	10,412 psi / 20%
Bending Stress / % SMYS	18,718 psi / 36%
Combined Tensile & Bending Stress / % SMYS	28,400 psi / 55%
Vertical Load at Support	55,400 lbs
Longitudinal Load At Support	5,540 lbs

Parameter	
Vertical Load at Roller Support	9,700 lbs
Support Spacing	80 ft
Roller Spacing	40 ft
Maximum Unsupported Overhang	60 ft
Overbend Radius	1,600 ft

CCI recommends that designed stresses imposed on the product pipe during pullback are limited to 80% SMYS to account for mishandling in the field during maneuvering and installation. The results from the stress analysis completed for the pullback show that the pipe will be subjected to stresses that are below the recommended limit and are therefore considered acceptable.

CCI recommends that the contractor selects adequately sized lifting equipment and rollers that can handle the expected loadings while providing an adequate factor of safety as per OSHA requirements. CCI recommends that the selected contractor independently evaluate the pullback and pipe lifting plan and account for weather conditions such as snow, rain, and winds to ensure that the equipment and product pipe do not become overloaded or overstressed during pipe handling and pullback.

5.2.4 Design Summary

For this crossing, the operating stresses govern the design of the pipe, and not the installation stresses. Calculations carried out by CCI indicate that the provided pipe specifications are suitable for the HDD installation, based upon the installation and operating conditions supplied.

5.3 HDD CONSTRUCTION RISK ASSESSMENT

The main construction risks and challenges for the Missouri River HDD crossing were identified in the risk assessment conducted by CCI, based on available data and previous experience. The risk items are ranked into the risk categories ranging from low risk to very high risk based on the probability and the consequence of each risk factor.

The descriptions of risk items and a summary of the risk assessment for the crossing detailing the risks prior to any mitigation and after mitigation is presented in Appendix C. The following are major risks and the main mitigation strategies developed.

Casing Installation / Removal:

Casing not Being Installed to Depth

Risk: Geotechnical conditions near surface can pose a problem when driving casing to a designed depth. It is expected both the entry and exit locations will require casing. The entry (south) is expected to be cased to the shale/siltstone bedrock, and the exit location will be cased past the coal layer. The proposed lengths of casing install, although expected to be achievable, are quite considerable.

Mitigation: Achievable casing installation lengths should be investigated prior to construction. The casing should be installed in 160-200ft lengths of telescoped casing. The final casing size shall be 48" and the initial casing should be sized to ensure the final casing will reach the required depth for seating.

Casing Not Being Fully Removed Upon Completion

Risk: Due to the proposed lengths of casing install, the makeup of the subsurface material traversed by the casing, and the expected length of time the casing will remain stationary, there is a risk that the full lengths of casing on either end may not be easily or successfully removed after completion of the product pipe installation.

Mitigation: Contractor shall submit casing plan that includes proper welding specifications to ensure integrity of the casing. Contractor shall also have a mitigation plan for grouting off any portions of casing left below-ground. Owner's integrity management personnel shall evaluate impact of casing left downhole and have a suitable cathodic protection mitigation plan prepared to address any possible related concerns.

Pilot Hole Operations:

Fracture to Water Body

Risk: Fractured formations (including coal seams as identified within the bedrock formation) or high annular pressures could result in release of fluid to surface. The length of the Missouri River crossing results in high pressures due to the building friction forces. The bedrock layer is inconsistent and dips significantly in the middle of the Missouri River, reducing the expected strength of the overburden formation.

Mitigation: The crossing is designed to be completed as an intersect which will limit the expected drilling pressures. The crossing has been designed with significant depth to limit the potential for fracture. Casing will also help with circulation back to entry/exit locations, which should reduce the potential for climbing annular pressures. Contractor shall utilize an Annular Pressure Tool to measure actual downhole pressures during drilling of the pilot hole to ensure any significant increases in pressure beyond planned ranges can be addressed and reduced to within expected ranges with mechanical tripping or additional circulation as applicable.

Large Fluid Loss to the Formation

Risk: Drilling fluid has the potential to migrate outside of the designed drill path in fractures. The crossing location is characterized by several coal seams, including two thick coal seams above and below the bottom tangent of the drill path, which may act as preferential path for drilling fluid.

Mitigation: The drill depth has been chosen to limit the risk of fracture to surface. Casing is included in the design to minimize the amount of coal seams the drill path will encounter. The contractor shall develop a mitigation plan for reducing significant losses where possible, including the use of Loss Circulation Material (LCM) pills to try to plug off any encountered zones of significant fluid loss.

Steering Control Issues

Risk: The crossing is 15,393ft long and each rig will need to drill approximately 7,000 – 8,000 ft. Maintaining weight on bit in order to be able to steer at this length is expected to be difficult, complicating the intersect operations.

Mitigation: The crossing is designed with a large radius which will reduce the steering requirements. The Contractor is utilizing 7 5/8" drill string and gyro steering systems to ensure accuracy and a successful intersect. The bottom tangent is very long and will allow the drills sufficient time to align for intersect operations. Casing at the entry and exit locations may help to maintain weight on bit.

Annular Pressure Issues

Risk: Drilling operations require soil cuttings to be cleaned out of the bore and hydro-transported back to the rig by the drilling fluid. This process requires large volumes of pressurized drilling fluid to be pumped downhole. The length of the crossing will increase the risk of annular pressure issues.

Mitigation: The Contractor shall maintain returns to both entry pits and monitor annular pressures. A mud engineer shall be on site to monitor adherence to the crossing specific Engineered Drilling Fluid Plan (EDFP). A bottoms up procedure (circulating the calculated amount of fluid that it takes to flow from the bit downhole back up to the entry pit) should be in place and followed when necessary to clean the hole.

Over Schedule Risk

Risk: Geotechnical conditions, permitting, and environmental issues can all contribute to delays in the schedule. The crossing is long with a large borehole size. Over schedule could significantly increase costs. Significant delays could have a large financial impact due to delay to in-service date.

Mitigation: All requirements of the permits should be strictly followed. The Contractor shall ensure proper drilling procedures are in place. Encountered geotechnical conditions should be monitored and reported during drilling so modifications can be made to execution strategy, as required, to ensure no negative impacts. It is recommended construction proceed 24/7 with 2 12hr rotational shifts per day.

Disposal of Drilling Fluid

Risk: Drilling fluid needs to be stored and disposed of. Running out of temporary storage can lead to schedule delays and environmental concerns. The length and large borehole size will result in significant volumes of drilling fluid. Drilling fluid may be contaminated due to coal seams.

Mitigation: Adequate storage should be on site. An EDFP should be followed and an adequate recycling system will be on site. An approved disposal plan should be developed prior to construction. Facility disposal should be expected.

Reaming Operations:

Over Schedule Risk

Risk: Geotechnical conditions, permitting, and environmental issues can all contribute to delays in the schedule. The crossing is long with a large borehole size. Over schedule could significantly increase costs. Significant delays could have a large financial impact due to delay to in-service date.

Mitigation: All requirements of the permits should be strictly followed. The Contractor shall ensure proper drilling procedures are in place. Encountered geotechnical conditions should be monitored and reported during drilling so modifications can be made to execution strategy, as required, to ensure no negative impacts. Using two rigs will split the workload which would be normally be placed upon a single rig.

Loss of Equipment in the Borehole

Risk: Reaming or enlarging the bore to the desired diameter may cause instability areas. These areas may cause downhole tooling to get stuck or lost. Loss of equipment within the borehole is a larger risk than with a shorter crossing.

Mitigation: The utilization of intersect methodology will mitigate the risk of losing equipment within the borehole. Using two rigs will split the workload which would be normally be placed upon a single rig. If problems arise on one side of the reamer, the opposite rig will maintain contact with the downhole tooling and be able to trip to surface. Drill string management plan should be provided by the contractor, which should include regularly switching out drill stem on either side of the reamers.

Poor Removal of Cuttings

Risk: Due to the large ream pass and length a large volume of cuttings will be created and therefore will have to be removed from the borehole.

Mitigation: Drilling fluid parameters will be optimized for maximum cutting transportation, through adherence to the EDFP. High pump rates throughout the ream passes of the HDD will increase the annular velocity and therefore carrying capacity. Additional trips will be necessary to mechanically remove cuttings from the borehole. The number of trips required will be based on the borehole conditions. The cut size should ensure that cuttings can be removed.

Drilling Fluid Control

Risk: As the volume of drilling fluid within the borehole increases, it becomes more difficult to change its properties with drilling fluid additives. The large diameter borehole combined with the length will impact the quality and makeup of the drilling fluid. Coal seams may contaminate drilling fluid. Contractor will be hauling in water.

Mitigation: The Contractor should prepare and adhere to an approved EDFP which will outline the steps required to ensure the highest quality of drilling fluid is used for the crossing. A premix tank should be made available in addition to the mud tank. Contractor should continue to adhere to the EDFP throughout reaming operations even if they are experiencing fluid losses.

Pullback Operations:

Stuck Pipe

Risk: There is a risk that the pipe section becomes stuck in the borehole due to borehole length, instability, blockages, or irregularities. The pullforce for this length is between approximately 502,000 and 960,000lbs.

Mitigation: One or more wiper trips shall be completed to ensure a clean hole. Required force should be monitored during the wiper passes. It is recommended that a Pipe Thruster (with custom inserts for NPS 24) be available on exit side to assist the rig with pullback in the event pullforces start to become exceedingly high.

Pull Forces Exceeding Theoretical Model

Risk: There is a risk that pull forces exceed the theoretical model, especially with the length of the drill. Contributing factors can include cuttings in the borehole, having to temporarily halt line pull, borehole instability, and heavy drilling fluid.

Mitigation: A swab pass should be completed and downtime during installation should be minimized. It is expected pipe pull will continue overnight as required. This should be planned for with crews in advance, lighting shall be sufficient to allow overnight operations for pull. Pipe thruster should be available on exit side to assist the rig will pullback.

Coating Damage

Risk: Gravel, cobbles, boulders, and bedrock interfaces within the bore path pose a risk that the pipe coating is damaged during line pull.

Mitigation: Wiper passes shall be completed to gauge any possible areas of issue, and additional passes may be used to ensure minimized risk prior to pullback. FBE and ARO coated pipe shall be used.

Pipe Handling

Risk: The exit angle, wall thickness, and size of the pipe result in a large radius overbend that reaches a height of 35 ft. The pipe section requires significant support equipment.

Mitigation: A pullback lift plan should be created prior to construction for review and approval. The equipment capacities should be sufficient for the anticipated loads. Spreader bars may reduce crane requirements. A traffic plan should be created for Highway 17A (52nd Street NW) and 54th Street NW (if required).

Pipe Preparation:

Over Schedule Risk

Risk: There is significant support equipment required for pullback. If pullback is delayed this could be a large cost to keep the equipment on site. If the pipe section is not ready for pull the hole could tighten.

Mitigation: A pullback lift plan should be created prior to construction for review and approval. The equipment capacities should be sufficient for the anticipated loads. Spreader bars may reduce crane requirements. A traffic plan should be created for Highway 17A (52nd Street NW) and 54th Street NW (if required). Progress of the HDD should be tracked closely.

Other Risks:

Crossing Length

Risk: The crossing is 15,393ft long, approaching record lengths for an HDD crossing. There is a risk that the crossing could encounter compounding issues that lead to the crossing not being completed successfully.

Mitigation: A competent contractor with adequate tooling and relevant experience with similarly large installations has been selected. The risks should be highlighted to all stakeholders.

Access to Water

Risk: Water sources should be investigated/confirmed. Water transport should be a major consideration.

Mitigation: Additional transport and water sources should be investigated prior to construction. Transport should include contingency to ensure a lack of water does not lead to any delays with progress of the drill, particularly in the event of significant fluid losses during drilling, where large volumes of make-up water may be required.

Public Attention

Risk: Scrutiny is possible in the area. There is a risk of negative public perception issues. The summer season will see high levels of lake use.

Mitigation: The contractor shall ensure all procedures are being followed and their impact is minimized. The contractor shall ensure all correspondence with the public is completed by WBI representation.

6 RECOMMENDATIONS

The following recommendations outline the main action items that should be completed in order to ensure smooth progression of the project into the construction phase:

a) Review of information by all stakeholders and issuance of the Issued for Construction (IFC) drawings incorporating any changes from the Owner, environment, or other consultants.

b) Ensure that all the requirements of the USACE Omaha district are met, and an open line of communication is maintained throughout design and construction.

c) Ensure all required ROW and TWS, environmental notifications and permits, and water withdrawal and disposal sites are acquired.

d) Review the Construction Execution Plan, including but not limited to Pullback Plan, Water Management and Drilling Fluid Disposal Plan, Drilling Rig Anchoring Plan, Casing Plan, and Site-Specific Environmental Plan.

e) Scope of construction inspection, turbidity monitoring and fluid disposal management services should be identified.

f) Review any new environmental concerns with respect to the crossings and develop contingency plans if required.

g) Select an appropriate level of qualified supervision on site for all stages of the drill to ensure that the drill profile is adhered to within the radius limits set forth on the IFC drawing, the proper drilling techniques and equipment are utilized, and schedule and costs are controlled.

h) Select a qualified drilling contractor with experience completing HDD installations of similar size and scope in the area who is familiar with the local geologic formations and associated risks.

7 CONCLUSIONS

This assessment shows the risks identified on the Missouri River NPS 24 HDD crossing and if adequately mitigated, reduces the overall impact on the project. Based on the available data, it is deemed feasible to construct the Missouri River HDD crossing along the proposed North Bakken Expansion Pipeline project successfully. The crossing is one of the longest HDD crossings completed, and there is potential for an unsuccessful HDD installation, however, this risk will be minimized if the recommendations included within this report are followed.

8 LIMITATIONS

This report has been prepared based on the available site-specific information for the exclusive use of WBI in the construction of the proposed Missouri River HDD crossing. No other warranty is expressed or implied and the information presented within this report shall not be applied to other projects.

Although subsurface conditions are not expected to vary significantly from those shown on the drawings, it should be appreciated that extrapolation of subsurface conditions between boreholes and to depths below the depth of exploration is subject to interpretation and could be at variance with actual field conditions.

9 REFERENCE DOCUMENTS – HDD DESIGN DRAWINGS

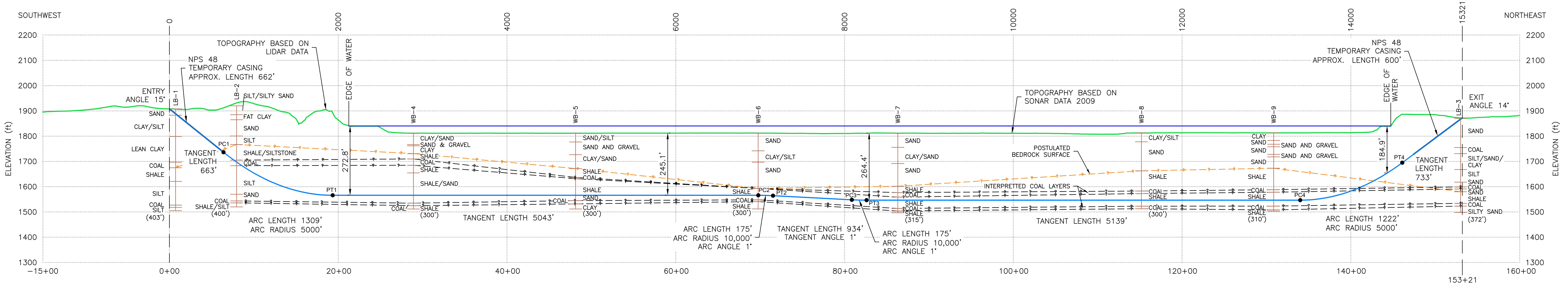
Drawing Name	Drawing Number	Revision	Sheet
Missouri River HDD Crossing Plan and Profile	2386-EG-0101	G	1 of 3
Missouri River HDD Pullback Plan and Detail	2386-EG-0102	D	2 of 3
Missouri River HDD Construction Notes	2386-EG-0103	A	3 of 3

Geotechnical Report: WBI North Bakken Land-based Geotech Report

Geotechnical Report: WBI North Bakken Water-based Geotech Report

APPENDIX A – HDD DESIGN DRAWINGS

PLAN VIEW
SCALE 1"=600'



PROFILE ALONG PROPOSED PIPELINE

SCALE 1"=600' HORIZONTAL
SCALE 1"=200' VERTICAL

TOTAL DRILL LENGTH 15393'

HORIZONTAL DIRECTIONAL DRILL DATA MISSOURI RIVER HDD		
DESCRIPTION	STATION (ft)	ELEVATION (ft)
ENTRY @ 15°	0+00.00	1907.85
PC1 = 5000' RADIUS	6+40.51	1736.23
PT1	19+34.61	1565.86
PC2 = 10,000' RADIUS	69+78.43	1565.86
PT2	71+52.95	1564.33
PC3 = 10,000' RADIUS	80+87.31	1548.02
PT3	82+61.83	1546.50
PC4 = 5000' RADIUS	134+00.95	1546.50
PT4	146+10.56	1695.02
EXIT @ 14°	153+21.04	1872.17
HORIZONTAL DISTANCE (ft) = 15321.04		
DIRECTIONAL DRILL PIPE LENGTH (ft) = 15392.57		

Pilot Hole Tolerances	
Item	Tolerance
Pilot Entry Angle	Increase in angle up to 1° (deeper), but no decrease in angle allowed as long as minimum 3-joint bending radius is not compromised.
Pilot Entry Location	As staked by COMPANY. No change without COMPANY approval.
Pilot Exit Angle	Change in angle up to +/-1° allowed as long as minimum 3-joint bending radius is not compromised.
Pilot Exit Location	Up to 40 feet longer or 10 feet shorter than exit stake. Between 10 feet left and 10 feet right of COMPANY survey centerline.
Pilot Depth	Up to 5 feet decrease in design depth (shallower) allowed except under critical areas such as roads, utilities, levees etc. near the entry and exit points. Up to 10 feet increase in depth (deeper) allowed. Best efforts shall be made to stay at or below pipe design profile depth.
Pilot Alignment	Shall remain within 10 feet left or right of COMPANY centerline survey.

GEOTECHNICAL BORE HOLE INFORMATION			
BOREHOLE	LATITUDE	LONGITUDE	DEPTH (ft)
LB-1	48° 6' 56.33"	-103° 5' 34.23"	403
LB-2	48° 7' 3.56"	-103° 5' 33.40"	400
LB-3	48° 9' 22.10"	-103° 4'39.62"	372
WB-4	48° 7' 23.30"	-103° 5'25.93"	300
WB-5	48° 7' 42.24"	-103° 5' 15.52"	300
WB-6	48° 8' 2.38"	-103° 5' 10.74"	300
WB-7	48° 8' 17.93"	-103° 5' 1.65"	315
WB-8	48° 8' 45.61"	-103° 4' 53.93"	300
WB-9	48° 9' 0.54"	-103° 4' 45.08"	310

REFERENCE DOCUMENT NO.	DATE
1. NBE_PL-PROPOSED_ROUTES 190824	2019-08-24
2. 2386-01-IMP STEEL STRESS-24-inch-02	2020-07-30

CCI & Associates Inc.
20445 State Highway 249, Suite 250
Houston, TX 77070
COCP 27692PE

ENGINEER AND PERMIT STAMPS

1"=600'
FT 0 600 1200 2400

PIPELINE SPECIFICATIONS

	NPS 24
OUTSIDE DIAMETER (OD)(in)	24
WALL THICKNESS (WT)(in)	0.99
GRADE (psi)	60,000
PRODUCT	NATURAL GAS
MATERIAL	STEEL
SPECIFICATIONS	API 5L
INTERNAL COATING	N/A
OUTER COATING	DUAL FBE
MAX. OPER. PRESSURE (psi)	1,480
MIN. TEST PRESSURE (psi)	1,850
MAX. OPER. TEMP (°F)	100
MIN. INSTALLATION TEMP (°F)	60

1"=200'
FT 0 200 400 800

STEERING TOLERANCES

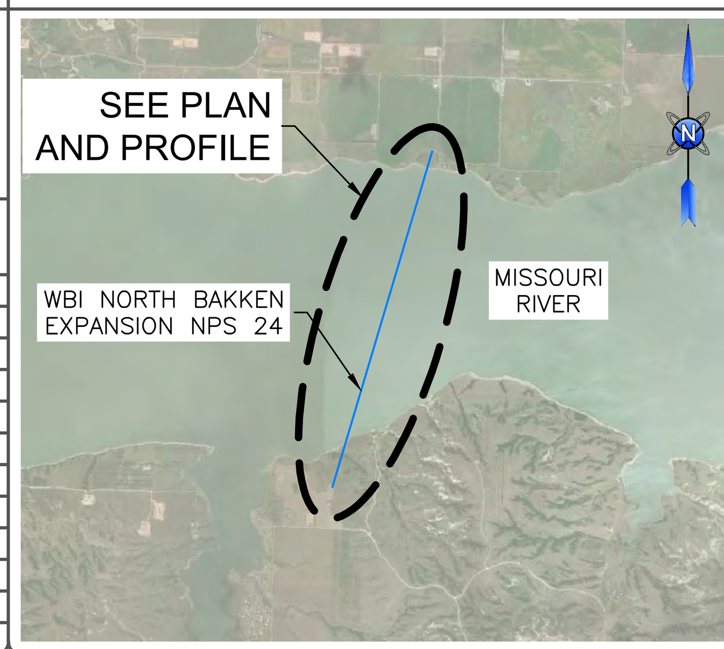
	30ft	100ft	DESIGN
MINIMUM RADIUS (ft)	1100	2000	5000

PULL FORCE / RIG SIZE / STRESS

PULL FORCE (w/o BUOYANCY CONTROL):	752,000 lbs (w/sf)
MINIMUM RECOMMENDED RIG SIZE:	1,000,000 lbs
COMBINED STRESS UNITY CHECK:	0.29
OPERATING STRESS	48.1%

DRAWING STATUS	DATE	DRN	CHK	DES	GEO	APR	CR
ISSUED FOR PERMIT	2020-07-31	MS	EY	CG	LC	KP	NM

LOCATION PLAN (1"=7000')



NAD83.ND-Nft

WBI ENERGY TRANSMISSION
An MDU Resources Group company

WBI NORTH BAKKEN EXPANSION PROJECT
MISSOURI RIVER HDD CROSSING
PLAN AND PROFILE
WATFORD CITY / TIOGA, MCKENZIE COUNTY, NORTH DAKOTA

SCALE	DWG. #	REVISION	SHEET
AS SHOWN	2386-EG-0101	G	1 OF 3

PULLBACK PLAN VIEW
SCALE 1"=600'

TOTAL PULLBACK LENGTH 15393'

PULLBACK DETAIL
SCALE 1"=40' HORIZONTAL
SCALE 1"=40' VERTICAL

REFERENCE DOCUMENT NO.	DATE
1. NBE_PL-PROPOSED_ROUTES 190824	2019-08-24
2. 2386-01-IMP STEEL STRESS-24-inch-02	2020-07-30

CCI & Associates Inc.
20445 State Highway 249, Suite 250
Houston, TX 77070
COCP 27692PE

ENGINEER AND PERMIT STAMPS

1"=600'
FT 0 600 1200 2400

PIPELINE SPECIFICATIONS

	NPS 24
OUTSIDE DIAMETER (OD)(in)	24
WALL THICKNESS (WT)(in)	0.99
GRADE (psi)	60,000
PRODUCT	NATURAL GAS
MATERIAL	STEEL
SPECIFICATIONS	API 5L
INTERNAL COATING	N/A
OUTER COATING	DUAL FBE
MAX. OPER. PRESSURE (psi)	1,480
MIN. TEST PRESSURE (psi)	1,850
MAX. OPER. TEMP (°F)	100
MIN. INSTALLATION TEMP (°F)	60

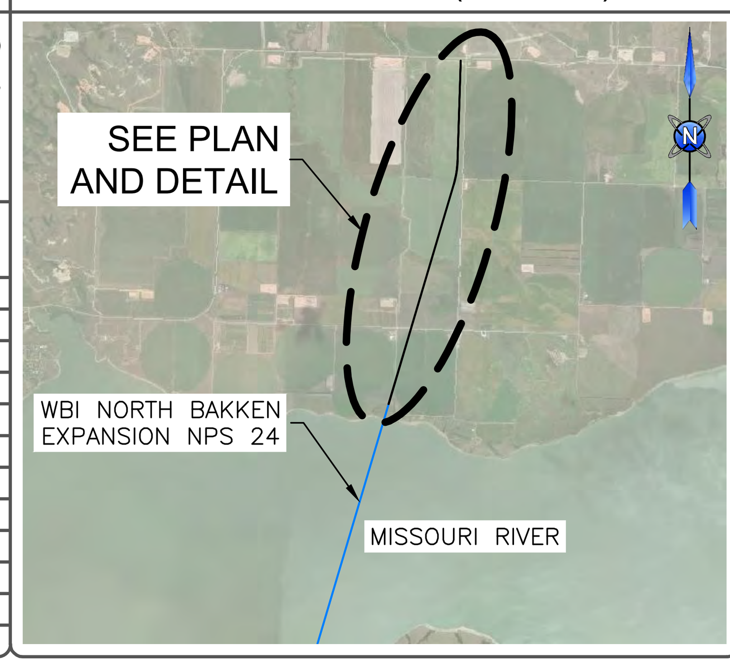
1"=40'
FT 0 40 80 160

PULL FORCE / RIG SIZE / STRESS

PULL FORCE (w/o BUOYANCY CONTROL):	752,000 lbs (w/sf)
MINIMUM RECOMMENDED RIG SIZE:	1,000,000 lbs

DRAWING STATUS	DATE	DRN	CHK	DES	GEO	APR	CR
ISSUED FOR PERMIT	2020-07-31	MH	EY	CG	N/A	KP	NM

LOCATION PLAN (1"=7000')



NAD83.ND-Nft

WBI ENERGY TRANSMISSION
An MDU Resources Group company

WBI NORTH BAKKEN EXPANSION PROJECT
MISSOURI RIVER HDD CROSSING
PULLBACK PLAN AND DETAIL
TIOGA, MCKENZIE COUNTY, NORTH DAKOTA

SCALE	DWG. #	REVISION	SHEET
AS SHOWN	2386-EG-0102	D	2 OF 3

NOTES

1. All dimensions are in feet unless otherwise specified. All dimensions are to the centerline of borehole unless otherwise specified.
2. All drill path lengths are rounded to the nearest foot and angles are rounded to the nearest degree, unless otherwise specified.
3. This drawing is based on information provided from various sources. Consulting company does not take responsibility for the accuracy of information provided by others.
4. The crossing shall be constructed in accordance with ASME B31.8 2018.

CONSTRUCTION

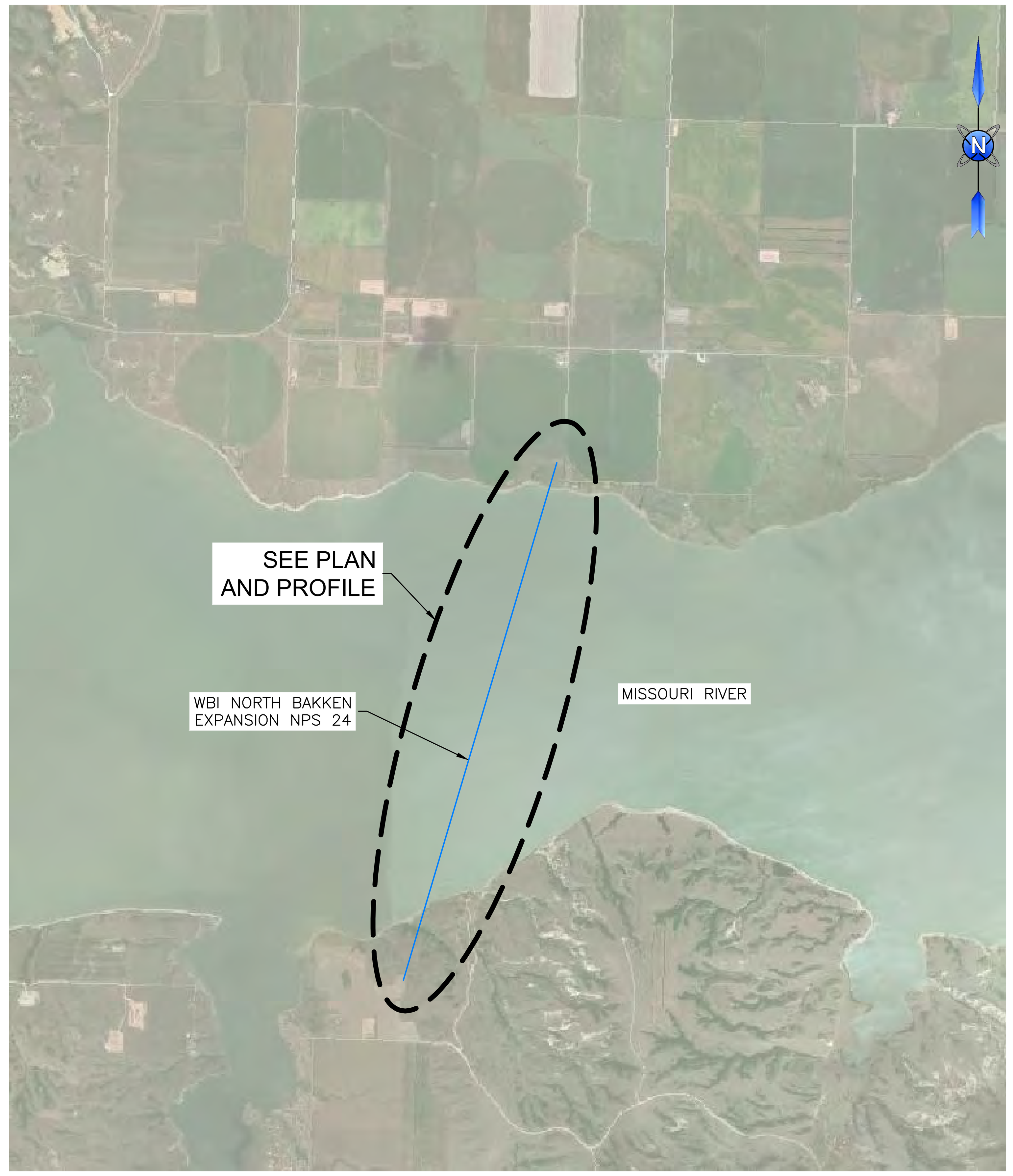
5. The estimated theoretical pull force (including safety factor) for this HDD crossing has been calculated to be 752,000 lbs without the consideration of pipeline buoyancy control.
6. Assumed final borehole size is 36".
7. The Contractor shall submit a Drilling Execution Plan for Company approval (prior to start of drilling operations) meeting the minimum requirements of the Contract Documents. Any deviation from the Execution Plan shall only be allowed with Company approval.
8. The Contractor shall verify topographical survey information represented on this drawing in the field prior to construction. Contractor shall inform the Owner of any topographical discrepancies identified.
9. The design drill path and existing utilities being crossed shall have a minimum separation of 10ft.
10. Contractor shall supply and use an approved annular pressure tool capable of operating within the expected pressure range. Annular pressure information provided is based on a mud motor assembly for a 13 1/2" pilot hole.
11. The locations of existing utilities, pipelines and structures shown on the drawing are approximate and shall be verified in the field by the Contractor prior to start of any excavation or pilot hole operations. Verification shall be in accordance with Company specifications and procedures. The Contractor shall ensure any utilities, pipelines and structures in the area are protected and not damaged by the construction.
12. The Contractor shall take specific precautions in protecting existing utilities, pipelines and structures at the entry and exit sites. Such precautions may include: entry/exit pits excavated below existing utilities, casing or sheet piling used to protect pipelines, ramping/matting and special drilling precautions employed during drilling. These precautions shall be used to ensure the drilling tools, pipe and product pipe maintain a safe distance from the existing pipelines, utilities and structures.
13. The Contractor shall assess the need for temporary casing, including both small diameter "wash–over" type casing during pilot hole, and large diameter hammered–in place casing. If large diameter casing is utilized, casing shall be sized to accommodate the final ream pass and shall utilize centralizer casing within the temporary conductor casing. Casing diameter, wall thickness, grade, and drive shoe design shall be determined by the Contractor. A Contractor's Casing Plan shall be submitted and approved by Company prior to casing installation. All temporary casings shall be removed at completion unless otherwise noted.
14. The pilot hole shall be drilled along the design drill path with the designated design radius of curvature shown in the drawing. The pilot hole shall be within the pilot hole tolerances noted on the drawing.
15. The design radius for this crossing is 5000 ft. The pilot hole drilling shall adhere to the following tolerances:
    30ft (single joint) radius shall not be less than 1100 ft
    100ft (3–joint) average radius shall not be less than 2000 ft
16. Crossing to be completed using an intersect methodology utilizing an HDD rig on either side of the crossing. Intersect shall be planned for near the mid–point of the drill geometry in order to ensure minimized risk of drilling fluid release throughout the drill.
17. This engineered design is based on the following minimum equipment requirements that the Contractor shall have onsite:
    a. Drilling Equipment:
       - Drilling Rig with a minimum pull force of 1,000,000 lbs;
       - Drill Pipe 7 5/8" (inspected as per the HDD specification);
       - Drill Bit – 13 1/2" in diameter or larger (provide details, condition, and supplier);
       - 8" Mud Motor or larger capable of running within its specified maximum load range (provide details, condition, and supplier);
       - Annular Pressure Tool (0 to 510 psi range);
       - Reamers designed for the formation (provide manufacturer's operating specifications, condition, and supplier);
       - Gyroscopic steering system;
       - Casing (specifications and details to be provided for approval).
    b. Drilling Fluid Recycling Equipment:
       - Pump Capacity (Operable Rate – 1050 gpm);
       - Shakers (Operable Rate – 1050 gpm);
       - Centrifuge/Desander/Desilter (Minimum Capacity of 1050 gpm);
       - Engineered Drilling Fluid Plan must be able to be implemented in the field with the proposed equipment.
    c. This is a minimum list of equipment and should not be considered a directive on how to complete the work. The Contractor is responsible for the execution of the work under its Approved Execution Plan and shall supply all necessary equipment to complete its plan at its own cost. All equipment shall be supplied in good working order, maintained, fueled and serviced.
18. Drilling Fluid is assumed to have a maximum density of 10 lbs/gallon and 1.0% sand content.

ENVIRONMENTAL

19. Emergency response spill kits must be on–site and available for use for the duration of the project.
20. Terrestrial "inadvertent return walks" shall be initiated every 4hrs. (at a minimum), or immediately following a loss of fluid event.
21. Contractor's proposed drilling fluid composition, including all expected additives, shall be reviewed and approved by the Owner's representative prior to construction.
22. The watercourse must be monitored for a potential release of drilling fluid and to assess the immediate effects of the works on the aquatic environment in accordance with applicable Federal and State regulations.
23. The Contractor shall ensure that the following documentation is on–site and readily available at all times (at a minimum):
    a. Emergency Response Procedure (ERP);
    b. Environmental Protection Plan (EPP);
    c. MSDS for all on–site material;
    d. Copies of Land Use Agreements.

GEOTECHNICAL

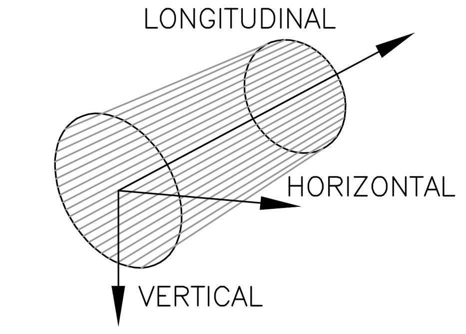
24. A land–based geotechnical investigation was completed at this site by Groundwater and Environmental Services, Inc (GES), and can be referenced from the report titled "Geotechnical Investigation Report WBI North Bakken Expansion Project", dated June 14, 2019. A supplemental water–based geotechnical investigation was also completed and can be referenced from the report titled "Geotechnical Investigation Report Water Based Borings", dated July 9, 2020.
25. The soil and bedrock stratigraphy shown is based on interpretation of data from three (3) land–based boreholes, and six (6) water–based boreholes, drilled at the locations shown and the designer's understanding of the local geology. Due to natural variations in subsurface conditions and inherent uncertainties associated with the interpretation of subsurface data, some variation in stratigraphy between boreholes and along the length of the bore should be expected.
26. The Contractor should independently evaluate the crossing with due consideration given to the suitability of its proposed equipment and construction procedures. Proposed construction means and methods shall be submitted to Company for approval but remain the sole responsibility of the Contractor.



LOCATION PLAN
SCALE 1"=3000'

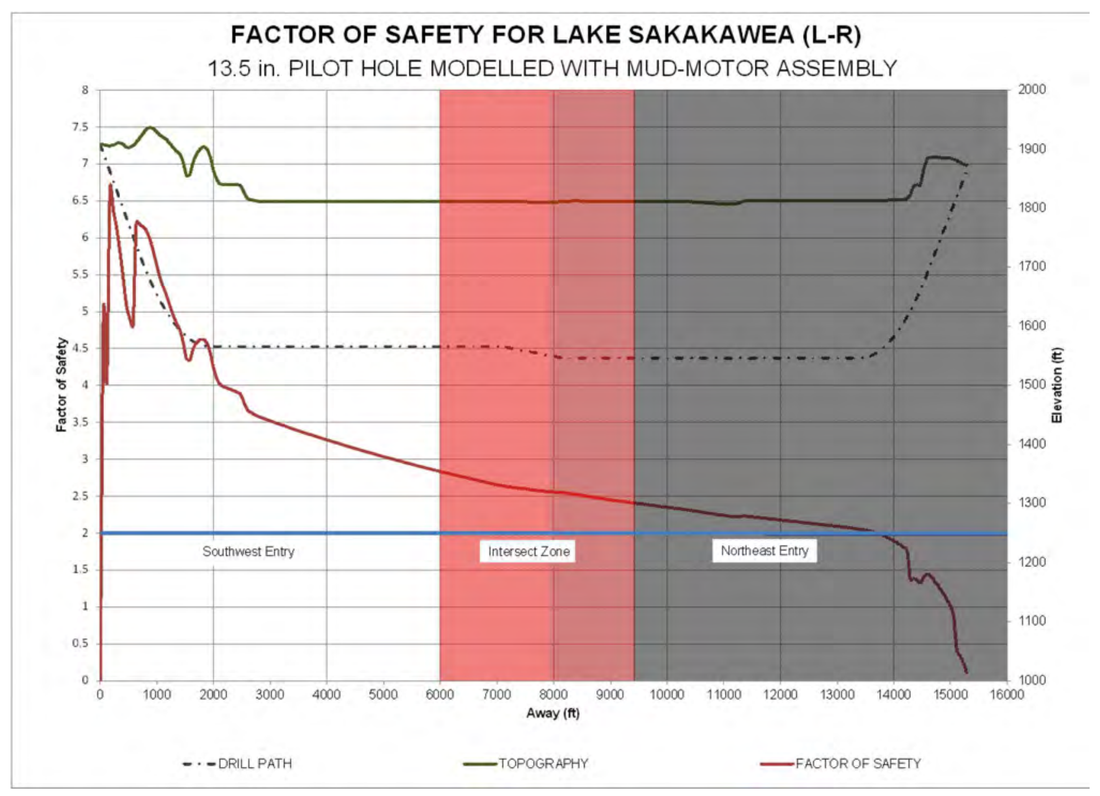
PULLBACK NOTES

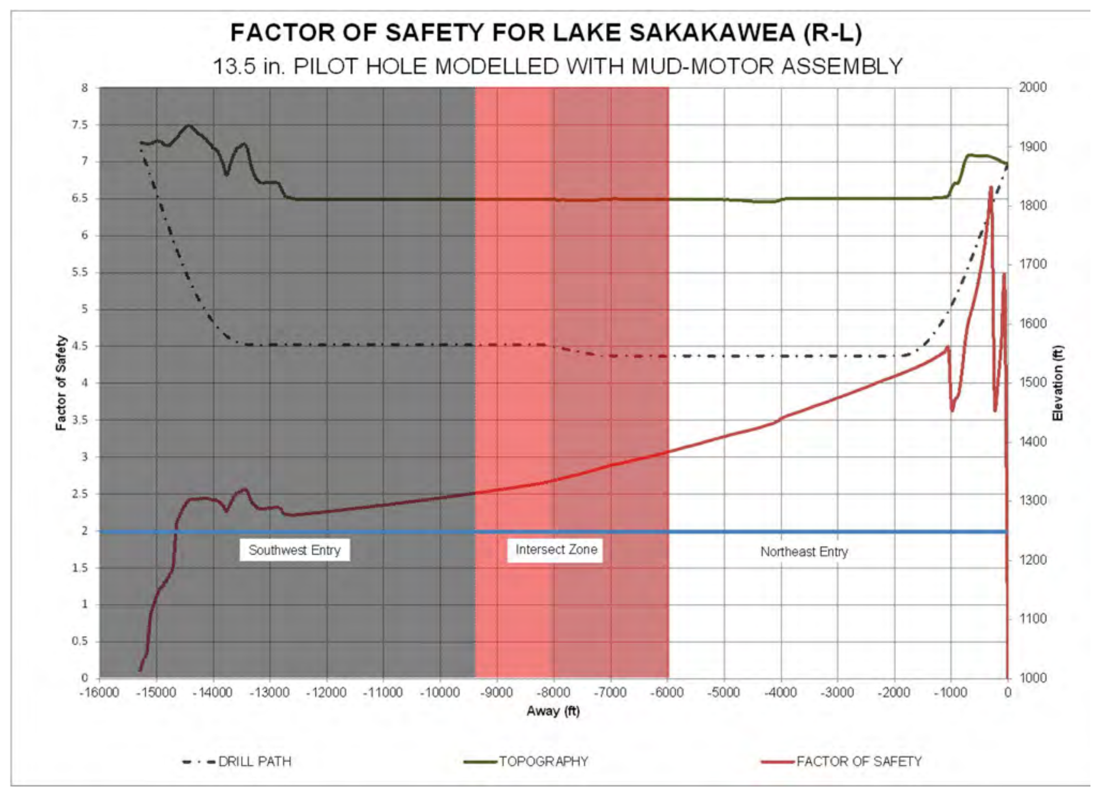
1. This drawing is engineered and designed to ensure the pipe section is not overstressed during the installation process.
2. This drawing is developed to inform the Contractor of the maximum spacing, anticipated lifting heights, minimum loading requirements and the minimum amount of support equipment to be provided by the Contractor. It is expected that the Pipeline Contractor will choose the type and size of equipment to manage the minimum loads provided.
3. The shown spacing and heights of supports represent a modeled maximum total stress on the pipe (including tension, bending and shear stress at the supports) of 80% of SMYS.
4. The support placement and spacing shown is based on provided topographical survey data. The Contractor shall field fit equipment according to the terrain or other on–site requirements adhering to a maximum spacing provided of 80ft between any two supports.
5. This drawing is based on information provided from various sources. Contractor shall confirm the accuracy of information prior to construction.
6. All loads shown assume that no buoyancy control will be utilized for this pullback.
7. All dimensions are to the bottom of pipe.
8. It is anticipated that all support equipment will utilize roller cradles during the pullback operation. Load capacity of each roller cradle is 56,500lbs (24"–36" roller cradle model). The load capacity shall be confirmed prior to use.
9. Equipment shall be sized with an adequate safety factor (2.0x or greater) to safely handle expected loads and to suit the heights recommended to facilitate the proper radius of curvature. It is expected that extended boom lengths or ramping under the side–booms may be necessary.
10. Shown pipe roller spacing based on roller load capacity of 12,000lbs. Roller spacing shall be adjusted to suit model of roller used.
11. It is the Contractor's responsibility to ensure they have crossing agreements from all utility and pipeline companies in the area where work will be performed overtop or in the vicinity of high pressure pipelines or utilities.
12. Proper padding/ramping above existing lines is required for all areas in which heavy equipment is moved or placed where the equipment may impact these lines.
13. Contractor shall ensure that there is minimal public disturbance and disruption during all parts of the work.
14. Contractor shall be prepared to work with other Contractors in the area.
15. Care shall be taken in manipulating the first and last section of pipe throughout the pullback. The maximum unsupported length at the leading and trailing ends of the pull section shall not exceed 60ft in order to prevent overstressing of the pipe.
16. Contractor shall implement an adequately sized catch off tractor as an anchor when the pipe section involves a slope, horizontal curve and/or a high to low installation. The tractor must be secured to the pipe section in an acceptable manner such as a pull head.
17. Contractor shall consider other factors such as weather conditions (wind, rain, snow, etc.) and site conditions on the pullback operations to ensure a safe lift and installation.
18. Contractor shall secure the load lines on cranes (if required) to the ground to minimize movement of the cradles along the pipe.
19. Contractor to take all precautions to minimize damage to pipe coating during pullback. Any damage to coating shall be repaired as specified in contract documents.
20. Contractor shall modify this plan (as required) to ensure the pipe pull section is sufficiently supported at all times during pullback. Contractor must provide a Pullback Plan for approval by the owner's representative two weeks in advance of commencing the work.
21. For the support design shown, the largest expected forces are:
    Single Cradle Support
    a. Vertical 55,400lbs
    b. Horizontal 95lbs
    c. Longitudinal 5,540lbs
22. The loads on the supports during pullback resolve to three directions; vertical, horizontal and longitudinal. The vertical direction is the weight of the pipe, the horizontal direction results from horizontal curves and the longitudinal direction results from the pipe being pulled through the cradles. A diagram can be seen in the detail to the right.



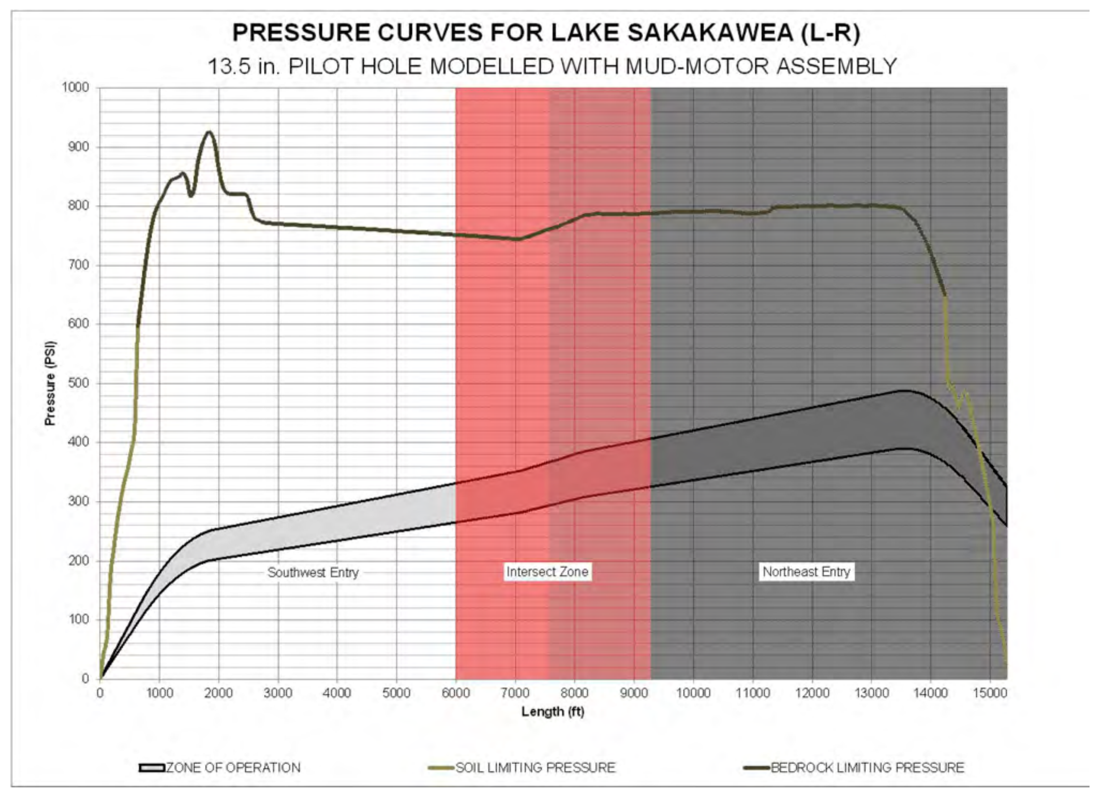
DIRECTIONAL FORCE DIAGRAM
N.T.S.

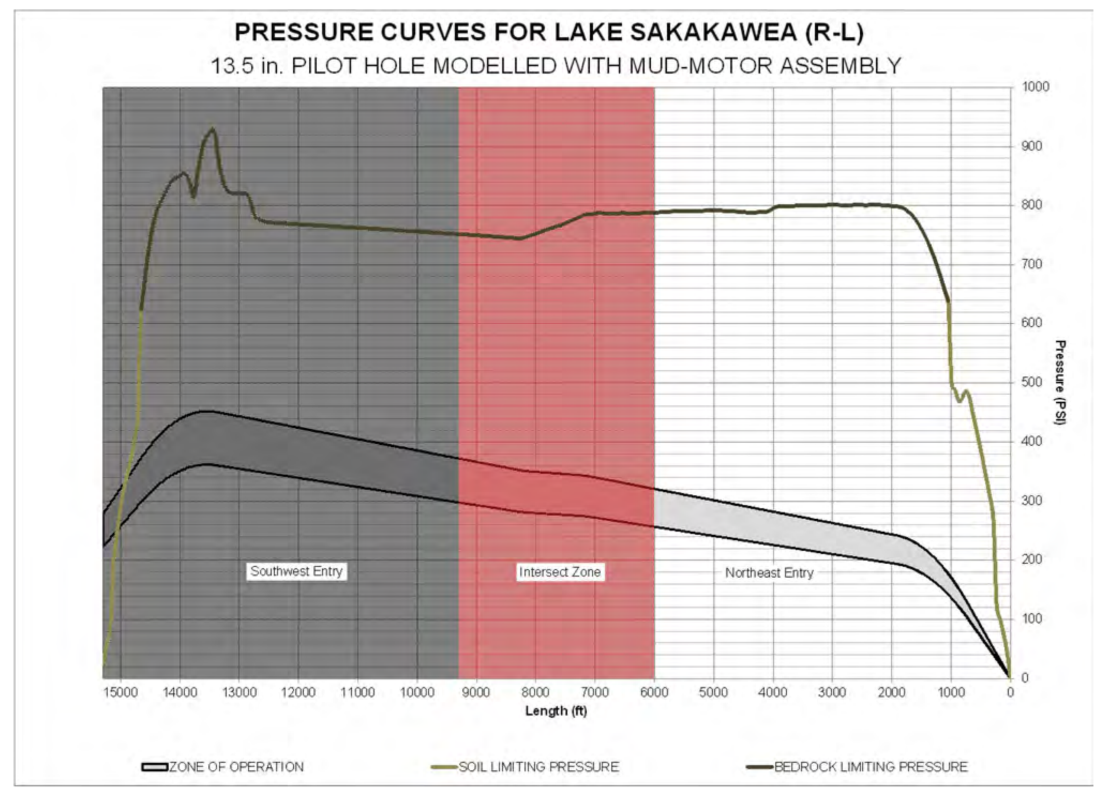
FACTOR OF SAFETY GRAPHS





ANNULAR PRESSURE CHART





REFERENCE DOCUMENT NO.	DATE
1. NBE_PL-PROPOSED_ROUTES 190824	2019-08-24
2. 2386-01-IMP STEEL STRESS-24-inch-02	2020-07-30
3. 2386-01-L2R-AP-02	2020-07-23
4. 2386-01-R2L-AP-02	2020-07-23
5. 2386-01-L2R-AP-02 (USACE FS)	2020-07-23
6. 2386-01-R2L-AP-02 (USACE FS)	2020-07-23

CCI & Associates Inc.
20445 State Highway 249, Suite 250
Houston, TX 77070
COCP 27692PE

ENGINEER AND PERMIT STAMPS

PIPELINE SPECIFICATIONS	
	NPS 24
OUTSIDE DIAMETER (OD)(in)	24
WALL THICKNESS (WT)(in)	0.99
GRADE (psi)	60,000
PRODUCT	NATURAL GAS
MATERIAL	STEEL
SPECIFICATIONS	API 5L
INTERNAL COATING	N/A
OUTER COATING	DUAL FBE
MAX. OPER. PRESSURE (psi)	1,480
MIN. TEST PRESSURE (psi)	1,850
MAX. OPER. TEMP (°F)	100
MIN. INSTALLATION TEMP (°F)	60

STEERING TOLERANCES	30ft	100ft	DESIGN
MINIMUM RADIUS (ft)	1100	2000	5000

PULL FORCE / RIG SIZE / STRESS	
PULL FORCE (w/o BUOYANCY CONTROL):	752,000 lbs (w/sf)
MINIMUM RECOMMENDED RIG SIZE:	1,000,000 lbs
COMBINED STRESS UNITY CHECK:	0.29
OPERATING STRESS	48.1

DRAWING STATUS	DATE	DRN	CHK	DES	GEO	APR	CR
ISSUED FOR PERMIT	2020-07-31	MH	EY	CG	LC	KP	NM

NAD83.ND-Nft

WBI ENERGY TRANSMISSION
An MDU Resources Group company

WBI NORTH BAKKEN EXPANSION PROJECT

MISSOURI RIVER HDD CROSSING
CONSTRUCTION NOTES AND PIPELINE INFORMATION

WATFORD CITY / TIOGA, MCKENZIE COUNTY, NORTH DAKOTA

SCALE	DWG. #	REVISION	SHEET
AS SHOWN	2386-EG-0103	A	3 OF 3

APPENDIX B – HDD STRESS SUMMARY

Owner:	WBI Energy Transmission	CCI & Associates Inc.
Project:	North Bakken Expansion	
Date:	2020-07-29	
Calculation Description:	Stress Assessment NPS 24 HDD	
Applicable Crossings:	Lake Sakakawea - 9.5 lb/gal Fluid	

Completed By:	KP	Reviewed By:	JT	Sheet Revision: R19.1

Pipe Information			**Design Criteria**				**Crossing Characteristics**	
Pipe Diameter (in)	**Pipe W.T. (in)**	**Pipe Grade (psi)**	**MOP (psi)**	**Max. Operating Temperature (°F)**	**Installation Temperature (°F)**	**Design Radius (ft)**	**Maximum Depth From Entry Location (ft)**	**HDD Length (ft)**
24	0.990	60000	1,480	100	60	5000	361	15393

The pipe section installated stresses are modelled in 5 sections (exit tangent (5), exit arc (4), bottom tangent (3), entry arc (2), entry tangent (1)) incorporating effects of buoyancy, soil friction, curvature, fluidic drag and pipe weight. The calculated stresses are evaluated using the AGA method (PRCI). Operating stresses incorporate hoop, bending, tensile, and thermal expansion.

Variable Definitions:

F_y - Specified Minimum Yield Strength

D - Outer Diameter of Product Pipe

E - Young's Modulus (Steel)

t - Wall Thickness of Product Pipe

Tensile Stress:

			% of Allowable
5	6761.2 psi	**PRCI 5.1.1, 5.5**	12.5%
4	7007.0 psi		**13.0%**
3	6434.7 psi	**Allowable Tensile Stress**	11.9%
2	6758.5 psi	$F_t = (0.9) * F_y$	12.5%
1	6961.7 psi	= 54000 psi	12.9%

Bending Stress:

			% of Allowable
5	295.0 psi	**PRCI 5.2.2**	0.7%
4	5900.0 psi	$f_b = (E/D)/(2R)$	**13.1%**
3	295.0 psi	**Allowable Bending Stress**	0.7%
2	5900.0 psi	$F_b = \{0.72 - (0.58\ F_y\ D / (E\ t)\}\ F_y$	**13.1%**
1	295.0 psi	= 45000 psi	0.7%

Hoop Stress:

			% of Allowable
5	1242.0 psi	**PRCI 5.2.3**	5.3%
4	2130.2 psi	$f_h = P_{ext}D/2t$	**9.1%**
3	2130.2 psi	**Allowable Hoop Stress**	**9.1%**
2	2130.2 psi	$F_{hc} = [0.88 \times E \times (t/D)^2] / 1.5$	**9.1%**
1	1111.3 psi	= 23300.7 psi	4.8%

Operating Stresses:

			% of Allowable
5	10197.0 psi	**PRCI 5.4.4.2:**	37.8%
4	12999.5 psi	**Allowable Shear Stress**	**48.1%**
3	10197.0 psi	F(v) = 45% of F_y	37.8%
2	12999.5 psi	F(v) = 27000 psi	**48.1%**
1	10197.0 psi		37.8%

Combined Stress (Tensile and Bending)

			% of Allowable
5	0.13	**PRCI 5.2.4**	13%
4	0.26	$f_t/0.9F_y + f_b/F_b \leq 1$	**26%**
3	0.13		13%
2	0.26		26%
1	0.14		14%

Combined Stress (Tensile, Bending, and Hoop)

			% of Allowable
5	0.02	**PRCI 5.2.4**	2%
4	0.08	$A^2+B^2+2v\|A\|B \leq 1$	**8%**
3	0.02	$A = ((f_t+f_b-0.5f_h)1.25)/F_y$	2%
2	0.07	$B = 1.5f_h/F_{hc}$	7%
1	0.02		2%

Estimated PullForce (without Buoyancy Control)

501,204 lbs

751,805 lbs (including 1.5x Safety Factor)

Owner:	WBI Energy Transmission	
Project:	North Bakken Expansion	
Date:	2020-07-29	
Calculation Description:	Stress Assessment NPS 24 HDD	
Applicable Crossings:	Lake Sakakawea - 10.5 lb/gal Fluid	

Completed By: KP | Reviewed By: JT | Sheet Revision: R19.1

Pipe Information			Design Criteria				Crossing Characteristics	
Pipe Diameter (in)	**Pipe W.T. (in)**	**Pipe Grade (psi)**	**MOP (psi)**	**Max. Operating Temperature (°F)**	**Installation Temperature (°F)**	**Design Radius (ft)**	**Maximum Depth From Entry Location (ft)**	**HDD Length (ft)**
24	0.990	60000	1,480	100	60	5000	361	15393

The pipe section installed stresses are modelled in 5 sections (exit tangent (5), exit arc (4), bottom tangent (3), entry arc (2), entry tangent (1)) incorporating effects of buoyancy, soil friction, curvature, fluidic drag and pipe weight. The calculated stresses are evaluated using the AGA method (PRCI). Operating stresses incorporate hoop, bending, tensile, and thermal expansion.

Variable Definitions:

- F_y - Specified Minimum Yield Strength
- D - Outer Diameter of Product Pipe
- E - Young's Modulus (Steel)
- t - Wall Thickness of Product Pipe

Tensile Stress:

Section	Stress		% of Allowable
5	6777.8 psi	**PRCI 5.1.1, 5.5**	12.6%
4	7208.1 psi		**13.3%**
3	5968.7 psi	**Allowable Tensile Stress**	11.1%
2	6336.4 psi	$F_t = (0.9) * F_y$	11.7%
1	6454.9 psi	= 54000 psi	12.0%

Bending Stress:

Section	Stress		% of Allowable
5	295.0 psi	**PRCI 5.2.2**	0.7%
4	5900.0 psi	$f_b = (E/D)/(2R)$	**13.1%**
3	295.0 psi	**Allowable Bending Stress**	0.7%
2	5900.0 psi	$F_b = \{0.72 - (0.58\ F_y\ D / (E\ t)\}\ F_y$	**13.1%**
1	295.0 psi	= 45000 psi	0.7%

Hoop Stress:

Section	Stress		% of Allowable
5	1353.3 psi	**PRCI 5.2.3**	5.8%
4	2335.1 psi	$f_h = P_{ext}D/2t$	**10.0%**
3	2335.1 psi	**Allowable Hoop Stress**	**10.0%**
2	2335.1 psi	$F_{hc} = [0.88 \times E \times (t/D)^2] / 1.5$	**10.0%**
1	1208.9 psi	= 23300.7 psi	5.2%

Operating Stresses:

Section	Stress		% of Allowable
5	10197.0 psi	**PRCI 5.4.4.2:**	37.8%
4	12999.5 psi	**Allowable Shear Stress**	**48.1%**
3	10197.0 psi	F(v) = 45% of F_y	37.8%
2	12999.5 psi	F(v) = 27000 psi	**48.1%**
1	10197.0 psi		37.8%

Combined Stress (Tensile and Bending)

Section	Value		% of Allowable
5	0.13	**PRCI 5.2.4**	13%
4	0.26	$f_t/0.9F_y + f_b/F_b \leq 1$	**26%**
3	0.12		12%
2	0.25		25%
1	0.13		13%

Combined Stress (Tensile, Bending, and Hoop)

Section	Value		% of Allowable
5	0.02	**PRCI 5.2.4**	2%
4	0.08	$A^2+B^2+2v\|A\|B \leq 1$	**8%**
3	0.02	$A = ((f_t+f_b-0.5f_h)1.25)/F_y$	2%
2	0.07	$B = 1.5f_h/F_{hc}$	7%
1	0.02		2%

Estimated PullForce (without Buoyancy Control)

515,588 lbs

773,382 lbs (including 1.5x Safety Factor)

Owner:	WBI Energy Transmission	CCI & Associates Inc.
Project:	North Bakken Expansion	
Date:	2020-07-29	
Calculation Description:	Stress Assessment NPS 24 HDD	
Applicable Crossings:	Lake Sakakawea - 12 lb/gal Fluid	

Completed By: KP | Reviewed By: JT | Sheet Revision: R19.1

Pipe Information			**Design Criteria**				**Crossing Characteristics**	
Pipe Diameter (in)	**Pipe W.T. (in)**	**Pipe Grade (psi)**	**MOP (psi)**	**Max. Operating Temperature (°F)**	**Installation Temperature (°F)**	**Design Radius (ft)**	**Maximum Depth From Entry Location (ft)**	**HDD Length (ft)**
24	0.990	60000	1,480	100	60	5000	361	15393

The pipe section installated stresses are modelled in 5 sections (exit tangent (5), exit arc (4), bottom tangent (3), entry arc (2), entry tangent (1)) incorporating effects of buoyancy, soil friction, curvature, fluidic drag and pipe weight. The calculated stresses are evaluated using the AGA method (PRCI). Operating stresses incorporate hoop, bending, tensile, and thermal expansion.

Variable Definitions:

- F_y - Specified Minimum Yield Strength
- D - Outer Diameter of Product Pipe
- E - Young's Modulus (Steel)
- t - Wall Thickness of Product Pipe

Tensile Stress:

Section	Stress		% of Allowable
5	6969.8 psi	**PRCI 5.1.1, 5.5**	12.9%
4	7689.7 psi		14.2%
3	8133.7 psi	**Allowable Tensile Stress**	15.1%
2	8807.5 psi	$F_t = (0.9) * F_y$	16.3%
1	8935.1 psi	= 54000 psi	**16.5%**

Bending Stress:

Section	Stress		% of Allowable
5	295.0 psi	**PRCI 5.2.2**	0.7%
4	5900.0 psi	$f_b = (E/D)/(2R)$	**13.1%**
3	295.0 psi	**Allowable Bending Stress**	0.7%
2	5900.0 psi	$F_b = \{0.72 - (0.58 F_y D / (E t)\} F_y$	**13.1%**
1	295.0 psi	= 45000 psi	0.7%

Hoop Stress:

Section	Stress		% of Allowable
5	1520.4 psi	**PRCI 5.2.3**	6.5%
4	2642.4 psi	$f_h = P_{ext}D/2t$	**11.3%**
3	2642.4 psi	**Allowable Hoop Stress**	**11.3%**
2	2642.4 psi	$F_{hc} = [0.88 \times E \times (t/D)^2] / 1.5$	**11.3%**
1	1355.4 psi	= 23300.7 psi	5.8%

Operating Stresses:

Section	Stress		% of Allowable
5	10197.0 psi	**PRCI 5.4.4.2:**	37.8%
4	12999.5 psi	**Allowable Shear Stress**	**48.1%**
3	10197.0 psi	$F(v) = 45\%$ of F_y	37.8%
2	12999.5 psi	$F(v) = 27000$ psi	**48.1%**
1	10197.0 psi		37.8%

Combined Stress (Tensile and Bending)

Section	Value		% of Allowable
5	0.14	**PRCI 5.2.4**	14%
4	0.27	$f_t/0.9F_y+f_b/F_b \le 1$	27%
3	0.16		16%
2	0.29		**29%**
1	0.17		17%

Combined Stress (Tensile, Bending, and Hoop)

Section	Value		% of Allowable
5	0.03	**PRCI 5.2.4**	3%
4	0.09	$A^2+B^2+2v\|A\|B \le 1$	9%
3	0.04	$A = ((f_t+f_b-0.5f_h)1.25)/F_y$	4%
2	0.10	$B = 1.5f_h/F_{hc}$	**10%**
1	0.04		4%

Estimated PullForce (without Buoyancy Control)

639,119 lbs

958,679 lbs (including 1.5x Safety Factor)

Owner:	WBI Energy Transmission
Project:	North Bakken Expansion
Date:	08/01/2019
Calculation Description:	HDD Pipe Pullback Analysis NPS 24
Applicable Crossings:	Lake Sakakawea - 12 lb/gal Fluid

Completed By: KP | Reviewed By: JT | Sheet Revision: R19.1

Pipe Information			Design Criteria					
Pipe Diameter (in)	**Pipe W.T. (in)**	**Pipe Grade (psi)**	**Overbend Radius (ft)**	**Total Supported Weight (lbs/ft)**	**Maximum Support Spacing (ft)**	**Roller Spacing (ft)**	**Maximum Unsupported Overhang (ft)**	**Estimated Pullforce (lbs)**
24.00	0.990	60000	1,600	242.0	80	40	60	958,679

The pipe pullback is modelled such that the pipe is not over-stressed due to the combination of bending, tensile, and shear stresses throughout the pullback section, both in the spans between supports and at the support locations.
The pullback is also modelled such that the supports are not overloaded with the weight of the pipe at any point during the pipe installation, including as the tailing end passes from support to support.

Definitions:

SMYS - Specified Minimum Yield Strength
Overhang - Where Unsupported Tail End of Pipe Extends Beyond Support
Full Span - Where Pipe Is Supported Between 2 Supports at Maximum Support Spacing Shown Above

SUPPORT LOADING

Vertical Load at Each Boom/Crane Support — **% of Support Capacity ***

At Support With Full Span:
25,100 kg — 55,400 lbs — **97.9%**

At Support With Overhang:
15,400 kg — 33,900 lbs — 60.1%

Longitudinal Load at Each Boom/Crane Support
2510.0 kg — 5,540 lbs

* based on load capacity of Darby 24"-36" Rolli-Cradle

Horizontal Load at Each Boom/Crane Support
43 kg — 95 lbs

Horizontal Load at Each Roller Support
43 kg — 95 lbs

PIPE STRESS

	% SMYS	% of Allowable (PRCI)
Bending Stress		
At Support With Full Span: 22355.6 psi	37.3%	53.9%
At Support with Overhanging Pipe: 26363.1 psi	43.9%	**63.5%**
Tensile Stress		
10411.5 psi	17.4%	**19.3%**
Combined Stress (Tensile and Bending)		
32767.1 psi	54.6%	**73%**

APPENDIX C – RISK ASSESSMENT SUMMARY

Missouri River Risk Assessment Summary

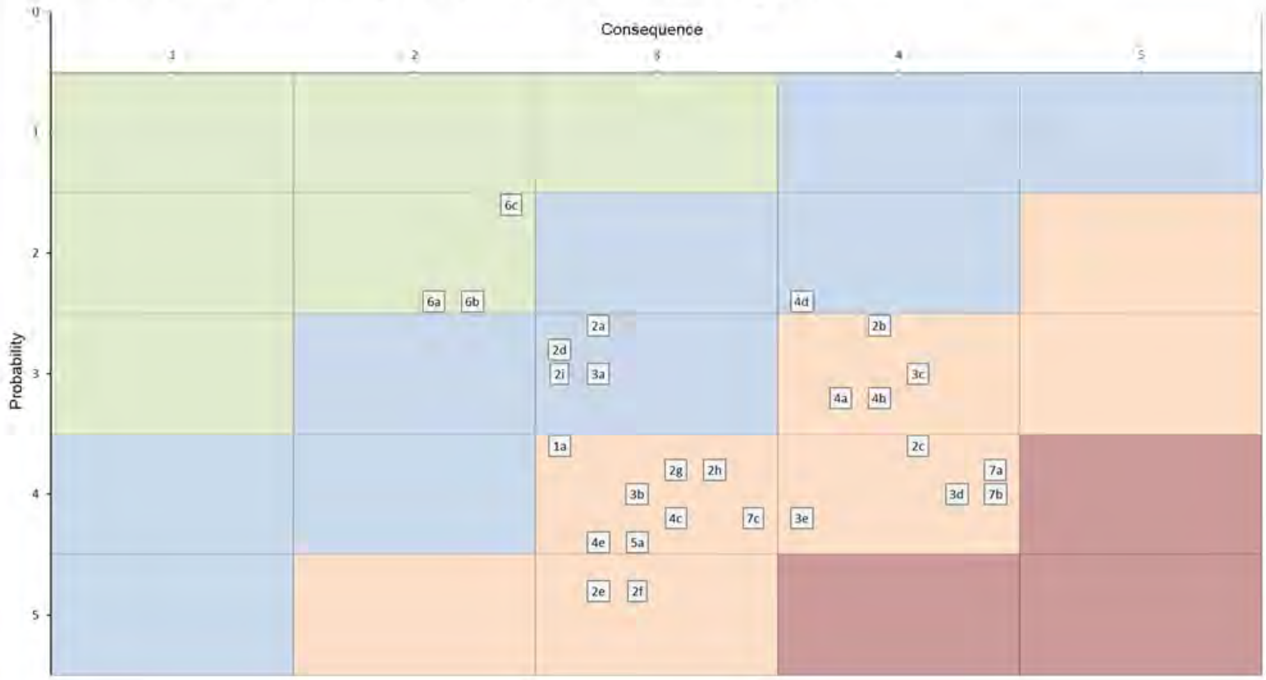
Phase	#	Description	Safety and Health Risk	Environmental Risk	Financial Risk	Production/Schedule Risk	Reputation Risk	Business Impact Risk	Risk Before Mitigation	Risk After Mitigation
Installation of Casing (Entry and Exit Points)	1a	Casing not Being Installed to Depth							High Risk	Medium Risk
Pilot Hole	2a	Fracture to Surface (Entry or exit, whichever poses as the greatest risk)		✓	✓	✓			Medium Risk	Medium Risk
	2b	Fracture to Water Body		✓	✓	✓	✓	✓	High Risk	Medium Risk
	2c	Large Fluid Loss to the Formation (>25% of total volume)		✓	✓	✓			High Risk	Medium Risk
	2d	Unstable Borehole (swelling, broken up, etc.)			✓	✓			Medium Risk	Medium Risk
	2e	Steering Control Issues			✓	✓			High Risk	High Risk
	2f	Annular Pressure Issues		✓	✓	✓			High Risk	High Risk
	2g	Over-Schedule Risk			✓	✓			High Risk	Medium Risk
	2h	Disposal of Drilling Fluid		✓	✓	✓			High Risk	Medium Risk
	2i	Water Ingress to Borehole			✓	✓			Medium Risk	Low Risk
Reaming Operations	3a	Unstable Borehole			✓	✓			Medium Risk	Medium Risk
	3b	Over-Schedule Risk			✓	✓			High Risk	Medium Risk
	3c	Loss of Equipment in Borehole			✓	✓	✓		High Risk	Medium Risk
	3d	Poor Removal of Cuttings			✓	✓			High Risk	High Risk
	3e	Drilling Fluid Control			✓	✓			High Risk	Medium Risk
Pullback Operations	4a	Pipe Section Gets Stuck in Borehole			✓	✓			High Risk	Medium Risk
	4b	Pull Forces Exceed Theoretical Model							High Risk	Medium Risk
	4c	Coating Damaged during Installation			✓	✓			High Risk	Medium Risk
	4d	Product Pipe is Damaged during Installation			✓	✓	✓		Medium Risk	Medium Risk
	4e	Pipe Handling on Exit	✓		✓	✓			High Risk	Medium Risk
Pipeline Contractor - Pipe Preparation and Support	5a	HDD Takes Longer than Scheduled to Complete			✓	✓			High Risk	Medium Risk
Construction Access and Pad Preparation	6a	Construction Access			✓	✓			Low Risk	Low Risk
	6b	Pad Layout & Construction			✓	✓			Low Risk	Low Risk
	6c	Travel Safety	✓				✓		Low Risk	Low Risk
Other Risks	7a	Crossing Length			✓	✓	✓	✓	High Risk	High Risk
	7b	Access to Water			✓	✓			High Risk	Medium Risk
	7c	Public Attention			✓		✓	✓	High Risk	Medium Risk
	7d				✓	✓	✓	✓		

Probability		
Value	**Description**	**Chance**
1	Rare	≤ 5%
2	Unlikely	~ 25%
3	Possible	~ 50%
4	Likely	~ 75%
5	Almost Certain	≥ 95%

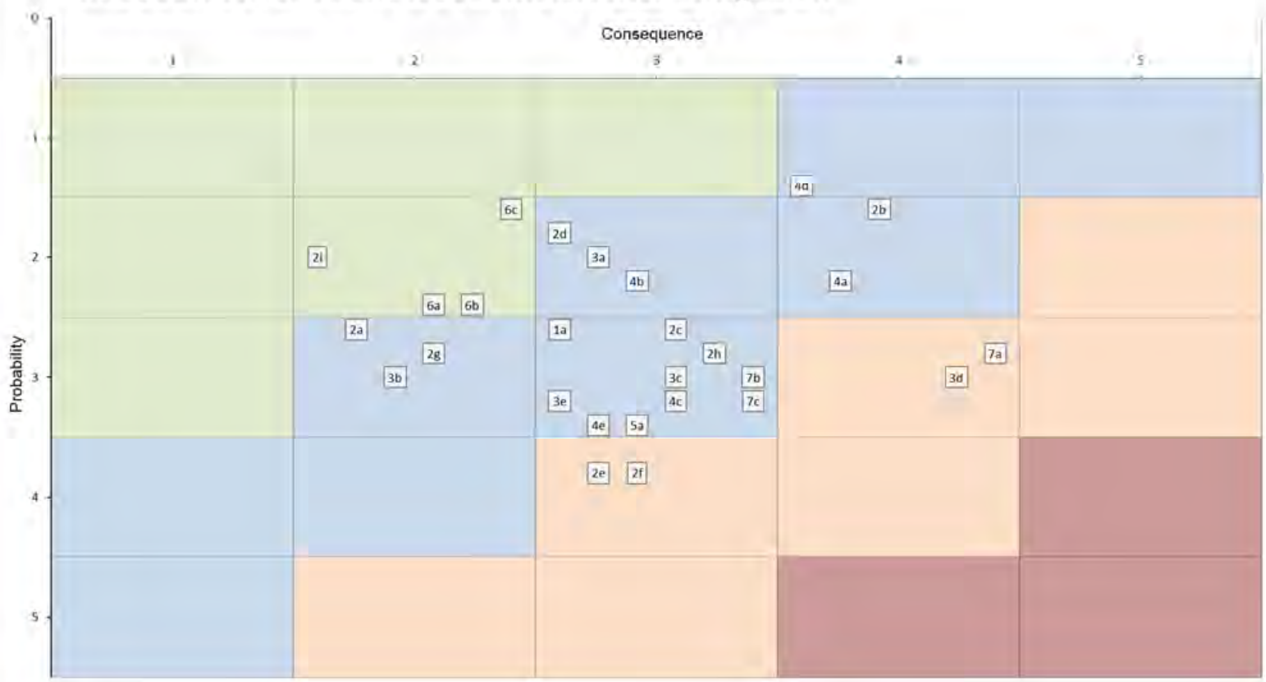
Consequence	
Value	**Description**
1	Insignificant
2	Minor
3	Moderate
4	Major
5	Catastrophic

L	Low Risk - Managed by routine procedures
M	Medium Risk - Planned Mitigation Strategy Required
H	High Risk - Prioritized Mitigation Strategy Required
VH	Very High Risk - Immediate Mitigation Strategy Required

Missouri River Risk Assessment Before Mitigation



Missouri River Risk Assessment After Mitigation



CCI

Attendance: Kerby, Chelsea, Justin, Landon, Stefan, Steve, Neil

Missouri River

Date: July 31, 2020

Rev: 0

Mud Motor HDD Risk Assessment

No.	Risk/Issue	Type of Risk/Issue		Pre-Mitigation Probability	Pre-Mitigation Consequence	Post-Mitigation Probability	Post-Mitigation Consequence	Review Cost Needed?
Installation of Casing (Entry and Exit Points)								
1a	Casing not Being Installed to Depth	Safety and Health	-	4	3	3	3	Select
		Environment	-	High Risk		Medium Risk		
		Financial	-	**Description**		**Mitigation Strategy**		
		Production/Schedule	-	Geotechnical conditions near surface can pose a problem when driving casing to a designed depth. It is expected both the entry and exit locations will require casing. The entry (south) is expected to be cased to the shale/siltstone bedrock, and the exit location will be cased past the coal layer. The proposed lengths of casing install, although expected to be achievable, are quite considerable.		Achievable casing installation lengths should be investigated prior to construction. The casing should be installed in 160-200ft lengths of telescoped casing. The final casing size shall be 48" and the initial casing should be sized to ensure the final casing will reach the required depth for seating.		
		Reputation	-					
		Business Impact	-					
Pilot Hole								
2a	Fracture to Surface (Entry or exit, whichever poses as the greatest risk)	Safety and Health	-	3	3	3	2	Select
		Environment	Yes	Medium Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Granular material near surface can pose a potential risk for drilling fluid to fracture to surface. The crossing is characterized by well graded to poorly graded sand to depths of 20-120ft.		The sand is expected to be stable enough to maintain an open borehole, or cased. The topography near entry and exit is relatively flat and allows the drill to obtain sufficient depth to effectively mitigate the risk of fracture.		
		Reputation	-					
		Business Impact	-					
2b	Fracture to Water Body	Safety and Health	-	3	4	2	4	Select
		Environment	Yes	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Fractured formations (including coal seams as identified within the bedrock formation) or high annular pressures could result in release of fluid to surface. The length of the Missouri River crossing results in high pressures due to the building friction forces. The bedrock layer is inconsistent and dips fairly significantly in the middle of the Missouri River, reducing the expected strength of the overburden formation.		The crossing is designed to be completed as an intersect which will limit the expected drilling pressures. The crossing has been designed with significant depth to limit the potential for fracture. Casing will also help with circulation back to entry/exit locations, which should reduce the potential for climbing annular pressures. Contractor shall utilize an Annular Pressure Tool to measure actual downhole pressures during drilling of the pilot hole to ensure any significant increases in pressure beyond planned ranges can be addressed and reduced to within expected ranges with mechanical tripping or additional circulation as applicable.		
		Reputation	Yes					
		Business Impact	Yes					
2c	Large Fluid Loss to the Formation (>25% of total volume)	Safety and Health	-	4	3	3	3	Select
		Environment	Yes	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Drilling fluid has the potential to migrate outside of the designed drill path in fractures. The crossing location is characterized by several coal seams, including two thick coal seams above and below the bottom tangent of the drill path, which may act as preferential path for drilling fluid.		The drill depth has been chosen to limit the risk of fracture to surface. Casing is included in the design to minimize the amount of coal seams the drill path will encounter. The contractor shall develop a mitigation plan for reducing significant losses where possible, including the use of Loss Circulation Material (LCM) pills to try to plug off any encountered zones of significant fluid loss.		
		Reputation	-					
		Business Impact	-					
2d	Unstable Borehole (swelling, broken up, etc.)	Safety and Health	-	3	3	2	3	Select
		Environment	-	Medium Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Site conditions have identified granular materials at both entry and exit locations. During drilling operations this material can become unstable and collapse, which may cause reduced returns. Casing has been specified on entry and exit.		The Contractor should monitoring annular pressure and returns to ensure the borehole remains clear of obstructions, if returns slow the Contractor should mechanically clean the hole.		
		Reputation	-					
		Business Impact	-					
2e	Steering Control Issues	Safety and Health	-	5	3	4	3	Select
		Environment	-	High Risk		High Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	The crossing is 15,393ft long and each rig will need to drill 7000ft-8000ft. Maintaining weight on bit in order to be able to steer at this length is expected to be difficult, complicating the intersect.		The crossing is designed with a large radius which will reduce the steering requirements. The Contractor is utilizing 7 5/8" drill string and gyro steering systems to ensure accuracy and a successful intersect. The bottom tangent is very long and will allow the drills sufficient time to align for intersect operations. Casing may help to maintain weight on bit.		
		Reputation	-					
		Business Impact	-					
2f	Annular Pressure Issues	Safety and Health	-	5	3	4	3	Select
		Environment	Yes	High Risk		High Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Drilling operations require soil cuttings to be cleaned out of the bore and hydro-transported back to the rig by the drilling fluid. This process requires large volumes of pressurized drilling fluid to be pumped downhole. The length of the crossing will increase the risk of annular pressure issues.		The Contractor shall maintain returns to both entry pits and monitor annular pressures. A mud engineer shall be on site to monitor adherence to the crossing specific Engineered Drilling Fluid Plan (EDFP). A bottoms up procedure (circulating the calculated amount of fluid that it takes to flow from the bit downhole back up to the entry pit) should be in place and followed when necessary to clean the hole.		
		Reputation	-					
		Business Impact	-					
2g	Over-Schedule Risk	Safety and Health	-	4	3	3	2	Select
		Environment	-	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Geotechnical conditions, permitting, and environmental issues can all contribute to delays in the schedule. The crossing is long with a large borehole size. Over schedule could significantly increase costs. Significant delays could have a large financial impact due to delay to in-service date.		All requirements of the permits should be strictly followed. The Contractor shall ensure proper drilling procedures are in place. Encountered geotechnical conditions should be monitored and reported during drilling so modifications can be made to execution strategy, as required, to ensure no negative impacts. It is recommended construction proceed 24/7 with 2 12hr rotational shifts per day.		
		Reputation	-					
		Business Impact	-					
2h	Disposal of Drilling Fluid	Safety and Health	-	4	3	3	3	Select
		Environment	Yes	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Drilling fluid needs to be stored and disposed of. Running out of temporary storage can lead to schedule delays and environmental concerns. The length and large borehole size will result in significant volumes of drilling fluid. Drilling fluid may be contaminated due to coal seams.		Adequate storage should be on site. An EDFP should be followed and an adequate recycling system will be on site. An approved disposal plan should be developed prior to construction. Facility disposal should be expected.		
		Reputation	-					
		Business Impact	-					
2i	Water Ingress to Borehole	Safety and Health	-	3	3	2	2	Select
		Environment	-	Medium Risk		Low Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Ground water tends to migrate to where soil has been cut/ displaced. Coal seams may provide preferential paths for water ingress into the borehole. The ingress of water may dilute the bentonite drilling fluid and reduce the carrying capacity.		The crossing is level and the hole will be full of drilling fluid. Since the identified seams are below rig elevation, it is anticipated that the hydrostatic pressure of the drilling fluid will minimize water ingress to a manageable range.		
		Reputation	-					
		Business Impact	-					
Reaming Operations								
3a	Unstable Borehole	Safety and Health	-	3	3	2	3	Select
		Environment	-	Medium Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Site conditions have identified granular materials at both entry and exit locations. During drilling operations this material can become unstable and collapse, which may cause reduced returns.		The Contractor should monitoring annular pressure and returns to ensure the borehole remains clear of obstructions, if returns slow the Contractor should mechanically clean the hole. Adequate pumps for the ream size and length should be on site.		
		Reputation	-					
		Business Impact	-					
3b	Over-Schedule Risk	Safety and Health	-	4	3	3	2	Select
		Environment	-	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Geotechnical conditions, permitting, and environmental issues can all contribute to delays in the schedule. The crossing is long with a large borehole size.		All requirements of the permits should be strictly followed. The Contractor shall ensure proper drilling procedures are in place. Geotechnical conditions should be monitored and reported during drilling so modifications can be made to execution strategy, as required, to ensure no negative impacts. Using two rigs will split the workload which would be normally be placed upon a single rig.		
		Reputation	-					
		Business Impact	-					
		Safety and Health	-	3	4	3	3	Select
		Environment	-	High Risk		Medium Risk		

3c	Loss of Equipment in Borehole	Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Reaming or enlarging the bore to the desired diameter may cause instability areas. These areas may cause downhole tooling to get stuck or lost. Loss of equipment within the borehole is a larger risk than with a shorter crossing.		The utilization of intersect methodology will mitigate the risk of losing equipment within the borehole. Using two rigs will split the workload which would be normally be placed upon a single rig. If problems arise on one side of the reamer, the opposite rig will maintain contact with the downhole tooling and be able to trip to surface. Drill string management plan should be provided by the contractor, which should include regularly switching out drill stem on either side of the reamers.		
		Reputation	Yes					
		Business Impact	-					
3d	Poor Removal of Cuttings	Safety and Health	-	4	4	3	4	Select
		Environment	-	High Risk		High Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Due to the large ream pass and length a large amount of cuttings will be created and therefore will have to be removed from the borehole.		Drilling fluid parameters will be optimized for maximum cutting transportation, through adherence to the EDFP. High pump rates throughout the ream passes of the HDD will increase the annular velocity and therefore carrying capacity. Additional trips will be necessary to mechanically remove cuttings from the borehole. The number of trips required will be based on the borehole conditions. The cut size should ensure that cuttings can be removed.		
		Reputation	-					
		Business Impact	-					
3e	Drilling Fluid Control	Safety and Health	-	4	4	3	3	Select
		Environment	-	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	As the volume of drilling fluid within the borehole increases, it becomes more difficult to change its properties with drilling fluid additives. The large diameter borehole combined with the length will impact the quality and makeup of the drilling fluid. Coal seams may contaminate drilling fluid. Contractor will be hauling in water.		The Contractor should prepare and adhere to an approved EDFP which will outline the steps required to ensure the highest quality of drilling fluid is used for the crossing. A premix tank should be made available in addition to the mud tank. Contractor should continue to adhere to the EDFP throughout reaming operations even if they are experiencing fluid losses.		
		Reputation	-					
		Business Impact	-					
Pullback Operations								
4a	Pipe Section Gets Stuck in Borehole	Safety and Health	-	3	4	2	4	Select
		Environment	-	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	There is a risk that the pipe section becomes stuck in the borehole due to borehole length, instability, blockages, or irregularities. The pullforce for this length is between approximately 502,000 and 960,000lbs.		One or more wiper trips shall be completed to ensure a clean hole. Required force should be monitored during the wiper passes. It is recommended that a Pipe Thruster (with custom inserts for NPS 24) be available on exit side to assist the rig with pullback in the event pullforces start to become exceedingly high.		
		Reputation	-					
		Business Impact	-					
4b	Pull Forces Exceed Theoretical Model	Safety and Health	-	3	4	2	3	Select
		Environment	-	High Risk		Medium Risk		
		Financial	-	**Description**		**Mitigation Strategy**		
		Production/Schedule	-	There is a risk that pull forces exceed the theoretical model, especially with the length of the drill. Contributing factors can include cuttings in the borehole, having to temporarily halt line pull, borehole instability, and heavy drilling fluid.		A swab pass should be completed and downtime during installation should be minimized. It is expected pipe pull will continue overnight as required. This should be planned for with crews in advance, lighting shall be sufficient to allow overnight operations for pull. Pipe thruster should be available on exit side to assist the rig will pullback.		
		Reputation	-					
		Business Impact	-					
4c	Coating Damaged during Installation	Safety and Health	-	4	3	3	3	Select
		Environment	-	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Gravel, cobbles, boulders, and bedrock interfaces within the bore path pose a risk that the pipe coating is damaged during line pull.		Wiper passes shall be completed to gauge any possible areas of issue, and additional passes may be used to ensure minimized risk prior to pullback. FBE and ARO coated pipe shall be used.		
		Reputation	-					
		Business Impact	-					
4d	Product Pipe is Damaged during Installation	Safety and Health	-	2	4	1	4	Select
		Environment	-	Medium Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	If the borehole has any ledges (intersect location or bedrock interface), the pipe could get hung up or scratched on these ledges resulting in pipe damage.		Ledges shall be reamed/smoothed out prior to product pipe installation. The intersect should be completed as straight as possible to reduce the potential for a ledges where the bits meet.		
		Reputation	Yes					
		Business Impact	-					
4e	Pipe Handling on Exit	Safety and Health	Yes	4	3	3	3	Select
		Environment	-	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	The exit angle, wall thickness, and size of the pipe result in a large radius overbend that reaches a height of 35 ft. The pipe section requires significant support equipment.		A pullback lift plan should be created prior to construction for review and approval. The equipment capacities should be sufficient for the anticipated loads. Spreader bars may reduce crane requirements. A traffic plan should be created for Highway 17A (52nd Street NW) and 54th Street NW (if required).		
		Reputation	-					
		Business Impact	-					
Pipeline Contractor - Pipe Preparation and Support								
5a	HDD Takes Longer than Scheduled to Complete	Safety and Health	-	4	3	3	3	Select
		Environment	-	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	There is significant support equipment required for pullback. If pullback is delayed this could be a large cost to keep the equipment on site. If the pipe section is not ready for pull the hole could tighten.		The pullback section should be completed significantly before pull is expected to ensure no unneccesary delays. Coordination of all contractors. Traffic plan for Highway 17A.		
		Reputation	-					
		Business Impact	-					
Construction Access and Pad Preparation								
6a	Construction Access	Safety and Health	-	2	2	2	2	Select
		Environment	-	Low Risk		Low Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Access is assumed to be along ROW, through agricultural fields.		All agreements should be in place prior to mobilization. All workspace should be cleared as required. Access should be prepared.		
		Reputation	-					
		Business Impact	-					
6b	Pad Layout & Construction	Safety and Health	-	2	2	2	2	Select
		Environment	-	Low Risk		Low Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	The workspace are within grassy fields, clearing and grading are expected to be minimal.		All agreements should be in place prior to mobilization. All workspace should be cleared as required.		
		Reputation	-					
		Business Impact	-					
6c	Travel Safety	Safety and Health	Yes	2	2	2	2	Select
		Environment	-	Low Risk		Low Risk		
		Financial	-	**Description**		**Mitigation Strategy**		
		Production/Schedule	-	Contractor will have to travel to site from a off project location. Could continue into winter.		A travel plan should be in place.		
		Reputation	Yes					
		Business Impact						
Other Risks								
7a	Crossing Length	Safety and Health	-	4	4	3	4	Select
		Environment	-	High Risk		High Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	The crossing is 15,393ft long, approaching record lengths for an HDD crossing. There is a risk that the crossing could encounter compounding issues that lead to the crossing not being completed successfully.		A competent contractor with adequate tooling and relevant experience with similarly large installations has been selected. The risks should be highlighted to all stakeholders.		
		Reputation	Yes					
		Business Impact	Yes					
7b	Access to Water	Safety and Health	-	4	4	3	3	Select
		Environment	-	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	Yes	Water sources should be investigated/confirmed. Water transport should be a major consideration.		Additional transport and water sources should be investigated prior to construction. Transport should include contingency to ensure a lack of water does not lead to any delays with progress of the drill, particularly in the event of significant fluid losses during drilling, where large volumes of make-up water may be required.		
		Reputation	-					
		Business Impact	-					
7c	Public Attention	Safety and Health	-	4	3	3	3	Select
		Environment	-	High Risk		Medium Risk		
		Financial	Yes	**Description**		**Mitigation Strategy**		
		Production/Schedule	-	Scrutiny is possible in the area. There is a risk of negative public perception issues. The summer season will see high levels of lake use.		The contractor shall ensure all procedures are being followed and their impact is minimized. The contractor shall ensure all correspondence with the public is completed by WBI representation.		
		Reputation	Yes					
		Business Impact	Yes					

APPENDIX D – GEOTECHNICAL REPORTS

CCI and Associates, Inc.

Geotechnical Investigation Report

WBI North Bakken Expansion Project

Lake Sakakawea/Missouri River

McKenzie and Williams County, North Dakota

Date:

June 14, 2019

Geotechnical Investigation Report

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Prepared for:
CCI and Associates, Inc.
20333 State Highway 249 Suite 480
Houston, Texas 77070

Prepared by:
Groundwater & Environmental Services, Inc.
1301 Corporate Center Drive, Suite 190
Eagan, Minnesota 55121
TEL: 800-735-1077
www.gesonline.com

Nicholas J. Schlagel
Staff Environmental Scientist

James F. Simonet
Senior Project Hydrogeologist

Robert E. Jenson, CHMM
Principal Scientist/Operations Manager

ANTHONY P. FRANCIS
REGISTERED
PROFESSIONAL
ENGINEER
8204
NORTH DAKOTA

6/14/2019

Anthony Frances, PE
Geotechnical Engineering
Material Testing Services, LLC.

Table of Contents

Figures

Tables

Appendices

Acronyms

ASTM	American Society for Testing and Materials
CCI	CCI and Associates, Inc.
GES	Groundwater & Environmental Services, Inc.
HDD	horizontal directional drilling
HSA	Hollow-stem auger
IDS	Interstate Drilling Services, LLP
MTS	Material Testing Services, LLC
TGCBA	Tobacco Garden Creek Bay Area
USACE	US Army Corp of Engineers

1 Introduction

This report presents the results of the geotechnical investigation that was performed by Groundwater and Environmental Services, Inc. (GES) for the project known as the WBI North Bakken Expansion Project in western North Dakota. Specifically, this report covers the geotechnical exploration at 3 land-based soil borings located along the proposed horizontal directional drilling (HDD) pipeline project under Lake Sakakawea/Missouri River (**Figure 1**). The proposed pipeline alignment under Lake Sakakawea is located approximately 1 mile northeast of the Tobacco Garden Creek Bay Area (TGCBA). The TGCBA is located approximately 23 miles northeast of Watford City, North Dakota.

Services for this investigation were performed in general accordance with the April 1, 2019 Services Contract by and between CCI and Associates, Inc. (CCI) and GES.

1.1 Project Location and Scope

The objective of this phase of the geotechnical investigation is to assist CCI with evaluating the subsurface conditions at 3 land-based boring locations (LB-1 through LB-3) located along the proposed HDD pipeline alignment on the north and south sides of Lake Sakakawea.

The scope of work included the following:

- Prepare a site-specific health and safety plan for GES employees and subcontractors for the proposed geotechnical investigation activities.
- Coordinate field activities and communication with project team and CCI.
- Arrange for utility clearance through North Dakota One Call.
- Mobilize our drilling project team to the project including Interstate Drilling Services, LLP (IDS) and GES personnel.
- Advance 3 land-based soil borings and collect samples at designated locations surveyed by a CCI subcontractor.
- Contract laboratory tests on soil samples obtained from the 3 land-based soil borings to evaluate physical properties.
- Provide a written geotechnical report.

2 Methods

2.1 Soil Borings

As part of the geotechnical investigation, GES contracted with IDS of Grand Forks, North Dakota, to advance the 3 land-based soil borings (**Figure 1**). IDS used a Diedrich D-50 track-mounted drill rig to advance the borings and collect soil samples.

The drilling rig, equipment and supplies mobilized to the project location on April 23, 2019. Advancement of soil boring LB-1 began on April 24 and the last soil boring LB-3 was completed on May 5, 2019. The drilling operation consisted of one crew working 12-hour shifts. Borehole locations for LB-1 through LB-3 were provided by CCI and are provided in **Table 1**.

Soil borings LB-1, LB-2, and LB-3 were completed to depths of 403 feet, 400 feet, and 370 feet below grade, respectively. Hollow-stem auger (HSA) boring methodology was used to collect soil samples while boring through unconsolidated sediment in the upper portion of each soil boring. Once competent sediment was encountered, a closed loop, fluid rotary drilling methodology was used to advance the borings. Rock coring drilling methodology was used at each boring for the last, approximately 200+ feet (to boring terminus). Upon completion, each boring was sealed from the boring terminus to ground surface with a concrete/bentonite slurry through a tremie rod. Drilling cuttings and sediment were thin spread at each boring location.

During HSA and fluid rotary drilling methodology, 1.5-foot samples were collected at 5 foot intervals using a split-spoon sampler in accordance with American Society for Testing and Materials (ASTM) D1586 (*Standard Test Method for Standard Penetration Test [SPT] and Split-Barrel Sampling of Soils*) using a 2-inch diameter split-spoon sampler. During rock coring drilling methodology, samples were generally collected at 5-foot sample intervals continuously in accordance with ASTM D2113 (*Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration*) using a using a NQ3 size, triple-tube core barrel with a diamond bit.

Soils were classified in the field by a GES field geologist using ASTM Visual-Manual procedures (ASTM D2488, *Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]*). The field geologist also collected samples from the split-spoon sampler and rock core sampler for geotechnical laboratory testing.

The boring logs and standard boring classification guidelines are contained in **Appendix A**. Photographic documentation of the project is provided in **Appendix B.**

2.2 Laboratory Testing

GES contracted with Material Testing Services, LLC (MTS) of Minot, North Dakota to provide geotechnical laboratory testing and evaluation services to aid in classifying and evaluating the physical properties of the soil/rock samples. Soil/rock sample selection and laboratory test parameters were determined by CCI.

The laboratory testing included the following:

- Moisture Content (ASTM D4959 - Standard Test Method for Determination of Water Content of Soil by Direct Heating and D4643 - Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating).
- Sieve Analysis (ASTM D422 – Test Method for Particle-size Analysis of Soils).
- Atterberg Limits (ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils).
- Unconfined Compression Testing (ASTM D2166 – Standard Test Method for Unconfined Compressive Strength of Cohesive Soils).

Test results are summarized in **Table 2** with the exception of the unconfined compression test results, which are provided with the laboratory reports in **Appendix C.**

3 Site Conditions

The proposed HDD pipeline crossing traverses southwest to northeast across Lake Sakakawea approximately 1 mile northeast of the TGCBA. The physiographic regions where the proposed HDD pipeline crossing is located consist of the McKenzie Upland Unit, located southwest of the Missouri River and the Coteau Slope Unit, located northeast of the Missouri River. These units are part of the Great Plains and are characterized by rolling to hilly plains with both erosional and glacial landforms. The proposed HDD crossing is located within the historic Missouri River floodplain that was flooded with the construction of the Garrison Dam in 1956 to form Lake Sakakawea. This area is located in the central portion of the Williston Basin.

The surface geology in the area consists of thin layers of glacial deposits underlain by the Tertiary-Aged Sentinel Butte Formation and Bullion Creek Formation. The Sentinel Butte Formation consists of layers of silt, clay, sand, lignite, carbonaceous shale, and mudstone (Carlson, 1985). The Bullion Creek Formation underlies the Sentinel Butte Formation and consists of yellowish layers of silt, clay, and sand with interbedded sandstone, lignite, baked clay, and limestone (Bluemle, 1977). Both formations form rolling topography over broad areas and has been eroded to badlands near rivers.

Soil borings LB-1 through LB-3 generally consisted of well graded to poorly graded sand in the upper portion of the borings. The well graded to poorly graded sand was logged from the ground surface to a depth of approximately 25 feet below grade at LB-1 and from the ground surface to approximately 120 feet below grade at LB-2 and LB-3. Underlying the sand, silt, clay (lean and fat), weathered shale, and silty sand were logged. Underlying the sand, lignite (laminations to layers >20 feet thick) were logged throughout each boring to boring terminus. Saturated conditions were only encountered at boring LB-3, at 24.5 feet below grade.

4 Limitations

The data generated and conclusions and opinions provided are based on the scope of work performed. All work was conducted in a manner consistent with currently accepted geotechnical engineering practices exercised by members of the profession practicing under similar conditions. No other warranty, expressed or implied, is made.

The samples collected and described in this report are representative of the subsurface conditions at the sampled locations and intervals, and therefore, do not necessarily reflect strata variations that may exist between sampled intervals and locations. If variations from the subsurface conditions described in this study are noted during additional investigations and/or construction, recommendations in this report must be re-evaluated.

GES is not responsible for the independent conclusions, opinions, or recommendations made by others based on the data presented in this report. Nor can GES warrant that this report will satisfy the dictates of or provide a legal defense in connection with an environmental law or regulation.

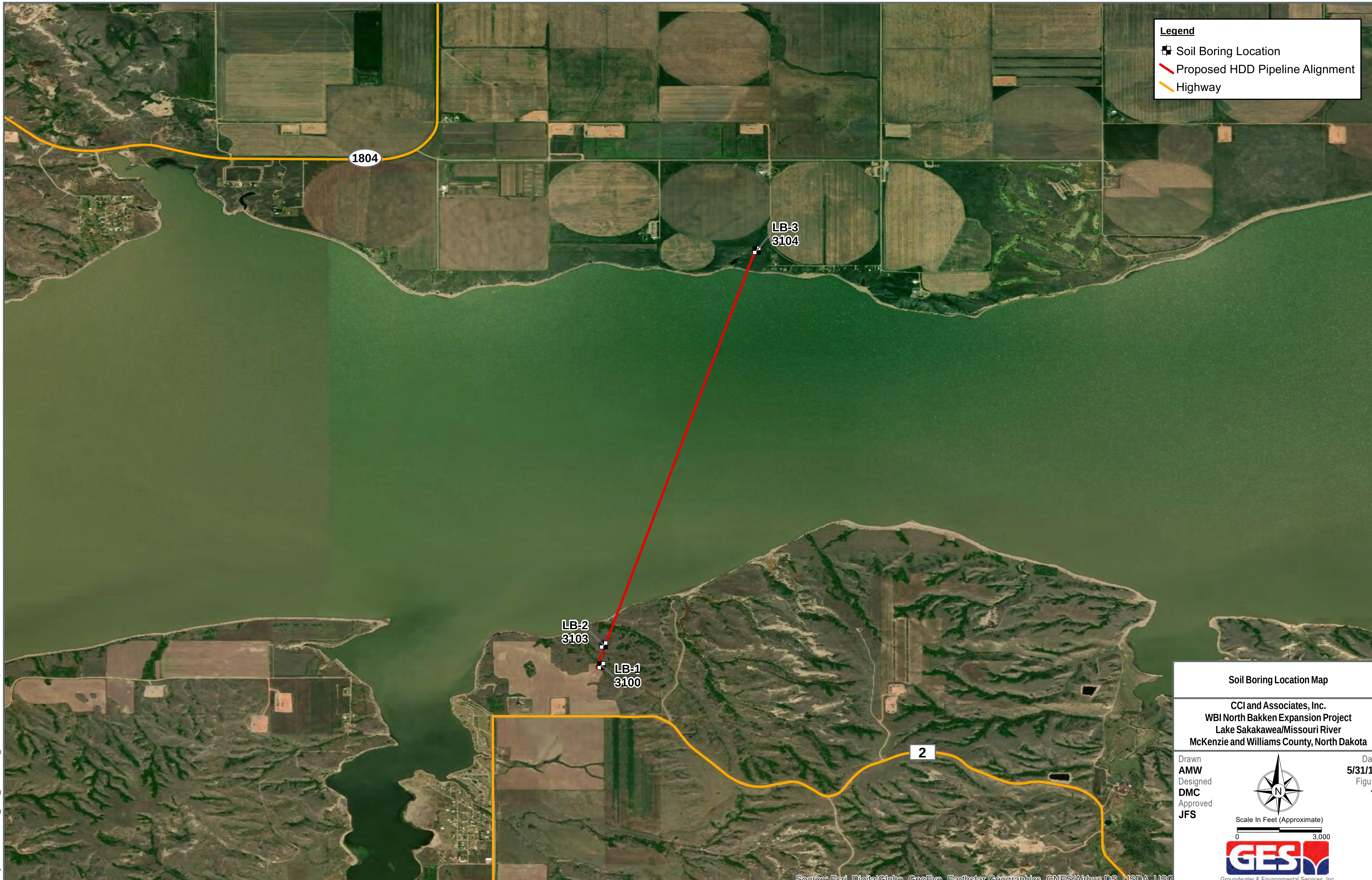
The results reported and any opinions reached by GES are for the benefit of the CCI & Associates and their client and unless agreed to by GES in writing, are not to be disclosed to or relied upon by any third party. The results and opinions set forth by GES in this report will be valid as of the date of the report.

References

Bluemle, J.P. 1977. *Geologic Highway Map of North Dakota*. North Dakota Geological Survey Educational Series 11, Miscellaneous Map 19.

Carlson, Clarence G. 1985. *Geology of McKenzie County, North Dakota.* North Dakota Geological Survey, Bulletin 80 – Part 1 and North Dakota State Water Commission, County Groundwater Studies 37 – Part 1.

Figure



L:\Projects\CCI\GIS\CCI_Lake_Sakakawea_SBLM.mxd - Scale 1:36,000 - 5/31/2019 2:03:58 PM - AWiddowson -

Tables

Table 1

Soil Boring Locations

HDD Crossing	Boring ID	Boring Depth (ft)	Sample Interval (ft)	Boring Coordinates	
				Northing	Easting
Lake Sakakawea/Missouri River	LB-1	403	5	417613.836	1335268.645
	LB-2	400	5	418344.342	1335349.645
	LB-3	372	5	432251.954	1339466.302

Table 2

Laboratory Soil Test Data

Boring No.	Sample Depth (ft)	Sample Type	Moisture Content	Grain Size Distribution				Atterberg Limits		
				% Gravel	% Sand	% Silt	% Clay	LL	PL	PI
LB-1	4.5 - 6	SS	9.5							
LB-1	9.5 - 11	SS	13.2							
LB-1	14.5 - 16	SS	32.4							
LB-1	19.5 - 21	SS	4.4							
LB-1	24.5 - 26	SS	19.2							
LB-1	29.5 - 31	SS	24.3							
LB-1	34.5 -36	SS	25.8					50	19	30
LB-1	39.5 - 41	SS	23.8							
LB-1	44.5 - 46	SS	22							
LB-1	49.5 - 51	SS								
LB-1	54.5 - 56	SS	20.7							
LB-1	59.5 - 61	SS	22.2							
LB-1	64.5 - 66	SS	25.8							
LB-1	69.5 - 70	SS								
LB-1	74.5 - 76	SS	26.3							
LB-1	79.5 - 81	SS	24.8							
LB-1	84.5 - 86	SS	22.9							
LB-1	89.5 - 91	SS						57	21	36
LB-1	94.5 - 95	SS								
LB-1	99.5 - 101	SS	23.2							
LB-1	104.5 - 106	SS	24.6							
LB-1	109.5 - 111	SS	23.9							
LB-1	114.5 - 116	SS	22							
LB-1	119.5 - 121	SS	24.4							
LB-1	124.5 - 126	SS	19.1							
LB-1	129.5 - 131	SS						36	20	16
LB-1	134.5 - 136	SS	21.2							
LB-1	139.5 - 141	SS	21.1							
LB-1	144.5 - 146	SS	21.9							
LB-1	149.5 - 151	SS	28.5							
LB-1	154.5 - 156	SS	19.4							
LB-1	159.5 - 161	SS	21							
LB-1	164.5 - 165.5	SS	24.9							
LB-1	169.5 - 171	SS						48	19	28
LB-1	174.5 - 175.5	SS	19.9							
LB-1	179.5 - 180.5	SS	22.6							

Table 2

Laboratory Soil Test Data

Boring No.	Sample Depth (ft)	Sample Type	Moisture Content	Grain Size Distribution				Atterberg Limits		
				% Gravel	% Sand	% Silt	% Clay	LL	PL	PI
LB-1	185 - 189	RC	8.5							
LB-1	189 - 193	RC	13.8							
LB-1	193 - 198	RC	15.4							
LB-1	198 - 203	RC	16							
LB-1	203 - 208	RC								
LB-1	208 -213	RC	16							
LB-1	213 - 218	RC								
LB-1	218 - 223	RC								
LB-1	223 - 228	RC	54.1							
LB-1	228 - 233	RC	60.4							
LB-1	233 - 238	RC	15.4							
LB-1	238 -243	RC								
LB-1	243 - 248	RC	11.6							
LB-1	248 - 253	RC	11							
LB-1	253 - 258	RC	17.9							
LB-1	258 - 263	RC						41	18	23
LB-1	263 - 268	RC	21.2							
LB-1	268 - 273	RC	12.2							
LB-1	273 - 278	RC	11.8							
LB-1	278 - 283	RC	13.8							
LB-1	283 - 288	RC	15.5							
LB-1	288 - 293	RC	15.3							
LB-1	293 -298	RC	14.1							
LB-1	298 - 203	RC	14.2							
LB-1	303 - 308	RC								
LB-1	308 - 313	RC	15.3							
LB-1	313 - 318	RC	21.3							
LB-1	318 - 323	RC	16.9							
LB-1	323 - 328	RC	16.3							
LB-1	328 - 333	RC	13.1							
LB-1	333 - 338	RC	14.3							
LB-1	338 - 343	RC	15.5							
LB-1	343 - 348	RC	15.5							
LB-1	348 - 353	RC	17.6							
LB-1	353 - 358	RC	16.9							
LB-1	358 - 363	RC	16							
LB-1	363 - 368	RC	18.9							
LB-1	368 - 373	RC	16.2							
LB-1	373 - 378	RC	20.2							

Table 2

Laboratory Soil Test Data

Boring No.	Sample Depth (ft)	Sample Type	Moisture Content	Grain Size Distribution				Atterberg Limits		
				% Gravel	% Sand	% Silt	% Clay	LL	PL	PI
LB-1	378 -383	RC	19.8							
LB-1	383 - 388	RC								
LB-1	388 - 393	RC	18.9							
LB-1	393 - 398	RC								
LB-1	398 - 403	RC	19.9							
LB-2	4.5 - 6	SS	20.5							
LB-2	9.5 - 11	SS	17.3							
LB-2	14.5 - 16	SS	25.5							
LB-2	19.5 - 21	SS	22.6							
LB-2	24.5 - 26	SS	10.4							
LB-2	29.5 - 31	SS	27.5							
LB-2	34.5 - 36	SS								
LB-2	39.5 - 41	SS	32.9							
LB-2	44.5 - 46	SS						73	26	46
LB-2	49.5 - 51	SS	33							
LB-2	54.5 - 56	SS	19.9							
LB-2	59.5 - 61	SS	12.5							
LB-2	64.5 - 66	SS	14.1							
LB-2	69.5 - 71	SS	18.8							
LB-2	74.5 - 76	SS	14.3							
LB-2	79.5 - 81	SS	22	0.0	82.0	11.5	6.5			
LB-2	84.5 - 86	SS	17.3							
LB-2	89.5 - 91	SS	16							
LB-2	94.5 - 96	SS	18.2							
LB-2	99.5 - 101	SS	17.5							
LB-2	104.5 - 106	SS	14.8							
LB-2	109.5 - 111	SS	18.6							
LB-2	114.5 - 116	SS	21.7							
LB-2	119.5 - 121	SS	19							
LB-2	124.5 - 126	SS	21.9							
LB-2	129.5 - 131	SS	23.4							
LB-2	134.5 - 136	SS						NP	NP	NP
LB-2	139.5 - 140.5	SS	20.6							
LB-2	144.5 - 145.5	SS	25.8							
LB-2	149.5 - 150.5	SS	23.6							
LB-2	153 - 158	RC						33	17	16
LB-2	158 - 160	RC	15.6							
LB-2	160 - 165	RC								
LB-2	165 - 170	RC	16.1							
LB-2	170 - 175	RC	17.4							
LB-2	175 - 180	RC	19.1							
LB-2	180 - 185	RC	57.2							
LB-2	185 - 190	RC	12.3							
LB-2	190 - 195	RC	11.8							

Table 2

Laboratory Soil Test Data

Boring No.	Sample Depth (ft)	Sample Type	Moisture Content	Grain Size Distribution				Atterberg Limits		
				% Gravel	% Sand	% Silt	% Clay	LL	PL	PI
LB-2	195 - 200	RC	15.5							
LB-2	200 - 205	RC	16.3							
LB-2	205 - 210	RC								
LB-2	210 - 215	RC	15.5							
LB-2	215 - 220	RC								
LB-2	220 - 225	RC	61.2							
LB-2	225 - 230	RC	53.5							
LB-2	230 - 235	RC	65.6							
LB-2	235 - 240	RC	17.4							
LB-2	240 - 245	RC	15.5							
LB-2	245 - 250	RC	11.7							
LB-2	250 - 255	RC	15.6							
LB-2	255 - 260	RC	21.5							
LB-2	260 - 265	RC						26	23	3
LB-2	265 - 270	RC	14.1							
LB-2	270 - 275	RC	16.3							
LB-2	275 - 280	RC	16							
LB-2	280 - 285	RC	15.4							
LB-2	285 - 290	RC								
LB-2	290 - 295	RC	14.9							
LB-2	295 - 300	RC	16							
LB-2	300 - 305	RC	17.8							
LB-2	305 - 310	RC	23.1							
LB-2	310 - 315	RC	20.7							
LB-2	315 - 320	RC	13.6							
LB-2	320 - 325	RC	11.2							
LB-2	325 - 330	RC	17.9							
LB-2	330 - 335	RC						53	24	29
LB-2	335 - 340	RC	16.9							
LB-2	340 - 345	RC	16.3							
LB-2	345 - 350	RC	17.5							
LB-2	350 - 355	RC	16.3							
LB-2	355 - 360	RC	18	0.0	57.7	24.7	17.6			
LB-2	360 - 365	RC								
LB-2	365 - 370	RC	14.2							
LB-2	370 - 375	RC	15.3							
LB-2	375 - 380	RC	17.2							
LB-2	380 - 385	RC	15.3							
LB-2	385 - 390	RC	17.2							
LB-2	390 - 395	RC	16.2							
LB-2	395 - 400	RC								
LB-3	4.5 - 6	SS	4.3							
LB-3	9.5 - 11	SS	3.7							
LB-3	14.5 - 16	SS	2.4							

Table 2

Laboratory Soil Test Data

Boring No.	Sample Depth (ft)	Sample Type	Moisture Content	Grain Size Distribution				Atterberg Limits		
				% Gravel	% Sand	% Silt	% Clay	LL	PL	PI
LB-3	19.5 - 21	SS	3							
LB-3	24.5 - 26	SS	24.3							
LB-3	29.5 - 31	SS	25							
LB-3	34.5 - 36	SS	22	0.0	96.0	0.0	0.0			
LB-3	39.5 - 41	SS	22.2							
LB-3	44.5 - 46	SS	18.5							
LB-3	49.5 - 51	SS	14.1							
LB-3	54.5 - 56	SS	21							
LB-3	59.5 - 61	SS	20.9							
LB-3	64.5 - 66	SS	11	19.5	72.6	5.9	1.9			
LB-3	69.5 - 71	SS	23.8							
LB-3	74.5 - 76	SS	21							
LB-3	79.5 - 81	SS	18.2							
LB-3	84.5 - 86	SS	17.7							
LB-3	89.5 - 91	SS	12							
LB-3	94.5 - 96	SS	20.8							
LB-3	99.5 - 101.5	SS	12.5							
LB-3	104.5 - 105.5	SS	21.9							
LB-3	109.5 - 111	SS	16	0.0	59.1	29.2	11.2			
LB-3	114.5 - 115.5	SS								
LB-3	119.5 - 120	SS								
LB-3	124.5 - 125	SS								
LB-3	129.5 - 130	SS								
LB-3	134.5 - 135	SS								
LB-3	139.5 - 141	SS	17.1							
LB-3	144.5 - 146	SS	22.3							
LB-3	149.5 - 151	SS	20.2							
LB-3	154.5 - 156	SS	21.4							
LB-3	159.5 - 161	SS	20.4							
LB-3	164.5 - 166	SS						24	18	6
LB-3	169.5 - 171	SS	19.2							
LB-3	175 - 180	RC	32.5							
LB-3	180 - 185	RC	28.4							
LB-3	185 - 187	RC	51							
LB-3	187 - 192	RC	60.3							
LB-3	192 - 197	RC								
LB-3	197 - 202	RC	20.3							
LB-3	202 - 207	RC	18.9							
LB-3	207 - 212	RC	15.1							
LB-3	212 - 217	RC	15.4							
LB-3	217 - 222	RC	13.3							
LB-3	222 - 227	RC	15.9							
LB-3	227 - 232	RC						24	23	1
LB-3	232 - 237	RC	11.1							

Table 2

Laboratory Soil Test Data

Boring No.	Sample Depth (ft)	Sample Type	Moisture Content	Grain Size Distribution				Atterberg Limits		
				% Gravel	% Sand	% Silt	% Clay	LL	PL	PI
LB-3	237 - 242	RC	18.5							
LB-3	242 - 247	RC	15.6							
LB-3	247 - 252	RC	17							
LB-3	252 - 257	RC	20.2							
LB-3	257 - 262	RC								
LB-3	262 - 267	RC	19.4							
LB-3	267 - 272	RC	16.9							
LB-3	272 - 277	RC								
LB-3	277 - 282	RC	18							
LB-3	282 - 287	RC	23.8							
LB-3	287 - 292	RC	17.1							
LB-3	292 - 297	RC	19.2							
LB-3	297 - 302	RC								
LB-3	302 - 307	RC	14.8							
LB-3	307 - 312	RC	15.9							
LB-3	312 - 317	RC	17.4							
LB-3	317 - 322	RC	16.3							
LB-3	322 - 327	RC	15.8							
LB-3	327 - 332	RC								
LB-3	332 - 337	RC	19.2							
LB-3	337 - 342	RC	17.9							
LB-3	342 - 347	RC								
LB-3	347 - 352	RC	15.8							
LB-3	352 - 357	RC								
LB-3	357 - 362	RC	16.2							
LB-3	362 - 367	RC	22.3							
LB-3	367 - 372	RC	18.7							

Notes:
SS = Split Spoon
RC = Rock Core
Per MTS, some moisture content tests were not conducted because of lignite or moisture was done with the Atterberg Limit Testing.

Appendix A – Boring Logs

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	Atterbergs LL	Atterbergs PI	G	S	M/C
0				SW: WELL GRADED SAND, fine to medium grained, with trace silt, pale brown (10YR 6/3), moist, medium dense.							
5	1	11 in.	7-7-6		-						
10	2	12 in.	8-5-4	Color changes to light yellowish brown (10YR 6/4) and loose at 9.5 ft.	-						
15	3	18 in.	5-3-4	CL: LEAN CLAY, with trace silt, brownish yellow (10YR 6/6), moist, medium stiff.	0.5						
20	4	13 in.	7-5-8	SW: WELL GRADED SAND, fine to medium grained, pale brown (10YR 6/3), moist, medium dense.	-						
25	5	17 in.	5-10-13	ML: SILT, light yellowish brown (2.5Y 6/3), moist, medium dense.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
30	6	18 in.	9-10-13	CL: LEAN CLAY, with trace silt, light olive brown (2.5Y 5/3) with gray (2.5Y 5/1) mottling, moist, very stiff to hard.	4.25						
35	7	18 in.	9-13-20		4.5	19	50	30			
40	8	14 in.	10-16-27	CL: LEAN CLAY, light brownish gray (2.5Y 6/2), moist, hard.	1.0						
45	9	17 in.	8-10-18	ML: SILT, light olive brown (2.5Y 5/3), moist, medium dense.	4.5						
50	10	18 in.	13-33-50/6"	CL: LEAN CLAY, gray (2.5Y 5/1), moist, hard. Lignite seam at least 12 in. thick at 50 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
55	11	18 in.	9-16-26		4.5						
60	12	13 in.	18-20-33	CL: LEAN CLAY, with trace silt, dark gray (2.5Y 4/1), moist, hard.	4.5						
65	13	18 in.	9-13-16	CL-ML: SILTY CLAY, gray (2.5Y 5/1), moist, very stiff.	3.25						
70	14	4 in.	50/4"	Lignite seam at least 4 in. thick at 69.5 ft.	-						
75	15	18 in.	15-21-32	ML: SILT, with trace clay, gray (2.5Y 5/1), moist, very dense. Lignite seam 1 in. thick at 75 ft.	4.5						
80	16	18 in.	10-14-16	CL: LEAN CLAY, with trace silt, gray (2.5Y 5/1), moist, hard.	4.5						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
85	17	18 in.	10-13-15	With trace lignite and very stiff at 84.5 ft.	3.75						
90	18	18 in.	23-30-41	CH: FAT CLAY, consolidated, possibly highly weathered shale, gray (2.5Y 5/1) moist, hard.	4.5	21	57	36			
95	19	5 in.	50/5"	Lignite seam at least 5 in. thick at 94.5 ft.	-						
100	20	18 in.	17-27-40	ML: SILT, with trace clay, gray (2.5Y 6/1), moist, very dense.	4.5						
105	21	18 in.	19-28-45		4.5						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
110	22	18 in.	11-28-48	CH: FAT CLAY, with trace silt and trace coal, consolidated, possibly highly weathered shale, gray (2.5Y 5/1) moist, hard.	4.5						
115	23	18 in.	17-33-50/6"	Lignite seam at least 1 in. thick at 116 ft.	4.5						
120	24	18 in.	21-28-41	CL: LEAN CALY, with some silt, gray (2.5Y 5/1), moist, very dense.	4.5						
125	25	18 in.	21-36-50/6"	With trace lignite at 124.5 ft.	4.5						
130	26	18 in.	16-25-36		4.5	20	36	16			

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	Atterbergs PL	LL	PI	G	S	M/C
135	27	15 in.	21-36-50/3"		4.5						
140	28	18 in.	22-35-43	Lignite seam at least 2 in. thick at 139.5 ft.	4.5						
145	29	17 in.	24-36-50/5"		4.5						
150	30	18 in.	24-36-50/6"	Consolidated, weakly cemented, with lignite seam at least 1 in. thick at 151 ft.	4.5						
155	31	17 in.	27-43-50/5"	CL: LEAN CLAY, with some silt, consolidated, highly weathered shale, gray (2.5Y 5/1), moist, hard.	4.5						
160	32	12 in.	27-33-50/6"		4.5						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

GES Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

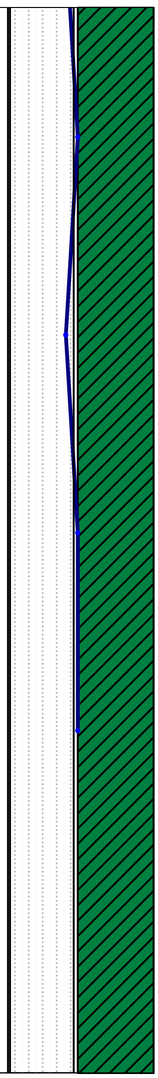
Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
165	33	10 in.	17-50/ 4"		4.5						
170	34	18 in.	27-40-43		4.5	19	48	28			
175	35	12 in.	33-50/ 6"		4.5						
180	36	11 in.	30-50/ 5"		4.5						
185	37	41 in.	100								



Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

GES

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
190	38	36 in.	100								
			83								
195	39	54 in.									
			63								
200	40	60 in.		Silt seam 4 in. thick at 200 ft.							
			95								
205	41	60 in.									
			81								
210	42	60 in.		Lignite seam 1 in. thick at 210 ft.							
				Coal: Lignite coal, black (2.5Y 2.5/1).							
			83								
215	43										

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client: **CCI & Associates Inc.**
Address: **NA**	GES Job #: **3502056**
County: **McKenzie**	GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel**	Date Drilled: **4/24/19 through 4/28/19**	Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services**	Completion Date: **4/28/19**	
Drill Operator: **Jared Zak**	Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**	
Drill Rig Type: **Diedrich D50**	Sampling Method: **Split Spoon & NQ Rock Core**	

Borehole Diameter: **8 in. to 4 in.**	Surface Elevation: **1,908 ft. msl**	Abandonment Method: **Tremie**
Total Depth: **403 ft.**	Approximate Water Depth: **Not Encountered**	Backfill Material: **Portland Cement**
Refusal Depth: **NA**		Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
			87								
220	44	60 in.									
			68								
225	45	60 in.									
			53								
230	46	60 in.									
			100	Shale: SHALE, highly weathered, gray (2.5Y 5/1), moist, hard.							
				ML: SILT, gray (2.5Y 5/1), moist, very dense.							
235	47	48 in.		Shale: SHALE, highly weathered, gray (2.5Y 5/1), moist, hard.							
			97	Trace Lignite less than 1 in. thick at 238 ft.							
240	48	60 in.		Lignite seam 6 in. thick at 242 ft.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client: **CCI & Associates Inc.**		
Address: **NA**	GES Job #: **3502056**		
County: **McKenzie**	GES Project Mgr: **Rob Jenson**		
Logged By: **Nick Schlagel**	Date Drilled: **4/24/19 through 4/28/19**	Soil Classification System: **USCS**	
Drilling Company: **Interstate Drilling Services**	Completion Date: **4/28/19**		
Drill Operator: **Jared Zak**	Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**		
Drill Rig Type: **Diedrich D50**	Sampling Method: **Split Spoon & NQ Rock Core**		
Borehole Diameter: **8 in. to 4 in.**	Surface Elevation: **1,908 ft. msl**	Abandonment Method: **Tremie**	
Total Depth: **403 ft.**	Approximate Water Depth: **Not Encountered**	Backfill Material: **Portland Cement**	
Refusal Depth: **NA**		Abandonment Completion Date: **4/28/19**	

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
			81	ML: SANDY SILT, fine grained, gray (2.5Y 5/1), moist, very dense.							
245	49	50 in.		Shale: SHALE, highly weathered, gray (2.5Y 5/1), moist, hard.							
			85	Trace Lignite 1 in. thick at 248 ft.							
				ML: SANDY SILT, fine grained, gray (2.5Y 5/1), moist, very dense.							
250	50	60 in.		Shale: SHALE, highly weathered, gray (2.5Y 5/1), moist, hard.							
				Calcified layer, light gray (2.5Y 7/1), harder than surrounding shale, 6 in. thick at 251.5 ft.							
			43	CL: LEAN CLAY with fine grained sand and silt, gray (2.5Y 5/1), moist, very dense.							
255	51	42 in.									
			100			18	41	23			
260	52	60 in.									
			100	Shale: SHALE, highly weathered, gray (2.5Y 5/1), moist, hard.							
265	53	55 in.									
			95	Lignite seam 2 in. thick at 269 ft.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
270											
	54	60 in.									
				Color turns greenish gray (GLEY1 6/1) at 272 ft.							
			97	Shale: SHALE, highly weathered, with trace lignite, dark gray (2.5Y 4/1), moist, hard.							
275											
	55	60 in.		Lignite seam 5 in. thick at 276 ft.							
			93	Color turns to gray (2.5Y 5/1) and lignite seam 4 in. thick at 278 ft.							
280											
	56	60 in.									
				ML: SANDY SILT, fine grained, gray (2.5Y 5/1), moist, very dense.							
			100	Shale: SHALE, highly weathered, with trace lignite, greenish gray (GLEY1 6/1), moist, hard.							
285											
	57	60 in.		Color turns to gray (2.5Y 5/1) and lignite seam 1 in. thick at 285.5 ft.							
			97	ML: SILT, with trace clay, consolidated, weakly cemented, greenish gray (GLEY1 6/1) moist, very dense.							
290											
	58	60 in.		Lignite seam 1 in. thick at 288.5 ft.							
			100	Color turns to gray (2.5Y 5/1) at 293 ft.							
295											
	59	54 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
			94								
300	60	54 in.									
			90	ML: SANDY SILT, fine grained, gray (2.5Y 5/1), moist, very dense.							
305	61	48 in.		Lignite seam 1 in. thick at 305 ft. ML: SILT, with trace clay, gray (2.5Y 5/1) moist, very dense.							
			100								
310	62	60 in.									
			79								
315	63	52 in.		Coal: Lignite coal, black (2.5Y 2.5/1).							
				ML: SILT, with trace clay, gray (2.5Y 5/1) moist, very dense.							
			72								
320	64	50 in.		Lignite seam 1 in. thick at 321.5 ft.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client: **CCI & Associates Inc.**
Address: **NA**	GES Job #: **3502056**
County: **McKenzie**	GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel**	Date Drilled: **4/24/19 through 4/28/19**	Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services**	Completion Date: **4/28/19**	
Drill Operator: **Jared Zak**	Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**	
Drill Rig Type: **Diedrich D50**	Sampling Method: **Split Spoon & NQ Rock Core**	

Borehole Diameter: **8 in. to 4 in.**	Surface Elevation: **1,908 ft. msl**	Abandonment Method: **Tremie**
Total Depth: **403 ft.**	Approximate Water Depth: **Not Encountered**	Backfill Material: **Portland Cement**
Refusal Depth: **NA**		Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
325	65	60 in.		ML: SILT, with trace clay, with fine grained sandy silt lenses throughout, gray (2.5Y 5/1) moist, very dense.							
				Coal: Lignite coal, black (2.5Y 2.5/1).							
			100	ML: SILT, with trace clay, with fine grained sandy silt lenses throughout, gray (2.5Y 5/1) moist, very dense.							
330	66	45 in.	87								
335	67	60 in.		Shale: SHALE, gray (2.5Y 5/1), moist, hard.							
			71	ML: SILT, with trace clay, with fine grained sandy silt lenses throughout, gray (2.5Y 5/1) moist, very dense.							
340	68	54 in.		Coal: Lignite coal, black (2.5Y 2.5/1).							
			93	ML: SILT, with trace clay, with fine grained sandy silt lenses throughout, gray (2.5Y 5/1) moist, very dense.							
345	69	60 in.		Lignite seam 3 in. thick at 345 ft.							
			92	Coal: Lignite coal, black (2.5Y 2.5/1).							
350											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
	70	32 in.		CH: FAT CLAY, with silt, with fine grained sandy silt lenses throughout, gray (2.5Y 5/1) moist, very dense.							
			100			23	196	173			
355	71	60 in.									
			92	ML: SILT, with trace fine grained sand, weakly cemented, gray (2.5Y 6/1) moist, very dense.							
360	72	60 in.									
			100								
365	73	50 in.									
			98								
370	74	60 in.									
			100								
375	75	60 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-1**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/24/19 through 4/28/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **4/28/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 185 ft.), NQ Rock Core (185 to 403 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,908 ft. msl** Abandonment Method: **Tremie**

Total Depth: **403 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **4/28/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
380	76	60 in.	83								
			74	Coal: Lignite coal, black (2.5Y 2.5/1).							
385	77	58 in.	94								
390	78	60 in.	100	ML: SILT, with trace clay, weakly cemented, gray (2.5Y 6/1) moist, very dense.							
395	79	60 in.	74								
400				Coal: Lignite coal, black (2.5Y 2.5/1).							
	80	58 in.		ML: SILT, with trace clay, weakly cemented, gray (2.5Y 6/1) moist, very dense. EOB at 403 ft. Target depth reached.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 6' 56.33"

Lon: 103° 5' 34.23"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	Atterbergs LL	Atterbergs PI	G	S	M/C
0				ML: SILT, with trace clay, light brownish gray (2.5Y 6/2), moist, medium dense.							
5	1	6 in.	7-8-9		-						
10	2	11 in.	6-6-11	SM: SILTY SAND, fine grained, light olive brown (2.5Y 5/3), moist, medium dense.	-						
15	3	13 in.	7-9-9	ML: SILT, with trace clay, light olive brown (2.5Y 5/3), moist, medium dense.	-						
20	4	16 in.	6-7-10	Color turns to dark grayish brown (2.5Y 4/2) at 19.5 ft.	-						
25	5	16 in.	4-4-4	SM: SILTY SAND, fine grained, light olive brown (2.5Y 5/3), moist, loose.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
30	6	15 in.	5-5-6	ML: SANDY SILT, fine grained, grayish brown (2.5Y 5/2), moist, medium dense.	-						
35	7	18 in.	4-4-8	CH: FAT CLAY, with trace silt, gray (2.5Y 5/1), moist, very stiff.	2.25						
40	8	18 in.	4-5-8		2.75						
45	9	18 in.	4-6-7		2.75	26	73	46			
50	10	18 in.	5-7-8		3.0						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
55	11	12 in.	10-13-13	SP: POORLY GRADED SAND, fine grained, with trace silt, grayish brown (2.5Y 5/2) moist, medium dense.	-						
60	12	16 in.	8-10-10	SP: POORLY GRADED SAND, fine grained, grayish brown (2.5Y 5/2) moist, medium dense.	-						
65	13	18 in.	7-8-12		-						
70	14	12 in.	7-4-6	SP: POORLY GRADED SAND, fine grained with trace medium grained, with trace silt, grayish brown (2.5Y 5/2) moist, loose.	-						
75	15	14 in.	11-14-16	SP: POORLY GRADED SAND, fine to medium grained, grayish brown (2.5Y 5/2) moist, medium dense.	-						
80	16	12 in.	13-11-12	With some silt and clay at 79.5 ft.	-					82.0	18.0

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
85	17	12 in.	13-17-19	Fine grained and dense at 84.5 ft.	-						
90	18	14 in.	6-7-9	With trace silt and medium dense at 89.5 ft.	-						
95	19	13 in.	10-14-14	Mostly fine grained with some medium grained at 94.5 ft.	-						
100	20	12 in.	9-17-17	Fine grained and dense at 99.5 ft.	-						
105	21	13 in.	8-9-9	Medium dense at 104.5 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	Atterbergs PL	LL	PI	G	S	M/C
110	22	13 in.	10-8-8	Trace lignite at 110 ft.	-						
115	23	16 in.	7-10-11	With trace silt and trace clay at 114.5 ft.	-						
120	24	15 in.	10-15-18	ML: SANDY SILT, fine grained, with trace clay, gray (2.5Y 5/1), moist, dense.	0.5						
125	25	18 in.	8-11-21	CL-ML: SILTY CLAY, gray (2.5Y 5/1), moist, hard.	3.0						
130	26	18 in.	15-25-36		4.5						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
135	27	18 in.	17-24-34	ML: SILT, with trace fine grained sand, gray (2.5Y 5/1), moist, very dense.	-						
140	28	12 in.	20-50/ 6"	ML: SILT, with trace clay, weakly cemented, gray (2.5Y 5/1), moist, very dense. Lignite seam at least 1 in. thick at 140.5 ft.	4.5						
145	29	12 in.	20-50/ 6"	With trace lignite at 144.5 ft.	4.5						
150	30	12 in.	18-50/ 6"		4.5						
			100	Shale: SHALE, highly weathered, consolidated lean clay, gray (2.5Y 5/1), moist, hard.		17	33	16			
155	31	48 in.									
			97								
160	32	24 in.	83	Lignite seam at least 4 in. thick at 160 ft.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
	33	60 in.									
165			83	Poor recovery, suspect non-cohesive sand was washed out and not collected in the core barrel from 165 to 170 ft.							
	34	15 in.									
170			81	Poor recovery, suspect non-cohesive sand was washed out and not collected in the core barrel from 170 to 175 ft.							
	35	11 in.									
175			0	No Recovery 175 to 180 ft.							
	36	0 in.									
180			35	Shale: SHALE, highly weathered, consolidated silty clay, gray (2.5Y 5/1), moist, hard. Poor recovery, suspect non-cohesive sand was washed out and not collected in the core barrel from 180 to 185 ft.							
	37	20 in.		Fine grained silty sand seam 3 in. thick at 183 ft.							
185			100								
	38	41 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
190			84								
	39	54 in.		Shale: SHALE, weathered, gray (2.5Y 5/1), moist, hard.							
				Shale: SHALE, gray (2.5Y 5/1), moist, hard.							
195			0	Poor recovery, suspect non-cohesive sand was washed out and not collected in the core barrel from 195 to 200 ft.							
	40	17 in.									
200			93	Siltstone: SILTSTONE, highly weathered, consolidated silt with trace clay, gray (2.5Y 5/1), moist, hard.							
	41	54 in.									
205			89								
	42	47 in.									
210			85								
	43	54 in.									
215			40	Lignite seam 1 in. thick at 214.5 ft.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
	44	48 in.		Coal: Lignite coal, black (2.5Y 2.5/1).							
220			33								
	45	60 in.									
225			9								
	46	58 in.									
230			33								
	47	60 in.									
235			50								
	48	48 in.		ML: SILT, with trace lignite, gray (2.5Y 5/1), moist, very dense.							
240			100	With trace fine grained sand at 240 ft. Lignite seam less than 1 in. thick at 240.5 ft.							
	49										

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**
Address: **NA** GES Job #: **3502056**
County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**
Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**
Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**
Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**
Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
	49			Lignite seam less than 1 in. thick at 243.5 and 244 ft.							
245			100	Poor recovery, suspect non-cohesive sand was washed out and not collected in the core barrel from 245 to 250 ft.							
	50	33 in.									
250			0	Poor recovery, suspect non-cohesive sand was washed out and not collected in the core barrel from 250 to 255 ft.							
	51	0 in.									
255			56	ML: SANDY SILT, fine grained, with trace clay, gray (2.5Y 5/1), moist, dense.							
				ML: SILT, gray (2.5Y 5/1), moist, very dense.							
	52	48 in.									
260			95	With trace clay at 260 ft.		23	26	3			
	53	60 in.									
265			95	Weakly cemented at 265 ft.							
	54	60 in.									

Notes:
Soil Lithologies based on field observations and laboratory analysis.
NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level
Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)
PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)
M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates
Lat: 48° 7' 3.56"
Lon: 103° 5' 33.40"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**
Address: **NA** GES Job #: **3502056**
County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**
Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**
Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**
Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**
Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
270	55	57 in.	75	ML: SANDY SILT, fine grained, weakly cemented, gray (2.5Y 5/1), moist, dense.							
275	56	48 in.	69	ML: SILT, with trace clay, weakly cemented, gray (2.5Y 5/1), moist, very dense. Lignite seam 3 in. thick at 276 ft. Lignite seam 6 in. thick at 277.5 ft.							
280	57	60 in.	100	With trace lignite seams throughout at 280 ft.							
285	58	45 in.	85	Lignite seam 4 in. thick at 286 ft. Lignite seam 4 in. thick at 288.5 ft.							
290	59	54 in.	100	ML: SILT, with trace clay, weakly cemented, with trace lignite throughout, gray (2.5Y 5/1), moist, very dense.							
295			95								

Notes:
Soil Lithologies based on field observations and laboratory analysis.
NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level
Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)
PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)
M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates
Lat: 48° 7' 3.56"
Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
	60	60 in.		Lignite seam 1 in. thick at 297.5 ft.							
				Sandy silt seam 4 in. thick at 299 ft.							
300			97								
	61	48 in.		SM: SILTY SAND, fine grained, gray (2.5Y 5/1), moist, very dense.							
305			30	Silt seam with trace clay 6 in. thick at 304 ft.							
				SP-SM: SAND WITH SILT, fine grained, gray (2.5Y 5/1), moist, very dense.							
	62	43 in.		ML: SILT, gray (2.5Y 5/1), moist, very dense.							
				Fine grained sand with silt seam 4 in. thick at 309 ft.							
310			80	Lignite seam 2 in. thick at 310 ft.							
				ML: SILT, with trace clay, gray (2.5Y 5/1) moist, very dense.							
	63	60 in.		Coal: Lignite coal, black (2.5Y 2.5/1).							
315			95	ML: SILT, with trace fine grained sand, with trace lignite throughout, gray (2.5Y 5/1) moist, very dense.							
	64	57 in.									
320			93	Coal: Lignite coal, black (2.5Y 2.5/1).							
				ML: SILT, with trace clay, gray (2.5Y 5/1) moist, very dense.							
	65	60 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
325			83	ML: SILT, with trace fine grained sand, gray (2.5Y 5/1) moist, very dense.							
	66	36 in.		CH: FAT CLAY, with silt and fine grained sand, gray (2.5Y 5/1), moist, very dense.							
330			67			24	53	29			
	67	36 in.		Coal: Lignite coal, black (2.5Y 2.5/1).							
335			100	ML: SANDY SILT, fine grained, gray (2.5Y 5/1), moist, dense.							
	68	60 in.									
340			97	ML: SILT, with trace fine grained sand, gray (2.5Y 5/1) moist, very dense. Lignite seams 5 in. thick at 341 ft. and 3 in. thick at 342 ft.							
	69	34 in.									
345			96	With trace clay and trace lignite throughout and color turns to greenish gray (GLEY1 6/1) at 345 ft.							
	70	60 in.									
350											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
	71	42 in.		SM: SILTY SAND, fine grained, with little clay, weakly cemented, greenish gray (GLEY1 6/1), moist, very dense.							
355			100							57.7	42.3
	72	59 in.									
360			95								
	73	60 in.									
365			100								
	74	55 in.									
370			88								
	75	60 in.									
375			78								
				Coal: Lignite coal, black (2.5Y 2.5/1).							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-2**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **4/28/19 through 5/1/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/1/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 25 ft.), Fluid Rotary (25 to 153 ft.), NQ Rock Core (153 to 400 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,920 ft. msl** Abandonment Method: **Tremie**

Total Depth: **400 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/1/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
375–380	76	58 in.									
380–385	77	60 in.	28	CL-ML: SILTY CLAY, with trace fine grained sand, greenish gray (GLEY1 6/1), moist, hard.							
385–390	78	59 in.	100	Trace lignite at 385 ft. Shale: SHALE, highly weathered, consolidated silty clay, greenish gray (GLEY1 6/1), moist, hard.							
390–395	79	0 in.	0	No Recovery 390 to 395 ft.							
395–400	80	60 in.	97	ML: SILT, with trace fine grained sand, weakly cemented, greenish gray (GLEY1 6/1) moist, very dense. EOB at 400 ft. Target depth reached.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 3.56"

Lon: 103° 5' 33.40"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**
Address: **NA** GES Job #: **3502056**
County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**
Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**
Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**
Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**
Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	Atterbergs PL	LL	PI	G	S	M/C
0				SP: POORLY GRADED SAND, fine to medium grained, brown (7.5YR 4/3) moist, loose.							
5	1	15 in.	3-3-2		-						
10	2	13 in.	4-3-3		-						
15	3	13 in.	3-2-2	Color turns to brown (7.5YR 5/4) and trace coarse grained sand, very loose at 14.5 ft. Trace lignite at 16 ft.	-						
20	4	16 in.	5-3-3	Trace lignite at 21 ft.	-						
25	5	18 in.	2-4-5	Color turns to brown (7.5YR 4/3) and wet at 24.5 ft.	-						

Notes:
Soil Lithologies based on field observations and laboratory analysis.
NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level
Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)
PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)
M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates
Lat: 48° 9' 22.10"
Lon: 103° 4' 39.62"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
30	6	18 in.	2-3-3	Color turns to brown (7.5YR 5/3) at 29.5 ft.	-						
35	7	18 in.	4-7-8	Color turns to brown (7.5YR 4/3) at 34.5 ft.	-					96.0	
40	8	18 in.	4-6-11		-						
45	9	18 in.	6-10-12	Lignite seam less than 1 in. thick at 46 ft.	-						
50	10	18 in.	3-3-5	SW: WELL GRADED SAND, fine to medium grained, dark brown (7.5YR 3/3) wet, loose. Gravel and sand seam, coarse grained, 4 in. thick at 50.5 ft. Trace lignite at 51 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
55	11	18 in.	3-4-7	SW: WELL GRADED SAND, fine to medium grained, brown (7.5YR 4/3) wet, medium dense.	-						
60	12	18 in.	7-5-6	Gravel and sand seam, coarse grained, 6 in. thick at 60.5 ft.	-						
65	13	12 in.	6-10-10	SPG: POORLY GRADED SAND WITH GRAVEL, coarse grained, dark brown (7.5YR 3/2), wet, medium dense.	-				19.5	72.6	7.8
70	14	18 in.	5-8-9	CL: LEAN CLAY WITH SAND, fine grained, with silt, dark grayish brown (10YR 4/2), wet, very stiff.	2.0						
75	15	18 in.	17-24-25	SM: SILTY SAND, fine grained, grayish brown (2.5Y 5/2), wet, dense.	-						
80	16	18 in.	15-21-21		-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
85	17	8 in.	12-10-16	SW: WELL GRADED SAND, fine to medium grained, gray (2.5Y 5/1) wet, medium dense.	-						
90	18	14 in.	24-33-25	SW: WELL GRADED SAND, fine to coarse grained, gray (2.5Y 5/1) wet, very dense.	-						
95	19	18 in.	33-36-50/6"	SP: POORLY GRADED SAND, fine grained, with trace silt, dark gray (2.5Y 4/1) wet, very dense.	-						
100	20	12 in.	23-50/6"	With trace lignite at 99.5 ft. Trace silty clay at 101.5 ft.	-						
105	21	11 in.	34-50/6"	SP: POORLY GRADED SAND, fine grained, dark gray (2.5Y 4/1) moist, very dense.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
110	22	14 in.	17-32-41	SM: SILTY SAND, fine grained, with trace clay, dark gray (2.5Y 4/1) moist, very dense.	-					59.1	40.4
115	23	12 in.	36-50/6"	Coal: Lignite coal, black (2.5Y 2.5/1), moist, very dense.	-						
120	24	3 in.	50/3"		-						
125	25	3 in.	50/3"		-						
130	26	2 in.	50/3"		-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
135	27	2 in.	50/2"		-						
140	28	18 in.	17-33-43	ML: SILT, with trace clay, gray (2.5Y 5/1), moist, very dense.	-						
145	29	18 in.	18-26-36	CL-ML: SILTY CLAY, dark gray (2.5Y 4/1), moist, hard.	4.5						
150	30	18 in.	15-20-30	SM: SILTY SAND, fine grained, gray (2.5Y 5/1), moist, very dense.	4.5						
155	31	18 in.	17-33-50/6"		-						
160	32	18 in.	16-23-28		-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
165	33	18 in.	17-24-27	CL-ML: SILTY CLAY, gray (2.5Y 5/1), moist, hard.	4.5	18	24	6			
170	34	18 in.	24-25-48	ML: SILT, with trace fine grained sand and trace clay, gray (2.5Y 5/1), moist, very dense.	3.5						
175	35	8.5 in.	59	Coal: Lignite coal, black (2.5Y 2.5/1).							
180	36	24 in.	75	CL: LEAN CLAY, with trace silt, gray (2.5Y 5/1). Lignite seam 2 in. thick at 182 ft. Lignite seam 2 in. thick at 184 ft.							
185	37	18 in.	89, 40	SM: SILTY SAND, fine grained, gray (2.5Y 5/1), moist, very dense.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
190	38	48 in.		Coal: Lignite coal, black (2.5Y 2.5/1).							
			50								
195	39	60 in.		CL-ML: SILTY CLAY, gray (2.5Y 5/1), moist, hard.							
			100	With trace lignite throughout from 197 to 202 ft.							
200	40	60 in.									
			75	Lignite seam 1 in. thick at 202 ft.							
				ML: SILT, with some clay, gray (2.5Y 5/1), moist, very dense.							
205	41	60 in.		ML: SILT, gray (2.5Y 5/1), moist, very dense.							
				ML: SILT, with trace clay, gray (2.5Y 5/1), moist, very dense.							
			80								
210	42	60 in.									
				Coal: Lignite coal, black (2.5Y 2.5/1).							
			63								
				ML: SILT, with trace fine grained sand, gray (2.5Y 5/1), moist, very dense.							
215	43	23 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
			98								
220	44	54 in.		Lignite seam 1 in. thick at 219.5 ft.							
				ML: SILT, gray (2.5Y 5/1), moist, very dense.							
			90	CL-ML: SILTY CLAY, gray (2.5Y 5/1), moist, hard.							
225	45	60 in.									
			100	ML: SILT, with trace fine grained sand, gray (2.5Y 5/1), moist, very dense.		23	24	1			
230	46	57 in.									
			84	ML: SILT, with trace clay, gray (2.5Y 5/1), moist, very dense.							
				Shale layer 6 in. thick at 234 ft.							
235	47	56 in.									
			85	Coal: Lignite coal, black (2.5Y 2.5/1).							
				ML: SILT, with trace clay and with trace lignite, gray (2.5Y 5/1), moist, very dense.							
240	48	54 in.									
			100								

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
				ML: SANDY SILT, fine grained, weakly cemented, greenish gray (GLEY1 6/1), moist, very dense.							
245	49	60 in.									
			100								
250	50	60 in.									
			100	SM: SILTY SAND, fine grained, weakly cemented, greenish gray (GLEY1 6/1), moist, very dense.							
255	51	60 in.									
			100								
260	52	60 in.									
			100								
265	53	60 in.									
			70	Shale seam 1 in. thick at 267 ft.							
	54	60 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
270											
			10	Coal: Lignite coal, black (2.5Y 2.5/1).							
	55										
275		60 in.		Silty clay layer 6 in. thick at 275 ft.							
			58								
				ML: SILT, with trace fine grained sand, gray (2.5Y 5/1), moist, very dense.							
280	56	48 in.									
			100	SM: SILTY SAND, fine grained, weakly cemented, greenish gray (GLEY1 6/1), moist, very dense.							
285	57	60 in.									
			95	Trace lignite less than 1 in. thick at 287 ft.							
				Trace lignite less than 1 in. thick at 289 ft.							
290	58	60 in.		Shale: SHALE, highly weathered, with trace coal, greenish gray (GLEY1 6/1), moist, hard.							
			91	Shale: SHALE, highly weathered, gray (2.5Y 5/1), moist, hard.							
295	59	60 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	Atterbergs LL	Atterbergs PI	G	S	M/C
			97	Shale layer, not weathered, 2 in. thick and color turns to dark gray (2.5Y 4/1) at 297 ft.							
300	60	60 in.									
				Sandstone layer 8 in. thick at 301 ft.							
			83	Color turns to gray (2.5Y 5/1) at 302 ft.							
305	61	60 in.									
			100	Silty sand layer, fine grained, 6 in. thick at 307 ft. Shale layer, not weathered, less than1 in. thick at 307.5 ft.							
310	62	60 in.									
			80								
315	63	60 in.									
				Lignite seam 3 in. thick at 316 ft.							
			100	SM: SILTY SAND, fine grained, gray (2.5Y 5/1), moist, very dense.							
				Shale: SHALE, highly weathered, gray (2.5Y 5/1), moist, hard.							
320	64	60 in.									
				SM: SILTY SAND, fine grained, gray (2.5Y 5/1), moist, very dense.							
			100	Shale: SHALE, highly weathered, with trace lignite throughout, gray (2.5Y 5/1), moist, hard.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **LB-3**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
325	65	60 in.									
			100			25	105	81			
330	66	60 in.									
			95								
				SM: SILTY SAND, fine grained, gray (2.5Y 5/1), moist, very dense.							
335	67	60 in.									
			70	Coal: Lignite coal, black (2.5Y 2.5/1). Silty clay layer 6 in. thick at 339 ft.							
340	68	60 in.									
			10								
345	69	60 in.		Silty clay layer 6 in. thick at 344 ft.							
			100	SM: SILTY SAND, fine grained, weakly cemented, gray (2.5Y 5/1), moist, very dense.							
350	70	46 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **Williams** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/3/19 through 5/4/19** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/5/19**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 65 ft.), Fluid Rotary (65 to 175 ft.), NQ Rock Core (175 to 370 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,870 ft. msl** Abandonment Method: **Tremie**

Total Depth: **372 ft.** Approximate Water Depth: **24.5 ft.** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/5/19**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
			57	Shale: SHALE, highly weathered, with trace lignite, gray (2.5Y 5/1), moist, hard.							
355	71	58 in.		Coal: Lignite coal, black (2.5Y 2.5/1).							
			62	SM: SILTY SAND, fine grained, gray (2.5Y 5/1), moist, very dense.							
360	72	50 in.		CL-ML: SILTY CLAY, gray (2.5Y 5/1), moist, hard.							
			94	SM: SILTY SAND, fine grained, gray (2.5Y 5/1), moist, very dense.							
365	73	54 in.									
			67								
370	74	58 in.		EOB at 372 ft. Target depth reached.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 22.10"

Lon: 103° 4' 39.62"

Appendix B – Photographic Documentation

Site Photographs

Geotechnical Investigation Report
CCI and Associates, Inc.
WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River, North Dakota

Description:
Soil Boring LB-1

Direction of View:
Looking North-northwest

Date Taken:
4/28/2019

Site Photographs

Geotechnical Investigation Report
CCI and Associates, Inc.
WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River, North Dakota

Description:
Soil Boring LB-2

Direction of View:
Looking North-northwest

Date Taken:
4/29/2019

Site Photographs

Geotechnical Investigation Report
CCI and Associates, Inc.
WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River, North Dakota

Description:
Soil Boring LB-3

Direction of View:
Looking South

Date Taken:
5/2/2019

Appendix C - Laboratory Reports

Project:	WBI N Bakken Expansion	Job Number:	G19-025	Sheet 1 of 10

Manager: ____ Client: ____ Project Description: ____

Location: Missouri River HDD Crossing

Elevation Datum: ____

Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data: Top	Bottom	Type	Rec	'N'
LB-1 4.5							9.5						
LB-1 9.5							13.2						
LB-1 14.5							32.4						
LB-1 19.5							4.4						
LB-1 24.5							19.2						
LB-1 29.5							24.3						
LB-1 34.5	49.6	19.2	31.0				21.0						
LB-1 39.5							23.8						
LB-1 44.5							22.0						
LB-1 54.5							20.7						
LB-1 59.5							22.2						
LB-1 64.5							25.8						
LB-1 74.5							26.3						
LB-1 79.5							24.8						
LB-1 84.5							22.9						
LB-1 89.5	56.7	20.8	36.0				22.4						
LB-1 99.5							23.2						
LB-1 104.5							24.6						
LB-1 109.5							23.9						

Material Testing Services, LLC	Summary of Material Properties	June 6, 2019

Project: **WBI N Bakken Expansion** Job Number: **G19-025** Sheet **2** of **10**

Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Top	Bottom	Type	Rec	'N'
LB-1 114.5							22.0						
LB-1 119.5							24.4						
LB-1 124.5							19.1						
LB-1 129.5	36.4	20.3	16.0				20.4						
LB-1 134.5							21.2						
LB-1 139.5							21.1						
LB-1 144.5							21.9						
LB-1 149.5							28.5						
LB-1 154.5							19.4						
LB-1 159.5							21.0						
LB-1 164.5							24.9						
LB-1 169.5	47.7	19.4	29.0				19.3						
LB-1 174.5							19.5						
LB-1 179.5							22.6						
LB-1 185.0							8.5						
LB-1 189.0							13.8						
LB-1 193.0							15.4						
LB-1 198.0							16.0						
LB-1 203.0					137.7	118.7	16.0						
LB-1 208.0							16.0						
LB-1 223.0							54.1						
LB-1 228.0							60.4						

Material Testing Services, LLC | **Summary of Material Properties** | June 6, 2019

Borehole Depth Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Top	Bottom	Type	Rec	'N'
LB-1 233.0							15.4						
LB-1 238.0					129.4	110.4	17.2						
LB-1 243.0							11.6						
LB-1 248.0							11.0						
LB-1 253.0							17.9						
LB-1 258.0	40.8	18.1	23.0				15.5						
LB-1 263.0							21.2						
LB-1 268.0							12.2						
LB-1 273.0							11.8						
LB-1 278.0							13.8						
LB-1 283.0							15.5						
LB-1 288.0							15.3						
LB-1 293.0							14.1						
LB-1 298.0							14.2						
LB-1 303.0					142.5	122.0	16.8						
LB-1 308.0							15.3						
LB-1 313.0							21.3						
LB-1 318.0							16.9						
LB-1 323.0							16.3						
LB-1 328.0							13.1						
LB-1 333.0							14.3						
LB-1 338.0							15.5						

Project:	WBI N Bakken Expansion	Job Number:	G19-025	Sheet 4 of 10

Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data Top	Sample Data Bottom	Sample Data Type	Sample Data Rec	Sample Data 'N'
LB-1 343.0							15.5						
LB-1 348.0							17.6						
LB-1 353.0	196.0	23.0	173.0				18.4						
LB-1 358.0							16.0						
LB-1 363.0							18.9						
LB-1 368.0							16.2						
LB-1 373.0							20.2						
LB-1 378.0							19.8						
LB-1 388.0							18.9						
LB-1 393.0					131.4	112.1	17.2						
LB-1 398.0							19.9						
LB-2 4.5							20.5						
LB-2 9.5							17.3						
LB-2 14.5							25.5						
LB-2 19.5							22.6						
LB-2 24.5							10.4						
LB-2 29.5							27.5						
LB-2 34.5							25.8						
LB-2 39.5							32.9						
LB-2 44.5	72.9	26.4	47.0				31.4						
LB-2 49.5							33.0						
LB-2 54.5							19.5						

Material Testing Services, LLC	Summary of Material Properties	June 6, 2019

Project: **WBI N Bakken Expansion** Job Number: **G19-025** Sheet **5** of **10**

Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data: Top	Bottom	Type	Rec	'N'
LB-2 59.5							12.5						
LB-2 64.5							14.1						
LB-2 69.5							18.8						
LB-2 74.5							14.3						
LB-2 79.5				18.0			21.9						
LB-2 84.5							17.3						
LB-2 89.5							16.0						
LB-2 94.5							18.2						
LB-2 99.5							17.5						
LB-2 104.5							14.8						
LB-2 109.5							18.6						
LB-2 114.5							21.7						
LB-2 119.5							19.0						
LB-2 124.5							21.9						
LB-2 129.5							23.4						
LB-2 134.5	NP	NP	NP				23.9						
LB-2 139.5							20.6						
LB-2 144.5							25.8						
LB-2 149.5							23.6						
LB-2 153.0	33.5	17.1	16.0				15.4						
LB-2 158.0							15.6						
LB-2 165.0							16.1						

Material Testing Services, LLC	Summary of Material Properties	June 6, 2019

Project: **WBI N Bakken Expansion** Job Number: **G19-025** Sheet **6** of **10**

Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data Top	Bottom	Type	Rec	'N'
LB-2 170.0							17.4						
LB-2 175.0							19.1						
LB-2 180.0							57.2						
LB-2 185.0							12.3						
LB-2 190.0							11.8						
LB-2 195.0							15.5						
LB-2 200.0							16.3						
LB-2 205.0					130.0	111.2	16.9						
LB-2 210.0							15.5						
LB-2 220.0							61.2						
LB-2 225.0							53.5						
LB-2 230.0							65.6						
LB-2 235.0							17.4						
LB-2 240.0							15.5						
LB-2 245.0							11.7						
LB-2 255.0							21.5						
LB-2 260.0	26.3	23.3	3.0				19.5						
LB-2 265.0					137.1	119.6	14.6						
LB-2 270.0							16.3						
LB-2 275.0							16.0						
LB-2 280.0							15.4						
LB-2 290.0							14.9						

Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Top	Bottom	Type	Rec	'N'
LB-2 295.0							16.0						
LB-2 300.0							17.8						
LB-2 305.0							23.1						
LB-2 310.0							20.7						
LB-2 315.0							13.6						
LB-2 320.0							11.2						
LB-2 325.0							17.9						
LB-2 330.0	52.8	23.9	29.0				18.2						
LB-2 335.0							16.9						
LB-2 340.0							16.3						
LB-2 345.0							17.5						
LB-2 350.0							16.3						
LB-2 355.0				42.3			17.9						
LB-2 360.0					135.7	114.6	18.4						
LB-2 365.0							14.2						
LB-2 370.0							15.3						
LB-2 375.0							17.2						
LB-2 380.0							15.3						
LB-2 385.0							17.2						
LB-2 390.0							16.2						
LB-2 395.0					129.3	109.5	18.1						
LB-3 4.5							4.3						

Project:	WBI N Bakken Expansion	Job Number:	G19-025	Sheet 8 of 10

Borehole / Depth / Elev.	Specimen Description	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data Top	Bottom	Type	Rec	'N'
LB-3 9.5								3.7						
LB-3 14.5								2.4						
LB-3 19.5								3.0						
LB-3 24.5								24.3						
LB-3 29.5								25.0						
LB-3 34.5	POORLY GRADED SAND				4.0			22.4						
LB-3 39.5								22.2						
LB-3 44.5								18.5						
LB-3 49.5								14.1						
LB-3 54.5								21.0						
LB-3 59.5								20.9						
LB-3 64.5					7.8			10.8						
LB-3 69.5								23.8						
LB-3 74.5								21.0						
LB-3 79.5								18.2						
LB-3 84.5								17.7						
LB-3 89.5								12.0						
LB-3 94.5								20.8						
LB-3 99.5								12.5						
LB-3 104.5								21.9						
LB-3 109.5					40.4			15.8						
LB-3 139.5								17.1						

Material Testing Services, LLC	Summary of Material Properties	June 6, 2019

Project: **WBI N Bakken Expansion** Job Number: **G19-025** Sheet **9** of **10**

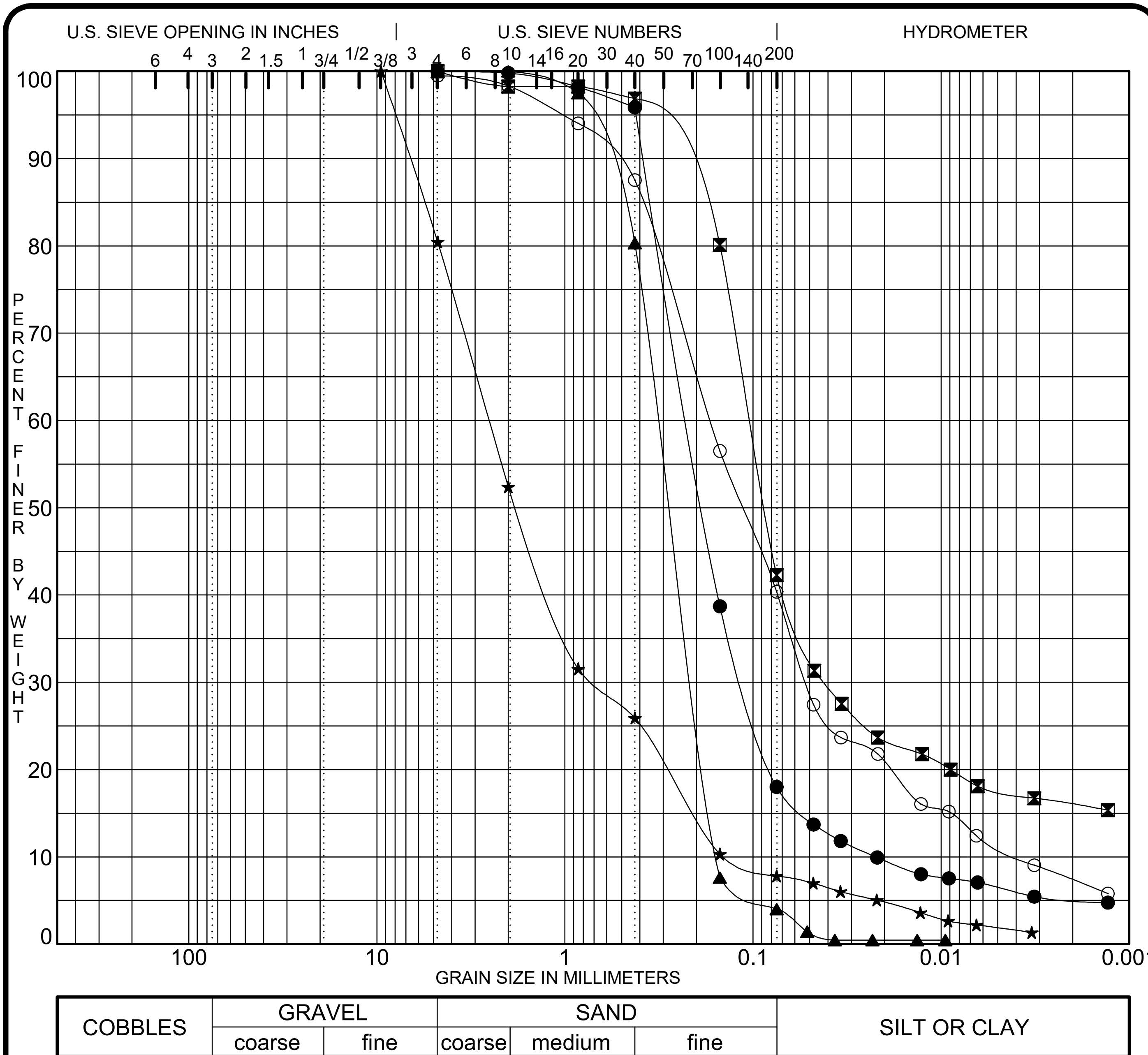
Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Top	Bottom	Type	Rec	'N'
LB-3 / 144.5							22.3						
LB-3 / 149.5							20.2						
LB-3 / 154.5							21.4						
LB-3 / 159.5							20.4						
LB-3 / 164.5	23.9	18.1	6.0				20.3						
LB-3 / 169.5							19.5						
LB-3 / 175.0							32.5						
LB-3 / 180.0							28.4						
LB-3 / 185.0							51.0						
LB-3 / 187.0							60.3						
LB-3 / 197.0							20.3						
LB-3 / 202.0							18.9						
LB-3 / 207.0							15.1						
LB-3 / 212.0							15.4						
LB-3 / 217.0							13.3						
LB-3 / 222.0							15.9						
LB-3 / 227.0	24.3	23.1	1.0				13.5						
LB-3 / 232.0							11.1						
LB-3 / 237.0							18.5						
LB-3 / 242.0							15.6						
LB-3 / 247.0							17.0						
LB-3 / 252.0							20.2						

Material Testing Services, LLC

Summary of Material Properties

June 6, 2019

Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data Top	Bottom	Type	Rec	'N'
LB-3 257.0					128.2	108.8	17.8						
LB-3 262.0							19.4						
LB-3 267.0							16.9						
LB-3 277.0							18.0						
LB-3 282.0							23.8						
LB-3 287.0							17.1						
LB-3 292.0							19.2						
LB-3 297.0					134.6	113.8	18.3						
LB-3 302.0							14.8						
LB-3 307.0							15.9						
LB-3 312.0							17.4						
LB-3 317.0							16.3						
LB-3 322.0							15.8						
LB-3 327.0	105.3	24.7	80.0				23.2						
LB-3 332.0							19.5						
LB-3 337.0							17.9						
LB-3 347.0							15.8						
LB-3 357.0							16.2						
LB-3 362.0					136.1	116.1	17.2						
LB-3 367.0							18.7						



	Boring No.	Depth (ft)	Classification	MC%	LL	PL	PI	Cc	Cu
●	**LB-2**	**79.5**		**22**				**2.55**	**9.9**
⧗	**LB-2**	**355.0**		**18**					
▲	**LB-3**	**34.5**	**POORLY GRADED SAND SP**	**22**				**0.87**	**2.0**
★	**LB-3**	**64.5**		**11**				**1.42**	**18.4**
⊙	**LB-3**	**109.5**		**16**				**4.12**	**43.1**

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**LB-2**	**79.5**	**4.75**	**0.22**	**0.112**	**0.0223**	**0.0**	**82.0**	**11.5**	**6.5**
⧗	**LB-2**	**355.0**	**4.75**	**0.10**	**0.042**		**0.0**	**57.7**	**24.7**	**17.6**
▲	**LB-3**	**34.5**	**2.00**	**0.32**	**0.207**	**0.1552**	**0.0**	**96.0**		
★	**LB-3**	**64.5**	**9.50**	**2.53**	**0.703**	**0.1375**	**19.5**	**72.6**	**5.9**	**1.9**
⊙	**LB-3**	**109.5**	**4.75**	**0.17**	**0.052**	**0.0039**	**0.0**	**59.1**	**29.2**	**11.2**

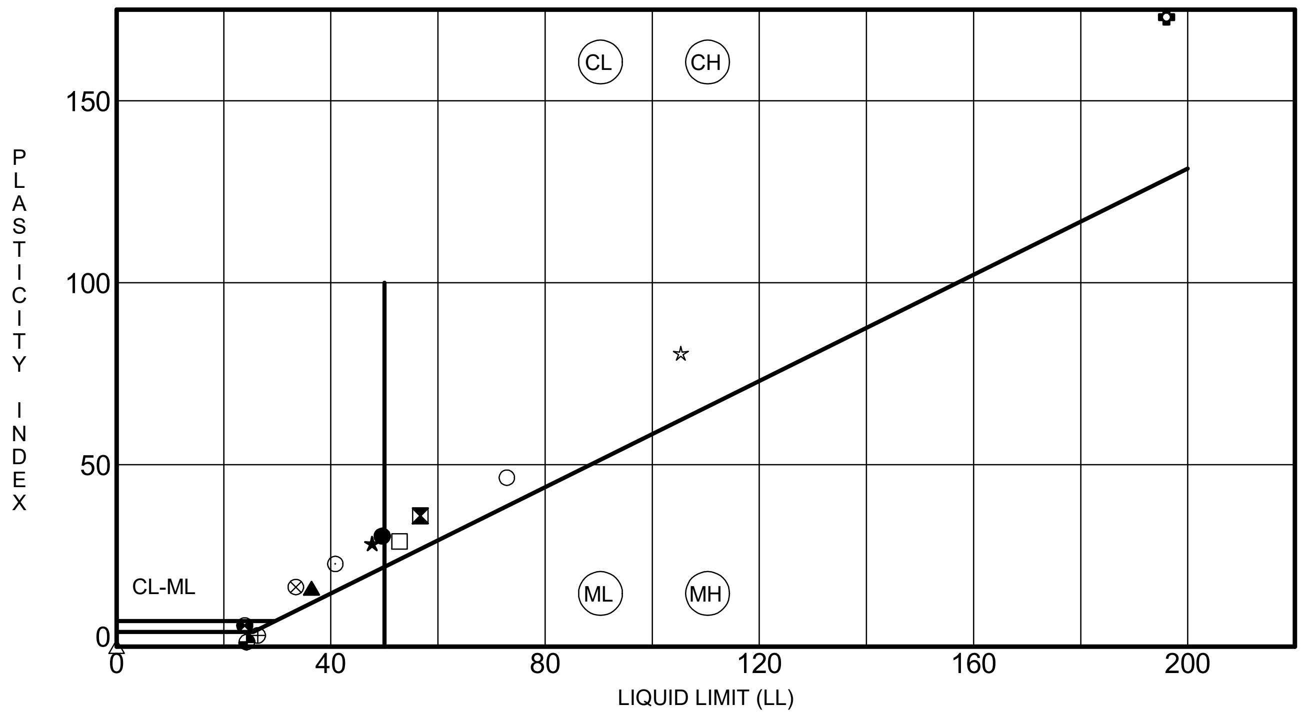
PROJECT **WBI N Bakken Expansion, Missouri River HDD Crossing**

JOB NO. **G19-025**

DATE **6/6/19**

PARTICLE SIZE ANALYSIS

Material Testing Services, LLC



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**LB-1**	**34.5**	**50**	**19**	**30**		
⧗	**LB-1**	**89.5**	**57**	**21**	**36**		
▲	**LB-1**	**129.5**	**36**	**20**	**16**		
★	**LB-1**	**169.5**	**48**	**19**	**28**		
⊙	**LB-1**	**258.0**	**41**	**18**	**23**		
✿	**LB-1**	**353.0**	**196**	**23**	**173**		
○	**LB-2**	**44.5**	**73**	**26**	**46**		
△	**LB-2**	**134.5**	**NP**	**NP**	**NP**		
⊗	**LB-2**	**153.0**	**33**	**17**	**16**		
⊕	**LB-2**	**260.0**	**26**	**23**	**3**		
□	**LB-2**	**330.0**	**53**	**24**	**29**		
◉	**LB-3**	**164.5**	**24**	**18**	**6**		
◕	**LB-3**	**227.0**	**24**	**23**	**1**		
☆	**LB-3**	**327.0**	**105**	**25**	**81**		

PROJECT **WBI N Bakken Expansion, Missouri River HDD Crossing**

JOB NO. **G19-025**

DATE **6/6/19**

ATTERBERG LIMITS' RESULTS

Material Testing Services, LLC

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING
ZGE 15-102

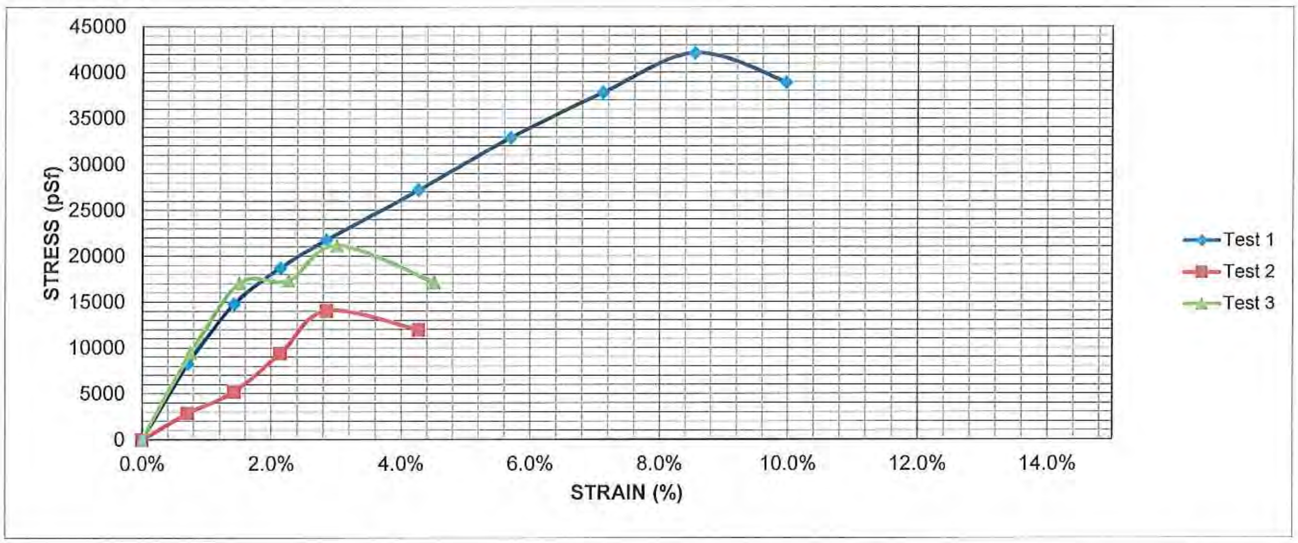
DATE: 6-Jun-19

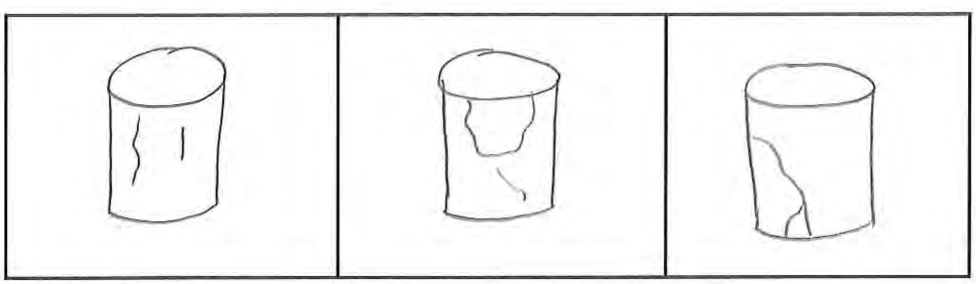
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G19-025

Specimen ID:	**Test 1**	**Test 2**	**Test 3**
	LB-1	LB-1	LB-1
	RC - 203-208 feet	RC - 238-243 feet	RC - 303-308 feet
Soil Class:			
Dry Density (pcf):	118.7	110.4	122.0
Water Content:	16.0%	17.2%	16.8%
Sample Dia. (mm):	42.3	45.3	42.9
Sample Ht (mm):	89.2	89.0	84.3
Height/Diameter:	2.11	1.97	1.97
Unc. Strength (psf):	**42174**	**14087**	**21196**
Strain at Failure (%):	8.5	2.9	3.0





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING
ZGE 15-102

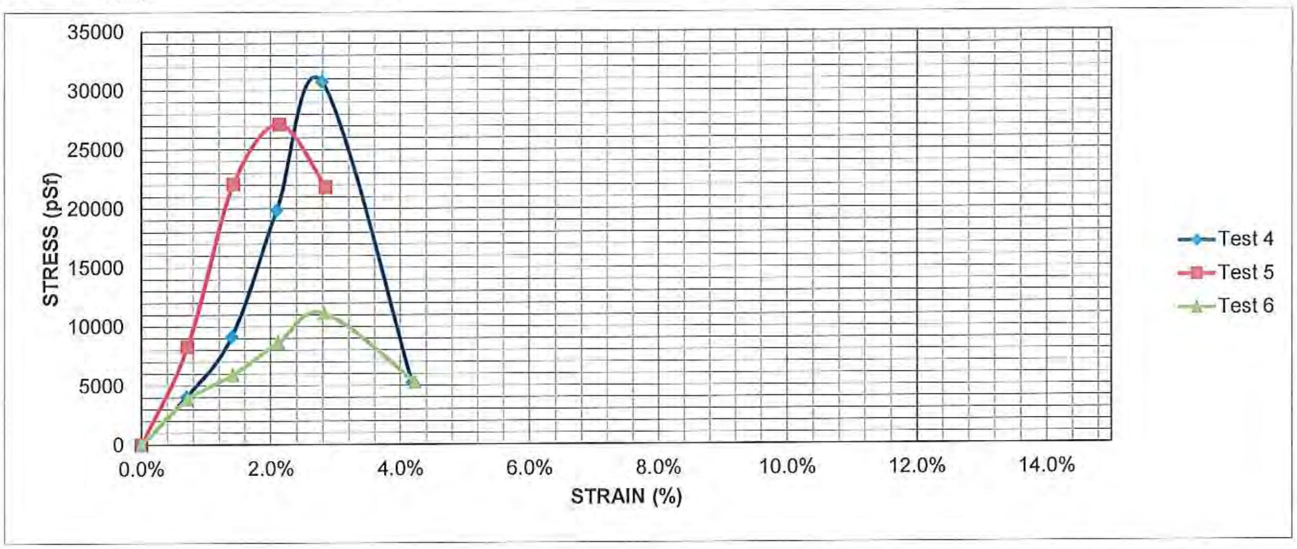
DATE: 6-Jun-19

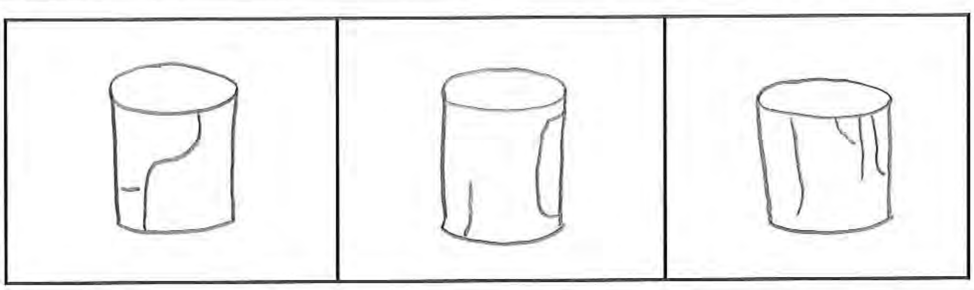
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G19-025

Specimen ID:	Test 4	Test 5	Test 6
	LB-1	LB-2	LB-2
	RC - 393-398 feet	RC - 160-165 feet	RC - 205-210 feet
Soil Class:			
Dry Density (pcf):	112.1	115.1	111.2
Water Content:	17.2%	15.1%	16.9%
Sample Dia. (mm):	44.7	44.5	44.9
Sample Ht (mm):	91.2	89.4	90.2
Height/Diameter:	2.04	2.01	2.01
Unc. Strength (psf):	**30776**	**27159**	**11160**
Strain at Failure (%):	2.8	2.1	2.8





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING
ZGE 15-102

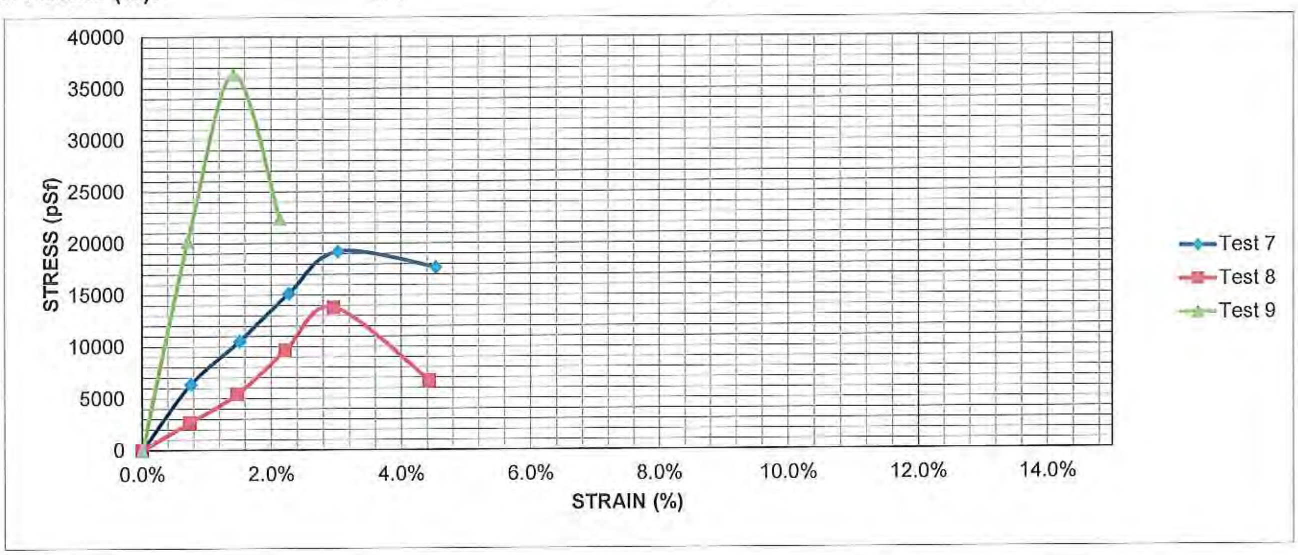
DATE: 6-Jun-19

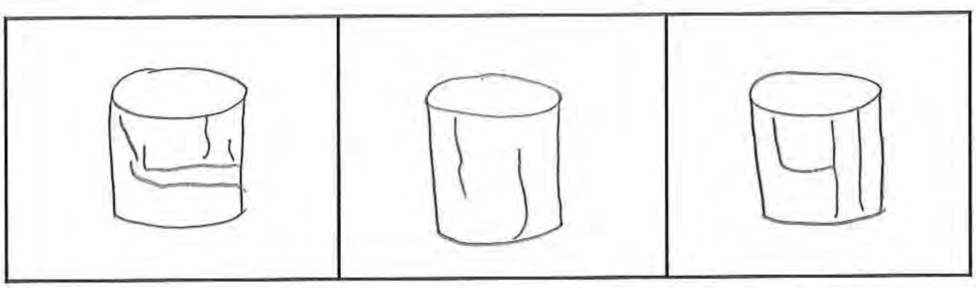
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G19-025

Specimen ID:	**Test 7** LB-2 RC - 265-270 feet	**Test 8** LB-2 RC - 360-365 feet	**Test 9** LB-2 RC - 395-400 feet
Soil Class:			
Dry Density (pcf):	119.6	114.6	109.5
Water Content:	14.6%	18.4%	18.1%
Sample Dia. (mm):	43.9	45.1	44.7
Sample Ht (mm):	84.1	86.0	89.5
Height/Diameter:	1.91	1.91	2.00
Unc. Strength (psf):	**19238**	**13841**	**36379**
Strain at Failure (%):	3.0	3.0	1.4





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by ____________

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING
ZGE 15-102

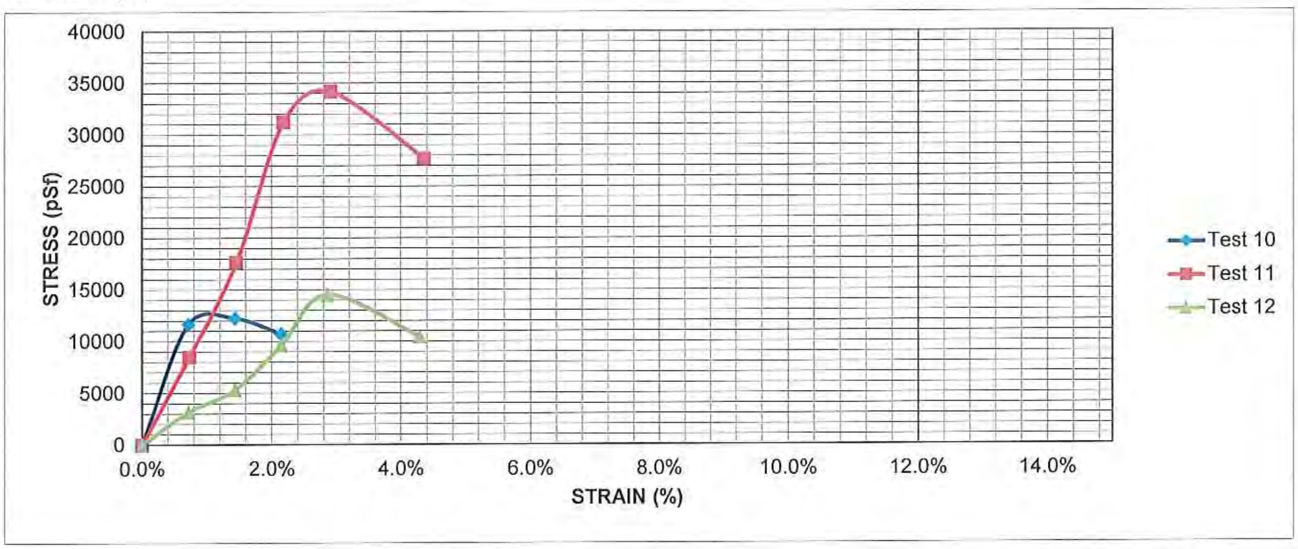
DATE: 6-Jun-19

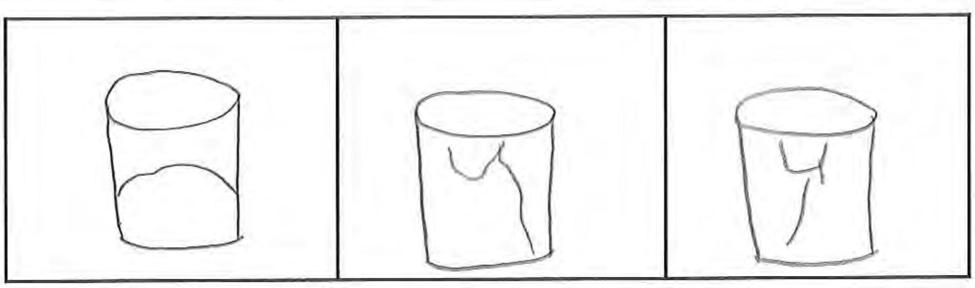
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G19-025

Specimen ID:	**Test 10** LB-3 RC -257-262 feet	**Test 11** LB-3 RC - 297-302 feet	**Test 12** LB-3 RC - 362-367 feet
Soil Class:			
Dry Density (pcf):	108.8	113.8	116.1
Water Content:	17.8%	18.3%	17.2%
Sample Dia. (mm):	45.1	43.7	45.1
Sample Ht (mm):	88.9	87.3	88.9
Height/Diameter:	1.97	2.00	1.97
Unc. Strength (psf):	**12245**	**34215**	**14547**
Strain at Failure (%):	1.4	2.9	2.9





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

UNIFIED SOIL CLASSIFICATION SYSTEM

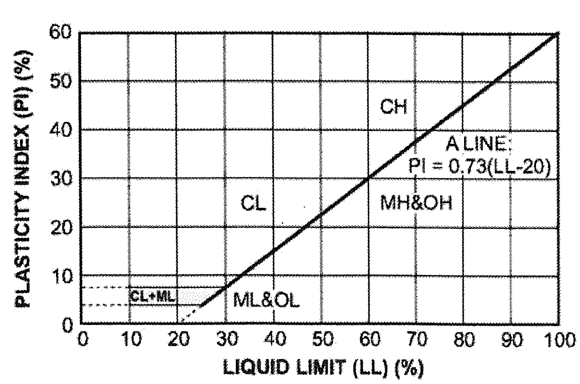
UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART		
COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

LABORATORY CLASSIFICATION CRITERIA		
GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent .... GW, GP, SW, SP
More than 12 percent .... GM, GC, SM, SC
5 to 12 percent .... Borderline cases requiring dual symbols

PLASTICITY CHART



LABORATORY TEST RESULTS

Testing Scope

Laboratory testing was proposed to characterize soils index properties including Atterberg limits (liquid and plastic limits) and moisture content. Strength testing included unconfined compression testing.

Index Properties

Testing and classification of soils was performed in accordance with the Unified Soil Classification System as described in ASTM D 2487. Atterberg limits were performed according to ASTM D 4318. Moisture content was determined in accordance with ASTM D 4959 and D 4643. The dry density was determined with direct measurement procedures. Mechanical sieve analysis was done in accordance with ASTM D 422.

Strength Testing

The strength tests consisted of unconfined compression (QU) testing. The QU tests were conducted in accordance with ASTM D 2166.

CCI and Associates, Inc.

Geotechnical Investigation Report – Water-Based Borings

WBI North Bakken Expansion Project

Lake Sakakawea/Missouri River

McKenzie and Williams County, North Dakota

Date:

July 9, 2020

Geotechnical Investigation Report – Water Based Borings

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Prepared for:
CCI and Associates, Inc.
20333 State Highway 249, Suite 480
Houston, Texas 77070

Prepared by:
Groundwater & Environmental Services, Inc.
1301 Corporate Center Drive, Suite 190
Eagan, Minnesota 55121
TEL: 800-735-1077
www.gesonline.com

Nicholas J. Schlagel
Staff Environmental Scientist

James F. Simonet
Senior Project Hydrogeologist

Robert E. Jenson, CHMM
Principal Scientist/Operations Manager

ANTHONY P. FRANCIS
REGISTERED
PROFESSIONAL
8204
ENGINEER
NORTH DAKOTA

Anthony Frances, PE
Geotechnical Engineering
Material Testing Services, LLC.

Table of Contents

References

Figures

Tables

Appendices

Acronyms

ASTM	American Society for Testing and Materials
CCI	CCI and Associates, Inc.
ESC	Erickson Contract Surveying, Inc.
GES	Groundwater & Environmental Services, Inc.
HDD	horizontal directional drilling
HAS	hollow-stem auger
IDS	Interstate Drilling Services, LLP
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NDGFD	North Dakota Game and Fish Department
MTS	Material Testing Services, LLC
TGCRA	Tobacco Garden Creek Recreation Area
USACE	US Army Corp of Engineers

1 Introduction

This report presents the results of the geotechnical investigation that was performed by Groundwater and Environmental Services, Inc. (GES) for the project known as the WBI North Bakken Expansion Project in western North Dakota. Specifically, this report covers the geotechnical exploration at 6 water-based soil borings located along the proposed horizontal directional drilling (HDD) pipeline project under Lake Sakakawea/Missouri River (**Figure 1**). The proposed pipeline alignment under Lake Sakakawea is located approximately 1 mile northeast of the Tobacco Garden Creek Recreation Area (TGCRA). The TGCRA is located approximately 23 miles northeast of Watford City, North Dakota.

Services for this investigation were performed in general accordance with the April 1, 2019 Services Contract by and between CCI and Associates, Inc. (CCI) and GES.

1.1 Project Location and Scope

The objective of this phase of the geotechnical investigation is to assist CCI with evaluating the subsurface conditions at 6 water-based boring locations (WB-4 through WB-9) located along the proposed HDD pipeline alignment in Lake Sakakawea.

The scope of work included the following:

- Prepare a site-specific health and safety plan for GES employees and subcontractors for the proposed geotechnical investigation activities.
- Coordinate field activities and communication with project team and CCI.
- Participate in a pre-construction meeting with the Garrison Project Natural Resource Office of the US Army Corp of Engineers (USACE), TGCRA stakeholders, GES project team and WBI Energy representatives.
- Arrange for an inspection of all equipment entering the Lake by the North Dakota Game and Fish Department (NDGFD). Provide proof that equipment has been cleaned of aquatic nuisance species, mud, standing water and aquatic vegetation.
- Arrange for utility clearance through North Dakota One Call.
- Install crane mat protection along shoreline at barge assembly area located within the TGCRA.
- Mobilize the drilling team (Interstate Drilling Services, LLP (IDS)) and assembly and deploy the barge.
- Advance 6 water-based soil borings and collect samples at designated locations
- Clean barge sections and boats during final demobilization.

- Contract laboratory tests on soil samples obtained from the 6 water-based soil borings to evaluate physical properties.
- Provide a written geotechnical report.

Photographs taking during the project are provided in **Appendix A.**

2 Methods

2.1 Soil Borings

GES contracted with IDS of Grand Forks, North Dakota, to assemble the barge and advance the 6 water-based soil borings (**Figure 1**). IDS used a Diedrich D-50 track-mounted drill rig to advance the borings and collect soil samples.

The barge was deployed at the TGCRA at a location adjacent to the north side of the low-water boat ramp. Prior to deployment, crane mats, consisting of wood timbers were placed on the beach from the gravel driveway to approximately 5 feet from the water line in order to allow the crane to drive down to the water's edge while protecting the beach area and bank from damage. A 6" wattle was placed along the lake shore between the crane pad and water for erosion protection. The crane pad location is provided on **Figure 2**.

The crane pad was installed on May 4, 2020 and the crane, barge sections, push boat, drilling rig, equipment and supplies were mobilized to the TGCRA on May 5th.

Prior to placing into the lake, the barge sections and push-boat were power-washed and inspected for aquatic nuisance species by the NDGFD, per the USACE Permit DACW45-3-17-8010. A copy of the inspection is provided in **Appendix B**. Once approved by the NDGFD, the barge sections were placed into the lake and assembled. The barge consisted of six 10'x40' sections. Loading of the drilling rig, equipment and supplies onto the barge was completed on May 6th.

The barge was directed over the boring locations with assistance from Erickson Contract Surveying, Inc. (ECS) of Sidney, Montana. The boring locations were located via boat using a handheld GPS system and then demarcated with a 14" diameter red buoy. The buoys were deployed approximately 50 feet from the proposed pipeline alignment. Once the barge reached the buoy, ECS personnel collected a second measurement of the actual boring location. The borehole locations and mudline elevations using North Dakota – North, State Plane datum (NAD 83, 2011) are provided in **Table 1**. The water elevation for Lake Sakakawea during the project was generally stable at approximately 1,841 feet (NAVD88).

Table 1 - Borehole Locations

Bore Hole	Easting	Northing	Mudline Elevation (feet)	Latitude	Longitude
WB-4	1335963.13	420346.33	1,811.7	N48°07'23.30"	W103°05'25.93
WB-5	1336623.75	422154.16	1,811.7	N48°07'42.24"	W103°05'15.52
WB-6	1337159.16	424253.25	1,811.9	N48°08'02.38"	W103°05'10.74
WB-7	1337758.65	425801.28	1,811.7	N48°08'17.93"	W103°05'01.65
WB-8	1338402.89	428621.66	1,812.7	N48°08'45.61"	W103°04'53.93
WB-9	1338983.19	430083.96	1,813.0	N48°09'00.54"	W103°04'45.07

Borehole advancement began on May 6, 2020 and the last boring was completed on the evening of May 16, 2020. The drilling operation consisted of 2 crews each working 12-hour shifts on the 24-hour operation. Work stoppages, due to high wind conditions occurred on May 8th, May 9th, May 12th and May 13th.

A hollow-stem auger (HSA) was used to collect soil samples while boring through soft lake sediment. Once competent sediment was encountered; a closed loop, fluid rotary drilling method was used to advance the borings through the sediments. Rock coring drilling methodology was then used to reach each boring terminus.

All borings were advanced to a total depth of 300 feet below the lake mudline except for WB-7 which was advanced to 315 feet and WB-9 which was advanced to 310 feet below the mudline. Upon completion, each boring was sealed from the boring terminus to the lake mudline with a concrete/bentonite slurry through a tremie rod.

During the fluid rotary drilling process, the spent drilling fluid was captured and run through a Mud Puppy 255 that removed drill cutting sand and grit from the drilling fluid, allowing the drilling fluid to be returned to the drilling operation. This process greatly reduced overall waste generation during the drilling process. Drilling cuttings and sediment were containerized for disposal and transported to the Grand Forks Landfill (Permit IT-202) located at 2701 North 69th Street, Grand Forks, North Dakota.

During HSA and fluid rotary methodologies, 1.5-foot samples were collected at 5 foot intervals using a split-spoon sampler in accordance with American Society for Testing and Materials (ASTM) D1586 (*Standard Test Method for Standard Penetration Test [SPT] and Split-Barrel Sampling of Soils*) using a 2-inch diameter split-spoon sampler. During rock coring drilling methodology, samples were generally collected at 5-foot sample intervals continuously in accordance with ASTM D2113 (*Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration*) using a using a NQ3 size, triple-tube core barrel with a diamond bit.

Soils were classified in the field by a GES field geologist using ASTM Visual-Manual procedures (ASTM D2488, *Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]*). The field geologist also collected samples from the split-spoon sampler and rock core sampler for geotechnical laboratory testing.

The boring logs and standard boring classification guidelines are contained in **Appendix C**.

2.2 Laboratory Testing

GES contracted with Material Testing Services, LLC (MTS) of Minot, North Dakota to provide geotechnical laboratory testing and evaluation services to aid in classifying and evaluating the physical properties of the soil/rock samples. Soil/rock sample selection and laboratory test parameters were determined by CCI.

The laboratory testing included the following:

- Moisture Content (ASTM D4959 - Standard Test Method for Determination of Water Content of Soil by Direct Heating and D4643 - Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating).
- Sieve Analysis (ASTM D422 – Test Method for Particle-size Analysis of Soils).
- Atterberg Limits (ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils).
- Unconfined Compression Testing (ASTM D2166 – Standard Test Method for Unconfined Compressive Strength of Cohesive Soils).

The laboratory data and reports are provided in **Appendix D.**

3 Site Conditions

The proposed HDD pipeline crossing traverses southwest to northeast across Lake Sakakawea approximately 1 mile northeast of the TGCRA. The physiographic regions where the proposed HDD pipeline crossing is located consist of the McKenzie Upland Unit, located south of the Missouri River and the Coteau Slope Unit, located north of the Missouri River. These units are part of the Great Plains and characterized by rolling to hilly plains with both erosional and glacial landforms. The proposed HDD crossing is located within the historic Missouri River floodplain that was flooded with the construction of the Garrison Dam in 1956 to form Lake Sakakawea. This area is located in the central portion of the Williston Basin.

The surface geology in the area consists of thin layers of glacial deposits underlain by the Paleocene-Aged Sentinel Butte Formation and the Bullion Creek Formation. The Sentinel Butte Formation consists of layers of silt, clay, sand, lignite, carbonaceous shale, and mudstone (Carlson, 1985). The Bullion Creek Formation underlies the Sentinel Butte Formation and consists of yellowish layers of silt, clay, and sand with interbedded sandstone, lignite, baked clay, and limestone (Bluemle, 1977). Both formations are poorly lithified and form rolling topography over broad areas of Western North Dakota. The Sentinel Butte Formation outcrops along the north south shoreline of the Missouri River near WB-4 and both the Sentinel Butte and Bullion Creek Formations outcrop along the north shoreline of the Missouri River near WB-9 (Bluemle, 1977).

Soil borings WB-4 through WB-9 generally consist of silts and poorly graded sands and gravels in the upper portions of the borings, consistent with more recent alluvial deposits originating from the Missouri River. These alluvial deposits extend to approximately 45 feet below the mudline in borings WB-4 and WB-9, and to approximately 220 below the mudline at boring WB-7. Underlying the more recent alluvial deposits are deposits of the Sentinel Butte and Bullion Creek Formations.

4 Limitations

The data generated and conclusions and opinions provided are based on the scope of work performed. All work was conducted in a manner consistent with currently accepted geotechnical engineering practices exercised by members of the profession practicing under similar conditions. No other warranty, expressed or implied, is made.

The samples collected and described in this report are representative of the subsurface conditions at the sampled locations and intervals, and therefore, do not necessarily reflect strata variations that may exist between sampled intervals and locations. If variations from the subsurface conditions described in this study are noted during additional investigations and/or construction, recommendations in this report must be re-evaluated.

GES is not responsible for the independent conclusions, opinions, or recommendations made by others based on the data presented in this report. Nor can GES warrant that this report will satisfy the dictates of or provide a legal defense in connection with an environmental law or regulation.

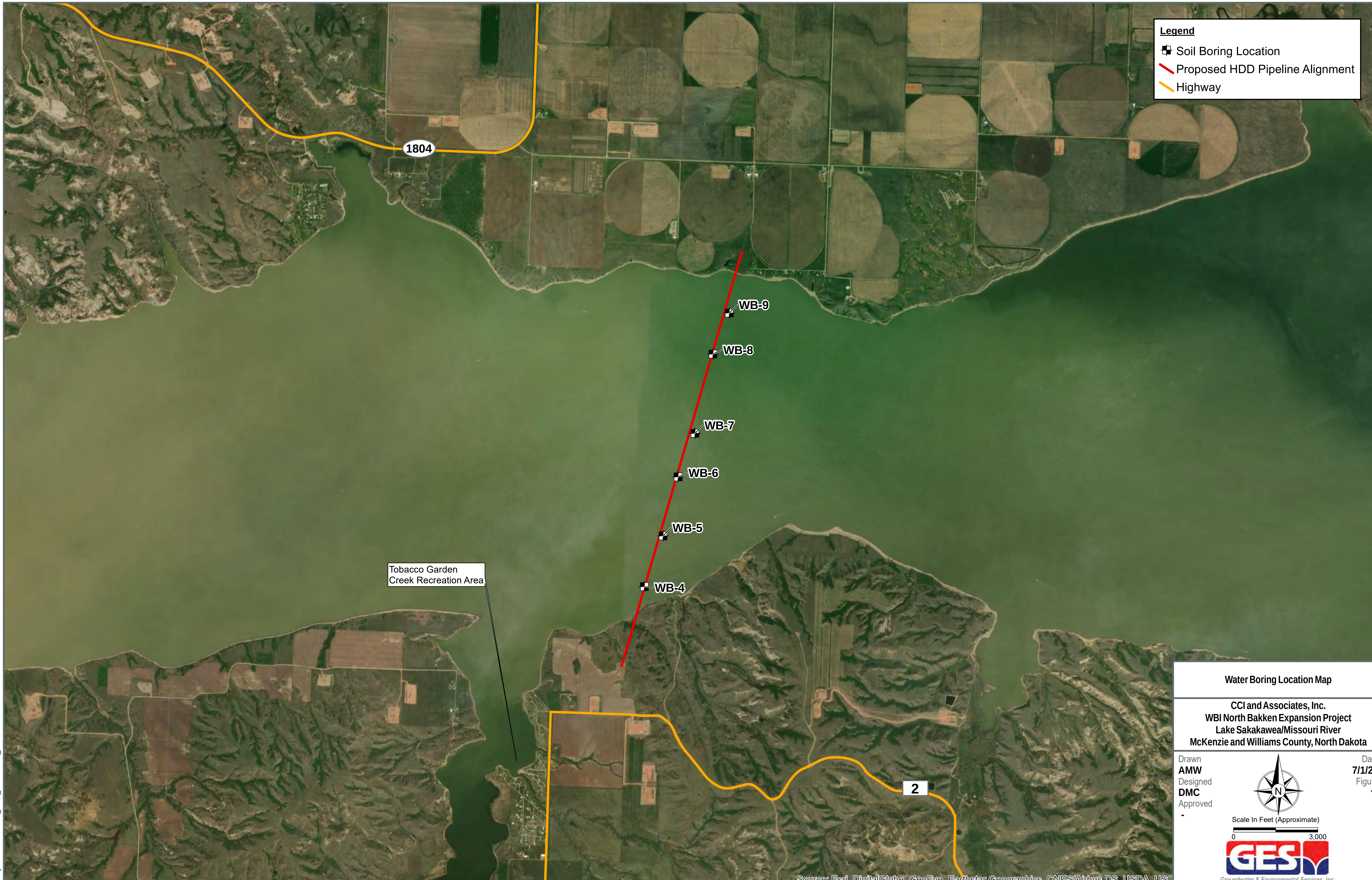
The results reported and any opinions reached by GES are for the benefit of the CCI & Associates and their client and unless agreed to by GES in writing, are not to be disclosed to or relied upon by any third party. The results and opinions set forth by GES in this report will be valid as of the date of the report.

References

Bluemle, J.P. 1977. *Geologic Highway Map of North Dakota*. North Dakota Geological Survey Educational Series 11, Miscellaneous Map 19.

Carlson, Clarence G. 1985. *Geology of McKenzie County, North Dakota.* North Dakota Geological Survey, Bulletin 80 – Part 1 and North Dakota State Water Commission, County Groundwater Studies 37 – Part 1.

Figures



L:\Projects\CCI\GIS\CCI_Lake_Sakakawea_SBLM.mxd - Scale 1:36,000 - 7/1/2020 3:53:16 PM - dcleland - NAD 1983 StatePlane North Dakota North FIPS 3301 Feet

L:\Projects\CCI\GIS\CCI_Lake_Sakakawea_Barge Area.mxd - Scale 1:1,774 - 7/1/2020 5:04:52 PM - dcleland - NAD 1983 StatePlane North Dakota North FIPS 3301 Feet

Appendix A – Photographic Documentation Boring Logs

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
View of low-water boat ramp and location of crane mat area before mobilization

Direction of View:
Southeast

Date Taken:
04/29/2020

Description:
View of low-water boat ramp location of crane mat area before mobilization

Direction of View:
Westward

Date Taken:
04/29/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Placing crane mats in preparation of mobilizing barge

Direction of View:
Westward

Date Taken:
05/04/2020

Description:
Completion of crane pad area

Direction of View:
Southeast

Date Taken:
05/04/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Positioning of crane in preparation of barge mobilization

Direction of View:
Westward

Date Taken:
05/05/2020

Description:
Lifting first barge section to the water

Direction of View:
Westward

Date Taken:
05/05/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Placing the barge winch on the barge

Direction of View:
Northwest

Date Taken:
05/05/2020

Description:
Placement of drilling rig on barge

Direction of View:
Northwest

Date Taken:
05/05/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Placement of push boat in Lake

Direction of View:
Northeast

Date Taken:
05/05/2020

Description:
Placement of Spud on Barge

Direction of View:
Northward

Date Taken:
05/05/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
View of drilling rig and barge deck

Date Taken:
05/06/2020

Description:
Overhead view of barge

Date Taken:
05/06/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
View of barge deck and two spill kit barrels

Direction of View:
Port side of barge

Date Taken:
05/06/2020

Description:
Photo of Mud Puppy mud recycling unit and secondary containment

Direction of View:
Starboard side of barge

Date Taken:
05/06/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Barge deck and portable light towers in secondary containment

Direction of View:
At bow of barge

Date Taken:
05/07/2020

Description:
Drilling Rig preparing to begin at WB-5

Date Taken:
05/07/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Completing boring WB-9

Date Taken:
05/15/2020

Description:
Demobilization of equipment

Direction of View:
Northwest

Date Taken:
05/19/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Demobilization of drilling rig

Direction of View:
Northwest

Date Taken:
05/19/2020

Description:
Demobilization of equipment

Direction of View:
Northwest

Date Taken:
05/19/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Removal of push boat from water

Direction of View:
Northwest

Date Taken:
05/19/2020

Description:
Removal of barge sections during demobilization

Direction of View:
Eastward

Date Taken:
05/19/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Pressure washing barge sections during demobilization

Direction of View:
Eastward

Date Taken:
05/19/2020

Description:
Preparing to remove crane from crane pad during demobilization

Direction of View:
Southeast

Date Taken:
05/19/2020

Site Photographs

WBI North Bakken Expansion Project
Lake Sakakawea/Missouri River
McKenzie and Williams County, North Dakota

Description:
Low water boat ramp and crane pad area after completion of demobilization

Direction of View:
Northwest

Date Taken:
05/19/2020

Description:
Low water boat ramp and crane pad area after completion of demobilization

Direction of View:
Southeast

Date Taken:
05/19/2020

Appendix B – Aquatic Nuisance Species Inspection

ANS INSPECTION REPORT - For equipment brought into or to be used in North Dakota
NORTH DAKOTA GAME AND FISH DEPARTMENT
FISHERIES DIVISION

Company name: Interstate Drilling **Contact:** Mike Zak	**E-mail address:** mikez@interstatedrilling.com	**Phone number:** (701) 741-9951

Water body: Lake Sakakawea **Location:** Tobacco Gardens
Equipment inspected: 6 barge sections, 1 tugboat, various aquatic equipment

Where equipment was last used

Tugboat and four sections of barge last used on Missouri River near Boonville, Mo (taken out 4/20/20)
One barge section has been sitting since December of 2019 – Rock River, Rock Island, IL (taken out DEC 2019)
One barge section has been sitting since August of 2019 – Missouri River, Nebraska City, NE (take out AUG 2019)

ANS Precautions used prior to equipment entering North Dakota

All barge sections were pressure washed with hot water prior to entering North Dakota. Additionally, barge sections and tugboat were dried for 2 weeks to 8 months.

Actual physical and visual ANS inspection

Barge section 1 – few very dry byssal threads found. No limpets or ZM. Cleared for launch.
Barge section 2 – numerous dried byssal threads and 2 dead zebra mussels found, all very dry. Required additional cleaning and inspection.
Barge section 3 – some byssal threads. No mussels or limpets. Cleared for launch.
Barge section 4 slanted – very few byssal threads. Cleared for launch.
Barge section 5 – no attached organism and very few dry byssal threads. Cleared for launch.
Barge section 6 – no attached organic material. Cleared for launch.
Tugboat – no byssal threads or mussels found on the outside of the boat. Required additional cleaning because it was not washed before entering North Dakota. Inside of tugboat does not take on water. No standing water or organics found inside, so did not require additional cleaning or disinfection inside.

Additional comments or notes:

One section of barge and the tugboat were power washed under supervision and were re-inspected. These were cleared to be put into Sakakawea.
Zebra mussels observed had desiccated organs, indicating that they were not alive. It is likely that the pressure washing in Missouri utilized hot water or the two week plus drying period allowed the mussels to die.
Crane did not get put in water – no inspection required.

Status:	**NDGF representative:**	**Date:**
Approved	Ben Holen, ANS Coordinator	5/5/2020

Barge section 2 and zebra mussel that was discovered on it.

Left: Pressure washing the tugboat. Right: Inside of tugboat. No standing water was present.

Line of barges.

Appendix C – Boring Logs

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-4**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/9/20 through 5/10/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/10/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
0				CL-ML: SILTY CLAY, with trace fine grained sand, very dark gray (5Y 3/1), very moist, soft.							
15	1	6 in.	2-2-2		0.25						
20	2	8 in.	1-12	SP: POORLY GRADED SAND, fine grained, dark gray (5Y 4/1), wet, very loose.	-						
25	3	15 in.	1-1-1		-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/9/20 through 5/10/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/10/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
30	4	10 in.	4-6-4	With trace medium grained sand and loose at 29.5 ft.	-						
35	5	10 in.	2-2-1		-						
40	6	10 in.	7-5-6	SP: POORLY GRADED SAND, medium to coarse grained, with little fine gravel, with trace small lignite pieces, olive (5Y 4/3), wet, medium dense.	-						
45	7	7 in.	4-4-6	SPG: POORLY GRADED SAND WITH GRAVEL, coarse grained with fine gravel, olive (5Y 4/3), wet, loose.	-						5.4
50	8	6 in.	6-9-11	SP: POORLY GRADED SAND, fine to medium grained, dark gray (5Y 4/1), wet, medium dense.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-4**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/9/20 through 5/10/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/10/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**

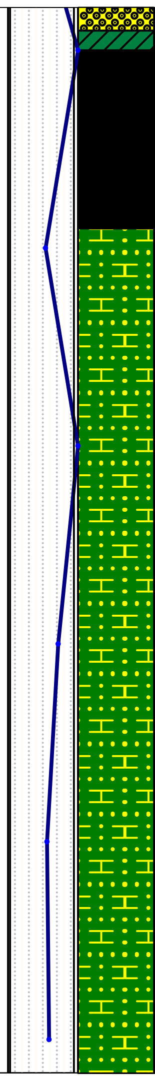
Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
				CL: LEAN CLAY, with little lignite, very dark gray (5Y 3/1), moist, hard.							
55	9	9 in.	10-50/ 5"	Coal: Lignite coal, black (5Y 2.5/1).	4.5						
60	10	18 in.	17-28-26	CL-ML: SILTY CLAY, gray (5Y 5/1), moist, hard.	4.5	18	40	22		19.4	
65	11	6 in.	50/3"		4.5						
70	12	18 in.	13-29-43		4.5						97.1
75	13	0 in.	14-23-33		-						
80	14	18 in.	24-2-37		4.5	19	31	13		19.1	



Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/9/20 through 5/10/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/10/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
			0	Shale: Highly weathered to overconsolidated silty clay, gray (5Y 6/1), moist, hard.							
	15	1 in.	0								
85	16	2 in.									
			85								
90	17	59 in.			3.3				108.6	22.1	
			100								
95	18	60 in.									
			73								
100	19	50 in.									
			0	Coal: Lignite, black (5Y 2.5/1).							
105	20	41 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

Project: WBI North Bakken Exp. Proj. Lake Sakakawea, ND
Client: CCI & Associates Inc.

Address: NA
GES Job #: 3502056

County: McKenzie
GES Project Mgr: Rob Jenson

Logged By: Nick Schlagel
Date Drilled: 5/9/20 through 5/10/20
Soil Classification System: USCS

Drilling Company: Interstate Drilling Services
Completion Date: 5/10/20

Drill Operator: Jared Zak
Drilling Method: HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)

Drill Rig Type: Diedrich D50
Sampling Method: Split Spoon & NQ Rock Core

Borehole Diameter: 8 in. to 4 in.
Surface Elevation: 1,812 ft. msl
Abandonment Method: Tremie

Total Depth: 300 ft.
Approximate Water Depth: Not Encountered
Backfill Material: Portland Cement

Refusal Depth: NA
Abandonment Completion Date: 5/10/20

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
110	21	60 in.		With some coarse sand from 110.5 to 112.5 ft.							
			0								
115	22	51 in.									
			0								
120	23	60 in.									
			0								
125	24	60 in.									
			78	Shale: Highly weathered to overconsolidated silty clay, gray (5Y 6/1), moist, hard.							
130	25	57 in.			11.3				113.7	15.2	
			83								

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-4**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/9/20 through 5/10/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/10/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
135	26	50 in.	93								
140	27	58 in.	85	Lignite seam 3 in. thick at 143 ft.							
145	28	55 in.	87	Lignite seam 2 in. thick at 145 ft.							
150	29	60 in.	95		17.6				118.9	15.5	
155	30	60 in.	0	SP: POORLY GRADED SAND, fine grained, gray (5Y 5/1).							
160	31	0 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-4**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/9/20 through 5/10/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/10/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
			0								
165	32	0 in.									
			0								
170	33	0 in.									
			0								
175	34	0 in.									
			7								
180	35	38 in.		Coal: Lignite, black (5Y 2.5/1).							
			85	Shale: Highly weathered to overconsolidated clay, gray (5Y 5/1), moist, hard.							
185	36	60 in.			23.8				115.1	19.1	
				Coal: Lignite, black (5Y 2.5/1).							
			87	Shale: Highly weathered to overconsolidated clay, gray (5Y							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/9/20 through 5/10/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/10/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
				5/1), moist, hard.							
190	37	60 in.									
			85	Lignite seam 6 in. thick at 192 ft.							
				CL: LEAN CALY, with fine grained sand, gray (5Y 5/1), moist, hard.							
195	38	58 in.		Coal: Lignite, black (5Y 2.5/1).							
				SM: SILTY SAND, fine grained, gray (5Y 5/1), moist, very dense.							
			83	Shale: Highly weathered to overconsolidated clay, gray (5Y 5/1), moist, hard.							
200	39	57 in.									
				Coal: Lignite, black (5Y 2.5/1).							
			100	CL: LEAN CLAY, with trace fine grained sand, consolidated, to highly weathered shale, gray (5Y 5/1), moist, hard.							
205	40	60 in.									
			27	SP: POORLY GRADED SAND, fine grained, with trace silt, gray (5Y 5/1) moist, very dense.							
210	41	24 in.		Seam of consolidated clay 6 in. thick at 210 ft.							
			10								
215	42	44 in.									

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/9/20 through 5/10/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/10/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
			50	Coal: Lignite, black (5Y 2.5/1).							
220	43	45 in.		CL: LEAN CLAY, consolidated, to highly weathered shale, gray (5Y 5/1), moist, hard.							
			93								
225	44	60 in.		Sandstone: Fine grained, weakly cemented, with some silt, gray (5Y 5/1), moist, very dense.							
			97								
230	45	60 in.									
			88	Shale: Highly weathered, gray (5Y 5/1), moist, hard.							
235	46	54 in.		Trace lignite less than 1 in. thick at 234 ft.							
			100	Color turns to dark gray (5Y 5/1) at 237.5 ft.							
240	47	60 in.			5.7				113.9	15.2	
				Siltstone: With trace fine grained sand, weakly cemented, dark gray (5Y 4/1), moist, very dense.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-4**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client: **CCI & Associates Inc.**
Address: **NA**	GES Job #: **3502056**
County: **McKenzie**	GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel**	Date Drilled: **5/9/20 through 5/10/20**	Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services**	Completion Date: **5/10/20**	
Drill Operator: **Jared Zak**	Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**	
Drill Rig Type: **Diedrich D50**	Sampling Method: **Split Spoon & NQ Rock Core**	

Borehole Diameter: **8 in. to 4 in.**	Surface Elevation: **1,812 ft. msl**	Abandonment Method: **Tremie**
Total Depth: **300 ft.**	Approximate Water Depth: **Not Encountered**	Backfill Material: **Portland Cement**
Refusal Depth: **NA**		Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
				Sandstone: Fine grained, weakly cemented, with some silt, dark gray (5Y 4/1), moist, very dense.							
245	48	60 in.									
			100								
250	49	60 in.			4.9				107.5	19.1	
			100								
255	50	60 in.									
			100								
260	51	60 in.									
			92								
265	52	57 in.									
			75								

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-4**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/9/20 through 5/10/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/10/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
270	53	45 in.		Seam of trace thin lignite laminations less than 1 in. thick from 269.5 to 270 ft.	4.5				109.4	18.6	
			100								
275	54	60 in.									
			0	Coal: Lignite, black (5Y 2.5/1).							
280	55	60 in.									
			0								
285	56	24 in.									
			93	Shale: Highly weathered, dark gray (5Y 4/1), moist, hard.							
290	57	60 in.			12.4				107.6	20.0	
			78								
				Coal: Lignite, black (5Y 2.5/1).							
295	58	60 in.		Shale: Highly weathered, dark gray (5Y 4/1), moist, hard.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-4**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel**	Date Drilled: **5/9/20 through 5/10/20**	Soil Classification System: **USCS**	
Drilling Company: **Interstate Drilling Services**	Completion Date: **5/10/20**		
Drill Operator: **Jared Zak**	Drilling Method: **HSA (0 to 81 ft.) and NQ Rock Core (81 to 300 ft.)**		
Drill Rig Type: **Diedrich D50**	Sampling Method: **Split Spoon & NQ Rock Core**		

Borehole Diameter: **8 in. to 4 in.**	Surface Elevation: **1,812 ft. msl**	Abandonment Method: **Tremie**
Total Depth: **300 ft.**	Approximate Water Depth: **Not Encountered**	Backfill Material: **Portland Cement**
Refusal Depth: **NA**		Abandonment Completion Date: **5/10/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
300	59	30 in.	100	EOB at 300 ft. Target depth reached.	11.1				105.9	21.1	

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 23.30"

Lon: 103° 5' 25.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-5**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
0				ML: SILT, with trace clay, dark gray (5Y 4/1), wet, medium stiff.							
14	1	18 in.	3-3-4	SM: SILTY SAND, fine grained, olive gray (5Y 4/2), wet, loose.	0.25						
19				SP: POORLY GRADED SAND, fine grained, with trace silt, dark gray (5Y 4/1), wet, loose.							
20	2	18 in.	2-3-3		-						
24				With trace coarse grained sand at 24 ft.							
25	3	18 in.	2-3-4		-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-5**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
30	4	18 in.	2-4-6	Fine to medium grained with trace coarse gained at 29 ft.	-						
35	5	0 in.	2-2-3	SPG: POORLY GRADED SAND WITH GRAVEL, coarse grained with fine gravel, dark gray (5Y 4/1), wet, loose.	-						
40	6	1 in.	4-4-4		-						
45	7	6 in.	10-7-6	With medium to coarse graind sand and medium dense at 44 ft.	-						7.7
50	8	4 in.	4-4-4	With trace medium to coarse graind sand and loose at 49 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-5**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
55	9	6 in.	9-14-14	With few medium to coarse graind sand and medium dense at 54 ft.	-						
60	10	16 in.	10-6-40	SPG: POORLY GRADED GRAVELLLY SAND, medium to coarse grained, dark gray (5Y 4/1), moist, dense.	-						
				CL: LEAN CLAY, consolidated, with trace silt, very dark gray (5Y 3/1), moist, very stiff.							
65	11	18 in.	10-13-17		3.75	22	47	25		28.0	
	12	16 in.	10								
70											
	13	24 in.	28	Coal: Lignite, black (2.5Y 2.5/1).							
75				NO RECOVERY (suspect same noncohesive material as below) from 74 to 79 ft.							
	14	0 in.	0								
80				SPG: POORLY GRADED GRAVELLLY SAND, fine grained, dark gray (5Y 4/1), moist, very dense.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
85	15	12 in.	12-24-36	CL-ML: SILTY CLAY, dark gray (5Y 4/1), moist, hard.	4.5						
90	16	18 in.	20-28-33		3.0						
95	17	18 in.	15-18-13	SPG: POORLY GRADED GRAVELLLY SAND, fine grained, dark gray (5Y 4/1), moist, dense. CL-ML: SILTY CLAY, with 2 in. thick coal seam at 95.5 ft., dark gray (5Y 4/1), moist, hard.	-						
100	18	18 in.	16-17-18	SC: CLAYEY SAND, fine grained, dark gray (5Y 4/1), moist, dense. ML: SILT, with trace clay, dark gray (5Y 4/1), moist, hard.	-						
105	19	18 in.	13-16-26	SC: CLAYEY SAND, fine grained, with trace silt, dark gray (5Y 4/1), moist, dense.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-5**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client: **CCI & Associates Inc.**
Address: **NA**	GES Job #: **3502056**
County: **McKenzie**	GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel**
Date Drilled: **5/7/20 through 5/8/20**
Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services**
Completion Date: **5/8/20**
Drill Operator: **Jared Zak**
Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**
Drill Rig Type: **Diedrich D50**
Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.**
Surface Elevation: **1,812 ft. msl**
Abandonment Method: **Tremie**
Total Depth: **300 ft.**
Approximate Water Depth: **Not Encountered**
Backfill Material: **Portland Cement**
Refusal Depth: **NA**
Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
											46.6
110	20	18 in.	16-17-10		-						
115	21	18 in.	9-13-14	CL-ML: SILTY CLAY, dark gray (5Y 4/1), moist, very stiff.	4.25						
120	22	11 in.	13-14-16	SP: POORLY GRADED SAND, fine to coarse grained, with trace silt, dark gray (5Y 4/1), wet, medium dense.	-						
125	23	18 in.	10-16-23	CL-ML: SILTY CLAY, dark gray (5Y 4/1), moist, hard.	4.25						
130	24	11 in.	43-50/3"	SP: POORLY GRADED SAND, fine grained, with trace silt, dark gray (5Y 4/1), wet, very dense.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-5**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
135	25	12 in.	15-16-16	With fine to coarse grained sand, with some fine gravel and silt and dense at 134.5 ft. Lignite seam 2 in. thick at 135 ft.	-						
140	26	6 in.	22-33-50/4"	Shale: Highly weathered, gray (2.5Y 5/1), moist, hard.	4.5						
145	27	0 in.	13-16-29		-						
150	28	17 in.	20-36-50/3"		4.5	16	35	19		18.1	
155	29	15 in.	20-39-50/4"		4.5						
160											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-5**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
	30	41 in.	53		2.5				108.2	66.2	
165											
	31	43 in.	38								
170											
	32	13 in.	13	ML: SILT, gray (2.5Y 5/1), moist, very dense.							
175				Coal: Lignite, black (5Y 2.5/1).							
	33	30 in.	18								
180				Shale: Highly weathered, gray (2.5Y 5/1), moist, hard.							
	34	58 in.	85		12.1				117.5	16.6	
				Lignite seam 2 in. thick at 184 ft.							
185				Lignite seam 5 in. thick at 184.5 ft.							
	35	60 in.	93								

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-5**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
190				Color tunrs to gray (5Y 5/1) at 190 ft. Lignite seam 2 in. thick at 190.5 ft.							
	36	60 in.	97								
195				With small fine to medium grained sand seams at 195 ft.							
	37	47 in.	75								
200				Coal: Lignite, black (5Y 2.5/1).							
				Shale: Highly weathered, gray (5Y 5/1), moist, hard.							
	38	59 in.	83		9.6				116.3	14.2	
				Coal: Lignite, black (5Y 2.5/1).							
				Shale: Highly weathered, gray (5Y 5/1), moist, hard.							
205											
	39	56 in.	88								
210											
	40	60 in.	100								
215											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
	41	50 in.	75								
220				Lignite seam 6 in. thick at 219.5 ft.							
	42	60 in.	90		4.1				105.8	19.2	
				Fine grained sand seam 2 in. think at 223.3 ft. Trace lignite at 224 ft.							
225				Color tunrs to dark gray (5Y 4/1) at 225 ft.							
	43	55 in.	87								
230											
	44	60 in.	100								
235											
	45	60 in.	100	With some fine grained sand from 237 ft. to 240 ft.							
240											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client: **CCI & Associates Inc.**
Address: **NA**	GES Job #: **3502056**
County: **McKenzie**	GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel**	Date Drilled: **5/7/20 through 5/8/20**	Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services**	Completion Date: **5/8/20**	
Drill Operator: **Jared Zak**	Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**	
Drill Rig Type: **Diedrich D50**	Sampling Method: **Split Spoon & NQ Rock Core**	
Borehole Diameter: **8 in. to 4 in.**	Surface Elevation: **1,812 ft. msl**	Abandonment Method: **Tremie**
Total Depth: **300 ft.**	Approximate Water Depth: **Not Encountered**	Backfill Material: **Portland Cement**
Refusal Depth: **NA**		Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
245				SP: POORLY GRADED SAND, fine grained, with trace silt and trace clay, dark gray (5Y 4/1), moist, very dense.							
	47	58 in.	92		3.3				107.9	17.0	
250				Slightly cohesive to weakly cemented at 250 ft. and below.							
	48	59 in.	98								
255											
	49	58 in.	97								
260											
	50	58 in.	97								
265											
	51	60 in.	97		2.0				108.8	20.5	
				Coal: Lignite, black (5Y 2.5/1).							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-5**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
270											
	52	60 in.	20								
275											
	53	30 in.	37	SP: POORLY GRADED SAND, fine grained, with trace silt and trace clay, slighly cohesive to weakly cemented, dark gray (5Y 4/1), moist, very dense.	8.7				106.5	20.2	
				Coal: Lignite, black (5Y 2.5/1).							
280				SP: POORLY GRADED SAND, fine grained, with trace silt and trace clay, slighly cohesive to weakly cemented, dark gray (5Y 4/1), moist, very dense.							
	54	60 in.	88								
285				CL: LEAN CLAY, with trace fine grained sand, consolidated, dark gray (5Y 4/1), moist, hard.							
	55	53 in.	78								
				Coal: Lignite, black (5Y 2.5/1).							
290				CL: LEAN CLAY, with trace fine grained sand, consolidated, dark gray (5Y 4/1), moist, hard.							
	56	60 in.	100								
295											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-5**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/7/20 through 5/8/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/8/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 66 ft.), Fluid Rotary (74 to 160 ft.), NQ Rock Core (66 to 74 and 160 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/8/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
	57	37 in.	62	EOB at 300 ft. Target depth reached.	6.4				106.7	21.6	
300											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 7' 42.24"

Lon: 103° 5' 15.52"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel**
Date Drilled: **5/10/20 through 5/12/20**
Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services**
Completion Date: **5/12/20**

Drill Operator: **Jared Zak**
Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50**
Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.**
Surface Elevation: **1,812 ft. msl**
Abandonment Method: **Tremie**

Total Depth: **300 ft.**
Approximate Water Depth: **Not Encountered**
Backfill Material: **Portland Cement**

Refusal Depth: **NA**
Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
0				SM: SILTY SAND, fine grained, very dark gray (2.5Y 3/1), wet, very loose.							
15	1	14 in.	1-2-1		-						
20	2	16 in.	3-9-9	Color turns to very dark grayish brown (2.5Y 3/2) and medium dense at 19.5 ft.	-						
25	3	4 in.	0-0-2	Very loose at 24.5 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

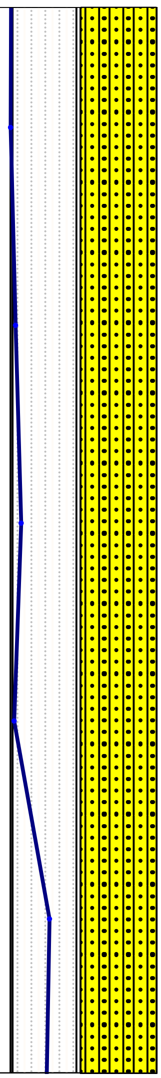
Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
30	4	5 in.	1-1-1		-						
35	5	6 in.	2-3-5	Loose at 34.5 ft.	-						
40	6	6 in.	4-11-5	Medium dense at 39.5 ft.	-						
45	7	10 in.	2-3-3	Loose with coarse grained sand and fine gravel seam 5 in. thick at 45 ft.	-						
50	8	13 in.	8-32-24	Very dense with angular coarse sand and gravel seam 7 in. thick at 50 ft.	-						10



Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
55	9	15 in.	11-21-30	Moist at 54.5 ft.	-						
60	10	14 in.	5-10-23	Dense at 59.5 ft.	-						
65	11	15 in.	5-10-18	Medium dense at 64.5 ft.	-						
70	12	17 in.	11-11-14	CL-ML: SILTY CLAY, dark gray (5Y 4/1), moist, very stiff.	3.75						
75	13	18 in.	8-11-20	SM: SILTY SAND, fine grained, dark gray (5Y 4/1), moist, medium dense.	3.75						
				CH: FAT CLAY, gray (5Y 5/1), moist, very stiff.							
80	14	17 in.	6-11-18		4.5	22	51	29			

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
85	15	18 in.	8-11-13		4.5						
90	16	18 in.	11-14-16		4.5						
95	17	18 in.	8-12-17	Color turns to dark gray (5Y 4/1) at 94.5 ft.	3.5						
100	18	18 in.	9-14-19	ML: SILT with some clay, gray (5Y 5/1), moist, dense.	3.5						
105	19	18 in.	13-18-26	SC: CLAYEY SAND, fine grained, with trace silt, dark gray (5Y 4/1), moist, dense.	1.5						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
110	20	18 in.	9-13-19	ML: SILT with trace clay, dark gray (5Y 4/1), moist, dense.	2.0	18	35	17		24.5	
115	21	14 in.	17-38-40	CL-ML: SILTY CLAY, gray (5Y 5/1), moist, hard.	4.5						
				SP: POORLY GRADED SAND, fine grained, gray (5Y 5/1), moist, very dense.							
120	22	18 in.	4-9-22	Fine to coarse grained, color turns to very dark grayish brown (2.5Y 3/2) and medium dense at 119.5 ft. Seam of lignite fragments 6 in. thick at 120.5 ft.	-						
125	23	10 in.	19-23-25	Dense at 124.5 ft.	-						
130	24	12 in.	16-24-25	With few gravel and color turns to dark olive brown (2.5Y 3/3) at 129.5 ft. and below.	-						6.4

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
135	25	13 in.	5-12-22	Wet at 134.5 ft. and below. Seam of lignite fragments 6 in. thick at 135.5 ft.	-						
140	26	13 in.	6-15-21		-						
145	27	18 in.	8-16-27		-						
150	28	12 in.	19-25-30	With lignite fragments and color turns to olive brown (5Y 4/2) at 149.5 ft.	-						
155	29	14 in.	23-24-28	Very dense at 154.5 ft.	-						
160	30	13 in.	29-38-38	Fine grained, color turns to gray (5Y 5/1) and very dense at 159.5 ft.	-						13.2

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
165	31	13 in.	29-31-41	With trace medium to coarse grained sand at 164.5 ft.	-						
170	32	13 in.	22-29-28		-						
175	33	12 in.	22-26-36	Fine to medium grained with trace coarse grains at 174.5 ft.	-						
180	34	8 in.	18-20-27	Medium to coarse grained with trace fine grains, color turns to olive brown (2.5Y 4/3) and dense at 179.5 ft.	-						
185	35	12 in.	22-29-37	Fine to medium grained, color turns to dark grayish brown (2.5Y 4/2) and very dense at 184.5 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

SOIL BORING LOG

GES Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
190	36	18 in.	22-31-29	Fine grained with trace medium grains, trace lignite fragments and color changes to dark olive gray (5Y 3/2) at 189.5 ft.	-						
195	37	9 in.	22-29-28	Fine to coarse grained with trace fine gravel and color turns to olive gray (5Y 4/2) at 194.5 ft.	-						6.7
200	38	17 in.	23-42-41	Fine to medium grained with fine grain sized lignite fragments and color turns to very dark gray (5y 3/1) at 199.5 ft. Coarse grained at 200.5 ft.	-						
205	39	10 in.	26-32-30	Fine to medium grained sand with trace fine gravel and color turns to olive (5Y 4/3) at 204.5 ft.	-						
210	40	10 in.	14-25-33	Color turns to olive gray (5Y 4/2) at 209.5 ft.	-						
215	41	14 in.	30-32-36	Fine to coarse grained with trace fine gravel and trace lignite fragments at 214.5 ft.	-						9.2

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
220	42	18 in.	16-24-30	Shale: Highly weathered, olive gray (2.5Y 4/2), moist, hard.	4.5						
225	43	18 in.	18-28-37	Color turns to dark gray (5Y 4/1) at 226 ft.	4.5					25.2	
	44	29 in.	60								
230	45	59 in.	78		8.0				102.7	23.1	
235	46	48 in.	62								
240											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
245											
	48	58 in.	77		4.6				110.8	18.2	
250											
	49	60 in.	87								
255											
	50	58 in.	40								
260											
	51	60 in.	85								
265				Coal: Lignite, black (2.5Y 2.5/1).							
	52	56 in.	10	Highly weathered shale seam 6 in. thick at 268.5 ft.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-6**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client: **CCI & Associates Inc.**
Address: **NA**	GES Job #: **3502056**
County: **McKenzie**	GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel**	Date Drilled: **5/10/20 through 5/12/20**	Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services**	Completion Date: **5/12/20**	
Drill Operator: **Jared Zak**	Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**	
Drill Rig Type: **Diedrich D50**	Sampling Method: **Split Spoon & NQ Rock Core**	

Borehole Diameter: **8 in. to 4 in.**	Surface Elevation: **1,812 ft. msl**	Abandonment Method: **Tremie**
Total Depth: **300 ft.**	Approximate Water Depth: **Not Encountered**	Backfill Material: **Portland Cement**
Refusal Depth: **NA**		Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
270											
				Shale: Highly weathered, dark gray (5Y 4/1), moist, hard.							
	53	52 in.	70								
275				Color turns to gray (5Y 5/1) at 275 ft.							
	54	60 in.	95								
280											
	55	60 in.	70								
				Coal: Lignite, black (5Y 2.5/1).							
285				Shale: Highly weathered, gray (5Y 5/1), moist, hard.							
	56	57 in.	95								
290											
	57	57 in.	95								
295											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 02.38"

Lon: 103° 5' 10.74"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**
Address: **NA** GES Job #: **3502056**
County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/10/20 through 5/12/20** Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services** Completion Date: **5/12/20**
Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 64.5 ft.), Fluid Rotary (64.5 to 226 ft.), NQ Rock Core (226 to 300 ft.)**
Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**
Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**
Refusal Depth: **NA** Abandonment Completion Date: **5/12/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
	58	59 in.	98		23.4				110.6	17.1	
300				EOB at 300 ft. Target depth reached.							

Notes:
Soil Lithologies based on field observations and laboratory analysis.
NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level
Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)
PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)
M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates
Lat: 48° 8' 02.38"
Lon: 103° 5' 10.74"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-7**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
0				SP: POORLY GRADED SAND, fine grained, with trace silt, very dark gray (2.5Y 3/1), wet, very loose.							
10	1	3 in.	0-0-1		-						
15	2	0 in.	WOH		-						
20	3	12 in.	2-1-1	Color turns to olive gray (5Y 4/2) at 19.5 ft.	-						
25	4	0 in.	WOH		-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-7**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	Atterbergs PL	Atterbergs LL	Atterbergs PI	G	S	M/C
30	5	18 in.	22-14-17	Medium dense at 29.5 ft.	-						
35	6	10 in.	1-2-1	Fine to medium grained with trace coarse grains, trace fine gravel and trace lignite fragments, very loose at 34.5 ft.	-						
40	7	9 in.	2-2-3	Loose at 39.5 ft.	-						
45	8	1 in.	7-8-11	GP: POORLY GRADED GRAVEL, coarse, olive gray (5Y 4/2), wet, medium dense.	-						
50	9	11 in.	8-9-10	SP: POORLY GRADED SAND, fine to medium grained, with trace lignite fragments, olive gray (5Y 4/2), wet, medium dense.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-7**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
55	10	14 in.	13-15-12	Fine grained with thin lignite laminations, color turns to dark gray (5Y 4/1) at 54.5 ft.	3.0						
				CL: LEAN CLAY, dark gray (5Y 4/1), moist, very stiff.							
60	11	18 in.	8-10-16	SM: SILTY SAND, fine grained, with trace clay, dark gray (5Y 4/1), wet, medium dense.	-					30.3	43.2
65	12	18 in.	1-5-8	SP: POORLY GRADED SAND, fine to medium grained, dark gray (5Y 4/1), wet, medium dense.	-						
70	13	18 in.	7-10-14	CL: LEAN CLAY, dark gray (5Y 4/1), moist, very stiff.	3.5						
75	14	18 in.	8-10-13		3.75	19	35	16		21.3	
80	15	18 in.	16-20-15	Hard at 79.5 ft.	3.5						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-7**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
85	16	18 in.	8-13-15	Very stiff at 84.5 ft.	4.0						
90	17	18 in.	8-19-22	Hard at 89.5 ft. SP: POORLY GRADED SAND, fine grained, dark gray (5Y 4/1), wet, dense.	3.5						
95	18	18 in.	3-10-28	Fine to medium grained at 94.5 ft.	-					27.0	8.0
100	19	17 in.	14-15-22	With trace lignite fragments and color turns to olive gray (5Y 4/2) at 99.5 ft. CL-ML: SILTY CLAY, with trace fine grained sand, olive gray (5Y 4/2), moist, hard.	-						
105	20	18 in.	9-13-20		2.5						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-7**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
110	21	18 in.	10-16-19		3.5						
115	22	18 in.	10-14-18		2.75	23	36	12		24.9	
120	23	12 in.	12-20-20	SP: POORLY GRADED SAND, fine to coarse grained, trace to few fine to medium gravel, trace silt and trace lignite fragments, olive gray (5Y 4/2), wet, dense.	-						
125	24	8 in.	12-20-18		-						
130	25	10 in.	16-22-22		-					13.3	6.5

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	Atterbergs PL	LL	PI	G	S	M/C
135	26	11 in.	17-24-26		-						
140	27	13 in.	21-44-50/5"	Very dense at 139.5 ft.	-						
145	28	13 in.	25-31-34	Fine to medium grained with trace silt at 144.5 ft.	-					18.6	13.3
150	29	11 in.	20-35-50/4"	Fine grained with trace silt, trace lignite fragments and color changes to black (2.5Y 2.5/1) at 149.5 ft.	-						
155	30	14 in.	25-48-41	Fine grained with trace silt and color turns to olive gray (5Y 4/2) at 154.5 ft.	-						
160	31	15 in.	17-22-22	Fine to medium grained with trace silt and trace lignite fragments and dense at 159.5 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client: **CCI & Associates Inc.**
Address: **NA**	GES Job #: **3502056**
County: **McKenzie**	GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel**	Date Drilled: **5/14/20 through 5/15/20**	Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services**	Completion Date: **5/15/20**	
Drill Operator: **Jared Zak**	Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**	
Drill Rig Type: **Diedrich D50**	Sampling Method: **Split Spoon & NQ Rock Core**	
Borehole Diameter: **8 in. to 4 in.**	Surface Elevation: **1,812 ft. msl**	Abandonment Method: **Tremie**
Total Depth: **315 ft.**	Approximate Water Depth: **Not Encountered**	Backfill Material: **Portland Cement**
Refusal Depth: **NA**		Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
165	32	16 in.	25-33-34	Fine grained with trace silt and very dense at 164.5 ft.	-					18.2	11.0
170	33	14 in.	21-32-38		-						
175	34	14 in.	19-23-36	Fine to coarse grained with trace silt and little lignite fragments at 174.5 ft.	-						
180	35	14 in.	26-30-30	Fine grained with trace silt at 179.5 ft.	-						
185	36	8 in.	30-50/6"	Fine to coarse grained with trace clay at 184.5 ft. Lignite lens 4 in. thick at 185 ft.	17.4				110.8	23.7	12.1

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
190	37	5 in.	20-25-34	Fine grained with trace silt and color changes to very dark gray (5Y 3/1) at 189.5 ft.	-						
195	38	6 in.	21-30-46		-						
200	39	14 in.	21-34-41	With trace lignite fragments at 199.5 ft.	-						
						23	37	14		13.1	
205	40	9 in.	49-50/6"		-						14.8
210	41	4 in.	50/4"	Shale: Highly weathered fragments, gray (2.5Y 6/1), moist, hard.	-						
215	42	0 in.	-	GP: NO RECOVERY, but drill cuttings appear to be angular	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
				fine gravel.							
220	43	8 in.	15-20-26	CH: FAT CLAY, with trace fine grained sand, gray (2.5Y 6/1), moist, hard.	4.5	17	57	40		21.6	
225	44	6 in.	18-23-27		4.5						
				ML: SILT, with fine grained sand, non-cohesive, dark gray (5Y 4/1), moist.							
	45	12 in.	0								
230				NO RECOVERY, suspect same material as above.							
	46	0 in.	-								
235											
	47	0 in.	-								
240											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-7**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
				Coal: Lignite, black (5Y 2.5/1).							
245				Trace large gravel at 245 ft.							
	49	18 in.	0								
250											
	50	22 in.	32	Shale: Highly weathered, dark gray (5Y 4/1), moist, hard.	0.8				102.0	21.4	
255				Siltstone to weathered shale with trace lignite at 255 ft.							
	51	60 in.	100								
260				With some siltstone layers and a lignite lens 1 in. thick at 260 ft.							
	52	59 in.	93								
265											
	53	60 in.	100								

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-7**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**

Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
270											
	54	53 in.	67								
275				Lignite lens 8 in. thick at 274.5 ft.							
	55	60 in.	100		9.3				104.2	22.3	
280											
	56	48 in.	77								
285											
	57	55 in.	92								
290											
	58	60 in.	100								
295											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 17.93"

Lon: 103° 5' 1.65"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**
Address: **NA** GES Job #: **3502056**
County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/14/20 through 5/15/20** Soil Classification System: **USCS**
Drilling Company: **Interstate Drilling Services** Completion Date: **5/15/20**
Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 35 ft.), Fluid Rotary (35 to 226 ft.), NQ Rock Core (226 to 300 ft.)**
Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,812 ft. msl** Abandonment Method: **Tremie**
Total Depth: **315 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**
Refusal Depth: **NA** Abandonment Completion Date: **5/15/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
	59	60 in.	60	Coal: Lignite, black (5Y 2.5/1).	7.3				103.8	27.3	
300											
	60	45 in.	0								
305											
	61	60 in.	38	Shale: Highly weathered, dark gray (5Y 4/1), moist, hard. Lignite lens 1 in. thick at 309 ft.							
310											
	62	60 in.	100							19.5	
315				EOB at 315 ft. Target depth reached.							

Notes:
Soil Lithologies based on field observations and laboratory analysis.
NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level
Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)
PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)
M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates
Lat: 48° 8' 17.93"
Lon: 103° 5' 1.65"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	Atterbergs LL	Atterbergs PI	G	S	M/C
0				CL: LEAN CLAY, dark grayish brown (2.5Y 4/2), moist, medium stiff.							
5	1	8 in.	2-3-4		0.5						
10	2	18 in.	2-2-3		0.5						
15	3	10 in.	1-1-1	CL-ML: SILTY CLAY, olive brown (2.5Y 4/3), very moist, very soft.	0.25						
20	4	14 in.	1-1-1	ML: SILT, with trace clay, dark gray (5Y 4/1), moist, very loose.	0.25						
25				CL-ML: SILTY CLAY, dark gray (5Y 4/1), moist, very soft.							
	5	18 in.	1-1-1	ML: SILT, dark gray (5Y 4/1), moist, very loose.	0.25						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
30	6	15 in.	1-2-7	SP: POORLY GRADED SAND, fine grained, with trace silt, dark gray (5Y 4/1), wet, loose.	-						
35	7	18 in.	1-5-8	CL-ML: SILTY CLAY, very dark gray (5Y 3/1), very moist, stiff.	0.25						
40	8	11 in.	2-1-0	SM: SILTY SAND, fine grained, with trace clay, very dark gray (5Y 3/1), wet, very loose. Trace lignite fragments 1 in. thick at 40 ft.	-						
45	9	12 in.	3-5-5	SP: POORLY GRADED SAND, fine grained, with trace fine gravel, dark gray (5Y 4/1), wet, loose.	-					20.4	6.6
50	10	9 in.	7-9-6	Medium dense at 49.5 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
55	11	12 in.	4-6-6	Fine to medium grained with trace coarse grains at 54.5 ft.	-						
60	12	15 in.	4-9-12	Clay lens 6 in. thick at 60 ft. With thin lignite laminations at 60.5 ft.	-						
65	13	8 in.	4-7-5	SPG: POORLY GRADED SAND WITH GRAVEL, fine to medium grained with fine gravel, dark gray (5Y 4/1), wet, medium dense.	-					14.7	10.0
70	14	10 in.	3-5-5	SP: POORLY GRADED SAND, fine grained, with trace medium grains, dark gray (5Y 4/1), wet, loose.	-						
75	15	10 in.	5-9-17	Fine grained and medium dense at 74.5 ft. With a few thin lignite laminations at 75.5 ft.	-						
80	16	9 in.	15-16-18	Fine to medium grained with trace coarse grains and dense at 79.5 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
85	17	9 in.	11-11-13	Fine grained and medium dense at 84.5 ft.	-						
90	18	9 in.	13-12-15		-					27.7	10.1
95	19	9 in.	11-12-15		-						
100	20	10 in.	6-5-7		-						
105	21	12 in.	8-10-17	With trace lignite laminations throughout at 104.5 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
110	22	15 in.	23-28-37	Fine grained with trace medium grains and very dense at 109.5 ft.	-					23.7	7.0
115	23	5 in.	17-19-17	Fine to medium grained with trace coarse grains, trace fine gravel and trace lignite fragments at 114.5 ft.	-						
				GP: POORLY GRADED GRAVEL, with some fine to coarse sand, trace lignite fragments, dark gray (5Y 4/1), wet, very dense.							
120	24	12 in.	26-47-50/4"	ML: SILT, cohesive, with little fine grained sand, dark gray (5Y 4/1), wet, very dense.	0.5						
125	25	15 in.	24-47-51	SP: POORLY GRADED SAND, fine grained, with trace silt, dark gray (5Y 4/1), wet, very dense.	-						
130	26	16 in.	20-27-40		-						26.0

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
135	27	0 in.	17-25-36		-						
140	28	18 in.	20-25-39		-						
145	29	2 in.	50/3"	Lignite lens at least 2 in. thick at 144.5 ft.	-						
150	30	18 in.	20-25-49	Shale: Highly weathered to consolidated silty clay, gray (5Y 5/1), moist, hard.	4.5	17	46	29			21.0
155	31	18 in.	24-31-50/3"	Lignite lens 2 in. thick at 155.75 ft.	4.5						
	32	42 in.	29	Coal: Lignite, black (2.5Y 2.5/1).							
160				Shale: Highly weathered to consolidated silty clay, gray (5Y 5/1), moist, hard.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client: **CCI & Associates Inc.**		
Address: **NA**	GES Job #: **3502056**		
County: **McKenzie**	GES Project Mgr: **Rob Jenson**		
Logged By: **Nick Schlagel**	Date Drilled: **5/13/20 through 5/14/20**	Soil Classification System: **USCS**	
Drilling Company: **Interstate Drilling Services**	Completion Date: **5/14/20**		
Drill Operator: **Jared Zak**	Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**		
Drill Rig Type: **Diedrich D50**	Sampling Method: **Split Spoon & NQ Rock Core**		
Borehole Diameter: **8 in. to 4 in.**	Surface Elevation: **1,813 ft. msl**	Abandonment Method: **Tremie**	
Total Depth: **300 ft.**	Approximate Water Depth: **Not Encountered**	Backfill Material: **Portland Cement**	
Refusal Depth: **NA**		Abandonment Completion Date: **5/14/20**	

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
	33	60 in.	92		12.3				115.0	16.1	
165											
	34	45 in.	70								
170											
	35	60 in.	98								
				Lignite lens 1 in. thick at 174 ft.							
175											
	36	44 in.	63								
180											
	37	60 in.	93		3.5				106.9	20.1	
185											
	38	59 in.	77	Lignite lens 6 in. thick at 188 ft.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
190				Color turns to dark gray (5Y 4/1) and lignite lens 2 in. thick at 190 ft.							
	39	56 in.	93								
195											
	40	60 in.	100								
200											
	41	55 in.	92		10.5				107.0	21.3	
205											
	42	60 in.	97								
210											
	43	59 in.	98								
215											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
	44	60 in.	100								
220											
	45	58 in.	97		7.7				108.9	20.3	
225											
	46	60 in.	95								
230				Coal: Lignite, black (2.5Y 2.5/1).							
	47	60 in.	0								
235				Highly weathered shale lens 4 in. thick at 236 ft.							
	48	28 in.	7								
240				Shale: Highly weathered to consolidated silty clay, dark gray (5Y 4/1), moist, hard.							
		60 in.	85								

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
245											
	50	34 in.	53		10.0				108.8	20.1	
250											
	51	27 in.	37								
255											
	52	60 in.	95								
260				Less weathered, fractured shale 1 in. thick at 260 ft.							
	53	0 in.	0								
265											
	54	60 in.	98		13.0				105.8	23.1	

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
270											
	55	33 in.	38								
275											
	56	60 in.	100		23.9				107.2	20.8	
280											
	57	60 in.	100								
285											
	58	60 in.	88		6.5				106.1	24.0	
290				Coal: Lignite, black (5Y 2.5/1).							
	59	60 in.	0								
295											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-8**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/13/20 through 5/14/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/14/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 75 ft.), Fluid Rotary (75 to 156 ft.), NQ Rock Core (156 to 300 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **300 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/14/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	Atterbergs PL	LL	PI	G	S	M/C
300	60	60 in.	0	EOB at 300 ft. Target depth reached.							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 8' 45.61"

Lon: 103° 4' 53.93"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	Atterbergs PL	Atterbergs LL	Atterbergs PI	G	S	M/C
0				CL-ML: SILTY CLAY, olive (5Y 4/4), very moist, very soft.							
15	1	15 in.	WOH		0						
20	2	13 in.	1-2-2	SM: SILTY SAND, fine grained with trace clay, olive gray (5Y 4/2), wet, very loose.	-						
25	3	10 in.	1-1-1	CL-ML: SILTY CLAY, with trace fine grained sand, olive gray (5Y 4/2), wet, very soft.	0						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project:	**WBI North Bakken Exp. Proj. Lake Sakakawea, ND**	Client:	**CCI & Associates Inc.**
Address:	**NA**	GES Job #:	**3502056**
County:	**McKenzie**	GES Project Mgr:	**Rob Jenson**

Logged By:	**Nick Schlagel**	Date Drilled:	**5/15/20 through 5/16/20**	Soil Classification System:	**USCS**
Drilling Company:	**Interstate Drilling Services**	Completion Date:	**5/16/20**		
Drill Operator:	**Jared Zak**	Drilling Method:	**HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**		
Drill Rig Type:	**Diedrich D50**	Sampling Method:	**Split Spoon & NQ Rock Core**		

Borehole Diameter:	**8 in. to 4 in.**	Surface Elevation:	**1,813 ft. msl**	Abandonment Method:	**Tremie**
Total Depth:	**310 ft.**	Approximate Water Depth:	**Not Encountered**	Backfill Material:	**Portland Cement**
Refusal Depth:	**NA**			Abandonment Completion Date:	**5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
30	4	18 in.	2-2-4	SP-SC: POORLY GRADED SAND WITH CLAY, fine grained with little silt, very dark gray (5Y 3/1), wet, loose.	0						
35	5	6 in.	3-7-3	Fine to medium gravel lens 2 in. thick at 35 ft. SM: SILTY SAND, fine to coarse grained with trace fine to medium gravel, dark olive gray (5Y 3/2), wet, medium dense.	0						
40	6	6 in.	4-5-7		-						
45	7	6 in.	3-3-7	SWG: WELL GRADED SAND WITH GRAVEL, fine to coarse grained with fine to medium gravel and trace silt, dark olive gray (5Y 3/2), wet, loose.	-						4.7
50	8	9 in.	11-24-18	Dense at 44.5 ft.	-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
55	9	12 in.	2-3-4	SM: SILTY SAND, fine grained, dark olive gray (5Y 3/2), wet, loose.	-						
60	10	5 in.	20-34-34	Fine to coarse grained and very dense at 59.5 ft.	-						
65	11	15 in.	6-9-10	Fine grained and medium dense at 64.5 ft.	-					29.1	29.1
70	12	12 in.	12-16-10		-						
75	13	14 in.	13-14-12		-						
80	14	12 in.	10-13-15		-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
85	15	12 in.	12-13-14	Fine to medium gravel lens 4 in. thick at 84.5 ft. SPG: POORLY GRADED SAND WITH GRAVEL , fine to coarse grained with fine gravel and trace silt, dark olive gray (5Y 3/2), wet, medium dense.	-						7.6
90	16	0 in.	3-4-12		-						
95	17	6 in.	8-12-12	SM: SILTY SAND, fine grained, dark olive gray (5Y 3/2), wet, medium dense.	-						
100	18	5 in.	7-7-8	Fine to coarse grained at 99.5 ft.	-						
105	19	6 in.	6-10-10	Fine grained and color turns to very dark gray (5Y 3/1) at 104.5 ft.	-						20.2

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
110	20	10 in.	7-10-10		-						
115	21	12 in.	13-13-33	Dense at 114.5 ft.	-						
120	22	14 in.	23-30-37	SP-SC: POORLY GRADED SAND WITH CLAY, fine grained with some silt, gray (2.5Y 5/1), moist, very dense.	-						
125	23	16 in.	23-30-39	SM: SILTY SAND, fine grained with trace clay, gray (2.5Y 5/1), moist, very dense.	-					23.2	21.0
130	24	15 in.	22-28-42		-						

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

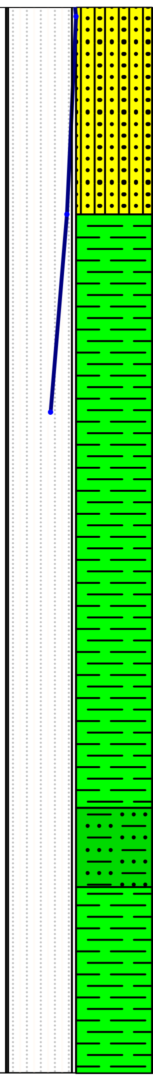
Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
135	25	9 in.	32-50/ 3"	Lens of lignite fragments 1 in. thick at 135 ft.	-						
				Trace clay at 139.5 ft.							
140	26	12 in.	30-32-50/4"	Shale: SHALE, highly weathered to consolidated silty clay, gray (2.5Y 5/1), moist, hard.	-						
145	27	18 in.	24-28-36		4.5	17	27	10		20.5	
				Color turns to gray (5Y 6/1) at 146 ft.							
	28	35 in.	68								
150											
				Lignite lens 1 in. thick at 152 ft.							
	29	48 in.	63								
155				Siltstone: Gray (5Y 6/1), moist, very dense.							
				Shale: Highly weathered to consolidated silty clay, gray (5Y 6/1), moist, hard.							
	30	55 in.	80								
				Lignite lens 1 in. thick at 159.5 ft.							
160											



Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
				With trace lignite from 162 to 164 ft.							
	31	58 in.	42								
165				Lignite lens 3 in. thick at 165.5 ft. Lignite lens 3 in. thick at 166 ft.							
	32	60 in.	95								
170						19	37	18			
	33	60 in.	95		12.7				108.6	20.4	
175				Lignite lens 1 in. thick at 174.5 ft.							
	34	48 in.	70								
180				Color turns to dark gray (5Y 4/1) at 180 ft.							
	35	48 in.	73								
185				Lignite lens 2 in. thick at 185 ft. Lignite lens 6 in. thick at 186 ft.							
	36	60 in.	86								

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
190											
	37	51 in.	85		11.1				116.3	14.2	
195											
	38	60 in.	58								
200											
	39	60 in.	100								
205											
	40	48 in.	77								
210											
	41	60 in.	100		7.2				104.4	23.0	
215											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
	42	56 in.	93								
220											
	43	60 in.	100								
225				Coal: Lignite, black (5Y 2.5/1).							
	44	60 in.	0								
230											
	45	30 in.	8								
235				Shale: Highly weathered to consolidated silty clay, dark gray (5Y 4/1), moist, hard.							
	46	60 in.	98		16.6				108.5	19.7	
240				Coal: Lignite, black (5Y 2.5/1).							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD (1 100)	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
				Shale: Highly weathered to consolidated silty clay, dark gray (5Y 4/1), moist, hard.							
245											
	48	60 in.	80								
250											
				Siltstone lens 1 in. thick at 251 ft.							
	49	29 in.	48								
255											
				Silt lens 2 in. thick at 256 ft.							
	50	32 in.	28		44.3				106.3	20.2	
260				NO RECOVERY, suspect more highly weathered shale material with trace lignite seams.							
	51	0 in.	0								
265											
	52	0 in.	0		5.0				112.7	15.3	

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project:	WBI North Bakken Exp. Proj. Lake Sakakawea, ND	Client:	CCI & Associates Inc.
Address:	NA	GES Job #:	3502056
County:	McKenzie	GES Project Mgr:	Rob Jenson

Logged By: **Nick Schlagel** | Date Drilled: **5/15/20 through 5/16/20** | Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** | Completion Date: **5/16/20**

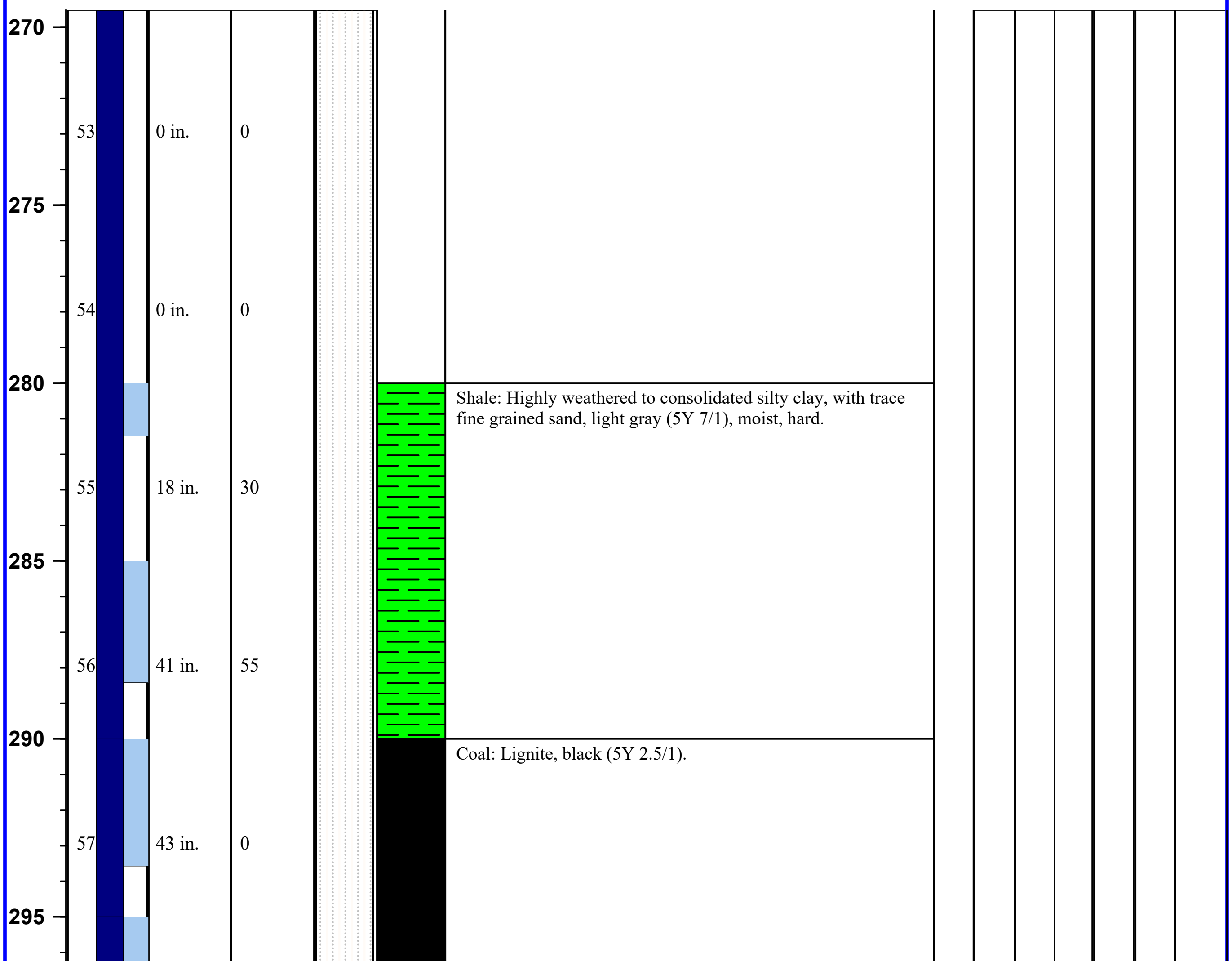
Drill Operator: **Jared Zak** | Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** | Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** | Surface Elevation: **1,813 ft. msl** | Abandonment Method: **Tremie**

Total Depth: **310 ft.** | Approximate Water Depth: **Not Encountered** | Backfill Material: **Portland Cement**

Refusal Depth: **NA** | Abandonment Completion Date: **5/16/20**



Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp /Qu	PL	LL	PI	G	S	M/C
	53	0 in.	0								
	54	0 in.	0								
280	55	18 in.	30	Shale: Highly weathered to consolidated silty clay, with trace fine grained sand, light gray (5Y 7/1), moist, hard.							
	56	41 in.	55								
290	57	43 in.	0	Coal: Lignite, black (5Y 2.5/1).							

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

SOIL BORING LOG

Groundwater & Environmental Services, Inc.

ID NO. **WB-9**

Project: **WBI North Bakken Exp. Proj. Lake Sakakawea, ND** Client: **CCI & Associates Inc.**

Address: **NA** GES Job #: **3502056**

County: **McKenzie** GES Project Mgr: **Rob Jenson**

Logged By: **Nick Schlagel** Date Drilled: **5/15/20 through 5/16/20** Soil Classification System: **USCS**

Drilling Company: **Interstate Drilling Services** Completion Date: **5/16/20**

Drill Operator: **Jared Zak** Drilling Method: **HSA (0 to 60 ft.), Fluid Rotary (60 to 146 ft.), NQ Rock Core (146 to 310 ft.)**

Drill Rig Type: **Diedrich D50** Sampling Method: **Split Spoon & NQ Rock Core**

Borehole Diameter: **8 in. to 4 in.** Surface Elevation: **1,813 ft. msl** Abandonment Method: **Tremie**

Total Depth: **310 ft.** Approximate Water Depth: **Not Encountered** Backfill Material: **Portland Cement**

Refusal Depth: **NA** Abandonment Completion Date: **5/16/20**

Depth (feet)	Sample Interval	Recovery (inches)	Blows / RQD 1 100	Geologic Description	Qp/Qu	PL	LL	PI	G	S	M/C
	58	60 in.	15	Shale: Highly weathered to consolidated silty clay, dark gray (5Y 4/1), moist, hard.							
300				Coal: Lignite with few shale lenses, black (5Y 2.5/1).							
	59	60 in.	25	Shale: Highly weathered to consolidated silty clay, dark gray (5Y 4/1), moist, hard.							
305				Coal: Lignite, black (5Y 2.5/1).							
	60	55 in.	65	Shale: Highly weathered to consolidated silty clay, dark gray (5Y 4/1), moist, hard. Lignite lens 1 in. thick at 308.25 ft. Sand with clay lens 9 in. thick at 309 ft.	15.2				117.6	14.2	
310											

Notes:

Soil Lithologies based on field observations and laboratory analysis.

NA = not applicable; fbg. = feet below grade; in. = inches; ft. = feet; msl = mean sea level

Qp/Qu = unconfined compressive strength (tons / square foot); G = Gravel Content (%)

PL = Plastic Limit (%); LL = Liquid Limit (%); PI = Plasticity Index (%); S = Sand Content (%)

M/C = Silt or Clay Content (%); Blows = blows per 6 inches; RQD = rock quality index (%)

GPS Coordinates

Lat: 48° 9' 0.54"

Lon: 103° 4' 45.08"

Appendix D – Laboratory Reports

Project: **WBI N Bakken Expansion** Job Number: **G20-045** Sheet **1** of **4**

Manager: Client: Project Description:

Location: **Missouri River HDD Crossing**

,

Elevation Datum:

Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data Top	Bottom	Type	Rec	'N'
WB4 44.5				5.4									
WB4 59.5	40.3	18.3	22.0				19.4						
WB4 69.5				97.2									
WB4 79.5	31.3	18.7	12.0				19.1						
WB4 87.5							22.1						
WB4 132.5							15.2						
WB4 147.5							15.6						
WB4 182.5							19.1						
WB4 237.5							15.2						
WB4 247.5							19.1						
WB4 262.5							18.6						
WB4 287.5	103.4	31.1	72.0				20.0						
WB4 297.5							21.1						
WB5 44.0				7.7									
WB5 64.0	46.8	22.2	25.0				28.0						
WB5 109.5				46.6									
WB5 149.5	35.5	16.1	19.0				18.1						
WB5 180.0							16.6						
WB5 200.0							14.2						

Material Testing Services, LLC

Summary of Material Properties

June 30, 2020

Project: WBI N Bakken Expansion	Job Number: G20-045	Sheet 2 of 4

Borehole	Depth	Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data: Top	Bottom	Type	Rec	'N'
WB5	220.0								19.2						
WB5	245.0		90.5	26.3	65.0				17.0						
WB5	265.0								20.5						
WB5	275.0		149.2	22.3	127.0				20.2						
WB5	295.0								21.6						
WB6	49.5					10.0									
WB6	79.5		50.6	22.0	29.0										
WB6	109.5		35.4	18.0	17.0				24.5						
WB6	129.5					6.4									
WB6	159.5					13.2									
WB6	194.5					6.7									
WB6	214.5					9.2									
WB6	224.5		127.4	20.0	107.0				25.2						
WB6	230.0								23.1						
WB6	245.0								18.2						
WB6	275.0		162.4	20.6	141.0										
WB6	295.0								17.1						
WB7	59.5					43.2			30.3						
WB7	74.5		34.9	19.0	16.0				21.3						
WB7	94.5					8.0			27.0						
WB7	114.5		35.7	23.2	13.0				24.9						
WB7	129.5					6.5			13.3						

Material Testing Services, LLC	Summary of Material Properties	June 30, 2020

Project: **WBI N Bakken Expansion** Job Number: **G20-045** Sheet **3** of **4**

Borehole Depth Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data Top	Bottom	Type	Rec	'N'
WB7 144.5				13.3			18.6						
WB7 164.5				11.0			18.2						
WB7 184.5				12.1			23.7						
WB7 202.5	36.7	22.7	14.0				13.1						
WB7 204.5				14.8									
WB7 219.5	57.3	17.3	40.0				21.6						
WB7 250.0							21.4						
WB7 275.0	203.2	23.7	179.0				22.3						
WB7 295.0							27.3						
WB7 310.0							19.5						
WB8 44.5				6.6			20.4						
WB8 64.5				10.0			14.7						
WB8 89.5				10.1			27.7						
WB8 109.5				6.9			23.7						
WB8 129.5				26.0									
WB8 149.5	46.1	17.3	29.0				21.0						
WB8 160.0							16.1						
WB8 180.0							20.1						
WB8 200.0							21.3						
WB8 220.0							20.3						
WB8 245.0							20.1						
WB8 265.0							23.1						

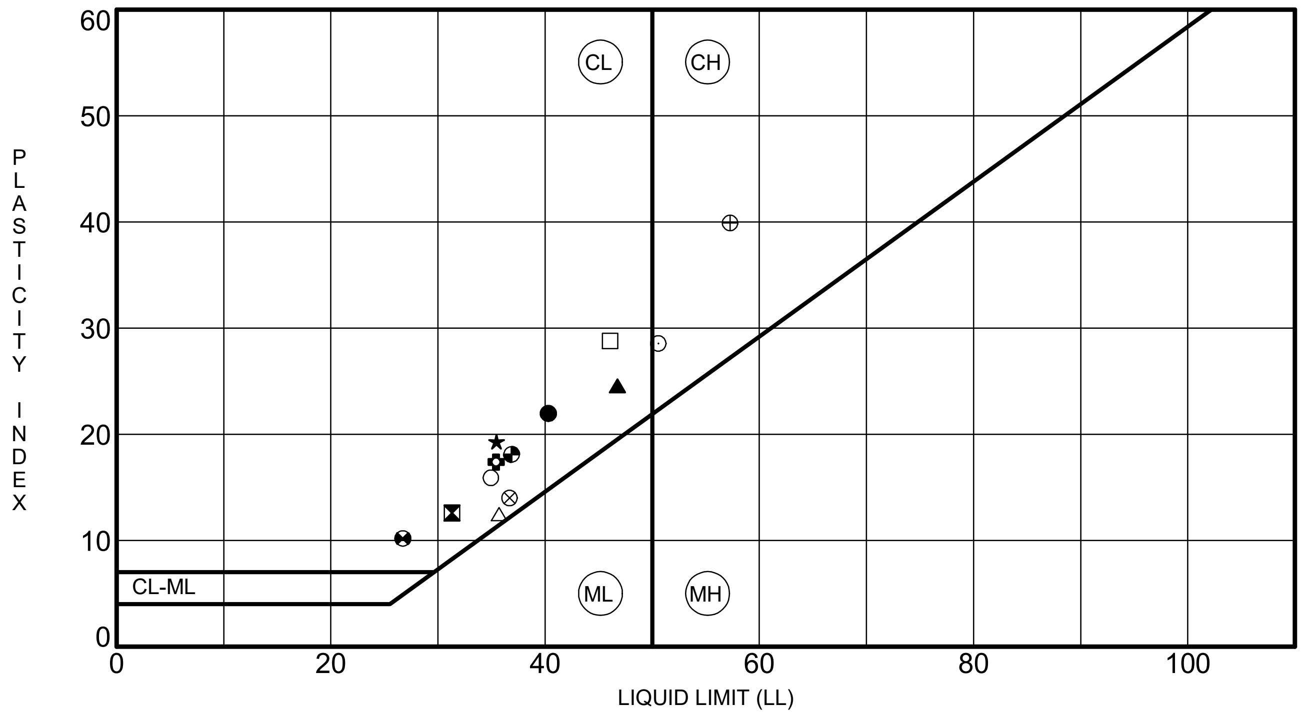
Material Testing Services, LLC

Summary of Material Properties

June 30, 2020

Project: **WBI N Bakken Expansion** Job Number: **G20-045** Sheet **4** of **4**

Borehole / Depth / Elev.	LL	PL	PI	Fines	Bulk Density	Dry Density	Water Content	Layer Code	Sample Data Top	Bottom	Type	Rec	'N'
WB8 275.0	169.4	22.6	146.0				20.8						
WB8 280.0							24.0						
WB9 44.5	WELL-GRADED SAND with GRAVEL			4.7									
WB9 64.5				29.2			29.1						
WB9 84.5				7.6									
WB9 104.5				20.2									
WB9 124.5				21.0			23.2						
WB9 144.5	26.7	16.5	10.0				20.5						
WB9 170.0	36.9	18.8	18.0				13.3						
WB9 190.0							20.4						
WB9 205.0							23.0						
WB9 235.0							19.7						
WB9 245.0	158.1	22.5	136.0				20.2						
WB9 255.0							15.3						
WB9 305.0							14.2						



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**WB4**	**59.5**	**40**	**18**	**22**		
⧗	**WB4**	**79.5**	**31**	**19**	**13**		
▲	**WB5**	**64.0**	**47**	**22**	**25**		
★	**WB5**	**149.5**	**35**	**16**	**19**		
⊙	**WB6**	**79.5**	**51**	**22**	**29**		
✿	**WB6**	**109.5**	**35**	**18**	**17**		
○	**WB7**	**74.5**	**35**	**19**	**16**		
△	**WB7**	**114.5**	**36**	**23**	**12**		
⊗	**WB7**	**202.5**	**37**	**23**	**14**		
⊕	**WB7**	**219.5**	**57**	**17**	**40**		
□	**WB8**	**149.5**	**46**	**17**	**29**		
◉	**WB9**	**144.5**	**27**	**17**	**10**		
◕	**WB9**	**170.0**	**37**	**19**	**18**		

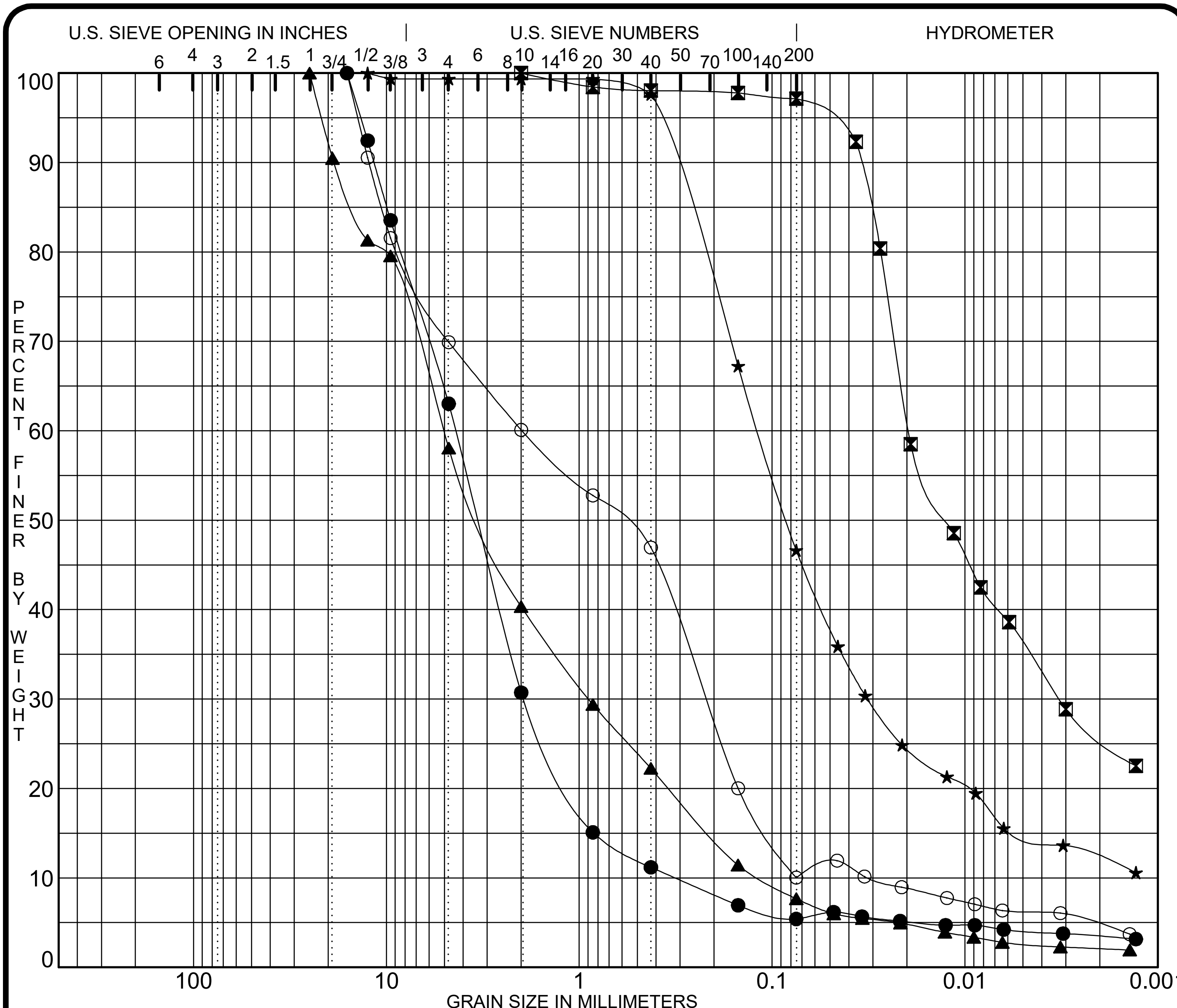
PROJECT **WBI N Bakken Expansion, Missouri River HDD Crossing**

JOB NO. **G20-045**

DATE **6/15/20**

ATTERBERG LIMITS' RESULTS

Material Testing Services, LLC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

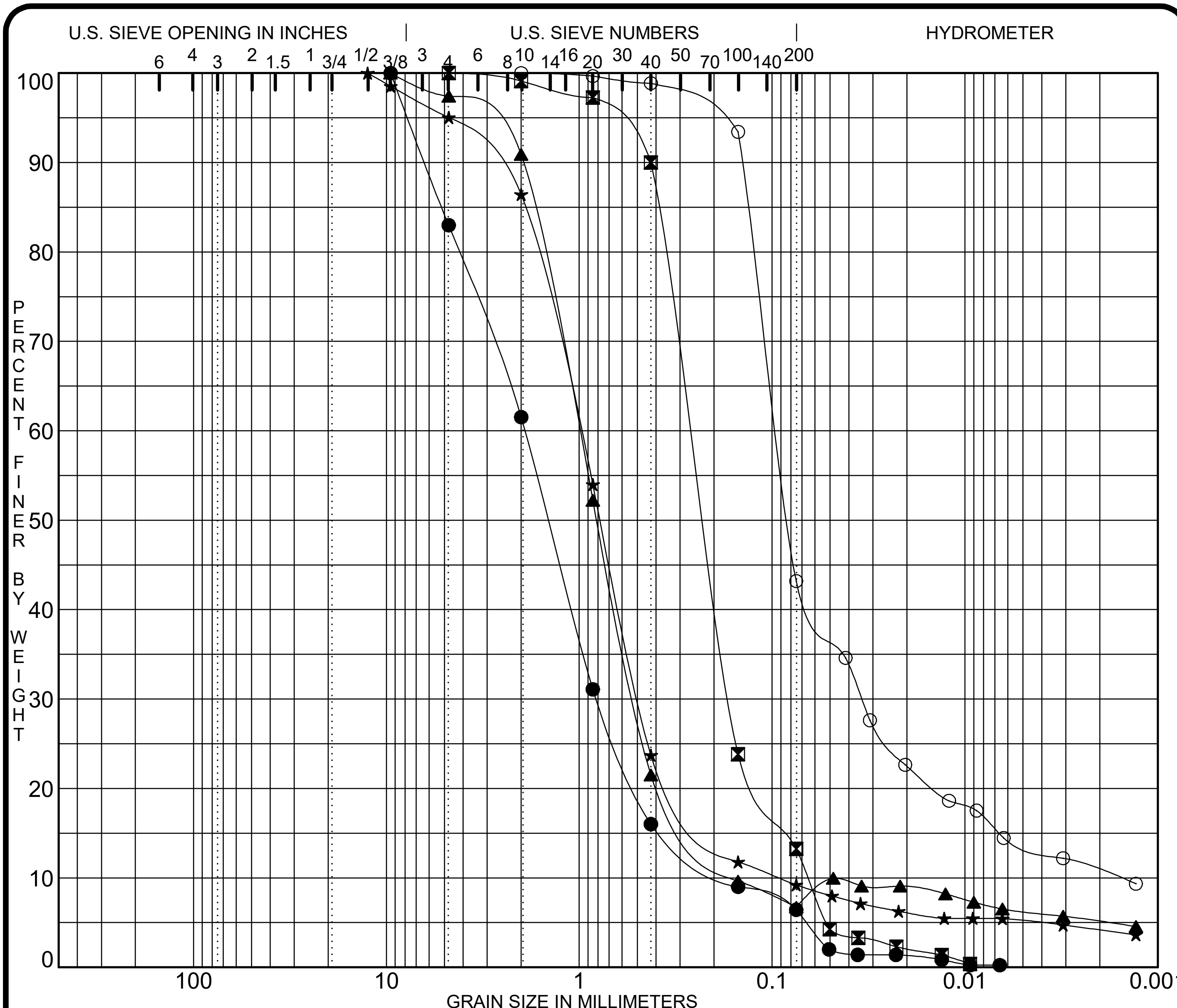
	Boring No.	Depth (ft)	Classification	MC%	LL	PL	PI	Cc	Cu
●	**WB4**	**44.5**						**2.65**	**13.8**
⧗	**WB4**	**69.5**							
▲	**WB5**	**44.0**						**1.36**	**43.8**
★	**WB5**	**109.5**							
⊙	**WB6**	**49.5**						**0.34**	**27.3**

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**WB4**	**44.5**	**16.00**	**4.38**	**1.923**	**0.3184**	**37.0**	**57.6**	**1.3**	**4.1**
⧗	**WB4**	**69.5**	**2.00**	**0.02**	**0.003**		**0.0**	**2.8**	**60.9**	**36.2**
▲	**WB5**	**44.0**	**25.00**	**5.06**	**0.892**	**0.1154**	**41.9**	**50.4**	**5.1**	**2.6**
★	**WB5**	**109.5**	**12.50**	**0.12**	**0.032**		**0.6**	**52.7**	**31.7**	**14.9**
⊙	**WB6**	**49.5**	**16.00**	**1.98**	**0.221**	**0.0724**	**30.1**	**59.9**	**3.8**	**6.2**

PROJECT **WBI N Bakken Expansion, Missouri River HDD Crossing**
JOB NO. **G20-045**
DATE **6/29/20**

PARTICLE SIZE ANALYSIS

Material Testing Services, LLC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.	Depth (ft)	Classification	MC%	LL	PL	PI	Cc	Cu
●	**WB6**	**129.5**						**1.96**	**11.0**
⧗	**WB6**	**159.5**						**1.59**	**4.1**
▲	**WB6**	**194.5**						**5.41**	**20.8**
★	**WB6**	**214.5**						**2.61**	**10.7**
⊙	**WB7**	**59.5**		**30**				**7.85**	**59.5**

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**WB6**	**129.5**	**9.50**	**1.92**	**0.809**	**0.1740**	**17.0**	**76.6**		
⧗	**WB6**	**159.5**	**4.75**	**0.27**	**0.165**	**0.0649**	**0.0**	**86.8**		
▲	**WB6**	**194.5**	**9.50**	**1.01**	**0.515**	**0.0486**	**2.6**	**90.7**	**0.5**	**6.2**
★	**WB6**	**214.5**	**12.50**	**1.00**	**0.491**	**0.0927**	**5.0**	**85.8**	**4.0**	**5.2**
⊙	**WB7**	**59.5**	**2.00**	**0.09**	**0.034**	**0.0016**	**0.0**	**56.8**	**29.5**	**13.7**

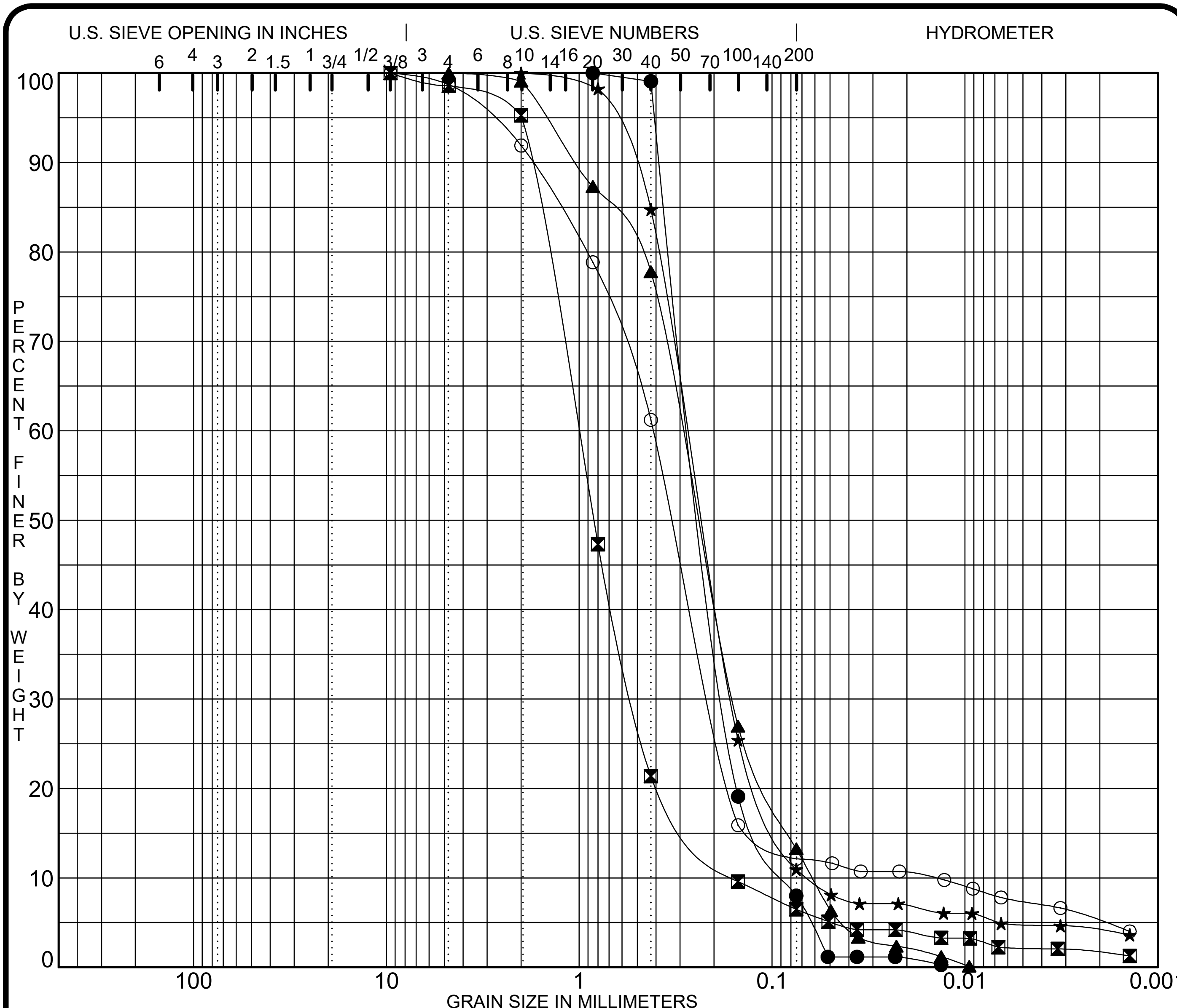
PROJECT **WBI N Bakken Expansion, Missouri River HDD Crossing**

JOB NO. **G20-045**

DATE **6/29/20**

PARTICLE SIZE ANALYSIS

Material Testing Services, LLC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.	Depth (ft)	Classification	MC%	LL	PL	PI	Cc	Cu
●	**WB7**	**94.5**		**27**				**1.38**	**3.0**
⧗	**WB7**	**129.5**		**13**				**1.73**	**6.5**
▲	**WB7**	**144.5**		**19**				**1.40**	**4.8**
★	**WB7**	**164.5**		**18**				**1.47**	**4.2**
⊙	**WB7**	**184.5**		**24**				**7.14**	**28.3**

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**WB7**	**94.5**	**0.85**	**0.26**	**0.173**	**0.0850**	**0.0**	**92.0**		
⧗	**WB7**	**129.5**	**9.50**	**1.02**	**0.524**	**0.1556**	**1.4**	**92.1**	**4.3**	**2.2**
▲	**WB7**	**144.5**	**4.75**	**0.30**	**0.160**	**0.0617**	**0.0**	**86.7**		
★	**WB7**	**164.5**	**2.00**	**0.28**	**0.163**	**0.0652**	**0.0**	**89.0**	**6.2**	**4.8**
⊙	**WB7**	**184.5**	**9.50**	**0.41**	**0.207**	**0.0146**	**1.3**	**86.6**	**4.7**	**7.4**

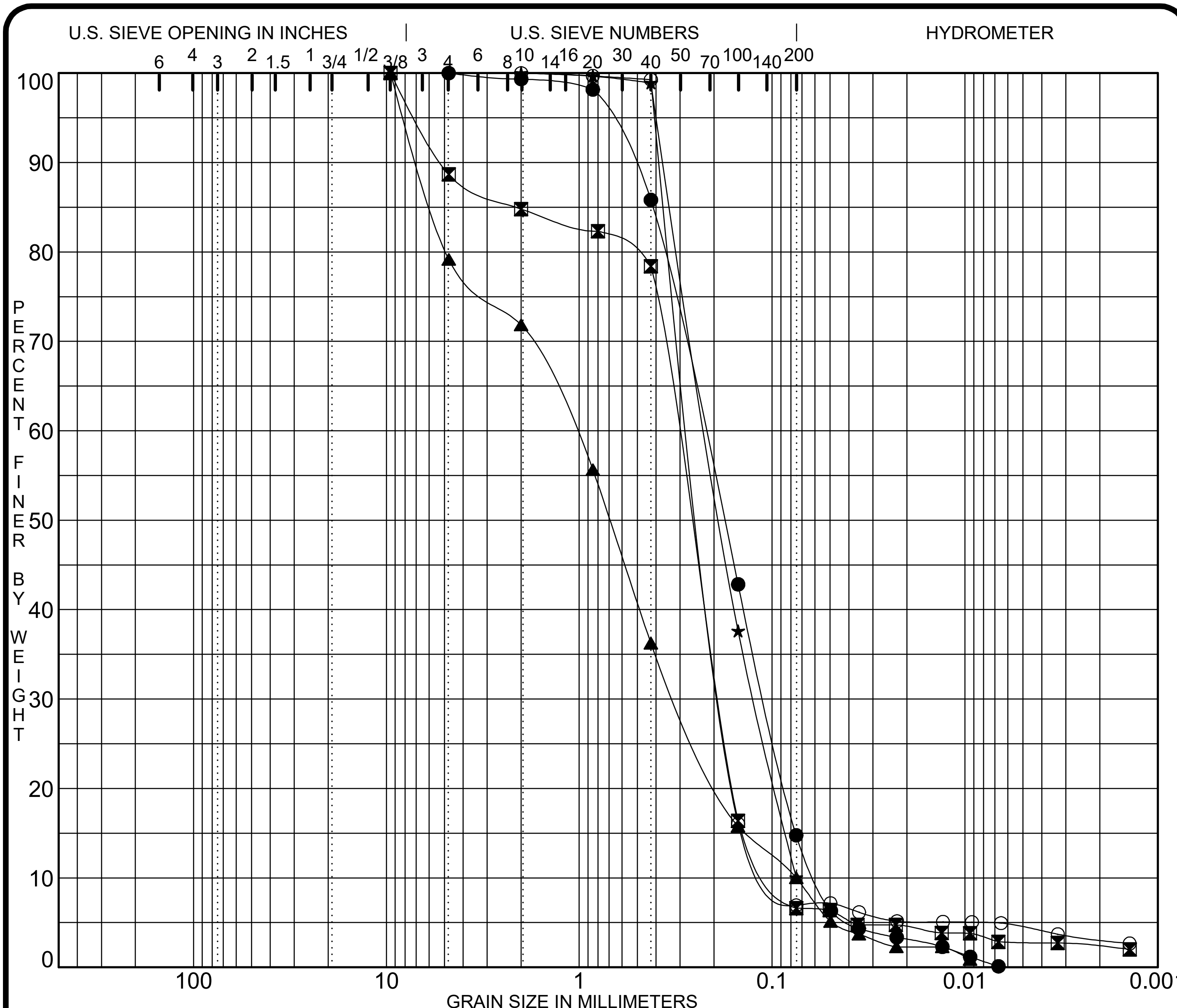
PROJECT **WBI N Bakken Expansion, Missouri River HDD Crossing**

JOB NO. **G20-045**

DATE **6/29/20**

PARTICLE SIZE ANALYSIS

Material Testing Services, LLC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

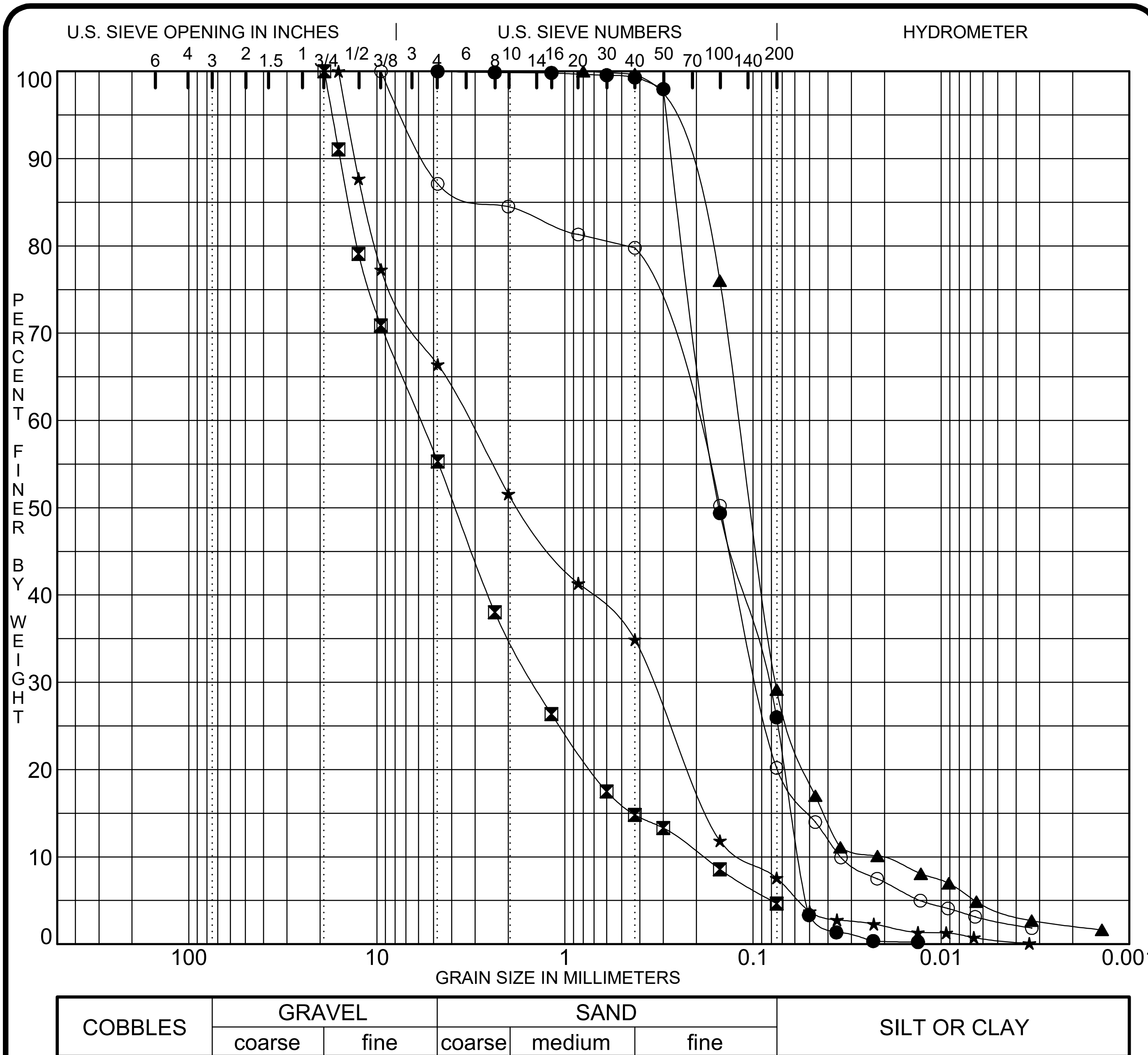
	Boring No.	Depth (ft)	Classification	MC%	LL	PL	PI	Cc	Cu
●	**WB7**	**204.5**						**0.88**	**3.8**
⧗	**WB8**	**44.5**		**20**				**1.19**	**3.3**
▲	**WB8**	**64.5**		**15**				**1.19**	**14.3**
★	**WB8**	**89.5**		**28**				**0.93**	**2.9**
⊙	**WB8**	**109.5**		**24**				**1.73**	**3.7**

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**WB7**	**204.5**	**4.75**	**0.23**	**0.109**	**0.0594**	**0.0**	**85.2**		
⧗	**WB8**	**44.5**	**9.50**	**0.31**	**0.189**	**0.0954**	**11.3**	**82.1**	**3.8**	**2.8**
▲	**WB8**	**64.5**	**9.50**	**1.07**	**0.309**	**0.0750**	**20.8**	**69.2**		
★	**WB8**	**89.5**	**2.00**	**0.22**	**0.124**		**0.0**	**89.9**	**10.1**	
⊙	**WB8**	**109.5**	**2.00**	**0.26**	**0.179**	**0.0709**	**0.0**	**93.1**	**2.5**	**4.5**

PROJECT **WBI N Bakken Expansion, Missouri River HDD Crossing**
JOB NO. **G20-045**
DATE **6/29/20**

PARTICLE SIZE ANALYSIS

Material Testing Services, LLC



	Boring No.	Depth (ft)	Classification	MC%	LL	PL	PI	Cc	Cu
●	WB8	129.5						0.72	3.1
⧗	WB9	44.5	WELL-GRADED SAND with GRAVEL SW					1.98	31.7
▲	WB9	64.5		29				2.29	5.6
★	WB9	84.5						0.32	29.4
⊙	WB9	104.5						1.22	6.2

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	WB8	129.5	4.75	0.17	0.084	0.0567	0.0	74.0		
⧗	WB9	44.5	19.00	5.86	1.465	0.1848	44.7	50.6	4.7	
▲	WB9	64.5	0.80	0.12	0.076	0.0213	0.0	70.8	25.1	4.0
★	WB9	84.5	16.00	3.27	0.341	0.1112	33.6	58.8	7.1	0.5
⊙	WB9	104.5	9.50	0.21	0.094	0.0343	12.9	66.9	17.6	2.6

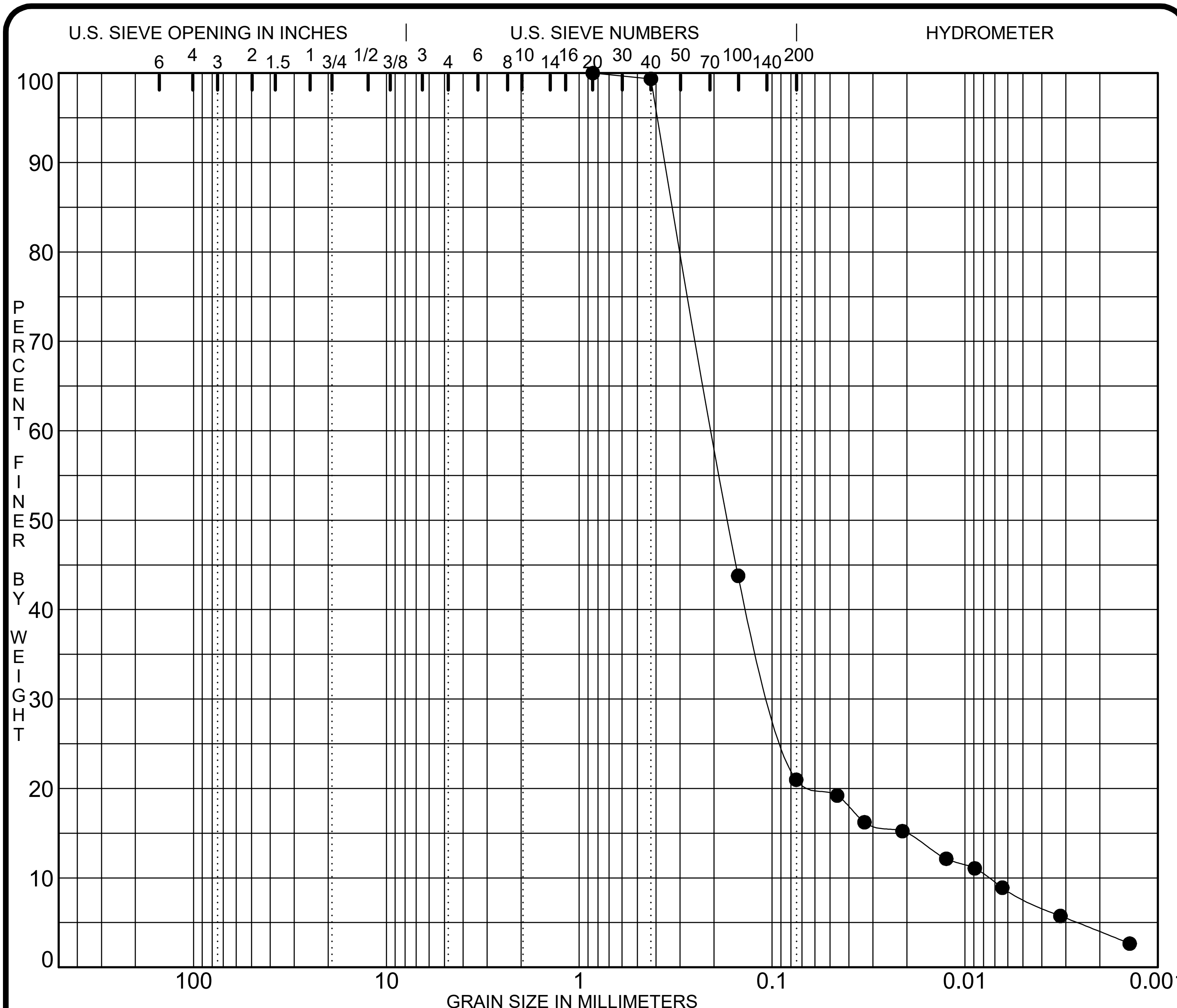
PROJECT **WBI N Bakken Expansion, Missouri River HDD Crossing**

JOB NO. **G20-045**

DATE **6/29/20**

PARTICLE SIZE ANALYSIS

Material Testing Services, LLC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring No.	Depth (ft)	Classification	MC%	LL	PL	PI	Cc	Cu
●	**WB9**	**124.5**		**23**				**6.33**	**26.9**

	Boring No.	Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**WB9**	**124.5**	**0.85**	**0.20**	**0.099**	**0.0076**	**0.0**	**79.0**	**13.2**	**7.8**

PROJECT **WBI N Bakken Expansion, Missouri River HDD Crossing**

JOB NO. **G20-045**

DATE **6/29/20**

PARTICLE SIZE ANALYSIS

Material Testing Services, LLC

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

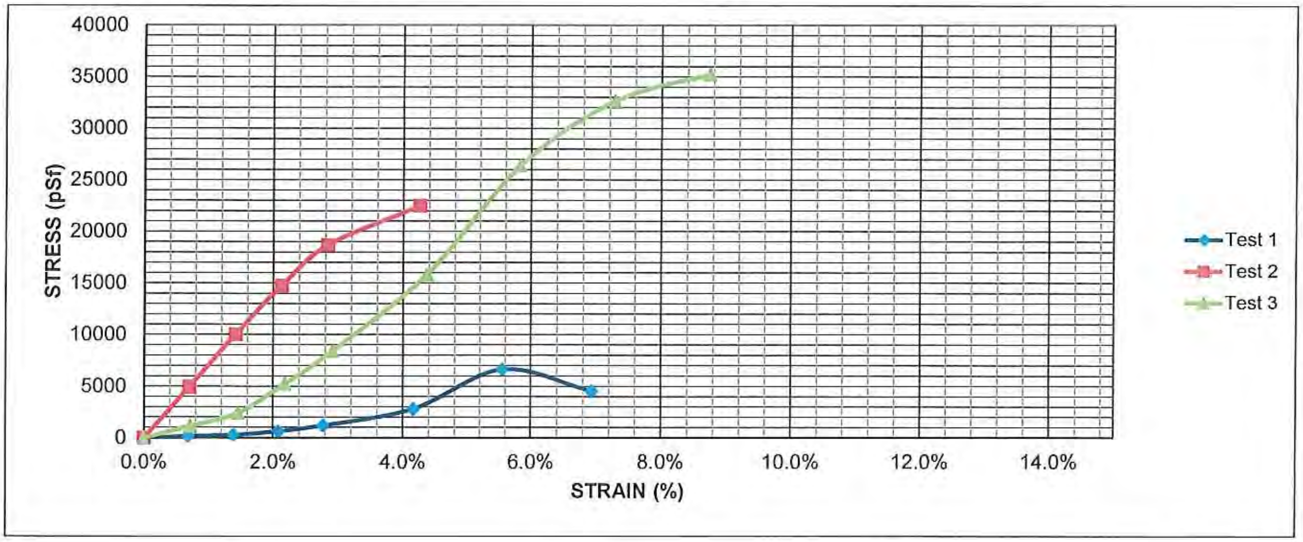
DATE: 4-Jun-20

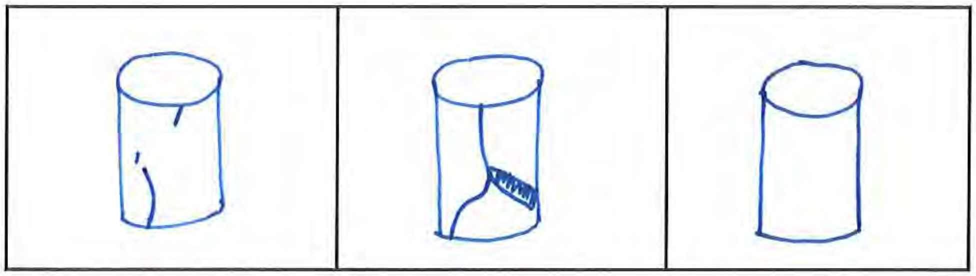
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	Test 1	Test 2	Test 3
	WB-4 RC - 87.5-92.5 feet	WB-4 RC - 127.5-132.5 feet	WB-4 RC - 147.5-152.5 feet
Soil Class:			
Dry Density (pcf):	108.6	113.7	118.9
Water Content:	22.1%	15.2%	15.5%
Sample Dia. (mm):	45.1	44.8	44.4
Sample Ht (mm):	91.5	89.4	87.2
Height/Diameter:	2.03	2.00	1.96
Unc. Strength (psf):	**6646**	**22535**	**35246**
Strain at Failure (%):	5.6	4.3	7.3





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

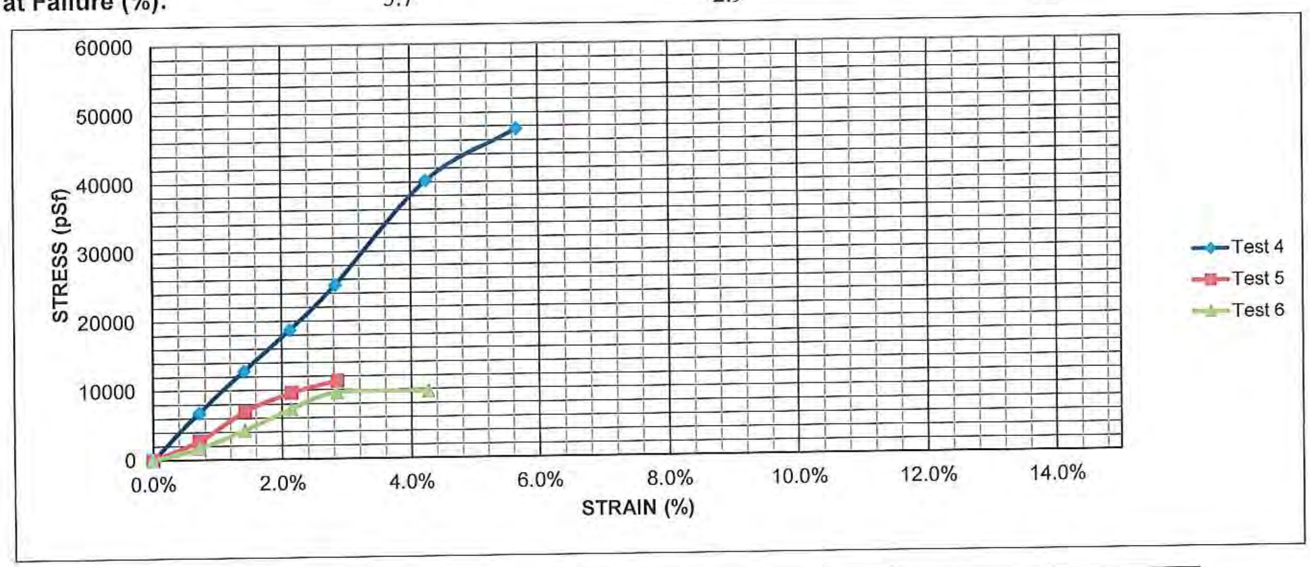
DATE: 4-Jun-20

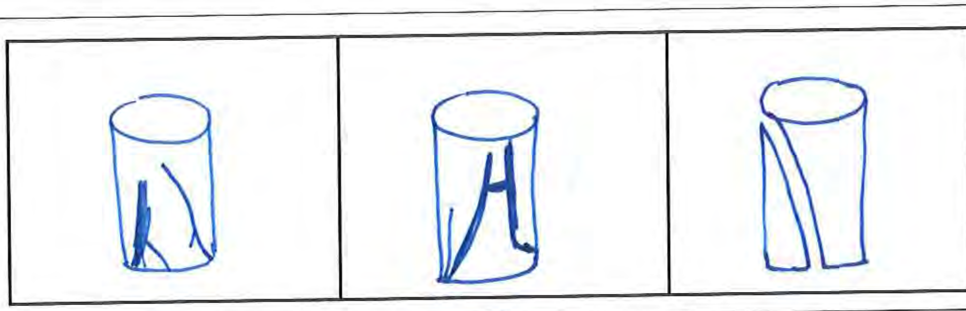
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	**Test 4**	**Test 5**	**Test 6**
	WB-4	WB-4	WB-4
	RC - 182.5-187.5 feet	RC - 237.5-242.5 feet	RC - 247.5-252.5 feet
Soil Class:			
Dry Density (pcf):	115.1	113.9	107.5
Water Content:	19.1%	15.2%	19.1%
Sample Dia. (mm):	44.6	45.3	45.7
Sample Ht (mm):	89.7	88.9	89.2
Height/Diameter:	2.01	1.96	1.95
Unc. Strength (psf):	**47624**	**11336**	**9726**
Strain at Failure (%):	5.7	2.9	4.3





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

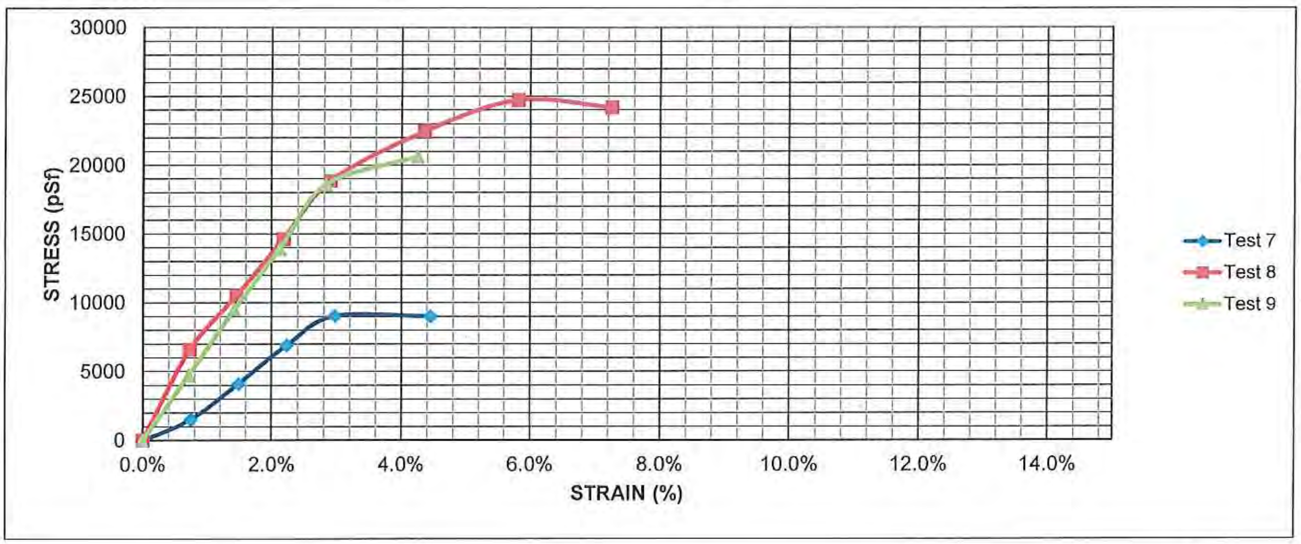
DATE: 4-Jun-20

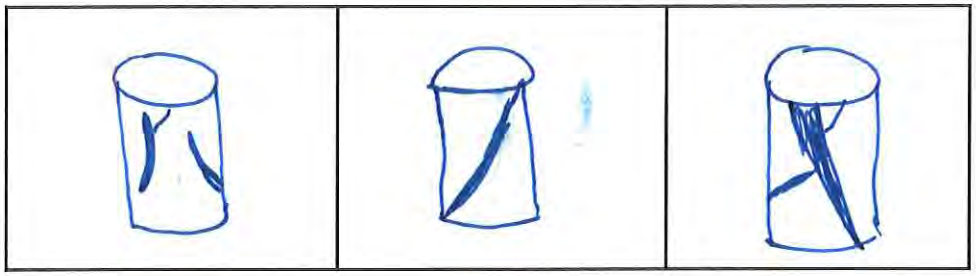
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	**Test 7**	**Test 8**	**Test 9**
	WB-4	WB-4	WB-4
	RC - 262.5-272.5 feet	RC - 287.5-292.5 feet	RC - 297.5-300 feet
Soil Class:			
Dry Density (pcf):	109.4	107.6	105.9
Water Content:	18.6%	20.0%	21.1%
Sample Dia. (mm):	45.7	44.4	44.6
Sample Ht (mm):	85.5	87.4	89.7
Height/Diameter:	1.87	1.97	2.01
Unc. Strength (psf):	**9054**	**24774**	**22188**
Strain at Failure (%):	3.0	5.8	4.2





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

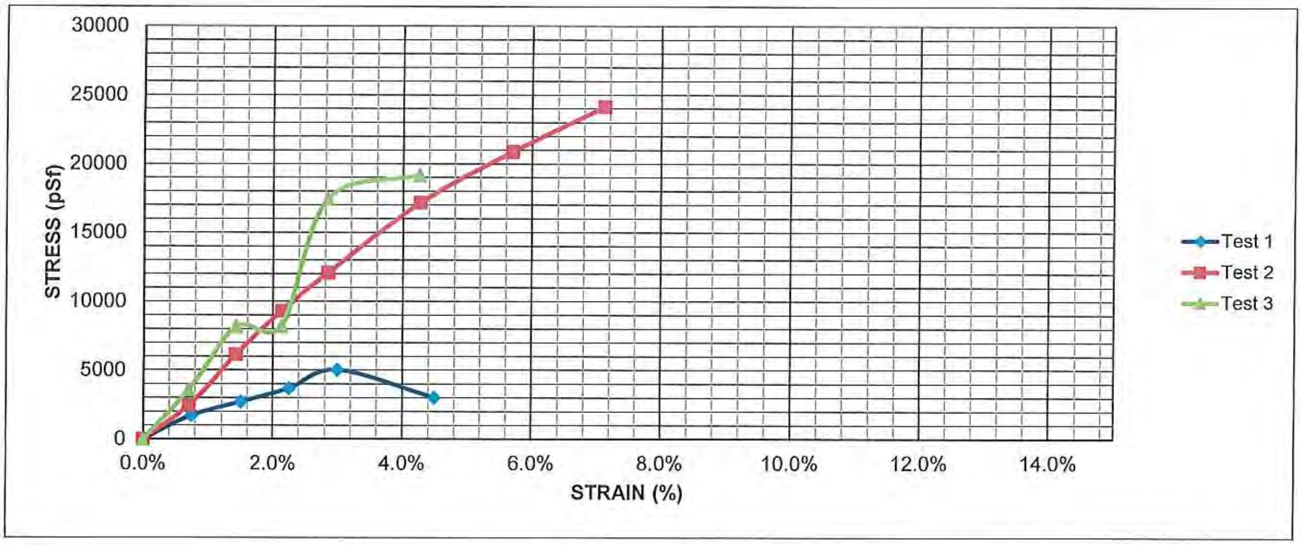
DATE: 5-Jun-20

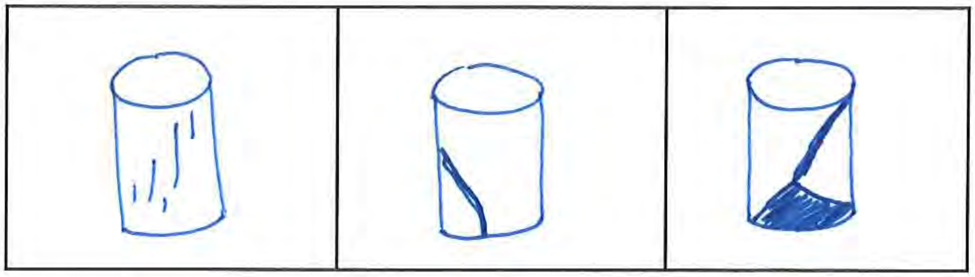
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	Test 1	Test 2	Test 3
	WB-5	WB-5	WB-5
	RC - 160-165 feet	RC - 180-185 feet	RC - 200-205 feet
Soil Class:			
Dry Density (pcf):	108.2	117.5	116.3
Water Content:	66.2%	16.6%	14.2%
Sample Dia. (mm):	42.9	44.2	44.6
Sample Ht (mm):	84.8	89.2	89.5
Height/Diameter:	1.98	2.02	2.01
Unc. Strength (psf):	**5047**	**24258**	**19234**
Strain at Failure (%):	3.0	7.1	4.3





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

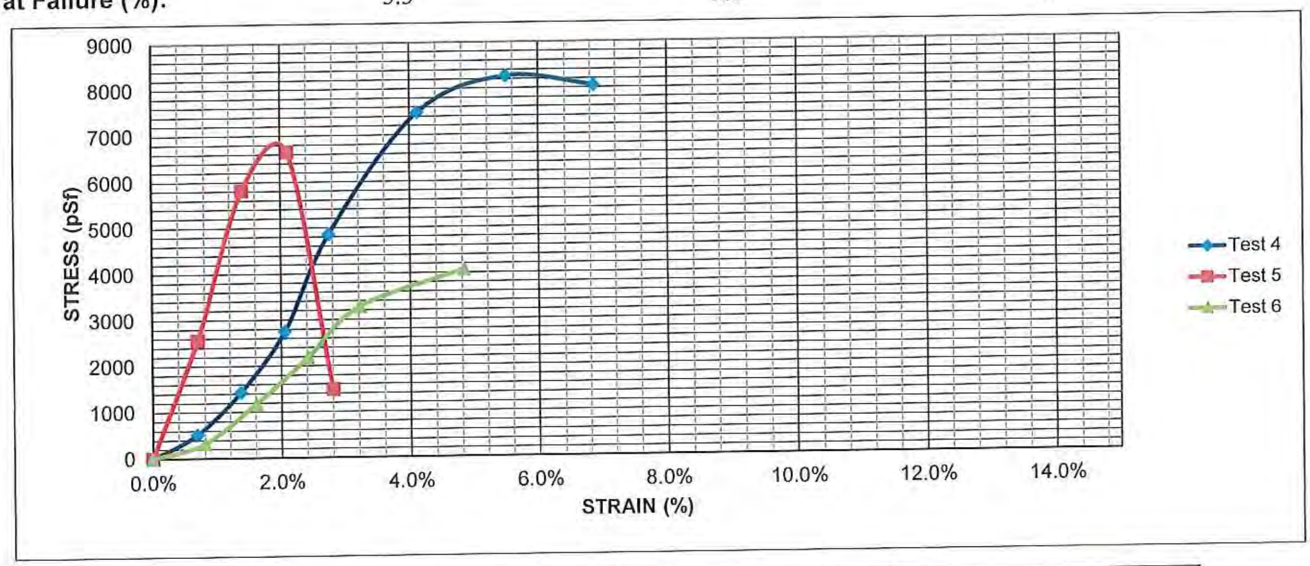
DATE: 5-Jun-20

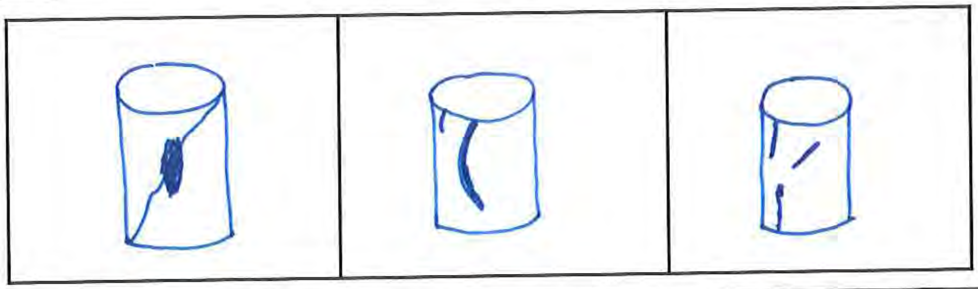
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

	Test 4	Test 5	Test 6
Specimen ID:	WB-5 RC - 220-225 feet	WB-5 RC - 245-250 feet	WB-5 RC - 265-270 feet
Soil Class:			
Dry Density (pcf):	105.8	107.9	108.8
Water Content:	19.2%	17.0%	20.5%
Sample Dia. (mm):	46.0	45.7	44.9
Sample Ht (mm):	92.5	90.5	78.9
Height/Diameter:	2.01	1.98	1.75
Unc. Strength (psf):	**8272**	**6658**	**4075**
Strain at Failure (%):	5.5	2.1	4.8





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

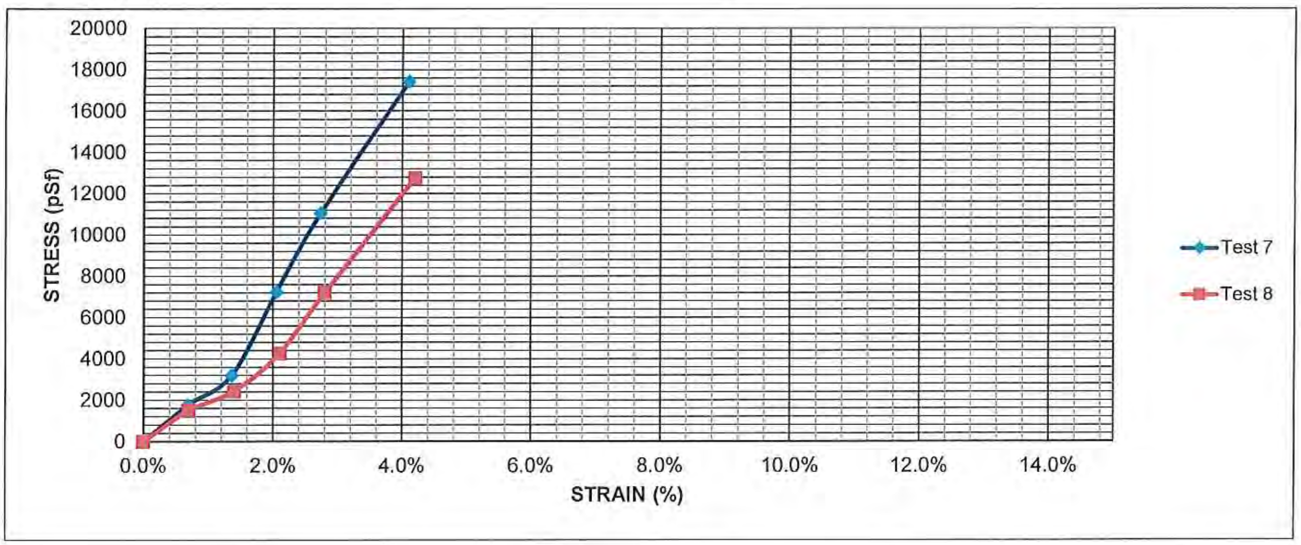
DATE: 7-Jun-20

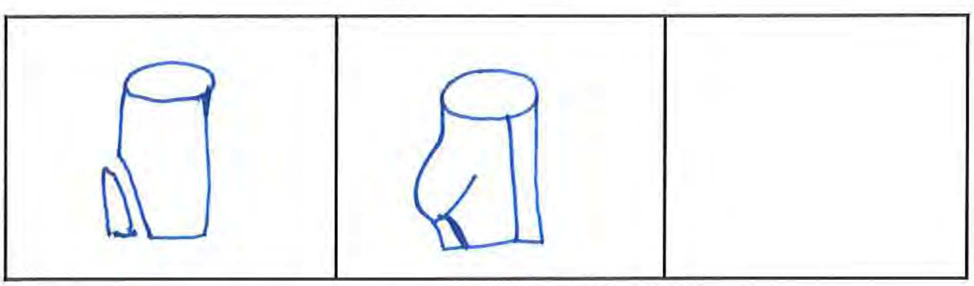
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	**Test 7**	**Test 8**
	WB-5	WB-5
	RC - 275-280 feet	RC - 295-300 feet
Soil Class:		
Dry Density (pcf):	106.5	106.7
Water Content:	20.2%	21.6%
Sample Dia. (mm):	44.6	45.7
Sample Ht (mm):	92.9	90.7
Height/Diameter:	2.08	1.98
Unc. Strength (psf):	**17425**	**12763**
Strain at Failure (%):	4.1	4.2





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

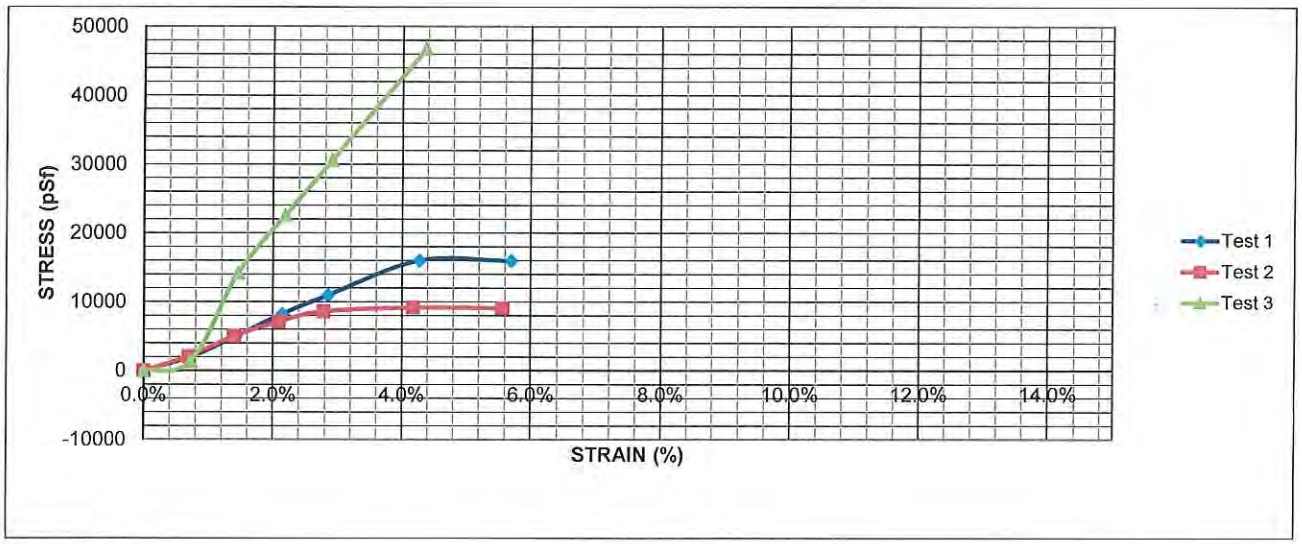
DATE: 10-Jun-20

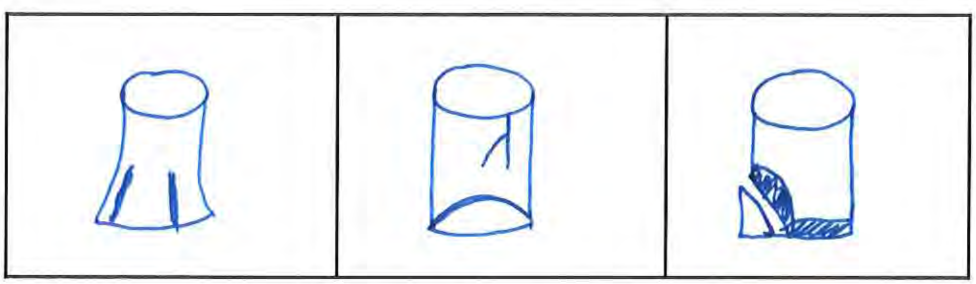
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	**Test 1**	**Test 2**	**Test 3**
	WB-6 RC - 230-2355 feet	WB-6 RC - 245-250 feet	WB-6 RC - 295-300 feet
Soil Class:			
Dry Density (pcf):	102.7	110.8	110.6
Water Content:	23.1%	18.2%	17.1%
Sample Dia. (mm):	44.7	45.2	44.8
Sample Ht (mm):	89.2	91.4	87.3
Height/Diameter:	2.00	2.02	1.95
Unc. Strength (psf):	**16058**	**9230**	**46813**
Strain at Failure (%):	3.0	4.2	4.4





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

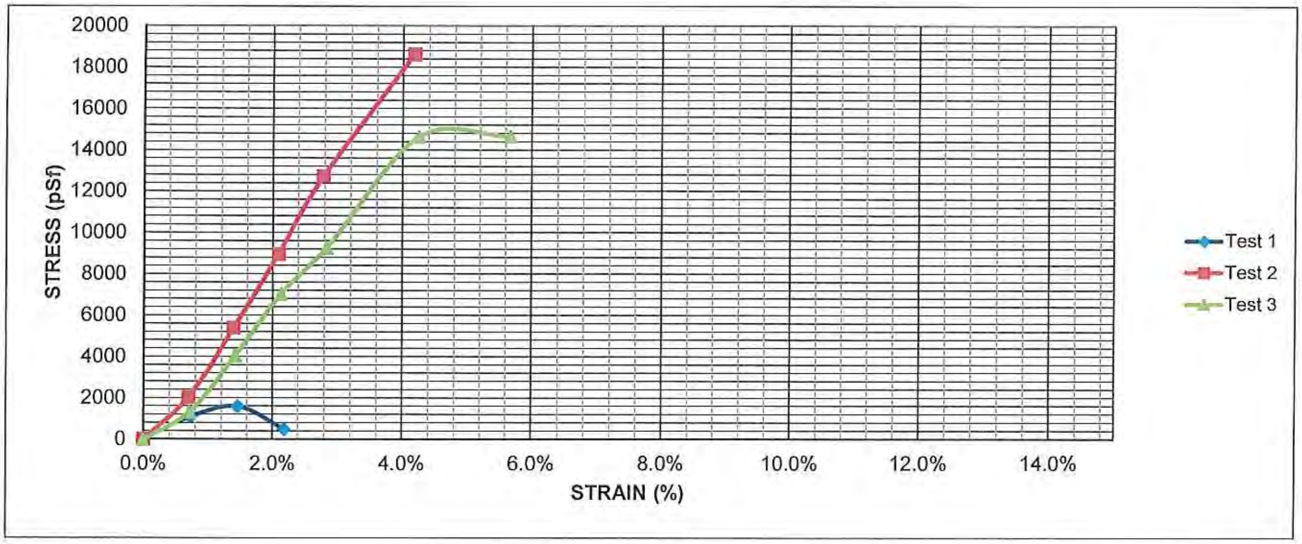
DATE: 4-Jun-20

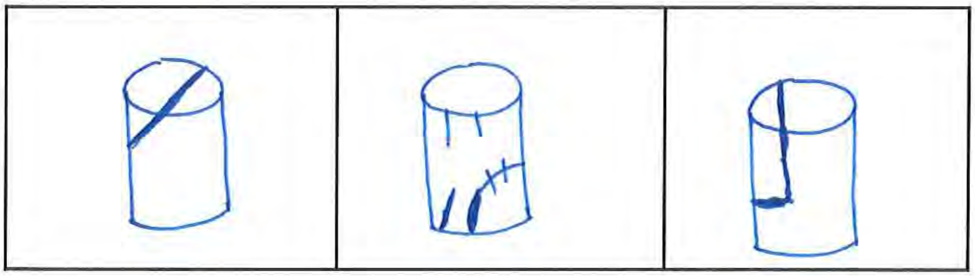
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	Test 1	Test 2	Test 3
	WB-7	WB-7	WB-7
	RC - 250-255 feet	RC - 275-280 feet	RC - 295-300 feet
Soil Class:			
Dry Density (pcf):	102.0	104.2	103.8
Water Content:	21.4%	22.3%	27.3%
Sample Dia. (mm):	44.3	45.7	44.8
Sample Ht (mm):	87.2	91.1	89.6
Height/Diameter:	1.97	1.99	2.00
Unc. Strength (psf):	**1599**	**18637**	**14666**
Strain at Failure (%):	1.5	4.2	5.7





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

DATE: 4-Jun-20

COPIES TO:

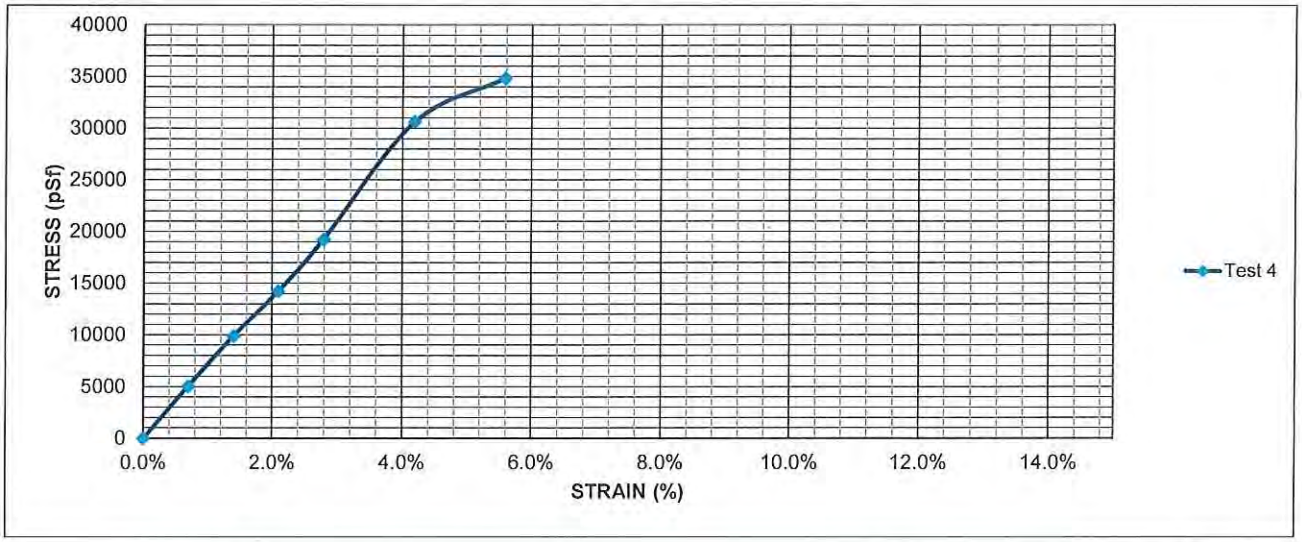
REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

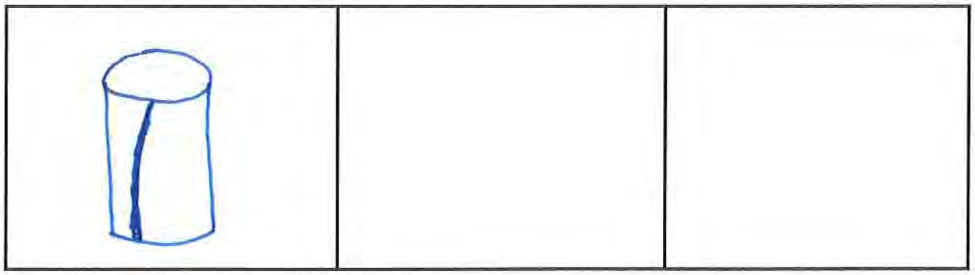
Laboratory Number G20-046

Specimen ID: **Test 4**
WB-7
RC - 182.5-187.5 feet

Soil Class:

Dry Density (pcf):	110.8
Water Content:	19.1%
Sample Dia. (mm):	45.1
Sample Ht (mm):	91.0
Height/Diameter:	2.02
Unc. Strength (psf):	**34830**
Strain at Failure (%):	5.6





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

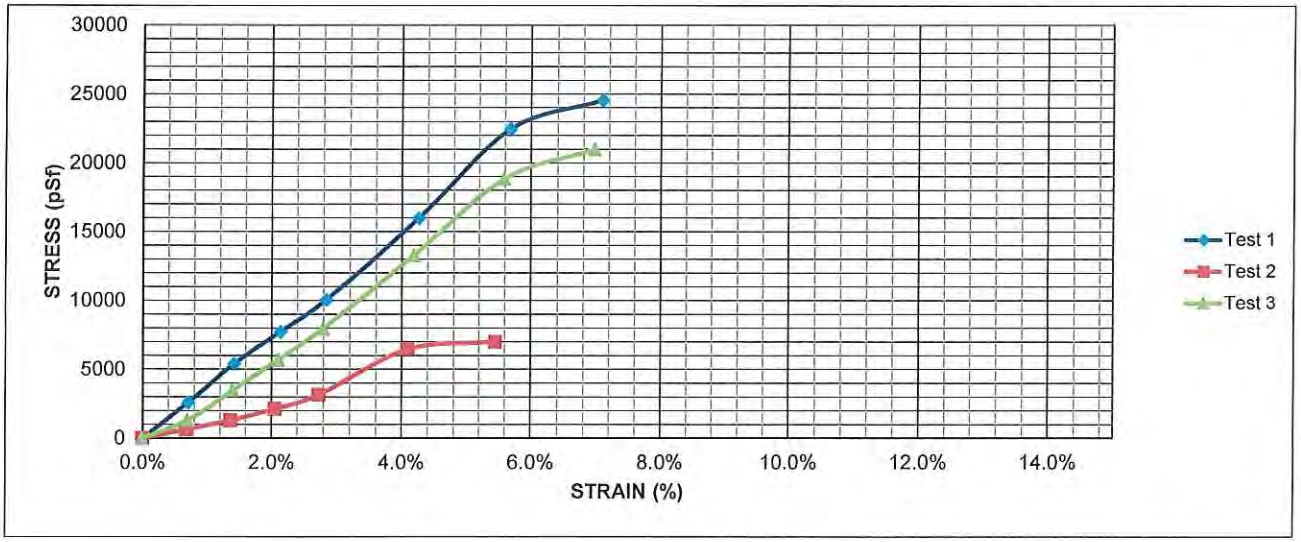
DATE: 5-Jun-20

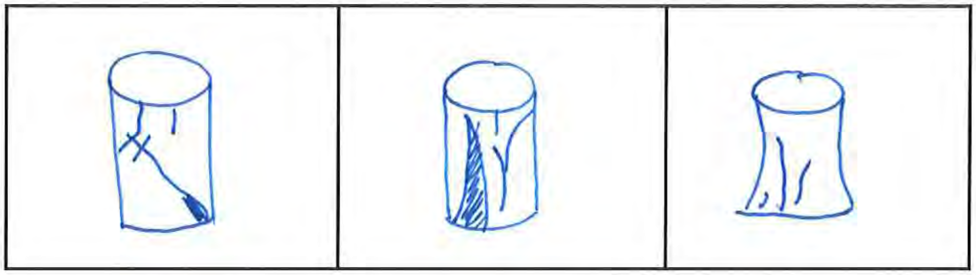
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	Test 1	Test 2	Test 3
	WB-8	WB-8	WB-8
	RC -160-165 feet	RC - 180-185 feet	RC - 200-205 feet
Soil Class:			
Dry Density (pcf):	115.0	106.9	107.0
Water Content:	16.1%	20.1%	21.3%
Sample Dia. (mm):	45.4	46.5	45.7
Sample Ht (mm):	89.4	93.2	91.0
Height/Diameter:	1.97	2.00	1.99
Unc. Strength (psf):	**24564**	**7009**	**21013**
Strain at Failure (%):	7.1	5.5	7.0





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

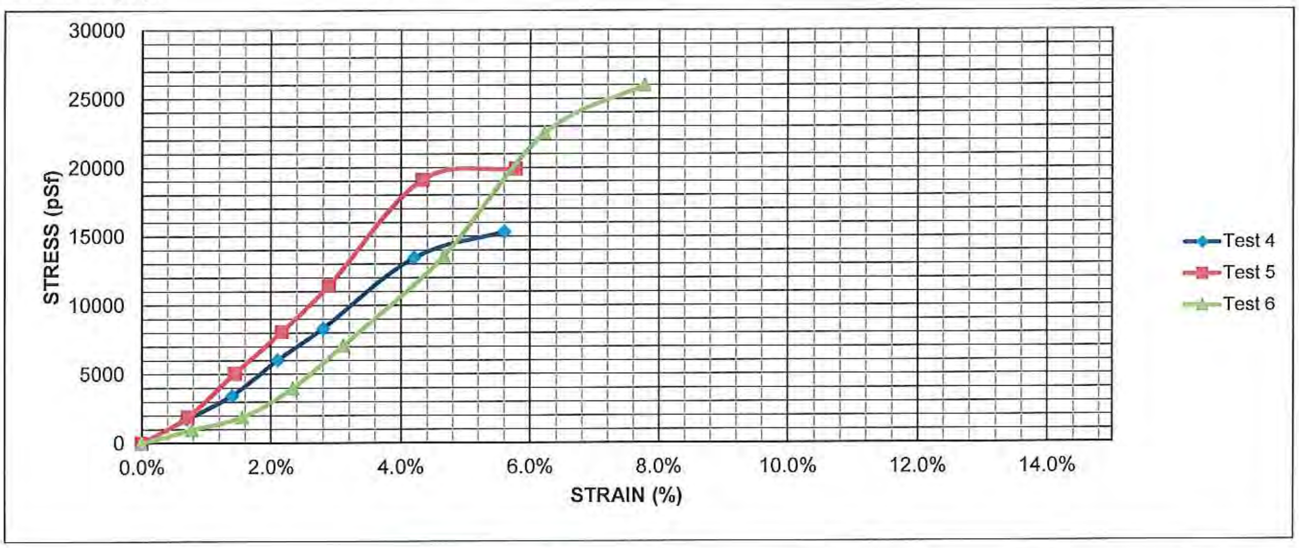
DATE: 5-Jun-20

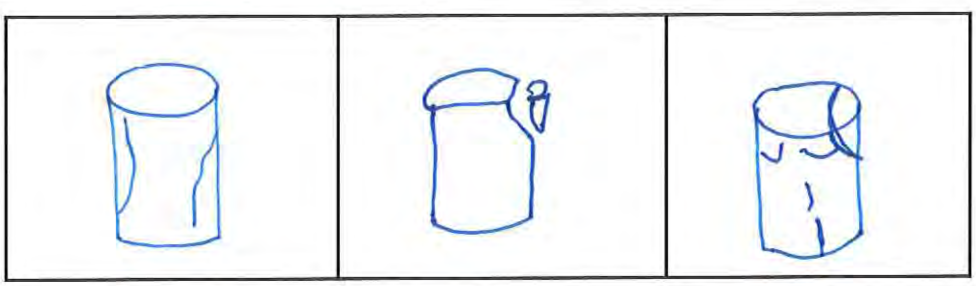
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	**Test 4**	**Test 5**	**Test 6**
	WB-8	WB-8	WB-8
	RC - 220-225 feet	RC - 245-250 feet	RC - 265-270 feet
Soil Class:			
Dry Density (pcf):	108.9	108.8	105.8
Water Content:	20.3%	20.1%	23.1%
Sample Dia. (mm):	45.4	45.3	44.7
Sample Ht (mm):	90.6	87.9	81.6
Height/Diameter:	1.99	1.94	1.83
Unc. Strength (psf):	**15346**	**19931**	**26024**
Strain at Failure (%):	5.6	5.8	7.8





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

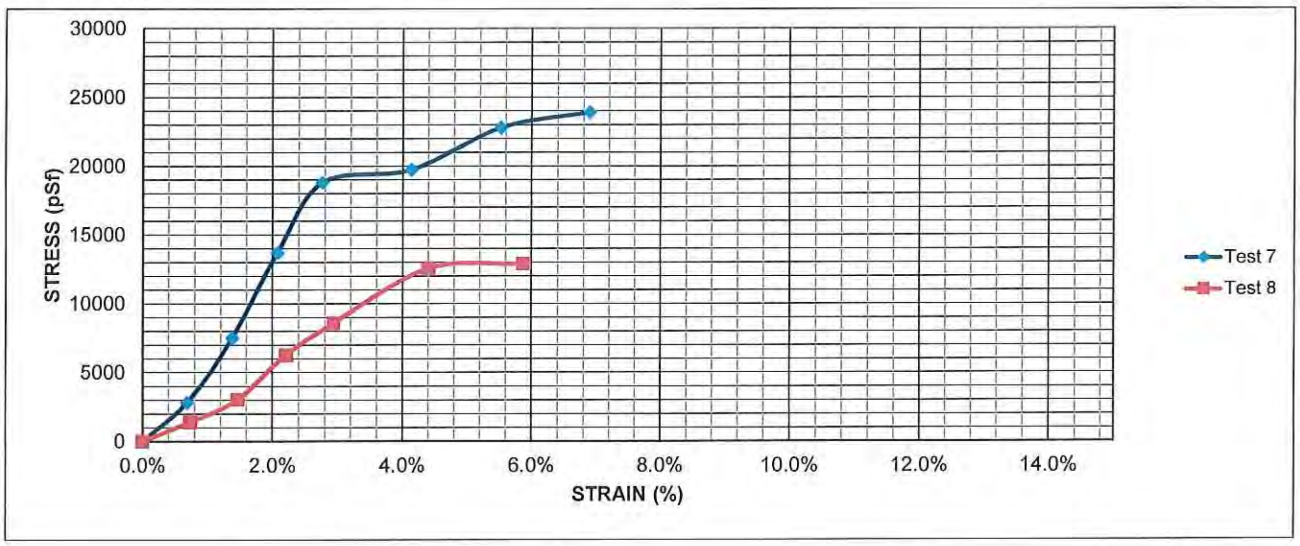
DATE: 5-Jun-20

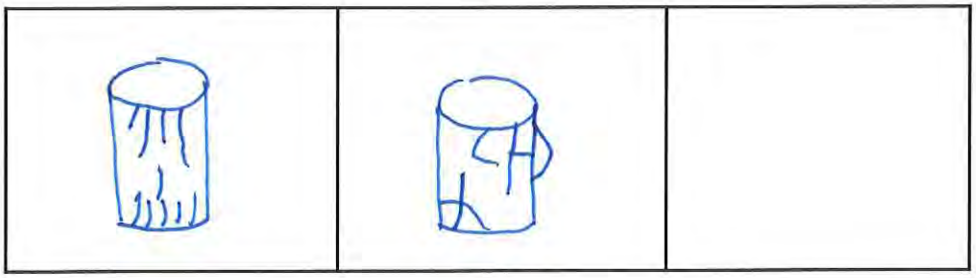
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	**Test 7**	**Test 8**
	WB-8	WB-4
	RC - 275-280 feet	RC - 287.5-292.5 feet
Soil Class:		
Dry Density (pcf):	107.2	106.1
Water Content:	20.8%	24.0%
Sample Dia. (mm):	45.3	45.0
Sample Ht (mm):	92.0	86.5
Height/Diameter:	2.03	1.92
Unc. Strength (psf):	**23927**	**12917**
Strain at Failure (%):	6.9	5.9





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

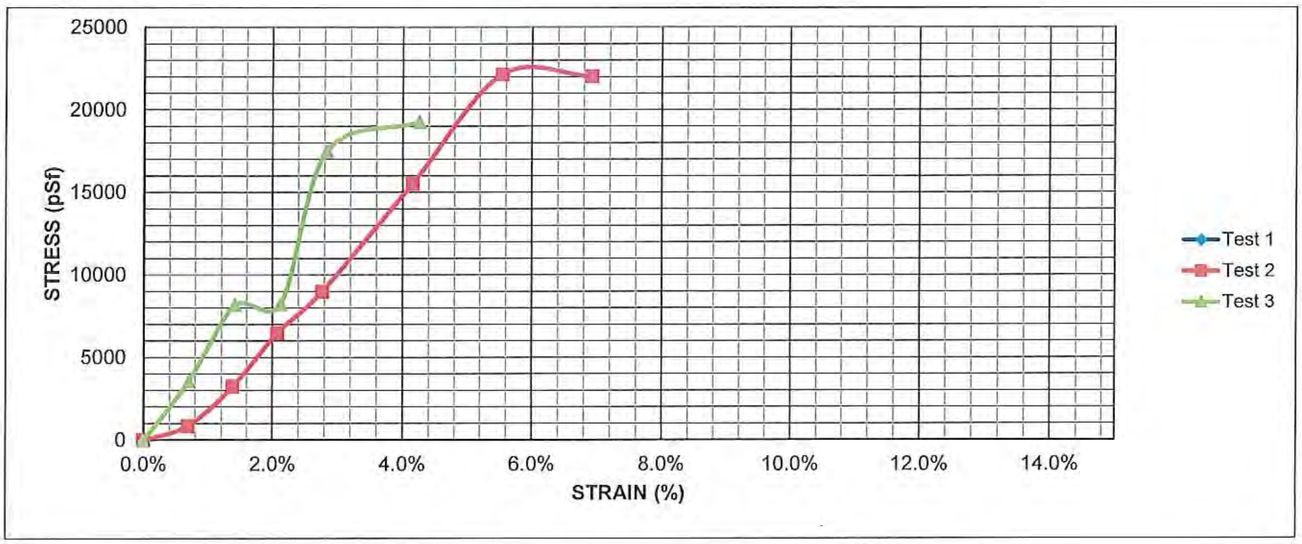
DATE: 7-Jun-20

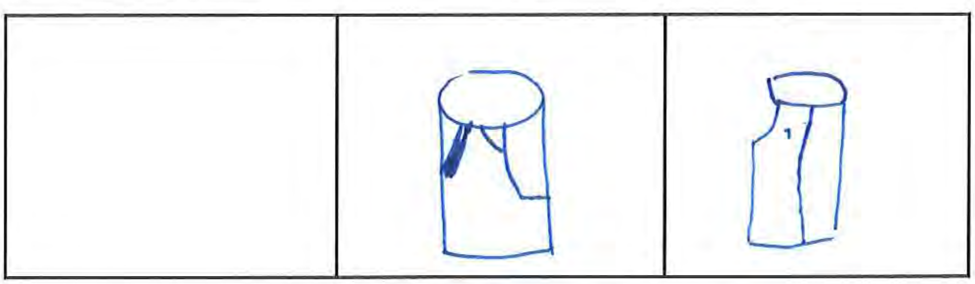
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

	Test 1	Test 2	Test 3
Specimen ID:	WB-5 RC - 87.5-92.5 feet	WB-9 RC - 170-175 feet	WB-9 RC - 190-195 feet
Soil Class:			
Dry Density (pcf):	Unable to Run	108.6	116.3
Water Content:		20.4%	14.2%
Sample Dia. (mm):		45.2	44.6
Sample Ht (mm):		91.7	89.5
Height/Diameter:		2.03	2.01
Unc. Strength (psf):		**25355**	**22155**
Strain at Failure (%):		4.1	5.3





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

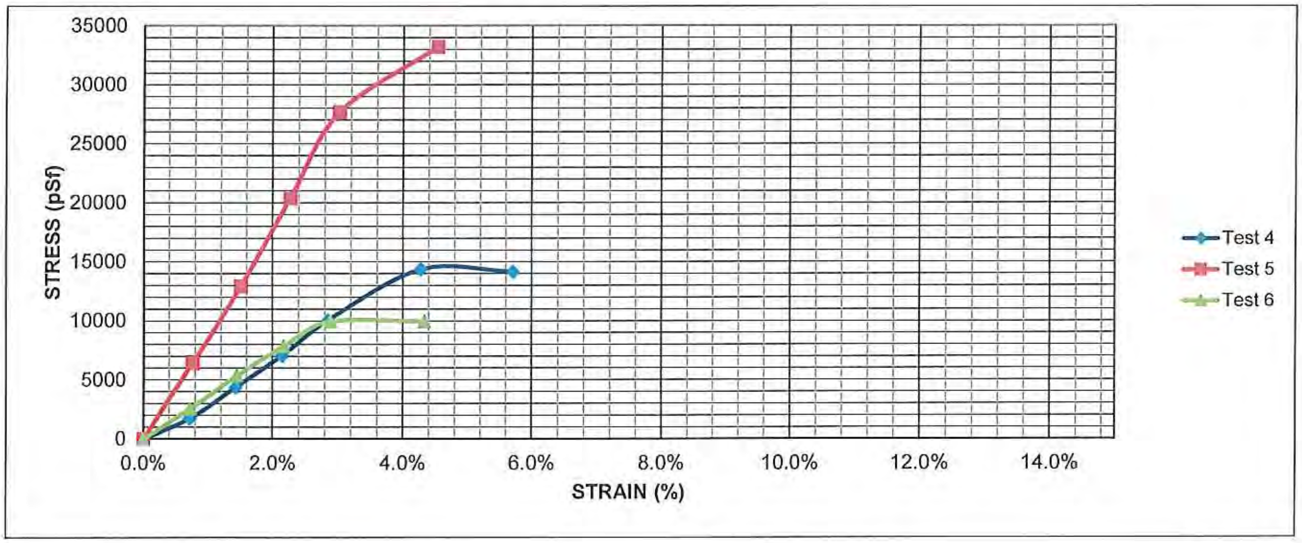
DATE: 7-Jun-20

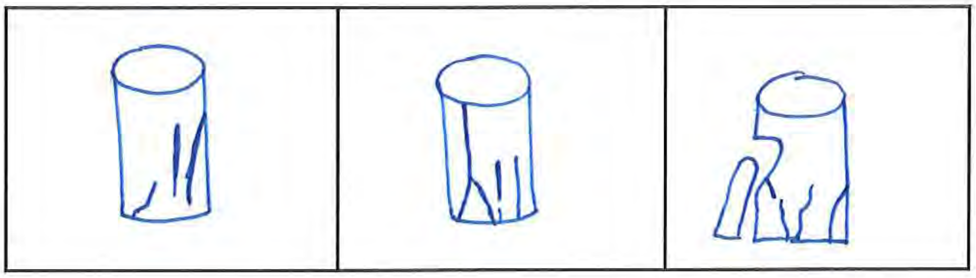
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	**Test 4**	**Test 5**	**Test 6**
	WB-9	WB-5	WB-5
	RC - 210-215 feet	RC - 235-240 feet	RC - 265-270 feet
Soil Class:			
Dry Density (pcf):	104.4	108.5	106.3
Water Content:	23.0%	19.7%	20.2%
Sample Dia. (mm):	45.6	44.5	44.5
Sample Ht (mm):	88.9	83.9	87.8
Height/Diameter:	1.95	1.89	1.97
Unc. Strength (psf):	**14375**	**33239**	**9965**
Strain at Failure (%):	4.3	4.5	4.3





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

MATERIAL TESTING SERVICES, LLC

P.O. Box 634
Minot, ND 58702
(701) 852-5553

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 2166

P.O. Box 1093
Williston, ND 58802
(701) 572-4226

PROJECT: WBI NORTH BAKKEN EXPANSION
MISSOURI RIVER HDD CROSSING

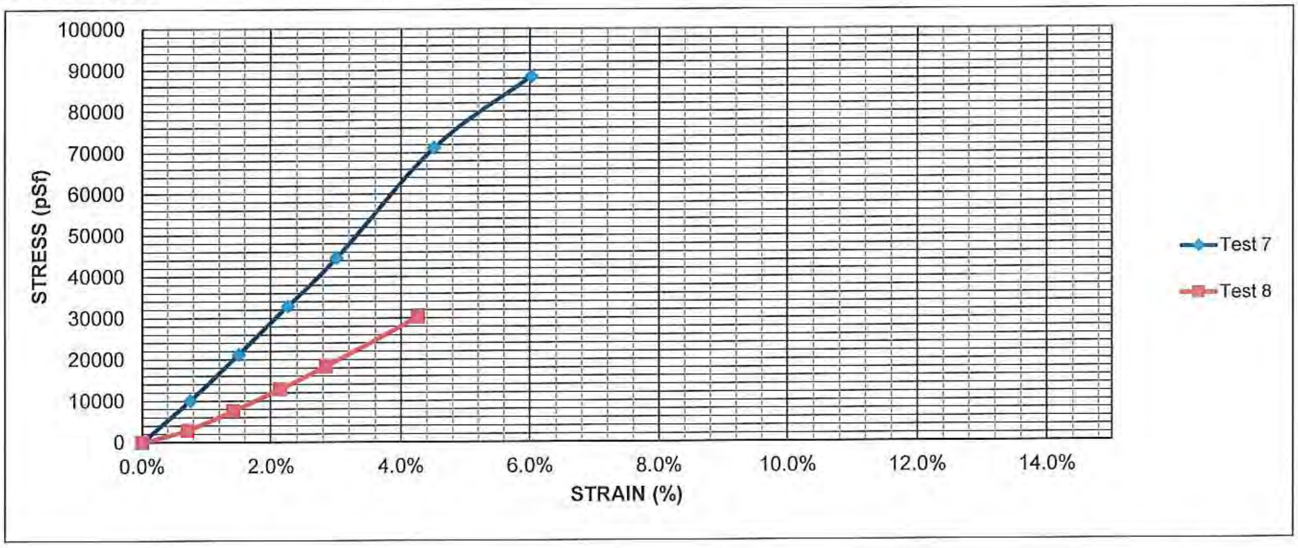
DATE: 7-Jun-20

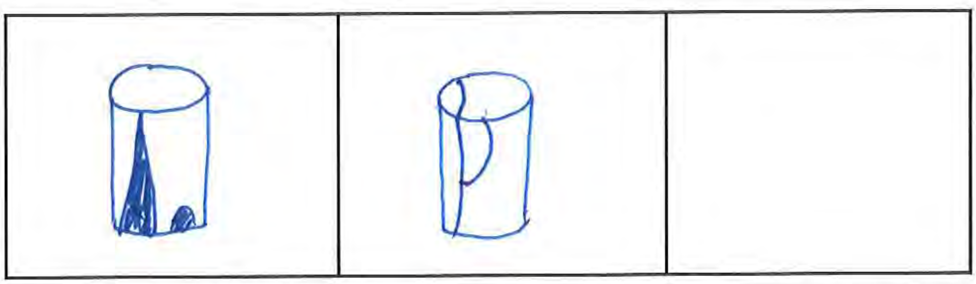
COPIES TO:

REPORTED TO: Attn: James Simonet, PG
GES
1301 Corporate Center Drive
Eagan, MN 55121

Laboratory Number G20-046

Specimen ID:	**Test 7**	**Test 8**
	WB-9	WB-9
	RC - 255-260 feet	RC - 305-310 feet
Soil Class:		
Dry Density (pcf):	112.7	117.6
Water Content:	15.3%	14.2%
Sample Dia. (mm):	42.2	44.9
Sample Ht (mm):	84.3	89.2
Height/Diameter:	2.00	1.99
Unc. Strength (psf):	**88505**	**30377**
Strain at Failure (%):	6.0	4.3





AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Material Testing Services, LLC

by

LABORATORY TEST RESULTS

Testing Scope

Laboratory testing was proposed to characterize soils index properties including Atterberg limits (liquid and plastic limits) and moisture content. Strength testing included unconfined compression testing.

Index Properties

Testing and classification of soils was performed in accordance with the Unified Soil Classification System as described in ASTM D 2487. Atterberg limits were performed according to ASTM D 4318. Moisture content was determined in accordance with ASTM D 4959 and D 4643. The dry density was determined with direct measurement procedures. Mechanical sieve analysis was done in accordance with ASTM D 422.

Strength Testing

The strength tests consisted of unconfined compression (QU) testing. The QU tests were conducted in accordance with ASTM D 2166.

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
		Clean Gravels (Less than 5% fines)
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels with fines (More than 12% fines)
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
		Clean Sands (Less than 5% fines)
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
		Sands with fines (More than 12% fines)
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

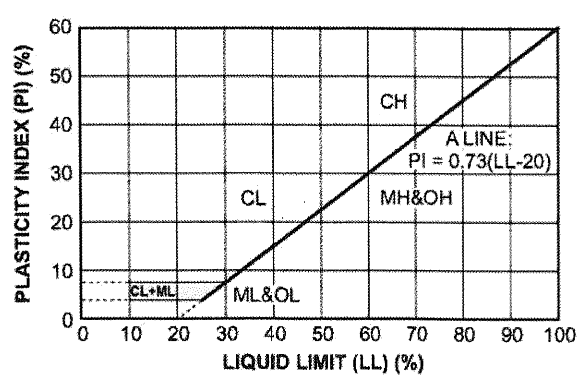
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent .... GW, GP, SW, SP
More than 12 percent .... GM, GC, SM, SC
5 to 12 percent .... Borderline cases requiring dual symbols

PLASTICITY CHART



NORTH BAKKEN EXPANSION PROJECT

Resource Report 1

APPENDIX 1J
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project

APPENDIX 1J

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation
Montana-Dakota Utilities Transmission Line	Energy	Montana-Dakota Utilities is seeking to purchase a 50-foot-wide strip of land from Stenehjem Holdings for the purpose of constructing an overhead electric transmission line in or near Watford City.	Early permitting phases	Unknown	Unknown	Williams	4	0	WW, VG, WF, TE, SO, LU, VS	(Watford City Planning and Zoning Commission, 2015)
Aurora Wind Electric Transmission Line	Energy	The Aurora Wind electric transmission line is an approximately 20-mile-long 345-kilovolt aboveground transmission line. It would extend from the proposed Aurora Wind Project substation in Williams County to the existing Basin Electric Power Cooperative Tande Substation located in Mountrail County.	Under construction	3Q 2019	4Q 2020	Mountrail, Williams	0	<1	WW, VG, WF, TE, CR, GS, N-con, N-op, SO, LU, RS, VS	(Burns & McDonnell, 2018a; Aurora Wind Project, LLC, 2020)
Aurora Wind Project	Energy	The Aurora Wind Project is a proposed wind energy development that would generate up to 300 megawatts of electricity at rated capacity. It would include construction of up to 121 wind turbines located on a 48,000-acre site approximately 5 miles northwest of Tioga.	Under construction	3Q 2019	4Q 2020	Williams, Mountrail	5 [4 - Weflen Staging Yard]	0	N-op, SO, LU, VS	(Burns & McDonnell, 2018b; Aurora Wind Project, LLC, 2020)

APPENDIX 1J (cont'd)

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation
Demicks Lake Plant II	Energy	ONEOK is constructing the Demicks Lake Plant II, a 200-million cubic feet per day natural gas processing facility northeast of Watford City and about 14 miles east of the proposed Tioga-Elkhorn Creek pipeline MP 45.	Completed	3Q 2019	1Q 2020	McKenzie	14	0	AQ-op, SO	(ONEOK, 2019)
Nesson Gathering Gas Plant (LU-0036-19)	Energy	Nesson Gathering Inc. proposes to construct a natural gas gathering plant on 76 acres and located in the SE/4 of section 35, T154N R102W.	Permit obtained	Unknown	Unknown	Williams	33 [17 - Springbrook Plant Receipt Station]	0	AQ-op, SO	(Williams County Planning and Zoning Commission, 2019b)
Nesson Gathering Gas Plant (LU-0001-19)	Energy	Nesson Gathering Inc. proposes to construct a natural gas gathering plant on a 158 acre property, located NE/4 of Section 1, T153N R104W.	Permit obtained	Unknown	Unknown	Williams	40 [26 - Springbrook Plant Receipt Station]	0	AQ-op, SO	(Williams County Planning and Zoning Commission, 2019b)
Natural Gas Plant Expansion (LU-0191-18)	Energy	An existing gas plant located about 5 miles south-southwest of Tioga will expand to include additional laydown space. The property is 73 acres and located in NW/4 of Section 4.	Permit obtained	Unknown	Unknown	Williams	Under 1	0	WW, VG, SO	(Williams County Planning and Zoning Commission, 2019c)

APPENDIX 1J (cont'd)

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation
Kinder Morgan Roosevelt Gas Plant Expansion	Energy	The expansion would increase the capacity to process 150 million cubic feet per day; located about 7 miles south of Watford City and about 10 miles west of proposed project MP 37.	Approved by ND PSC 4Q 2018	Unknown	Unknown	McKenzie	27 [25 - Springbrook Plant Receipt Station]	0	WW, AQ-op, SO	(Hilland Partners, 2018a)
Arrow Bear Den Gas Processing Plant II	Energy	McKenzie Arrow Field Services, LLC proposes to construct the Arrow Bear Den Gas Processing Plant II, a 200mcfd capacity processing plant. The proposed site is within 1 mile of MP 59 of the proposed Tioga-Elkhorn Creek pipeline.	Completed	1Q 2018	3Q 2019	McKenzie	Under 1	0	AQ-op, SO, LU, RS, VS	(Arrow Field Services, LLC, 2017, 2020)
Robinson Lake Gas Plant	Energy	The Robinson Lake Gas Plant Expansion is located 32 miles west of the proposed Tioga-Elkhorn Creek pipeline MP 30. This proposal is to increase the capacity of the existing plant from 97.5 to 110 million standard cubic feet per day.	Unknown	Unknown	Unknown	McKenzie	32 [16 - Robinson Lake Plant Receipt Station]	0	AQ-op, SO	(Whiting Oil and Gas Corporation, 2013 and PSC, 2019)
Demicks Lake - Cherry Creek Pipeline Project	Energy	WBI Energy's Demicks Lake - Cherry Creek Pipeline Project will carry gas from ONEOK Rockies Midstream LLC's Demicks Lake gas processing plant near Keene, North Dakota,	Completed	1Q 2019	3Q 2019	McKenzie	0	2	WW, VG, WF, TE, CR, SO, LU	(WBI Energy Transmission, Inc., 2018)

APPENDIX 1J (cont'd)

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation
		to an interconnect with Northern Border Pipeline Co.'s mainline outside of Watford City, North Dakota. The proposed Tioga-Elkhorn Creek pipeline would cross the 12.2 mile pipeline near MP 47.								
Wild Basin to Sax Valve Looped Pipeline	Energy	WBI Energy's Wild Basin to Sax Valve Looped Pipeline consists of approximately 2 miles of 20-inch-diameter natural gas pipeline in McKenzie County, North Dakota. Project falls under WBI Energy's Blanket Authorization.	Completed	4Q 2019	1Q 2020	McKenzie	Under 1	0	WW, VG, WF, TE, CR, GS, SO, LU, VS	(WBI Energy Transmission, Inc., 2019)
Bakken Pipeline LLC	Energy	The ONEOK Bakken Pipeline Project is a 10.8-mile, 12-inch-diameter steel natural gas liquids pipeline that would originate at the Targa Badlands, LLC. Little Missouri Gas Processing Plant and terminate at an interconnection with ONEOK's Demicks Lake Plant. The Project would be located in McKenzie County, and is approximately 2 miles west of the proposed Tioga-	Completed	2Q 2019	4Q 2019	McKenzie, Richland	2	0	WW, VG, WF, TE, CR, GS, AR-con, N-con, SO	(ONEOK Bakken Pipeline, LLC, 2019a, 2019b)

APPENDIX 1J (cont'd)

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation
		Elkhorn Creek pipeline MP 60.								
Bakken Missouri River Crossing Project	Energy	Kinder Morgan's Bakken Missouri River Crossing Project plans to connect the existing Kinder Morgan Brogger compressor station located in Williams County, North Dakota, to a Kinder Morgan natural gas gathering system located in McKenzie County, North Dakota. The project will include the installation of approximately 10 miles of 20-inch diameter pipeline between the Brogger compressor station and Kinder Morgan natural gas gathering system.	Unknown	2Q 2019	Unknown	Williams	7	0	SO	(Hilland Partners, 2018b)
Gunslinger Federal and Gladstone Oil and Gas Well Pads	Energy	The Gunslinger Federal well pad would have 10 wells and be operated by Slawson. The Gladstone well pad would have seven wells and be operated by Burlington. The proposed project also includes construction of a new access road and corridor for associated oil and gas equipment and utilities. The well pads would be constructed on the Little Missouri National	Decision Notice and Finding of No Significant Impacts received	Under Construction	Unknown	McKenzie	0	<1	WW, VG, WF, CR, LU	(U.S. Forest Service, 2019)

APPENDIX 1J (cont'd)

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation
		Grasslands (LMNG), which are part of the Dakota Prairie Grasslands (DPG) managed by the USFS in the Tobacco Gardens Area of McKenzie County, North Dakota.								
Other Oil and Gas Well Developments (various)	Energy	Various oil and gas developments including well pads, directional drill (horizontal) wells, and access roads are planned throughout McKenzie county.	Analysis and document preparation	Unknown	Unknown	McKenzie	3 to 25	0	WW, VG, AQ-con, SO	(U.S. Bureau of Land Management, 2019)
North Bakken Expansion Project Customer Tie-In Facilities	Energy	Customer tie-in facilities at the proposed transfer/receipt/delivery stations that are part of the proposed North Bakken Expansion Project.	Under Development	2020-2021	2021	Various	0	Unknown	WW, VG, WF, CR, LU	N/A
Lower Sundhagen Scoria Mine Reclamation	Energy	Reclamation of scoria (clinker) pits in Williams County would require backfill of 6,300 cubic yards of soil and revegetation of 3 acres.	Decision and Appeal	Unknown	Unknown	Williams	4	0	N/A	(U.S. Bureau of Land Management, 2016)
Williston Basin International Airport	Commer-cial	The Williston Basin International Airport will have 2 runways and 110,000 square foot terminal building and will be located about 10 miles NW of Williston.	Completed	2018	4Q 2019	Williams	32 [12 - Springbrook Plant Receipt Station]	0	AQ-op, N-op, SO	(KLJ, 2015)

APPENDIX 1J (cont'd)

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation
Cenex Pipeline	Energy	Cenex Pipeline, LLC plans to construct a 10" refined fuels pipeline from Sidney, Montana, to Minot, North Dakota, to replace a portion of an existing 8-inch pipeline system, while adding throughput capacity. The proposed route is in the early permitting phase and would intersect the proposed Tioga-Elkhorn Creek pipeline near MP 10.	Under construction	2019	2020	Williams, Mountrail	0	<1	WW, VG, WF, CR, GS, N-con, SO, LU, RS, VS	(KLJ, 2017)
Water transmission line in Watford City	Utilities (Non Energy)	A proposed water transmission line in Watford City pipeline would furnish water to "The Crossings at Watford City" and to support the oil industry.	Early permitting phases	Unknown	Unknown	McKenzie	1	0	WW, VG, WF, TE, CR, GS, AR-con, N-con, SO	(Watford City Planning and Zoning Commission, 2019)
Western Area Water Supply Project	Utilities (Non Energy)	The Western Area Water Supply Project (WAWSP) was developed to supply drinking water from the Missouri River supplemented with groundwater from the R&T Water Supply Commerce Authority (WSCA) to meet the municipal, rural, and industrial water needs for all or parts of McKenzie, Williams, Divide, Burke,	Under construction	Under construction	Unknown	Mountrail, McKenzie	0	Unknown – Exact locations of projects are not known, only the develop-ment areas	WW, VG, WF, TE, CR, GS, AR-con, N-con, SO, LU	(Western Area Water Supply Authority, 2019)

APPENDIX 1J (cont'd)

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation
		and Mountrail Counties. Two of the development areas, East White Earth and System I Spring Creek, intersect the proposed Tioga-Elkhorn Creek pipeline near MP 61.9.								
Route 9 Reconstruction	Transpor-tation	USACE has issued a permit for reconstruction of Route 9 approximately 6 miles east of the proposed Tioga-Elkhorn Creek pipeline MP 6.	Permit issued by USACE 4Q 2018	Unknown	Unknown	Mountrail	6	0	WW, TE	(U.S. Army Corps of Engineers, 2018)
DOT Road Improvements - Red Mike Area to County Road 42	Transpor-tation	Improvements are planned along ND 1804 from Red Mike Area to CR 42 (Epping Road). Improvements include increasing structural capacity, widening the shoulders, improving the road surface and installing a stop light.	Unknown	2020	2020	Williams	2	0	WW, VG, AQ-op, SO, VS	(North Dakota Department of Transporta-tion, 2019a)
US 85 – I-94 to Watford City Bypass	Transpor-tation	The U.S. Highway 85 Project encompasses approximately 62 miles of roadway in Stark, Billings, and McKenzie counties, North Dakota. The project begins at the Interstate 94 (I-94) interchange and extends north to the Watford City Bypass (McKenzie County Road	Record of Decision 2Q 2019	2019	2020	McKenzie	3	0	WW, VG, WF, TE, AQ-op, SO, VS	(North Dakota Department of Transporta-tion, 2019b)

APPENDIX 1J (cont'd)

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation
		30). The proposed action is to expand this segment of U.S. Highway 85 from a two-lane highway to a four-lane highway. The north end of the improvements are approximately 3 miles west of the south end of the proposed Tioga-Elkhorn pipeline.								
Pine Ridge Development	Residen-tial	The Pine Ridge Development would include curbs, gutters, paved streets, and the addition of single-family homes and additional duplexes and a four-plex in Tioga.	Unknown	Unknown	2019	Williams	Under 1	0	WW, VG, WF, TE, CR, GS, N-con, SO, VS	(Landgrid, 2016)
Homestead at Watford City First Addition	Residen-tial	Homestead at Watford City First Addition is a development of six single family homes in Watford City.	Unknown	Unknown	Unknown	McKenzie	4	0	VG, SO	(Homestead at Watford City, 2015)
Aspen Heights Condominiums	Residen-tial	Aspen Heights Condominiums would include 48 new apartment units at 1000 South Pheasant Ridge Street.	Early permitting phases	Unknown	Unknown	McKenzie	4	0	VG, SO	(Orange Property Management, 2019)
Elementary School	Government	McKenzie County School District is proposes to build a new elementary school in Watford City, in the Fox Hills Village Subdivision.	Rezoning process	Unknown	Unknown	McKenzie	3	0	WW, VG, CR, GS, N-con, VS	(McKenzie County, 2019)

APPENDIX 1J (cont'd)

North Bakken Expansion Project
Past, Present, and Reasonably Foreseeable Future Projects Evaluated for Potential Cumulative Impacts with the North Bakken Expansion Project [a,b]

Project Name	Category	Project Description	Status	Construction Commences	Operation Commences	County(ies)	Distance from Pipeline [or Other Project Facility if Closer] (miles)	Approx-imate Acres of Overlap	Resources with Potential for Cumulative Impacts	Citation

AQ-con = air quality (construction); AQ-op = air quality (operations); CR = cultural resources; GS = geology and soils; LU = land use; N/A = Not available; N-con = noise (construction); N-op = noise (operation); RS = recreation and special interest areas; SO = socioeconomics; TE = threatened and endangered species; VG = vegetation; VS = visual resources; WF = wildlife, fish; WW = wetlands, water resources

[a] The impacts of past actions are expressed as the baseline environmental conditions and are not included in this table, although recent past actions that continue to contribute to discernable impacts on a resource are included.

[b] A description of the geographic and temporal scope of the analysis for each resource is provided tables 1.10-1 and 1.10-2 of Resource Report 1.

REFERENCES

Arrow Field Services, LLC. 2017. Application for a Certificate of Site Compatibility for the Arrow Bear Den Gas Processing Plant II. October 2017.

Arrow Field Services, LLC. 2020. PU-17-397 Arrow Bear Den Gas Processing Plant II As-Built Inspection Report. Available online at https://psc.nd.gov/database/documents/17-0397/076-010.pdf. Accessed August 2020.

Aurora Wind Project, LLC. 2020. PU-18-352 Aurora Wind Project Progress Report – month ending July 2020. August 10, 2020. Available online at https://psc.nd.gov/database/docket_file_list.php?s_dept=PU&s_company_name=Aurora+Wind+Project%2C+LLC&docket_viewPage=2&s_year_case=18&s_seq_num=352&s_doc=156. Accessed August 2020.

Burns & McDonnell Engineering Company, Inc. 2018a. Application to the North Dakota Public Service Commission for a Certificate of Corridor Compatibility and Route Permit for the Aurora Wind Project Transmission Line. September 2018. Accessed August 2019.

Burns & McDonnell Engineering Company, Inc. 2018b. Application to the North Dakota Public Service Commission for a Site Certificate of Compatibility for the Aurora Wind Project, LLC. September 2018. Accessed August 2019.

Hilland Partners Holdings. 2018a. Application for Certificate of Site Compatibility for the Roosevelt Gas Plant Expansion Project. July 2018.

Hilland Partners Holdings. 2018b. Bakken Missouri River Crossing Fact Sheet. October 2018.

Homestead at Watford City. 2015. Recent News. Available online at http://www.homesteadatwatfordcity.com/. Accessed August 2019.

KLJ. 2015. Final Environmental Assessment. Sloulin Field International Airport. Williston, North Dakota. September 22, 2015.

KLJ. 2017. Consolidates Application for a Certificate of Corridor Compatibility and Route Permit for the Cenex Pipeline Project. February 2017.

Landgrid. 2016. Pine Ridge Development, LLC. Parcel ID 03000008128035. Available online at https://landgrid.com/us/58852#b=none&o=PINE+RIDGE+DEVELOPMENT+LLC&op=/us/nd/williams&t=property&p=/us/nd/williams/tioga-twp/29737. Accessed August 2019.

McKenzie County. 2019. Board looks to build second elementary school. Neal A. Shipman. Available online at https://county.mckenziecounty.net/News/Board-looks-to-build-second-elementary-school. Accessed August 2019.

North Dakota Department of Transportation. 2019a. Red Mike Area to County Road 42 (Epping Road) Environmental Assessment. June 2019.

North Dakota Department of Transportation. 2019b. U.S. Highway 85 I-94 Interchange to Watford City Bypass Record of Decision. February 2019.

ONEOK Bakken Pipeline, LLC. 2019a. Consolidated Application for Certificate of Corridor Compatibility and Route Permit for the Little Missouri Lateral Project. February 2019.

ONEOK Bakken Pipeline, LLC. 2019b. PU-19-85 Final monthly construction report. Available online at https://www.psc.nd.gov/database/docket_file_list.php?s_dept=PU&s_company_name=ONEOK+Bakken+Pipeline%2C+L.L.C.&s_year_case=19&s_seq_num=85&s_doc=86. Accessed August 2020.

ONEOK, 2019. Third Quarter 2019 Results. October 2019.

Orange Property Management, LLC. 2019. Aspen Heights Apartments. Available online at https://www.opm.rent/portfolio_page/aspen-heights-apartments-watford-city/. Accessed August 2019.

Public Service Commission. 2019. February 2019 Siting Spreadsheet. Available online at: https://www.psc.nd.gov/public/consinfo/docs/Feb_2019_siting_spreadsheet.pdf. Accessed August 2020.

U.S. Army Corps of Engineers. 2018. Public Notice of Permit Application. NWO-2013-01203-BIS. October 2018.

U.S. Bureau of Land Management. 2016. DOI-BLM-MT-C030-2016-0047-CX. Decision on Proposed Action. March 2016. North Dakota Field Office.

U.S. Bureau of Land Management. 2019. DOI-BLM-MT-0000-2018-0007-EA. Oil and Gas Lease Parcel Sale March 27, 2019. Billings. Dillon, Glasgow, Havre, Miles City, South Dakota, and North Dakota Field Offices.

U.S. Forest Service. 2019. Dakota Prairie Grasslands, McKenzie Ranger District. July 2019. Environmental Assessment, Gunslinger Federal and Gladstone Oil and Gas Well Pads, Access Road, and Utilities. McKenzie County, North Dakota.

Watford City Planning and Zoning Commission. 2015. Meeting Minutes August 2015. Available online at https://county.mckenziecounty.net/Department/PNZ/Planning_-_Zoning/Meeting-Minutes. Accessed August 2019.

Watford City Planning and Zoning Commission 2019. Meeting Minutes February 25, 2019. Available online at https://www.cityofwatfordcity.com/Department/Planning ZoningCommission/2019-Meeting-Packets. Accessed August 2019.

WBI Energy Transmission, Inc. 2018. Demicks Lake - Cherry Creek Pipeline Project. Volume II - Environmental Report. December 2018.

WBI Energy Transmission, Inc. 2019. Personal Communication between Lori Myerchin of WBI Energy and Andrea Thornton of Environmental Resources Management. October 2019.

Western Area Water Supply Authority. 2019. Western Area Water Supply Project. Available online at https://wawsa.maps.arcgis.com/apps/View/index.html?appid=e85b4f447b954959b7400b43453b0225. Accessed August 2019.

Williams County Planning and Zoning Commission. 2019a. Meeting Minutes June 20, 2019. Available online at https://www.williamsnd.com/Minutes?kw=Planning. Accessed August 2019.

Williams County Planning and Zoning Commission. 2019b. Meeting Minutes May 23, 2019. Available online at https://www.williamsnd.com/Minutes?kw=Planning. Accessed August 2019.

Williams County Planning and Zoning Commission. 2019c. Meeting Minutes January 17, 2019. Available online at https://www.williamsnd.com/Minutes?kw=Planning. Accessed August 2019.