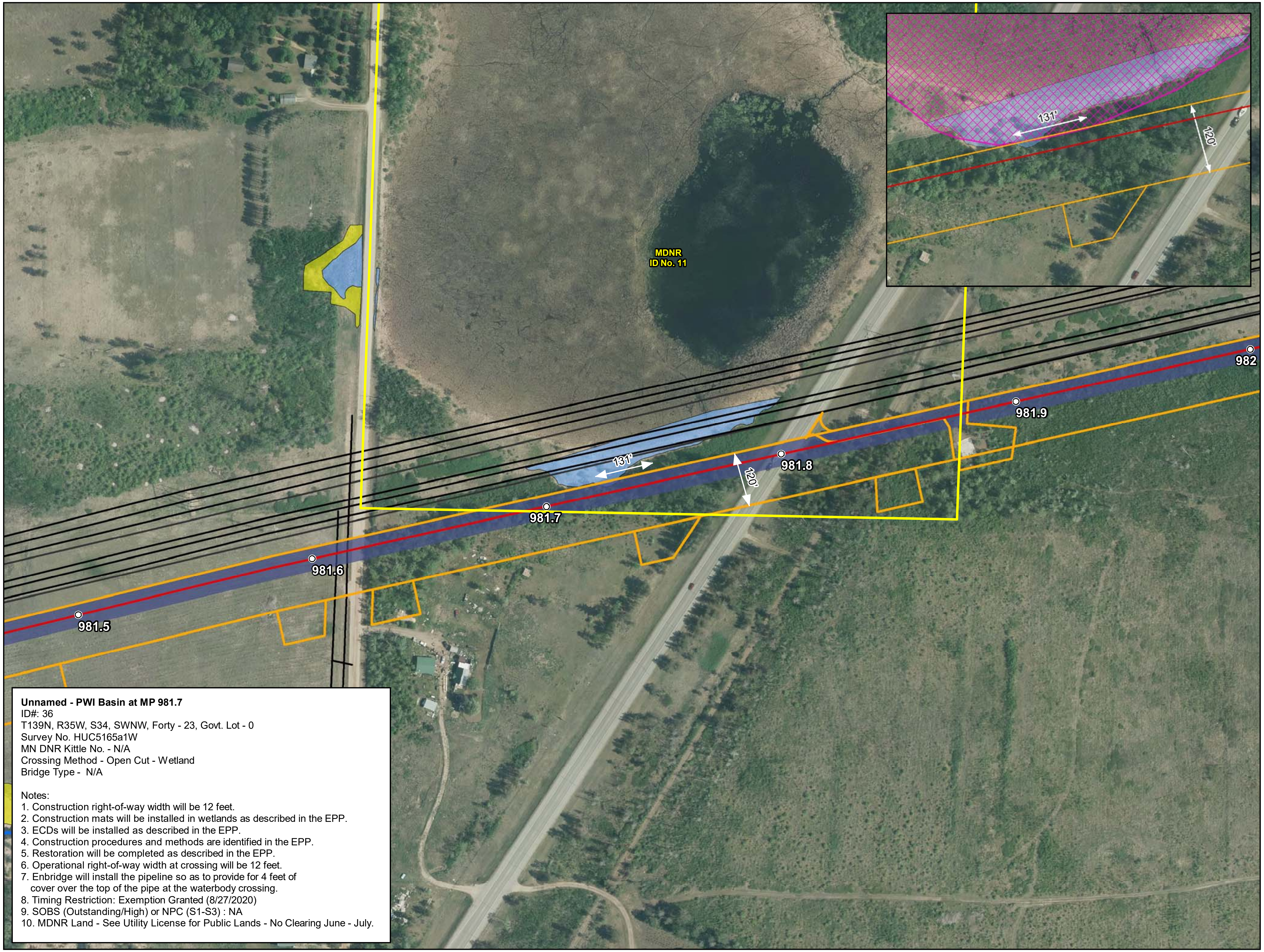
MDNR ID No. 36: MP 981.7; Unnamed Basin



Unnamed - PWI Basin at MP 981.7
ID#: 36
T139N, R35W, S34, SWNW, Forty - 23, Govt. Lot - 0
Survey No. HUC5165a1W
MN DNR Kittle No. - N/A
Crossing Method - Open Cut - Wetland
Bridge Type - N/A

Notes:
1. Construction right-of-way width will be 12 feet.
2. Construction mats will be installed in wetlands as described in the EPP.
3. ECDs will be installed as described in the EPP.
4. Construction procedures and methods are identified in the EPP.
5. Restoration will be completed as described in the EPP.
6. Operational right-of-way width at crossing will be 12 feet.
7. Enbridge will install the pipeline so as to provide for 4 feet of cover over the top of the pipe at the waterbody crossing.
8. Timing Restriction: Exemption Granted (8/27/2020)
9. SOBS (Outstanding/High) or NPC (S1-S3) : NA
10. MDNR Land - See Utility License for Public Lands - No Clearing June - July.

0 100 200 Feet
1 inch = 200 feet

○ Milepost
🟥 Proposed L3R Centerline
— Existing Utility
— Existing Utility
🟦 Permanent Right-of-Way
🟧 Construction Right-of-Way/ATWS
🟨 MDNR-Administered Land
Field Delineated Waterbody
Delineated Wetlands
PEM
PSS

Line 3 Replacement Project

Crossing Plan

ID# 36
Survey No. HUC5165a1W

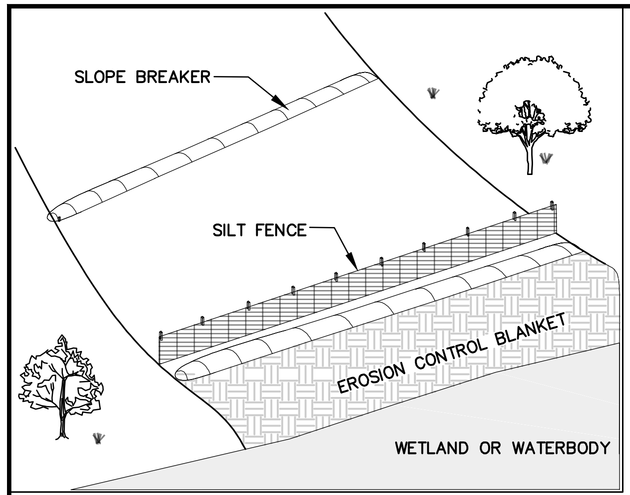
Unnamed - PWI Basin

Hubbard County, Minnesota

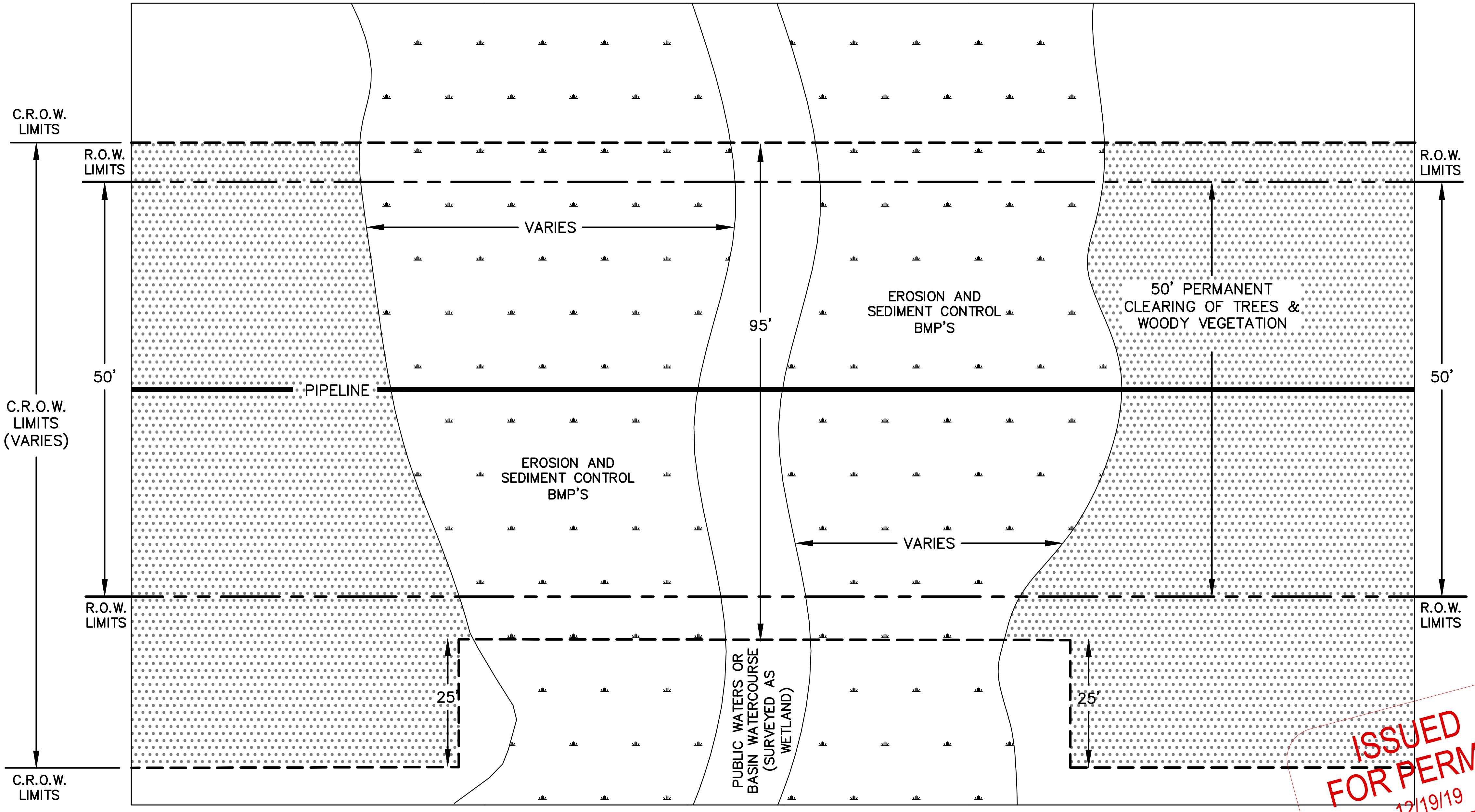
ENBRIDGE
October 2020

For Environmental Review Purposes Only

Date: (10/7/2020) Source: Z:\Clients\E_H\Enbridge\Line_3_Full_Replacement\Permitting\State\Public_Waters\2020_09\Figures\L3R_Waters_App_Open_Cut_2020_09_ID36.mxd



▨ SEEDING AREA



ISSUED FOR PERMIT
12/19/19

<u>PUBLIC WATERS BASIN OR WATERCOURSE (SURVEYED AS WETLAND) CROSSING</u>

1) PRIOR TO DISTURBANCE, EROSION AND SEDIMENT CONTROL BMPS (E.G., STRAW BALES, FILTER SOCKS, SILT FENCES) WILL BE INSTALLED AS PRIOR TO DISTURBANCE AND WILL REMAIN IN PLACE UNTIL THE AREA HAS STABILIZED AND ADEQUATE REVEGETATION HAS ESTABLISHED (SECTION 3.4).

2) SUBSEQUENT TO PIPE INSTALLATION, BACKFILLING OF WETLAND TRENCHES WILL TAKE PLACE IMMEDIATELY, OR AS APPROVED BY THE EI.

3) IN AREAS WHERE TOPSOIL HAS BEEN SEGREGATED, THE SUBSOIL WILL BE REPLACED FIRST.

4) ROUGH GRADING WILL TAKE PLACE NO LATER THAN THE END OF THE WORKDAY FOLLOWING TRENCH BACKFILLING.

5) ENBRIDGE WILL BACKFILL THE TRENCH TO AN ELEVATION SIMILAR TO THE ADJACENT AREAS OUTSIDE THE DITCH LINE AND WILL ADD A SLIGHT CROWN OF APPROXIMATELY 3 TO 6 INCHES (DEPENDING ON SOIL TYPE) OVER THE BACKFILLED TRENCH TO ALLOW FOR SUBSIDENCE.

6) PERIODIC BREAKS IN THE CROWN WILL BE IMPLEMENTED TO ALLOW FOR NORMAL HYDROLOGIC FLOW ACROSS THE BACKFILLED TRENCH. CROWNING WILL NOT EXTEND BEYOND THE PREVIOUSLY EXCAVATED TRENCH LIMITS. AS THE BACKFILL MATERIAL SETTLES, THERE IS POTENTIAL THAT THE ORIGINAL CROWN MAY NOT COMPLETELY RECEDE TO PRE-CONSTRUCTION CONTOURS.

7) AFTER ROUGH GRADING, WHERE TOPSOIL HAS BEEN SEGREGATED, IT WILL BE SPREAD UNIFORMLY OVER THE TRENCH AREA FROM WHICH IT WAS REMOVED.

8) ADDITIONAL (FINAL) GRADING MAY OCCUR WHEN CONDITIONS ALLOW TO ENSURE THE DISTURBED AREA HAS BEEN RETURNED TO PRE-CONSTRUCTION CONDITIONS.

9) PERMANENT SLOPE BREAKERS WILL BE INSTALLED NEAR THE BOUNDARY BETWEEN THE WETLAND AND ADJACENT SLOPED APPROACHES TO PREVENT SEDIMENT FLOW INTO THE WETLAND AS DESCRIBED IN THE EPP (FIGURE 20):

a. PERMANENT SLOPE BREAKERS WILL BE INSTALLED TO MINIMIZE CONCENTRATED OR SHEET FLOW RUNOFF IN DISTURBED AREAS IN ACCORDANCE WITH THE FOLLOWING MAXIMUM ALLOWABLE SPACING UNLESS OTHERWISE SPECIFIED IN PERMIT CONDITIONS.

i.

	SLOPE (%)	APPROXIMATE SPACING (FT)
1.	<5	250
2.	>5-15	200
3.	15-25	150
4.	>25	<100

10) NO FERTILIZER, LIME, OR MULCH WILL BE APPLIED IN WETLANDS, EXCEPT FOR PEATLANDS AS DESCRIBED IN THE EPP (SECTION 7.7.3.).

11) PERMANENT REVEGETATION SEEDING WILL TAKE PLACE IN ACCORDANCE WITH THE EPP (SECTION 7.7).

12) THE APPROPRIATE SEED MIX WILL BE DETERMINED USING THE RESULTS OF PRE-CONSTRUCTION WETLAND FIELD DELINEATIONS, HYDROLOGICAL CHARACTERISTICS AND SITE-SPECIFIC CONDITIONS.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	AJM	12/19/19	KEH	KD
B	ISSUED FOR PERMIT	AJM	12/13/19	KEH	KD
A	ISSUED FOR REVIEW	AJM	12/10/19	KEH	KD

DWN. BY: AJM	DATE 12/10/19
CHK. KEH	
PROJ. ENGR. DG	
PROJ. MGR. KD	
CLIENT APP.	

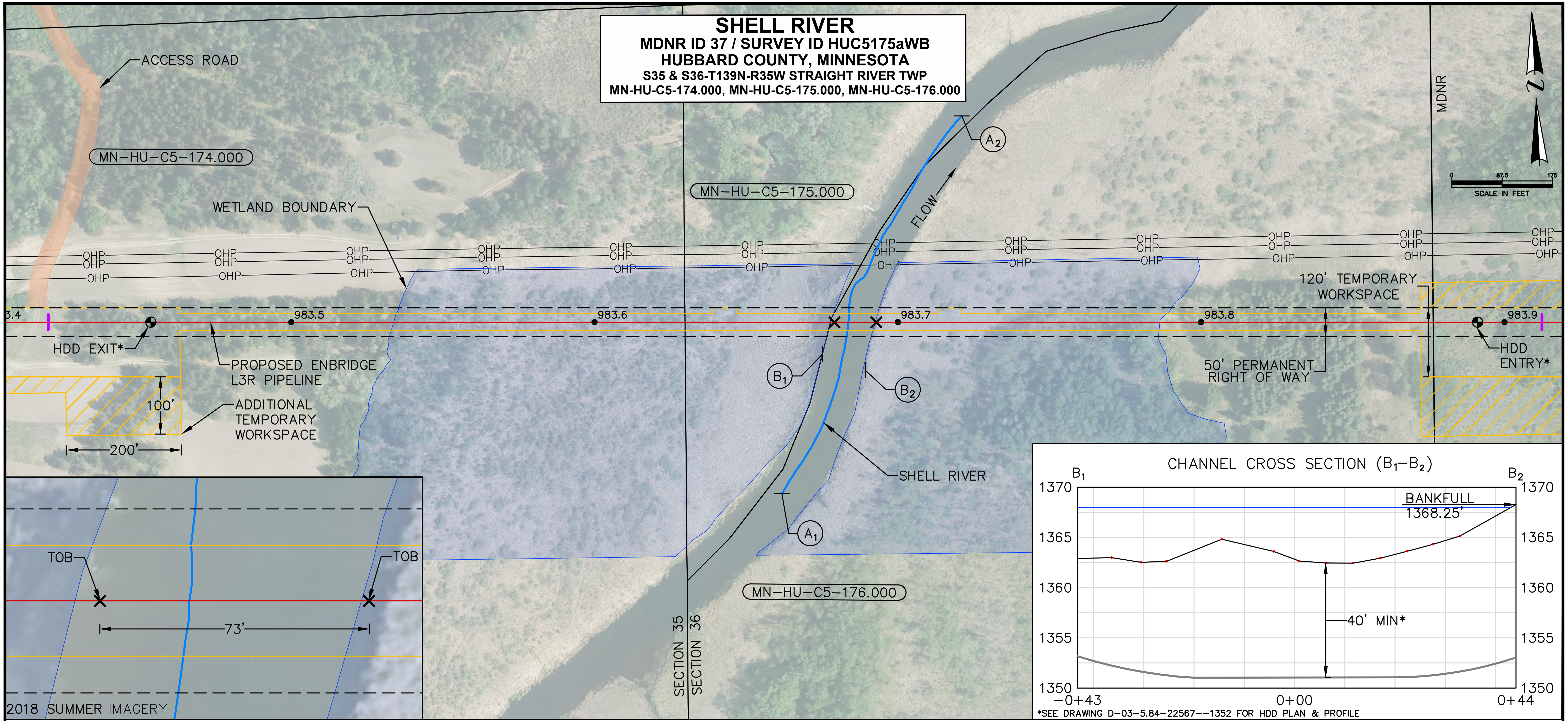
ENBRIDGE

LINE 3 REPLACEMENT
PUBLIC WATERS BASIN OR WATERCOURSE
(SURVEYED AS WETLAND) TYPICAL XING
FINAL STREAM BANK STABILIZATION
& EROSION CONTROL

SCALE NTS
DWG. NO.

MDNR ID No. 37: MP 983.7; Shell River (M-096-035)

SHELL RIVER
MDNR ID 37 / SURVEY ID HUC5175aWB
HUBBARD COUNTY, MINNESOTA
S35 & S36-T139N-R35W STRAIGHT RIVER TWP
MN-HU-C5-174.000, MN-HU-C5-175.000, MN-HU-C5-176.000



*SEE DRAWING D–03–5.84–22567––1352 FOR HDD PLAN & PROFILE

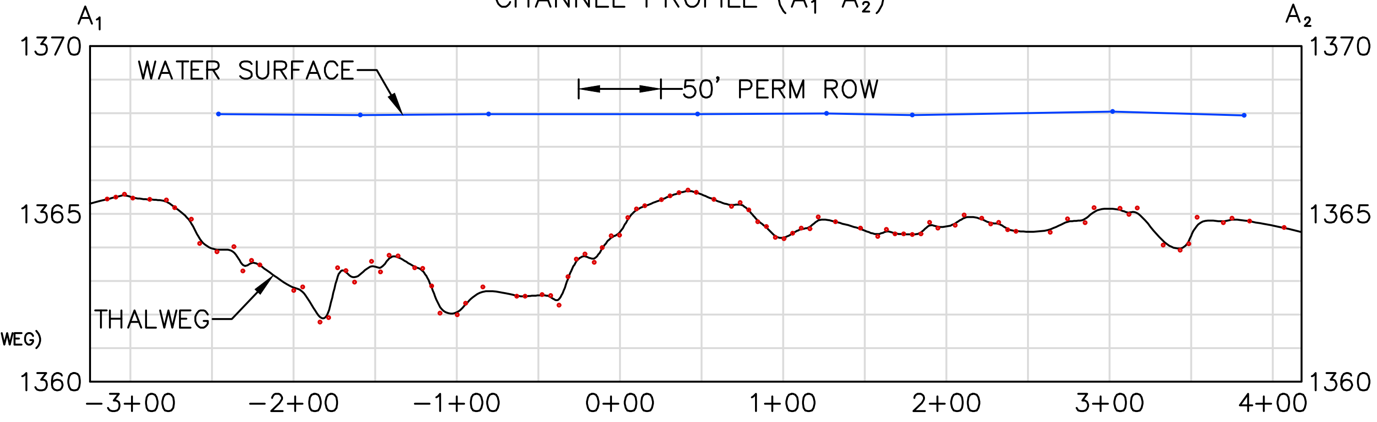
NOTES
1. NO FEMA DIGITAL FLOODPLAIN DATA AVAILABLE
2. SOBS (O/H) OR NPC (S1–3): N/A
3. MDNR REGION 1 PWI – COOL/WARM WATER FISHERY: MARCH 15 – JUNE 30. 24–HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
4. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

CHANNEL CROSS SECTION NOTE:
1. CHANNEL LOCATIONS, DIMENSIONS, AND/OR ELEVATIONS ARE BASED ON 2015 TOPOGRAPHIC/BATHYMETRIC SURVEY(S), AND AS SUCH DO NOT REFLECT CHANGES TO THE CHANNEL THAT MAY HAVE OCCURRED SINCE THAT TIME.

LEGEND

———————	PROPOSED ENBRIDGE L3R PIPELINE
— — — — — —	PERMANENT RIGHT OF WAY
▬▬▬▬▬	TEMPORARY WORKSPACE
▬▬▬▬▬	WATERBODY (ROSGEN SURVEY – THALWEG)
———OHP———	OVERHEAD POWER
———————	TRACT BOUNDARY
MDNR	MINNESOTA DEPARTMENT OF NATURAL RESOURCES (MDNR) BOUNDARY
▭	ACCESS ROAD
▭	WETLAND
▨	ADDITIONAL TEMPORARY WORKSPACE
(MN–XX–XX–XXX.XXX)	TRACT ID
•	ROSGEN SURVEY POINT – WATER SURFACE
•	ROSGEN SURVEY POINT – RIVER BOTTOM (THALWEG)
⊕	HDD ENTRY EXIT POINT
×	TOP OF BANK
|	TRENCH BREAKER (LOCATIONS ARE APPROXIMATE)

CHANNEL PROFILE (A₁–A₂)



FOR ENVIRONMENTAL REVIEW PURPOSES ONLY

0	ISSUED FOR PERMIT APPLICATION	AJJ	10/2020	BAB	BAB
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D

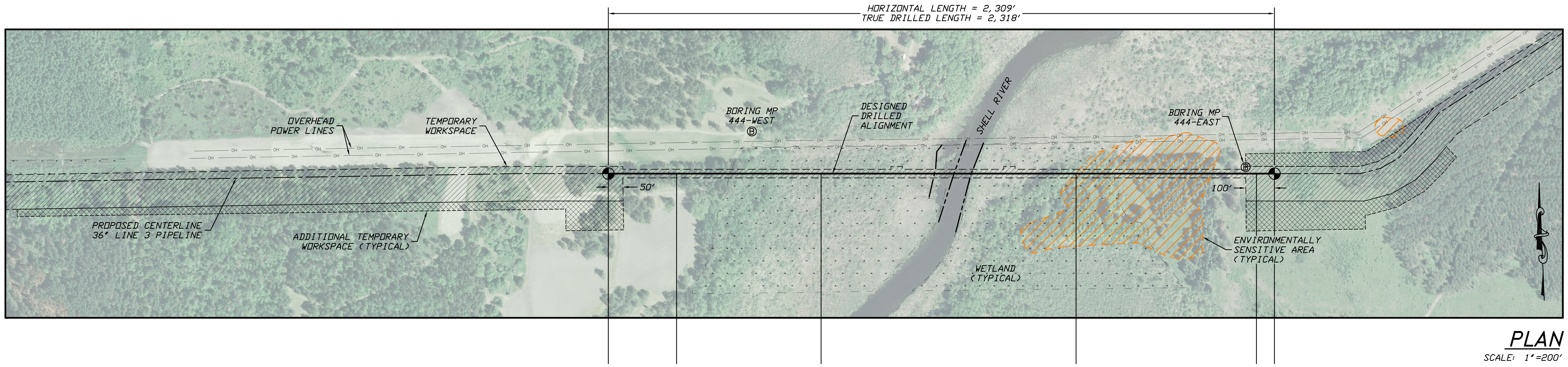
ENBRIDGE

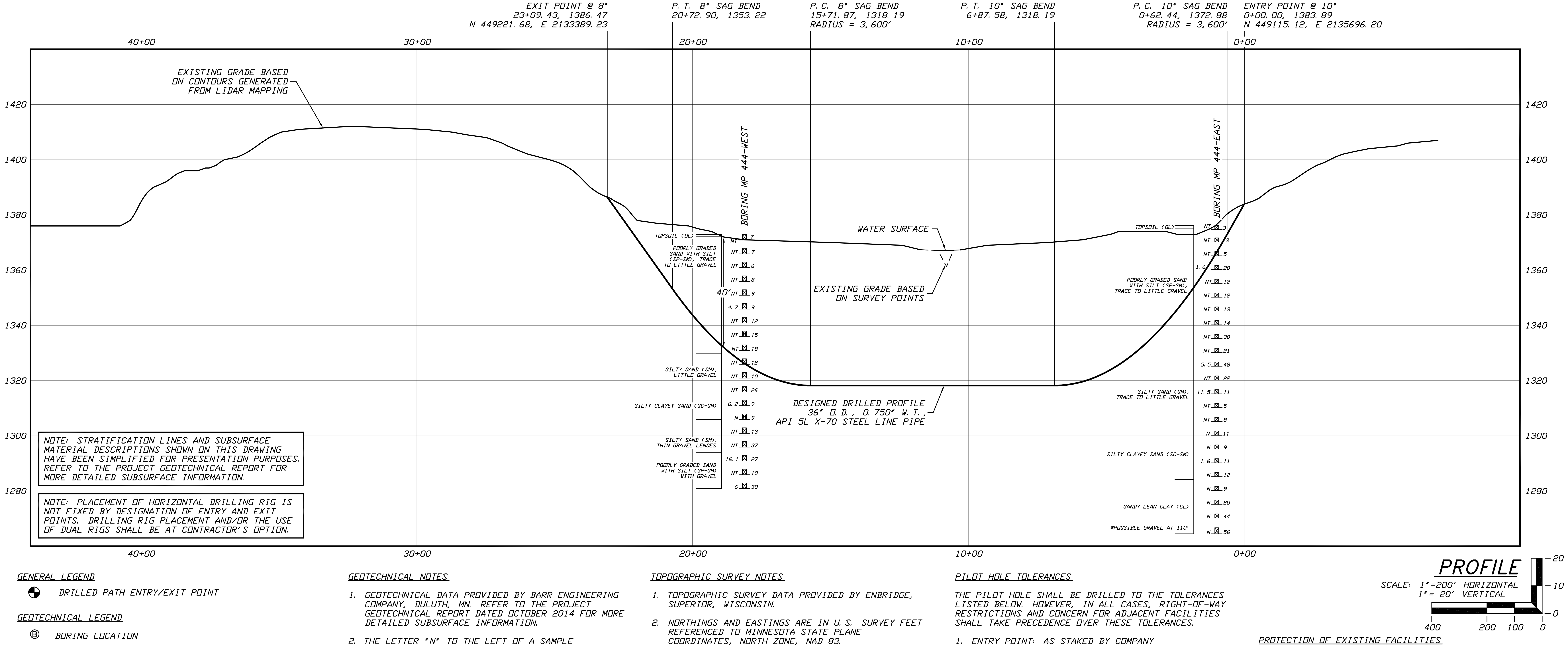
DWN. BY: AJJ	DATE 10/2020
CHK.	
PROJ. ENGR.	
PROJ. MGR.	
CLIENT APP.	

PROPOSED ENBRIDGE L3R PIPELINE
PRIMARY METHOD – HDD
CROSSING OF SHELL RIVER
ENBRIDGE MP 983.7
HUBBARD COUNTY, MINNESOTA

SCALE
NOTED

DWG. NO.
B–93–5.84–MDNR–37–0





NOTE: STRATIFICATION LINES AND SUBSURFACE MATERIAL DESCRIPTIONS SHOWN ON THIS DRAWING HAVE BEEN SIMPLIFIED FOR PRESENTATION PURPOSES. REFER TO THE PROJECT GEOTECHNICAL REPORT FOR MORE DETAILED SUBSURFACE INFORMATION.

NOTE: PLACEMENT OF HORIZONTAL DRILLING RIG IS NOT FIXED BY DESIGNATION OF ENTRY AND EXIT POINTS. DRILLING RIG PLACEMENT AND/OR THE USE OF DUAL RIGS SHALL BE AT CONTRACTOR'S OPTION.

GENERAL LEGEND

⊕ DRILLED PATH ENTRY/EXIT POINT

GEOTECHNICAL LEGEND

Ⓑ BORING LOCATION

SPLIT SPOON SAMPLE

53 ⊠ 23 ← PENETRATION RESISTANCE IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES
↑ PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

MODIFIED CALIFORNIA SAMPLER

53 ⊠
↑ PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

GEOTECHNICAL NOTES

1. GEOTECHNICAL DATA PROVIDED BY BARR ENGINEERING COMPANY, DULUTH, MN. REFER TO THE PROJECT GEOTECHNICAL REPORT DATED OCTOBER 2014 FOR MORE DETAILED SUBSURFACE INFORMATION.
2. THE LETTER "N" TO THE LEFT OF A SAMPLE INDICATES THAT NO GRAVEL WAS OBSERVED IN THE SAMPLE. THE LETTERS "NT" INDICATE THAT GRAVEL WAS OBSERVED BUT NO GRADATION TEST WAS PERFORMED.
3. THE GEOTECHNICAL DATA IS ONLY DESCRIPTIVE OF THE LOCATIONS ACTUALLY SAMPLED. EXTENSION OF THIS DATA OUTSIDE OF THE ORIGINAL BORINGS MAY BE DONE TO CHARACTERIZE THE SOIL CONDITIONS, HOWEVER, COMPANY DOES NOT GUARANTEE THESE CHARACTERIZATIONS TO BE ACCURATE. CONTRACTOR MUST USE HIS OWN EXPERIENCE AND JUDGMENT IN INTERPRETING THIS DATA.

TOPOGRAPHIC SURVEY NOTES

1. TOPOGRAPHIC SURVEY DATA PROVIDED BY ENBRIDGE, SUPERIOR, WISCONSIN.
2. NORTHINGS AND EASTINGS ARE IN U.S. SURVEY FEET REFERENCED TO MINNESOTA STATE PLANE COORDINATES, NORTH ZONE, NAD 83.
3. ELEVATIONS ARE IN FEET REFERENCED TO NAVD 88.

DRILLED PATH NOTES

1. DRILLED PATH STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND IS REFERENCED TO CONTROL ESTABLISHED FOR THE DRILLED SEGMENT.
2. DRILLED PATH COORDINATES REFER TO CENTERLINE OF PILOT HOLE AS OPPOSED TO TOP OF INSTALLED PIPE.

PILOT HOLE TOLERANCES

THE PILOT HOLE SHALL BE DRILLED TO THE TOLERANCES LISTED BELOW. HOWEVER, IN ALL CASES, RIGHT-OF-WAY RESTRICTIONS AND CONCERN FOR ADJACENT FACILITIES SHALL TAKE PRECEDENCE OVER THESE TOLERANCES.

1. ENTRY POINT: AS STAKED BY COMPANY
2. EXIT POINT: UP TO 10 FEET SHORT OR 20 FEET LONG RELATIVE TO THE DESIGNED EXIT POINT; UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
3. ELEVATION: UP TO 2 FEET ABOVE AND 10 FEET BELOW THE DESIGNED PROFILE
4. ALIGNMENT: UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
5. CURVE RADIUS: NO LESS THAN 2,400 FEET BASED ON A 3-JOINT AVERAGE (ASSUMING RANGE 2 DRILL PIPE)

PROTECTION OF EXISTING FACILITIES

CONTRACTOR SHALL UNDERTAKE THE FOLLOWING STEPS PRIOR TO COMMENCING DRILLING OPERATIONS.

1. CONTACT THE UTILITY LOCATION/NOTIFICATION SERVICE FOR THE CONSTRUCTION AREA.
2. POSITIVELY LOCATE AND STAKE ALL EXISTING UNDERGROUND FACILITIES. ANY FACILITIES LOCATED WITHIN 10 FEET OF THE DESIGNED DRILLED PATH SHALL BE EXPOSED.
3. MODIFY DRILLING PRACTICES AND DOWNHOLE ASSEMBLIES AS NECESSARY TO PREVENT DAMAGE TO EXISTING FACILITIES.

LINE 3 PIPELINE PROJECT

PLAN AND PROFILE
36-INCH PIPELINE CROSSING OF THE SHELL RIVER
BY HORIZONTAL DIRECTIONAL DRILLING

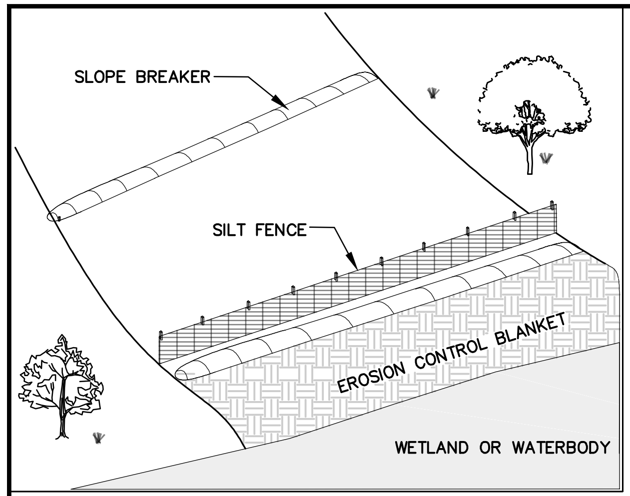
LOCATION: HUBBARD COUNTY, MINNESOTA

DRAWN	DATE	CHECKED	APPROVED	DRAWING NUMBER	REVISION
ACM	07/25/17	DMP	JSP	D-03-5.84-22567-C-1352	C

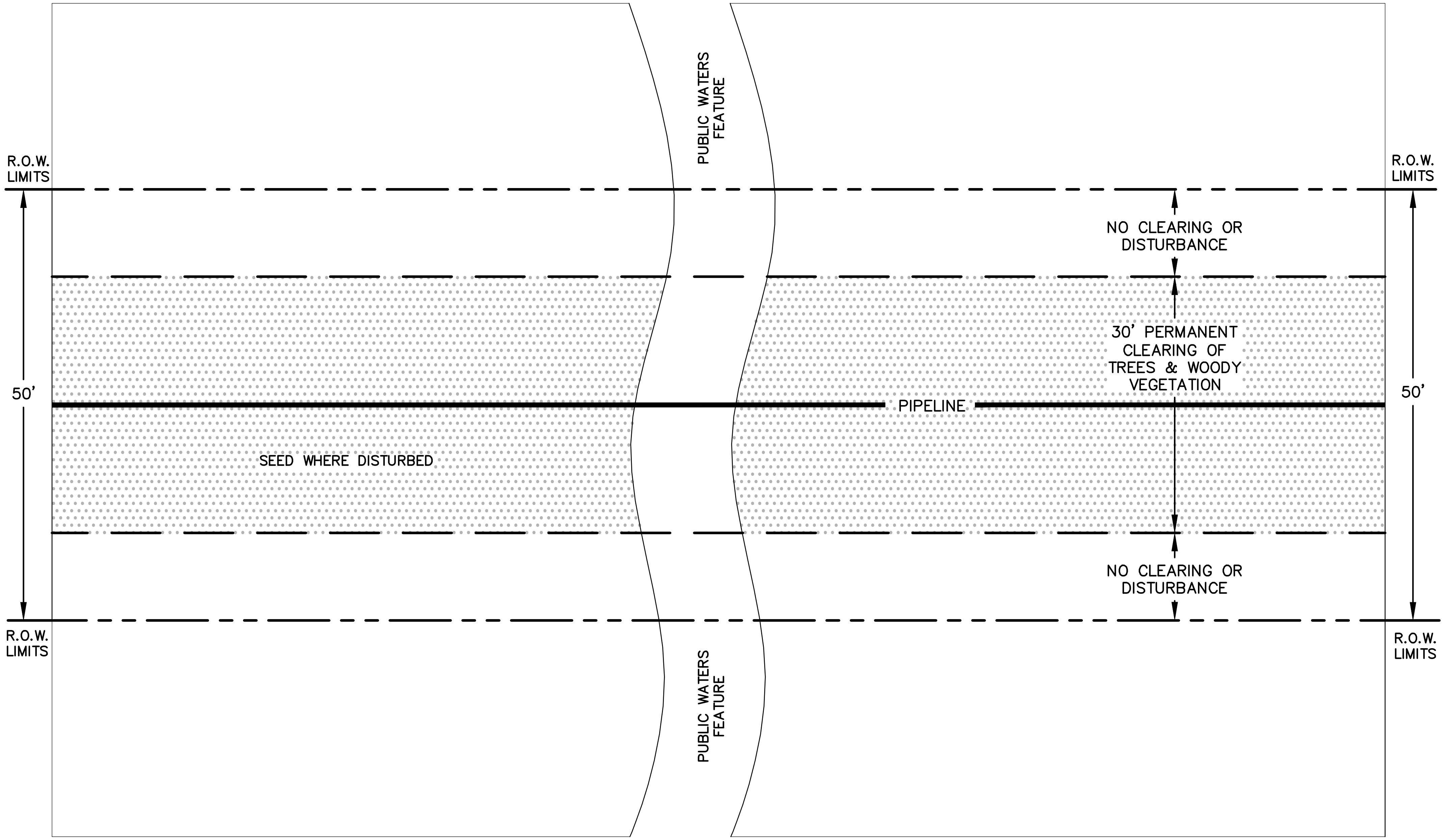
NO.	DATE	REVISION DESCRIPTION	BY	CHK'D	APP.
C	10/27/19	UPDATE WETLAND BOUNDARIES AND WORKSPACE	KWW	JSP	JSP
B	09/29/17	UPDATE ESA LABEL	LKB	JSP	JSP
A	07/25/17	ISSUE FOR CONSTRUCTION	ACM	DMP	JSP

J.D.Hair&Associates,Inc.
Consulting Engineers
2424 East 21st Street
Suite 510
Tulsa, Oklahoma 74114

PROJECT NO.
Enbridge\1404
MILEPOST
D983



▨ SEEDING AREA



ISSUED FOR PERMIT
12/13/19

PUBLIC WATERS FEATURE - HDD CROSSING

1) DISTURBANCE OF THE ROW IS LIMITED TO THE 30-FOOT-WIDE CLEARING OF TREES AND WOODY VEGETATION AND IMPACTS RESULTING FROM TRAVEL LANES AND/OR BRIDGES.
2) ANY WETLAND OR WATERBODY BANK THAT IS DISTURBED WILL BE STABILIZED WITH EROSION AND SEDIMENT CONTROL BMP AND RESTORED TO AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS.
3) PERMANENT REVEGETATION SEEDING OF DISTURBED WATERBODY BANKS WILL UTILIZE THE BWSR RIPARIAN SEED MIXES IN ACCORDANCE WITH THE EPP (SECTION 7.8).
4) PERMANENT REVEGETATION SEEDING OF DISTURBED WETLANDS WILL TAKE PLACE IN ACCORDANCE WITH THE EPP (SECTION 7.7). 7) IN DISTURBED WETLAND AREAS, THE APPROPRIATE SEED MIX WILL BE DETERMINED USING THE RESULTS OF PRE-CONSTRUCTION WETLAND IN DISTURBED WETLAND AREAS, HYDROLOGICAL CHARACTERISTICS, AND SITE-SPECIFIC CONDITIONS.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	AJM	12/13/19	KEH	KD
A	ISSUED FOR REVIEW	AJM	12/10/19	KEH	KD

DWN. BY: AJM	DATE 12/10/19
CHK. KEH	
PROJ. ENGR. DG	
PROJ. MGR. KD	
CLIENT APP.	

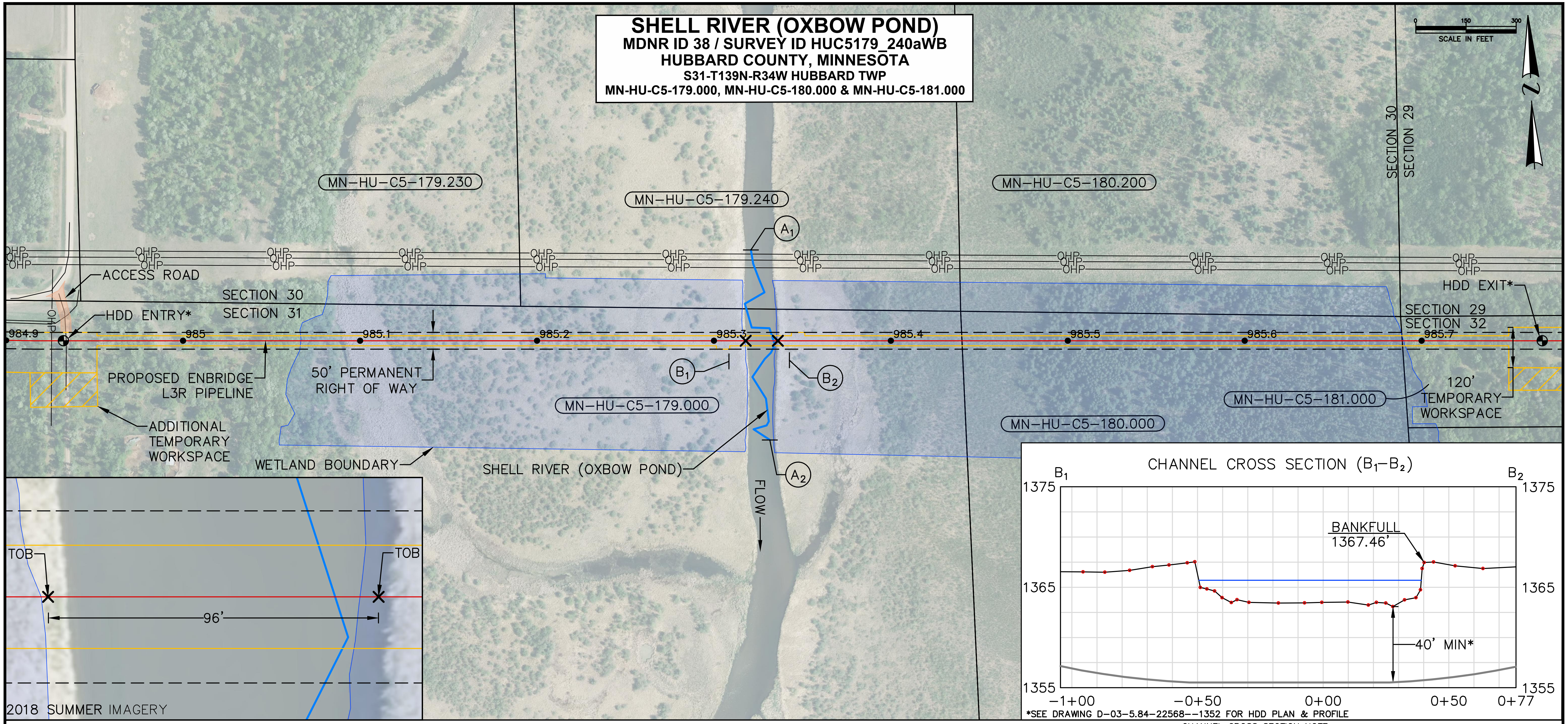
ENBRIDGE®

LINE 3 REPLACEMENT
PUBLIC WATERS HDD CROSSING TYPICAL
FINAL STREAM STABILIZATION &
EROSION CONTROL

SCALE NTS
DWG. NO.

MDNR ID No. 38: MP 985.3; Shell River - Oxbow Pond (M-096-035)

SHELL RIVER (OXBOW POND)
MDNR ID 38 / SURVEY ID HUC5179_240aWB
HUBBARD COUNTY, MINNESOTA
S31-T139N-R34W HUBBARD TWP
MN-HU-C5-179.000, MN-HU-C5-180.000 & MN-HU-C5-181.000



*SEE DRAWING D-03-5.84-22568--1352 FOR HDD PLAN & PROFILE

CHANNEL CROSS SECTION NOTE:
1. CHANNEL LOCATIONS, DIMENSIONS, AND/OR ELEVATIONS ARE BASED ON 2015 TOPOGRAPHIC/BATHYMETRIC SURVEY(S), AND AS SUCH DO NOT REFLECT CHANGES TO THE CHANNEL THAT MAY HAVE OCCURRED SINCE THAT TIME.

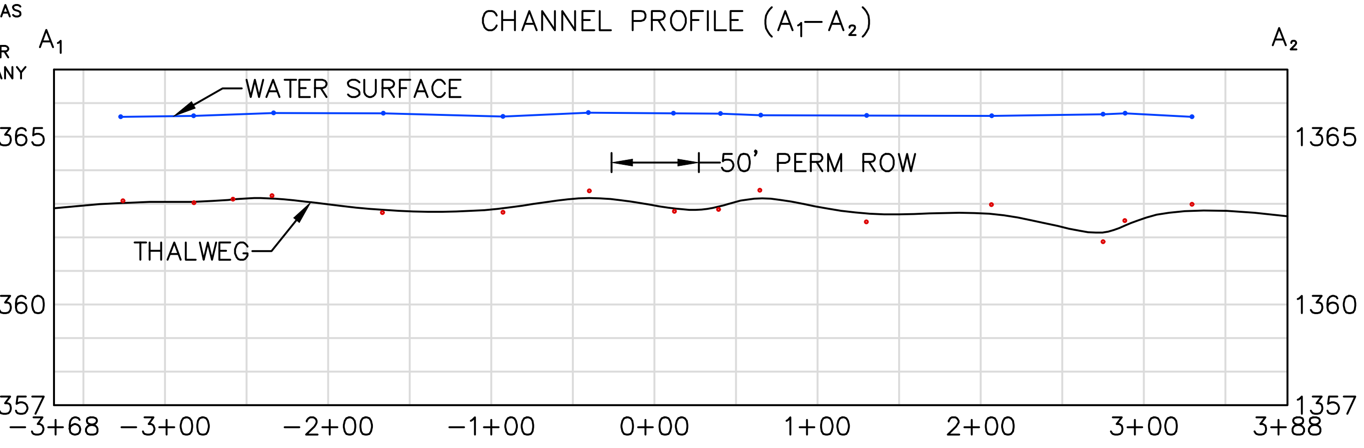
NOTES
1. NO FEMA DIGITAL FLOODPLAIN DATA AVAILABLE
2. SOBS (O/H) OR NPC (S1–3): N/A
3. MDNR REGION 1 PWI – COOL/WARM WATER FISHERY: MARCH 15 – JUNE 30. 24–HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
4. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

LEGEND

──	PROPOSED ENBRIDGE L3R PIPELINE
— — — —	PERMANENT RIGHT OF WAY
──	TEMPORARY WORKSPACE
──	WATERBODY (ROSGEN SURVEY – THALWEG)
——OHP——	OVERHEAD POWER
—— — ——	ROAD CENTERLINE
──	TRACT BOUNDARY
▭	ACCESS ROAD
▭	WETLAND
▨	ADDITIONAL TEMPORARY WORKSPACE
MN–XX–XX–XXX.XXX	TRACT ID
•	ROSGEN SURVEY POINT – WATER SURFACE
•	ROSGEN SURVEY POINT – RIVER BOTTOM (THALWEG)
◕	HDD ENTRY EXIT POINT
✕	TOP OF BANK

FOR ENVIRONMENTAL REVIEW PURPOSES ONLY

CHANNEL PROFILE (A_1–A_2)



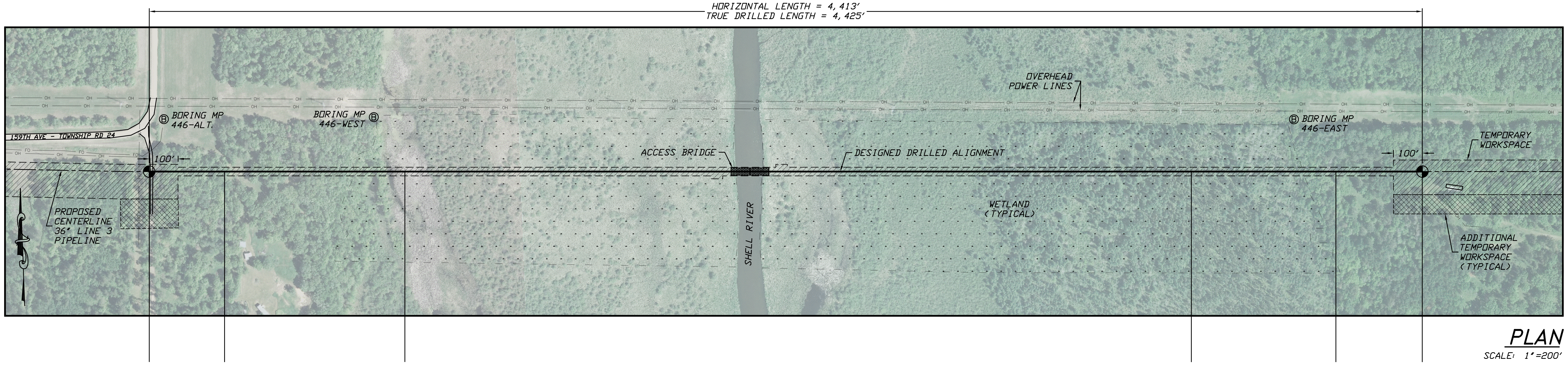
0	ISSUED FOR PERMIT APPLICATION	AJJ	10/2020	BAB	BAB
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE

DWN. BY: AJJ	DATE 10/2020
CHK.	
PROJ. ENGR.	
PROJ. MGR.	
CLIENT APP.	

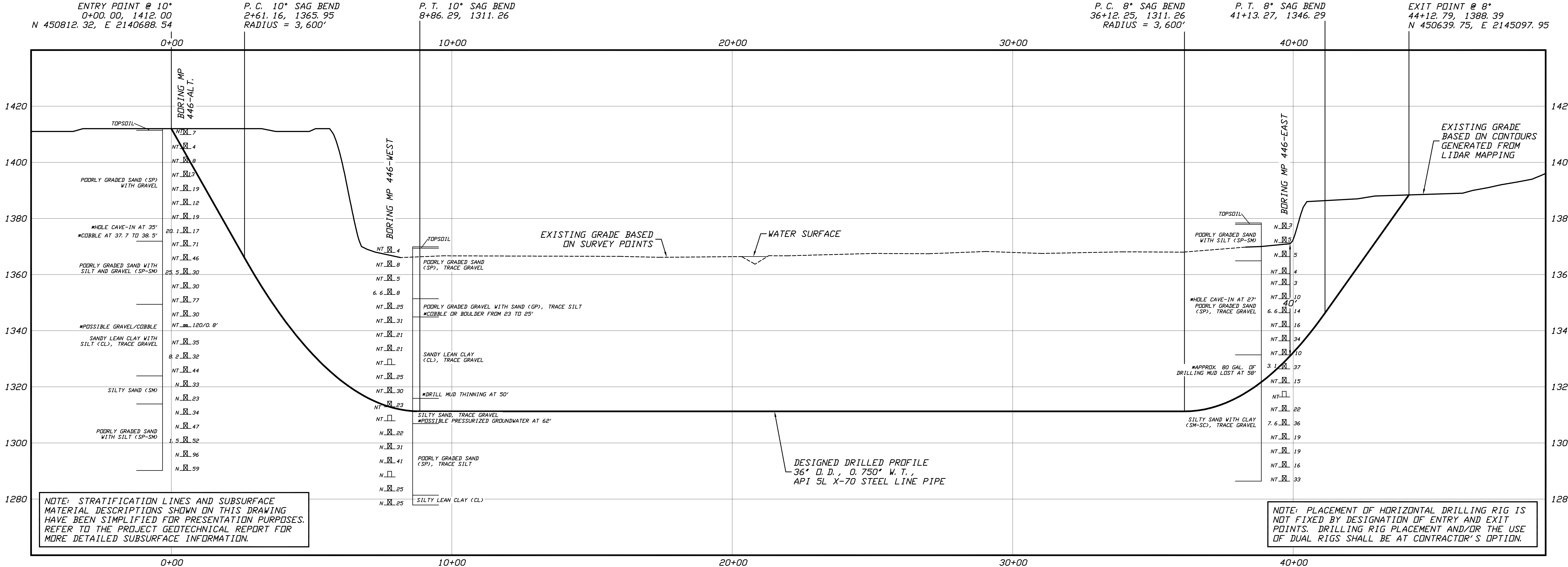
PROPOSED ENBRIDGE L3R PIPELINE
PRIMARY METHOD – HDD
CROSSING OF SHELL RIVE–OXBOW POND
ENBRIDGE MP 985.3
HUBBARD COUNTY, MINNESOTA

SCALE NOTED
DWG. NO. B–93–5.84–MDNR–38–0



PLAN

SCALE: 1"=200'



NOTE: STRATIFICATION LINES AND SUBSURFACE MATERIAL DESCRIPTIONS SHOWN ON THIS DRAWING HAVE BEEN SIMPLIFIED FOR PRESENTATION PURPOSES. REFER TO THE PROJECT GEOTECHNICAL REPORT FOR MORE DETAILED SUBSURFACE INFORMATION.

NOTE: PLACEMENT OF HORIZONTAL DRILLING RIG IS NOT FIXED BY DESIGNATION OF ENTRY AND EXIT POINTS. DRILLING RIG PLACEMENT AND/OR THE USE OF DUAL RIGS SHALL BE AT CONTRACTOR'S OPTION.

PROFILE

SCALE: 1"=200' HORIZONTAL
1"= 20' VERTICAL

GENERAL LEGEND

⊕ DRILLED PATH ENTRY/EXIT POINT

GEOTECHNICAL LEGEND

Ⓑ BORING LOCATION

SPLIT SPOON SAMPLE

53 ☒ 23 ← PENETRATION RESISTANCE IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES
↑ PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

SHELBY TUBE SAMPLE

53 ⊓
↑ PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

GEOTECHNICAL NOTES

1. GEOTECHNICAL DATA PROVIDED BY BARR ENGINEERING COMPANY, DULUTH, MN. REFER TO THE PROJECT GEOTECHNICAL REPORT DATED FEBRUARY, 2015 FOR MORE DETAILED SUBSURFACE INFORMATION.
2. THE LETTER "N" TO THE LEFT OF A SAMPLE INDICATES THAT NO GRAVEL WAS OBSERVED IN THE SAMPLE. THE LETTERS "NT" INDICATE THAT GRAVEL WAS OBSERVED BUT NO GRADATION TEST WAS PERFORMED.
3. THE GEOTECHNICAL DATA IS ONLY DESCRIPTIVE OF THE LOCATIONS ACTUALLY SAMPLED. EXTENSION OF THIS DATA OUTSIDE OF THE ORIGINAL BORINGS MAY BE DONE TO CHARACTERIZE THE SOIL CONDITIONS, HOWEVER, COMPANY DOES NOT GUARANTEE THESE CHARACTERIZATIONS TO BE ACCURATE. CONTRACTOR MUST USE HIS OWN EXPERIENCE AND JUDGMENT IN INTERPRETING THIS DATA.

TOPOGRAPHIC SURVEY NOTES

1. TOPOGRAPHIC SURVEY DATA PROVIDED BY ENBRIDGE, SUPERIOR, WISCONSIN.
2. NORTHINGS AND EASTINGS ARE IN U.S. SURVEY FEET REFERENCED TO MINNESOTA STATE PLANE COORDINATES, NORTH ZONE, NAD 83.
3. ELEVATIONS ARE IN FEET REFERENCED TO NAVD 88.

DRILLED PATH NOTES

1. DRILLED PATH STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND IS REFERENCED TO CONTROL ESTABLISHED FOR THE DRILLED SEGMENT.
2. DRILLED PATH COORDINATES REFER TO CENTERLINE OF PILOT HOLE AS OPPOSED TO TOP OF INSTALLED PIPE.

PILOT HOLE TOLERANCES

THE PILOT HOLE SHALL BE DRILLED TO THE TOLERANCES LISTED BELOW. HOWEVER, IN ALL CASES, RIGHT-OF-WAY RESTRICTIONS AND CONCERN FOR ADJACENT FACILITIES SHALL TAKE PRECEDENCE OVER THESE TOLERANCES.

1. ENTRY POINT: AS STAKED BY COMPANY
2. EXIT POINT: UP TO 10 FEET SHORT OR 20 FEET LONG RELATIVE TO THE DESIGNED EXIT POINT; UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
3. ELEVATION: UP TO 2 FEET ABOVE AND 10 FEET BELOW THE DESIGNED PROFILE
4. ALIGNMENT: UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
5. CURVE RADIUS: NO LESS THAN 2,400 FEET BASED ON A 3-JOINT AVERAGE (ASSUMING RANGE 2 DRILL PIPE)

PROTECTION OF EXISTING FACILITIES

CONTRACTOR SHALL UNDERTAKE THE FOLLOWING STEPS PRIOR TO COMMENCING DRILLING OPERATIONS.

1. CONTACT THE UTILITY LOCATION/NOTIFICATION SERVICE FOR THE CONSTRUCTION AREA.
2. POSITIVELY LOCATE AND STAKE ALL EXISTING UNDERGROUND FACILITIES. ANY FACILITIES LOCATED WITHIN 10 FEET OF THE DESIGNED DRILLED PATH SHALL BE EXPOSED.
3. MODIFY DRILLING PRACTICES AND DOWNHOLE ASSEMBLIES AS NECESSARY TO PREVENT DAMAGE TO EXISTING FACILITIES.

LINE 3 PIPELINE PROJECT

PLAN AND PROFILE
36-INCH PIPELINE CROSSING OF THE SHELL RIVER - OXBOW POND BY HORIZONTAL DIRECTIONAL DRILLING

LOCATION: HUBBARD COUNTY, MINNESOTA

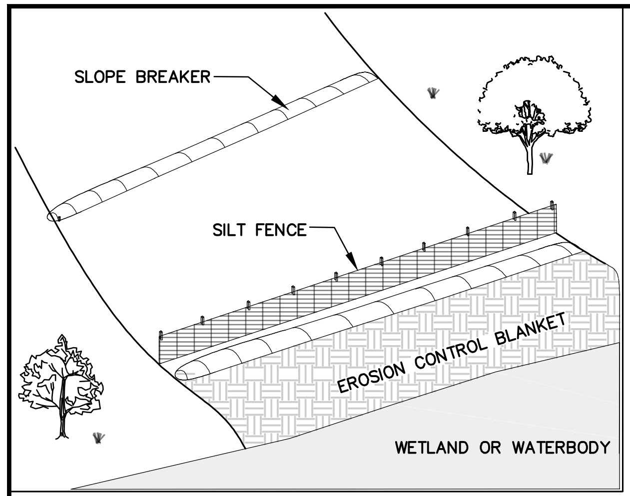
DRAWN	DATE	CHECKED	APPROVED	DRAWING NUMBER	REVISION
ACM	07/25/17	DMP	JSP	D-03-5.84-22568-D-1352	D

NO.	DATE	REVISION DESCRIPTION	BY	CHK'D	APP.
D	10/27/19	UPDATE WETLAND BOUNDARIES AND WORKSPACE	KWW	JSP	JSP
C	10/09/19	UPDATE WORKSPACE AND ADD BRIDGE	DLB	CDS	JSP
B	09/29/17	UPDATE WORKSPACE AND CROSSING NAME	LKB	JSP	JSP
A	07/25/17	ISSUE FOR CONSTRUCTION	ACM	DMP	JSP

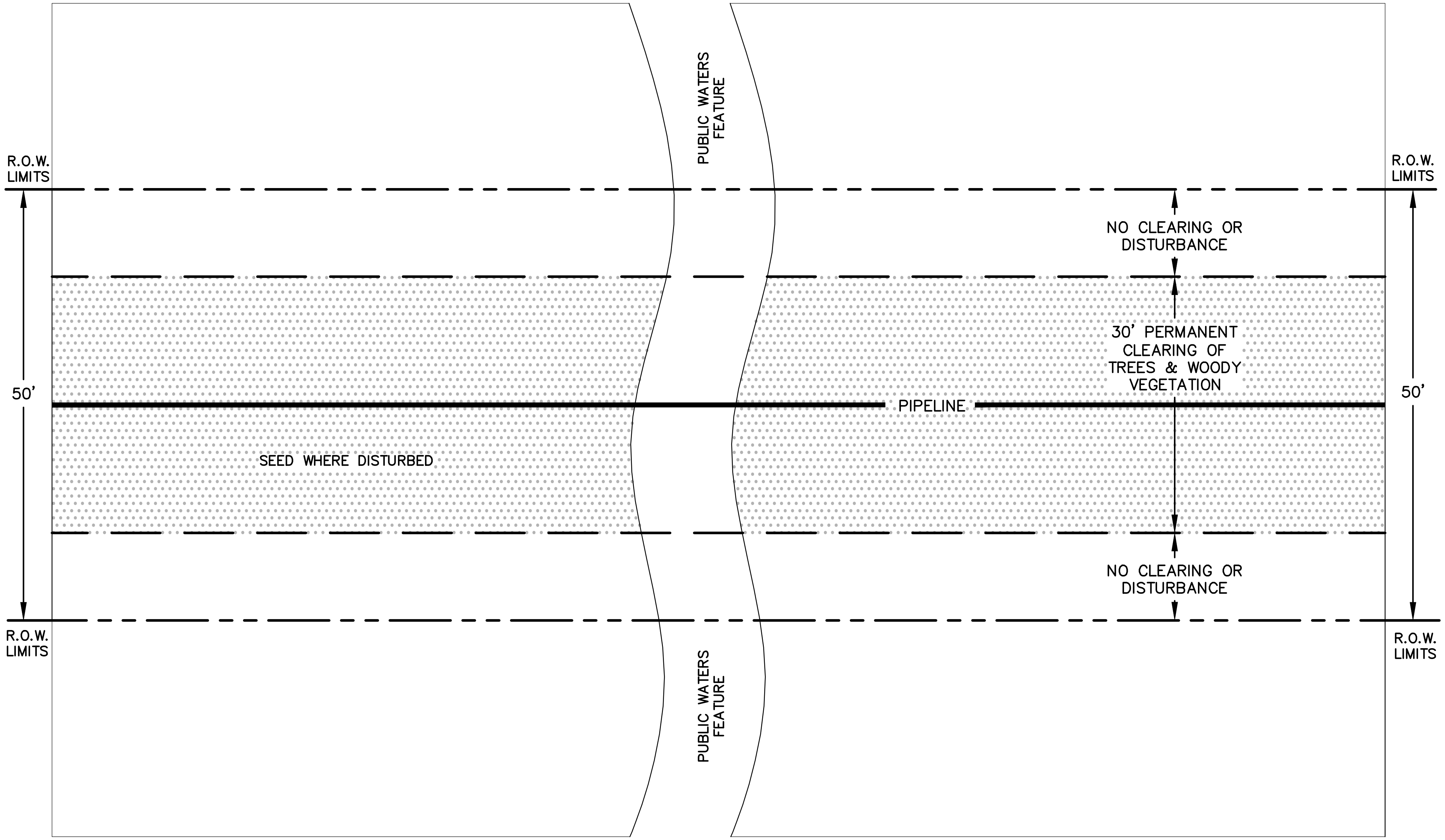
J.D.Hair&Associates,Inc.
Consulting Engineers
2424 East 21st Street
Suite 510
Tulsa, Oklahoma 74114

PROJECT NO.
Enbridge\1404

MILEPOST
D985



▨ SEEDING AREA



ISSUED FOR PERMIT
12/13/19

PUBLIC WATERS FEATURE - HDD CROSSING

1) DISTURBANCE OF THE ROW IS LIMITED TO THE 30-FOOT-WIDE CLEARING OF TREES AND WOODY VEGETATION AND IMPACTS RESULTING FROM TRAVEL LANES AND/OR BRIDGES.

2) ANY WETLAND OR WATERBODY BANK THAT IS DISTURBED WILL BE STABILIZED WITH EROSION AND SEDIMENT CONTROL BMP AND RESTORED TO AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS.

3) PERMANENT REVEGETATION SEEDING OF DISTURBED WATERBODY BANKS WILL UTILIZE THE BWSR RIPARIAN SEED MIXES IN ACCORDANCE WITH THE EPP (SECTION 7.8).

4) PERMANENT REVEGETATION SEEDING OF DISTURBED WETLANDS WILL TAKE PLACE IN ACCORDANCE WITH THE EPP (SECTION 7.7). 7) IN DISTURBED WETLAND AREAS, THE APPROPRIATE SEED MIX WILL BE DETERMINED USING THE RESULTS OF PRE-CONSTRUCTION WETLAND IN DISTURBED WETLAND AREAS, HYDROLOGICAL CHARACTERISTICS, AND SITE-SPECIFIC CONDITIONS.

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	AJM	12/13/19	KEH	KD
A	ISSUED FOR REVIEW	AJM	12/10/19	KEH	KD

DWN. BY: AJM	DATE 12/10/19
CHK. KEH	
PROJ. ENGR. DG	
PROJ. MGR. KD	
CLIENT APP.	

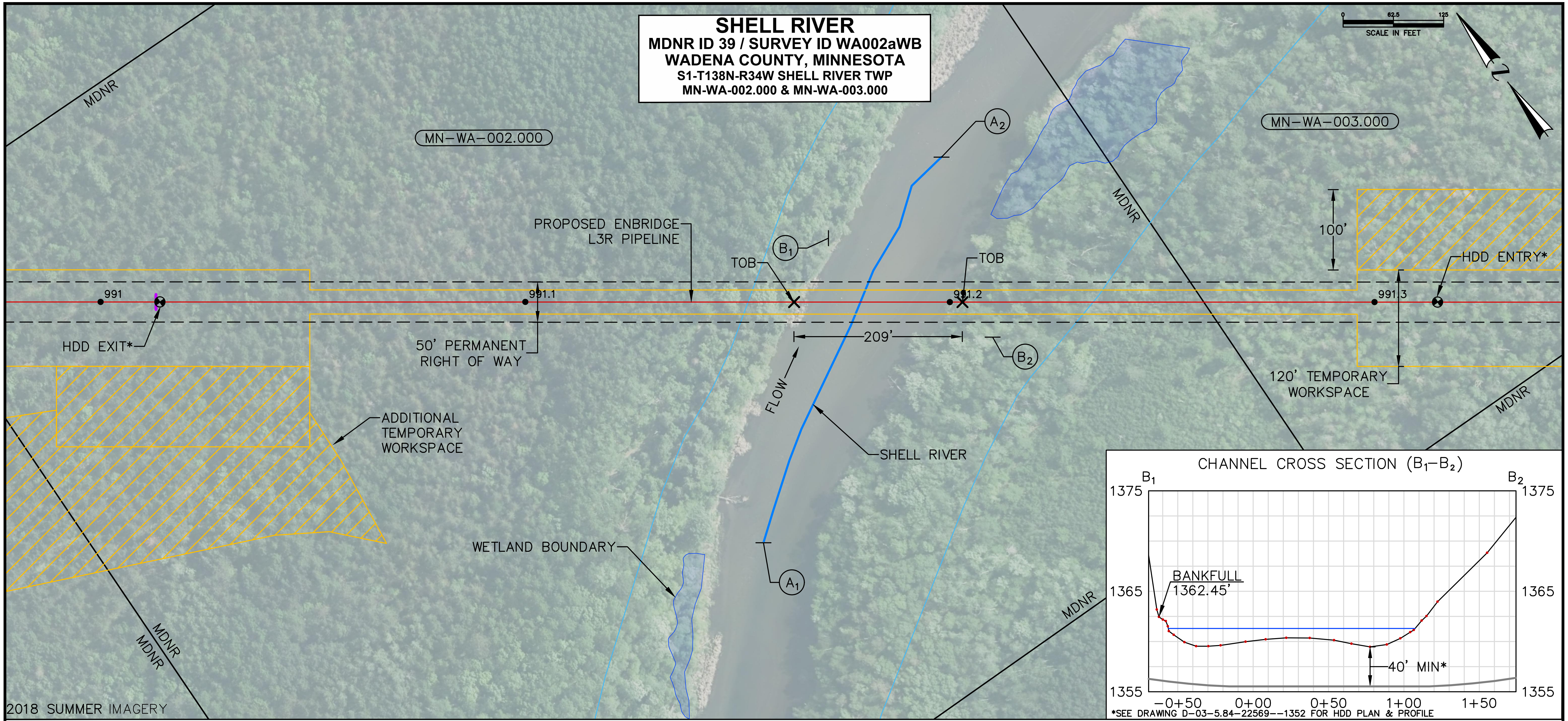
ENBRIDGE®

LINE 3 REPLACEMENT
PUBLIC WATERS HDD CROSSING TYPICAL
FINAL STREAM STABILIZATION &
EROSION CONTROL

SCALE NTS
DWG. NO.

MDNR ID No. 39: MP 991.2; Shell River (M-096-035)

SHELL RIVER
MDNR ID 39 / SURVEY ID WA002aWB
WADENA COUNTY, MINNESOTA
S1-T138N-R34W SHELL RIVER TWP
MN-WA-002.000 & MN-WA-003.000



*SEE DRAWING D–03–5.84–22569––1352 FOR HDD PLAN & PROFILE

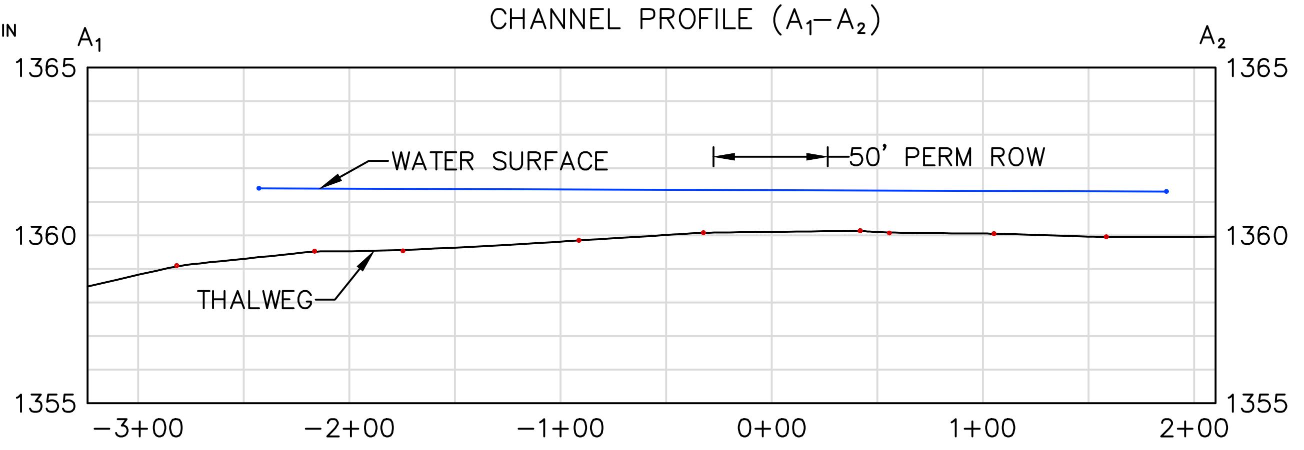
NOTES
1. SOBS (O/H) OR NPC (S1–3): N/A
2. MDNR REGION 1 PWI – COOL/WARM WATER FISHERY: MARCH 15 – JUNE 30. 24–HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
3. MDNR LAND – SEE UTILITY CROSSING LICENSE. NO CLEARING: JUNE–JULY.
4. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

LEGEND

🟥	PROPOSED ENBRIDGE L3R PIPELINE
— — — —	PERMANENT RIGHT OF WAY
🟨	TEMPORARY WORKSPACE
🟦	WATERBODY (ROSGEN SURVEY – THALWEG)
—	FEMA FLOODPLAIN
—	TRACT BOUNDARY
MDNR	MINNESOTA DEPARTMENT OF NATURAL RESOURCES (MDNR) BOUNDARY
▭	WETLAND
▨	ADDITIONAL TEMPORARY WORKSPACE
MN–XX–XX–XXX.XXX	TRACT ID
•	ROSGEN SURVEY POINT – WATER SURFACE
•	ROSGEN SURVEY POINT – RIVER BOTTOM (THALWEG)
◕	HDD ENTRY EXIT POINT
×	TOP OF BANK
▍	TRENCH BREAKER (LOCATIONS ARE APPROXIMATE)

FOR ENVIRONMENTAL REVIEW PURPOSES ONLY

CHANNEL PROFILE (A1–A2)



CHANNEL CROSS SECTION NOTE:
1. CHANNEL LOCATIONS, DIMENSIONS, AND/OR ELEVATIONS ARE BASED ON 2015 TOPOGRAPHIC/BATHYMETRIC SURVEY(S), AND AS SUCH DO NOT REFLECT CHANGES TO THE CHANNEL THAT MAY HAVE OCCURRED SINCE THAT TIME.

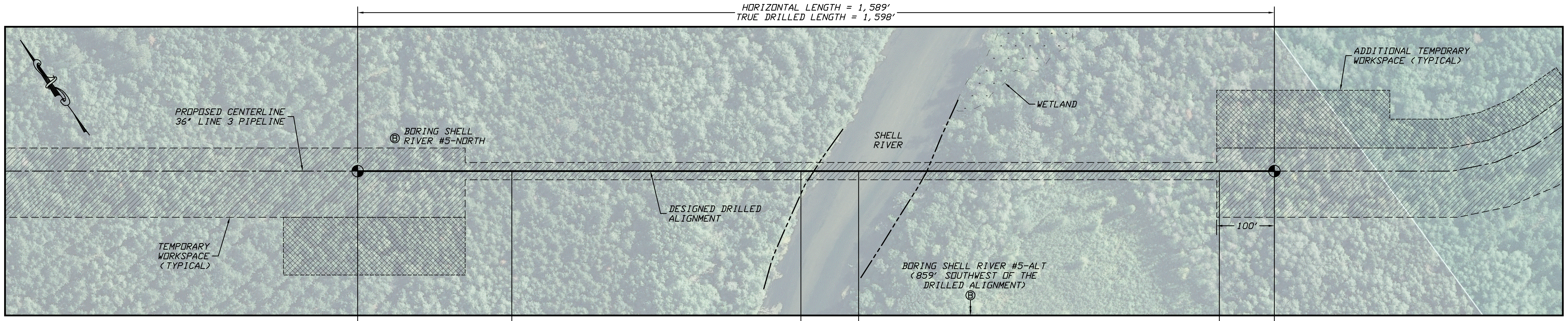
0	ISSUED FOR PERMIT APPLICATION	AJJ	10/2020	BAB	BAB
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE

DWN. BY: AJJ	DATE 10/2020
CHK.	
PROJ. ENGR.	
PROJ. MGR.	
CLIENT APP.	

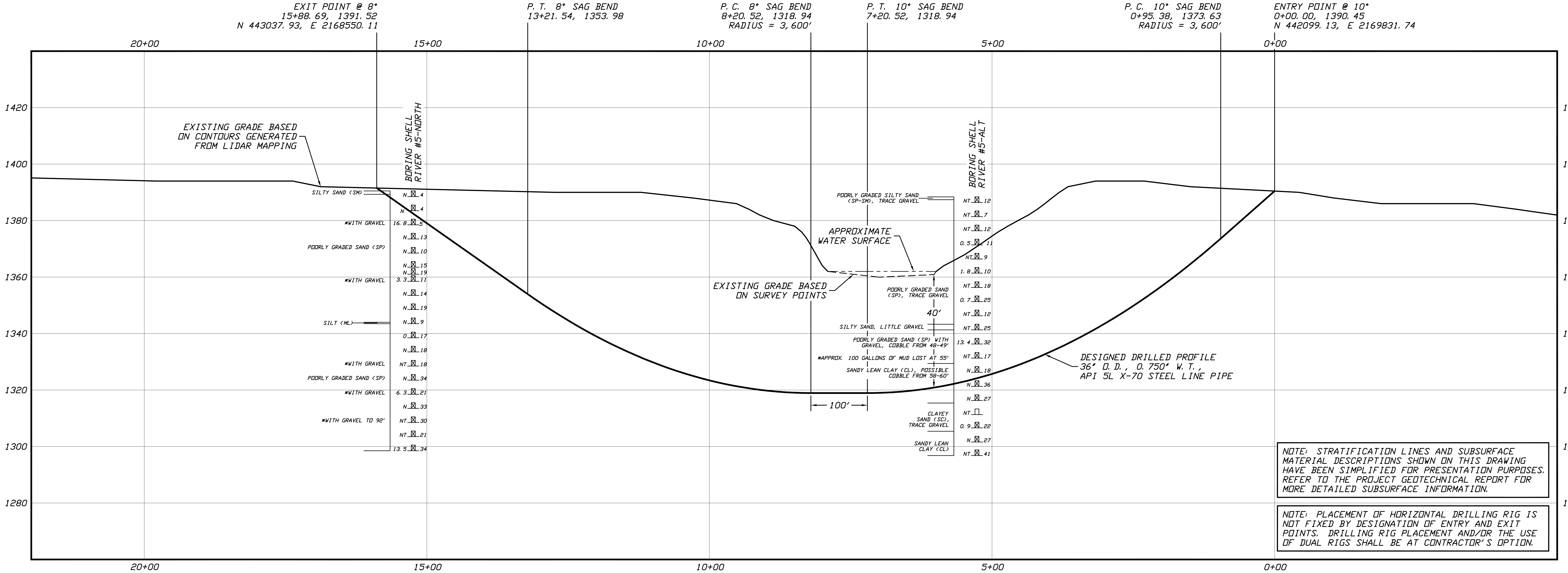
PROPOSED ENBRIDGE L3R PIPELINE
PRIMARY METHOD – HDD
CROSSING OF SHELL RIVER
ENBRIDGE MP 991.2
WADENA COUNTY, MINNESOTA

SCALE NOTED
DWG. NO. B–93–5.84–MDNR–39–0



PLAN

SCALE: 1"=100'



NOTE: STRATIFICATION LINES AND SUBSURFACE MATERIAL DESCRIPTIONS SHOWN ON THIS DRAWING HAVE BEEN SIMPLIFIED FOR PRESENTATION PURPOSES. REFER TO THE PROJECT GEOTECHNICAL REPORT FOR MORE DETAILED SUBSURFACE INFORMATION.

NOTE: PLACEMENT OF HORIZONTAL DRILLING RIG IS NOT FIXED BY DESIGNATION OF ENTRY AND EXIT POINTS. DRILLING RIG PLACEMENT AND/OR THE USE OF DUAL RIGS SHALL BE AT CONTRACTOR'S OPTION.

PROFILE

SCALE: 1"=100' HORIZONTAL
1"= 20' VERTICAL

200 100 50 0
0 10 20

GENERAL LEGEND

● DRILLED PATH ENTRY/EXIT POINT

GEOTECHNICAL LEGEND

Ⓑ BORING LOCATION

SPLIT SPOON SAMPLE

53 ☒ 23 ← PENETRATION RESISTANCE IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES
↑ PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

SHELBY TUBE SAMPLE

53 ⊓
↑ PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

GEOTECHNICAL NOTES

1. GEOTECHNICAL DATA PROVIDED BY BARR ENGINEERING COMPANY, DULUTH, MN. REFER TO THE PROJECT GEOTECHNICAL REPORT DATED FEBRUARY, 2015 FOR MORE DETAILED SUBSURFACE INFORMATION.
2. THE LETTER "N" TO THE LEFT OF A SAMPLE INDICATES THAT NO GRAVEL WAS OBSERVED IN THE SAMPLE. THE LETTERS "NT" INDICATE THAT GRAVEL WAS OBSERVED BUT NO GRADATION TEST WAS PERFORMED.
3. THE GEOTECHNICAL DATA IS ONLY DESCRIPTIVE OF THE LOCATIONS ACTUALLY SAMPLED. EXTENSION OF THIS DATA OUTSIDE OF THE ORIGINAL BORINGS MAY BE DONE TO CHARACTERIZE THE SOIL CONDITIONS, HOWEVER, COMPANY DOES NOT GUARANTEE THESE CHARACTERIZATIONS TO BE ACCURATE. CONTRACTOR MUST USE HIS OWN EXPERIENCE AND JUDGMENT IN INTERPRETING THIS DATA.

TOPOGRAPHIC SURVEY NOTES

1. TOPOGRAPHIC SURVEY DATA PROVIDED BY ENBRIDGE, SUPERIOR, WISCONSIN.
2. NORTHINGS AND EASTINGS ARE IN U.S. SURVEY FEET REFERENCED TO MINNESOTA STATE PLANE COORDINATES, NORTH ZONE, NAD 83.
3. ELEVATIONS ARE IN FEET REFERENCED TO NAVD 88.

DRILLED PATH NOTES

1. DRILLED PATH STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND IS REFERENCED TO CONTROL ESTABLISHED FOR THE DRILLED SEGMENT.
2. DRILLED PATH COORDINATES REFER TO CENTERLINE OF PILOT HOLE AS OPPOSED TO TOP OF INSTALLED PIPE.

PILOT HOLE TOLERANCES

THE PILOT HOLE SHALL BE DRILLED TO THE TOLERANCES LISTED BELOW. HOWEVER, IN ALL CASES, RIGHT-OF-WAY RESTRICTIONS AND CONCERN FOR ADJACENT FACILITIES SHALL TAKE PRECEDENCE OVER THESE TOLERANCES.

1. ENTRY POINT: AS STAKED BY COMPANY
2. EXIT POINT: UP TO 10 FEET SHORT OR 20 FEET LONG RELATIVE TO THE DESIGNED EXIT POINT; UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
3. ELEVATION: UP TO 2 FEET ABOVE AND 10 FEET BELOW THE DESIGNED PROFILE
4. ALIGNMENT: UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
5. CURVE RADIUS: NO LESS THAN 2,400 FEET BASED ON A 3-JOINT AVERAGE (ASSUMING RANGE 2 DRILL PIPE)

PROTECTION OF EXISTING FACILITIES

CONTRACTOR SHALL UNDERTAKE THE FOLLOWING STEPS PRIOR TO COMMENCING DRILLING OPERATIONS.

1. CONTACT THE UTILITY LOCATION/NOTIFICATION SERVICE FOR THE CONSTRUCTION AREA.
2. POSITIVELY LOCATE AND STAKE ALL EXISTING UNDERGROUND FACILITIES. ANY FACILITIES LOCATED WITHIN 10 FEET OF THE DESIGNED DRILLED PATH SHALL BE EXPOSED.
3. MODIFY DRILLING PRACTICES AND DOWNHOLE ASSEMBLIES AS NECESSARY TO PREVENT DAMAGE TO EXISTING FACILITIES.

LINE 3 PIPELINE PROJECT

PLAN AND PROFILE
36-INCH PIPELINE CROSSING OF THE SHELL RIVER BY HORIZONTAL DIRECTIONAL DRILLING

LOCATION: WADENA COUNTY, MINNESOTA

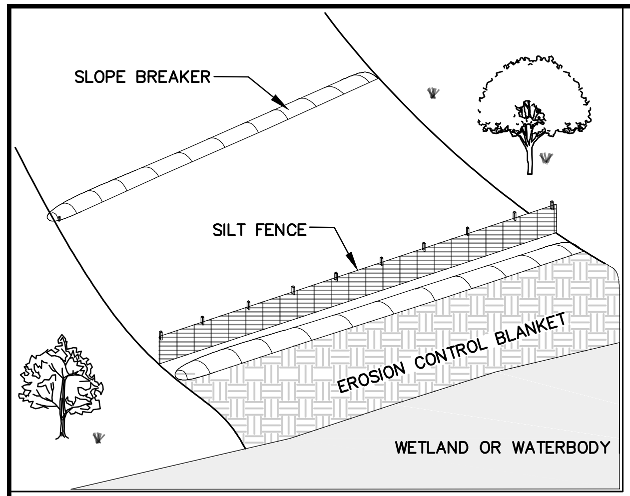
DRAWN	DATE	CHECKED	APPROVED	DRAWING NUMBER	REVISION
ACM	07/25/17	DMP	JSP	D-03-58.4-22569-B-1352	B

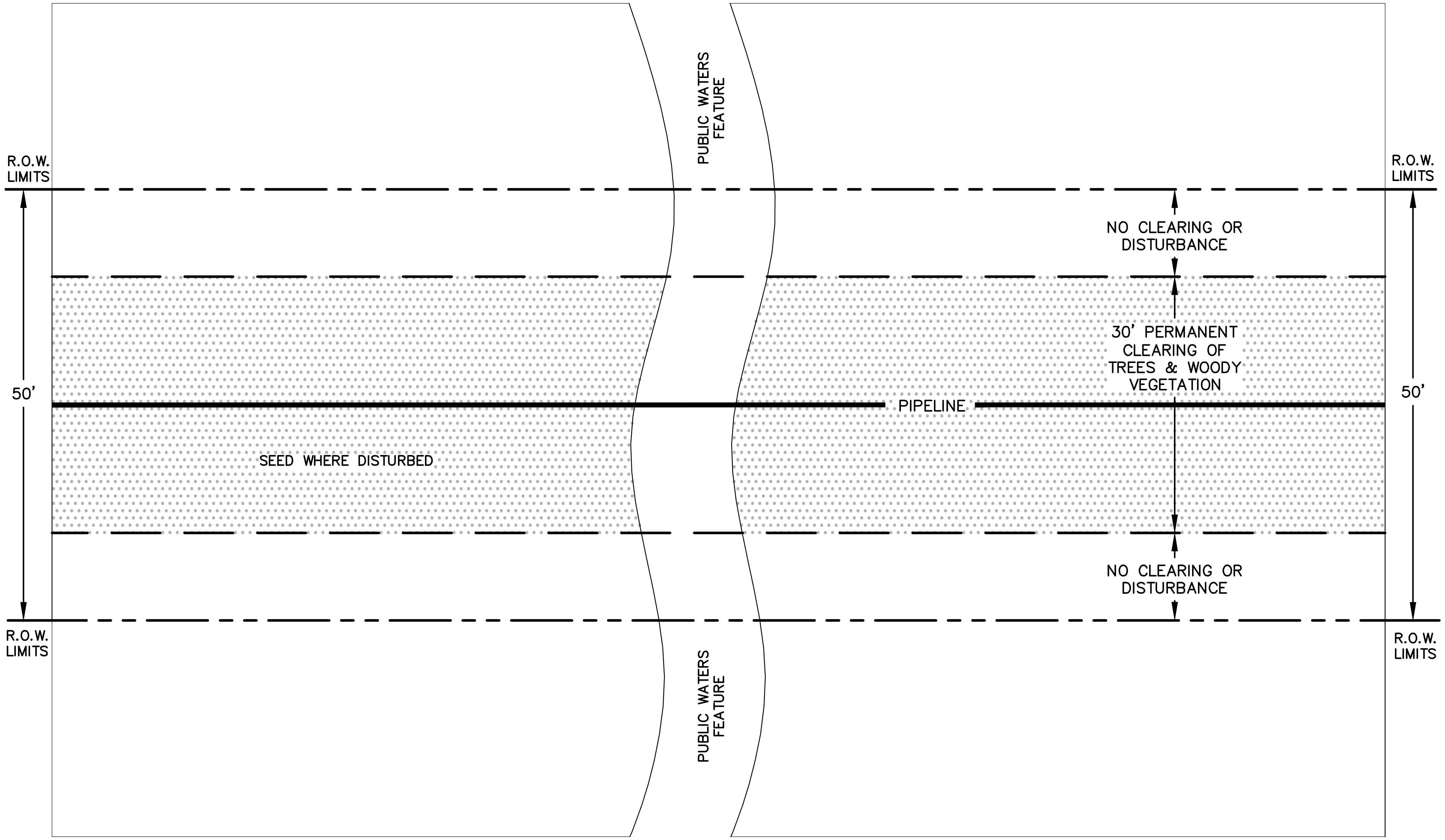
NO.	DATE	REVISION DESCRIPTION	BY	CHK'D	APP.
B	10/27/19	UPDATE WETLAND BOUNDARIES AND WORKSPACE	KWW	JSP	JSP
A	07/25/17	ISSUE FOR CONSTRUCTION	ACM	DMP	JSP

J.D.Hair&Associates,Inc.
Consulting Engineers
2424 East 21st Street
Suite 510
Tulsa, Oklahoma 74114

PROJECT NO.
Enbridge\1404

MILEPOST
D991





▨ SEEDING AREA

PUBLIC WATERS FEATURE - HDD CROSSING

1) DISTURBANCE OF THE ROW IS LIMITED TO THE 30-FOOT-WIDE CLEARING OF TREES AND WOODY VEGETATION AND IMPACTS RESULTING FROM TRAVEL LANES AND/OR BRIDGES.
2) ANY WETLAND OR WATERBODY BANK THAT IS DISTURBED WILL BE STABILIZED WITH EROSION AND SEDIMENT CONTROL BMP AND RESTORED TO AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS.
3) PERMANENT REVEGETATION SEEDING OF DISTURBED WATERBODY BANKS WILL UTILIZE THE BWSR RIPARIAN SEED MIXES IN ACCORDANCE WITH THE EPP (SECTION 7.8).
4) PERMANENT REVEGETATION SEEDING OF DISTURBED WETLANDS WILL TAKE PLACE IN ACCORDANCE WITH THE EPP (SECTION 7.7). 7) IN DISTURBED WETLAND AREAS, THE APPROPRIATE SEED MIX WILL BE DETERMINED USING THE RESULTS OF PRE-CONSTRUCTION WETLAND IN DISTURBED WETLAND AREAS, HYDROLOGICAL CHARACTERISTICS, AND SITE-SPECIFIC CONDITIONS.

ISSUED
FOR PERMIT
12/13/19

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	AJM	12/13/19	KEH	KD
A	ISSUED FOR REVIEW	AJM	12/10/19	KEH	KD

DWN. BY: AJM	DATE 12/10/19	
CHK. KEH		
PROJ. ENGR. DG		
PROJ. MGR. KD		
CLIENT APP.		

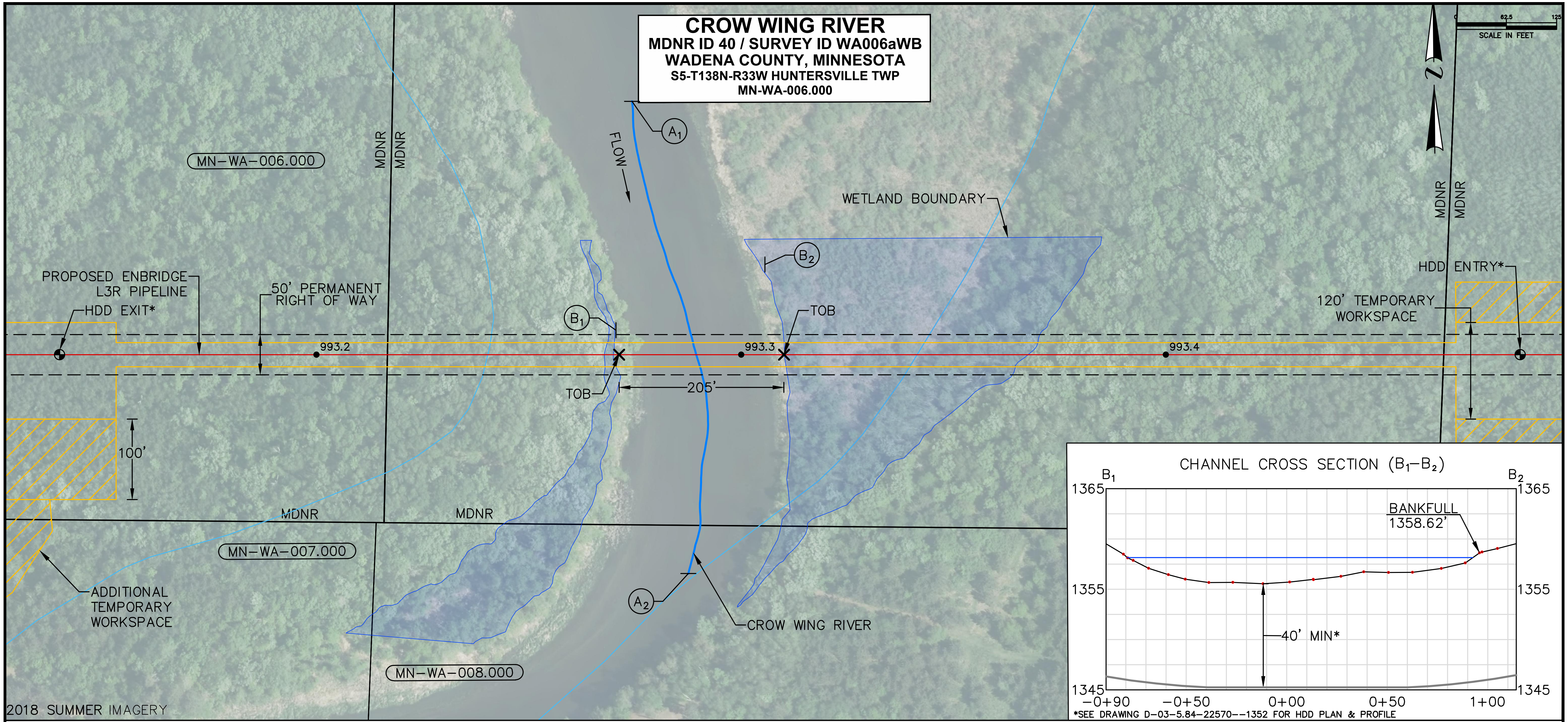
ENBRIDGE

LINE 3 REPLACEMENT
PUBLIC WATERS HDD CROSSING TYPICAL
FINAL STREAM STABILIZATION &
EROSION CONTROL

SCALE	DWG. NO.
NTS	

MDNR ID No. 40: MP 993.3; Crow Wing River (M-096)

CROW WING RIVER
MDNR ID 40 / SURVEY ID WA006aWB
WADENA COUNTY, MINNESOTA
S5-T138N-R33W HUNTERSVILLE TWP
MN-WA-006.000



*SEE DRAWING D-03-5.84-22570--1352 FOR HDD PLAN & PROFILE

CHANNEL CROSS SECTION NOTE:
1. CHANNEL LOCATIONS, DIMENSIONS, AND/OR ELEVATIONS ARE BASED ON 2015 TOPOGRAPHIC/BATHYMETRIC SURVEY(S), AND AS SUCH DO NOT REFLECT CHANGES TO THE CHANNEL THAT MAY HAVE OCCURRED SINCE THAT TIME.

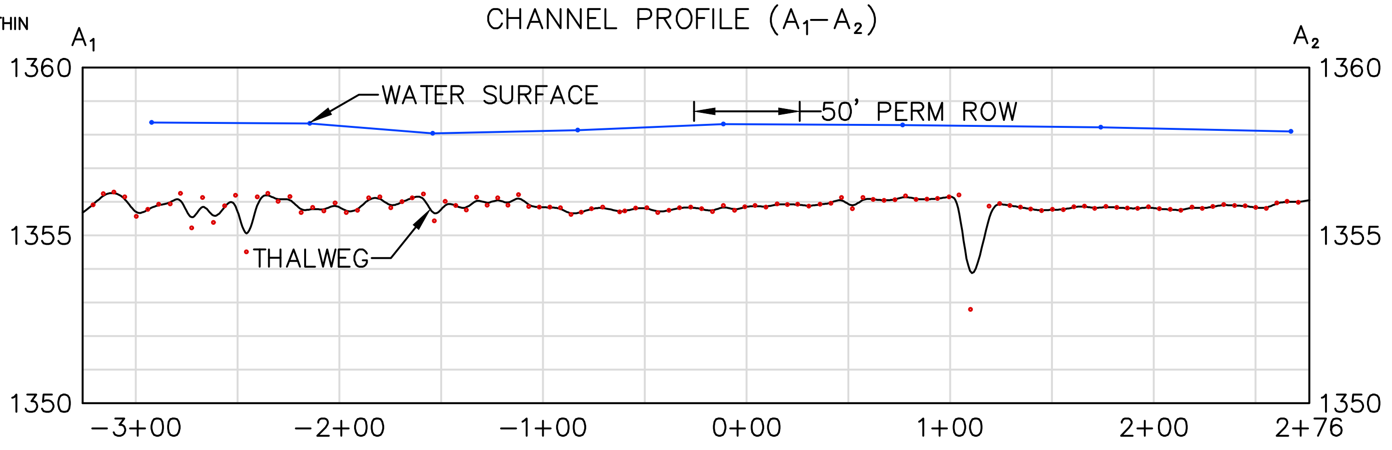
NOTES
1. SOBS (O/H) OR NPC (S1-3): N/A
2. MDNR REGION 1 PWI – COOL/WARM WATER FISHERY: MARCH 15 – JUNE 30. 24-HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
3. MDNR LAND – SEE UTILITY CROSSING LICENSE. NO CLEARING: JUNE-JULY.
4. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

LEGEND

━	PROPOSED ENBRIDGE L3R PIPELINE
— — —	PERMANENT RIGHT OF WAY
━	TEMPORARY WORKSPACE
━	WATERBODY (ROSGEN SURVEY – THALWEG)
─	FEMA FLOODPLAIN
─	TRACT BOUNDARY
MDNR	MINNESOTA DEPARTMENT OF NATURAL RESOURCES (MDNR) BOUNDARY
▭	WETLAND
▨	ADDITIONAL TEMPORARY WORKSPACE
MN-XX-XX-XXX.XXX	TRACT ID
•	ROSGEN SURVEY POINT – WATER SURFACE
•	ROSGEN SURVEY POINT – RIVER BOTTOM (THALWEG)
◕	HDD ENTRY EXIT POINT
✕	TOP OF BANK
│	TRENCH BREAKER (LOCATIONS ARE APPROXIMATE)

FOR ENVIRONMENTAL REVIEW PURPOSES ONLY

CHANNEL PROFILE (A1–A2)



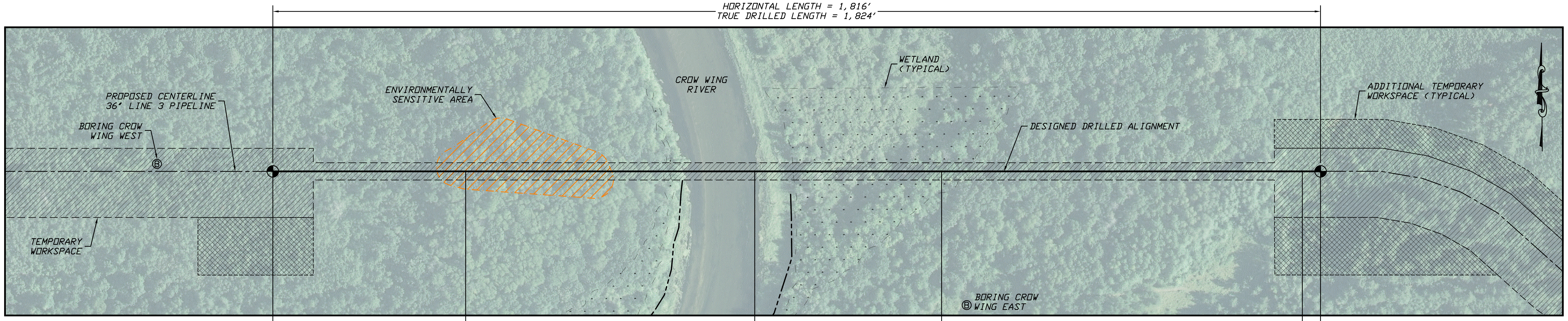
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
0	ISSUED FOR PERMIT APPLICATION	AJJ	10/2020	BAB	BAB

ENBRIDGE

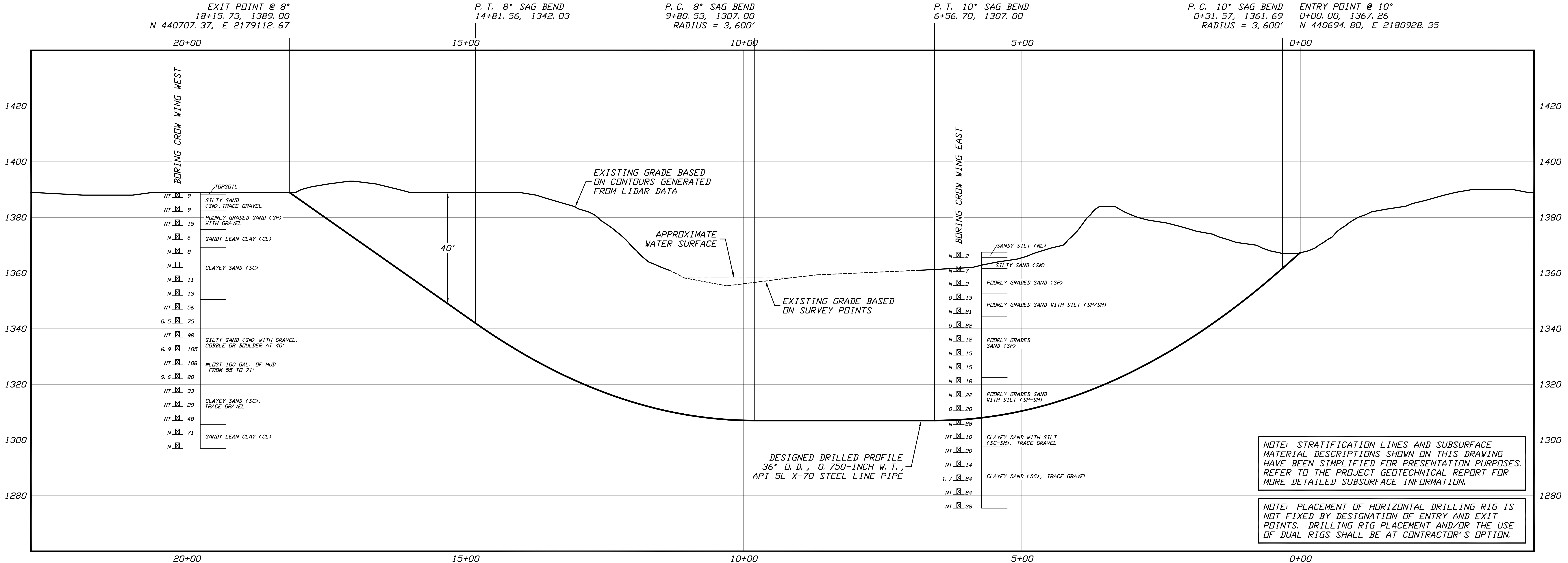
DWN. BY: AJJ	DATE 10/2020
CHK.	
PROJ. ENGR.	
PROJ. MGR.	
CLIENT APP.	

PROPOSED ENBRIDGE L3R PIPELINE
PRIMARY METHOD – HDD
CROSSING OF CROW WING RIVER
ENBRIDGE MP 993.3
WADENA COUNTY, MINNESOTA

SCALE NOTED
DWG. NO. B-93-5.84-MDNR-40-0



PLAN
SCALE: 1"=100'



NOTE: STRATIFICATION LINES AND SUBSURFACE MATERIAL DESCRIPTIONS SHOWN ON THIS DRAWING HAVE BEEN SIMPLIFIED FOR PRESENTATION PURPOSES. REFER TO THE PROJECT GEOTECHNICAL REPORT FOR MORE DETAILED SUBSURFACE INFORMATION.

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PROFILE
SCALE: 1"=100' HORIZONTAL
1"= 20' VERTICAL
200 100 50 0
20 10 0

GENERAL LEGEND

◐ DRILLED PATH ENTRY/EXIT POINT

GEOTECHNICAL LEGEND

Ⓑ BORING LOCATION

SPLIT SPOON SAMPLE

53 ☒ 23 — PENETRATION RESISTANCE IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES
PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

SHELBY TUBE SAMPLE

53 ☐
PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

GEOTECHNICAL NOTES

1. GEOTECHNICAL DATA PROVIDED BY BARR ENGINEERING COMPANY, DULUTH, MN. REFER TO THE PROJECT GEOTECHNICAL REPORT DATED FEBRUARY, 2015 FOR MORE DETAILED SUBSURFACE INFORMATION.
2. THE LETTER "N" TO THE LEFT OF A SAMPLE INDICATES THAT NO GRAVEL WAS OBSERVED IN THE SAMPLE. THE LETTERS "NT" INDICATE THAT GRAVEL WAS OBSERVED BUT NO GRADATION TEST WAS PERFORMED.
3. THE GEOTECHNICAL DATA IS ONLY DESCRIPTIVE OF THE LOCATIONS ACTUALLY SAMPLED. EXTENSION OF THIS DATA OUTSIDE OF THE ORIGINAL BORINGS MAY BE DONE TO CHARACTERIZE THE SOIL CONDITIONS, HOWEVER, COMPANY DOES NOT GUARANTEE THESE CHARACTERIZATIONS TO BE ACCURATE. CONTRACTOR MUST USE HIS OWN EXPERIENCE AND JUDGMENT IN INTERPRETING THIS DATA.

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1. TOPOGRAPHIC SURVEY DATA PROVIDED BY ENBRIDGE, SUPERIOR, WISCONSIN.
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3. ELEVATIONS ARE IN FEET REFERENCED TO NAVD 88.

DRILLED PATH NOTES

1. DRILLED PATH STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND IS REFERENCED TO CONTROL ESTABLISHED FOR THE DRILLED SEGMENT.
2. DRILLED PATH COORDINATES REFER TO CENTERLINE OF PILOT HOLE AS OPPOSED TO TOP OF INSTALLED PIPE.

PILOT HOLE TOLERANCES

THE PILOT HOLE SHALL BE DRILLED TO THE TOLERANCES LISTED BELOW. HOWEVER, IN ALL CASES, RIGHT-OF-WAY RESTRICTIONS AND CONCERN FOR ADJACENT FACILITIES SHALL TAKE PRECEDENCE OVER THESE TOLERANCES.

1. ENTRY POINT: AS STAKED BY COMPANY
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2. POSITIVELY LOCATE AND STAKE ALL EXISTING UNDERGROUND FACILITIES. ANY FACILITIES LOCATED WITHIN 10 FEET OF THE DESIGNED DRILLED PATH SHALL BE EXPOSED.
3. MODIFY DRILLING PRACTICES AND DOWNHOLE ASSEMBLIES AS NECESSARY TO PREVENT DAMAGE TO EXISTING FACILITIES.

LINE 3 PIPELINE PROJECT

PLAN AND PROFILE
36-INCH PIPELINE CROSSING OF THE CROW WING RIVER
BY HORIZONTAL DIRECTIONAL DRILLING

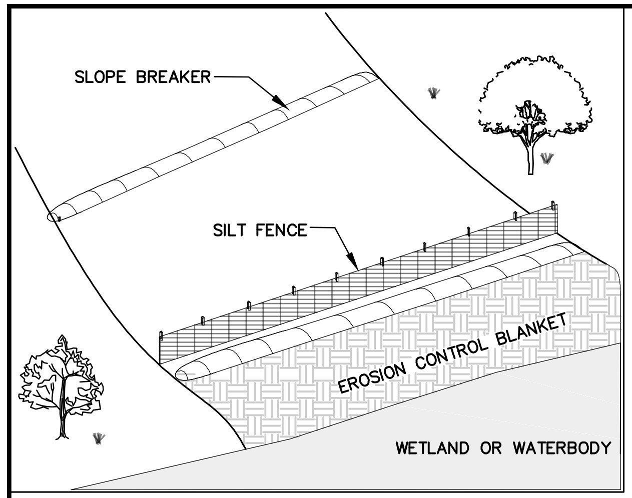
LOCATION: WADENA COUNTY, MINNESOTA

DRAWN	DATE	CHECKED	APPROVED	DRAWING NUMBER	REVISION
ACM	07/26/17	DMP	JSP	D-03-5.84-22570-D-1352	D

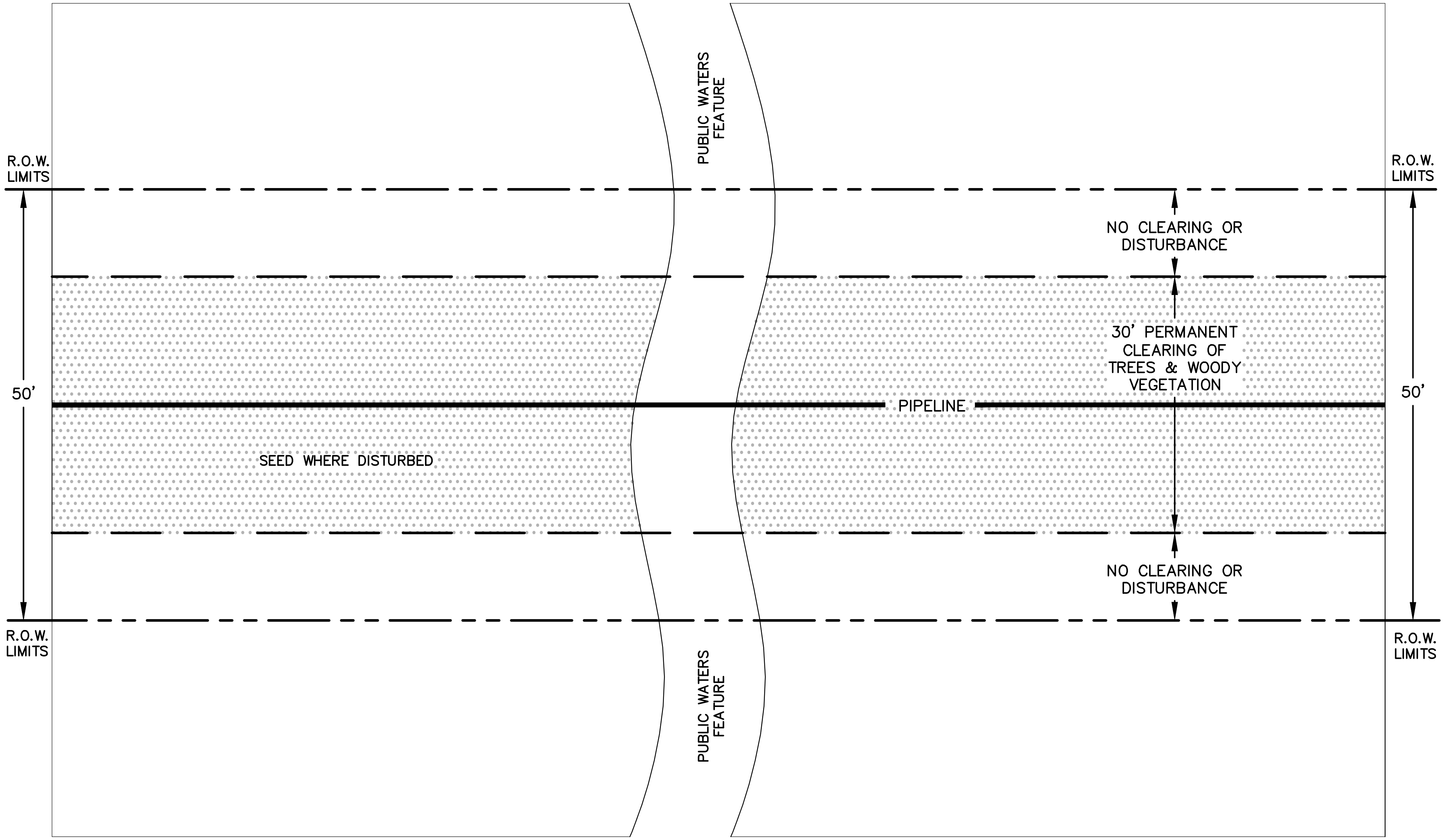
NO.	DATE	REVISION DESCRIPTION	BY	CHK'D	APP.
D	10/17/19	UPDATE WETLAND BOUNDARIES AND WORKSPACE	KWW	JSP	JSP
C	09/20/19	MOVE ENTRY POINT 180' EAST PER ENBRIDGE	JSP	CDS	JSP
B	09/29/17	UPDATE WORKSPACE	LKB	JSP	JSP
A	07/26/17	ISSUE FOR CONSTRUCTION	ACM	DMP	JSP

J.D.Hair&Associates,Inc.
Consulting Engineers
2424 East 21st Street
Suite 510
Tulsa, Oklahoma 74114

PROJECT NO.
Enbridge\1404
MILEPOST
D993



▨ SEEDING AREA



PUBLIC WATERS FEATURE - HDD CROSSING

1) DISTURBANCE OF THE ROW IS LIMITED TO THE 30-FOOT-WIDE CLEARING OF TREES AND WOODY VEGETATION AND IMPACTS RESULTING FROM TRAVEL LANES AND/OR BRIDGES.
2) ANY WETLAND OR WATERBODY BANK THAT IS DISTURBED WILL BE STABILIZED WITH EROSION AND SEDIMENT CONTROL BMP AND RESTORED TO AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS.
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ISSUED
FOR PERMIT
12/13/19

B	ISSUED FOR PERMIT	AJM	12/13/19	KEH	KD
A	ISSUED FOR REVIEW	AJM	12/10/19	KEH	KD
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D

DWN. BY: AJM	DATE 12/10/19
CHK. KEH	
PROJ. ENGR. DG	
PROJ. MGR. KD	
CLIENT APP.	

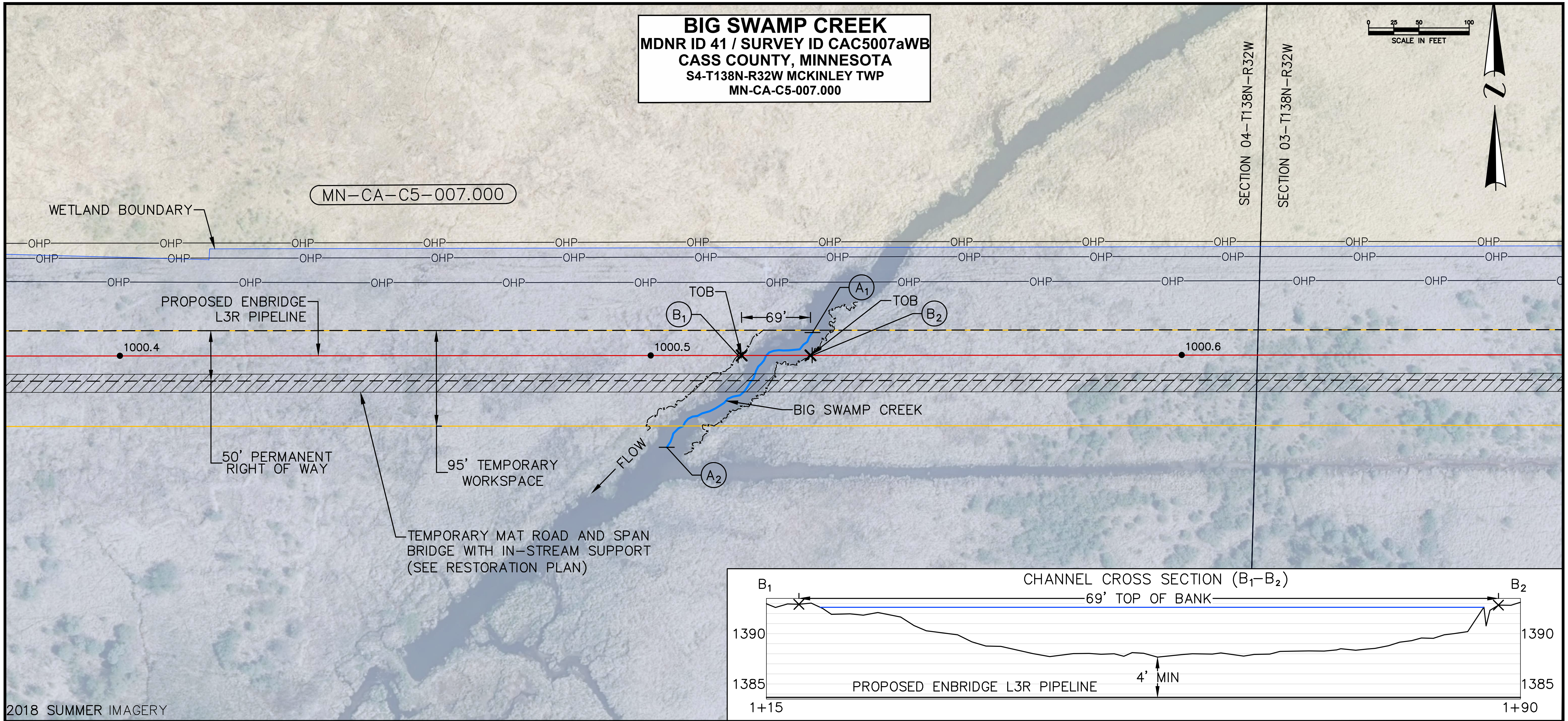
ENBRIDGE

LINE 3 REPLACEMENT
PUBLIC WATERS HDD CROSSING TYPICAL
FINAL STREAM STABILIZATION &
EROSION CONTROL

SCALE NTS
DWG. NO.

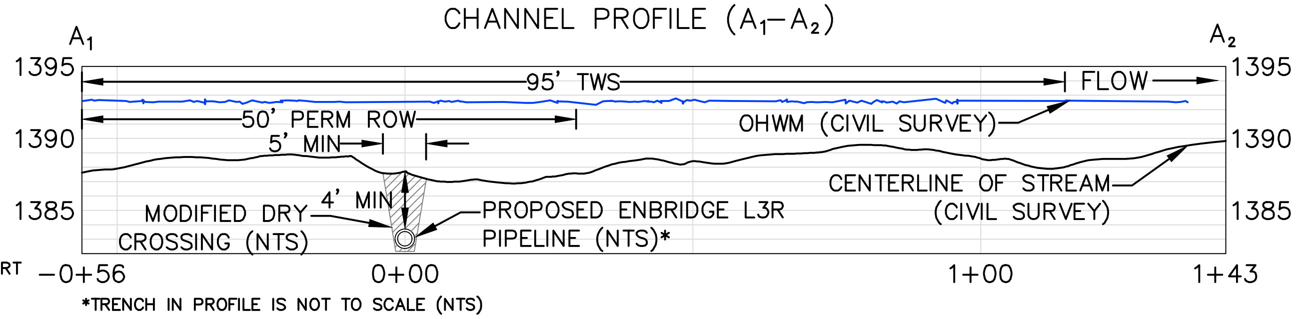
MDNR ID No. 41: MP 1000.5; Big Swamp Creek (M-096-030)

BIG SWAMP CREEK
MDNR ID 41 / SURVEY ID CAC5007aWB
CASS COUNTY, MINNESOTA
S4-T138N-R32W MCKINLEY TWP
MN-CA-C5-007.000



NOTES
1. NO ROSGEN DATA AVAILABLE
2. SOBS (O/H) OR NPC (S1–3): N/A
3. MDNR REGION 1 PWI – COOL/WARM WATER FISHERY: MARCH 15 – JUNE 30. 24-HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
4. CROSSING PROPOSED FOR WINTER CONSTRUCTION BASED ON DECEMBER 1, 2020 START DATE.
5. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

CHANNEL PROFILE (A_1–A_2)



*TRENCH IN PROFILE IS NOT TO SCALE (NTS)

LEGEND

―	PROPOSED ENBRIDGE L3R PIPELINE
— — — —	PERMANENT RIGHT OF WAY
―	TEMPORARY WORKSPACE
—OHP——OHP—	OVERHEAD ELECTRIC
―	WATERBODY
―	FEMA FLOODPLAIN
―	TRACT BOUNDARY
― MDNR	MINNESOTA DEPARTMENT OF NATURAL RESOURCES (MDNR) BOUNDARY
▨	TEMPORARY MAT ROAD AND SPAN BRIDGE WITH IN-STREAM SUPPORT
▭	WETLAND
▨	ADDITIONAL TEMPORARY WORKSPACE
MN–XX–XX–XXX.XXX	TRACT ID
×	TOP OF BANK

FOR ENVIRONMENTAL REVIEW PURPOSES ONLY

CHANNEL CROSS SECTION NOTE:
1. CHANNEL LOCATIONS, DIMENSIONS, AND/OR ELEVATIONS ARE BASED ON 2020 TOPOGRAPHIC/BATHYMETRIC SURVEY(S), AND AS SUCH DO NOT REFLECT CHANGES TO THE CHANNEL THAT MAY HAVE OCCURRED SINCE THAT TIME.
2. DEPTH OF COVER AT CENTERLINE WAS DEVELOPED USING THE BOTTOM ELEVATION OF THE DEEPEST UPSTREAM OR DOWNSTREAM POOL WITHIN THE SURVEYED REACH, UNLESS OTHERWISE NOTED IN APPLICATION MATERIALS.
3. MEAN MEANDER BELT WIDTH: N/A
4. MEANDER WIDTH RATIO: N/A

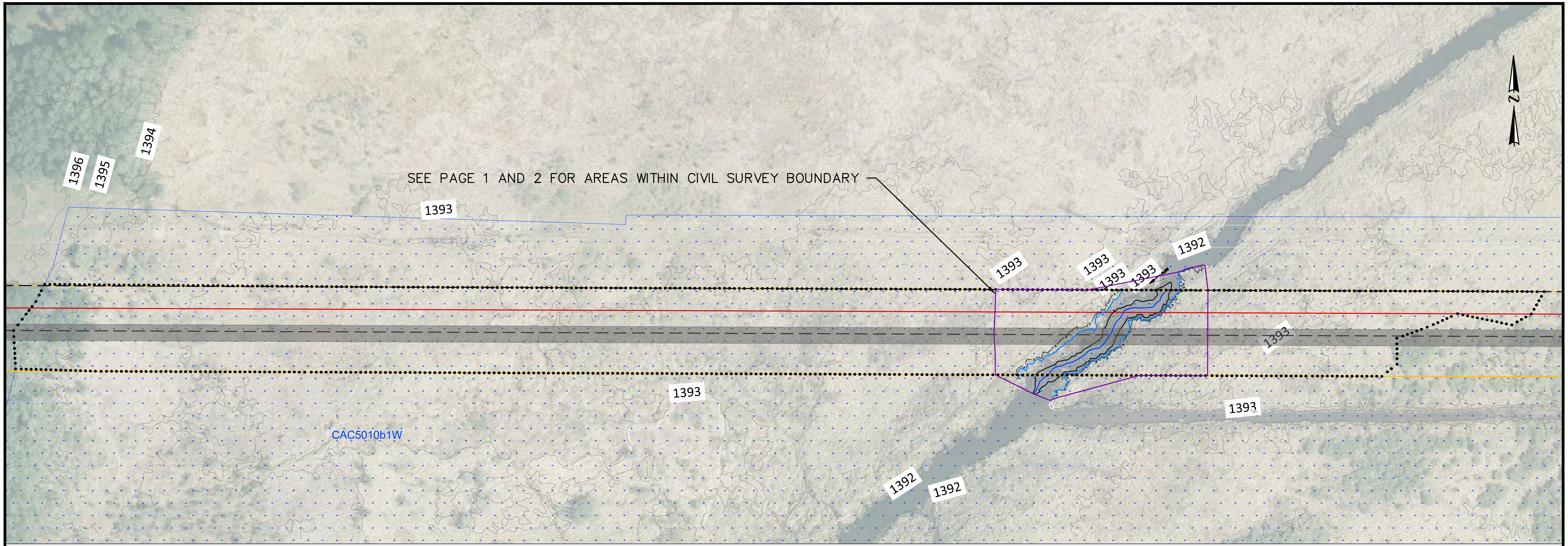
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
0	ISSUED FOR PERMIT APPLICATION	AJJ	10/2020	BAB	BAB

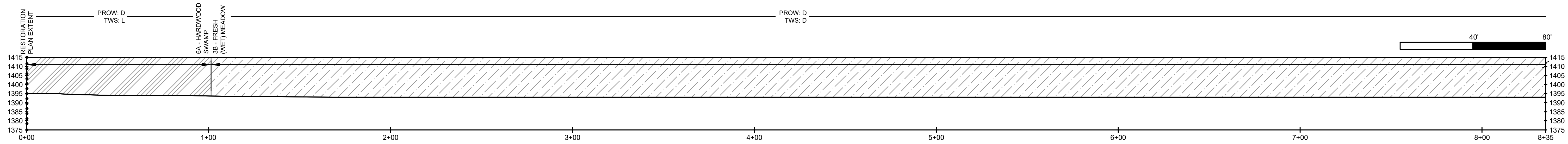
ENBRIDGE

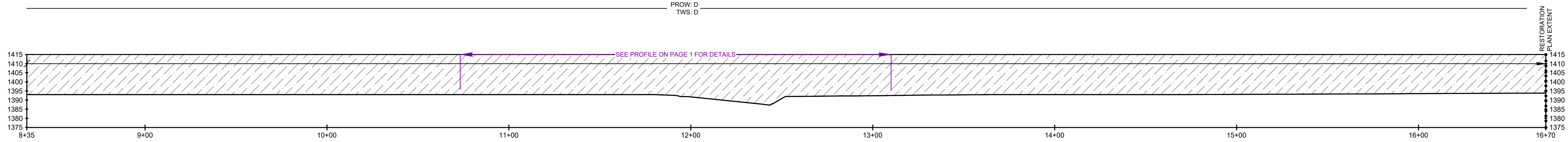
DWN. BY: AJJ	DATE 10/2020
CHK.	
PROJ. ENGR.	
PROJ. MGR.	
CLIENT APP.	

PROPOSED ENBRIDGE L3R PIPELINE
PRIMARY METHOD – MODIFIED DRY CROSSING
CROSSING OF BIG SWAMP CREEK
ENBRIDGE MP 1000.5
CASS COUNTY, MINNESOTA

SCALE: NOTED
DWG. NO. B-93-5.84-MDNR-41-0







BWSR SEED MIX	D: WET MEADOW NE (34–371); L: NATURAL REVEGETATION
SOBS (O/H) or NPC (S1-3)	N/A

1. ELEVATIONS OUTSIDE OF THE AREA WITHIN CIVIL SURVEY BOUNDARY ARE DERIVED FROM LIDAR. ENBRIDGE WILL RESTORE THE AREAS ADJACENT TO THE PUBLIC WATER WITHIN THE MDNR EXPANDED RESTORATION BOUNDARY TO PRE–CONSTRUCTION CONDITIONS.
2. MDNR REGION 1 PWI – COOL/WARM WATER FISHERY: MARCH 15 – JUNE 30. 24–HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
3. AIR PHOTOS ARE FROM 2018 ENBRIDGE AERIAL PHOTOGRAPHY.
4. ADDITIONAL ON–THE GROUND PHOTOS MAY BE TAKEN PRIOR TO CONSTRUCTION AT MDNR REQUEST.
5. PRE–CONSTRUCTION PHOTOS WILL BE USED TO AID IN RESTORATION.
6. SEE GENERAL NOTES PAGE FOR ADDITIONAL DETAIL.
7. SEE THE PLANTING PLAN FOR ADDITIONAL DETAIL REGARDING SEEDING PRACTICES AND SEED MIXES AT PUBLIC WATER CROSSINGS.
8. ON PUBLIC LANDS AND WHEREVER PRACTICABLE AT WATERBODY CROSSINGS, ENBRIDGE WILL USE WILDLIFE–FRIENDLY EROSION AND SEDIMENT CONTROL BMPS THAT CONTAIN BIODEGRADABLE NETTING (CATEGORY 3N OR 4N NATURAL FIBER) AND WILL AVOID THE USE OF PLASTIC MESH (SECTIONS 1.17.1 AND 2.6.1 OF THE EPP).
9. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

LEGEND

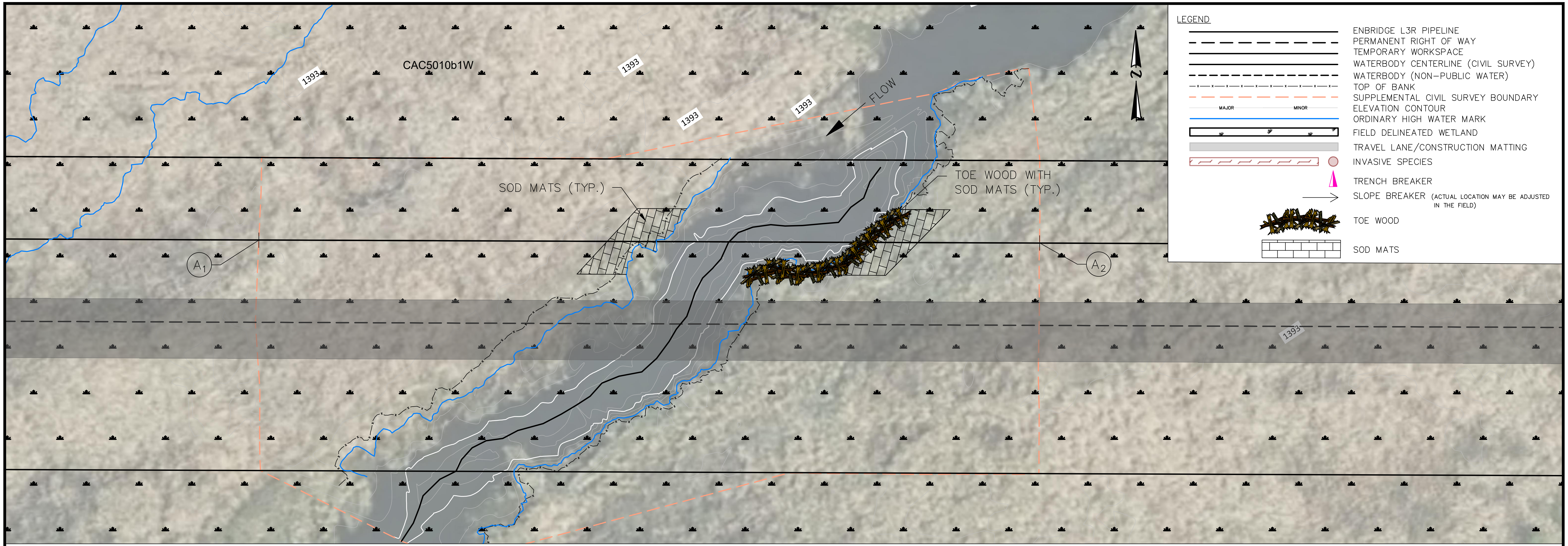
ENBRIDGE L3R PIPELINE
PERMANENT RIGHT OF WAY
TEMPORARY WORKSPACE
WATERBODY CENTERLINE (CIVIL SURVEY)
WATERBODY (NON–PUBLIC WATER)
PUBLIC WATER CIVIL SURVEY BOUNDARY
MDNR EXPANDED RESTORATION BOUNDARY
TOP OF BANK
MAJOR MINOR ELEVATION CONTOUR
ORDINARY HIGH WATER MARK
FIELD DELINEATED WETLAND
TRAVEL LANE/CONSTRUCTION MATTING

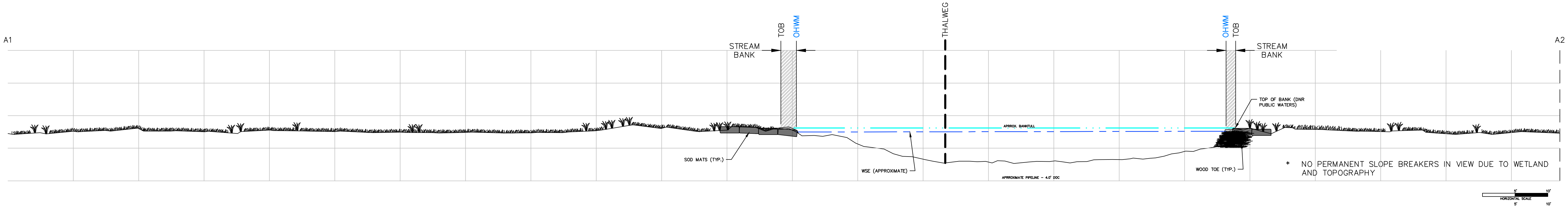
INVASIVE SPECIES
TRENCH BREAKER
PERMANENT SLOPE BREAKER
(ACTUAL LOCATION MAY BE ADJUSTED IN THE FIELD)
1 – SHALLOW, OPEN WATER
2B – SHALLOW MARSH
3A – SEDGE MEADOW
3B – FRESH (WET) MEADOW
5A – SHRUB–CARR
5B – ALDER THICKET
6A – HARDWOOD SWAMP
6B – CONIFEROUS SWAMP

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING	MJT	10/2020		
A	ISSUED FOR REVIEW	MJT	09/2020		

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
BIG SWAMP CREEK – MP 1000.5 – MDNR ID 41
RE–VEGETATION PLAN: EXPANDED EXTENT

SCALE: NOTED
DWG. NO.: SSRP–1000.5–001A
PAGE NO.: 1A/5





* NO PERMANENT SLOPE BREAKERS IN VIEW DUE TO WETLAND AND TOPOGRAPHY

PROPOSED RESTORATION ACTIVITIES WILL BE REVIEWED BY DNR AND ENBRIDGE DURING SITE VISIT AND MAY BE CHANGED TO REFLECT SITE CONDITIONS AT THE TIME OF CONSTRUCTION.

FEATURE ID	CAC5007aWB; IFC ID: S-210.0
CROSSING TYPE	MODIFIED DRY CROSSING
PROPOSED RESTORATION (SEE DETAILS FOR LIVE STAKING, TRANSPLANTS, AND SHRUB SPECIES IF APPLICABLE)	EC BLANKET -NATURAL FIBER MPCA TYPE 3.B/MNDOT CATEGORY 4N; BRUSH - TOE WOOD
WITHIN OR ADJACENT WETLAND	FRESH WET MEADOW
BWSR SEED MIX	WET MEADOW NE (34-371)
DOMINANT WETLAND VEGETATION	1. CALAMAGROSTIS CANADENSIS
SOBS (O/H) or NPC (S1-3)	N/A

NOTES

1. CONSTRUCTION TIMING RESTRICTIONS
   1.1.MDNR REGION 1 PWI – COOL/WARM WATER FISHERY: MARCH 15 – JUNE 30.
   1.2. WHEN WORK OCCURS WITHIN "WORK IN WATER RESTRICTIONS", ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE STABILIZED WITHIN 24 HOURS DURING THE RESTRICTION PERIOD. STABILIZATION OF ALL EXPOSED SOILS WITHIN 200 FEET OF THE PUBLIC WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY OR TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD
2. WORK SHALL BE CONDUCTED IN ACCORDANCE WITH APPLICABLE STANDARDS IN ENBRIDGE'S EPP AND VMP FOR PUBLIC LANDS AND WATERS. THE SPECIFICATIONS WITHIN THIS SSRP MAY MODIFY OR REPLACE THESE STANDARDS.
3. SEE GENERAL NOTES PAGE FOR ADDITIONAL DETAIL.
4. INFORMATION REGARDING SEEDING SPECIFICATIONS, SEED BED PREPARATION TECHNIQUES, ETC. ARE DESCRIBED IN THE PLANTING PLAN CONTAINED WITHIN THE VMP.
5. TRENCH BREAKER LOCATION IS APPROXIMATE PENDING FIELD VERIFICATION (EPP SECTION 1.13)

ENBRIDGE

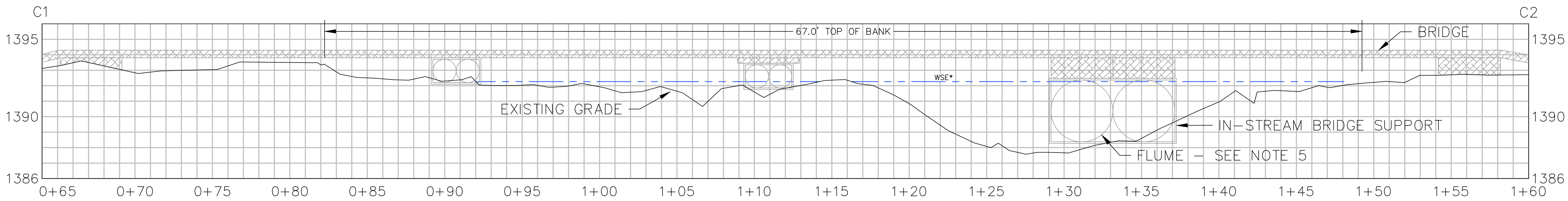
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		
NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE-SPECIFIC RESTORATION PLAN
BIG SWAMP CREEK – MP 1000.5 – MDNR ID 41
RE-VEGETATION PLAN

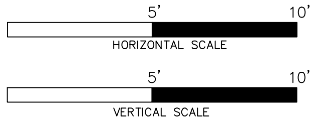
SCALE	DWG. NO.	PAGE NO.
NOTED	SSRP-1000.5-001	1/6

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

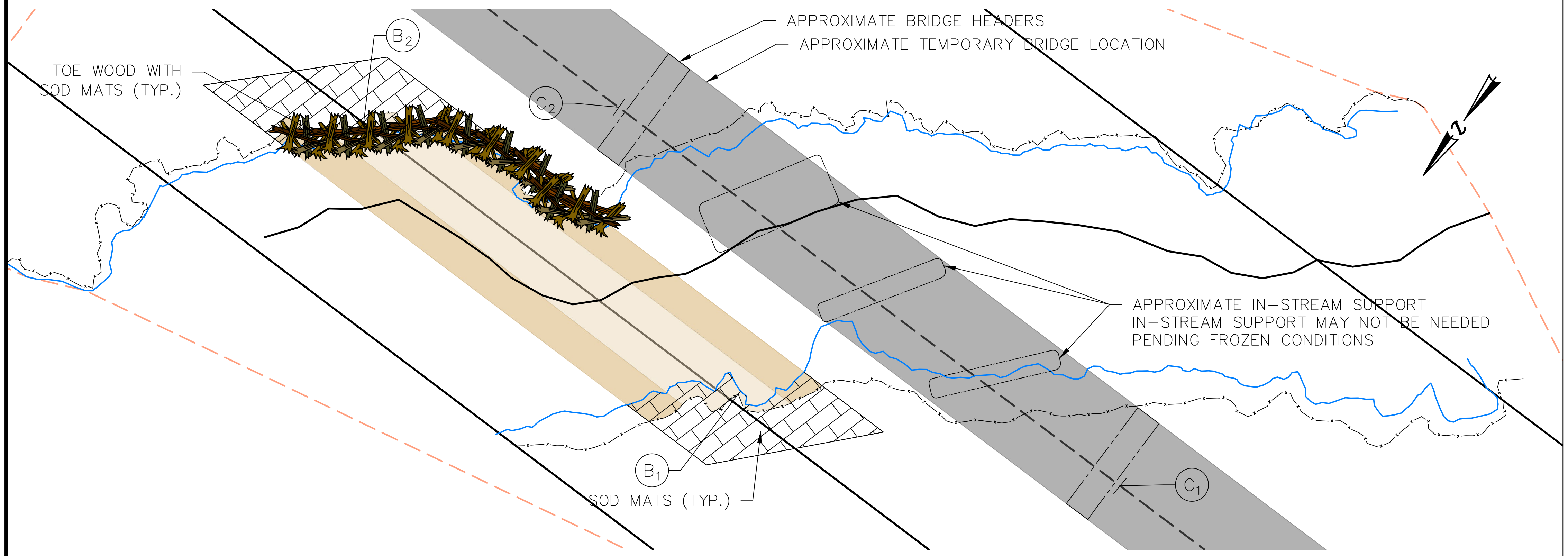
BANK RESTORATION (BRIDGE)

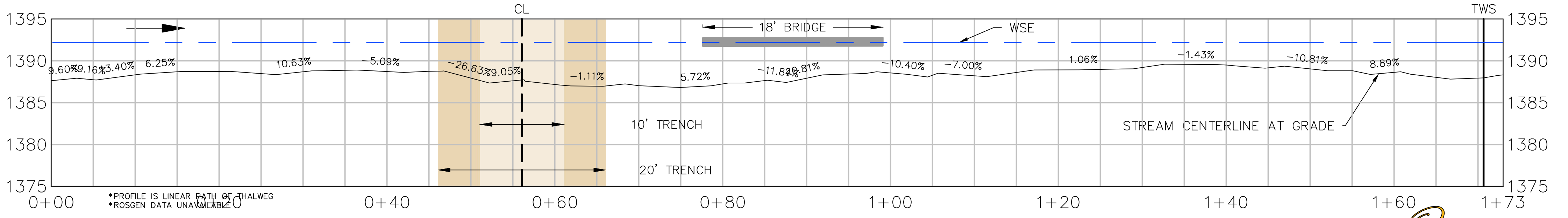


*APPROXIMATE WSE IS PROVIDED
FOR CONSTRUCTION ACTIVITIES



STREAMBED RESTORATION





*PROFILE IS LINEAR PATH OF THALWEG
*ROSGEN DATA UNAVAILABLE

NOTES

1. TRANSITIONS BETWEEN EXISTING CHANNEL FEATURES (BED, BANK, FLOODPLAIN) AND PROPOSED RESTORED TRENCH CROSSING WILL BE SMOOTH AND EVENLY GRADED WITHOUT ABRUPT OR PROTRUDING OBSTRUCTIONS.
2. BANK MIGRATION POTENTIAL IS LOW. PRIMARY FLOW IS LOCATED IN THE CENTER OF THE CHANNEL.
3. PLACE MATS DIRECTLY ON TOP OF EXISTING VEGETATION TO AVOID OR MINIMIZE DISTURBANCE OF VEGETATION ON THE CHANNEL BANKS AND AT THE TOP OF THE STREAM BANK.
4. SEE DETAIL SHEET FOR SPECIFIC RESTORATION METHODS AND DETAILS.
5. FLUMES SIZES MAY VARY BETWEEN 18–48 INCHES AND MUST EXTEND ABOVE OHWM OR SURFACE WATER AT TIME OF CONSTRUCTION, WHICHEVER IS GREATER.
6. BANK STABILIZATION AND RESTORATION MAY VARY PENDING SITE CONDITIONS AND SEASON OF CONSTRUCTION.
7. MINIMIZE DISTURBANCE OF BED MATERIALS AND FEATURES DURING CONSTRUCTION OF THE TRENCH AND INSTALLATION AND REMOVAL OF IN-STREAM SUPPORT
8. BED AND/OR BANK MATERIALS TEMPORARILY ADJUSTED OR REMOVED DURING CONSTRUCTION SHALL BE PLACED IN THE APPROXIMATE ORIGINAL LOCATION DURING RESTORATION. MATERIALS SHALL BE FIELD ADJUSTED DURING PLACEMENT BASE ON THE OBSERVED FLOW PATH AT THE TIME OF CONSTRUCTION.
9. ALIGNMENT OF IN-STREAM SUPPORT SHALL BE FIELD ADJUSTED BASED ON FLOW PATH TO PROTECT CHANNEL BANKS.
10. SEE RESTORATION SHEET FOR B1–B2 CROSS SECTION.

LEGEND

━━━━	ENBRIDGE L3R PIPELINE
— — —	PERMANENT RIGHT OF WAY
────	TEMPORARY WORKSPACE
🟥	WATERBODY – RIFFLE (ROSGEN SURVEY)
🟦	WATERBODY – POOL (ROSGEN SURVEY)
🟪	WATERBODY – RUN (ROSGEN SURVEY)
🟩	WATERBODY – GLIDE (ROSGEN SURVEY)
MAJOR MINOR	CONTOUR (1' INTERVAL)
-·-·-·-	TOP OF BANK
────	ORDINARY HIGH WATER MARK
▭	FIELD DELINEATED WETLAND
▨	TRAVEL LANE/CONSTRUCTION MATTING
▨	TRENCH – 10'
▨	TRENCH – 20'

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE-SPECIFIC RESTORATION PLAN
BIG SWAMP CREEK – MP 1000.5 – MDNR ID 41
STABILIZATION PLAN

ENBRIDGE

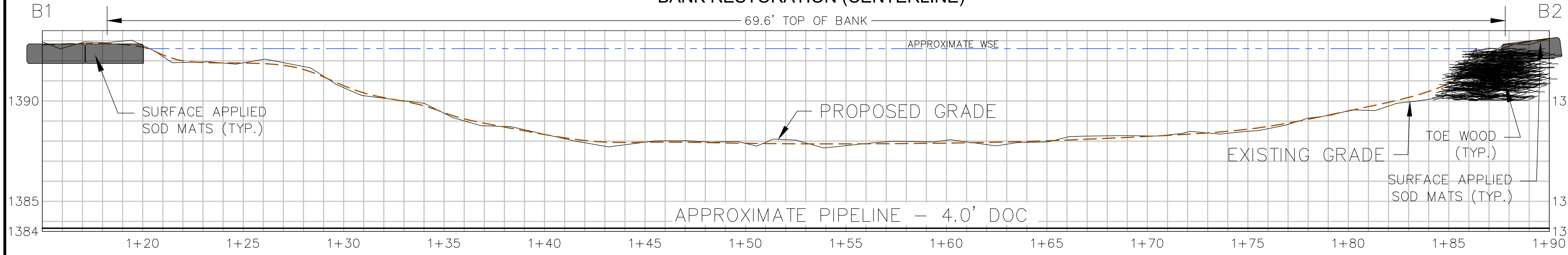
SCALE

DWG. NO.
SSRP-1000.5-002

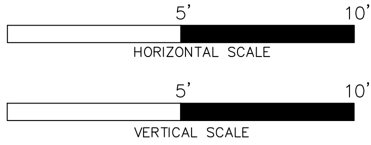
PAGE NO.
2/6

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

BANK RESTORATION (CENTERLINE)



SEE DETAILS FOR BANK RESTORATION
TECHNIQUES ON BOTH BANKS (1/4) (1/5)



LEGEND

▬	SOD MAT
▨	TOE WOOD

RESTORATION NOTES:

GENERAL

1. REFER TO RESTORATION DETAIL SHEETS FOR ADDITIONAL INFORMATION RELATED TO PROPOSED RESTORATION MEASURES.
2. REFER TO SITE PHOTOS FOR INFORMATION ON PRE-CONSTRUCTION CROSSING CONDITIONS AND TO PROVIDE ADDITIONAL GUIDANCE FOR RESTORATION EFFORTS.

TOE WOOD

1. ROUGH GRADE CHANNEL BED FEATURES INCLUDING POOLS AND PLACEMENT OF SUBSTRATE.
2. INSTALL FOOTER LOG(S) ALONG PROPOSED TOE OF SLOPE. FOOTER LOGS SHOULD BE ANGLED TO ALLOW FOR TOE ALIGNMENT TO GENERALLY MATCH THE EXISTING CURVE AND EVENLY TRANSITION FROM UPSTREAM TO DOWNSTREAM.
3. PUSH FOOTER LOG INTO SOIL APPLY A SMALL AMOUNT OF GRAVEL OR STONE AS NEEDED TO PREVENT FLOATATION OF FOOTER LOG PRIOR TO PLACING WOODY DEBRIS.
4. PLACE A LAYER WOODY DEBRIS IN 6" TO 8" LIFTS, APPLY 3"-4" GRAVEL AND/OR SOIL FILL AND COMPACT WITH EXCAVATOR BUCKET. WASH FILL MATERIAL INTO WOODY DEBRIS MATRIX WITH WATER FROM CHANNEL. APPLY ADDITIONAL LAYERS "AS NEEDED" TO REACH THE SPECIFIED TOE WOOD HEIGHT.
5. PLACE STACKED SOD MATS ABOVE TOE WOOD. THE USE OF TRANSPLANTS OR FABRIC LIFTS MAY BE FIELD APPROVED BY ENBRIDGE IN CONSULTATION WITH MN DNR.

SOD MATTING

1. REMOVE 15 LINEAR FEET OF VEGETATED MATS ON EITHER SIDE OF THE STREAM CROSSING USING ONSITE EQUIPMENT WHICH CAN UNDERCUT THE VEGETATION FOR REMOVAL. SMALL SHRUBS AND/OR TREES WITHIN THE SOD MATS ARE ACCEPTABLE AND SHOULD NOT BE REMOVED.
2. DEPENDING ON THE LEVEL OF SATURATION AT THE TIME OF REMOVAL, IT MAY BE DIFFICULT TO OBTAIN INTACT CONSOLIDATED MATS, BUT GENERALLY THE NATIVE VEGETATION WILL BE RETAINED AND CAPTURED FOR PLACEMENT.
3. SOD MATS CAN BE TRANSPLANTED DURING ANY SEASON
4. SOD MAT WILL BE PLACED ON CLEAR GROUND OR MATS WITHIN THE WORKSPACE.
5. MONITOR MATS TO SUPPORT SURVIVABILITY; WATERING MAY BE NEEDED.
6. PRIOR TO PLACEMENT OF SOD MATS FINISH GRADE CHANNEL BANK AND ADJACENT FLOODPLAIN APPLICATION AREA TO PROVIDE A SMOOTH AND EVEN SURFACE. SUBGRADE ELEVATION SHOULD ALLOW FOR THE FINISHED SOD SURFACE TO TRANSITION EVENLY WITH THE CHANNEL BANKS UPSTREAM AND DOWNSTREAM OF THE INSTALLATION AREA. AVOID ABRUPT CHANGES IN GRADE.
7. VEGETATED MATS WILL BE RETURNED/SET IN PLACE WITH ONSITE EQUIPMENT.
    a. SURFACE APPLIED SOD MATTING SHOULD BE PLACED WITH THE LONG SIDE PERPENDICULAR TO THE CHANNEL / FLOW.
    b. STACKED SOD MATTING SHOULD BE PLACED WITH THE LONG SIDE PARALLEL TO THE CHANNEL / FLOW.
8. WHEN PLACING SOD MATS, DO NOT LEAVE LARGE GAPS BETWEEN EACH SOD MAT AS NON-NATIVE VEGETATION WILL QUICKLY ATTEMPT TO COLONIZE THESE VOIDS.
9. WATER SOD MATS AFTER REPLACEMENT IF CONDITIONS ARE HOT AND DRY. DAMP AND/OR FROZEN SOD MATS DO NOT REQUIRE WATERING.
10. THE TOP MAT AND/OR OTHER MATS CAN BE ANCHORED WITH A LIVE AND/OR DEAD STOUT STAKE TO ENSURE THAT IT DOES NOT MOBILIZE DURING A FLOOD EVENT BEFORE THE ROOTS HAVE ESTABLISHED.
11. THE VEGETATED MATS WILL BE REPLACED AS SOON AS PRACTICAL FOLLOWING BACKFILLING OF THE TRENCH AND STABILIZED PER THE TIMING REQUIREMENTS DESCRIBED IN SECTION 1.9.1 OF THE EPP.

TRANSPLANTS

1. SHRUBS AND/OR ALDER REMOVED FROM THE TRENCH AREA MAY BE USED IN LIEU OF SOD MATS IN ACCORDANCE WITH THE TRANSPLANT DETAIL.

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
BIG SWAMP CREEK – MP 1000.5 – MDNR ID 41
SITE SPECIFIC DETAILS

ENBRIDGE

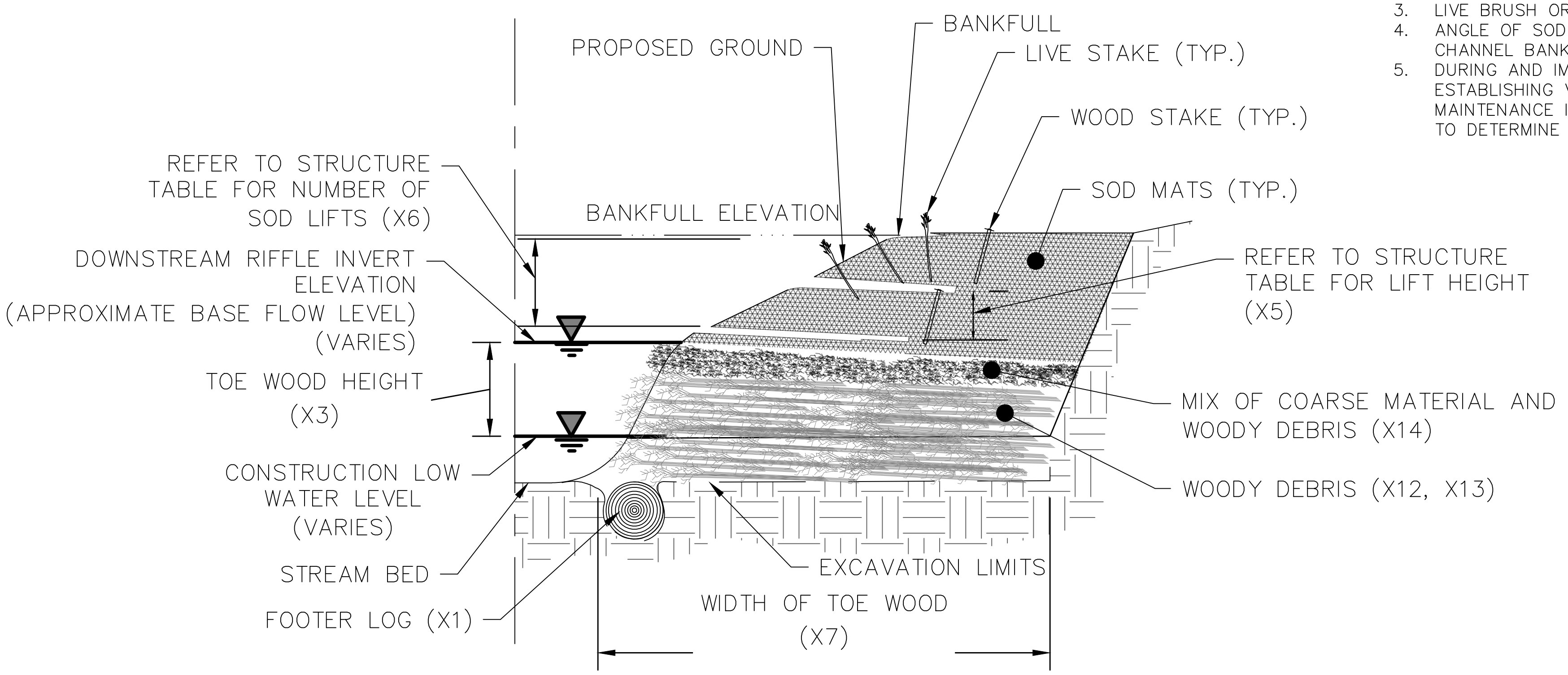
SCALE	DWG. NO.	PAGE NO.
NOTED	SSRP–1000.5–004	3/6

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

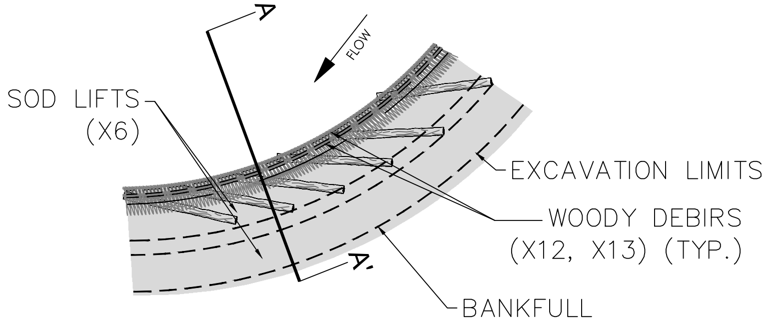
TOE WOOD DIMENSIONS			
VARIABLE	VALUE	TYPICAL UNIT	DESCRIPTION
X1	6.0 - 10.0	IN.	FOOTER LOG DIAMETER
X2	8.0 - 12.0	FT.	FOOTER LOG LENGTH
X3	3.0	FT.	TOE WOOD HEIGHT
X4	SEE SHEET 3	N/A	MATCH TYPICAL SECTION
X5	SEE SHEET 5	FT.	SOD LIFT HEIGHT
X6	1.0	#	SOD LIFTS
X7	8.0 - 10.0	FT.	TOE WOOD WIDTH
X8	3.0 - 6.0	FT.	SOD LIFT WIDTH
X9	24.0	IN.	WOOD STAKE LENGTH
X10	4.0	IN.	WOOD STAKE WIDTH (TOP)
X11	0.5	IN.	WOOD STAKE WIDTH (BOTTOM)
X12	1/2 - 3.0	IN.	WOODY DEBRIS DIAMETER
X13	8.0 - 12.0	FT.	WOODY DEBRIS LENGTH
X14	3" MINING GRAVEL WITH FINES	%	SELECT COARSE MATERIAL BACKFILL (BY VOLUME)

TOE WOOD EXAMPLE

NOTES:
1. WOODY MATERIAL OF APPROPRIATE SIZE CONSISTING OF LOGS, TRUNKS, LIMBS, BRANCHES, AND SMALLER WOODY DEBRIS INCLUDING TOPS OR SLASH. ON-SITE WOODY MATERIAL IS PREFERRED.
2. WOODY DEBRIS SHOULD BE GREEN OR RELATIVELY GREEN AND MAY CONSIST OF HARDWOODS, CONIFERS, OR A COMBINATION OF BOTH.
3. LIVE BRUSH OR OTHER BANK VEGETATION MAY BE INCORPORATED.
4. ANGLE OF SOD MAT SURFACE SHALL MATCH THE PROPOSED CHANNEL CROSS SECTION AND PROVIDE A SMOOTH AND EVEN CHANNEL BANK SURFACE BETWEEN UPSTREAM AND DOWNSTREAM BANKS.
5. DURING AND IMMEDIATELY AFTER CONSTRUCTION, BANK SLOPES ABOVE THE WOOD TOE ARE VULNERABLE TO EROSION. ESTABLISHING VEGETATION OR OTHER COVER MATERIAL AS SOON AS POSSIBLE WILL HELP REDUCE EROSION. ADDITIONAL MAINTENANCE IS NOT EXPECTED ONCE VEGETATION ESTABLISHES. INSPECTION AFTER LARGE FLOW EVENTS MAY BE ADVISABLE TO DETERMINE IF ANY MATERIAL MOVEMENT OR UNEXPECTED SCOUR HAS OCCURRED.



SECTION A-A'



PLAN VIEW AT BANKFULL ELEVATION

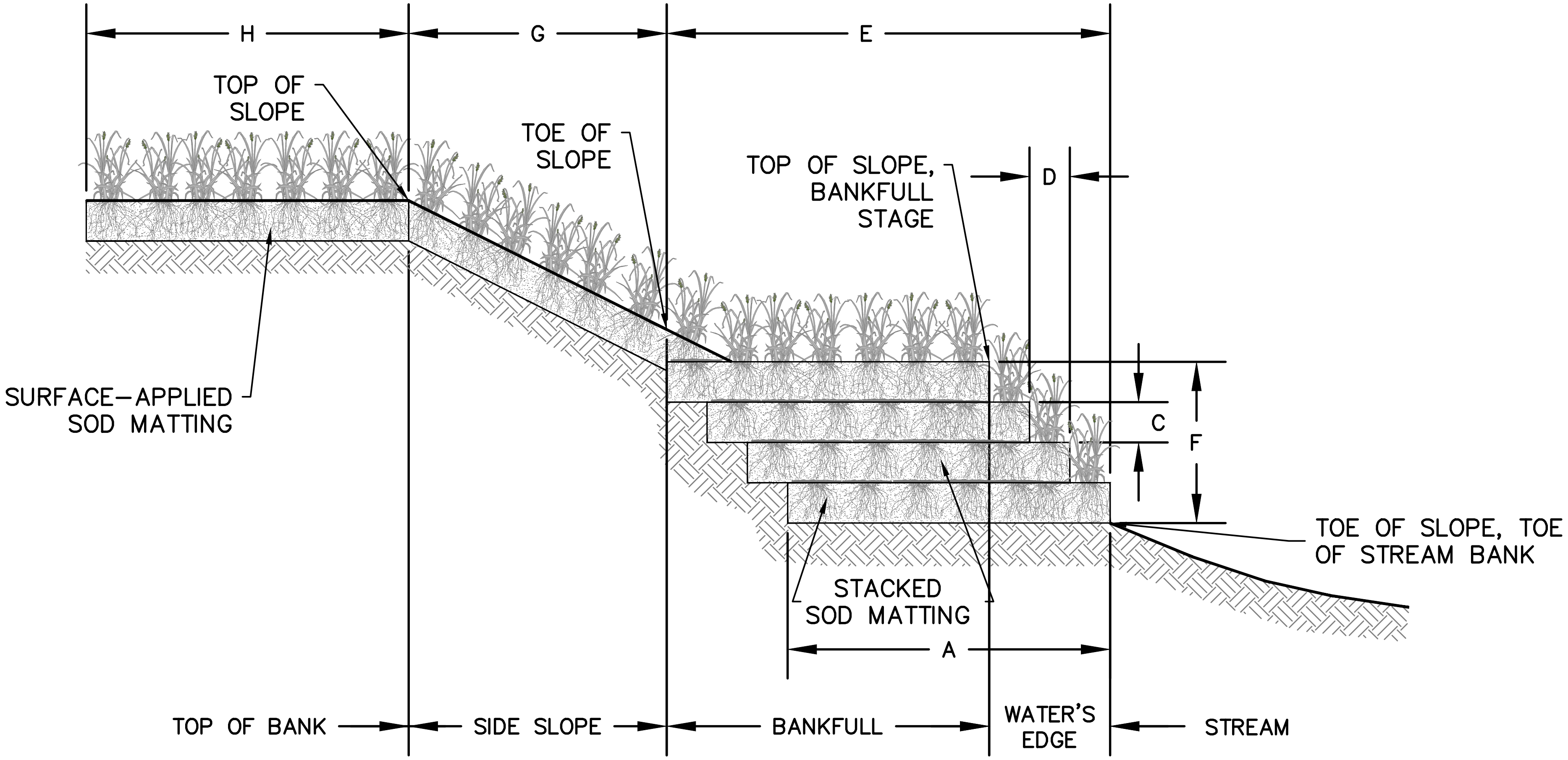
1 TOE WOOD DETAIL

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		

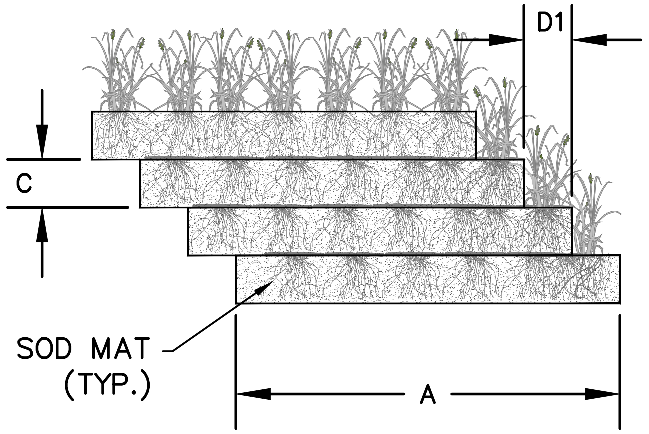
ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE-SPECIFIC RESTORATION PLAN
BIG SWAMP CREEK – MP 1000.5 – MDNR ID 41
SITE SPECIFIC DETAILS

SCALE NOTED
DWG. NO. SSRP-1000.5-004
PAGE NO. 4/6

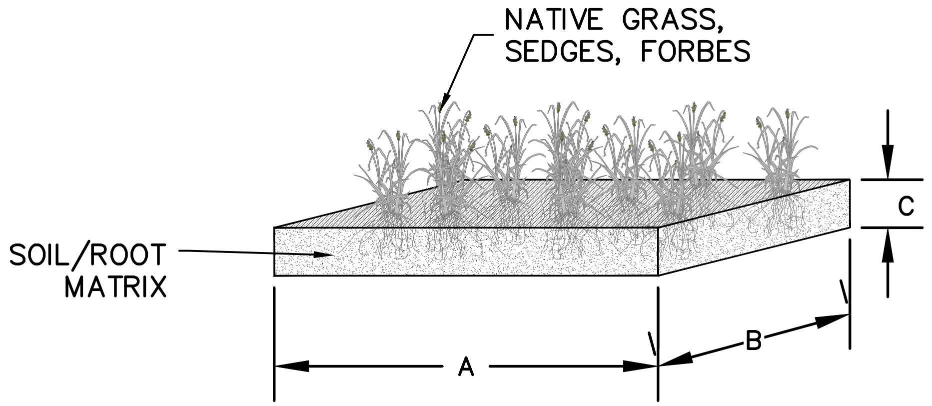
PLOTTED SIZE: ANSI FULL BLEED B (17x11)



CROSS SECTION



STACKED SOD MATTING DETAIL



SOD MAT DETAIL

DIMENSION[1]	NAME	TYPICAL UNIT	VALUE	DESCRIPTION
A	SOD MAT WIDTH	FEET	3 – 4	WIDTH OF INDIVIDUAL SOD MAT.
B	SOD MAT LENGTH	FEET	3 – 6	LENGTH OF INDIVIDUAL SOD MAT.
C	SOD MAT THICKNESS	INCHES	12	THICKNESS OF INDIVIDUAL SOD MAT.
D	STACKED SOD MAT SETBACK	INCHES	N/A	THE DISTANCE BETWEEN THE EDGES OF SOD MATS STACKED TO FORM A SLOPE
E	WIDTH OF STACKED SOD MATS	FEET, INCHES	N/A	WIDTH OF A BANK CREATED BY STACKED SOD MATS
F	HEIGHT OF STACKED SOD MATS	FEET	N/A	HEIGHT OF A SLOPE CREATED BY STACKED SOD MATS
G	WIDTH OF SURFACE- APPLIED SOD MATS	FEET	10 – 20	WIDTH OF A SLOPE STABILIZED WITH SURFACE-APPLIED SOD MATS
H	TOP OF BANK SOD MATTING DISTANCE	FEET	N/A	DISTANCE SOD MATTING IS INSTALLED ON THE TOP OF BANK

NOTES:

1. DIMENSION LABELS ARE REFERENCED IN THE DETAIL DRAWINGS.

SOD MAT EXAMPLES

SOD MATTING DETAIL

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
BIG SWAMP CREEK – MP 1000.5 – MDNR ID 41
SITE SPECIFIC DETAILS

SCALE	DWG. NO.	PAGE NO.
NOTED	SSRP–1000.5–004	5/6

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

① CENTERLINE – FACING WEST BANK

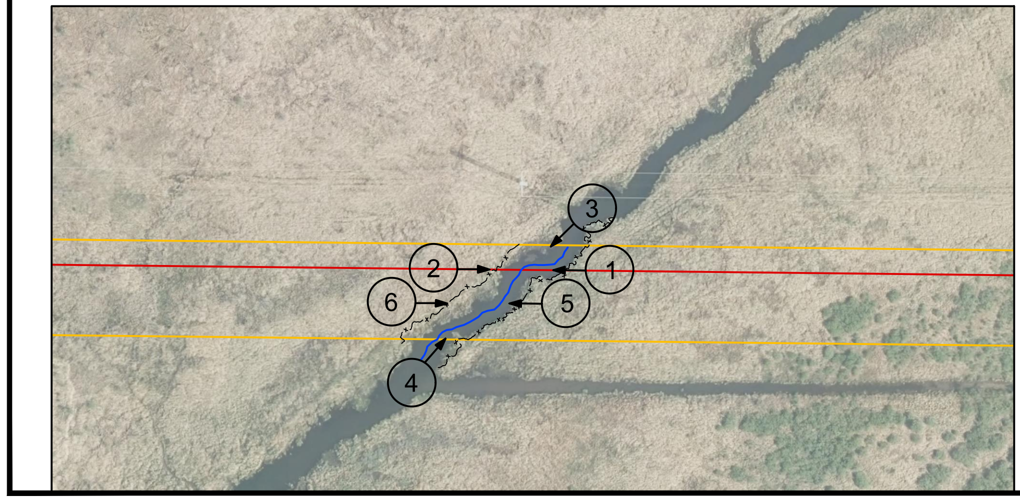
③ EDGE OF WORKSPACE – FACING DOWNSTREAM

⑤ BRIDGE – FACING WEST BANK

② CENTERLINE – FACING EAST BANK

④ EDGE OF WORKSPACE – FACING UPSTREAM

⑥ BRIDGE – FACING EAST BANK



NOTES:

1. AIR PHOTOS ARE FROM 2018 ENBRIDGE AERIAL PHOTOGRAPHY.
2. ADDITIONAL ON–THE GROUND PHOTOS MAY BE TAKEN PRIOR TO CONSTRUCTION AT MDNR REQUEST.
3. PRE–CONSTRUCTION PHOTOS WILL BE USED TO AID IN RESTORATION.

B	ISSUED FOR PERMITTING	MJT	10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
BIG SWAMP CREEK – MP 1000.5 – MDNR ID 41
PHOTO PAGE

SCALE	DWG. NO.	PAGE NO.
	SSRP–1000.5–005	5/5

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

GENERAL

1. THE SPECIFICATIONS WITHIN THIS SSRP MAY MODIFY OR REPLACE PROJECT-WIDE STANDARDS PRESENTED IN THE EPP. WHERE MATERIAL WITHIN THESE SSRPS EXCEEDS STANDARD CONSTRUCTION MEASURES IN THE EPP, THESE SSRPS SUPERSEDE THE EPP.

2. CONSTRUCTION AND RESTORATION OF WATERBODY CROSSINGS WILL FOLLOW THESE GENERAL STEPS:

   A. SITE CLEARING
   B. INSTALLATION OF TEMPORARY EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES ("BMPS")
   C. BRIDGE INSTALLATION
   D. EXCAVATION/BACKFILLING OF THE WATERBODY INCLUDING:
      - SOD SAVING TOPSOIL SEGREGATION AT NON-WOODED SITES
      - STREAMBED MATERIAL SEGREGATION
      - PIPE INSTALLATION
      - BACKFILL, INCLUDING IMPLEMENTATION OF CONSTRUCTION-RELATED RESTORATION METHODS (I.E., TOE WOOD)
   E. REPLACEMENT OF STREAMBED MATERIAL AND TOPSOIL/SOD LAYER
   F. RESTORATION OF STREAM BANKS TO PRE-CONSTRUCTION CONTOURS
   G. IF FINAL GRADING NOT POSSIBLE AT THE TIME, TEMPORARY STABILIZATION AND REPLACEMENT/REINFORCEMENT OF TEMPORARY BMPS
   H. AFTER FINAL GRADING, PERMANENT SEEDING AND/OR WOODY VEGETATION RESTORATION, STABILIZATION AND REPLACEMENT/REINFORCEMENT OF TEMPORARY BMPS
   I. BRIDGE REMOVAL DURING FINAL RESTORATION AFTER STABILIZATION AND PERMANENT SEEDING
   J. POST-CONSTRUCTION MONITORING

CROSSING METHODS

1. ALL WATERBODY AND WETLAND CROSSINGS WILL BE CONDUCTED IN COMPLIANCE WITH SECTION 2.0 AND SECTION 3.0 OF THE ENVIRONMENTAL PROTECTION PLAN ("EPP"), RESPECTIVELY. SECTION 2.0 AND 3.0 OF THE WINTER CONSTRUCTION PLAN PRESENTS MODIFICATIONS FOR WATERBODY AND WETLAND CONSTRUCTION METHODS, RESPECTIVELY, IN WINTER CONDITIONS.

2. ENBRIDGE'S SUMMARY OF CONSTRUCTION METHODS AND PROCEDURES (THE "PROCEDURES," APPENDIX A OF THE EPP) OUTLINES THE VARIOUS CONSTRUCTION METHODS THAT ENBRIDGE MAY UTILIZE TO CONSTRUCT THROUGH WATERBODIES AND WETLANDS/BASINS AS PRESENTED ON THESE SITE-SPECIFIC RESTORATION PLANS ("SSRPS").

   A. DRY CROSSING (ISOLATED) METHODS (INCLUDING THE DRY CROSSING AND MODIFIED DRY CROSSING METHOD) ARE DESCRIBED SECTIONS 4.3 OF THE PROCEDURES, AND IN SECTIONS 2.5.2 AND 2.5.3 AND FIGURES 23 AND 24 OF THE EPP.
   B. THE BORE METHOD (NON-PRESSURIZED) IS DESCRIBED IN SECTION 3.5 OF THE PROCEDURES, AND SECTION 4.0 OF THE EPP.
   C. THE MODIFIED UPLAND CONSTRUCTION (WETLAND) METHOD IS DESCRIBED IN SECTION 3.3 OF THE PROCEDURES, AND SECTION 3.0 AND FIGURES 30 TO 34 OF THE EPP.
   D. ALTHOUGH NOT PROPOSED AS A PRIMARY METHOD AT THESE SSRP WATERBODIES, THE OPEN CUT (NON-ISOLATED) WATERBODY CROSSING METHOD IS DESCRIBED IN SECTION 4.1 OF THE PROCEDURES, AND SECTION 2.5.1 AND FIGURE 24 OF THE EPP.
   E. ALTHOUGH NOT PROPOSED AS A PRIMARY METHOD AT THESE SSRP WATERBODIES, THE PUSH-PULL METHOD IS DESCRIBED IN SECTION 3.4 OF THE PROCEDURES, AND SECTION 3.7.1 AND FIGURES 35 AND 36 OF THE EPP.

CLEARING/VEGETATION REMOVAL

1. STUMPS WITHIN THE TRENCH LINE WILL BE COMPLETELY REMOVED, GROUND, AND/OR HAULED OFF-SITE TO AN APPROVED LOCATION. TREE STUMPS OUTSIDE THE TRENCH LINE WILL BE GROUND BELOW NORMAL GROUND SURFACE TO FACILITATE A SAFE WORK AREA AND TO ALLOW TOPSOIL REMOVAL, IF NECESSARY. IN SOME CIRCUMSTANCES, TREE STUMPS OUTSIDE THE TRENCH LINE MAY BE COMPLETELY REMOVED TO ALLOW FOR A SAFE WORK AREA AND HAULED OFF-SITE TO AN APPROVED LOCATION AS OUTLINED IN SECTION 1.8.3 OF THE EPP.

2. CLEARING WILL BE CONDUCTED IN WATERBODIES AND WETLANDS AS OUTLINED IN SECTION 2.2 AND 3.2 OF THE EPP, RESPECTIVELY. CHIPS, MULCH, OR MECHANICALLY CUT WOODY DEBRIS SHALL NOT BE STOCKPILED IN A WETLAND. HYDRO-AX DEBRIS, OR SIMILAR CAN BE LEFT IN THE WETLAND IF SPREAD EVENLY IN THE CONSTRUCTION WORKSPACE TO A DEPTH THAT WILL ALLOW FOR NORMAL REVEGETATION, AS DETERMINED BY THE EI. CHIPPING IS NOT ALLOWED ON PUBLIC LANDS. ON PUBLIC LANDS, MULCH AND MECHANICALLY CUT WOODY DEBRIS MUST BE UNIFORMLY BROADCAST TO LESS THAN 2-INCH THICKNESS AND IN A MANNER THAT MAINTAINS VISIBLE GROUND.

3. ENBRIDGE WILL PROPERLY INSTALL AND MAINTAIN REDUNDANT SEDIMENT CONTROL MEASURES IMMEDIATELY AFTER CLEARING AND PRIOR TO INITIAL GROUND DISTURBANCE AT SURFACE WATERS LOCATED WITHIN 50 FEET OF THE PROJECT AND WHERE STORMWATER FLOWS TO THE SURFACE WATER (REFER TO THE ENVIRONMENTAL PLAN SHEETS IN THE SWPPP), AND WITHIN 100 FEET OF SPECIAL AND IMPAIRED WATERS, INCLUDING TROUT STREAMS.

4. ON PUBLIC LANDS AND WHEREVER PRACTICABLE AT WATERBODY CROSSINGS, ENBRIDGE WILL USE WILDLIFE-FRIENDLY EROSION AND SEDIMENT CONTROL BMPS THAT CONTAIN BIODEGRADABLE NETTING (CATEGORY 3N OR 4N NATURAL FIBER) AND WILL AVOID THE USE OF PLASTIC MESH (SECTIONS 1.17.1 AND 2.6.1 OF THE EPP).

TEMPORARY STABILIZATION

1. ON PORTIONS OF THE PROJECT WHERE WORK WILL BE OCCURRING DURING APPLICABLE "WORK IN WATER RESTRICTIONS" FOR PUBLIC WATERS (REFER TO SECTION 2.1), ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE STABILIZED WITHIN 24 HOURS DURING THE RESTRICTION PERIOD. STABILIZATION OF ALL EXPOSED SOILS WITHIN 200 FEET OF THE PUBLIC WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY OR TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD. THESE AREAS WILL BE IDENTIFIED ON THE ENVIRONMENTAL PLAN SHEETS ACCOMPANYING THE SWPPP.

2. HYDRO-MULCH AND LIQUID TACKIFIER CAN BE USED IN PLACE OF CERTIFIED WEED-FREE STRAW OR HAY MULCH WITH PRIOR APPROVAL FROM ENBRIDGE. ALL HYDROMULCH AND LIQUID TACKIFIER PRODUCTS USED WILL BE ON THE APPLICABLE STATE DOT PRODUCT LIST. HYDRO-MULCH AND LIQUID TACKIFIER PRODUCTS CONTAINING PLASTIC/POLYPROPYLENE FIBER ADDITIVES AND MALACHITE GREEN (COLORANT) WILL NOT BE UTILIZED ON THIS PROJECT. APPLICATION RATES WILL BE AT THE MANUFACTURER'S RECOMMENDED RATE. ENBRIDGE WILL AVOID THE USE OF HYDROMULCH ON PUBLIC LANDS; HOWEVER, ENBRIDGE MAY USE HYDROMULCH ON STEEP SLOPES TO PREVENT EROSION UNTIL PERMANENT COVER HAS BEEN ESTABLISHED AS OUTLINED IN SECTION 1.8.3 OF THE EPP.

RESTORATION AND STABILIZATION

1. ENBRIDGE WILL RESTORE THE STREAM BANKS AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS UNLESS THAT SLOPE IS DETERMINED TO BE UNSTABLE. IF THE SLOPE IS CONSIDERED UNSTABLE, ENBRIDGE WILL RESHAPE THE BANKS TO PREVENT SLUMPING. FOR PUBLIC WATERS, ENBRIDGE WILL RETURN THE BANK TO PRE-CONSTRUCTION CONTOURS, UNLESS OTHERWISE DIRECTED BY THE SITE-SPECIFIC RESTORATION PLAN. IF ENBRIDGE CANNOT RESTORE TO PRE-CONSTRUCTION CONTOURS AT A PUBLIC WATER, ENBRIDGE WILL CONSULT WITH THE MDNR BEFORE PROCEEDING FURTHER AS OUTLINED IN SECTION 2.6 OF THE EPP.

2. UNSTABLE SOILS AND/OR SITE-SPECIFIC FACTORS SUCH AS STREAM VELOCITY AND FLOW DIRECTION MAY REQUIRE ADDITIONAL RESTORATION EFFORTS, SUCH AS INSTALLATION OF WOODY VEGETATION, GEOTEXTILE FABRIC, OR TREE, LOG, ROOTWAD, OR BOULDER REVETMENTS TO STABILIZE DISTURBED STREAM BANKS (SEE FIGURE 29) AS OUTLINED IN SECTION 2.6.2 OF THE EPP. ENBRIDGE WILL WORK WITH THE MDNR TO ENSURE ALL WORK/ADJUSTMENTS ARE APPROVED AND ARE CONDUCTED WITHIN APPLICABLE TIMING RESTRICTIONS.

3. IN UPLAND AND WETLAND AREAS, CLEANUP AND ROUGH GRADING WILL OCCUR AS OUTLINED IN SECTIONS 1.16 AND 3.9 OF THE EPP. ENBRIDGE WILL BACKFILL THE TRENCH TO AN ELEVATION SIMILAR TO THE ADJACENT AREAS OUTSIDE THE TRENCH LINE AND WILL ADD A SLIGHT CROWN OF APPROXIMATELY 3 TO 6 INCHES (DEPENDING ON SOIL TYPE) OVER THE BACKFILLED TRENCH TO ALLOW FOR SUBSIDENCE. GENERALLY, EXCESS SUBSOIL DISPLACED BY THE PIPE INSTALLATION WILL BE SPREAD ACROSS THE PORTION OF THE CONSTRUCTION WORKSPACE WHERE TOPSOIL REMOVAL HAS OCCURRED. ANY REMAINING EXCESS SUBSOIL WILL BE REMOVED AND DISPOSED OF AT AN APPROVED OFF-SITE LOCATION AS NEEDED TO ENSURE CONTOURS ARE RESTORED TO AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS.

4. REVEGETATION ACTIVITIES WILL OCCUR AS OUTLINED IN SECTION 7.0 OF THE EPP. SEED MIXES AT PUBLIC WATERS WILL BE SELECTED AND APPLIED AS INDICATED IN THE PLANTING PLAN, WHICH IS APPENDIX A OF THE POST-CONSTRUCTION VEGETATION MANAGEMENT PLAN FOR PUBLIC LANDS AND WATERS ("VMP"). SEED MIXES RELATIVE TO THESE SSRP CROSSINGS ARE CODED AS FOLLOWS:

A	EMERGENT (34-181)	G	DRY PRAIRIE GENERAL (35-221)
B	RIPARIAN NE (34-361)	H	MESIC PRAIRIE GENERAL (35-241)
C	RIPARIAN S&W (34-261)	I	MESIC PRAIRIE NW (35-441)
D	WET MEADOW NE (34-371)	J	DRY PRAIRIE NORTHWEST (35-421)
E	WET MEADOW S&W (34-271)	K	WOODLAND EDGE NE (36-311)
F	WETLAND REHABILITATION (34-171)	L	NATURAL REVEGETATION

5. ENBRIDGE WILL NOT SEED STANDING WATER OR WOODED (PSS AND PFO) WETLAND COMMUNITIES. NATURAL REVEGETATION WILL TAKE PLACE FROM EXISTING PLANT MATERIAL AND ROOT STOCK IN THESE COMMUNITIES.

6. ALL MATERIALS USED FOR CONSTRUCTION OF THE PROJECT MUST BE REMOVED FROM THE SITE.

7. ENBRIDGE WILL CONDUCT POST-CONSTRUCTION MONITORING IN ACCORDANCE WITH THE POST-CONSTRUCTION MONITORING PLAN FOR WETLANDS AND WATERBODIES, AND IN ACCORDANCE WITH THE VMP FOR THE UPLAND PORTIONS OF THE PROJECT ON PUBLIC LANDS.

B	ISSUED FOR PERMITTING	MJT	10/2020		
NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE

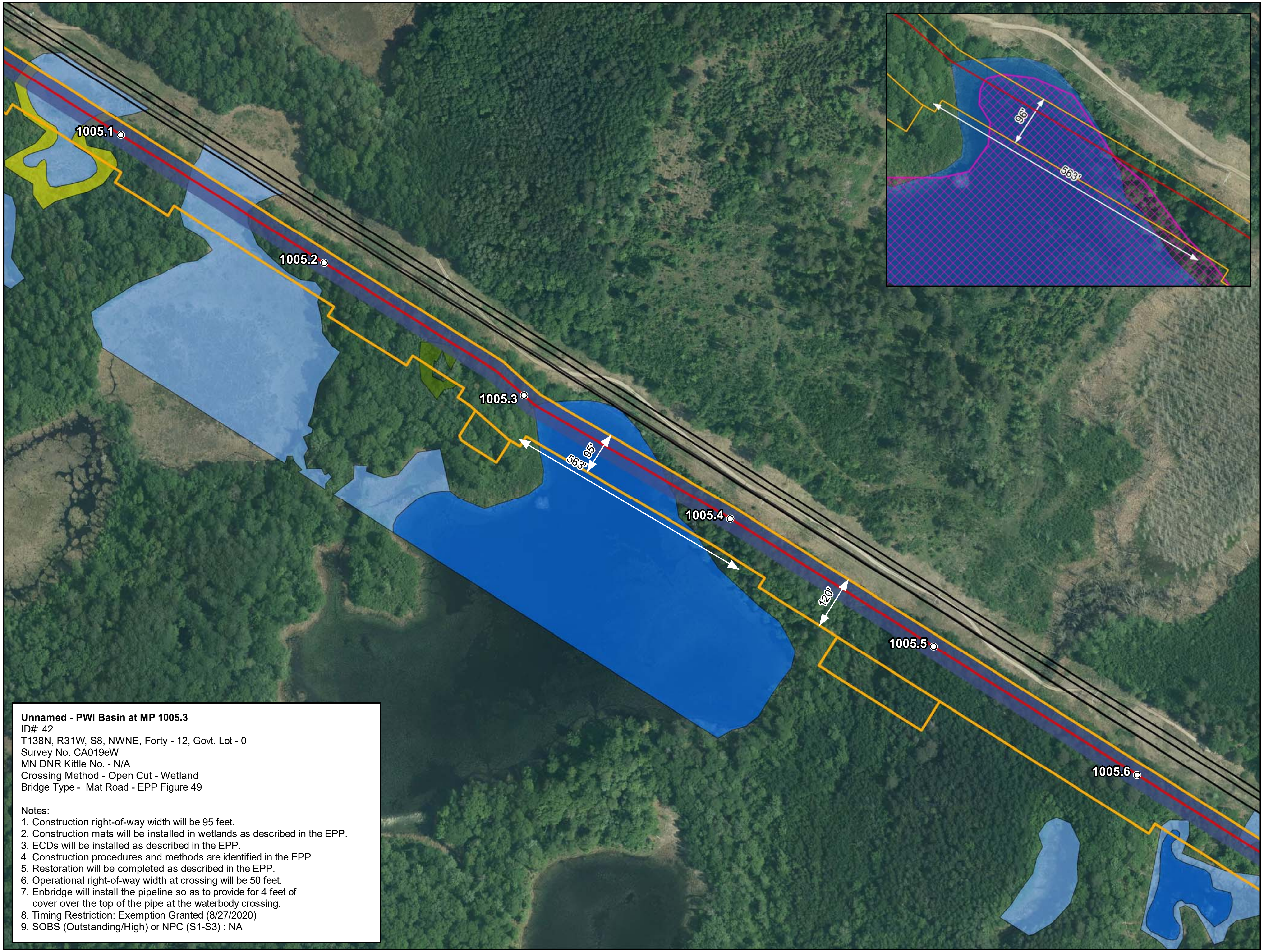
ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE-SPECIFIC RESTORATION PLAN

CONSTRUCTION NOTES

SCALE
DWG. NO. SSRP-NOTES
PAGE NO.

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

MDNR ID No. 42: MP 1005.3; Unnamed Public Water Basin



Unnamed - PWI Basin at MP 1005.3
ID#: 42
T138N, R31W, S8, NWNE, Forty - 12, Govt. Lot - 0
Survey No. CA019eW
MN DNR Kittle No. - N/A
Crossing Method - Open Cut - Wetland
Bridge Type - Mat Road - EPP Figure 49

Notes:
1. Construction right-of-way width will be 95 feet.
2. Construction mats will be installed in wetlands as described in the EPP.
3. ECDs will be installed as described in the EPP.
4. Construction procedures and methods are identified in the EPP.
5. Restoration will be completed as described in the EPP.
6. Operational right-of-way width at crossing will be 50 feet.
7. Enbridge will install the pipeline so as to provide for 4 feet of cover over the top of the pipe at the waterbody crossing.
8. Timing Restriction: Exemption Granted (8/27/2020)
9. SOBS (Outstanding/High) or NPC (S1-S3) : NA

0 100 200
Feet
1 inch = 200 feet

○	Milepost
🟥	Proposed L3R Centerline
━	Existing Utility
━	Existing Utility
▬	Permanent Right-of-Way
☐	Construction Right-of-Way/ATWS

Delineated Wetlands

▨	PEM
▨	PFO
▨	PSS
▨	PUB

Line 3 Replacement Project

Crossing Plan

ID# 42
Survey No. CA019eW

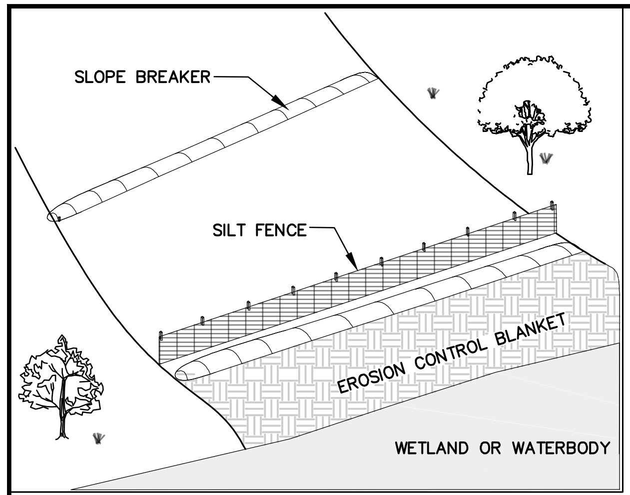
Unnamed - PWI Basin

Cass County, Minnesota

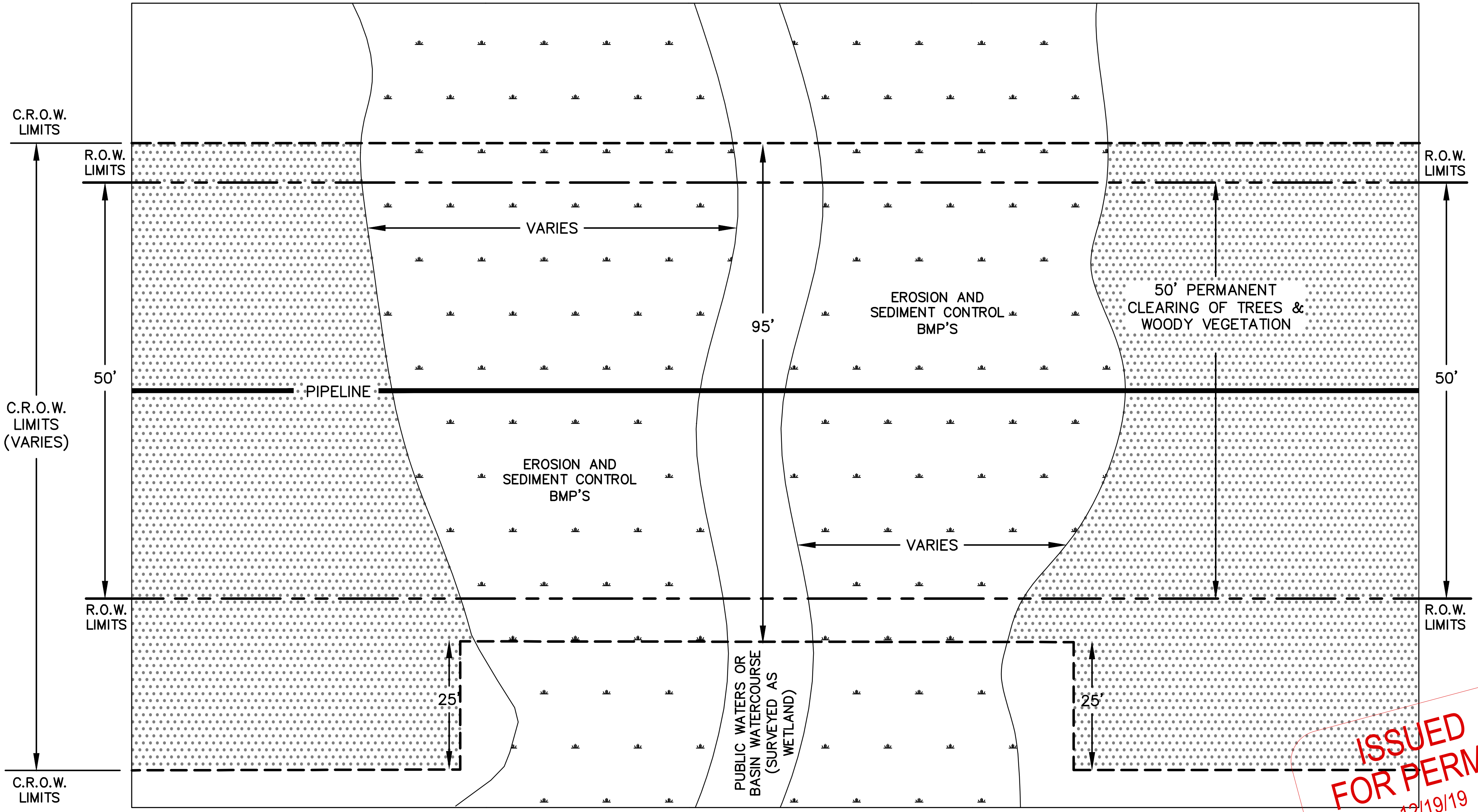
ENBRIDGE
October 2020

For Environmental Review Purposes Only

Date: (10/7/2020) **Source:** Z:\Clients\E_H\Enbridge\Line_3_Full_Replacement\Permitting\State\Public_Waters\2020_09\Figures\L3R_Waters_App_Open_Cut_2020_09.mxd



▨ SEEDING AREA



ISSUED FOR PERMIT
12/19/19

PUBLIC WATERS BASIN OR WATERCOURSE (SURVEYED AS WETLAND) CROSSING

1) PRIOR TO DISTURBANCE, EROSION AND SEDIMENT CONTROL BMPS (E.G., STRAW BALES, FILTER SOCKS, SILT FENCES) WILL BE INSTALLED AS PRIOR TO DISTURBANCE AND WILL REMAIN IN PLACE UNTIL THE AREA HAS STABILIZED AND ADEQUATE REVEGETATION HAS ESTABLISHED (SECTION 3.4).

2) SUBSEQUENT TO PIPE INSTALLATION, BACKFILLING OF WETLAND TRENCHES WILL TAKE PLACE IMMEDIATELY, OR AS APPROVED BY THE EI.

3) IN AREAS WHERE TOPSOIL HAS BEEN SEGREGATED, THE SUBSOIL WILL BE REPLACED FIRST.

4) ROUGH GRADING WILL TAKE PLACE NO LATER THAN THE END OF THE WORKDAY FOLLOWING TRENCH BACKFILLING.

5) ENBRIDGE WILL BACKFILL THE TRENCH TO AN ELEVATION SIMILAR TO THE ADJACENT AREAS OUTSIDE THE DITCH LINE AND WILL ADD A SLIGHT CROWN OF APPROXIMATELY 3 TO 6 INCHES (DEPENDING ON SOIL TYPE) OVER THE BACKFILLED TRENCH TO ALLOW FOR SUBSIDENCE.

6) PERIODIC BREAKS IN THE CROWN WILL BE IMPLEMENTED TO ALLOW FOR NORMAL HYDROLOGIC FLOW ACROSS THE BACKFILLED TRENCH. CROWNING WILL NOT EXTEND BEYOND THE PREVIOUSLY EXCAVATED TRENCH LIMITS. AS THE BACKFILL MATERIAL SETTLES, THERE IS POTENTIAL THAT THE ORIGINAL CROWN MAY NOT COMPLETELY RECEDE TO PRE–CONSTRUCTION CONTOURS.

7) AFTER ROUGH GRADING, WHERE TOPSOIL HAS BEEN SEGREGATED, IT WILL BE SPREAD UNIFORMLY OVER THE TRENCH AREA FROM WHICH IT WAS REMOVED.

8) ADDITIONAL (FINAL) GRADING MAY OCCUR WHEN CONDITIONS ALLOW TO ENSURE THE DISTURBED AREA HAS BEEN RETURNED TO PRE–CONSTRUCTION CONDITIONS.

9) PERMANENT SLOPE BREAKERS WILL BE INSTALLED NEAR THE BOUNDARY BETWEEN THE WETLAND AND ADJACENT SLOPED APPROACHES TO PREVENT SEDIMENT FLOW INTO THE WETLAND AS DESCRIBED IN THE EPP (FIGURE 20):

a. PERMANENT SLOPE BREAKERS WILL BE INSTALLED TO MINIMIZE CONCENTRATED OR SHEET FLOW RUNOFF IN DISTURBED AREAS IN ACCORDANCE WITH THE FOLLOWING MAXIMUM ALLOWABLE SPACING UNLESS OTHERWISE SPECIFIED IN PERMIT CONDITIONS.

i.

SLOPE (%)	APPROXIMATE SPACING (FT)
1. <5	250
2. >5–15	200
3. 15–25	150
4. >25	<100

10) NO FERTILIZER, LIME, OR MULCH WILL BE APPLIED IN WETLANDS, EXCEPT FOR PEATLANDS AS DESCRIBED IN THE EPP (SECTION 7.7.3.).

11) PERMANENT REVEGETATION SEEDING WILL TAKE PLACE IN ACCORDANCE WITH THE EPP (SECTION 7.7).

12) THE APPROPRIATE SEED MIX WILL BE DETERMINED USING THE RESULTS OF PRE–CONSTRUCTION WETLAND FIELD DELINEATIONS, HYDROLOGICAL CHARACTERISTICS AND SITE–SPECIFIC CONDITIONS.

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	AJM	12/19/19	KEH	KD
B	ISSUED FOR PERMIT	AJM	12/13/19	KEH	KD
A	ISSUED FOR REVIEW	AJM	12/10/19	KEH	KD

DWN. BY: AJM	DATE 12/10/19
CHK. KEH	
PROJ. ENGR. DG	
PROJ. MGR. KD	
CLIENT APP.	

ENBRIDGE

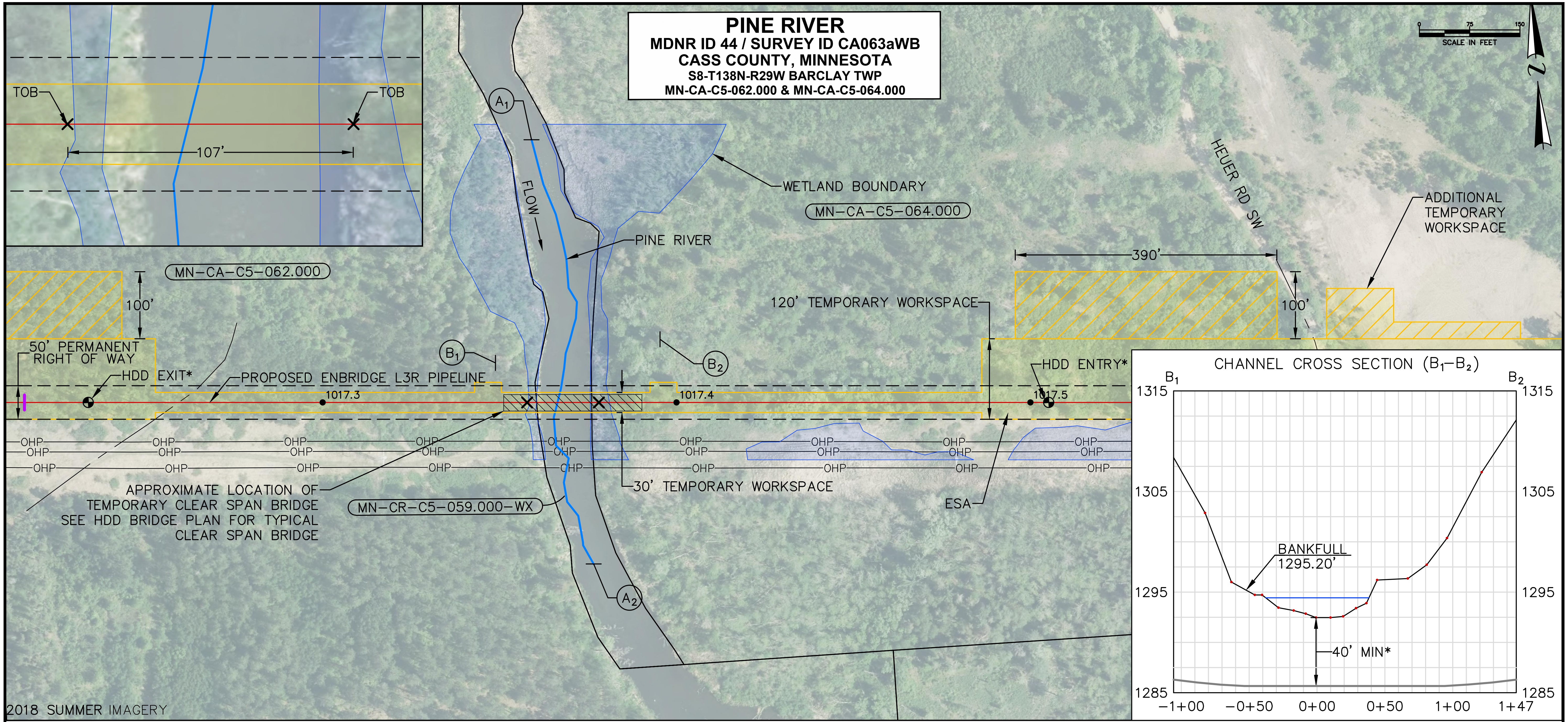
LINE 3 REPLACEMENT
PUBLIC WATERS BASIN OR WATERCOURSE
(SURVEYED AS WETLAND) TYPICAL XING
FINAL STREAM BANK STABILIZATION
& EROSION CONTROL

SCALE NTS
DWG. NO.

MDNR ID No. 44: MP 1017.4; Pine River (M-106)

PINE RIVER

MDNR ID 44 / SURVEY ID CA063aWB
CASS COUNTY, MINNESOTA
S8-T138N-R29W BARCLAY TWP
MN-CA-C5-062.000 & MN-CA-C5-064.000



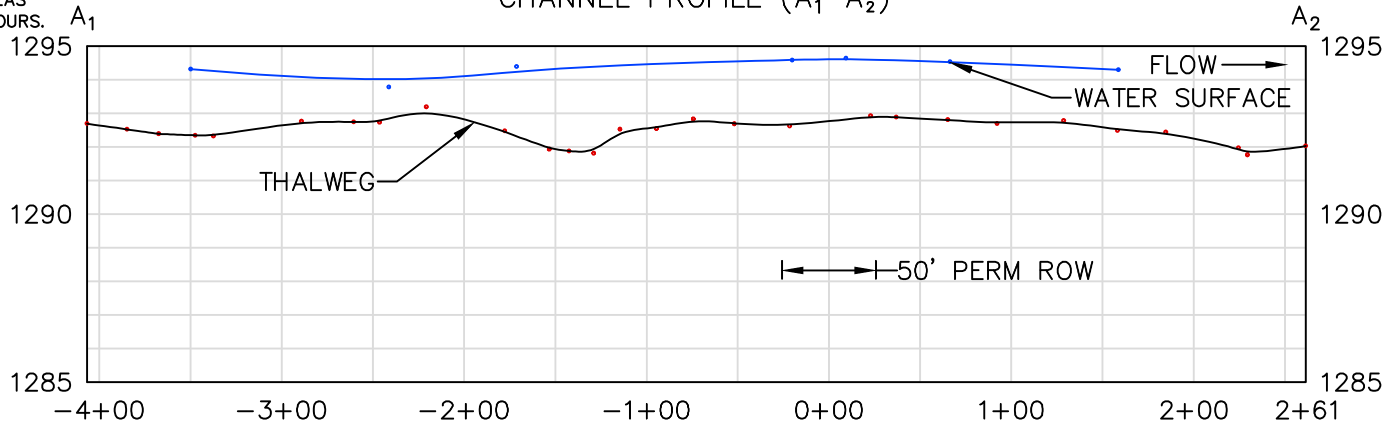
NOTES
1. NO FEMA DIGITAL FLOODPLAIN DATA AVAILABLE
2. SOBS (O/H) OR NPC (S1–3): N/A
3. MDNR REGION 1 PWI – COOL/WARM WATER FISHERY: MARCH 15 – JUNE 30. 24–HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
4. NHIS: SEE BLANDING'S TURTLE NEST MANAGEMENT PRACTICES. NO CLEARING: APRIL–OCTOBER.
5. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

CHANNEL CROSS SECTION NOTE:
1. CHANNEL LOCATIONS, DIMENSIONS, AND/OR ELEVATIONS ARE BASED ON 2014 TOPOGRAPHIC/BATHYMETRIC SURVEY(S), AND AS SUCH DO NOT REFLECT CHANGES TO THE CHANNEL THAT MAY HAVE OCCURRED SINCE THAT TIME.

LEGEND

───	PROPOSED ENBRIDGE L3R PIPELINE
— — — —	PERMANENT RIGHT OF WAY
───	TEMPORARY WORKSPACE
───	WATERBODY (ROSGEN SURVEY – THALWEG)
——— — ———	CENTERLINE OF ROAD
——OHP——	OVERHEAD POWER
───	TRACT BOUNDARY
▭	WETLAND
▨	ADDITIONAL TEMPORARY WORKSPACE
MN–XX–XX–XXX.XXX	TRACT ID
•	ROSGEN SURVEY POINT – WATER SURFACE
•	ROSGEN SURVEY POINT – RIVER BOTTOM (THALWEG)
⊕	HDD ENTRY/EXIT
×	TOP OF BANK
|	TRENCH BREAKER (LOCATIONS ARE APPROXIMATE)

CHANNEL PROFILE (A1–A2)



FOR ENVIRONMENTAL REVIEW PURPOSES ONLY

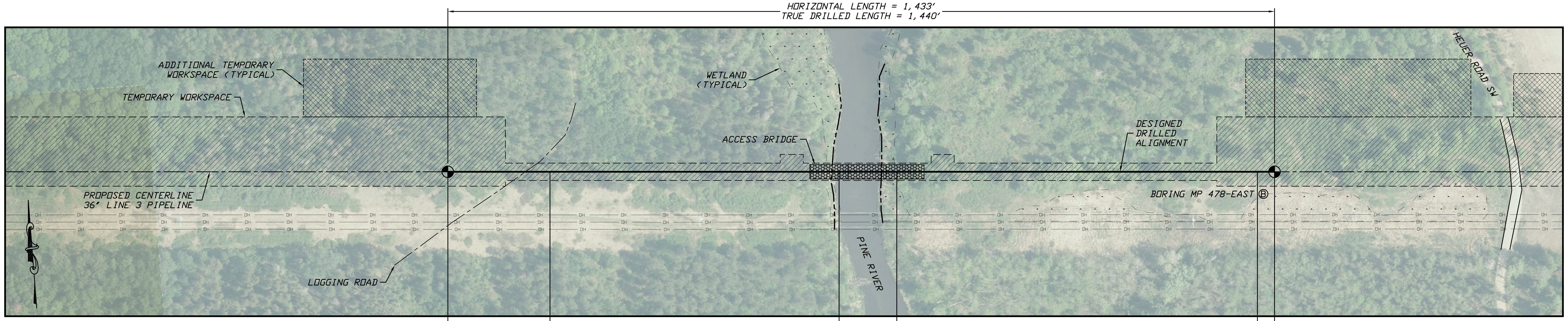
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
0	ISSUED FOR PERMIT APPLICATION	AJJ	10/2020	BAB	BAB

ENBRIDGE

DWN. BY: AJJ	DATE 10/2020
CHK.	
PROJ. ENGR.	
PROJ. MGR.	
CLIENT APP.	

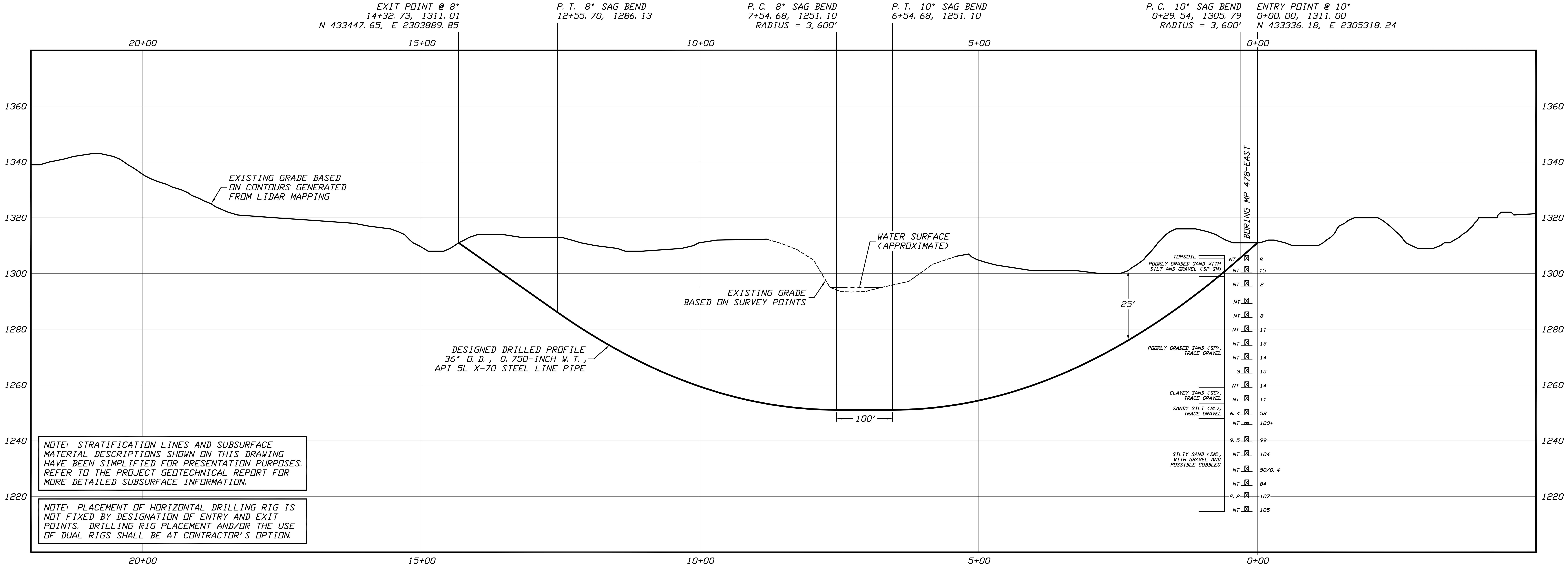
PROPOSED ENBRIDGE L3R PIPELINE
PRIMARY METHOD – HDD
CROSSING OF PINE RIVER
ENBRIDGE MP 1017.4
CASS COUNTY, MINNESOTA

SCALE NOTED
DWG. NO. B–93–5.84–MDNR–44–0



PLAN

SCALE: 1"=100'



NOTE: STRATIFICATION LINES AND SUBSURFACE MATERIAL DESCRIPTIONS SHOWN ON THIS DRAWING HAVE BEEN SIMPLIFIED FOR PRESENTATION PURPOSES. REFER TO THE PROJECT GEOTECHNICAL REPORT FOR MORE DETAILED SUBSURFACE INFORMATION.

NOTE: PLACEMENT OF HORIZONTAL DRILLING RIG IS NOT FIXED BY DESIGNATION OF ENTRY AND EXIT POINTS. DRILLING RIG PLACEMENT AND/OR THE USE OF DUAL RIGS SHALL BE AT CONTRACTOR'S OPTION.

PROFILE

SCALE: 1"=100' HORIZONTAL
1"= 20' VERTICAL

GENERAL LEGEND

● DRILLED PATH ENTRY/EXIT POINT

GEOTECHNICAL LEGEND

Ⓑ BORING LOCATION

SPLIT SPOON SAMPLE

53 ☒ 23 ← PENETRATION RESISTANCE IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES

↑ PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

GEOTECHNICAL NOTES

1. GEOTECHNICAL DATA PROVIDED BY BARR ENGINEERING COMPANY, DULUTH, MN. REFER TO THE PRELIMINARY GEOTECHNICAL DATA REPORT DATED OCTOBER 2014 FOR MORE DETAILED SUBSURFACE INFORMATION.
2. THE LETTER "N" TO THE LEFT OF A SAMPLE INDICATES THAT NO GRAVEL WAS OBSERVED IN THE SAMPLE. THE LETTERS "NT" INDICATE THAT GRAVEL WAS OBSERVED BUT NO GRADATION TEST WAS PERFORMED.
3. THE GEOTECHNICAL DATA IS ONLY DESCRIPTIVE OF THE LOCATIONS ACTUALLY SAMPLED. EXTENSION OF THIS DATA OUTSIDE OF THE ORIGINAL BORINGS MAY BE DONE TO CHARACTERIZE THE SOIL CONDITIONS, HOWEVER, COMPANY DOES NOT GUARANTEE THESE CHARACTERIZATIONS TO BE ACCURATE. CONTRACTOR MUST USE HIS OWN EXPERIENCE AND JUDGMENT IN INTERPRETING THIS DATA.

TOPOGRAPHIC SURVEY NOTES

1. TOPOGRAPHIC SURVEY DATA PROVIDED BY ENBRIDGE, SUPERIOR, WISCONSIN.
2. NORTHINGS AND EASTINGS ARE IN U.S. SURVEY FEET REFERENCED TO MINNESOTA STATE PLANE COORDINATES, NORTH ZONE, NAD 83.
3. ELEVATIONS ARE IN FEET REFERENCED TO NAVD 88.

DRILLED PATH NOTES

1. DRILLED PATH STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND IS REFERENCED TO CONTROL ESTABLISHED FOR THE DRILLED SEGMENT.
2. DRILLED PATH COORDINATES REFER TO CENTERLINE OF PILOT HOLE AS OPPOSED TO TOP OF INSTALLED PIPE.

PILOT HOLE TOLERANCES

THE PILOT HOLE SHALL BE DRILLED TO THE TOLERANCES LISTED BELOW. HOWEVER, IN ALL CASES, RIGHT-OF-WAY RESTRICTIONS AND CONCERN FOR ADJACENT FACILITIES SHALL TAKE PRECEDENCE OVER THESE TOLERANCES.

1. ENTRY POINT: AS STAKED BY COMPANY
2. EXIT POINT: UP TO 10 FEET SHORT OR 20 FEET LONG RELATIVE TO THE DESIGNED EXIT POINT; UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
3. ELEVATION: UP TO 2 FEET ABOVE AND 10 FEET BELOW THE DESIGNED PROFILE
4. ALIGNMENT: UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
5. CURVE RADIUS: NO LESS THAN 2,400 FEET BASED ON A 3-JOINT AVERAGE (ASSUMING RANGE 2 DRILL PIPE)

PROTECTION OF EXISTING FACILITIES

CONTRACTOR SHALL UNDERTAKE THE FOLLOWING STEPS PRIOR TO COMMENCING DRILLING OPERATIONS.

1. CONTACT THE UTILITY LOCATION/NOTIFICATION SERVICE FOR THE CONSTRUCTION AREA.
2. POSITIVELY LOCATE AND STAKE ALL EXISTING UNDERGROUND FACILITIES. ANY FACILITIES LOCATED WITHIN 10 FEET OF THE DESIGNED DRILLED PATH SHALL BE EXPOSED.
3. MODIFY DRILLING PRACTICES AND DOWNHOLE ASSEMBLIES AS NECESSARY TO PREVENT DAMAGE TO EXISTING FACILITIES.

LINE 3 PIPELINE PROJECT

PLAN AND PROFILE
36-INCH PIPELINE CROSSING OF THE PINE RIVER
BY HORIZONTAL DIRECTIONAL DRILLING

LOCATION: CASS COUNTY, MINNESOTA

DRAWN	DATE	CHECKED	APPROVED	DRAWING LABEL	REVISION
ACM	02/04/19	DMP	JSP	D-03-5.84-23067-B-1354	B

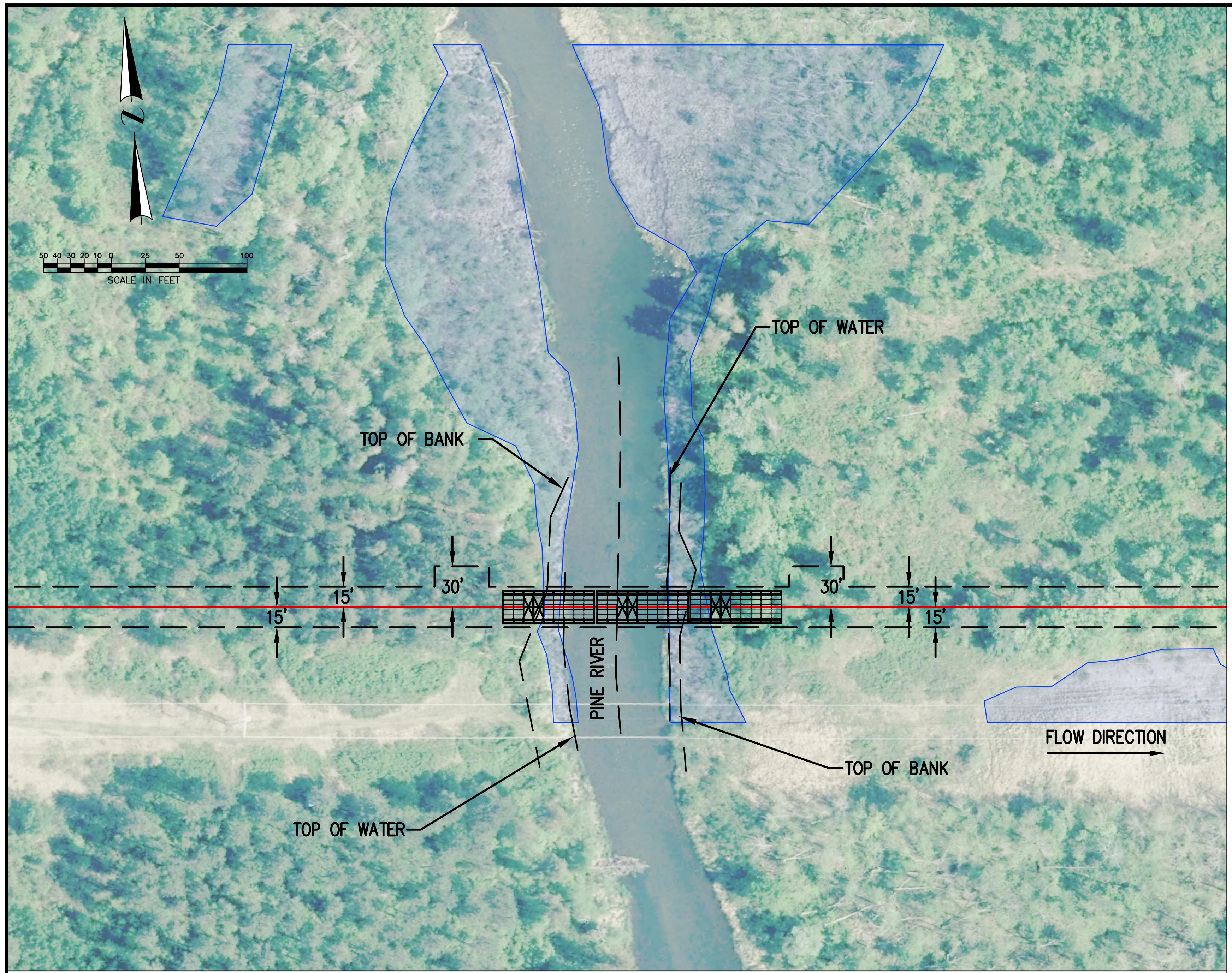
NO.	DATE	REVISION DESCRIPTION	BY	CHK'D	APP.
B	10/27/19	UPDATE WETLAND BOUNDARIES AND WORKSPACE	KWW	JSP	JSP
A	10/09/19	UPDATE W.S., ADD BRIDGE, ISSUED FOR CONSTRUCTION	DLB	CDS	JSP

J.D.Hair&Associates,Inc.
Consulting Engineers

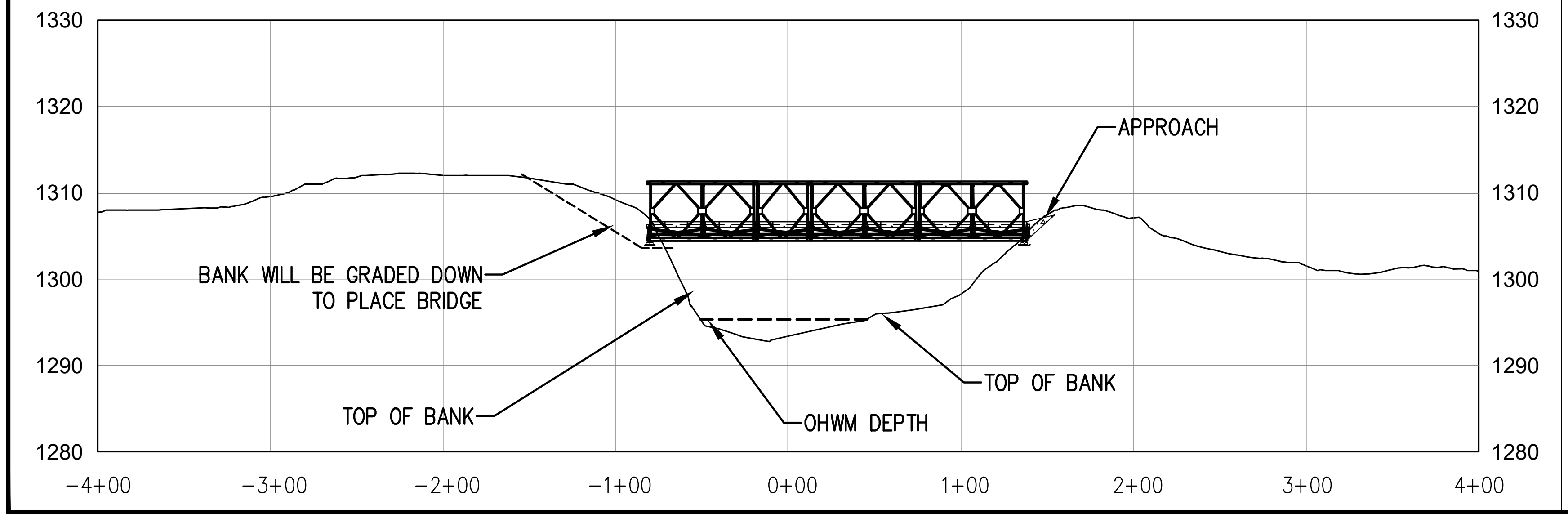
2424 East 21st Street
Suite 510
Tulsa, Oklahoma 74114

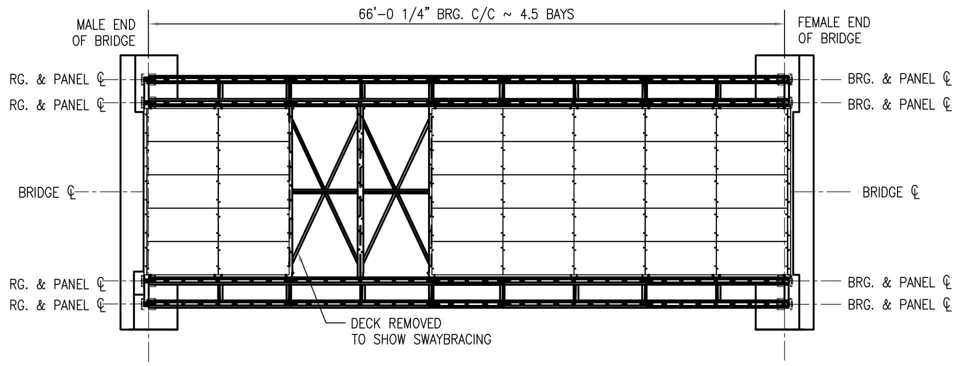
PROJECT NO.
Enbridge\1404

SHEET NO.
D1017

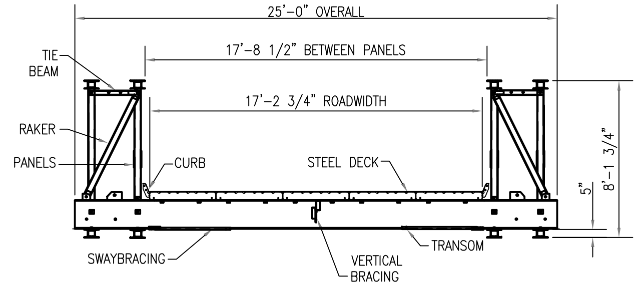


PROFILE





PLAN
NTS



SECTION
NTS

STREAM CLASSIFICATION:
REFER TO ENVIRONMENTAL PROTECTION PLAN (EPP) AND ENVIRONMENTAL ALIGNMENT SHEETS (EAS) FOR ALL STREAM CLASSIFICATION AND RESTRICTED ACTIVITY PERIOD (RAP) DETAILS

CONSTRUCTION NOTES:
CONTRACTOR WILL BE RESPONSIBLE FOR THE DESIGN OF THE TEMPORARY BRIDGE AS PER CONSTRUCTION NOTES THAT ARE LISTED BELOW AND APPLICABLE PERMIT CONDITIONS:

1. TEMPORARY BRIDGES USED FOR CONSTRUCTION SHALL BE DESIGNED AND CONSTRUCTED IN COMPLIANCE WITH MOST RECENT LOCAL GOVERNMENT AND ENVIRONMENTAL PERMITS AND PLANS. THE FOUNDATION AND INSTALLATION OF THE TEMPORARY BRIDGE SHALL PROVIDE FOR THE SAFE PASSAGE OF CONSTRUCTION VEHICLES, EQUIPMENT AND MATERIALS, MINIMIZE SOIL EROSION AND PROVIDE FOR PROPER DRAINAGE AS OUTLINED IN THE ENVIRONMENTAL PROTECTION PLAN (EPP).
2. PRIOR TO THE INSTALLATION AND USE OF A STRUCTURE GREATER THAN A SPAN OF 20 FEET, THE CONTRACTOR SHALL ENSURE THAT THE STRUCTURAL DOCUMENTATION SHALL INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING:
   - DESIGN, PLANS & SPECIFICATION SHEETS STAMPED BY A LICENSED PROFESSIONAL ENGINEER
   - STRUCTURES LOADING CAPACITY
   - INSTALLATION, REMOVAL AND MAINTENANCE INSTRUCTIONS
3. SIGNS SHOWING MAXIMUM LOADS AND SPEED LIMITS SHALL BE POSTED ON BOTH SIDES OF ALL BRIDGES. VISIBLE TO APPROACHING VEHICLES AND EQUIPMENT. ENBRIDGE RESERVES THE RIGHT TO EXECUTE INSPECTIONS VERIFYING THE CONTRACTOR IS IN COMPLIANCE WITH THEIR DOCUMENTS.
4. TEMPORARY "WARNING–PIPELINE CONSTRUCTION AHEAD" SIGNS MUST BE PLACED 400 FEET UPSTREAM AND DOWNSTREAM OF THE CROSSING ALONG THE WATERWAY AND AT ADDITIONAL LOCATIONS AS SUGGESTED BY THE MINNESOTA DEPARTMENT OF NATURAL RESOURCES. SIGNS MUST BE POSTED DURING FULL DURATION OF CROSSING CONSTRUCTION AND LEGIBLE AT A MINIMUM DISTANCE OF 100 FEET.
5. BRIDGE LOCATIONS SUPPORTS MUST BE PLACED BEYOND THE TOP OF BANK. CONTRACTOR MUST RECEIVE ENBRIDGE APPROVAL FOR FINAL BRIDGE LOCATION.
6. BRIDGE MUST BE DESIGNED TO HANDLE ALL REQUIRED LOADS DURING CONSTRUCTION.
7. THE BRIDGE HEIGHT WILL BE DESIGNED TO ALLOW FOR ADEQUATE CLEARANCE TO ALLOW RECREATIONAL USERS TO PASS SAFELY UNDER THE BRIDGE.
8. PER SECTION 2.4.2 OF THE EPP, BRIDGES WILL BE MAINTAINED TO PREVENT SOIL FROM ENTERING THE WATERBODY. SOIL THAT ACCUMULATES ON THE BRIDGE DECKING WILL BE REMOVED DAILY, OR AS DEEMED NECESSARY BY THE EI.
9. REFLECTIVE TAPE OR SIGNAGE SHALL BE USED ON THE EDGES OF THE BRIDGE AND THE RAILINGS.

DESIGN AND DRAWING NOTES:
1. GROUND PROFILE AND PLAN INFORMATION ARE DERIVED FROM SURVEY CONSULTANT DRAWING # 3638S-EAGLEX- 32-18-3-WS-22-R3, DATED SEPTEMBER 14, 2016.
2. THE SCALES OF THIS DRAWING ARE CONSIDERED RELIABLE ONLY AT ANSI D (22"x34") SIZE.
3. CHAINAGES ARE BASED ON THE ON HORIZONTAL MEASUREMENTS.
4. ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE NOTED.
5. BRIDGE DESIGN BASED ON DRAWINGS SUPPLIED BY RAPID SPAN STRUCTURES LTD. AND IS FOR INFORMATION ONLY.

ISSUED FOR CONSTRUCTION
10/13/2020

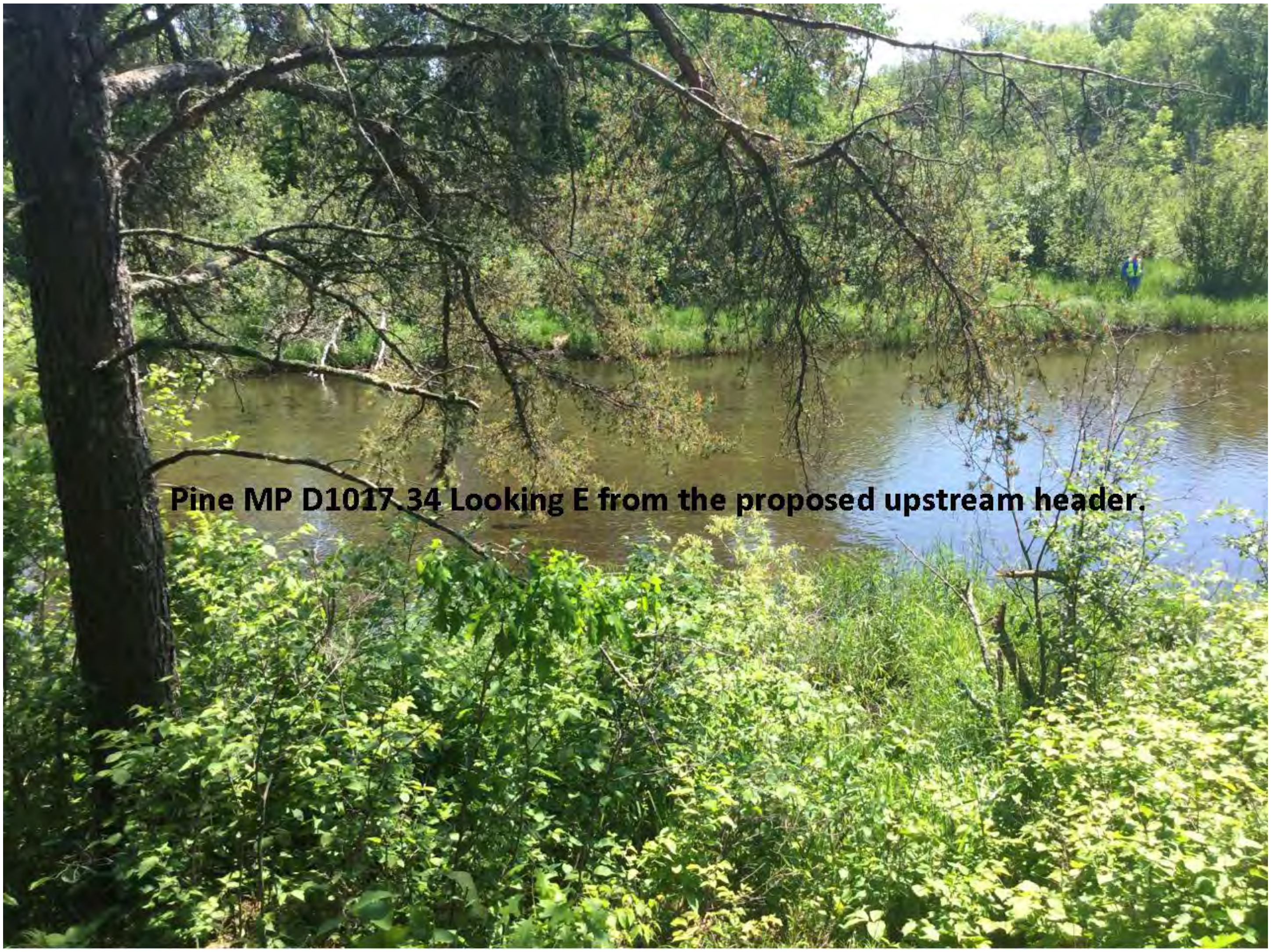
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR CONSTRUCTION	AM	10/13/2020	NKD	MB
A	ISSUED FOR REVIEW	AM	7/2/2019	NKD	MB

ENBRIDGE

DWN. BY: AM	DATE 7/2/2019	PROPOSED 36in. LINE 3 REPLACEMENT CROSSING OF PINE RIVER ENBRIDGE M.P. D1017.4	
CHK. NKD			
PROJ. ENGR.			
PROJ. MGR.		SCALE NOTED	DWG. NO. B-3-5.84-23063-B-1354
CLIENT APP.			

Milepost	MDNR License Application ID Number	Waterbody Name	County	Top-of-Bank Header-to-Header (feet)	Waterbody Width (feet) [b]	OHWM Depth (feet) [c]	Drawing Number
1017.4	44	Pine River	Cass	100.0	75.0	1.5	B-3-5.84-23063-A-1354

Crossing Location: The Pine River HDD is in Cass County and is situated west of State Highway 84 and north of N River Rd. SW. The bridge would be located on private land on either side of the crossing. The topography consists of rolling hills in uplands with a steep bank leading to the upstream side of the crossing.

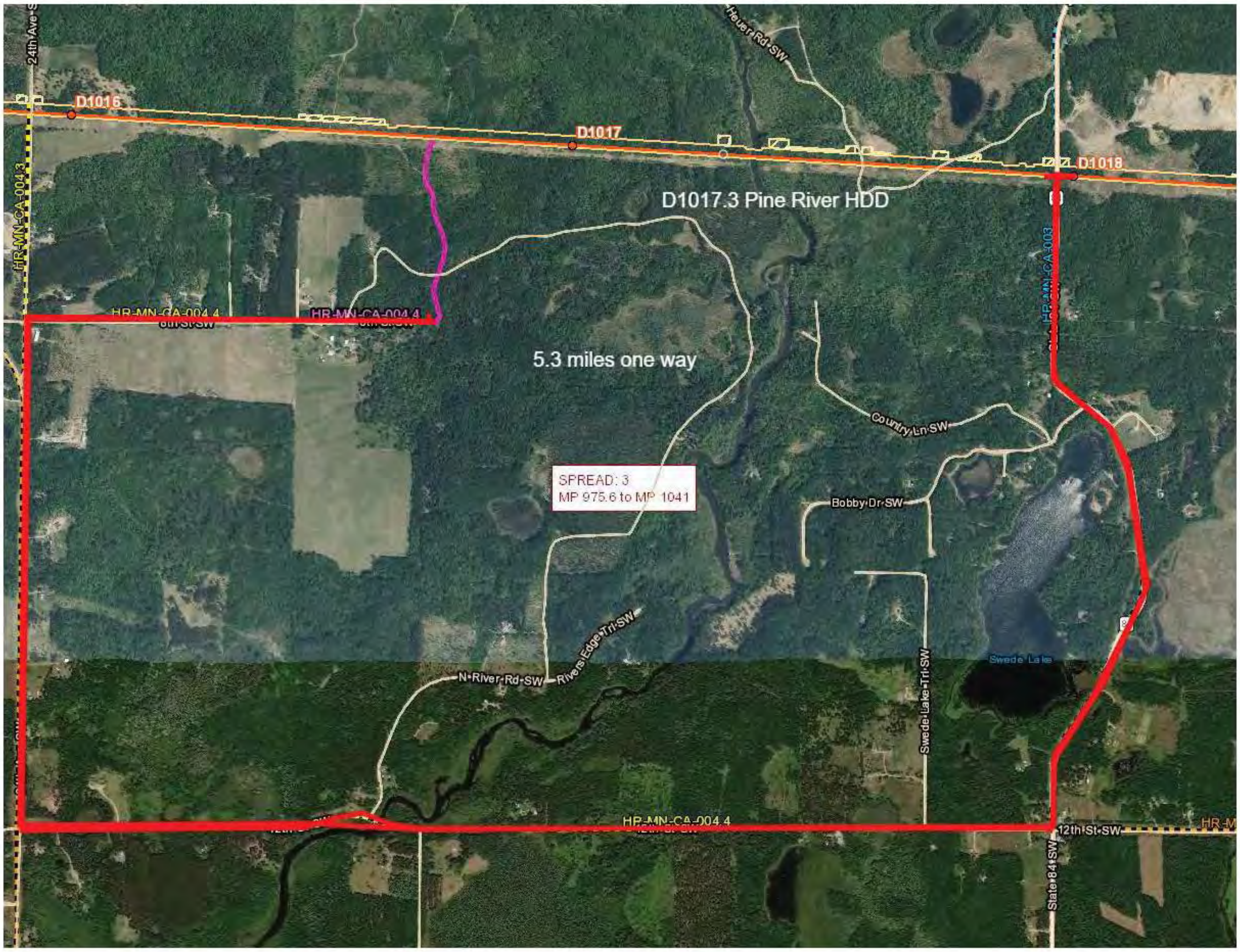


Pine MP D1017.34 Looking E from the proposed upstream header.

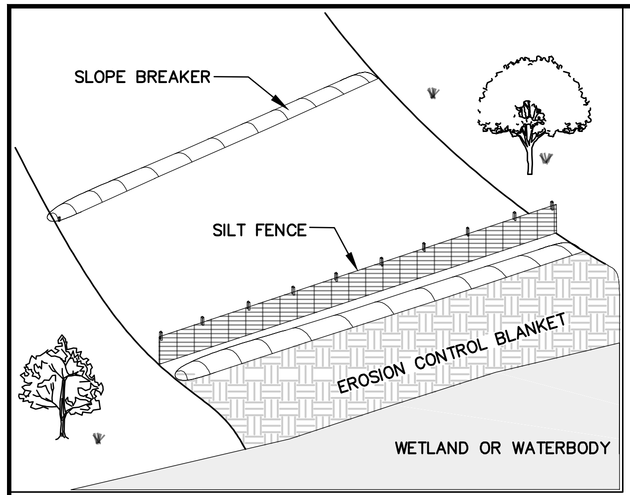
Bridge Description: A modular bridge would be built on site from pre-engineered and ready to assemble components. The design would consist of steel bracing, panels and decking. The Bridge would have an approximately 18 foot travel lane, with a total width of 25 feet. The length of the bridge at this site would be 100 feet, allowing for a setback from the steep banks of at least 20 feet from the edge on each side. Because the Pine River is designated as a Public Canoe Route, the Bridge will be at least 3 feet above the 50 year flood elevation.

Bridge Installation Method: Because of a sharp decline on the upstream side of the crossing, and to utilize the access off of Highway 84, the bridge would be set from the west side of the waterbody. The 30 foot ROW would be matted appropriately to allow safe passage of the Mainline Construction equipment and a 30 by 40 foot work space would be used on each side to set the bridge. Clearing of an additional 15 feet by 30 feet for this ATWS would be needed outside of the 30 foot wide ROW, but would be within the original 50' easement. Excavators, cranes and/or side booms would be used to position the bridge over the water body. The bridge and any support headers would be set 20 feet back from the edge of bank and secured by cables attached to temporary anchors on either side of the river. As this bridge will require no in-stream support, all work would occur outside the Ordinary High Water Mark and placement of the bridge would not affect the course, current or cross-section of the waterbody

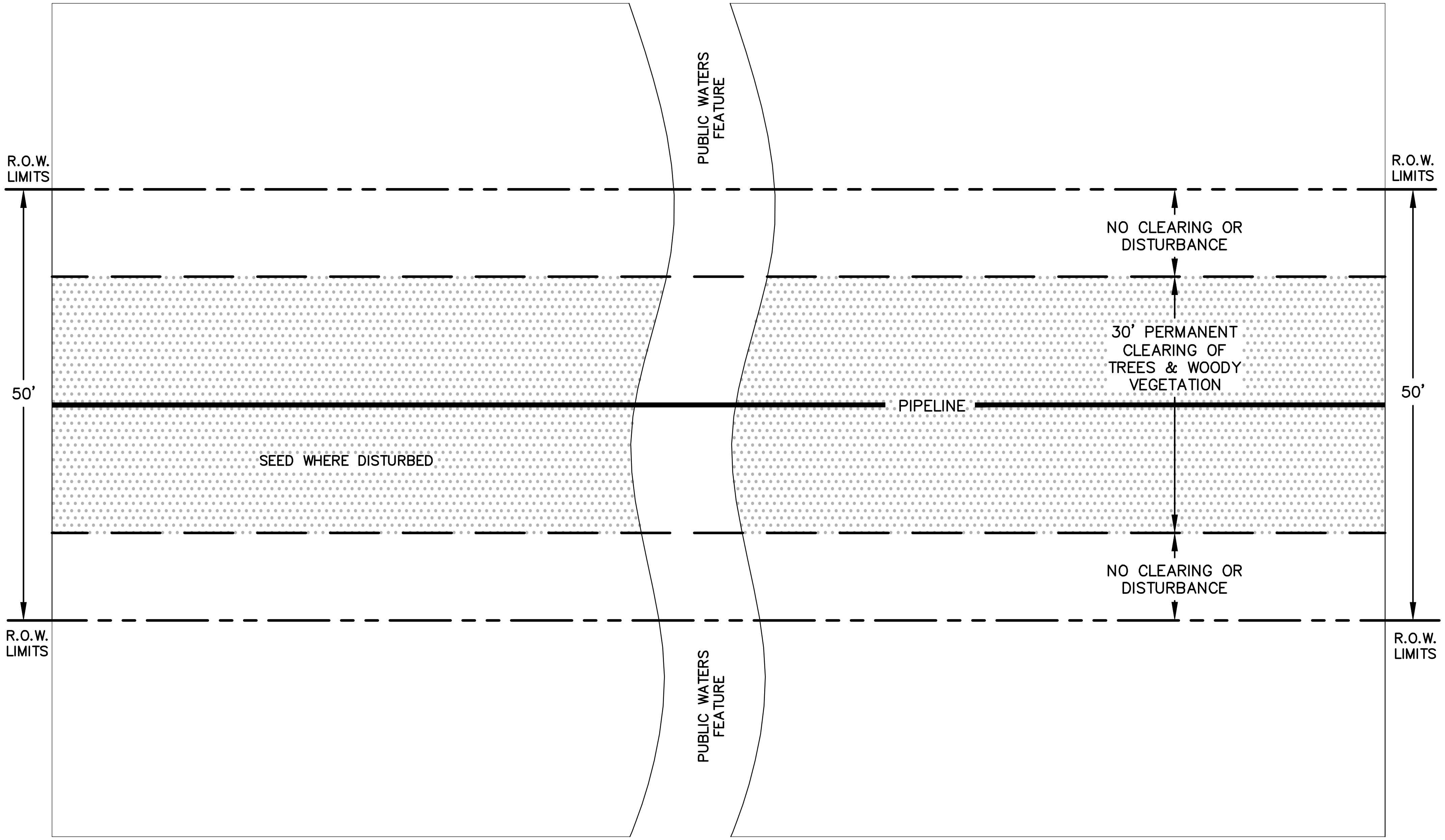
Need of Bridge/Justification: Enbridge is proposing to install a bridge at this crossing location to avoid the spread move that would result in impacts to local roadways, residents, and communities along the spread move travel path. At this location, the spread move is approximately 10.5 miles round trip, with an estimated 45-55 truckloads needed to complete the move. Trucks would exit the right-of-way off of Access Road 362.1 until it meets 8th St SW. Crews would then travel on 8th St SW for almost a mile before heading south on 24th Ave SW. Turning East onto 12th St SW and traveling 2 miles until turning north on State Highway 84 and back to the right-of-way. After unloading the trucks would need to turn around before taking the same route back around to reach the other side of the crossing. A map of this travel path is included below:



Installation of a bridge will allow all crews except for the clearing crews to remain on the construction right-of way and avoid the need to access public roads. Spread moves also require that Enbridge disassemble heavy equipment and make multiple travel trips around the spread moves to transport and reassemble equipment. Enbridge is also working with the MPCA to plan for inadvertent release of HDD drilling mud at all HDD locations. The construction of a mat road to the waterbody and a bridge across the feature would also provide for more rapid response to a release, should one occur.



▨ SEEDING AREA



PUBLIC WATERS FEATURE - HDD CROSSING

1) DISTURBANCE OF THE ROW IS LIMITED TO THE 30-FOOT-WIDE CLEARING OF TREES AND WOODY VEGETATION AND IMPACTS RESULTING FROM TRAVEL LANES AND/OR BRIDGES.
2) ANY WETLAND OR WATERBODY BANK THAT IS DISTURBED WILL BE STABILIZED WITH EROSION AND SEDIMENT CONTROL BMP AND RESTORED TO AS NEAR AS PRACTICABLE TO PRE–CONSTRUCTION CONDITIONS.
3) PERMANENT REVEGETATION SEEDING OF DISTURBED WATERBODY BANKS WILL UTILIZE THE BWSR RIPARIAN SEED MIXES IN ACCORDANCE WITH THE EPP (SECTION 7.8).
4) PERMANENT REVEGETATION SEEDING OF DISTURBED WETLANDS WILL TAKE PLACE IN ACCORDANCE WITH THE EPP (SECTION 7.7). 7) IN DISTURBED WETLAND AREAS, THE APPROPRIATE SEED MIX WILL BE DETERMINED USING THE RESULTS OF PRE–CONSTRUCTION WETLAND IN DISTURBED WETLAND AREAS, HYDROLOGICAL CHARACTERISTICS, AND SITE–SPECIFIC CONDITIONS.

ISSUED FOR PERMIT
12/13/19

B	ISSUED FOR PERMIT	AJM	12/13/19	KEH	KD
A	ISSUED FOR REVIEW	AJM	12/10/19	KEH	KD
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D

DWN. BY: AJM	DATE 12/10/19
CHK. KEH	
PROJ. ENGR. DG	
PROJ. MGR. KD	
CLIENT APP.	

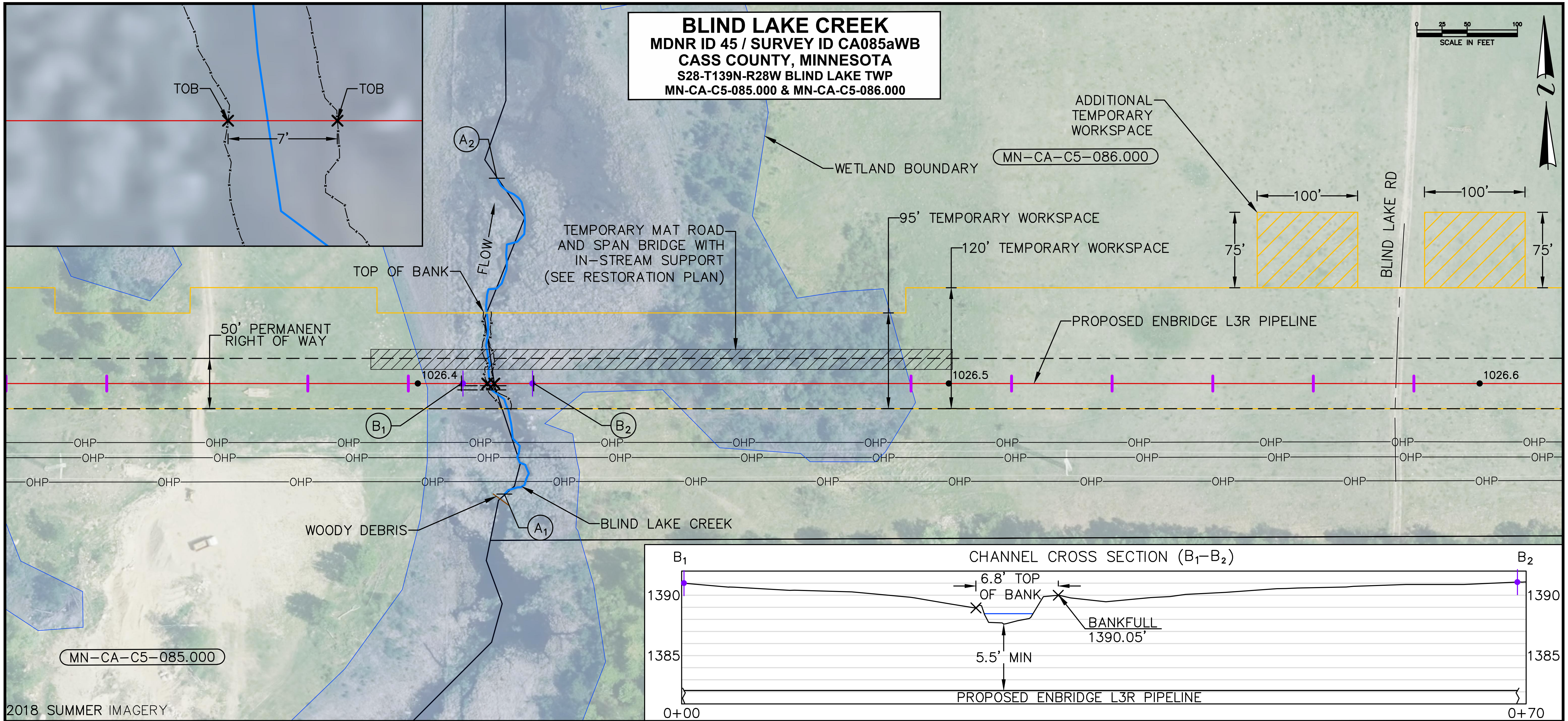
ENBRIDGE

LINE 3 REPLACEMENT
PUBLIC WATERS HDD CROSSING TYPICAL
FINAL STREAM STABILIZATION &
EROSION CONTROL

SCALE NTS
DWG. NO.

MDNR ID No. 45: MP 1026.4; Blind Lake Creek (M-106-014-002)

BLIND LAKE CREEK
MDNR ID 45 / SURVEY ID CA085aWB
CASS COUNTY, MINNESOTA
S28-T139N-R28W BLIND LAKE TWP
MN-CA-C5-085.000 & MN-CA-C5-086.000

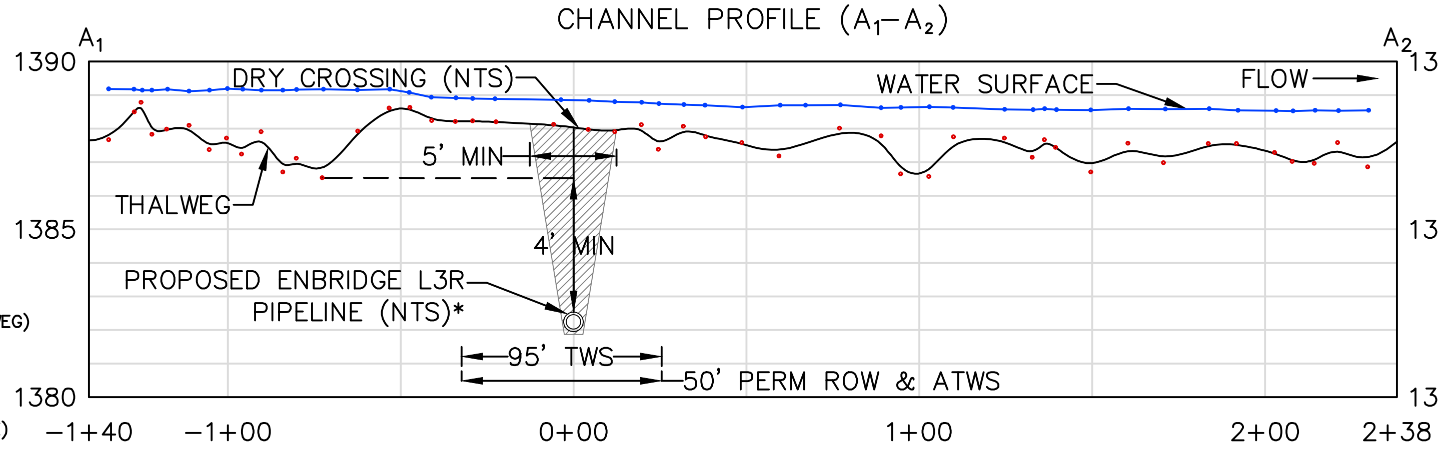


NOTES
1. NO FEMA DIGITAL FLOODPLAIN DATA AVAILABLE
2. SOBS (O/H) OR NPC (S1-3): N/A
3. MDNR REGION 1 PWI - COOL/WARM WATER FISHERY: MARCH 15 - JUNE 30. 24-HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
4. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

LEGEND

━━━━	PROPOSED ENBRIDGE L3R PIPELINE
— — — —	PERMANENT RIGHT OF WAY
━━━━	TEMPORARY WORKSPACE
━━━━	WATERBODY (ROSGEN SURVEY - THALWEG)
——— — ———	CENTERLINE OF ROAD
-·-·-·-	WOODY DEBRIS
—·—·—·—	FORD
——OHP——	OVERHEAD POWER
————	TRACT BOUNDARY
▨	TEMPORARY MAT ROAD AND SPAN BRIDGE
▭	WETLAND
▨	ADDITIONAL TEMPORARY WORKSPACE
MN-XX-XX-XXX.XXX	TRACT ID
·	ROSGEN SURVEY POINT - WATER SURFACE
·	ROSGEN SURVEY POINT - RIVER BOTTOM (THALWEG)
●	PROPOSED INCREASED DEPTH OF COVER EXTENT
×	TOP OF BANK
┃	TRENCH BREAKER (LOCATIONS ARE APPROXIMATE)

CHANNEL PROFILE (A1-A2)



FOR ENVIRONMENTAL REVIEW PURPOSES ONLY

CHANNEL CROSS SECTION NOTE:
1. CHANNEL LOCATIONS, DIMENSIONS, AND/OR ELEVATIONS ARE BASED ON 2020 TOPOGRAPHIC/BATHYMETRIC SURVEY(S), AND AS SUCH DO NOT REFLECT CHANGES TO THE CHANNEL THAT MAY HAVE OCCURRED SINCE THAT TIME.
2. DEPTH OF COVER AT CENTERLINE WAS DEVELOPED USING THE BOTTOM ELEVATION OF THE DEEPEST UPSTREAM OR DOWNSTREAM POOL WITHIN THE SURVEYED REACH, UNLESS OTHERWISE NOTED IN APPLICATION MATERIALS.
3. MEAN MEANDER BELT WIDTH: 69'
4. MEANDER WIDTH RATIO: 3.86

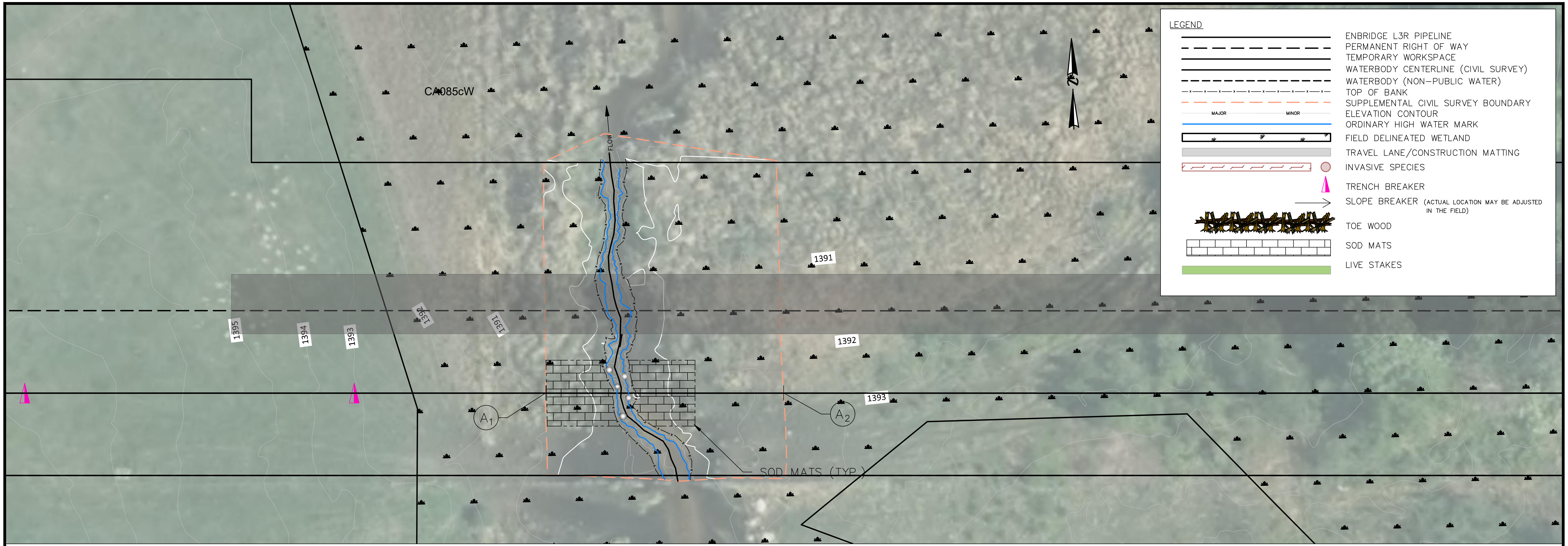
0	ISSUED FOR PERMIT APPLICATION	AJJ	10/2020	BAB	BAB
NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D

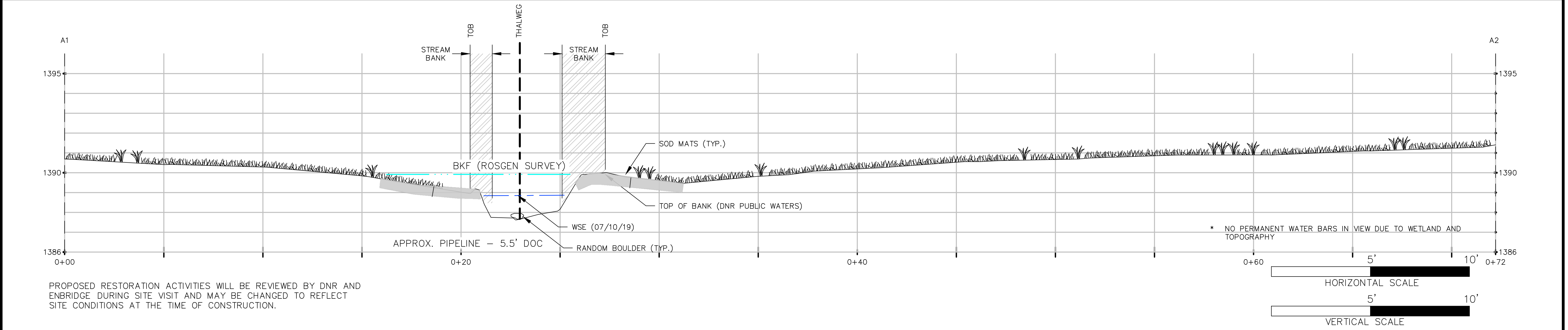
ENBRIDGE

DWN. BY: AJJ	DATE 10/2020
CHK.	
PROJ. ENGR.	
PROJ. MGR.	
CLIENT APP.	

PROPOSED ENBRIDGE L3R PIPELINE
PRIMARY METHOD - DRY CROSSING
CROSSING OF BLIND LAKE CREEK
ENBRIDGE MP 1026.4
CASS COUNTY, MINNESOTA

SCALE NOTED
DWG. NO. B-93-5.84-MDNR-45-0





PROPOSED RESTORATION ACTIVITIES WILL BE REVIEWED BY DNR AND ENBRIDGE DURING SITE VISIT AND MAY BE CHANGED TO REFLECT SITE CONDITIONS AT THE TIME OF CONSTRUCTION.

FEATURE ID	CA085aWB; IFC ID: S-218.0
CROSSING TYPE	DRY CROSSING
PROPOSED RESTORATION (SEE DETAILS FOR LIVE STAKING, TRANSPLANTS, AND SHRUB SPECIES IF APPLICABLE)	SOD MATS
WITHIN OR ADJACENT WETLAND	FRESH WET MEADOW
BWSR SEED MIX	RIPARIAN NE (34-361)
DOMINANT WETLAND VEGETATION	1. PHALARIS ARUNDIANCEA 2. LEERSIA ORYZOIDES
SOBS (O/H) or NPC (S1-3)	N/A

NOTES

1. CONSTRUCTION TIMING RESTRICTIONS
   1.1. MDNR REGION 1 PWI -COOL/WARM WATER FISHERY: MARCH 15 -JUNE 30.
   1.2. WHEN WORK OCCURS WITHIN "WORK IN WATER RESTRICTIONS", ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE STABILIZED WITHIN 24 HOURS DURING THE RESTRICTION PERIOD. STABILIZATION OF ALL EXPOSED SOILS WITHIN 200 FEET OF THE PUBLIC WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY OR TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD
2. WORK SHALL BE CONDUCTED IN ACCORDANCE WITH APPLICABLE STANDARDS IN ENBRIDGE'S EPP AND VMP FOR PUBLIC LANDS AND WATERS. THE SPECIFICATIONS WITHIN THIS SSRP MAY MODIFY OR REPLACE THESE STANDARDS.
3. SEE GENERAL NOTES PAGE FOR ADDITIONAL DETAIL.
4. INFORMATION REGARDING SEEDING SPECIFICATIONS, SEED BED PREPARATION TECHNIQUES, ETC. ARE DESCRIBED IN THE PLANTING PLAN CONTAINED WITHIN THE VMP.
5. TRENCH BREAKER LOCATION IS APPROXIMATE PENDING FIELD VERIFICATION (EPP SECTION 1.13)

ENBRIDGE

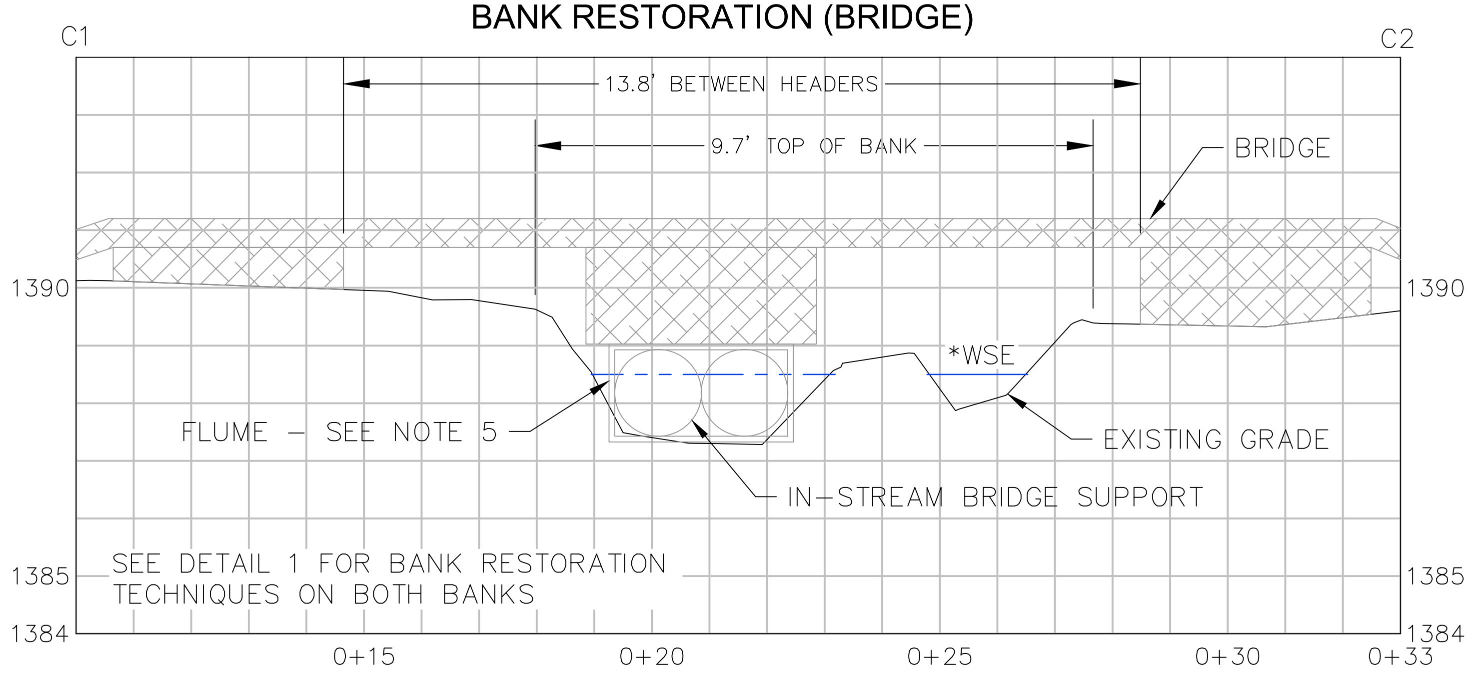
NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE-SPECIFIC RESTORATION PLAN
BLIND LAKE CREEK – MP 1026.4 – MDNR ID 45
RE-VEGETATION PLAN

SCALE	DWG. NO.	PAGE NO.
NOTED	SSRP-1026.4-001	1/5

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

BANK RESTORATION (BRIDGE)



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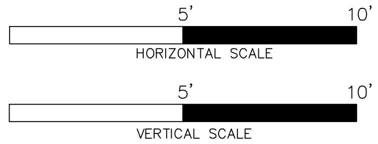
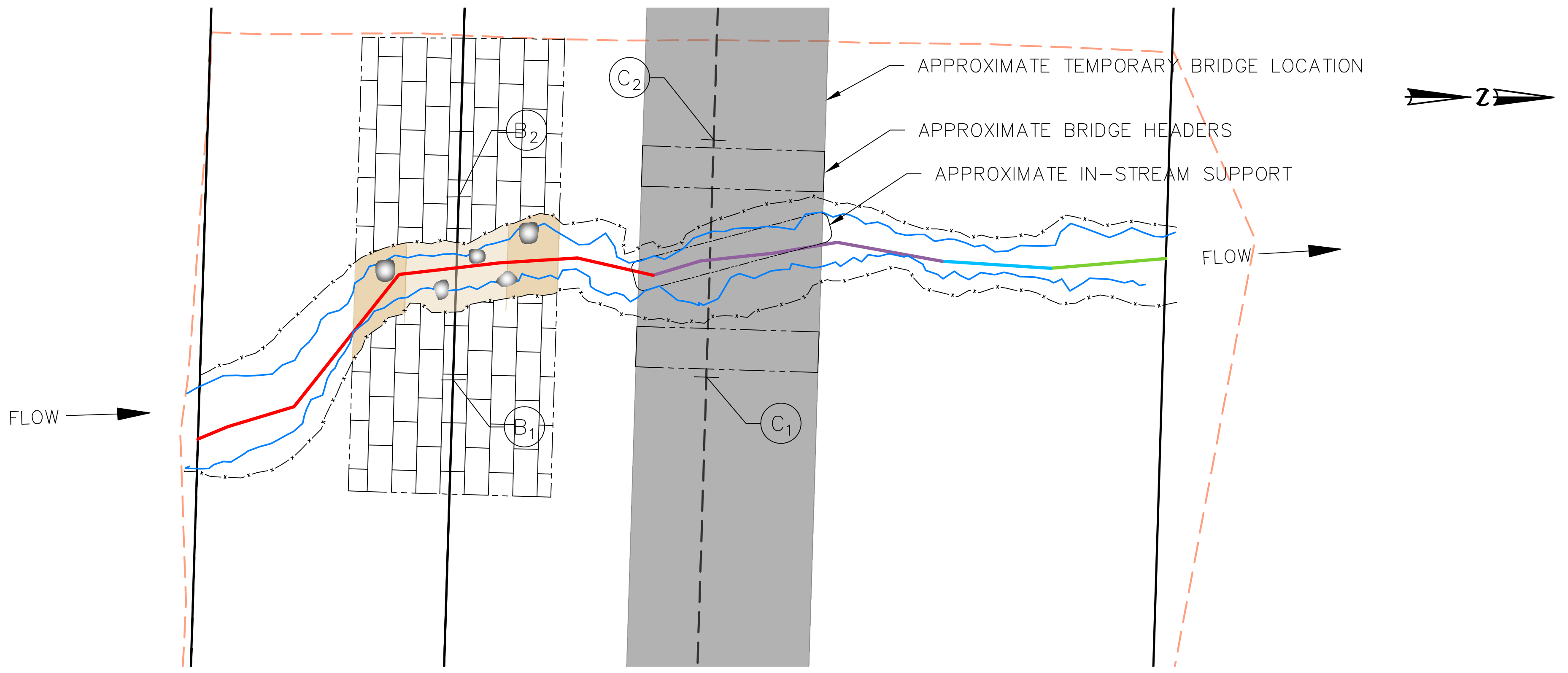
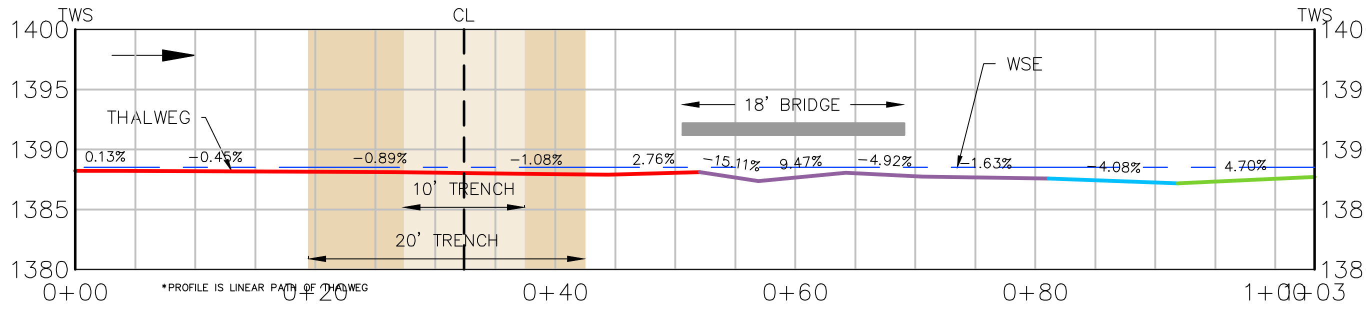


STREAMBED RESTORATION





*PROFILE IS LINEAR PATH OF THALWEG

NOTES

1. TRANSITIONS BETWEEN EXISTING CHANNEL FEATURES (BED, BANK, FLOODPLAIN) AND PROPOSED RESTORED TRENCH CROSSING WILL BE SMOOTH AND EVENLY GRADED WITHOUT ABRUPT OR PROTRUDING OBSTRUCTIONS.
2. ENBRIDGE WILL RESTORE THE BANKS TO PRE–CONSTRUCTION CONDITIONS, WITH ANTICIPATING RECLAMATION TOLERANCES AS DEPICTED IN BANK RESTORATION PROFILES.
3. BANK MIGRATION POTENTIAL IS TO THE WEST. PRIMARY FLOW IS LOCATED ON THE UPSTREAM SIDE OF THE CHANNEL.
4. PLACE MATS DIRECTLY ON TOP OF EXISTING VEGETATION TO AVOID OR MINIMIZE DISTURBANCE OF VEGETATION ON THE CHANNEL BANKS AND AT THE TOP OF THE STREAM BANK.
5. SEE DETAIL SHEET FOR SPECIFIC RESTORATION METHODS AND DETAILS.
6. FLUMES SIZES MAY VARY BETWEEN 18–48 INCHES AND MUST EXTEND ABOVE OHWM OR SURFACE WATER AT TIME OF CONSTRUCTION, WHICHEVER IS GREATER.
7. USE OF CATTLE EXCLUSION MAY BE ADDRESSED DURING THE OPERATIONAL PHASE OF THE PROJECT, PENDING LANDOWNER DISCUSSION.
8. IF IN–STREAM SUPPORT IS UTILIZED, BOULDERS IN THE TRAVEL LANE WILL TEMPORARILY BE STOCKPILED UNTIL RESTORATION.
9. MINIMIZE DISTURBANCE OF BED MATERIALS AND FEATURES DURING CONSTRUCTION OF THE TRENCH AND INSTALLATION AND REMOVAL OF IN–STREAM SUPPORT
10. BED AND/OR BANK MATERIALS TEMPORARILY ADJUSTED OR REMOVED DURING CONSTRUCTION SHALL BE PLACED IN THE APPROXIMATE ORIGINAL LOCATION DURING RESTORATION. MATERIALS SHALL BE FIELD ADJUSTED DURING PLACEMENT BASE ON THE OBSERVED FLOW PATH AT THE TIME OF CONSTRUCTION.
11. ALIGNMENT OF IN–STREAM SUPPORT SHALL BE FIELD ADJUSTED BASED ON FLOW PATH TO PROTECT CHANNEL BANKS.
12. SEE RESTORATION SHEET FOR B1–B2 CROSS SECTION.

LEGEND

━━━━	ENBRIDGE L3R PIPELINE
— — — —	PERMANENT RIGHT OF WAY
━━━━	TEMPORARY WORKSPACE
🟥	WATERBODY – RIFFLE (ROSGEN SURVEY)
🟦	WATERBODY – POOL (ROSGEN SURVEY)
🟪	WATERBODY – RUN (ROSGEN SURVEY)
🟩	WATERBODY – GLIDE (ROSGEN SURVEY)
MAJOR MINOR	CONTOUR (1' INTERVAL)
—x—x—x—	TOP OF BANK
━━━━	ORDINARY HIGH WATER MARK
▭	FIELD DELINEATED WETLAND
▨	TRAVEL LANE/CONSTRUCTION MATTING
▨	TRENCH – 10'
▨	TRENCH – 20'

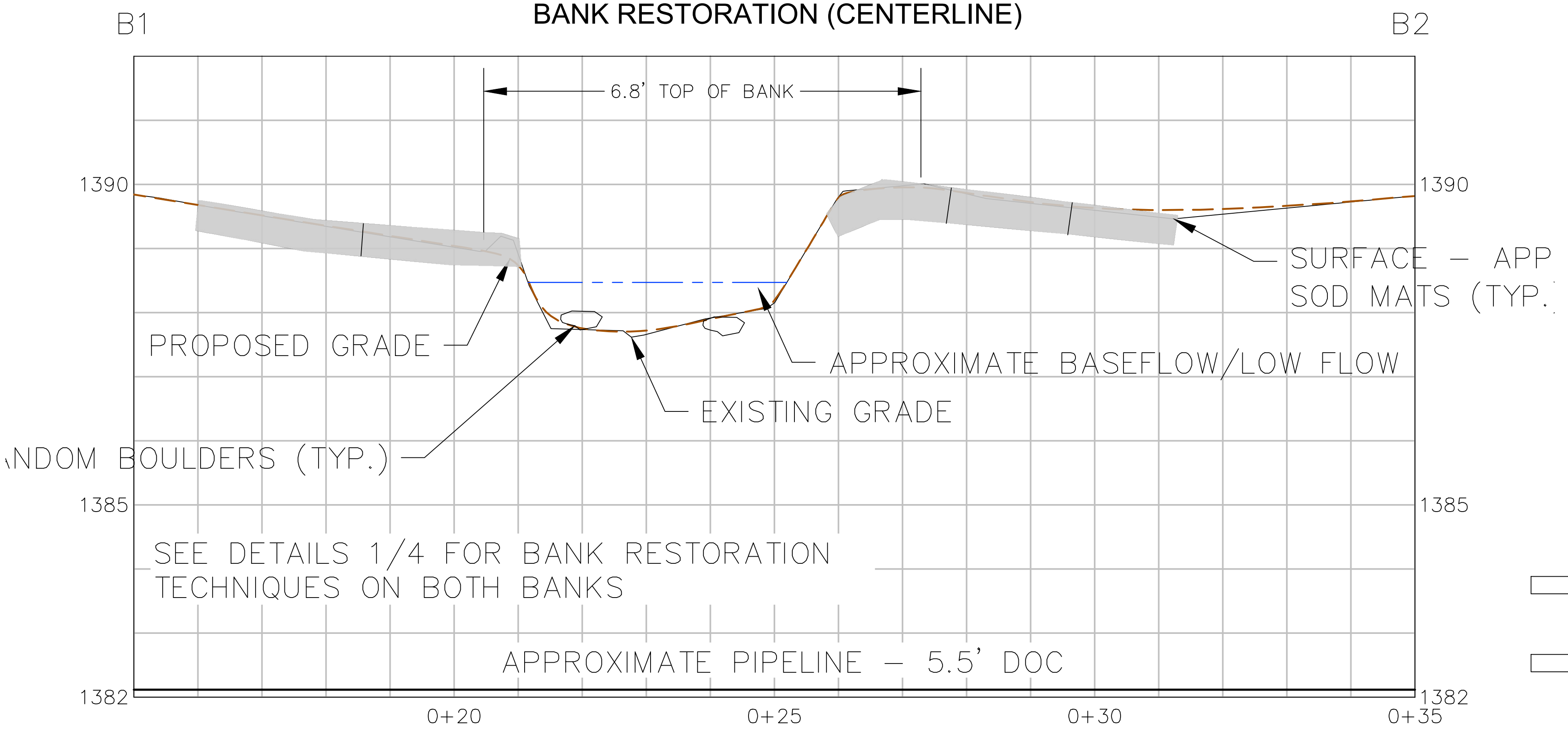
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		

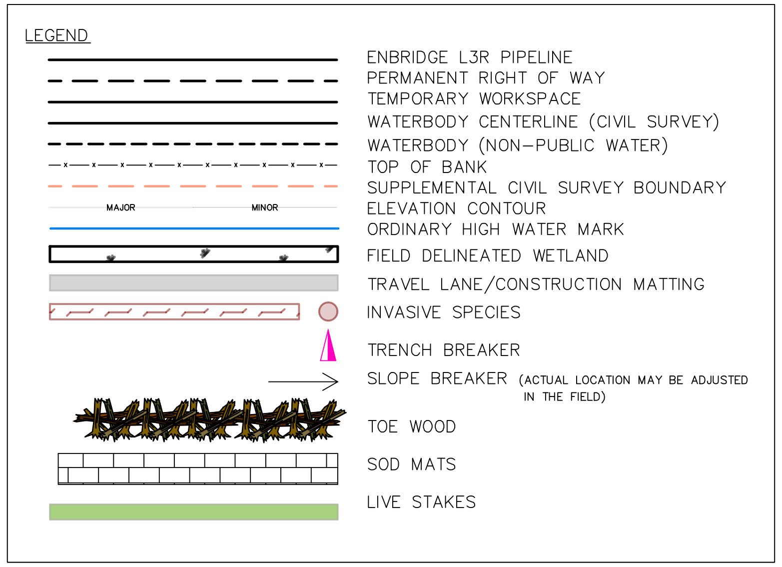
ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
BLIND LAKE CREEK – MP 1026.4 – MDNR ID 45
STABILIZATION PLAN

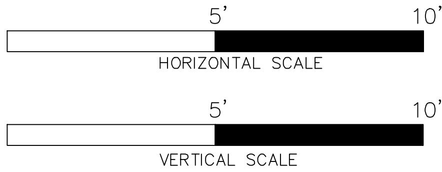
SCALE	DWG. NO.	PAGE NO.
	SSRP–1026.4–002	2/5

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

BANK RESTORATION (CENTERLINE)







RESTORATION NOTES:

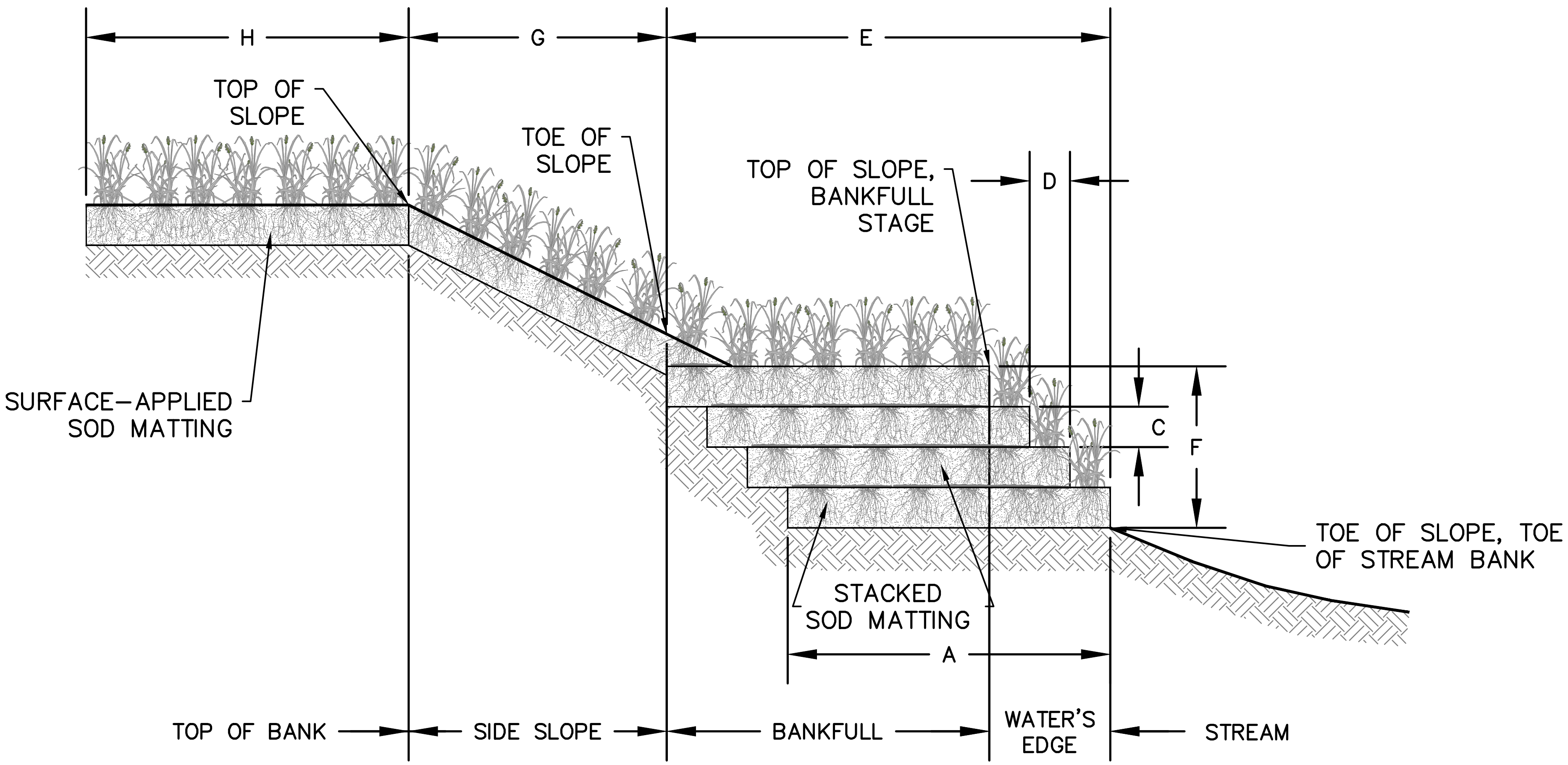
GENERAL
1. REFER TO RESTORATION DETAIL SHEETS FOR ADDITIONAL INFORMATION RELATED TO PROPOSED RESTORATION MEASURES.
2. REFER TO SITE PHOTOS FOR INFORMATION ON PRE-CONSTRUCTION CROSSING CONDITIONS AND TO PROVIDE ADDITIONAL GUIDANCE FOR RESTORATION EFFORTS.
3. 3RENCH IS LOCATED WITHIN AN EXISTING RIFFLE, AS SUCH, THE BED MATERIAL SHALL BE EXCAVATED AND TEMPORARILY STOCKPILED TO BE REINSTALLED AS PART OF CHANNEL BED AND TOE OF BANK RESTORATION EFFORTS. REFER TO RESTORATION CROSS SECTION AND BED PROFILE SHEET 2 TO MAINTAIN THE EXISTING BED FEATURE GRADE CONTROL.
4. RIFFLE MATERIAL IS NATURALLY COMMINGLED WITH A VARIETY OF PARTICLE SIZES TO PROMOTE CHANNEL SURFACE FLOWS. MATERIAL THICKNESS GENERALLY EXTENDS TO A DEPTH OF 1.5 TO 2 TIMES THE LARGEST SURFACE PARTICLE. RESTORED CHANNEL RIFFLE SECTION SHALL INCLUDE RANDOMLY SORTED MATERIALS.

SOD MATTING
1. REMOVE VEGETATED MATS ON EITHER SIDE OF THE STREAM CROSSING USING ONSITE EQUIPMENT WHICH CAN UNDERCUT THE VEGETATION FOR REMOVAL. SMALL SHRUBS AND/OR TREES WITHIN THE SOD MATS ARE ACCEPTABLE AND SHOULD NOT BE REMOVED.
2. DEPENDING ON THE LEVEL OF SATURATION AT THE TIME OF REMOVAL, IT MAY BE DIFFICULT TO OBTAIN INTACT CONSOLIDATED MATS, BUT GENERALLY THE NATIVE VEGETATION WILL BE RETAINED AND CAPTURED FOR PLACEMENT.
3. SOD MATS CAN BE TRANSPLANTED DURING ANY SEASON.
4. SOD MATS WILL BE PLACED ON CLEAR GROUND OR MATS WITHIN THE WORKSPACE.
5. MONITOR MATS TO SUPPORT SURVIVABILITY; WATERING MAY BE NEEDED.
6. PRIOR TO PLACEMENT OF SOD MATS FINISH GRADE CHANNEL BANK AND ADJACENT FLOODPLAIN APPLICATION AREA TO PROVIDE A SMOOTH AND EVEN SURFACE. SUBGRADE ELEVATION SHOULD ALLOW FOR THE FINISHED SOD SURFACE TO TRANSITION EVENLY WITH THE CHANNEL BANKS UPSTREAM AND DOWNSTREAM OF THE INSTALLATION AREA. AVOID ABRUPT CHANGES IN GRADE.
7. VEGETATED MATS WILL BE RETURNED/SET IN PLACE WITH ONSITE EQUIPMENT.
    a. SURFACE APPLIED SOD MATTING SHOULD BE PLACED WITH THE LONG SIDE PERPENDICULAR TO THE CHANNEL / FLOW.
    b. STACKED SOD MATTING SHOULD BE PLACED WITH THE LONG SIDE PARALLEL TO THE CHANNEL / FLOW.
8. WHEN PLACING SOD MATS, DO NOT LEAVE LARGE GAPS BETWEEN EACH SOD MAT AS NON-NATIVE VEGETATION WILL QUICKLY ATTEMPT TO COLONIZE THESE VOIDS.
9. WATER SOD MATS AFTER REPLACEMENT IF CONDITIONS ARE HOT AND DRY. DAMP AND/OR FROZEN MATS DO NOT REQUIRE WATERING.
10. THE TOP MAT AND/OR OTHER MATS CAN BE ANCHORED WITH A LIVE AND/OR DEAD STOUT STAKE TO ENSURE THAT IT DOES NOT MOBILIZE DURING A FLOOD EVENT BEFORE THE ROOTS HAVE ESTABLISHED.
11. THE VEGETATED MATS WILL BE REPLACED AS SOON AS PRACTICAL FOLLOWING BACKFILLING OF THE TRENCH AND STABILIZED PER THE TIMING REQUIREMENTS DESCRIBED IN SECTION 1.9.1 OF THE EPP.

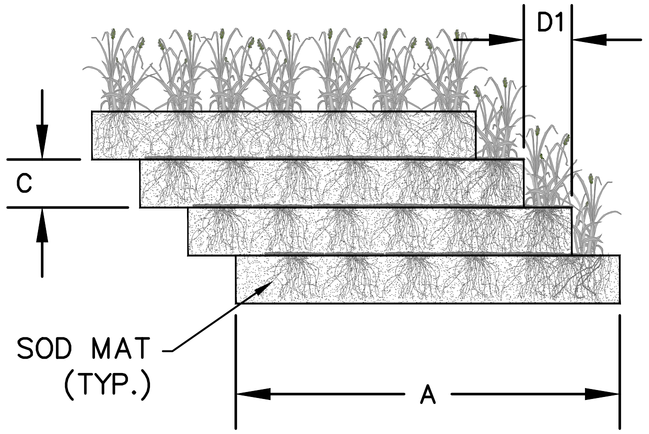
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
BLIND LAKE CREEK – MP 1026.4 – MDNR ID 45
SITE SPECIFIC DETAILS

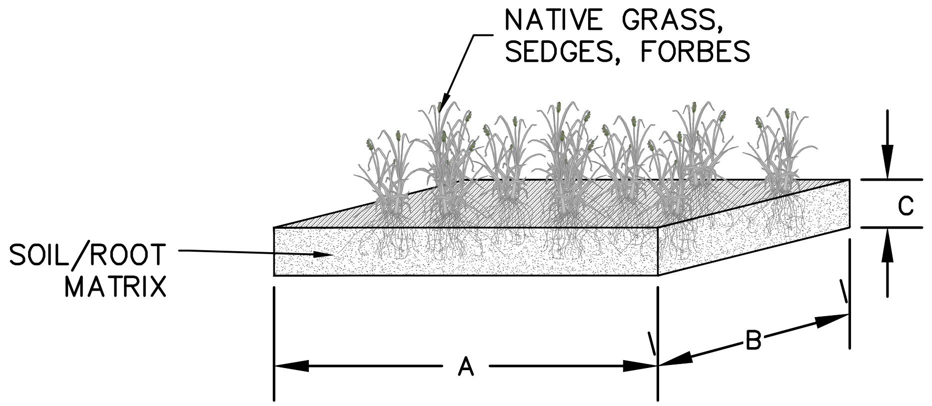
SCALE	DWG. NO.	PAGE NO.
NOTED	SSRP–1026.4–004	3/5



CROSS SECTION



STACKED SOD MATTING DETAIL



SOD MAT DETAIL

DIMENSION	NAME	TYPICAL UNIT	VALUE	DESCRIPTION
A	SOD MAT WIDTH	FEET	3–4	WIDTH OF INDIVIDUAL SOD MAT.
B	SOD MAT LENGTH	FEET	3–6	LENGTH OF INDIVIDUAL SOD MAT.
C	SOD MAT THICKNESS	INCHES	12	THICKNESS OF INDIVIDUAL SOD MAT.
D	STACKED SOD MAT SETBACK	FEET, INCHES	N/A	THE DISTANCE BETWEEN THE EDGES OF SOD MATS STACKED TO FORM A SLOPE
E	WIDTH OF STACKED SOD MATS	FEET, INCHES	N/A	WIDTH OF A BANK CREATED BY STACKED SOD MATS
F	HEIGHT OF STACKED SOD MATS	FEET, INCHES	N/A	HEIGHT OF A SLOPE CREATED BY STACKED SOD MATS
G	WIDTH OF SURFACE- APPLIED SOD MATS	FEET	10–20	WIDTH OF A SLOPE STABILIZED WITH SURFACE-APPLIED SOD MATS
H	TOP OF BANK SOD MATTING DISTANCE	FEET	15	DISTANCE SOD MATTING IS INSTALLED ON THE TOP OF BANK

NOTES:

1. DIMENSION LABELS ARE REFERENCED IN THE DETAIL DRAWINGS.

SOD MAT EXAMPLES

SOD MATTING DETAIL

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
BLIND LAKE CREEK – MP 1026.4 – MDNR ID 45
SITE SPECIFIC DETAILS

SCALE NOTED
DWG. NO. SSRP–1026.4–004
PAGE NO. 4/5

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

1 CENTERLINE – FACING WEST BANK

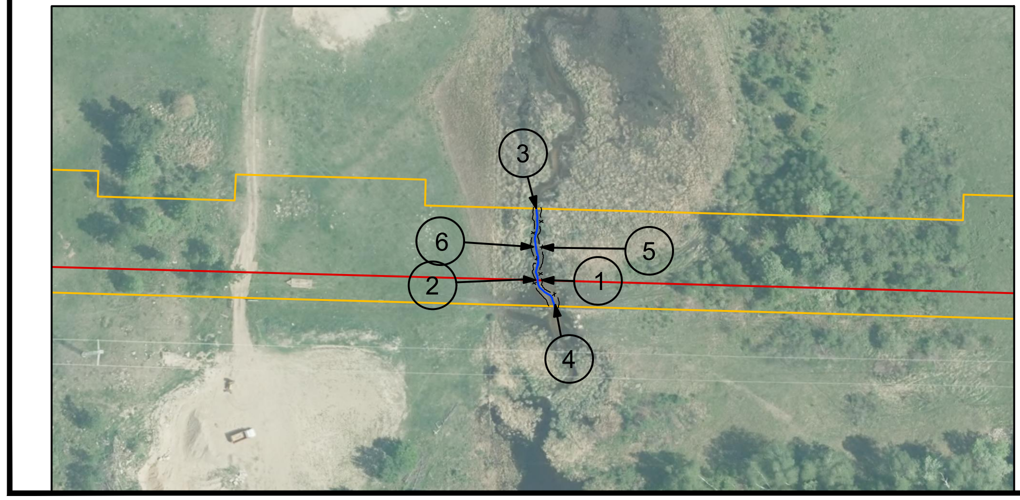
2 CENTERLINE – FACING EAST BANK

3 EDGE OF WORKSPACE – FACING DOWNSTREAM

4 EDGE OF WORKSPACE – FACING UPSTREAM

5 BRIDGE – FACING WEST BANK

6 BRIDGE – FACING EAST BANK



NOTES:

1. AIR PHOTOS ARE FROM 2018 ENBRIDGE AERIAL PHOTOGRAPHY.
2. ADDITIONAL ON–THE GROUND PHOTOS MAY BE TAKEN PRIOR TO CONSTRUCTION AT MDNR REQUEST.
3. PRE–CONSTRUCTION PHOTOS WILL BE USED TO AID IN RESTORATION.

B	ISSUED FOR PERMITTING	MJT	10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
BLIND LAKE CREEK – MP 1026.4 – MDNR ID 45
PHOTO PAGE

SCALE	DWG. NO.	PAGE NO.
	SSRP–1026.4–005	5/5

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

GENERAL

1. THE SPECIFICATIONS WITHIN THIS SSRP MAY MODIFY OR REPLACE PROJECT-WIDE STANDARDS PRESENTED IN THE EPP. WHERE MATERIAL WITHIN THESE SSRPS EXCEEDS STANDARD CONSTRUCTION MEASURES IN THE EPP, THESE SSRPS SUPERSEDE THE EPP.

2. CONSTRUCTION AND RESTORATION OF WATERBODY CROSSINGS WILL FOLLOW THESE GENERAL STEPS:

   A. SITE CLEARING
   B. INSTALLATION OF TEMPORARY EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (“BMPS”)
   C. BRIDGE INSTALLATION
   D. EXCAVATION/BACKFILLING OF THE WATERBODY INCLUDING:
      - SOD SAVING TOPSOIL SEGREGATION AT NON-WOODED SITES
      - STREAMBED MATERIAL SEGREGATION
      - PIPE INSTALLATION
      - BACKFILL, INCLUDING IMPLEMENTATION OF CONSTRUCTION-RELATED RESTORATION METHODS (I.E., TOE WOOD)
   E. REPLACEMENT OF STREAMBED MATERIAL AND TOPSOIL/SOD LAYER
   F. RESTORATION OF STREAM BANKS TO PRE-CONSTRUCTION CONTOURS
   G. IF FINAL GRADING NOT POSSIBLE AT THE TIME, TEMPORARY STABILIZATION AND REPLACEMENT/REINFORCEMENT OF TEMPORARY BMPS
   H. AFTER FINAL GRADING, PERMANENT SEEDING AND/OR WOODY VEGETATION RESTORATION, STABILIZATION AND REPLACEMENT/REINFORCEMENT OF TEMPORARY BMPS
   I. BRIDGE REMOVAL DURING FINAL RESTORATION AFTER STABILIZATION AND PERMANENT SEEDING
   J. POST-CONSTRUCTION MONITORING

CROSSING METHODS

1. ALL WATERBODY AND WETLAND CROSSINGS WILL BE CONDUCTED IN COMPLIANCE WITH SECTION 2.0 AND SECTION 3.0 OF THE ENVIRONMENTAL PROTECTION PLAN (“EPP”), RESPECTIVELY. SECTION 2.0 AND 3.0 OF THE WINTER CONSTRUCTION PLAN PRESENTS MODIFICATIONS FOR WATERBODY AND WETLAND CONSTRUCTION METHODS, RESPECTIVELY, IN WINTER CONDITIONS.

2. ENBRIDGE'S SUMMARY OF CONSTRUCTION METHODS AND PROCEDURES (THE “PROCEDURES,” APPENDIX A OF THE EPP) OUTLINES THE VARIOUS CONSTRUCTION METHODS THAT ENBRIDGE MAY UTILIZE TO CONSTRUCT THROUGH WATERBODIES AND WETLANDS/BASINS AS PRESENTED ON THESE SITE-SPECIFIC RESTORATION PLANS (“SSRPS”).

   A. DRY CROSSING (ISOLATED) METHODS (INCLUDING THE DRY CROSSING AND MODIFIED DRY CROSSING METHOD) ARE DESCRIBED SECTIONS 4.3 OF THE PROCEDURES, AND IN SECTIONS 2.5.2 AND 2.5.3 AND FIGURES 23 AND 24 OF THE EPP.
   B. THE BORE METHOD (NON-PRESSURIZED) IS DESCRIBED IN SECTION 3.5 OF THE PROCEDURES, AND SECTION 4.0 OF THE EPP.
   C. THE MODIFIED UPLAND CONSTRUCTION (WETLAND) METHOD IS DESCRIBED IN SECTION 3.3 OF THE PROCEDURES, AND SECTION 3.0 AND FIGURES 30 TO 34 OF THE EPP.
   D. ALTHOUGH NOT PROPOSED AS A PRIMARY METHOD AT THESE SSRP WATERBODIES, THE OPEN CUT (NON-ISOLATED) WATERBODY CROSSING METHOD IS DESCRIBED IN SECTION 4.1 OF THE PROCEDURES, AND SECTION 2.5.1 AND FIGURE 24 OF THE EPP.
   E. ALTHOUGH NOT PROPOSED AS A PRIMARY METHOD AT THESE SSRP WATERBODIES, THE PUSH-PULL METHOD IS DESCRIBED IN SECTION 3.4 OF THE PROCEDURES, AND SECTION 3.7.1 AND FIGURES 35 AND 36 OF THE EPP.

CLEARING/VEGETATION REMOVAL

1. STUMPS WITHIN THE TRENCH LINE WILL BE COMPLETELY REMOVED, GROUND, AND/OR HAULED OFF-SITE TO AN APPROVED LOCATION. TREE STUMPS OUTSIDE THE TRENCH LINE WILL BE GROUND BELOW NORMAL GROUND SURFACE TO FACILITATE A SAFE WORK AREA AND TO ALLOW TOPSOIL REMOVAL, IF NECESSARY. IN SOME CIRCUMSTANCES, TREE STUMPS OUTSIDE THE TRENCH LINE MAY BE COMPLETELY REMOVED TO ALLOW FOR A SAFE WORK AREA AND HAULED OFF-SITE TO AN APPROVED LOCATION AS OUTLINED IN SECTION 1.8.3 OF THE EPP.

2. CLEARING WILL BE CONDUCTED IN WATERBODIES AND WETLANDS AS OUTLINED IN SECTION 2.2 AND 3.2 OF THE EPP, RESPECTIVELY. CHIPS, MULCH, OR MECHANICALLY CUT WOODY DEBRIS SHALL NOT BE STOCKPILED IN A WETLAND. HYDRO-AX DEBRIS, OR SIMILAR CAN BE LEFT IN THE WETLAND IF SPREAD EVENLY IN THE CONSTRUCTION WORKSPACE TO A DEPTH THAT WILL ALLOW FOR NORMAL REVEGETATION, AS DETERMINED BY THE EI. CHIPPING IS NOT ALLOWED ON PUBLIC LANDS. ON PUBLIC LANDS, MULCH AND MECHANICALLY CUT WOODY DEBRIS MUST BE UNIFORMLY BROADCAST TO LESS THAN 2-INCH THICKNESS AND IN A MANNER THAT MAINTAINS VISIBLE GROUND.

3. ENBRIDGE WILL PROPERLY INSTALL AND MAINTAIN REDUNDANT SEDIMENT CONTROL MEASURES IMMEDIATELY AFTER CLEARING AND PRIOR TO INITIAL GROUND DISTURBANCE AT SURFACE WATERS LOCATED WITHIN 50 FEET OF THE PROJECT AND WHERE STORMWATER FLOWS TO THE SURFACE WATER (REFER TO THE ENVIRONMENTAL PLAN SHEETS IN THE SWPPP), AND WITHIN 100 FEET OF SPECIAL AND IMPAIRED WATERS, INCLUDING TROUT STREAMS.

4. ON PUBLIC LANDS AND WHEREVER PRACTICABLE AT WATERBODY CROSSINGS, ENBRIDGE WILL USE WILDLIFE-FRIENDLY EROSION AND SEDIMENT CONTROL BMPS THAT CONTAIN BIODEGRADABLE NETTING (CATEGORY 3N OR 4N NATURAL FIBER) AND WILL AVOID THE USE OF PLASTIC MESH (SECTIONS 1.17.1 AND 2.6.1 OF THE EPP).

TEMPORARY STABILIZATION

1. ON PORTIONS OF THE PROJECT WHERE WORK WILL BE OCCURRING DURING APPLICABLE “WORK IN WATER RESTRICTIONS” FOR PUBLIC WATERS (REFER TO SECTION 2.1), ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE STABILIZED WITHIN 24 HOURS DURING THE RESTRICTION PERIOD. STABILIZATION OF ALL EXPOSED SOILS WITHIN 200 FEET OF THE PUBLIC WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY OR TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD. THESE AREAS WILL BE IDENTIFIED ON THE ENVIRONMENTAL PLAN SHEETS ACCOMPANYING THE SWPPP.

2. HYDRO-MULCH AND LIQUID TACKIFIER CAN BE USED IN PLACE OF CERTIFIED WEED-FREE STRAW OR HAY MULCH WITH PRIOR APPROVAL FROM ENBRIDGE. ALL HYDROMULCH AND LIQUID TACKIFIER PRODUCTS USED WILL BE ON THE APPLICABLE STATE DOT PRODUCT LIST. HYDRO-MULCH AND LIQUID TACKIFIER PRODUCTS CONTAINING PLASTIC/POLYPROPYLENE FIBER ADDITIVES AND MALACHITE GREEN (COLORANT) WILL NOT BE UTILIZED ON THIS PROJECT. APPLICATION RATES WILL BE AT THE MANUFACTURER'S RECOMMENDED RATE. ENBRIDGE WILL AVOID THE USE OF HYDROMULCH ON PUBLIC LANDS; HOWEVER, ENBRIDGE MAY USE HYDROMULCH ON STEEP SLOPES TO PREVENT EROSION UNTIL PERMANENT COVER HAS BEEN ESTABLISHED AS OUTLINED IN SECTION 1.8.3 OF THE EPP.

RESTORATION AND STABILIZATION

1. ENBRIDGE WILL RESTORE THE STREAM BANKS AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS UNLESS THAT SLOPE IS DETERMINED TO BE UNSTABLE. IF THE SLOPE IS CONSIDERED UNSTABLE, ENBRIDGE WILL RESHAPE THE BANKS TO PREVENT SLUMPING. FOR PUBLIC WATERS, ENBRIDGE WILL RETURN THE BANK TO PRE-CONSTRUCTION CONTOURS, UNLESS OTHERWISE DIRECTED BY THE SITE-SPECIFIC RESTORATION PLAN. IF ENBRIDGE CANNOT RESTORE TO PRE-CONSTRUCTION CONTOURS AT A PUBLIC WATER, ENBRIDGE WILL CONSULT WITH THE MDNR BEFORE PROCEEDING FURTHER AS OUTLINED IN SECTION 2.6 OF THE EPP.

2. UNSTABLE SOILS AND/OR SITE-SPECIFIC FACTORS SUCH AS STREAM VELOCITY AND FLOW DIRECTION MAY REQUIRE ADDITIONAL RESTORATION EFFORTS, SUCH AS INSTALLATION OF WOODY VEGETATION, GEOTEXTILE FABRIC, OR TREE, LOG, ROOTWAD, OR BOULDER REVETMENTS TO STABILIZE DISTURBED STREAM BANKS (SEE FIGURE 29) AS OUTLINED IN SECTION 2.6.2 OF THE EPP. ENBRIDGE WILL WORK WITH THE MDNR TO ENSURE ALL WORK/ADJUSTMENTS ARE APPROVED AND ARE CONDUCTED WITHIN APPLICABLE TIMING RESTRICTIONS.

3. IN UPLAND AND WETLAND AREAS, CLEANUP AND ROUGH GRADING WILL OCCUR AS OUTLINED IN SECTIONS 1.16 AND 3.9 OF THE EPP. ENBRIDGE WILL BACKFILL THE TRENCH TO AN ELEVATION SIMILAR TO THE ADJACENT AREAS OUTSIDE THE TRENCH LINE AND WILL ADD A SLIGHT CROWN OF APPROXIMATELY 3 TO 6 INCHES (DEPENDING ON SOIL TYPE) OVER THE BACKFILLED TRENCH TO ALLOW FOR SUBSIDENCE. GENERALLY, EXCESS SUBSOIL DISPLACED BY THE PIPE INSTALLATION WILL BE SPREAD ACROSS THE PORTION OF THE CONSTRUCTION WORKSPACE WHERE TOPSOIL REMOVAL HAS OCCURRED. ANY REMAINING EXCESS SUBSOIL WILL BE REMOVED AND DISPOSED OF AT AN APPROVED OFF-SITE LOCATION AS NEEDED TO ENSURE CONTOURS ARE RESTORED TO AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS.

4. REVEGETATION ACTIVITIES WILL OCCUR AS OUTLINED IN SECTION 7.0 OF THE EPP. SEED MIXES AT PUBLIC WATERS WILL BE SELECTED AND APPLIED AS INDICATED IN THE PLANTING PLAN, WHICH IS APPENDIX A OF THE POST-CONSTRUCTION VEGETATION MANAGEMENT PLAN FOR PUBLIC LANDS AND WATERS (“VMP”). SEED MIXES RELATIVE TO THESE SSRP CROSSINGS ARE CODED AS FOLLOWS:

A	EMERGENT (34-181)	G	DRY PRAIRIE GENERAL (35-221)
B	RIPARIAN NE (34-361)	H	MESIC PRAIRIE GENERAL (35-241)
C	RIPARIAN S&W (34-261)	I	MESIC PRAIRIE NW (35-441)
D	WET MEADOW NE (34-371)	J	DRY PRAIRIE NORTHWEST (35-421)
E	WET MEADOW S&W (34-271)	K	WOODLAND EDGE NE (36-311)
F	WETLAND REHABILITATION (34-171)	L	NATURAL REVEGETATION

5. ENBRIDGE WILL NOT SEED STANDING WATER OR WOODED (PSS AND PFO) WETLAND COMMUNITIES. NATURAL REVEGETATION WILL TAKE PLACE FROM EXISTING PLANT MATERIAL AND ROOT STOCK IN THESE COMMUNITIES.

6. ALL MATERIALS USED FOR CONSTRUCTION OF THE PROJECT MUST BE REMOVED FROM THE SITE.

7. ENBRIDGE WILL CONDUCT POST-CONSTRUCTION MONITORING IN ACCORDANCE WITH THE POST-CONSTRUCTION MONITORING PLAN FOR WETLANDS AND WATERBODIES, AND IN ACCORDANCE WITH THE VMP FOR THE UPLAND PORTIONS OF THE PROJECT ON PUBLIC LANDS.

B	ISSUED FOR PERMITTING	MJT	10/2020		
NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE-SPECIFIC RESTORATION PLAN

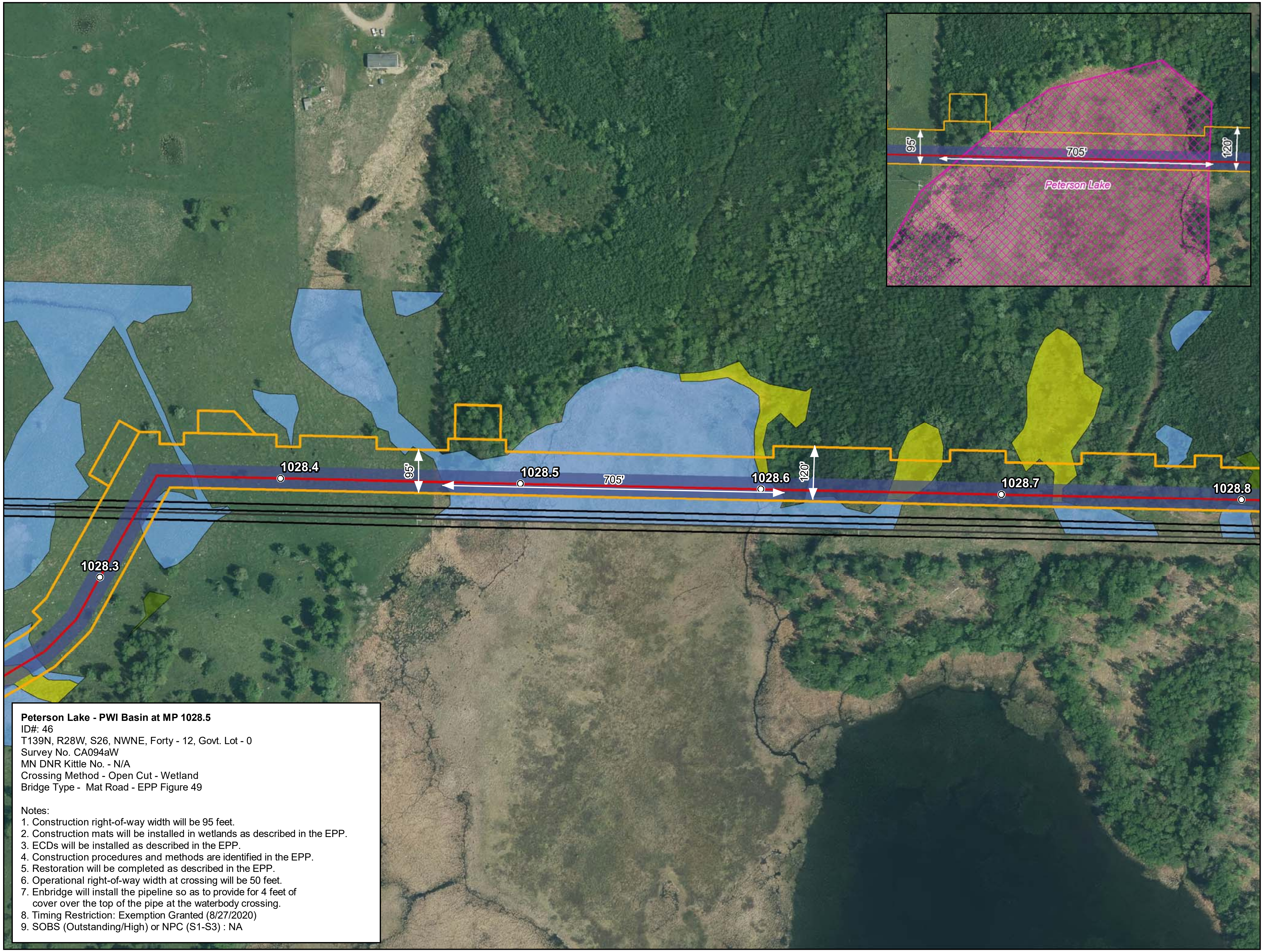
CONSTRUCTION NOTES

ENBRIDGE

SCALE
DWG. NO.
SSRP-NOTES
PAGE NO.

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

MDNR ID No. 46: MP 1028.5; Peterson Lake - Public Water Basin



Peterson Lake - PWI Basin at MP 1028.5
ID#: 46
T139N, R28W, S26, NWNE, Forty - 12, Govt. Lot - 0
Survey No. CA094aW
MN DNR Kittle No. - N/A
Crossing Method - Open Cut - Wetland
Bridge Type - Mat Road - EPP Figure 49

Notes:
1. Construction right-of-way width will be 95 feet.
2. Construction mats will be installed in wetlands as described in the EPP.
3. ECDs will be installed as described in the EPP.
4. Construction procedures and methods are identified in the EPP.
5. Restoration will be completed as described in the EPP.
6. Operational right-of-way width at crossing will be 50 feet.
7. Enbridge will install the pipeline so as to provide for 4 feet of cover over the top of the pipe at the waterbody crossing.
8. Timing Restriction: Exemption Granted (8/27/2020)
9. SOBS (Outstanding/High) or NPC (S1-S3) : NA

0 100 200
Feet
1 inch = 200 feet

N
W E
S

○ Milepost
Proposed L3R Centerline
Existing Utility
Existing Utility
▬ Permanent Right-of-Way
▭ Construction Right-of-Way/ATWS

Delineated Wetlands
PEM
PFO
PSS

Line 3 Replacement Project

Crossing Plan

ID# 46
Survey No. CA094aW

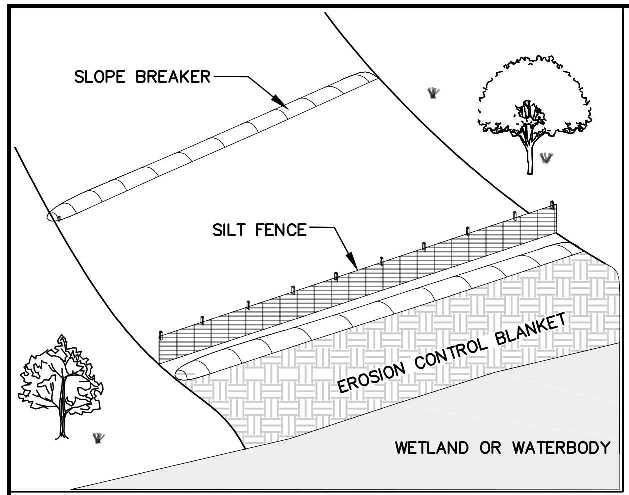
Peterson Lake - PWI Basin

Cass County, Minnesota

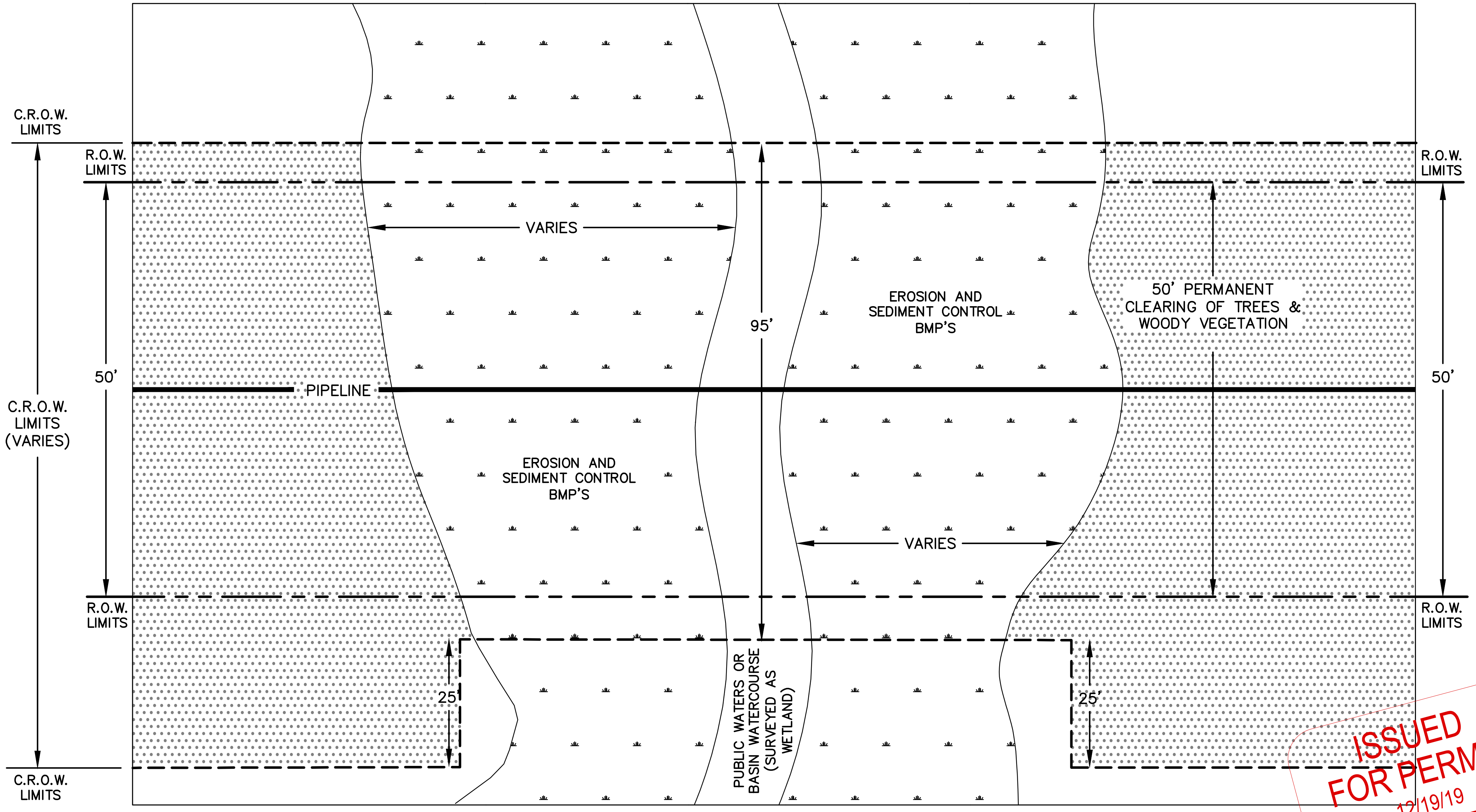
ENBRIDGE
October 2020

For Environmental Review Purposes Only

Date: (10/7/2020) **Source:** Z:\Clients\E_H\Enbridge\Line_3_Full_Replacement\Permitting\State\Public_Waters\2020_09\Figures\L3R_Waters_App_Open_Cut_2020_09.mxd



▨ SEEDING AREA



ISSUED FOR PERMIT
12/19/19

PUBLIC WATERS BASIN OR WATERCOURSE (SURVEYED AS WETLAND) CROSSING

1) PRIOR TO DISTURBANCE, EROSION AND SEDIMENT CONTROL BMPS (E.G., STRAW BALES, FILTER SOCKS, SILT FENCES) WILL BE INSTALLED AS PRIOR TO DISTURBANCE AND WILL REMAIN IN PLACE UNTIL THE AREA HAS STABILIZED AND ADEQUATE REVEGETATION HAS ESTABLISHED (SECTION 3.4).

2) SUBSEQUENT TO PIPE INSTALLATION, BACKFILLING OF WETLAND TRENCHES WILL TAKE PLACE IMMEDIATELY, OR AS APPROVED BY THE EI.

3) IN AREAS WHERE TOPSOIL HAS BEEN SEGREGATED, THE SUBSOIL WILL BE REPLACED FIRST.

4) ROUGH GRADING WILL TAKE PLACE NO LATER THAN THE END OF THE WORKDAY FOLLOWING TRENCH BACKFILLING.

5) ENBRIDGE WILL BACKFILL THE TRENCH TO AN ELEVATION SIMILAR TO THE ADJACENT AREAS OUTSIDE THE DITCH LINE AND WILL ADD A SLIGHT CROWN OF APPROXIMATELY 3 TO 6 INCHES (DEPENDING ON SOIL TYPE) OVER THE BACKFILLED TRENCH TO ALLOW FOR SUBSIDENCE.

6) PERIODIC BREAKS IN THE CROWN WILL BE IMPLEMENTED TO ALLOW FOR NORMAL HYDROLOGIC FLOW ACROSS THE BACKFILLED TRENCH. CROWNING WILL NOT EXTEND BEYOND THE PREVIOUSLY EXCAVATED TRENCH LIMITS. AS THE BACKFILL MATERIAL SETTLES, THERE IS POTENTIAL THAT THE ORIGINAL CROWN MAY NOT COMPLETELY RECEDE TO PRE–CONSTRUCTION CONTOURS.

7) AFTER ROUGH GRADING, WHERE TOPSOIL HAS BEEN SEGREGATED, IT WILL BE SPREAD UNIFORMLY OVER THE TRENCH AREA FROM WHICH IT WAS REMOVED.

8) ADDITIONAL (FINAL) GRADING MAY OCCUR WHEN CONDITIONS ALLOW TO ENSURE THE DISTURBED AREA HAS BEEN RETURNED TO PRE–CONSTRUCTION CONDITIONS.

9) PERMANENT SLOPE BREAKERS WILL BE INSTALLED NEAR THE BOUNDARY BETWEEN THE WETLAND AND ADJACENT SLOPED APPROACHES TO PREVENT SEDIMENT FLOW INTO THE WETLAND AS DESCRIBED IN THE EPP (FIGURE 20):

- a. PERMANENT SLOPE BREAKERS WILL BE INSTALLED TO MINIMIZE CONCENTRATED OR SHEET FLOW RUNOFF IN DISTURBED AREAS IN ACCORDANCE WITH THE FOLLOWING MAXIMUM ALLOWABLE SPACING UNLESS OTHERWISE SPECIFIED IN PERMIT CONDITIONS.
  - i.

	SLOPE (%)	APPROXIMATE SPACING (FT)
1.	<5	250
2.	>5–15	200
3.	15–25	150
4.	>25	<100

10) NO FERTILIZER, LIME, OR MULCH WILL BE APPLIED IN WETLANDS, EXCEPT FOR PEATLANDS AS DESCRIBED IN THE EPP (SECTION 7.7.3.).

11) PERMANENT REVEGETATION SEEDING WILL TAKE PLACE IN ACCORDANCE WITH THE EPP (SECTION 7.7).

12) THE APPROPRIATE SEED MIX WILL BE DETERMINED USING THE RESULTS OF PRE–CONSTRUCTION WETLAND FIELD DELINEATIONS, HYDROLOGICAL CHARACTERISTICS AND SITE–SPECIFIC CONDITIONS.

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	AJM	12/19/19	KEH	KD
B	ISSUED FOR PERMIT	AJM	12/13/19	KEH	KD
A	ISSUED FOR REVIEW	AJM	12/10/19	KEH	KD

DWN. BY: AJM	DATE 12/10/19
CHK. KEH	
PROJ. ENGR. DG	
PROJ. MGR. KD	
CLIENT APP.	

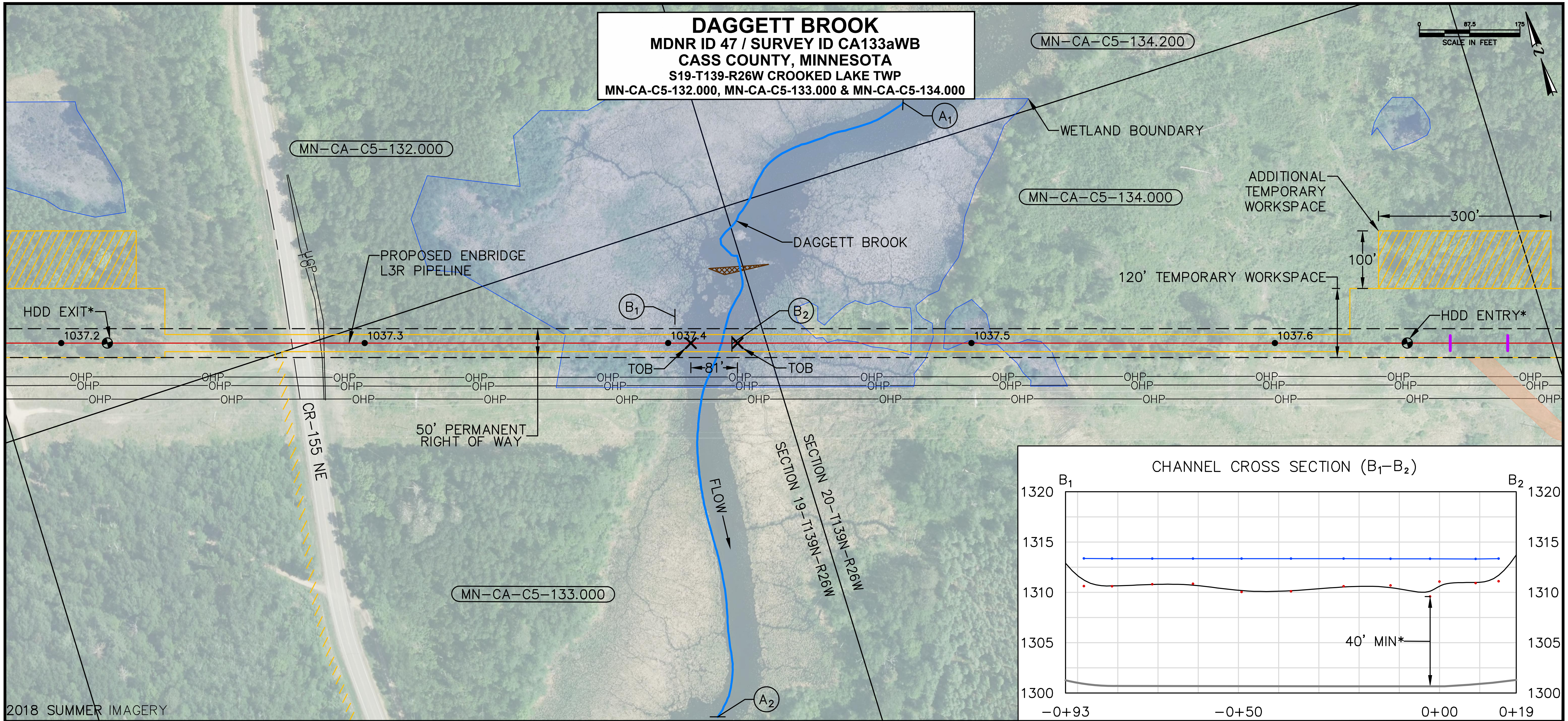
ENBRIDGE

LINE 3 REPLACEMENT
PUBLIC WATERS BASIN OR WATERCOURSE
(SURVEYED AS WETLAND) TYPICAL XING
FINAL STREAM BANK STABILIZATION
& EROSION CONTROL

SCALE NTS
DWG. NO.

MDNR ID No. 47: MP 1037.4; Daggett Brook (M-106-004)

DAGGETT BROOK
MDNR ID 47 / SURVEY ID CA133aWB
CASS COUNTY, MINNESOTA
S19-T139-R26W CROOKED LAKE TWP
MN-CA-C5-132.000, MN-CA-C5-133.000 & MN-CA-C5-134.000



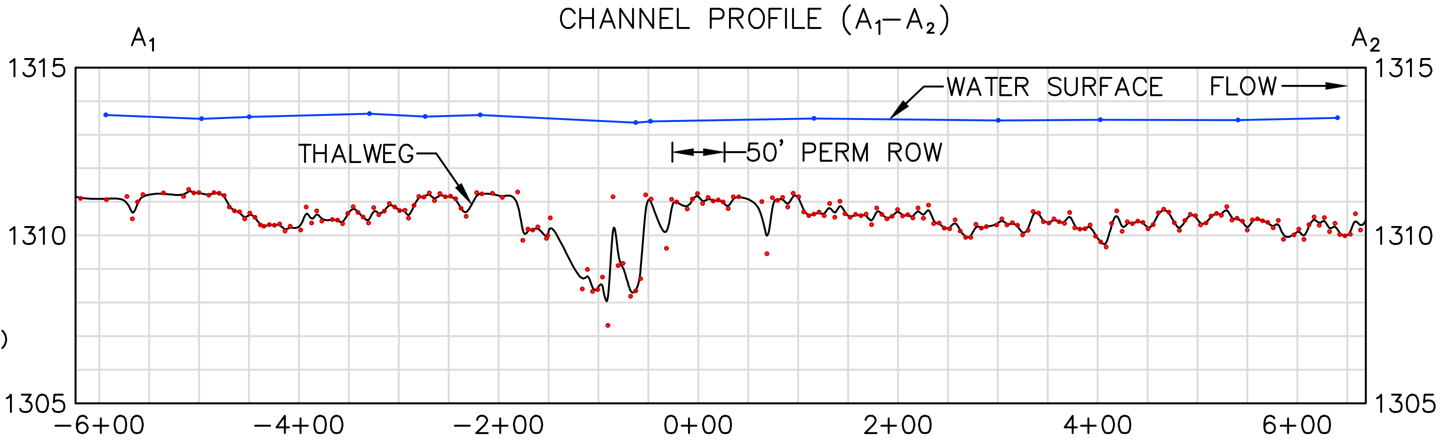
NOTES
1. NO FEMA DIGITAL FLOODPLAIN DATA AVAILABLE
2. SOBS (O/H) OR NPC (S1–3): N/A
3. MDNR REGION 1 PWI – COOL/WARM WATER FISHERY: MARCH 15 – JUNE 30. 24–HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
4. NHIS: COLONIAL WATERBIRD BMPS/EQUIPMENT SPECIFICATIONS.
5. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

CHANNEL CROSS SECTION NOTE:
1. CHANNEL LOCATIONS, DIMENSIONS, AND/OR ELEVATIONS ARE BASED ON 2014 TOPOGRAPHIC/BATHYMETRIC SURVEY(S), AND AS SUCH DO NOT REFLECT CHANGES TO THE CHANNEL THAT MAY HAVE OCCURRED SINCE THAT TIME.

LEGEND

—	PROPOSED ENBRIDGE L3R PIPELINE
— — — —	PERMANENT RIGHT OF WAY
—	TEMPORARY WORKSPACE
—	WATERBODY (ROSGEN SURVEY – THALWEG)
— —	CENTERLINE OF ROAD
—FO—	FIBER OPTIC CABLE
—UGP—	UNDERGROUND POWER
—OHP—	OVERHEAD POWER
—	TRACT BOUNDARY
XXXXXXXX	BEAVER DAM
▭	ACCESS ROAD
▭	WETLAND
▨	ADDITIONAL TEMPORARY WORKSPACE
(MN–XX–XX–XXX.XXX)	TRACT ID
•	ROSGEN SURVEY POINT – WATER SURFACE
•	ROSGEN SURVEY POINT – RIVER BOTTOM (THALWEG)
⊕	HDD ENTRY/EXIT
X	TOP OF BANK
|	TRENCH BREAKER (LOCATIONS ARE APPROXIMATE)

CHANNEL PROFILE (A1–A2)



FOR ENVIRONMENTAL REVIEW PURPOSES ONLY

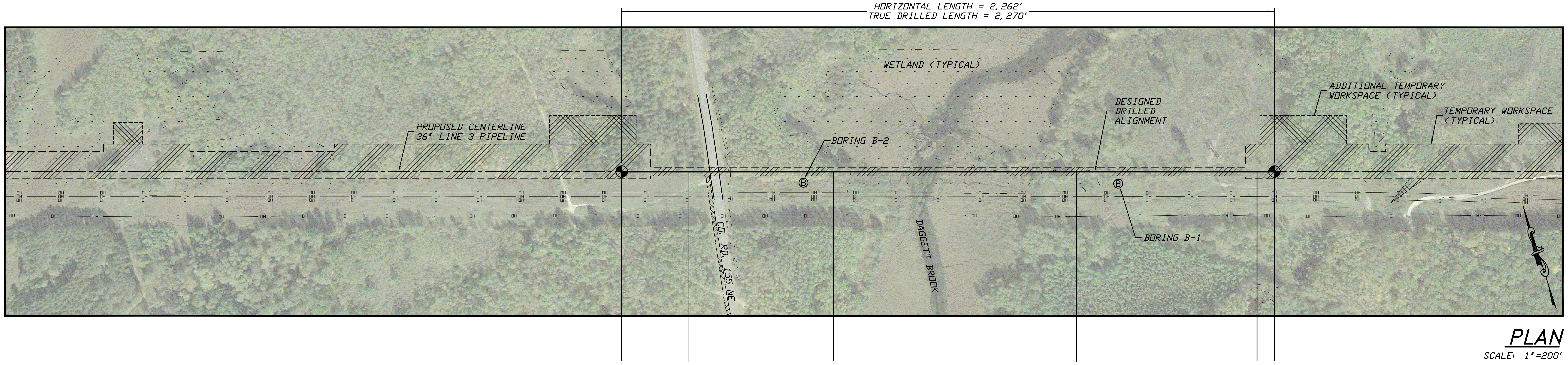
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
0	ISSUED FOR PERMIT APPLICATION	AJJ	10/2020	BAB	BAB

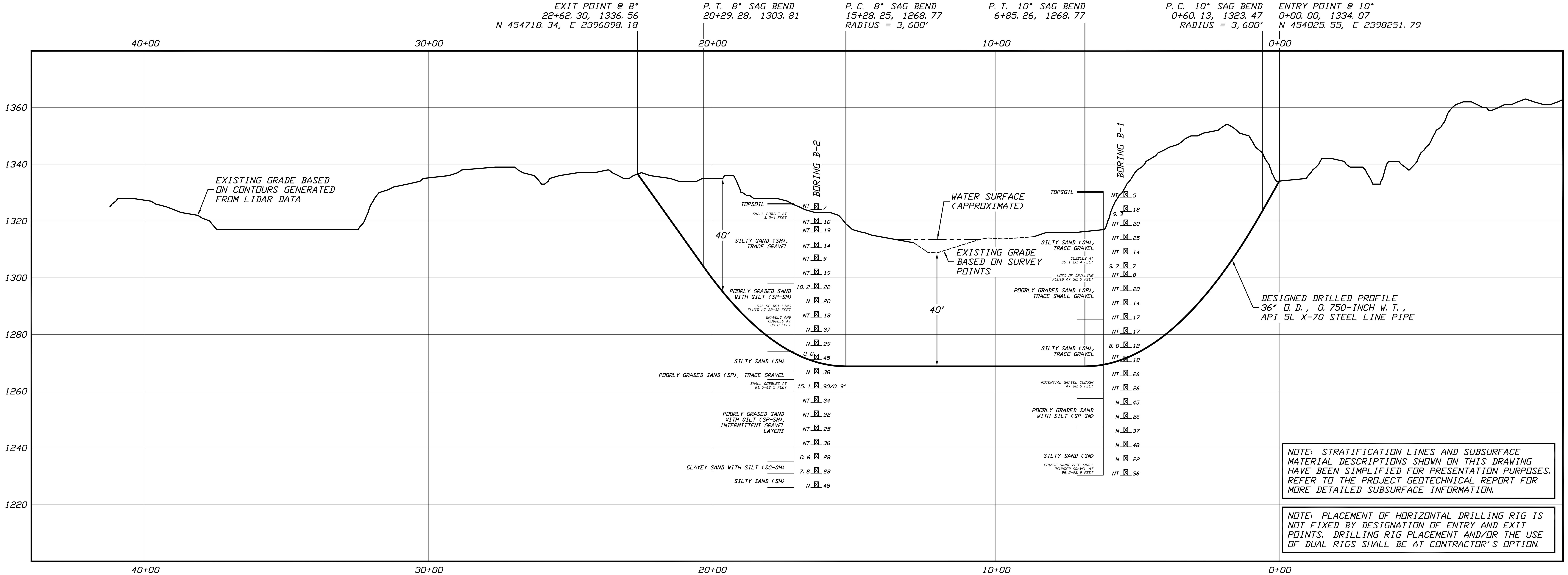
ENBRIDGE

DWN. BY: AJJ	DATE 10/2020
CHK.	
PROJ. ENGR.	
PROJ. MGR.	
CLIENT APP.	

PROPOSED ENBRIDGE L3R PIPELINE
PRIMARY METHOD – HDD
CROSSING OF DAGGETT BROOK
ENBRIDGE MP 1037.4
CASS COUNTY, MINNESOTA

SCALE NOTED
DWG. NO. B–93–5.84–MDNR–47–0





NOTE: STRATIFICATION LINES AND SUBSURFACE MATERIAL DESCRIPTIONS SHOWN ON THIS DRAWING HAVE BEEN SIMPLIFIED FOR PRESENTATION PURPOSES. REFER TO THE PROJECT GEOTECHNICAL REPORT FOR MORE DETAILED SUBSURFACE INFORMATION.

NOTE: PLACEMENT OF HORIZONTAL DRILLING RIG IS NOT FIXED BY DESIGNATION OF ENTRY AND EXIT POINTS. DRILLING RIG PLACEMENT AND/OR THE USE OF DUAL RIGS SHALL BE AT CONTRACTOR'S OPTION.

PROFILE

SCALE: 1"=200' HORIZONTAL
1"= 20' VERTICAL

GENERAL LEGEND

⊕ DRILLED PATH ENTRY/EXIT POINT

GEOTECHNICAL LEGEND

Ⓑ BORING LOCATION

SPLIT SPOON SAMPLE

53 ⊠ 23 ← PENETRATION RESISTANCE IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES
53 ← PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

CORE BARREL SAMPLE

UCS 6,250 ← UNCONFINED COMPRESSIVE STRENGTH (PSI)
6 ← MOHS HARDNESS
53 ← ROCK QUALITY DESIGNATION (PERCENT)

GEOTECHNICAL NOTES

1. GEOTECHNICAL DATA PROVIDED BY BARR ENGINEERING COMPANY, DULUTH, MN. REFER TO THE PROJECT GEOTECHNICAL REPORT DATED OCTOBER 2017 FOR MORE DETAILED SUBSURFACE INFORMATION.
2. THE LETTER "N" TO THE LEFT OF A SAMPLE INDICATES THAT NO GRAVEL WAS OBSERVED IN THE SAMPLE. THE LETTERS "NT" INDICATE THAT GRAVEL WAS OBSERVED BUT NO GRADATION TEST WAS PERFORMED.
3. THE GEOTECHNICAL DATA IS ONLY DESCRIPTIVE OF THE LOCATIONS ACTUALLY SAMPLED. EXTENSION OF THIS DATA OUTSIDE OF THE ORIGINAL BORINGS MAY BE DONE TO CHARACTERIZE THE SOIL CONDITIONS, HOWEVER, COMPANY DOES NOT GUARANTEE THESE CHARACTERIZATIONS TO BE ACCURATE. CONTRACTOR MUST USE HIS OWN EXPERIENCE AND JUDGMENT IN INTERPRETING THIS DATA.

TOPOGRAPHIC SURVEY NOTES

1. TOPOGRAPHIC SURVEY DATA PROVIDED BY ENBRIDGE, SUPERIOR, WISCONSIN.
2. NORTHINGS AND EASTINGS ARE IN U.S. SURVEY FEET REFERENCED TO MINNESOTA STATE PLANE COORDINATES, NORTH ZONE, NAD 83.
3. ELEVATIONS ARE IN FEET REFERENCED TO NAVD 88.

DRILLED PATH NOTES

1. DRILLED PATH STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND IS REFERENCED TO CONTROL ESTABLISHED FOR THE DRILLED SEGMENT.
2. DRILLED PATH COORDINATES REFER TO CENTERLINE OF PILOT HOLE AS OPPOSED TO TOP OF INSTALLED PIPE.

PILOT HOLE TOLERANCES

THE PILOT HOLE SHALL BE DRILLED TO THE TOLERANCES LISTED BELOW. HOWEVER, IN ALL CASES, RIGHT-OF-WAY RESTRICTIONS AND CONCERN FOR ADJACENT FACILITIES SHALL TAKE PRECEDENCE OVER THESE TOLERANCES.

1. ENTRY POINT: AS STAKED BY COMPANY
2. EXIT POINT: UP TO 10 FEET SHORT OR 20 FEET LONG RELATIVE TO THE DESIGNED EXIT POINT; UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
3. ELEVATION: UP TO 2 FEET ABOVE AND 10 FEET BELOW THE DESIGNED PROFILE
4. ALIGNMENT: UP TO 5 FEET RIGHT OR LEFT OF THE DESIGNED ALIGNMENT
5. CURVE RADIUS: NO LESS THAN 2,400 FEET BASED ON A 3-JOINT AVERAGE (ASSUMING RANGE 2 DRILL PIPE)

PROTECTION OF EXISTING FACILITIES

CONTRACTOR SHALL UNDERTAKE THE FOLLOWING STEPS PRIOR TO COMMENCING DRILLING OPERATIONS.

1. CONTACT THE UTILITY LOCATION/NOTIFICATION SERVICE FOR THE CONSTRUCTION AREA.
2. POSITIVELY LOCATE AND STAKE ALL EXISTING UNDERGROUND FACILITIES. ANY FACILITIES LOCATED WITHIN 10 FEET OF THE DESIGNED DRILLED PATH SHALL BE EXPOSED.
3. MODIFY DRILLING PRACTICES AND DOWNHOLE ASSEMBLIES AS NECESSARY TO PREVENT DAMAGE TO EXISTING FACILITIES.

LINE 3 PIPELINE PROJECT

PLAN AND PROFILE
36-INCH PIPELINE CROSSING OF DAGGETT BROOK BY HORIZONTAL DIRECTIONAL DRILLING

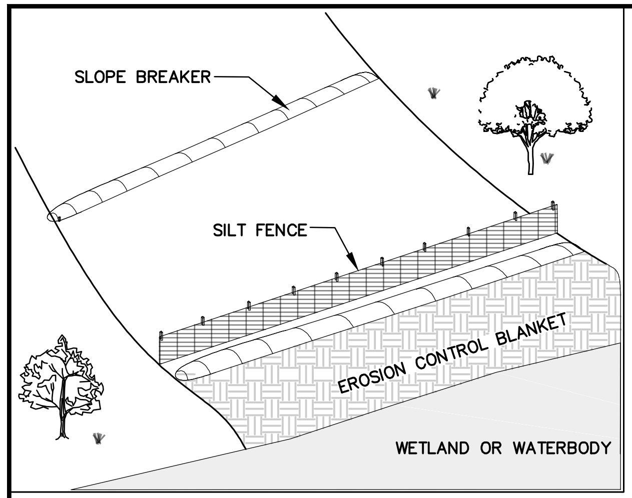
LOCATION: CASS COUNTY, MINNESOTA

DRAWN	DATE	CHECKED	APPROVED	DRAWING LABEL	REVISION
JSP	10/23/19	CDS	JSP	D-03-5.83-23068-A-1354	A

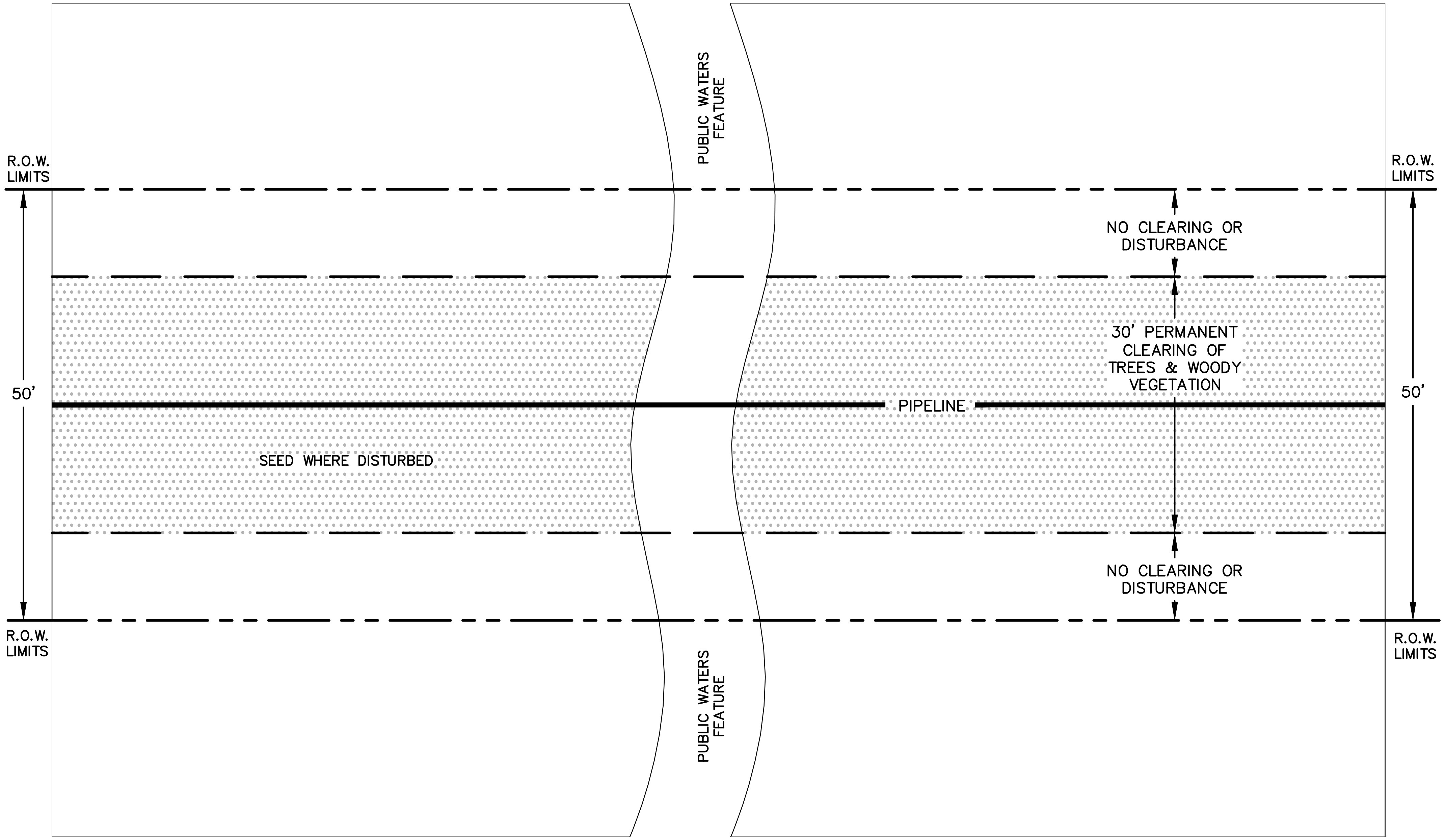
NO.	DATE	REVISION DESCRIPTION	BY	CHK'D	APP.
A	10/23/19	UPDATE WORKSPACE AND WETLANDS, ISSUE FOR CONST.	JSP	CDS	JSP

J.D.Hair&Associates,Inc.
Consulting Engineers
2424 East 21st Street
Suite 510
Tulsa, Oklahoma 74114

PROJECT NO.
Enbridge\1404
SHEET NO.
D1037



▨ SEEDING AREA



PUBLIC WATERS FEATURE - HDD CROSSING

1) DISTURBANCE OF THE ROW IS LIMITED TO THE 30-FOOT-WIDE CLEARING OF TREES AND WOODY VEGETATION AND IMPACTS RESULTING FROM TRAVEL LANES AND/OR BRIDGES.
2) ANY WETLAND OR WATERBODY BANK THAT IS DISTURBED WILL BE STABILIZED WITH EROSION AND SEDIMENT CONTROL BMP AND RESTORED TO AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS.
3) PERMANENT REVEGETATION SEEDING OF DISTURBED WATERBODY BANKS WILL UTILIZE THE BWSR RIPARIAN SEED MIXES IN ACCORDANCE WITH THE EPP (SECTION 7.8).
4) PERMANENT REVEGETATION SEEDING OF DISTURBED WETLANDS WILL TAKE PLACE IN ACCORDANCE WITH THE EPP (SECTION 7.7). 7) IN DISTURBED WETLAND AREAS, THE APPROPRIATE SEED MIX WILL BE DETERMINED USING THE RESULTS OF PRE-CONSTRUCTION WETLAND IN DISTURBED WETLAND AREAS, HYDROLOGICAL CHARACTERISTICS, AND SITE-SPECIFIC CONDITIONS.

ISSUED FOR PERMIT
12/13/19

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	AJM	12/13/19	KEH	KD
A	ISSUED FOR REVIEW	AJM	12/10/19	KEH	KD

DWN. BY:	AJM	DATE 12/10/19
CHK.	KEH	
PROJ. ENGR.	DG	
PROJ. MGR.	KD	
CLIENT APP.		

ENBRIDGE

LINE 3 REPLACEMENT
PUBLIC WATERS HDD CROSSING TYPICAL
FINAL STREAM STABILIZATION &
EROSION CONTROL

SCALE NTS
DWG. NO.

MDNR ID No. 48: MP 1041.3; Spring Brook (M-106-004-002-001)

Spring Brook Construction and Restoration Plan

Enbridge Energy, Limited Partnership • Line 3 Replacement Project

October 2020

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FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AMA	Aquatic Management Area
AMSL	above mean sea level
ATWS	additional temporary workspace
Barr	Barr Engineering Co.
BMPs	best management practices
Braun	Braun Intertec
BWSR	Minnesota Board of Water & Soil Resources
DOC	depth of cover
ECDs	erosion and sediment control devices
EI	Environmental Inspector
Enbridge	Enbridge Energy, Limited Partnership
EPP	Environmental Protection Plan
GPS	Global Positioning System
HDD	horizontal direction drill
L3R or Project	Line 3 Replacement Project
MDNR	Minnesota Department of Natural Resources
MP	milepost
MPCA	Minnesota Pollution Control Agency
MWI	Minnesota Well Index
PCMP	Post-Construction Wetland and Waterbody Monitoring Plan
Plan	Spring Brook Construction and Restoration Plan
SP	Spring
SSCP	Spring Brook Site-Specific Crossing Plan
SSRP	Site-Specific Restoration Plan
TOB	top-of-bank
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture

1.0 INTRODUCTION

Enbridge Energy, Limited Partnership ("Enbridge") has applied for a License to Cross Public Waters and a Work in Public Waters Permit from the Minnesota Department of Natural Resources ("MDNR") for the passage of utilities[1] under public waters[2] related to the construction and operation of the Line 3 Replacement Project ("L3R" or "Project"). Enbridge has prepared this Spring Brook Construction and Restoration Plan ("Plan") to address the crossing of Spring Brook, a Minnesota public water watercourse and the Scout Camp Pond public water wetland.

The Project crosses Spring Brook in a general west to east and northeast alignment approximately 0.25 mile south of the southernmost 40 acres of the Spire Valley Aquatic Management Area ("AMA"), approximately 0.5 mile south of the MDNR Spire Valley Hatchery property, and approximately 0.8 mile south of the Hatchery facilities (see Figure 1.0-1). This route is entirely located on private lands and avoids public, federally encumbered lands. Enbridge owns 80 acres of land that completely contain the stream crossing location as well as the western and eastern sides of the crossing location.

The crossing of the Spring Brook public water watercourse will be reviewed as part of the MDNR's License to Cross Public Waters permitting process. The crossing of the Scout Camp Pond public water wetland, which is a public water inventory wetland that surrounds Spring Brook, will be reviewed as part of the MDNR's Work in Public Waters permitting process as it is located on privately owned land. MDNR has communicated its concern regarding the possibility of encountering uncontrolled flow from springs or seeps during construction on the western hillslope leading to Spring Brook. MDNR is concerned that such an event could lead to erosion, sediment loss, and/or sloughing negatively affecting the stability of the hillside, water supply at nearby wells, and/or water quality/quantity in Spring Brook.

The Plan was initially submitted with initial permit applications in October 2018 and was updated in April 2019 to reflect discussions during 2018 site visits and subsequent field work carried out by Enbridge to characterize the pre-construction conditions present at the pipeline crossing location. MDNR provided comments on the Plan in June 2019, which Enbridge incorporated into a December 2019 revision. Enbridge then conducted fieldwork in 2020 at the MDNR's request and resubmitted the Plan in August 2020 to reflect additional field efforts and discussions between MDNR and Enbridge. This version addresses MDNR's September 2020 comments on the Plan and outlines construction and restoration activities at the crossing (see the Site-Specific Crossing Plan ("SSCP") in Appendix A and the Site-Specific Restoration Plan ("SSRP") in Appendix B). It includes the use of standard best management practices ("BMPs") and additional measures to minimize impacts on springs and seeps[3] along Spring Brook during construction and operations.

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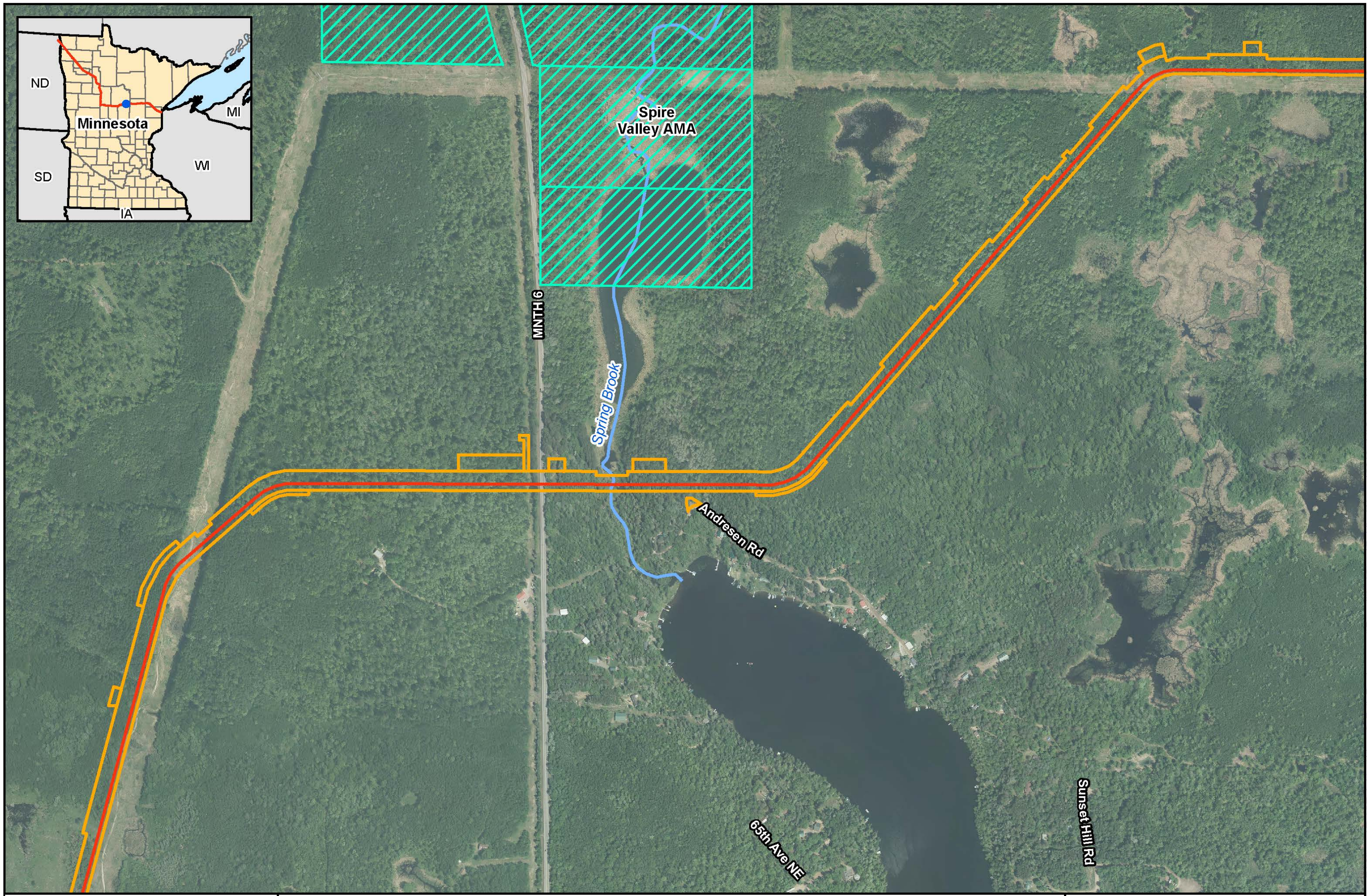
[1] Utilities means lines, cables, and conduits for telephone, telegraph, or electric power, and pipelines for gases, liquids, or solids in suspension, and any other such item covered by the licensing requirements of Minnesota Statues, section 84.415 (Minnesota Rules 6135.0200, Subp. 3)

[2] Public water or public waters means those waters of the state identified under Minnesota Statutes, section 103G.005, subdivision 15 or 15a, or 103G.201, as shown on the public water inventory maps.

[3] According to the *Minnesota Spring Inventory Guidance Document* (MDNR, 2017), "a spring has focused flow from a discrete source (as opposed to a pool of accumulation). By contrast, seeps do not have noticeable flow…Flowing water distinguishes springs from seeps…A seep is caused by diffuse discharge and does not involve noticeable flow at its outlet, except where seepage forms pools of accumulation, where it often mixes with surface water."



ENBRIDGE

For Environmental Review Purposes Only

Figure 1.0-1
Proposed Construction Route
Line 3 Replacement Project
Cass County, Minnesota

- Proposed L3R Centerline
- ☐ Construction Right-of-Way/ATWS
- PWI Watercourse
- ▨ Aquatic Management Area

Source: Z:\Clients\E_H\Enbridge\Line_3_Full_Replacement\Permitting\State\Public_Waters\2019_11\Spire_Valley\L3R_Spire_Valley_Construction_Route_Overview_2019_12.mxd

Date: (12/13/2019)

2.0 GENERAL SITE DESCRIPTION

The topography in the area is generally sloping to rolling with approximately 70 feet of elevation change through the stream valley. The landscape is a heavily wooded area, primarily with hardwood deciduous trees. The pipeline route immediately east of State Highway 6 descends a slope to the Spring Brook valley floor, crosses Spring Brook, and ascends a slope on the east bank as the route progresses generally upslope northeast to converge with a powerline right-of-way east of the stream (see Figure 2.0-1). Slopes range from 6 to 40 percent.

Through this area, the Project crosses soils in the Friendship, Menahga, and Bowstring soil map units. The Friendship and Menahga series lie in the upland tops and side slopes. These soils are very deep, excessively drained to well-drained soils that formed in sandy glacial outwash sediments on outwash plains, valley trains, and some moraines and drumlins, and have rapid permeability in the upper horizons (Soil Survey Staff, 2019).

The Bowstring-Seelyeville complex occupies the nearly level valley floor on either side of Spring Brook. The Bowstring series consists of very deep, very poorly drained soils that formed in highly decomposed organic soil material that is stratified with thin layers of sandy or loamy material. The soil horizons consist of an upper layer of muck over a layer of sand and gravel over a deeper layer of muck to a depth 60 inches. This series is located on floodplains in glacial moraines, glacial outwash plains, and glacial lake plains. These soils have rapid to moderately slow permeability (Soil Survey Staff, 2019).

3.0 SPRING BROOK AND SCOUT CAMP POND

Spring Brook is a public water watercourse and is also classified as a coldwater trout stream by the MDNR. The public water wetland Scout Camp Pond surrounds the boundaries of Spring Brook. According to an MDNR Stream Special Assessment report (internal MDNR report 2007), brook trout are present in the stream along with creek chubs, northern redbelly dace, blunt nose minnows, common shiners, white suckers, brook sticklebacks, and central mudminnows. The stream originates from an outlet of Abe Lake and flows in a southerly direction into Scout Camp Pond, and then Roosevelt Lake. Numerous springs and seeps along the banks provide adequate groundwater inflows to reduce the water temperature and provide suitable habitat for brook trout.

Enbridge collected wetland and waterbody survey data in accordance with the U.S. Army Corps of Engineers Wetland Delineation Manual[4] and applicable Regional Supplements[5] within the environmental survey corridor in July 2015. Based on survey data, Spring Brook is bordered on either side by a forested and scrub-shrub wetland complex; the scrub-shrub wetland component lies adjacent to the waterway. The forested wetland on the west side of Spring Brook also extends upslope due to the spring seeps. On the east side, the wetland complex is a narrow strip and lies along the valley floor. The scrub-shrub wetland is a located on a level bench.

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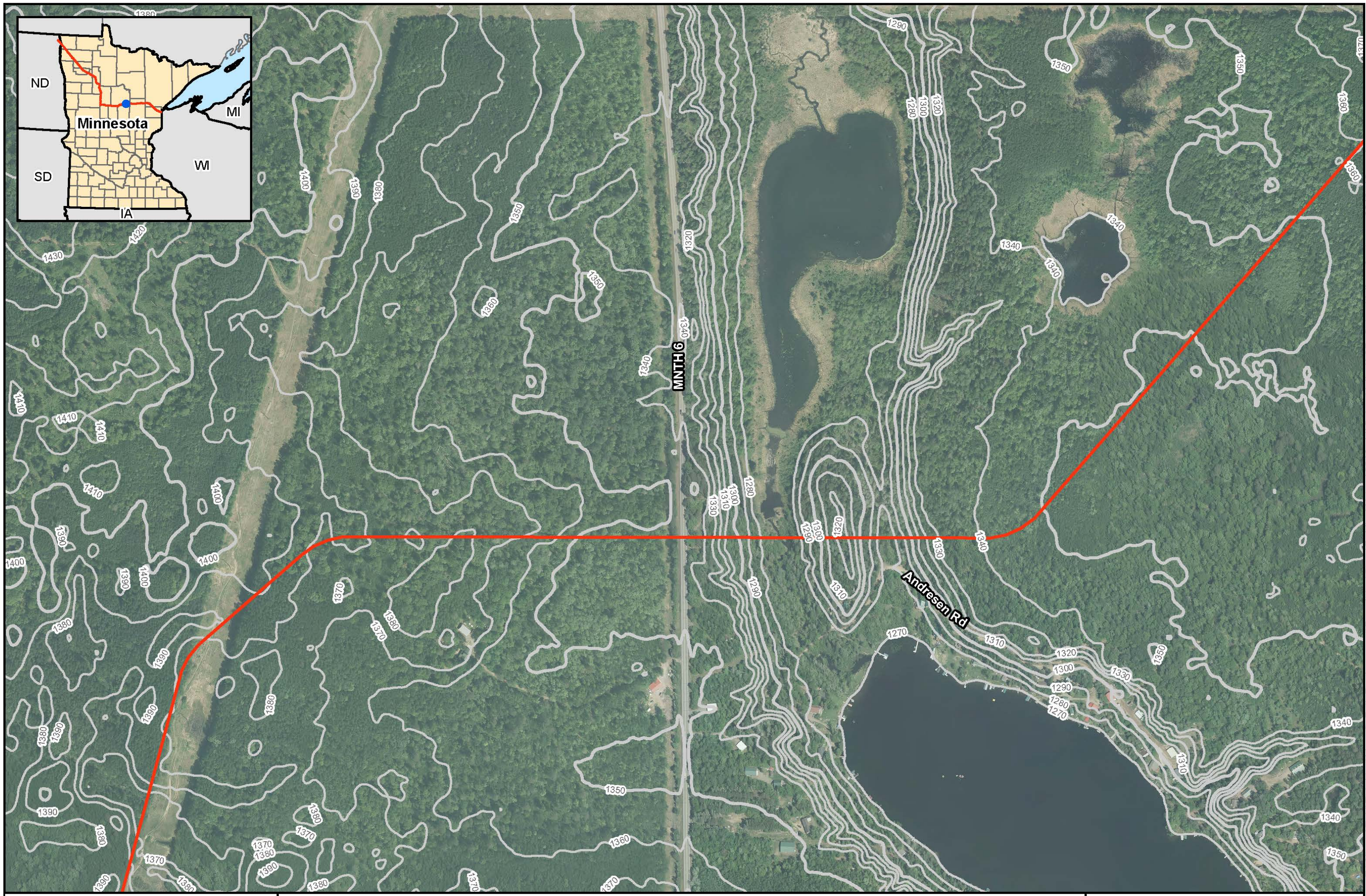
[4] Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

[5] USACE. 2009. “Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region.” J.S. Wakeley, R.W. Lichvar, and C.V. Noble (eds.). ERDC/EL TR-09-19. U.S. Army Engineer Research and Development Center. Vicksburg, MS.
USACE. 2010. “Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region, Version 2.0.” J.S. Wakeley, R.W. Lichvar, and C.V. Noble (eds.). ERDC/EL TR-10-16. U.S. Army Engineer Research and Development Center. Vicksburg, MS.



For Environmental Review Purposes Only

Figure 2.0-1
Spire Valley Topographic Contours
Line 3 Replacement Project
Cass County, Minnesota

Date: (12/13/2019) Source: Z:\Clients\E_H\Enbridge\Line_3_Full_Replacement\Permitting\State\Public_Waters\2019_11\Spire_Valley\L3R_Spire_Valley_Contours_2019_12.mxd

Enbridge collected Rosgen geomorphic stream survey data at Spring Brook in 2015 (Stantec, 2016; see Appendix C). Field crews collected Rosgen survey data using both a handheld Global Positioning System ("GPS") capable of sub-meter accuracy and "survey-grade" GPS capable of sub-centimeter accuracy. Data collected included width, depth, flow rate, bank height, ordinary high water mark, evidence of bank erosion or instability, runs, riffles, pools, and dominant substrate in several reaches up and downstream from the crossing site. Enbridge also visited the site to collect civil and environmental survey information to inform restoration plans in June 2020.

Spring Brook is approximately 17.7 feet wide from top-of-bank ("TOB") to TOB at the pipeline crossing location. The stream is low-gradient and features a slightly meandering channel with a coarse sand/gravel bottom. The average flow velocity is approximately 0.7 foot per second. A beaver dam is located upstream of the crossing location and outside of the proposed construction workspace and will not be impacted. The SSCP in Appendix A reflects field data gathered to date.

4.0 SUMMARY OF DATA COLLECTED

Enbridge has conducted multiple field efforts to characterize the nature of the groundwater dynamics present in the vicinity of Spring Brook. These efforts are summarized in the sections below.[6]

4.1 2014 GEOTECHNICAL EXPLORATION

In November 2014, Enbridge completed geotechnical survey at two locations in coordination with the MDNR: these drilling locations are referred to as MP-504-E and MP-504-W.

4.2 2015 SPRING SURVEY

Enbridge conducted a spring survey in July 2015 to assist in the development of the September 2018 revision of this Construction Plan (Stantec, 2015; see Appendix D). These surveys were conducted at the request of MDNR; MDNR staff reviewed Enbridge's field protocol in advance of the field work, were present during the survey activities, and reviewed the survey results. The 2015 spring survey identified the extent and spatial arrangement of springs and seeps in an area to the south of the AMA and the Hatchery.

Two seeps were identified within the L3R construction workspace: SP-11 South, and SP-13 (see Appendix A). Seep SP-13 will be intersected at approximately the 1,300-foot elevation above mean sea level ("AMSL") contour, between 175 and 200 feet east of the edge of the State Highway 6 pavement. As surveyed, SP-13 was identified as a marshy wet meadow seep with no discrete source. SP-13 is a cluster of non-discrete discharge locations, resulting in a seep that converges and forms a single channel that extends generally south and discharges into a wetland adjacent to Spring Brook. Seep SP-11 South will be intersected along the east side of Spring Brook. This seep is a clustered wetland seep that originates from a shrub-carr/forested wetland

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[6] In the winter of 2019, Enbridge evaluated the suitability of potential geophysical methods to aid in understanding the site conditions. Geophysical methods showed limited potential to define a discrete condition that may result in spring discharge. Geophysical methods are challenged by site topography, wooded conditions, as well as subsurface conditions such as clay and moisture content that limit penetration depths and were not further pursued.

complex at the base of the slope into Spring Brook. An additional 16 spring and seep features were observed within the 80-acre parcel but will not be affected by construction in the area.

4.3 2019 THERMAL IMAGING SURVEY

In March 2019, Enbridge conducted a thermal imaging survey to aid in understanding the conceptual hydrogeologic model of the shallow unconfined materials in the vicinity of the crossing, including the possibility of significant spring discharge (Braun, 2019a; see Appendix E). This effort did not indicate the presence of persistent spring discharge at SP-11 South or SP-13. The conclusions of the survey indicated that groundwater expressed at the site is either coincidental to Spring Brook or is being expressed within the topographic expression of the site and do not appear to be fed from discrete geologic or hydrologic conditions. The seeps are likely originating from groundwater infiltration to the water table above the clay and flow above the clay. The survey did not indicate that these seeps are due to a significant upward vertical gradient from a deeper groundwater feature.

4.4 2019/2020 GEOTECHNICAL STUDIES

In September and December of 2019 Enbridge completed additional fieldwork to further additional geotechnical borings to further evaluate the geotechnical and hydrologic conditions present along the L3R alignment. Further investigation details and results can be found in Appendix F and G.

- Two geotechnical borings were completed: SV-19-West and SV-19-Middle. SV-19-West was completed approximately 50 feet north of MP-504-W (see Section 4.1). SV-19-Middle was completed approximately 20 feet north of MP-504-E to a deeper depth of 105 feet. Three nested vibrating wire piezometers were installed in each of the 2019 borings at various depths to measure the groundwater conditions and investigate the potential for pressurized groundwater conditions.

- Thirteen (13) hand auger borings were completed to supplement data in areas that were not accessible by a drill rig. Vibrating wire piezometers were installed in 8 of the 13 hand auger locations and standpipe piezometers were installed in the remaining 5 hand auger locations.

- One (1) vibrating wire piezometer was installed in a residential well at the Spire Valley Fish Hatchery to assess the connectivity between the aquifer feeding the hatchery wells and the surrounding systems.

In March 2020, Enbridge completed five additional hand auger borings along the western hillslope at the request of MDNR. These borings which were advanced to a depth of 10 feet, or, greater than the pipeline trench excavation. The results of this investigation confirmed the absence of artesian conditions. MDNR, following review of the report presented in Appendix F, stated that it did not need Enbridge to continue to collect monitoring data at this site to inform consideration of the application.

4.5 CONCLUSIONS

A significant amount of data has been collected between 2014 and 2020 to inform the interpretation of the site-specific hydrogeology of the Spire Valley area. Additional borings and piezometers did not find any evidence to suggest that there is an artesian aquifer beneath the proposed crossing. The evidence indicating the lack of an artesian aquifer include:

- The absence of thick, low-permeability deposits (such as fine silts and clays) at depth in the borings. Some clayey layers were encountered but their lateral continuity could not be projected, indicating that they are local heterogeneities in an otherwise relatively uniform sand outwash.

- The absence of upward vertical gradients within multi-level piezometers and the very small downward vertical gradients. For artesian (and especially flowing) conditions to be present, significant upward vertical gradients need to form with potentiometric heads above the ground surface (for flowing conditions). Care was taken in locating piezometer points above and below clay and silt layers in order to discern the presence of vertical gradients. The absence of upward vertical gradients is a primary indicator that artesian conditions are not present along the pipeline crossing.

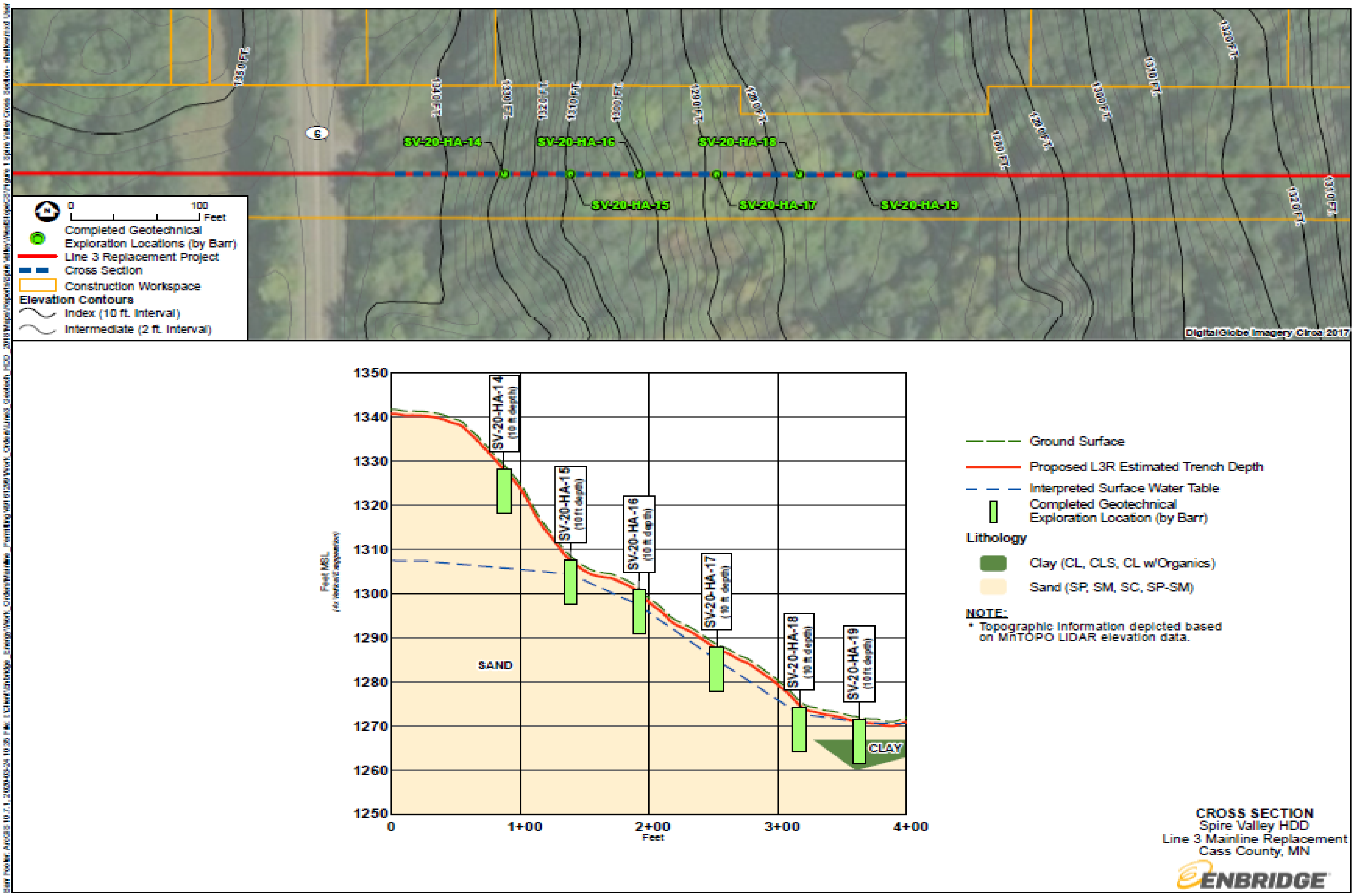
- The temporal variability of water levels in shallow piezometers follows precipitation events closely. This phenomenon indicates that shallow groundwater levels are driven primarily by downward seepage through the unsaturated soils to the water table and not by more regional upward flow from artesian aquifers. The effects of variable pumping at the nearby Spire Valley Hatchery well was not observed in the instrumented piezometers.

Where shallow groundwater was encountered (for example, along the valley slope adjacent to Spring Brook) the water-table elevation was entirely consistent with the intersection of the potentiometric surface with the ground surface, forming seepage faces and coalescing seepage rivulets and springs. At distances away from the valley bottom, the water table depth (compared to the ground surface) became greater, which reflects the nature of the water-table surface. Shallower water-table conditions were found near the top of the hill in the very eastern portion of the study area, along the Project route. This shallower water table could be an indication of perched groundwater conditions, but because it is on hill (and not in a valley), it is highly unlikely that it is due to artesian conditions.

In March 2020, Enbridge proposed to MDNR that to minimize the potential for intersecting groundwater features, Enbridge would install the pipeline to a depth of cover of 3 feet along the western hillslope instead of its standard 4 feet of cover (see Section 5.0). Based on the investigations it is concluded that excavation of a pipeline trench to this depth will not encounter artesian conditions or confining layers (see Figure 4.0-1). Pipeline installation to required depths is presented in detail in Section 5.2.

The data supports the conclusion that a shallow pipeline excavation will mostly be above the water table and where it does encounter saturated conditions, they will be unpressurized water-table conditions that should be easily handled using common pipeline construction methods. Trenching will not affect the quality and quantity of groundwater available to the Hatchery or nearby residences or result in an inconvenience or disruption to the domestic water supply for residences in the local area.

Figure 4.0-1: Shallow Excavation Cross-Section



5.0 CONSTRUCTION OVERVIEW

Enbridge has prepared a SSCP for Spring Brook that shows all workspace dimensions and waterbody crossing details relative to the Spring Brook crossing and adjacent western hillslope (see Appendix A). Based on site-specific conditions of Spring Brook and the results of the data gathering and interpretation efforts described in Section 4.0, the preferred crossing method for Spring Brook is the dry crossing technique using a dam-and-pump method. This method is preferred based on the relatively narrow channel width, expected substrate composition, seasonally low flow conditions that are prevalent during late summer and early fall, minimization of the amount of time it takes to complete the crossing, and adjacent site characteristics. The L3R construction workspace will be 120 feet wide in the upland areas east of State Highway 6 on either side of the waterbody crossing and will be reduced to 95 feet wide across wetland areas and Spring Brook.

In addition to the construction workspace, Enbridge will use two additional temporary workspaces ("ATWS") to complete the Spring Brook crossing. One approximately 75-foot-wide by 100-foot-long ATWS will be located on the west of the waterbody, abutting State Highway 6. The other 75-foot-wide by 150-foot-long ATWS will be located on the east side of the waterbody. The eastern ATWS is larger to accommodate temporary vegetated mat storage (per the MDNR's request; see discussion in Section 5.2.1) and provide an area suitable for construction dewatering discharge for trench water encountered during construction. Enbridge has placed both ATWS in upland areas.

Enbridge's initial proposal for the Spire Valley crossing along the western hillslope consisted of a standard open cut construction method with a trench depth of approximately 7 feet to allow for a standard 4-foot depth of cover. Federal regulation requires a minimum of 3 feet of cover above the pipeline.[7] On March 25, 2020, Enbridge submitted a memo that proposed the pipeline be buried on the western hillslope to allow for 3 feet depth of cover instead Enbridge's standard 4 feet of cover to minimize the excavation depth (see Appendix F). The MDNR approved this proposal on June 23, 2020 and confirmed that Enbridge does not need to continue to collect additional data at the site.

This section provides step-by-step details regarding Enbridge's execution of the Spring Brook crossing, including the adjacent western hillslope leading to Spring Brook. These steps include:

- Site Preparation: Flagging and clearing of the construction workspace; installation of temporary erosion and sediment control devices; removal of woody vegetation while leaving the vegetated mat intact; and installation of a construction mat road and a temporary span bridge over Spring Brook.
- Spring Brook Crossing: Completion of the waterbody crossing, including use of the dam and pump crossing method considering timing considerations and fisheries restrictions; fabrication of the pipe used at the crossing; trenching activities, including spoil storage and trench dewatering; vegetated mat storage; installation of the pre-fabricated waterbody crossing pipe segment; depth of cover; tie-in; installation of trench breakers; and backfill.
- Adjacent Western Hillslope Crossing: Preparation and staging of the pipeline used along the hillside; excavation of the trench in 1-foot lifts in multiple sets working either down or

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[7] 49 Code of Federal Regulation 195.248

up the hillslope; storage of trench spoils; installation of the pipeline along the hillslope; tie-in; installation of trench breakers and long-term water management controls; and backfilling.

Enbridge has developed a Groundwater Management Contingency Plan (see Appendix H) that would be executed should pressurized groundwater be encountered during excavation.

All work will be subject to applicable Enbridge construction plans, including the Environmental Protection Plan ("EPP"). However, where material within this Plan exceeds standard construction measures presented in the EPP, this Plan supersedes the EPP.

5.1 SITE PREPARATION

Prior to construction, the boundaries of the construction workspace and ATWS will be clearly marked with flagging by professional surveyors. The locations of SP-11 South and SP-13, the seeps which intersect the construction workspace, will be located using GPS coordinates and on-site observations. Both seeps will be flagged as environmentally sensitive areas to alert clearing equipment operators of their presence. Construction procedures at these intersecting seeps are presented in Section 5.3.

The construction workspace and two ATWS associated with the waterbody crossing will be cleared of woody vegetation after the boundaries have been surveyed and flagged. Clearing will occur immediately prior to Enbridge's work in this area. Enbridge will grind tree stumps to the ground surface, leaving the existing root systems intact to promote soil stability. Merchantable timber will be cleared, limbed, and hauled away. Limbs may be chipped and uniformly broadcast across the construction workspace in a manner that avoids inhibiting revegetation as referenced Section 1.8.1 of the EPP. Chipped material provides additional soil stabilization, preventing erosion and sediment loss. All clearing work will be conducted in accordance with the EPP. Clearing equipment will not be allowed to ford Spring Brook at any time. The anticipated time required to compete site preparation activities will be 7 to 10 days.

Next, Enbridge will install redundant erosion and sediment best management practices ("BMPs") consisting of two courses of silt fence or a combination of strawbale-reinforced or filter log-reinforced silt fence once construction encroaches within 100 feet of Spring Brook to limit construction-related sediment from entering the waterbody. These BMPs must be installed per the requirements of the Minnesota Pollution Control Agency ("MPCA") Construction Stormwater General Permit.[8] The 100-foot-wide buffer will be identified in Enbridge's Environmental Plan Sheets prepared as part of Enbridge's Stormwater Pollution Prevention Plan, which is currently in preparation in coordination with the MPCA. Redundant and reinforced (as necessary) BMPs will also be installed at the toe of the slope on either side of Spring Brook to prevent sediment discharge to the waterbody. Enbridge's Environmental Inspector ("EI") will monitor the performance of BMPs and will modify approaches as needed to prevent impacts to Spring Brook. The following bullet list presents the proposed BMPs for this site:

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[8] Spring Brook is a trout stream, which is a considered a "Special or Impaired Water" in the MPCA Construction Stormwater General Permit.

- Sediment barriers will be installed and maintained along the construction workspace adjacent to wetlands and within the construction workspace and ATWS to minimize the potential for sediment runoff.

- Temporary slope breakers also will be installed across the construction workspace after grading to minimize the potential for sediment runoff, prevent erosion, and maintain slope stability.

- Temporary slope breakers will be maintained and repaired.

- Sediment traps and straw bale reinforced silt fence will be installed at the discharge outfall of slope breakers.

Enbridge will install a construction mat travel lane on the working side of the construction workspace on either side of the waterbody. Construction mats help avoid rutting,[9] minimize disturbance to soils and vegetation, and ensure safe and stable working surfaces for construction equipment and personnel. The construction mat travel lane will be approximately 18 feet wide. The anticipated length of the construction mat travel lane on either side of the waterbody crossing is presented in Appendix A; this drawing is based on field conditions observed prior to development of this Plan. Enbridge may extend the construction mat travel lane westerly relative to that shown in Appendix A based on field conditions observed at the time of construction. Enbridge also may install a temporary diversion channel or flume pipe where the construction mat travel lane crosses SP-13 to effectively convey water flow across the construction area to off-right-of way areas on Enbridge property. The construction mat travel lane will likely be a single layer (see Figure 30 of the EPP); however, Enbridge may need to use more than one layer of mats if saturated conditions are encountered so as to provide a stable working surface (see Figure 32 of the EPP). If a flume must be installed under the mat road to convey flow, it will be installed as outlined in Figure 49 of the EPP based on site-specific conditions.

Enbridge will also install an engineered span bridge (no in-stream support) over Spring Brook. The bridge setting is shown on the bridge cross-section in Appendix B. Bridge headers have been placed perpendicular to the construction mat travel lane for equipment travel safety; however, the headers will be set 5 feet back from the TOB as shown in Appendix B.

5.2 PIPELINE INSTALLATION

This section generally introduces the order in which the pipeline would be installed. These procedures are based pipeline installation during non-frozen conditions. It is preferable to construct during non-frozen conditions at Spring Brook as Enbridge will be able to more effectively manage trench dewatering efforts associated with the crossing. In addition, the MDNR trout stream fisheries restriction prohibits in-water work between September 15 to April 15, during winter conditions (EPP Section 2.1 work exclusion dates are September 1 – June 30).

Enbridge is proposing a strategy that provides schedule flexibility to mobilize equipment to take advantage of optimal weather conditions for construction. Optimal weather conditions are periods of average or below average precipitation when no additional impacts to resources would occur

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[9] Rutting is defined as creation of linear depressions made by tire tracks of machinery 6 inches or greater in depth that results in the mixing of topsoil and subsoil per MDNR State Land Rutting Guidelines and Erosion and Sediment Control Decision Tree.

due to site conditions during construction. Enbridge's construction contractor and EIs will monitor upcoming weather forecasts to determine if significant rainfall (greater than 0.5 inch) is predicted during construction. Enbridge will be responsible for appropriately planning for work, considering for the potential for wet conditions, and being prepared to implement mitigation measures in the event of wet weather conditions and/or excessive waterbody flow. Enbridge will be responsible for implementing any and all such corrective measures deemed necessary.

Enbridge will install the pipeline across the valley to the prescribed depths of cover as shown on the profile drawing in Figure 5.2-1. Enbridge will first use a specialized and experienced waterbody crossing crew to install the waterbody crossing, wetland crossing, and western hillslope; this crew will work independently from the mainline crews. By using a crew specifically devoted to this location, Enbridge will minimize the total construction time in the area, allowing restoration to commence as soon as all construction activity is completed.

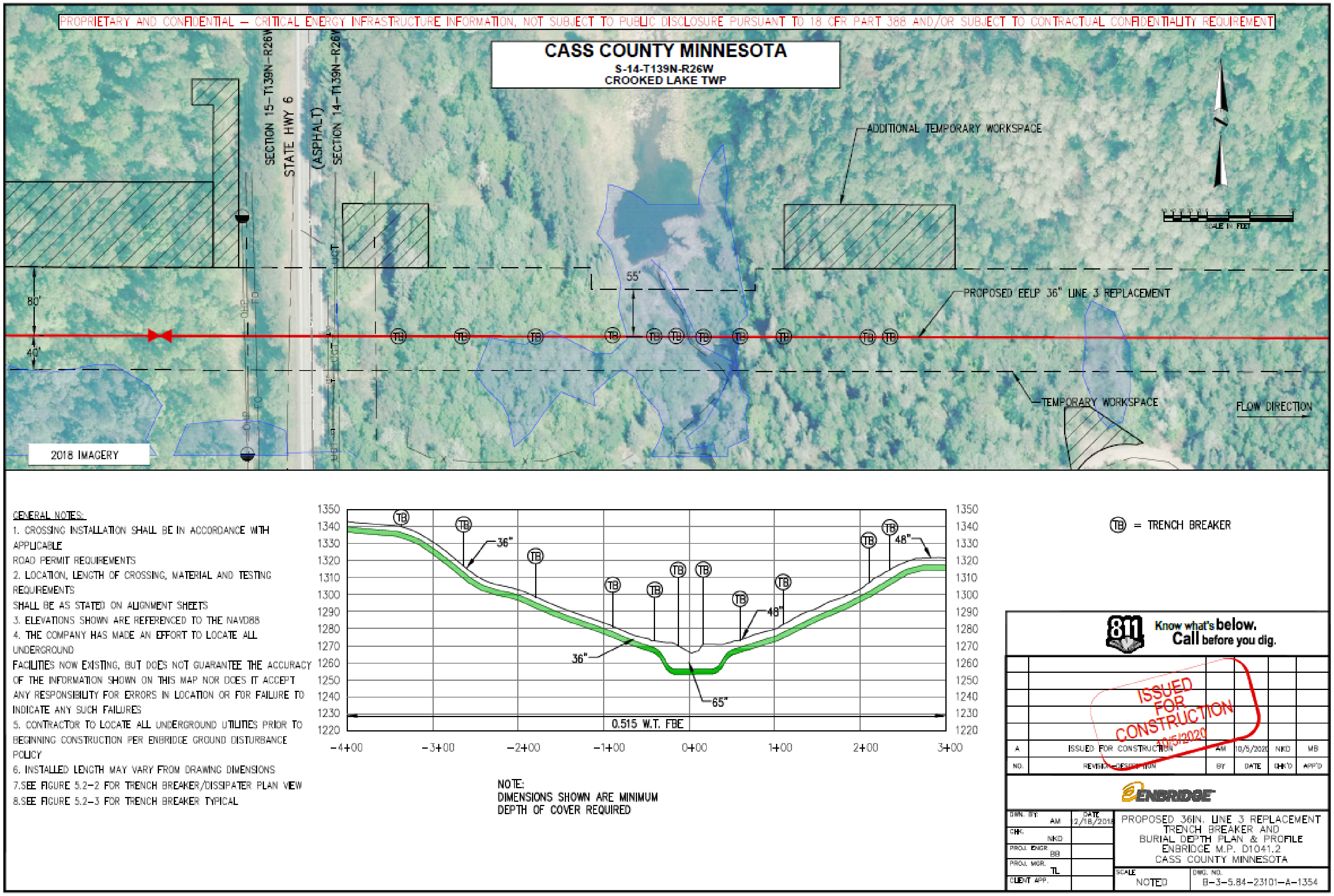
Enbridge is proposing to install the Spring Brook waterbody crossing first, before the adjacent western hillslope crossing. The western hillslope installation would not proceed until the waterbody crossing is completed. Working from lower to higher elevations is an effective technique to minimize the potential for sedimentation and erosion. Installing the waterbody first results in reduced potential for sediment to reach Spring Brook by reducing the time required for installation and duration of disturbed soils upslope of Spring Brook.

5.2.1 Spring Brook Installation

Enbridge will provide advanced notice to MDNR Fisheries staff of pending construction at the waterbody 2 weeks in advance so that MDNR Hatchery staff are aware of construction activities and may conduct site visits as needed. Enbridge will then provide additional updates closer to the actual date of work.

Enbridge is proposing to cross Spring Brook and the surrounding wetlands using a dry crossing, dam-and-pump method. Due to the size of Spring Brook, Enbridge anticipates that it will complete this stream crossing within 48 hours. Completing the crossing in 48 hours or less reduces the required time that stream flow will be diverted as part of the dry-crossing, dam and pump method. Reducing the duration of work at the waterbody reduces potential sediment and erosion concerns and any potential impacts to aquatic organisms.

Figure 5.2-1: Trench Breaker Burial Depth Plan and Profile



GENERAL NOTES:
1. CROSSING INSTALLATION SHALL BE IN ACCORDANCE WITH APPLICABLE ROAD PERMIT REQUIREMENTS
2. LOCATION, LENGTH OF CROSSING, MATERIAL AND TESTING REQUIREMENTS SHALL BE AS STATED ON ALIGNMENT SHEETS
3. ELEVATIONS SHOWN ARE REFERENCED TO THE NAVD88
4. THE COMPANY HAS MADE AN EFFORT TO LOCATE ALL UNDERGROUND FACILITIES NOW EXISTING, BUT DOES NOT GUARANTEE THE ACCURACY OF THE INFORMATION SHOWN ON THIS MAP NOR DOES IT ACCEPT ANY RESPONSIBILITY FOR ERRORS IN LOCATION OR FOR FAILURE TO INDICATE ANY SUCH FAILURES
5. CONTRACTOR TO LOCATE ALL UNDERGROUND UTILITIES PRIOR TO BEGINNING CONSTRUCTION PER ENBRIDGE GROUND DISTURBANCE POLICY
6. INSTALLED LENGTH MAY VARY FROM DRAWING DIMENSIONS
7.SEE FIGURE 5.2-2 FOR TRENCH BREAKER/DISSIPATER PLAN VIEW
8.SEE FIGURE 5.2-3 FOR TRENCH BREAKER TYPICAL

NOTE:
DIMENSIONS SHOWN ARE MINIMUM
DEPTH OF COVER REQUIRED

After the site is prepared as described in Section 5.1, Enbridge will then install sheet piling/steel plate (as ground conditions allow) to create the upstream and downstream dams required for the dam-and-pump method. The proposed extent of sheet piling/steel plate is shown on the SSCP in Appendix A. Sheet piling/steel plate creates a secure and effective water dam, which reduces the potential for water flowing into the excavation. Reducing water inflow into the excavation area then reduces the need to dewater the excavation and potential for sediment loss off site. Sheet piling/steel plate also provides stability to the excavated trench, resulting in a smaller excavation size and limited ground disturbance. Sheet piling/steel plate is advantageous in this specific situation as less trench spoil (the soil excavated from the pipeline ditch) will need to be excavated and the potential for trench wall collapse is eliminated. Additionally, excavating less material will reduce erosion and sediment loss concerns as the temporary spoil piles will be smaller. Smaller spoil piles reduce the potential for equipment congestion and the potential for materials to leave the construction workspace. Sheet piling/steel plate will be installed by a separate crew from the crew completing the waterbody excavation and pipeline crossing at Spring Brook and will occur earlier than the waterbody crossing itself. Once the full of extent sheet piling/steel plate is installed, the portions of the sheet piling/steel plate within the waterbody will be driven down to allow for flow to continue until the waterbody crossing can be completed.

Once the waterbody crossing crew is ready to execute the crossing, Enbridge will set up pumps and hoses to move flowing water around the upstream and downstream sheet piling/steel plate dams (see the SSCP in Appendix A). This will allow Spring Brook to continue flowing around the work area and will prevent upstream water from mixing with water at the construction site, minimizing the potential for sedimentation. Enbridge will place the pumps near the sheet piling/steel plate and away from the beaver dam located to the north of the crossing as to preserve the dam's integrity. Pump hoses will connect to a discharge structure on the downstream side.

Enbridge will then pull up the sections of the sheet piling/steel plate within the waterbody that were previously driven down, creating a dam on either side of the crossing. Pumping will begin before the sheet piling/steel plate is pulled back up to serve as dams in order to maintain constant downstream flow throughout the process. Energy dissipation devices, such as plywood boards and/or plastic sheeting, will be placed under the discharge structure on the downstream side to prevent streambed scour and sediment discharge. Pump intake hoses will be fitted with 3/16-inch screens to prevent entrainment of fish and other aquatic organisms. Backup pumps, hoses, and fittings will be available on site at all times, in the event a primary pump or any other pumping components fail, for immediate deployment to maintain consistent streamflow.

Separately, the segment of pipe for installation at the waterbody will have been delivered to the nearby ATWS and bent to accommodate the ground contours and maintain the prescribed depth-of-cover over the pipeline at the crossing location. Once the sections are bent, the pipe will be joined by welding it into one segment that will cross the entire waterbody.

To complete the waterbody crossing, excavators will then excavate a trench across the dry stream section between the dams for placement of the welded stream crossing segment. Trench width excavation will vary depending on topography and soil conditions. Enbridge will excavate an approximately 8.5- to 9-foot-deep trench to provide a depth of cover ("DOC") of 5.4 feet at the Spring Brook crossing and to the DOC points past TOB, as shown on Appendix A and as requested by the MDNR. Equipment will separate the upper 12 inches of the stream bed material and store it separately from the subsoil (below the 12 inches of stream bed material). All spoil will be stored outside of the stream bed and within the construction workspace.

If water accumulates in the working trench, it may need to be periodically pumped out. The bottom of the trench must be able to be inspected for rocks, debris, and other items that could dent the pipe or otherwise compromise the protective pipe coating. If trench dewatering is needed, it will be discharged into an energy dissipating sediment filtration device located away from the water's edge. Enbridge's preferred construction dewatering discharge site is located within the eastern ATWS identified on the SSCP in Appendix A. Enbridge has identified an alternate construction dewatering discharge location to the west of the crossing and State Highway 6, also shown on the SSCP in Appendix A. Enbridge will determine the optimal dewatering location prior to construction based on site conditions.

Spoil excavated from the trench will be stored within the ATWS on either side of the crossing. MDNR requested that Enbridge remove and store vegetated mats from the banks of Spring Brook to aid in restoration efforts (see Section 6.0). Therefore, Enbridge will extract existing vegetated mats along with the preliminary removal of topsoil within the trench line. Enbridge proposes to remove 25 linear feet of vegetated mats on either side of the stream crossing using an excavator which will remove 9 to 12 inches of soil along with the vegetation. Depending on the level of saturation at the time of removal, it may be difficult to obtain intact consolidated mats, but generally the native vegetation will be retained and captured. Enbridge will then place the vegetated mats on timber mats located in the ATWS added for this purpose. The vegetated mats will be covered with tarps if a precipitation event is forecasted. Per the Minnesota Board of Water & Soil Resources' ("BWSR") Native Vegetation Establishment and Enhancement Guidelines,[10] BWSR does not recommend the use of vegetated mats during mid-summer through early fall without watering or favorable weather conditions; low success is attributed to this method in early fall. Therefore, because favorable weather conditions cannot be ensured, Enbridge may need to water the mats to effectively implement the sod saving effort. The vegetated mats will be replaced as soon as practical following backfilling of the trench, and stabilized per the timing requirements described in Section 1.9.1 of the EPP. Mats will be watered once replaced; staking could include live stakes as illustrated in the SSRP (see Appendix B).

Once the trench is suitably excavated and inspected, the welded pipe segment will be lowered-in to the excavation. The trench breakers within the stream crossing segment will be installed. Trench breakers are permanent devices installed to prevent subsurface water flow along the installed pipeline. The number and location of trench breakers adjacent to the waterbody crossing are depicted on Figure 5.2-1. Trench breakers will also be identified on construction alignment sheets with a note to "Field Verify." The precise location of trench breakers will be determined through coordination between Enbridge's EIs, Enbridge's Craft Inspectors, and the Contractor's Foreman. The trench breakers may be moved short distances in either direction from the location shown on Figure 5.2-1 to find more stable soils, or to avoid other site-specific conditions. The excavation at the stream crossing will then be backfilled and the streambed contours restored, starting with the subsoil material and then the top 12 inches of parent streambed material.

Once waterbody crossing activities are complete, Enbridge will begin to remove all installed sheet piling/steel plate. The pumps will continue to divert water around the work area as Enbridge removes the portion of the sheet piling/steel plate within the waterbody to re-establish flow. After the flow is re-established, Enbridge will shut off the pumps to allow normal flow to resume. Materials and equipment used specifically for the operation (e.g., pumps, hoses, dissipation devices) will be removed from the streambank and approaches. Enbridge will remove all

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[10] https://bwsr.state.mn.us/sites/default/files/2019-07/Updated%20guidelines%20Final%2007-01-19.pdf; see page 28.

remaining sheet piling/steel plate outside of the waterbody crossing and temporary bank stabilization[11] efforts will begin.

The pace and progress of construction would dictate the sequencing of tie-ins of the stream crossing segment to the mainline pipe. If the mainline pipeline has been installed up to the stream crossing on the eastern side, the waterbody crew will weld the stream crossing segment to the mainline and will coat the welds. This operation may require the tie-in excavations to be dewatered to provide a dry and safe working area. If water seeps into the tie-in excavations, it will be pumped into a sediment containment structure in the ATWS used for trench dewatering and will be discharged as discussed above. If the mainline pipeline has not been installed on the eastern side of the stream, the crossing segment will not be tied into the eastern mainline pipeline until a later date. If that situation occurs, tie-in excavations located outside of the bank of the stream feature will remain open until the tie-in has been completed. Temporary erosion and sediment BMPs will be maintained at the waterbody crossing to prevent sediment discharge to the stream until the tie-in is complete and permanent stabilization measures are completed. After the stream and wetland crossing segment has been tied in, the tie-in excavations will be backfilled. The western side of the valley will be constructed following the stream crossing (see Section 5.2.2) and will be tied in at that time.

5.2.2 Western Hillslope Installation

Enbridge will install the pipeline along the western hillslope following the completion of installation of the pipeline at the stream crossing.

Pipe segments for the hillslope will be delivered to the construction workspace, bent to follow ground contours, and joined by welding into sections accordingly along the hillslope. Based on environmental site conditions present at the time of the installation, Enbridge could install the pipe in one or multiple segments. The method selected would be based on the site-specific conditions encountered at the time of the construction, while taking into consideration environmental and construction feasibility concerns. The amount of water and/or saturated conditions will be the primary conditions that would drive decisions around construction methods.

At this time, Enbridge is proposing to install the pipe in one segment; however, this is dependent upon site conditions at the time of the crossing and the approach may need to change. This will require that the excavation of the trench on the hillslope be completed before lowering the pipe into position, but it would result in a shorter duration of time for completion, thereby reducing the time the hillslope will be disturbed. Environmental controls to minimize the potential for erosion and sediment control issues include robust erosion and sediment BMPs; temporary slope breakers; and a shorter duration of activity. Enbridge believes that the pre-joined method presents the best scenario to prevent environmental concerns. Joining the pipe on the slope would reduce the amount of excavated trench and overall area of exposed soil and spoil storage necessary; however, this method would require more time and would increase the duration of construction activity and slope disturbance. In either scenario, pipe welds will be completed, coated, and x-rayed.

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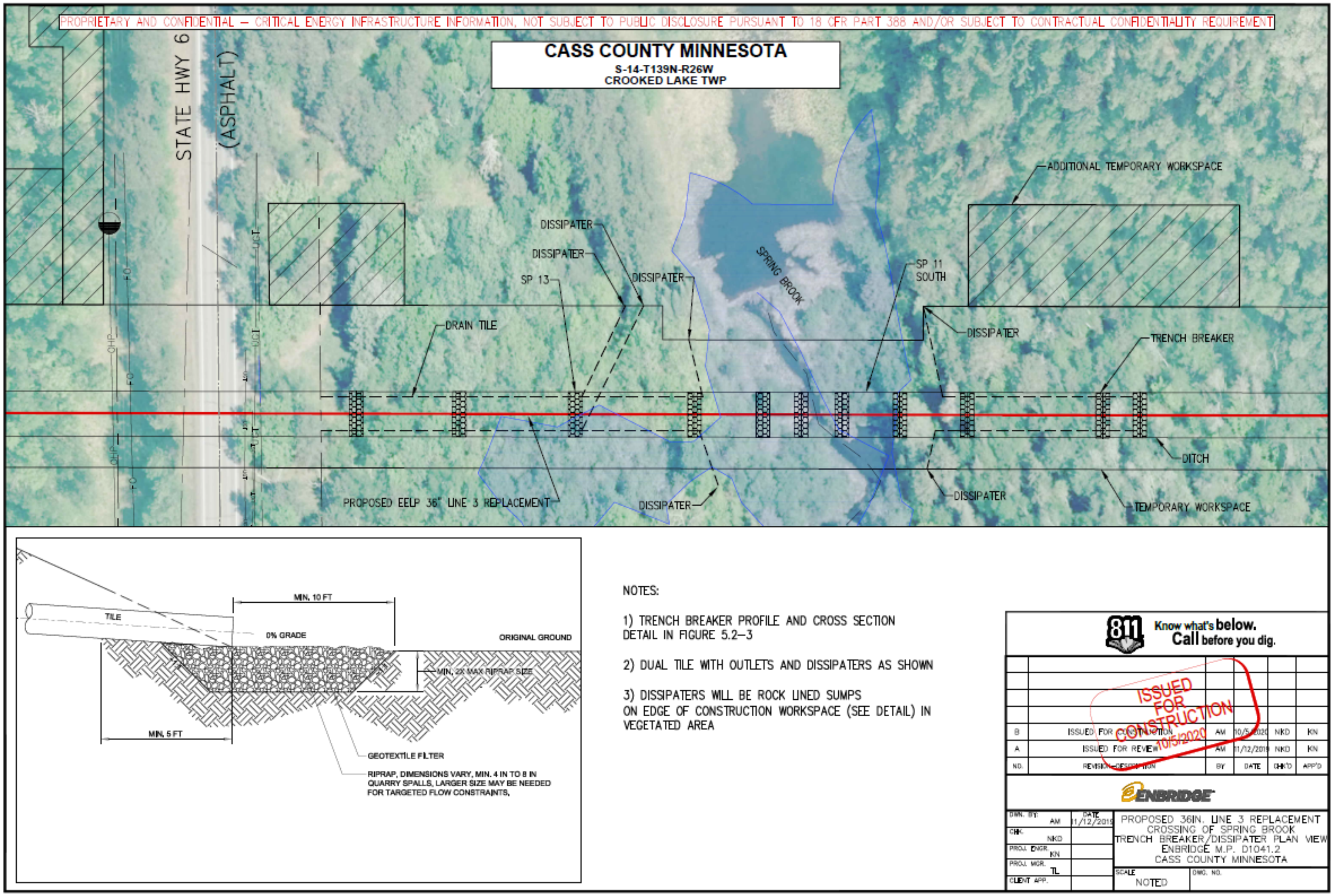
[11] Stabilization means that the exposed ground surface has been covered by appropriate materials such as mulch, staked sod, erosion control blanket, mats or other material that prevents erosion from occurring. Grass seeding, agricultural crop seeding or other seeding alone is not stabilization. Mulch materials must achieve approximately 90 percent ground coverage (Minnesota Rules 7090).

The western hillslope trench will then be excavated by a track hoe in subsequent 1-foot lifts, excavating to a total depth not to exceed 6.5 feet, which will be determined by a professional surveyor. This minimized depth is planned to address MDNR's concerns with encountering groundwater. Following completion of each 1-foot lift, the professional hydrogeologist in coordination with an MDNR representative will inspect for any visible groundwater. If groundwater is observed, the professional hydrogeologist in coordination with the MDNR and Enbridge Construction Team will determine if activation of any components of the Groundwater Management Contingency Plan are needed (see Appendix H).

Excavated trench spoils from upland areas will remain segregated from wetland soils and will be stored within the construction workspace. Once trenching is complete, the joined section of pipe will be lowered-in to the trench and trench breakers. Trench-line drain tiles along each side of the pipeline will be installed by an individual crew as shown on Figure 5.2-2. Preventing subsurface water flow is important for the structural integrity of the pipeline as well as preventing alteration of the existing environmental hydrologic conditions. Enbridge's long-term water management proposal for the western hillslope will be installed at this time and is shown on the trench breaker/dissipater plan view in Figure 5.2-2 and more detail is provided on the typicals on Figure 5.2-3.

Figure 5.2-2: Trench Breaker/Dissipater Plan View



NOTES:

1) TRENCH BREAKER PROFILE AND CROSS SECTION DETAIL IN FIGURE 5.2–3

2) DUAL TILE WITH OUTLETS AND DISSIPATERS AS SHOWN

3) DISSIPATERS WILL BE ROCK LINED SUMPS ON EDGE OF CONSTRUCTION WORKSPACE (SEE DETAIL) IN VEGETATED AREA

Know what's below. Call before you dig.

ISSUED FOR CONSTRUCTION 10/5/2020

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR CONSTRUCTION	AM	10/5/2020	NKD	KN
A	ISSUED FOR REVIEW	AM	11/12/2019	NKD	KN

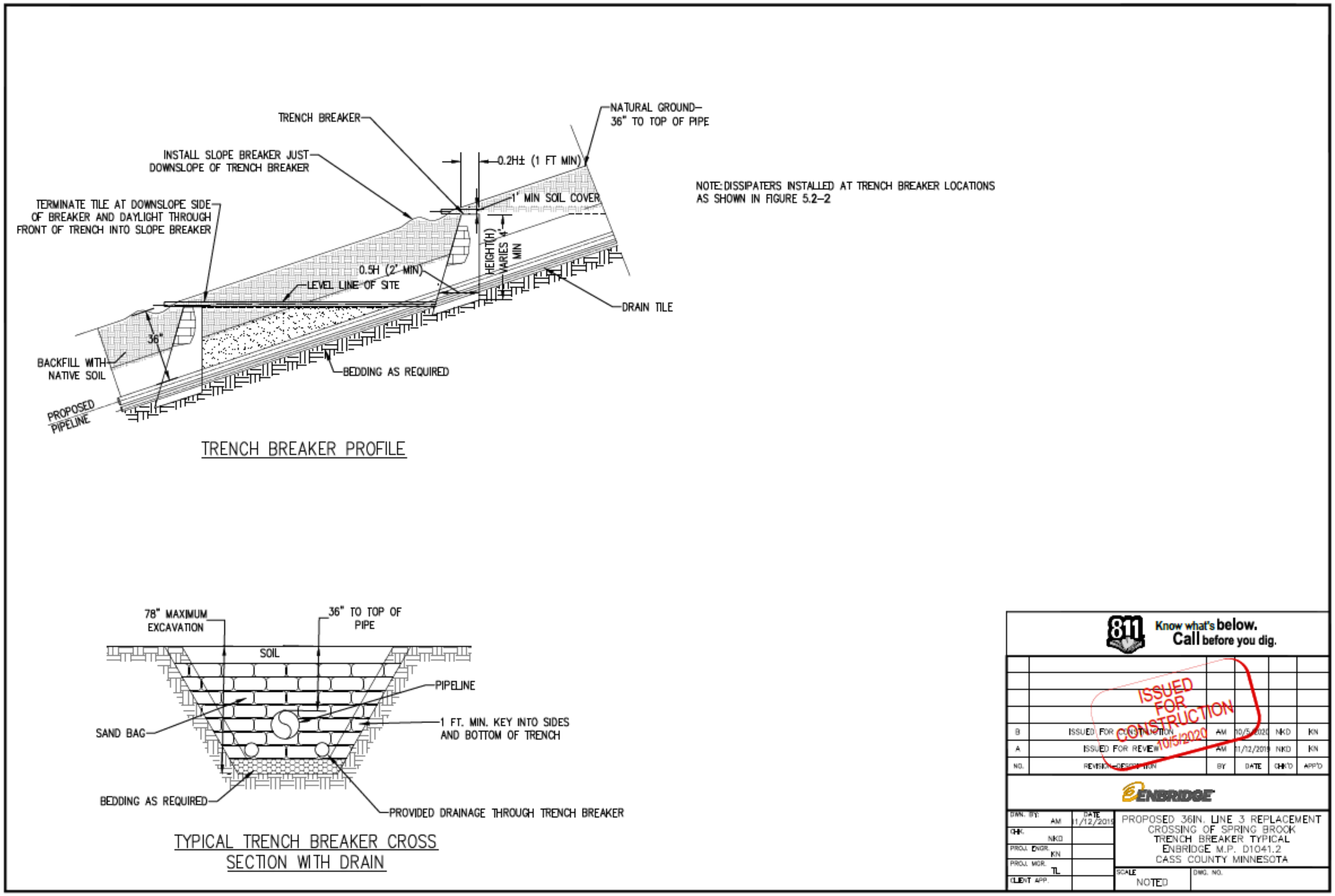
ENBRIDGE

DWN. BY: AM	DATE 11/12/2019
CHK. NKD	
PROJ. ENGR. KN	
PROJ. MGR. TL	
CLIENT APP.	

PROPOSED 36IN. LINE 3 REPLACEMENT
CROSSING OF SPRING BROOK
TRENCH BREAKER/DISSIPATER PLAN VIEW
ENBRIDGE M.P. D1041.2
CASS COUNTY MINNESOTA

SCALE NOTED
DWG. NO.

Figure 5.2-3: Trench Breaker Typical



On the west side of Spring Brook, Enbridge will install a series of five trench breakers up to the tie-in point starting at 1,340 feet above mean sea level ("AMSL") and ending at 1,270 feet AMSL for a distance of between 300 and 350 feet. A trench breaker profile relative to the pipeline and drain tile is shown in Figure 5.2-3. The first four trench breakers will be installed with a drain tile line running through the trench breaker and down either side of the pipeline to provide a conduit for subsurface water to flow down the trench (see cross-section on Figure 5.2-3). The two main drain tiles will lead to two drain tile lines off of the third and fourth trench breakers down the hillslope, which will lead to rock-lined energy dissipaters where trench water will be discharged on the edge of the construction workspace (see Figure 5.2-2). This water management strategy will be maintained for the life of the pipeline as outlined in Section 6.0.

Backfilling will follow installation of the trench breakers but may not occur immediately after the trench breakers are installed. Backfilling may not occur immediately due to pending tie-in with the adjoining mainline segments of pipe to the west which would be constructed following completion of pipe at the waterbody crossing. Enbridge will provide for 3 feet depth of cover over the pipeline along the western hillslope as shown in Figure 5.2-1.

5.2.3 Seep Considerations for Hillslope Installation

Enbridge will intersect a seep at SP-13 on the west side of Spring Brook and on the working side of the construction workspace. The outlet channel is characterized by one central flow way. Enbridge may employ one of several methods described above and below to mitigate impacts on the SP-13 flow way if SP-13 produces surficial flow during active construction.

The area around SP-13 will experience limited disturbance during clearing immediately prior to installation of the pipeline. SP-13 will be marked as presented in Section 2.1, which will limit ground disturbance in this phase.

During site preparation and construction mat installation, Enbridge may extend the construction mat travel lane westerly from Spring Brook or install a temporary diversion channel or flume pipe to effectively convey water flow from the seep across the construction area to off-right-of way areas on Enbridge property as described above in Section 5.1.

During excavation, the surface soils of SP-13 within the trench will be stripped and stockpiled with wetland soils prior to excavation of subsurface material. Soil conditions may require the trench width for a safe and stable trench to be 12 feet to obtain up to a 6.5-foot depth near SP-13. Enbridge and its construction contractor will confirm the need for sheet piling/steel plate during construction activities, depending on site-specific conditions. During excavation of the trench, surficial groundwater is expected to be encountered when trenching at approximate elevation 1,300 feet AMSL or when trench excavation reaches the 1,295-foot AMSL elevation. Surficial groundwater, if present, will either collect in the trench or infiltrate into the sandy subsurface material on the trench bottom. The trench will be dewatered as necessary.

Following excavation of the trench, the pipe will be installed and backfilled with native soil and non-native materials as outlined in Section 5.2.2. Enbridge may elect to carry out additional compaction measures during trench backfilling to encourage soil cohesion and mitigate subsidence or sloughing where the pipeline trench intersects SP-13. This determination will be made by Enbridge and the professional hydrogeologist during trench excavation.

MDNR has expressed concern regarding the stability of the slopes adjacent to Spring Brook following construction, due to the groundwater seeps present in the area. Enbridge is conservatively planning to encounter a medium to heavy flow scenario while constructing on the western hillslope, which has led to the planning for post-construction seep mitigation measures. These measures include the use of subsurface drainage conveyances that are used in conjunction with the trench breakers installed during construction as described in Section 5.2.2 and as shown on Figures 5.2-2 and 5.2-3. Successful implementation of these measures along with trench breakers will prevent the likelihood of a path for water to flow downslope along the pipe, because the water will be diverted away from the trench.

6.0 RESTORATION MEASURES

6.1 STABILIZATION

Restoration of the stream bank and bed contours will be initiated prior to restoring flow at the waterbody crossing after the installation of the dam and pump method is complete, unless site and permit conditions delay permanent installation (see Section 2.6 of the EPP). Cleanup and rough grading of the hillslope construction area will begin as soon as practicable after the pipe sections are tied in and the trench is backfilled.

As required by the MPCA National Pollutant Discharge Elimination System/State Disposal System Construction Stormwater General Permit, stabilization will be initiated immediately[12] and completed within 7 calendar days whenever construction activity has permanently or temporarily ceased on any portion of this site, as this site is within 1 mile of and drains to a trout stream, which is defined as a special water. The process to install the western hillslope in segments will take approximately 3 to 7 days to install. In addition, all exposed soil areas within 200 feet of the water's edge of Spring Brook, and that drain to that water, will be stabilized within 24 hours during the applicable "work in water restrictions" for Public Waters. Stabilization of all exposed soils within 200 feet of the public water's edge, and that drain to that water, will be initiated immediately and completed within 7 calendar days whenever construction activity has permanently or temporarily ceased on any portion of the site outside of the restriction period. Upon completion, Enbridge will stabilize the upland hillslope using hydro-mulch or natural fiber erosion control blanket[13] (no ultraviolet biodegradable polyester materials). Enbridge will install permanent slope breakers lined with erosion blankets as shown on the SSRP.

The travel lane portion of the construction workspace and the temporary bridge will remain in place until final cleanup activities have occurred on both sides of Spring Brook. Construction mats will be removed from wetlands during final cleanup operations. The temporary bridge will be removed after final cleanup, seeding, mulching, and other construction workspace restoration activities have been completed. Appropriate temporary erosion and sediment BMPs will remain installed until permanent cover is achieved.

6.2 REVEGETATION

Enbridge will conduct permanent site restoration efforts at the Spring Brook crossing in accordance with the SSRP presented as Appendix B. The Rosgen survey indicates that the

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[12] Initiated immediately means taking an action to commence soil stabilization as soon as practicable, but no later than the end of the work day, following the day when the land-disturbing activities temporarily or permanently cease (Minnesota Rules 7090).

[13] Category 3N or 4N as described in Table 3885-2 (3885.2A Erosion Control Blanket Requirements) in Minnesota Department of Transportation Standard Specifications for Construction, 2018 Edition (http://www.dot.state.mn.us/pre-letting/spec/2018/2018-spec-book-final.pdf).

stream type is C4c, which is a low gradient, sinuous stream with gravel bed and a high width/depth ratio channel with a well-developed floodplain. Based on the steam survey data, Spring Brook has a low Bank Erosion Hazard Index score of 13.4 and a low Near Bank Stress rating; therefore, the stream is considered to have a low sensitivity to disturbance with good potential for natural recovery (National Engineering Handbook, 2007).

Enbridge's restoration approach to-date has been informed by data collected during its wetland and waterbody field surveys and the SSRP site visits conducted in June 2020. Enbridge and MDNR will complete a site visit to confirm the restoration methodology as presented on the SSRP.

As outlined in the SSRP, the vegetated mats surrounding Spring Brook that were removed during construction will be replaced by backhoe following backfilling and will be watered once replaced and staked into the subsoil on the banks using live stakes (see Section 5.2.1). Enbridge will use site photos and information from site visits to identify appropriate species for restoration; MDNR has recommended red osier dogwood and bog birch, and these species will be considered based on availability. Enbridge will plant live stakes along the entire width of the construction workspace for an approximate 5-foot buffer on each side of the waterbody. Transplant or container shrubs may be substituted for live stakes based on site-specific conditions. All woody species will be verified as native and found within Cass County, consistent with the SSRP. A restoration specialist will be on-site during construction and restoration of the pipeline as outlined in Section 5.2 to ensure effective implementation of restoration methods.

The permanent right-of-way in wetlands adjacent to Spring Brook will be seeded with the BWSR Wetland Rehabilitation (34-171) seed mix where native vegetation is expected to come back from the seedbank as outlined in the SSRP. Enbridge proposes to allow natural reforestation of the temporary construction workspace through the forested and scrub-shrub wetland communities via stump sprouting, root sprouting, and natural recruitment. The upland hillslope areas will be seeded with BWSR Woodland Edge Northeast (36-311) or Native Construction (32-241). Mulch will be applied as needed on approaches. No fertilizer, lime, or mulch will be applied in wetlands. Appropriate temporary erosion and sediment BMPs will remain installed until permanent cover[14] is achieved.

6.3 MONITORING

Enbridge will complete spring and fall site visits with the MDNR for the first 3 years following construction to observe the success of the post-construction seep mitigation measures described in Sections 5.2.2 and 5.2.3. Enbridge can also arrange for MDNR site visits throughout the year, upon request.

Enbridge has developed a Post-Construction Wetland and Waterbody Monitoring Plan ("PCMP") for aquatic resources affected by the Project, including the Spring Brook crossing. The PCMP was developed with input from the U.S. Army Corps of Engineers, MPCA, and MDNR. Section 3.0 of the PCMP contains performance standards for hydrology and wetland and riparian vegetation, including invasive and noxious species, compared to the baseline conditions observed during pre-construction surveys. Currently, Enbridge is proposing to conduct post-construction

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[14] Permanent cover means surface types that will prevent soil failure under erosive conditions. Examples include: gravel, concrete, perennial cover, or other landscaped material that will permanently arrest soil erosion. Permittees must establish a uniform perennial vegetative cover (i.e., evenly distributed, without large bare areas) with a density of 70 percent of the native background vegetative cover on all areas not covered by permanent structures, or equivalent permanent stabilization measures. Permanent cover does not include temporary BMPs such as wood fiber blanket, mulch, and rolled erosion control products (Minnesota Rules 7090).

monitoring of the Spring Brook crossing immediately after restoration work is complete. Follow-up monitoring will occur in years 1, 2, 3, and 5 following construction.

A formal Monitoring Report will be submitted to applicable agencies, including the MDNR, by December 31 of each monitoring year. Enbridge will meet with the applicable agencies at the end of each monitoring year to review the results of the Monitoring Report and to determine if additional actions are required to complete restoration.

7.0 REFERENCES

Barr. 2019a. Geotechnical Data Report Line 3 Replacement, Spire Valley. December 12. See Appendix D.

Barr. 2019b. Memorandum, Line 3 Replacement Project. December 12. See Appendix E.

Braun. 2019a. Evaluation of Spring Flow Potential by Thermal Drone Flight. March 29. See Appendix C.

MDNR, Fisheries Division. 2007. Spring Brook electroshocking survey results. Unpublished. 3 pages.

MDNR. 2017. Minnesota Spring Inventory Guidance Document. MDNR County Geologic Atlas Program. Available on-line at: https://files.dnr.state.mn.us/waters/groundwater_section/mapping/msi/MSI_GuideDoc.pdf.

National Engineering Handbook. 2007. Rosgen Stream Classification Technique – Supplemental Materials. Part 654. Technical Supplement 3E. Pages TS3E-17.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at the following link: https://websoilsurvey.sc.egov.usda.gov/. Accessed April 2019.

Stantec. 2015. Spring Survey Report. July 27, 2015. See Appendix B.

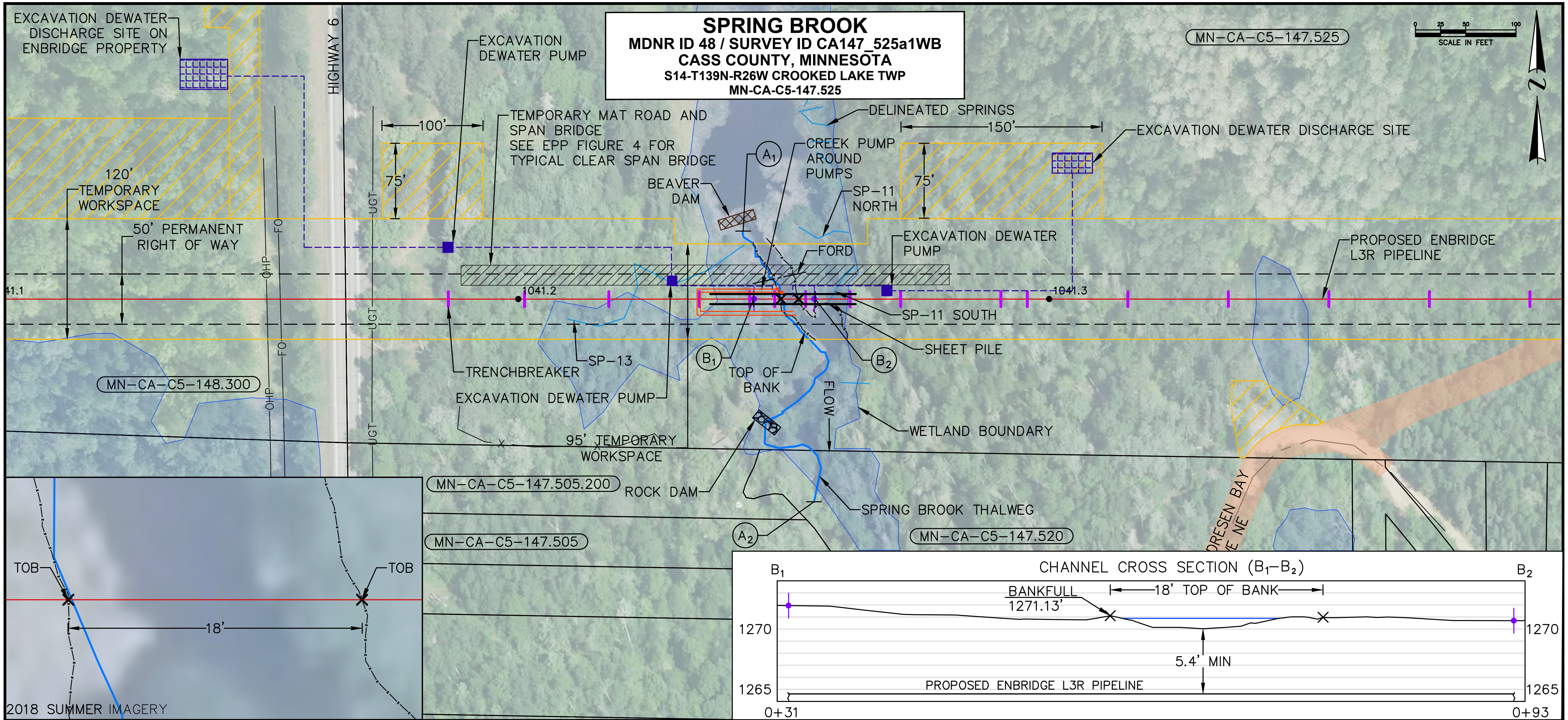
Stantec. 2016. Rosgen Geomorphological Stream Survey Report for Spring Brook, Cass County. Dated April 8, 2016. See Appendix A.

Appendix A

Site-Specific Crossing Plan

SPRING BROOK

MDNR ID 48 / SURVEY ID CA147_525a1WB
CASS COUNTY, MINNESOTA
S14-T139N-R26W CROOKED LAKE TWP
MN-CA-C5-147.525



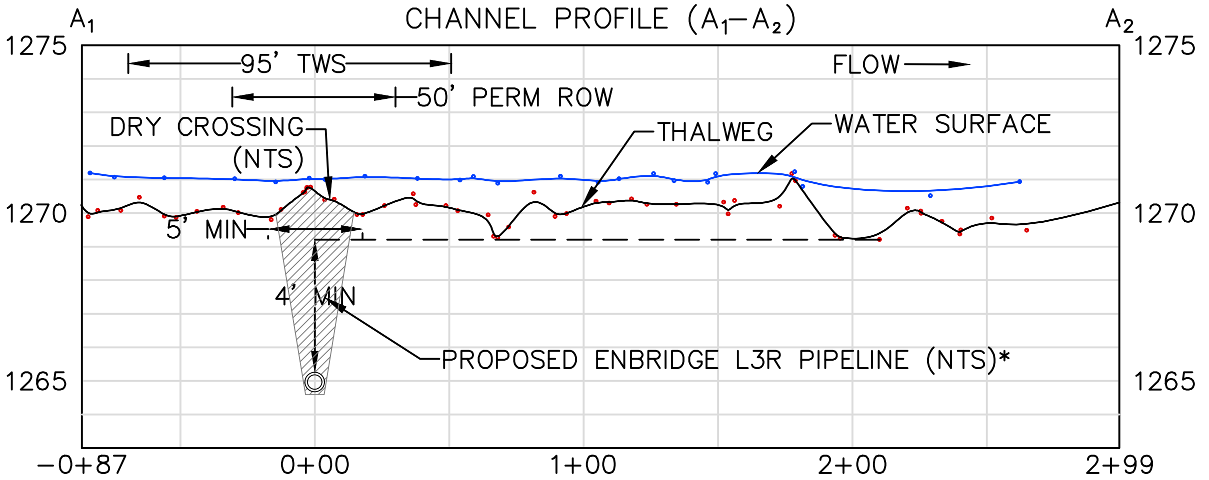
NOTES
1. NO FEMA DIGITAL FLOODPLAIN DATA AVAILABLE
2. SOBS (O/H) OR NPC (S1–3): N/A
3. MDNR REGION 1 PWI – COLD WATER FISHERY: SEPTEMBER 1 – JUNE 30. 24–HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
4. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.
5. CONTACT MDNR TWO WEEKS PRIOR TO WATERBODY CROSSING.

LEGEND

———	PROPOSED ENBRIDGE L3R PIPELINE
— — — —	PERMANENT RIGHT OF WAY
———	TEMPORARY WORKSPACE
———	WATERBODY (ROSGEN SURVEY – THALWEG)
——UGT——	UNDERGROUND TELEPHONE
——FO——	FIBER OPTIC CABLE
——OHP——	OVERHEAD POWER
—— X ——	FENCE
—·—·—	FORD
———	SPRING
———	TRACT BOUNDARY
▨	TEMPORARY MAT ROAD AND SPAN BRIDGE
▨	BEAVER DAM
▨	ROCK DAM
▭	WETLAND
▨	ADDITIONAL TEMPORARY WORKSPACE
MN–XX–XX–XXX.XXX	TRACT ID
•	ROSGEN SURVEY POINT – WATER SURFACE
•	ROSGEN SURVEY POINT – RIVER BOTTOM (THALWEG)
●	PROPOSED INCREASED DEPTH OF COVER EXTENT
X	TOP OF BANK

FOR ENVIRONMENTAL REVIEW PURPOSES ONLY

CHANNEL PROFILE (A1–A2)



*TRENCH IN PROFILE IS NOT TO SCALE (NTS)

CHANNEL CROSS SECTION NOTE:
1. CHANNEL LOCATIONS, DIMENSIONS, AND/OR ELEVATIONS ARE BASED ON 2020 TOPOGRAPHIC/BATHYMETRIC SURVEY(S), AND AS SUCH DO NOT REFLECT CHANGES TO THE CHANNEL THAT MAY HAVE OCCURRED SINCE THAT TIME.
2. DEPTH OF COVER AT CENTERLINE WAS DEVELOPED USING THE BOTTOM ELEVATION OF THE DEEPEST UPSTREAM OR DOWNSTREAM POOL WITHIN THE SURVEYED REACH, UNLESS OTHERWISE NOTED IN APPLICATION MATERIALS.
3. MEAN MEANDER BELT WIDTH: 58'
4. MEANDER WIDTH RATIO: 4.48
5. TRENCH BREAKER LOCATIONS ARE APPROXIMATE.

0	ISSUED FOR PERMIT APPLICATION	AJJ	10/2020	BAB	BAB
NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE

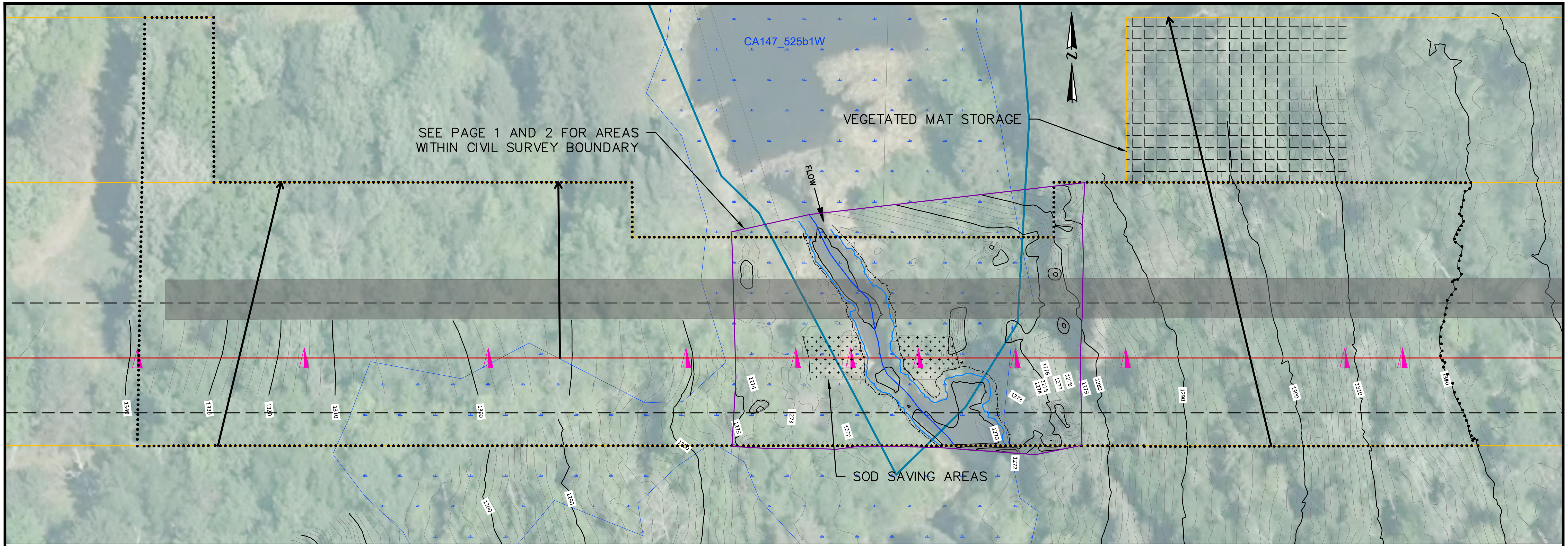
DWN. BY: AJJ	DATE 10/2020
CHK.	
PROJ. ENGR.	
PROJ. MGR.	
CLIENT APP.	

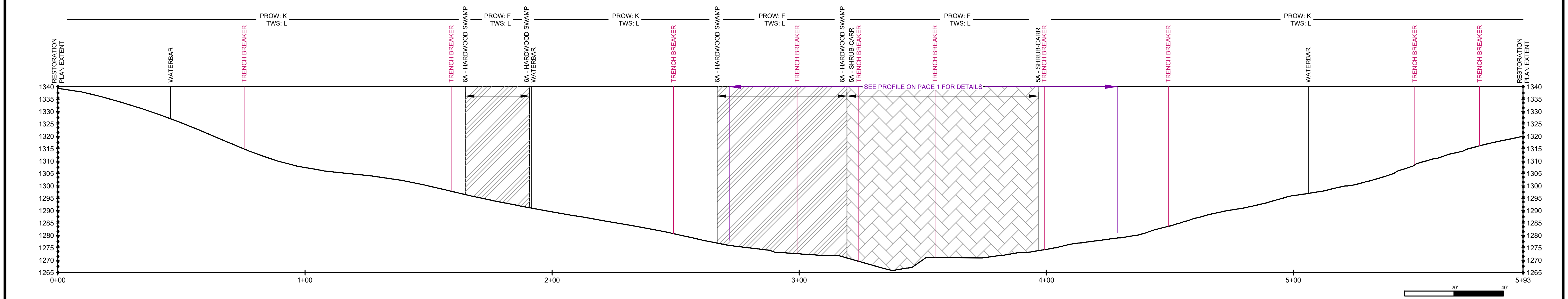
PROPOSED ENBRIDGE L3R PIPELINE
PRIMARY METHOD – DRY CROSSING
CROSSING OF SPRING BROOK
ENBRIDGE MP 1041.3
CASS COUNTY, MINNESOTA

SCALE: NOTED
DWG. NO.: B–93–5.84–MDNR–48–0

Appendix B

Site-Specific Restoration Plan





BWSR SEED MIX	F: WETLAND REHABILITATION (34– 171); K: WOODLAND EDGE NE (36–311); L: NATURAL REVEGETATION
SOBS (O/H) or NPC (S1-3)	NO (MODERATE–PRELIM); N/A

1. ELEVATIONS OUTSIDE OF THE AREA WITHIN CIVIL SURVEY BOUNDARY ARE DERIVED FROM LIDAR. ENBRIDGE WILL RESTORE THE AREAS ADJACENT TO THE PUBLIC WATER WITHIN THE MDNR EXPANDED RESTORATION BOUNDARY TO PRE–CONSTRUCTION CONDITIONS.
2. MDNR REGION 1 PWI – COLD WATER FISHERY: SEPTEMBER 1 – JUNE 30. 24–HOUR SOIL STABILIZATION REQUIRED WITHIN 200 FEET DURING RESTRICTION.
3. AIR PHOTOS ARE FROM 2018 ENBRIDGE AERIAL PHOTOGRAPHY.
4. ADDITIONAL ON–THE GROUND PHOTOS MAY BE TAKEN PRIOR TO CONSTRUCTION AT MDNR REQUEST.
5. PRE–CONSTRUCTION PHOTOS WILL BE USED TO AID IN RESTORATION.
6. SEE GENERAL NOTES PAGE FOR ADDITIONAL DETAIL.
7. SEE THE PLANTING PLAN FOR ADDITIONAL DETAIL REGARDING SEEDING PRACTICES AND SEED MIXES AT PUBLIC WATER CROSSINGS.
8. ON PUBLIC LANDS AND WHEREVER PRACTICABLE AT WATERBODY CROSSINGS, ENBRIDGE WILL USE WILDLIFE–FRIENDLY EROSION AND SEDIMENT CONTROL BMPS THAT CONTAIN BIODEGRADABLE NETTING (CATEGORY 3N OR 4N NATURAL FIBER) AND WILL AVOID THE USE OF PLASTIC MESH (SECTIONS 1.17.1 AND 2.6.1 OF THE EPP).
9. WHEN WORKING WITHIN "WORK IN WATER RESTRICTIONS", STABILIZE ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WITHIN 24 HOURS. STABILIZATION WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY/ TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD.

LEGEND

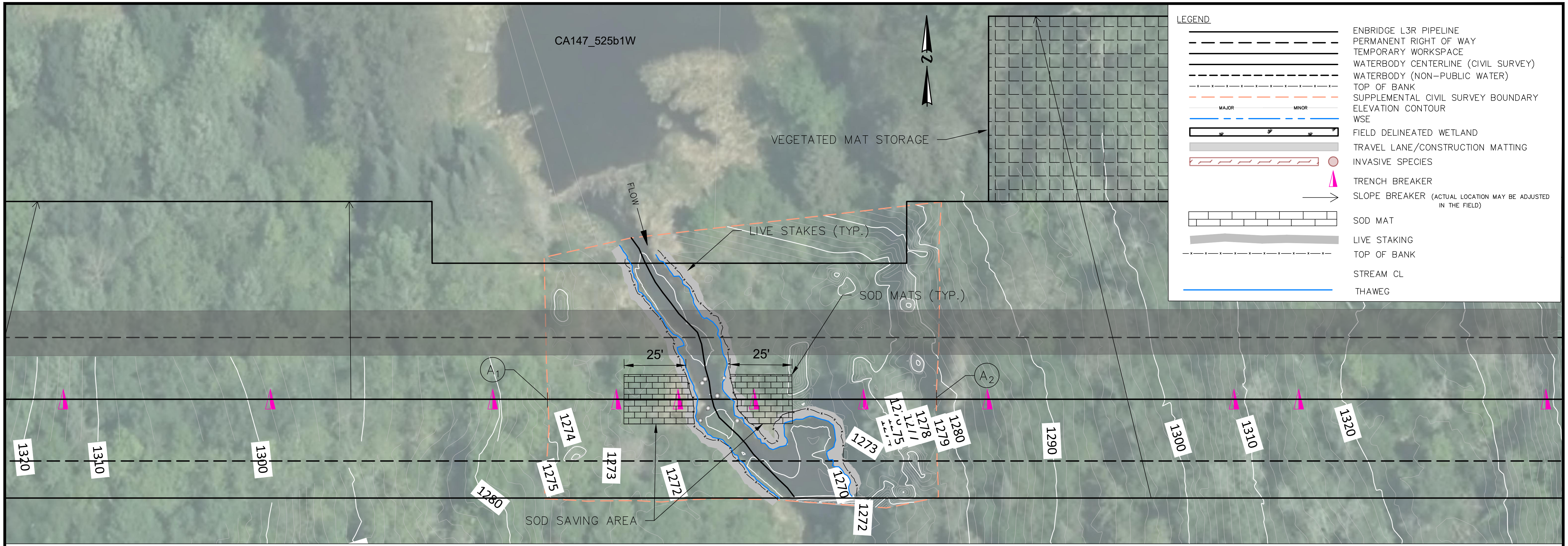
ENBRIDGE L3R PIPELINE
PERMANENT RIGHT OF WAY
TEMPORARY WORKSPACE
WATERBODY CENTERLINE (CIVIL SURVEY)
WATERBODY (NON–PUBLIC WATER)
PUBLIC WATER CIVIL SURVEY BOUNDARY
MDNR EXPANDED RESTORATION BOUNDARY
TOP OF BANK
ELEVATION CONTOUR (MAJOR / MINOR)
ORDINARY HIGH WATER MARK
FIELD DELINEATED WETLAND
TRAVEL LANE/CONSTRUCTION MATTING

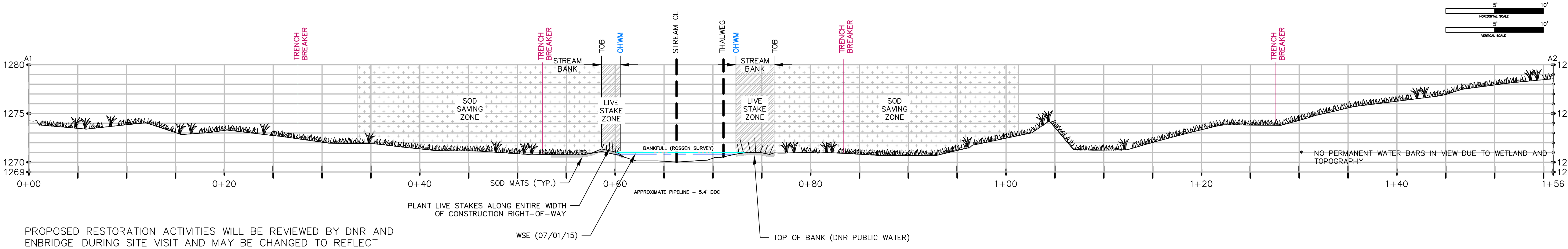
INVASIVE SPECIES
TRENCH BREAKER
PERMANENT SLOPE BREAKER
(ACTUAL LOCATION MAY BE ADJUSTED IN THE FIELD)
1 – SHALLOW, OPEN WATER
2B – SHALLOW MARSH
3A – SEDGE MEADOW
3B – FRESH (WET) MEADOW
5A – SHRUB–CARR
5B – ALDER THICKET
6A – HARDWOOD SWAMP
6B – CONIFEROUS SWAMP

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING	MJT	10/2020		
A	ISSUED FOR REVIEW	MJT	09/2020		

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
SPRING BROOK – MP 1041.3 – MDNR ID 48
RE–VEGETATION PLAN: EXPANDED EXTENT

SCALE	DWG. NO.	PAGE NO.
NOTED	SSRP–1041.3–001A	1A/7





PROPOSED RESTORATION ACTIVITIES WILL BE REVIEWED BY DNR AND ENBRIDGE DURING SITE VISIT AND MAY BE CHANGED TO REFLECT SITE CONDITIONS AT THE TIME OF CONSTRUCTION.

FEATURE ID	CA147_525a1WB; IFC ID: S–230.0
CROSSING TYPE	DRY CROSSING
PROPOSED RESTORATION (SEE DETAILS FOR LIVE STAKING, TRANSPLANTS, AND SHRUB SPECIES IF APPLICABLE)	LIVE STAKES, VEGETATED MAT RESTORATION
WITHIN OR ADJACENT WETLAND	SHRUB–CARR
BWSR SEED MIX	WETLAND REHABILITATION (34–171)
DOMINANT WETLAND VEGETATION	1. CAREX LACUSTRIS 2. ATHYRIUM FILIX–FEMINA 3. EURYBIA MACROPHYLLA 4. ALNUS INCANA
SOBS (O/H) or NPC (S1-3)	NO (MODERATE–PRELIM); N/A

NOTES
1. CONSTRUCTION TIMING RESTRICTIONS
1.1. MDNR REGION 1 PWI –COLD WATER FISHERY: SEPTEMBER 1 –JUNE 30.
1.2. WHEN WORK OCCURS WITHIN "WORK IN WATER RESTRICTIONS", ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE STABILIZED WITHIN 24 HOURS DURING THE RESTRICTION PERIOD. STABILIZATION OF ALL EXPOSED SOILS WITHIN 200 FEET OF THE PUBLIC WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY OR TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD
2. WORK SHALL BE CONDUCTED IN ACCORDANCE WITH APPLICABLE STANDARDS IN ENBRIDGE'S EPP AND VMP FOR PUBLIC LANDS AND WATERS. THE SPECIFICATIONS WITHIN THIS SSRP MAY MODIFY OR REPLACE THESE STANDARDS.
3. SEE GENERAL NOTES PAGE FOR ADDITIONAL DETAIL.
4. INFORMATION REGARDING SEEDING SPECIFICATIONS, SEED BED PREPARATION TECHNIQUES, ETC. ARE DESCRIBED IN THE PLANTING PLAN CONTAINED WITHIN THE VMP.
5. TRENCH BREAKER LOCATION IS APPROXIMATE PENDING FIELD VERIFICATION (EPP SECTION 1.13)

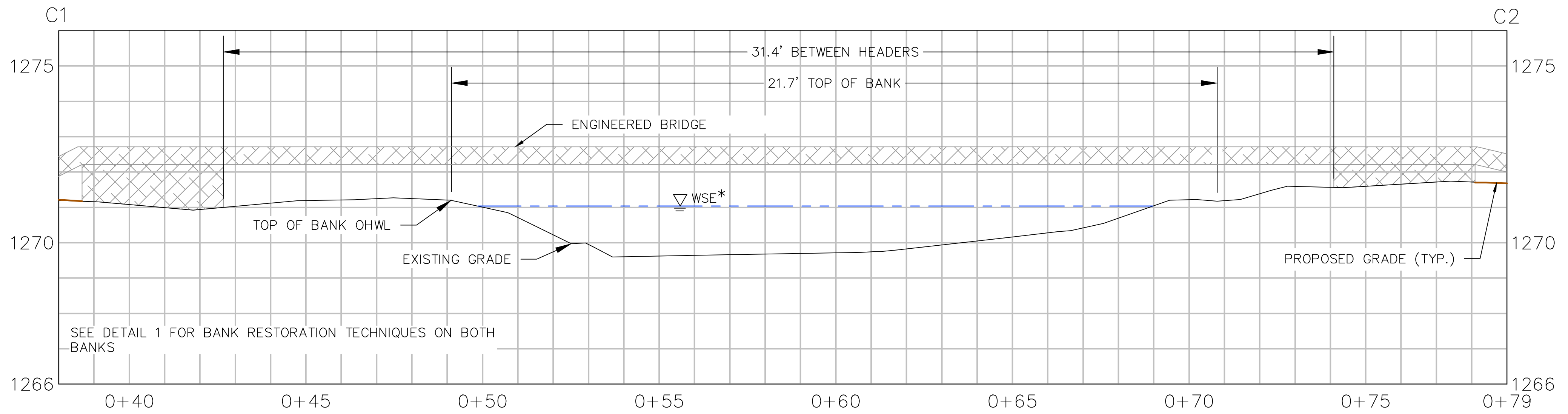
RIDGE®

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
SPRING BROOK – MP 1041.3 – MDNR ID 48
RE–VEGETATION PLAN

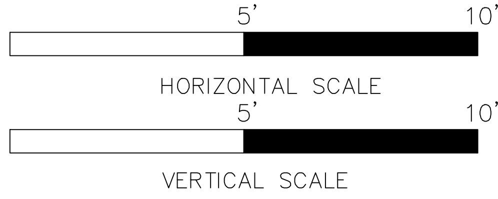
SCALE	DWG. NO.	PAGE NO.
NOTED	SSRP–1041.3–001	1/7

BANK RESTORATION (BRIDGE)



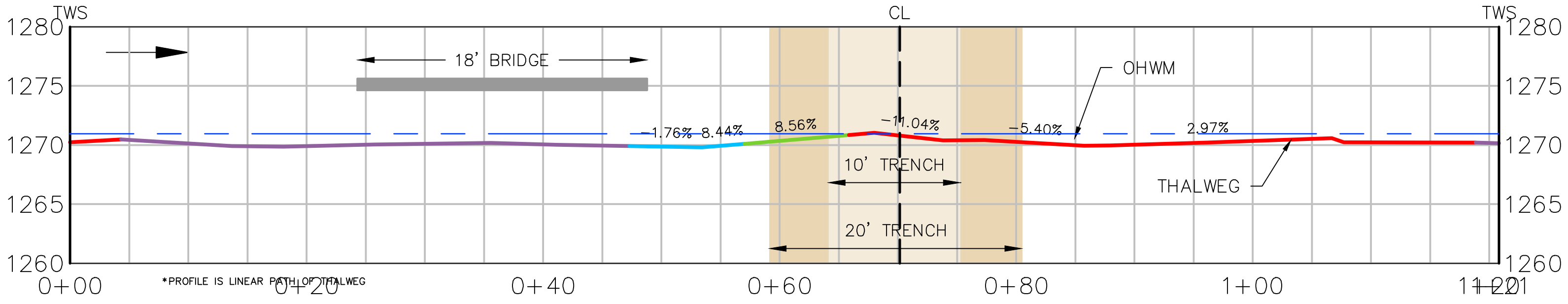
Note: Bridge headers will be set back 5 feet from Top of Bank

* APPROXIMATE WSE IS PROVIDED FOR CONSTRUCTION RELATED ACTIVITIES



STREAMBED RESTORATION

Note: Bridge headers will be set back 5 feet from Top of Bank



NOTES

1. TRANSITIONS BETWEEN EXISTING CHANNEL FEATURES (BED, BANK, FLOODPLAIN) AND PROPOSED RESTORED TRENCH CROSSING WILL BE SMOOTH AND EVENLY GRADED WITHOUT ABRUPT OR PROTRUDING OBSTRUCTIONS.
2. BANK MIGRATION POTENTIAL IS TO THE EAST. PRIMARY FLOW IS LOCATED ON THE DOWNSTREAM SIDE OF THE CHANNEL.
3. PLACE MATS DIRECTLY ON TOP OF EXISTING VEGETATION TO AVOID OR MINIMIZE DISTURBANCE OF VEGETATION ON THE CHANNEL BANKS AND AT THE TOP OF THE STREAM BANK (LIMITED STUMP REMOVAL MAY BE REQUIRED).
4. SEE DETAIL SHEET FOR SPECIFIC RESTORATION METHODS AND DETAILS.
5. MINIMIZE DISTURBANCE OF BED MATERIALS AND FEATURES DURING CONSTRUCTION OF THE TRENCH.
6. BED AND/OR BANK MATERIALS TEMPORARILY ADJUSTED OR REMOVED DURING CONSTRUCTION SHALL BE PLACED IN THE APPROXIMATE ORIGINAL LOCATION DURING RESTORATION. MATERIALS SHALL BE FIELD ADJUSTED DURING PLACEMENT BASE ON THE OBSERVED FLOW PATH AT THE TIME OF CONSTRUCTION.
7. SEE RESTORATION SHEET FOR B1–B2 CROSS SECTION.

LEGEND

———	ENBRIDGE L3R PIPELINE
— — —	PERMANENT RIGHT OF WAY
———	TEMPORARY WORKSPACE
———	WATERBODY – RIFFLE (ROSGEN SURVEY)
———	WATERBODY – POOL (ROSGEN SURVEY)
———	WATERBODY – RUN (ROSGEN SURVEY)
———	WATERBODY – GLIDE (ROSGEN SURVEY)
MAJOR MINOR	CONTOUR (1' INTERVAL)
-·-·-·-	TOP OF BANK
———	ORDINARY HIGH WATER MARK
▭	FIELD DELINEATED WETLAND
▬	TRAVEL LANE/CONSTRUCTION MATTING
▬	TRENCH – 10'
▬	TRENCH – 20'
▦	SOD MAT

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMITTING		10/2020		
A	ISSUED FOR REVIEW	MJT	08/2020		

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE-SPECIFIC RESTORATION PLAN
SPRING BROOK – MP 1041.3 – MDNR ID 48
STABILIZATION PLAN

ENBRIDGE

SCALE	DWG. NO.	PAGE NO.
	SSRP-1041.3-002	2/7

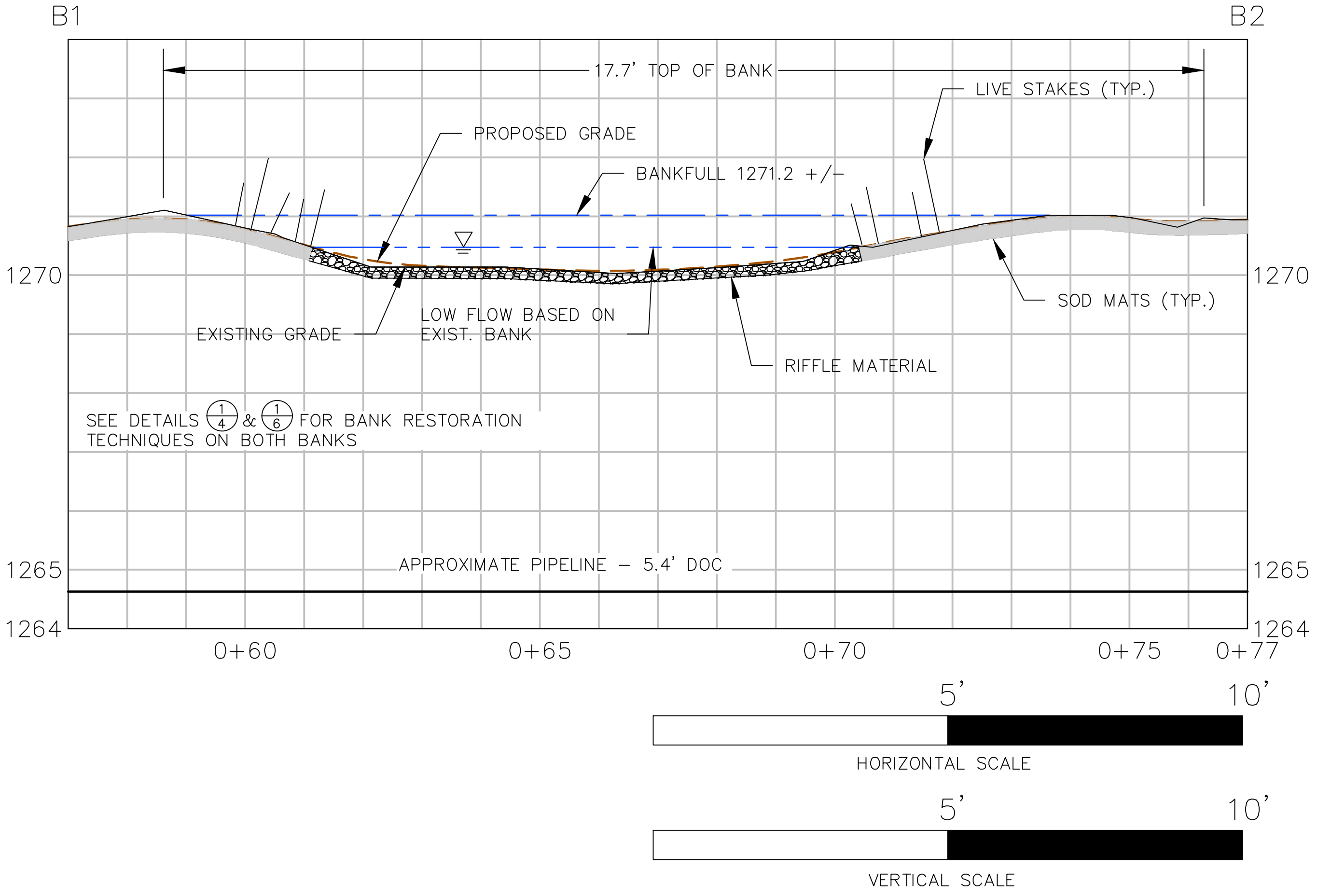
PLOTTED SIZE: ANSI FULL BLEED B (17x11)

	COMMON NAME	SCIENTIFIC NAME
LIVE STAKE SPECIES	ELDERBERRY	SAMBUCUS CANADENSIS
	HIGH BUSH CRANBERRY	VIBURNUM OPOLUS (TRILOBUM)
	RED-OSIER DOGWOOD	CORNUS STOLONIFERA
	SILKY DOGWOOD	CORNUS AMOMUM
	SPECKLED ALDER	ALNUS INCANA
TRANSPLANTS	NONE	NONE
SHRUBS	BUTTONBUSH	(CEPHALANTHUS OCCIDENTALIS)
	SILKY DOGWOOD	(CORNUS AMOMUM)
	GRAY DOGWOOD	(CORNUS FOEMINA)
	RED-OSIER DOGWOOD	(CORNUS STOLONIFERA)
	ELDERBERRY	(SAMBUCUS CANADENSIS)
	NANNYBERRY	(VIBURNUM LENTAGO)
	SPECKLED ALDER	ALNUS INCANA

1. PRELIMINARY SPECIES. PRIOR TO RESTORATION ACTIVITIES, ALL SPECIES WILL BE REQUIRED TO BE VERIFIED AS NATIVE AND FOUND WITHIN THE COUNTY WHERE PLANTED ON MNTAXA.
2. LIVE STAKE SPECIES SELECTION: USE AT LEAST THREE (3) SPECIES WITH NO MORE THAN 60% OF ANY ONE (1) SPECIES; ALTERNATIVE SPECIES MAY BE SELECTED BASED ON SITE CONDITIONS AND AVAILABILITY. ALTERNATIVE SPECIES SHOULD BE REVIEWED AGAINST USDA DATA BASE FOR MN NATIVE SPECIES.
3. (WHERE APPLICABLE) TRANSPLANTS AND/OR CONTAINER SHRUBS MAY BE SUBSTITUTED FOR LIVE STAKES BASED ON SITE SPECIFIC CONDITIONS.
   - 3.1. CONTAINER PLANTED SHRUBS ARE RECOMMENDED TO BE 18"– 24"IN SIZE.
   - 3.2. CONTAINER PLANTED SHRUBS SPACING: 1 SHRUB PER 3 LINEAR FEET OF BANK, ADDITIONAL ROWS SPACED 3 FEET APART, AND 3–5 SHRUBS OF THE SAME SPECIES.
4. (WHERE APPLICABLE) TRANSPLANTS SHOULD BE EXCAVATED WITH A MINIMUM OF 12" SOIL, DIAMETER EQUAL TO PLANT DRIP LINE, AND LOOSE UNBOUND BALL.
5. LIVE STAKE SPACING (WHERE APPLICABLE): STAGGER 1 STAKE PER 3 LINEAR FEET OF STREAM BANK IN 2 – 3 ROWS SPACED 1 FOOT APART. PLACE FIRST ROW ALONG TOP OF BANK (BANKFULL) AND THE LOWER ROW(S) BETWEEN THE TOP OF BANK AND OHWM

① VEGETATION CHART

CROSSING RESTORATION (CENTERLINE)



RESTORATION NOTES:

GENERAL

1. REFER TO RESTORATION DETAIL SHEETS FOR ADDITIONAL INFORMATION RELATED TO PROPOSED RESTORATION MEASURES.
2. REFER TO SITE PHOTOS FOR INFORMATION ON PRE-CONSTRUCTION CROSSING CONDITIONS AND TO PROVIDE ADDITIONAL GUIDANCE FOR RESTORATION EFFORTS.
3. TRENCH IS LOCATED WITHIN AN EXISTING RIFFLE, AS SUCH, THE BED MATERIAL SHALL BE EXCAVATED AND TEMPORARILY STOCKPILED TO BE REINSTALLED AS PART OF CHANNEL BED AND TOE OF BANK RESTORATION EFFORTS. REFER TO RESTORATION CROSS SECTION AND BED PROFILE SHEET 2 TO MAINTAIN THE EXISTING BED FEATURE GRADE CONTROL.
4. RIFFLE MATERIAL IS NATURALLY COMMINGLED WITH A VARIETY OF PARTICLE SIZES TO PROMOTE CHANNEL SURFACE FLOWS. MATERIAL THICKNESS GENERALLY EXTENDS TO A DEPTH OF 1.5 TO 2 TIMES THE LARGEST SURFACE PARTICLE. RESTORED CHANNEL RIFFLE SECTION SHALL INCLUDE RANDOMLY SORTED MATERIALS.
5. EROSION AND SEDIMENT CONTROL WILL BE LIMITED TO NATURAL FIBERS (I.E., CATEGORY 3N OR 4N IN THE 2016 & 2018 MNDOT STANDARDS SPECIFICATIONS FOR CONSTRUCTION).

SOD MATTING

1. REMOVE 10 LINEAR FEET OF VEGETATED MATS ON EITHER SIDE OF THE STREAM CROSSING USING ONSITE EQUIPMENT WHICH CAN UNDERCUT THE VEGETATION FOR REMOVAL. SMALL SHRUBS AND/OR TREES WITHIN THE SOD MATS ARE ACCEPTABLE AND SHOULD NOT BE REMOVED.
2. DEPENDING ON THE LEVEL OF SATURATION AT THE TIME OF REMOVAL, IT MAY BE DIFFICULT TO OBTAIN INTACT CONSOLIDATED MATS, BUT GENERALLY THE NATIVE VEGETATION WILL BE RETAINED AND CAPTURED FOR PLACEMENT.
3. SOD MATS CAN BE TRANSPLANTED DURING ANY SEASON.
4. PLACE THE VEGETATED MATS ON TIMBER MATS LOCATED IN THE ATWS USING ONSITE EQUIPMENT.
5. MONITOR MATS TO SUPPORT SURVIVABILITY; WATERING MAY BE NEEDED.
6. PRIOR TO PLACEMENT OF SOD MATS FINISH GRADE CHANNEL BANK AND ADJACENT FLOODPLAIN APPLICATION AREA TO PROVIDE A SMOOTH AND EVEN SURFACE. SUBGRADE ELEVATION SHOULD ALLOW FOR THE FINISHED SOD SURFACE TO TRANSITION EVENLY WITH THE CHANNEL BANKS UPSTREAM AND DOWNSTREAM OF THE INSTALLATION AREA. AVOID ABRUPT CHANGES IN GRADE.
7. RETURN THE VEGETATED MATS.
   - a. SURFACE APPLIED SOD MATTING SHOULD BE PLACED WITH THE LONG SIDE PERPENDICULAR TO THE CHANNEL / FLOW.
   - b. STACKED SOD MATTING SHOULD BE PLACED WITH THE LONG SIDE PARALLEL TO THE CHANNEL / FLOW.
8. WHEN PLACING SOD MATS, DO NOT LEAVE LARGE GAPS BETWEEN EACH SOD MAT AS NON-NATIVE VEGETATION WILL QUICKLY ATTEMPT TO COLONIZE THESE VOIDS.
9. WATER SOD MATS AFTER REPLACEMENT IF CONDITIONS ARE HOT AND DRY. DAMP AND/OR FROZEN SOD MATS DO NOT REQUIRE WATERING.
10. THE TOP MAT AND/OR OTHER MATS CAN BE ANCHORED WITH A LIVE AND/OR DEAD STOUT STAKE TO ENSURE THAT IT DOES NOT MOBILIZE DURING A FLOOD EVENT BEFORE THE ROOTS HAVE ESTABLISHED.
11. THE VEGETATED MATS WILL BE REPLACED AS SOON AS PRACTICAL FOLLOWING BACKFILLING OF THE TRENCH AND STABILIZED PER THE TIMING REQUIREMENTS DESCRIBED IN SECTION 1.9.1 OF THE EPP.

LIVE STAKING

1. CLEANLY REMOVE ALL SIDE BRANCHES AND THE TOP GROWTH, AND FASHION THE CUTTINGS INTO LIVE STAKES AS DEPICTED IN THE DETAIL DRAWING. AN OPTION DURING PREPARATION IS TO PAINT AND SEAL THE TOP OF THE LIVE STAKE BY DIPPING THE TOP 1-2 INCHES INTO A 50-50 MIX OF LIGHT-COLORED LATEX PAINT AND WATER. SEALING THE TOP OF STAKE WILL REDUCE THE POSSIBILITY OF DESICCATION, ASSURE THE STAKES ARE PLANTED WITH THE TOP UP, AND MAKES THE STAKES MORE VISIBLE FOR SUBSEQUENT PLANTING EVALUATIONS.
2. USE A PUNCH BAR OR HAND AUGER TO CREATE A NARROW PILOT HOLE, PERPENDICULAR TO THE SLOPE, THROUGH ANY EROSION CONTROL MATTING, RIP RAP, OR OTHER REVETMENT, FILTER FABRIC, ETC., IF PRESENT, AND DEEP ENOUGH TO INTERCEPT THE WATER TABLE. THE HOLE SHOULD BE ONLY AS LARGE AS NECESSARY TO INSTALL THE LIVE STAKE WITHOUT DAMAGE WHILE ENSURING THE HIGHEST AMOUNT OF STAKE-SOIL CONTACT.
3. INSERT THE POINTED END OF THE LIVE STAKE INTO THE PILOT HOLE. TAMP INTO THE GROUND WITH A DEAD BLOW HAMMER TAKING CARE NOT TO SPLIT OR OTHERWISE DAMAGE THE LIVE STAKE. USE WATER, SOIL BACKFILL, TAMPING, ETC. TO ACHIEVE GOOD SOIL-TO-STEM CONTACT AND REMOVE AIR POCKETS.
4. USE ONSITE EQUIPMENT TO APPLY WATER FROM THE CHANNEL AFTER INSTALLATION.
5. ALL CUTS SHOULD BE CLEAN AND SMOOTH. NO CRACKED OR SPLIT LIVE STAKES SHOULD BE USED. IF THEY SPLIT DURING TAMPING, THEY SHOULD BE CUT BELOW THE CRACK OR REPLACED.
6. THE SPECIFIED NUMBER OF LIVE STAKES SHOULD BE INSTALLED INTO THE SOIL AND PROTRUDE ABOVE THE SOIL AND ANY SOD MATTING, MULCHING, EROSION CONTROL MATTING, RIP RAP, OR OTHER REVETMENT.
7. LIVE STAKE SHOULD NOT MOVE AFTER INSTALLATION; ENSURING IT IS IN FIRM CONTACT WITH THE SOIL.
8. IT IS IMPORTANT TO ENSURE THAT THE UPSTREAM AND DOWNSTREAM ENDS OF THE LIVE STAKING A MERGE SMOOTHLY INTO THE UNDISTURBED BANK BEYOND THE PROJECT AREA. THE RATE OF INSTALLING LIVE STAKES SHOULD TAPER OFF GRADUALLY TO BLEND IN WITH THE EXISTING VEGETATION.

B	ISSUED FOR PERMITTING		10/2020		
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ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE–SPECIFIC RESTORATION PLAN
SPRING BROOK – MP 1041.3 – MDNR ID 48
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SCALE: NOTED
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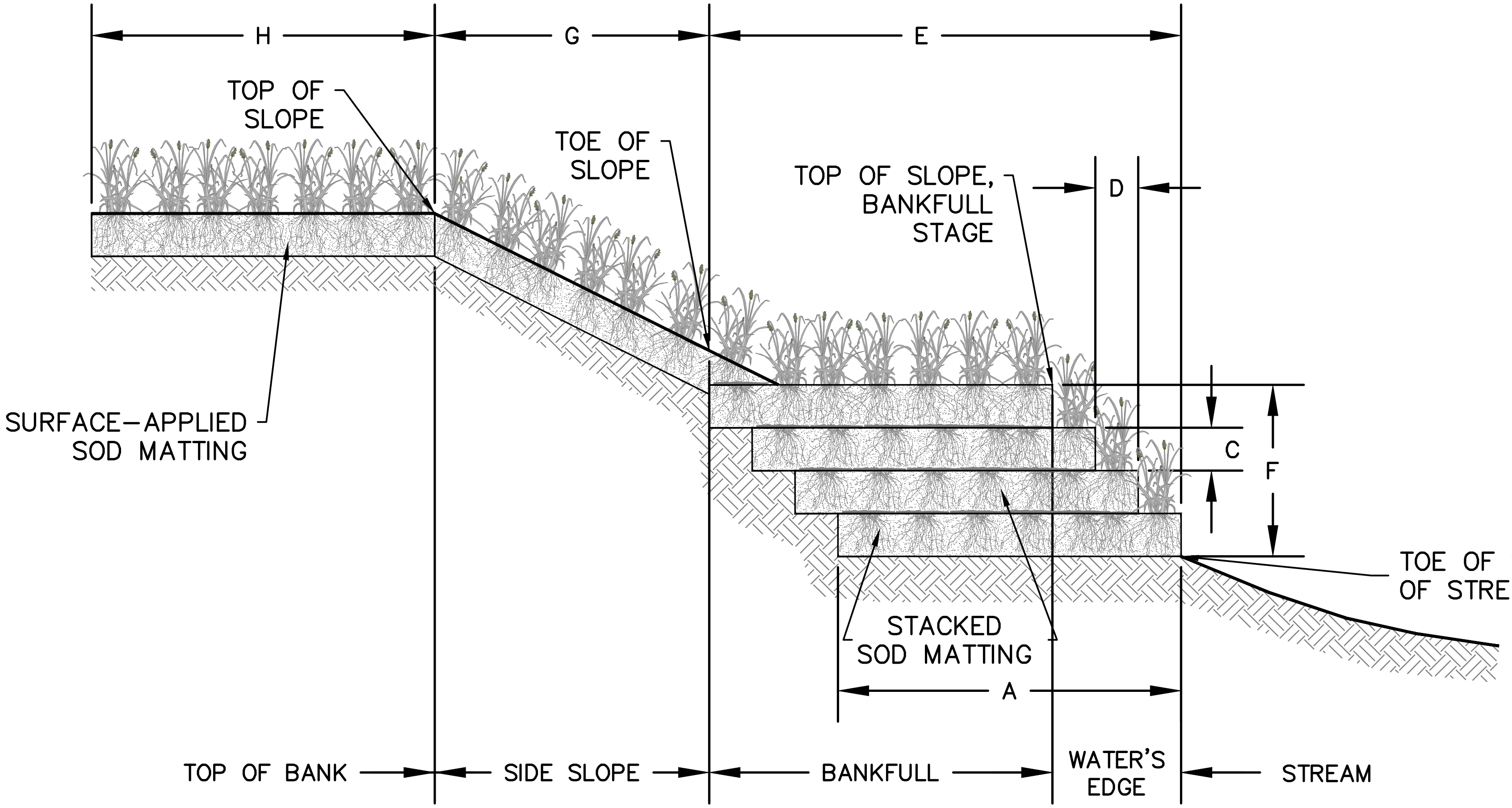
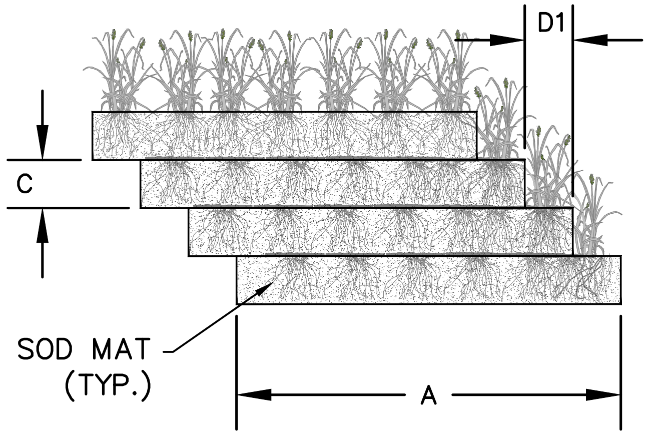
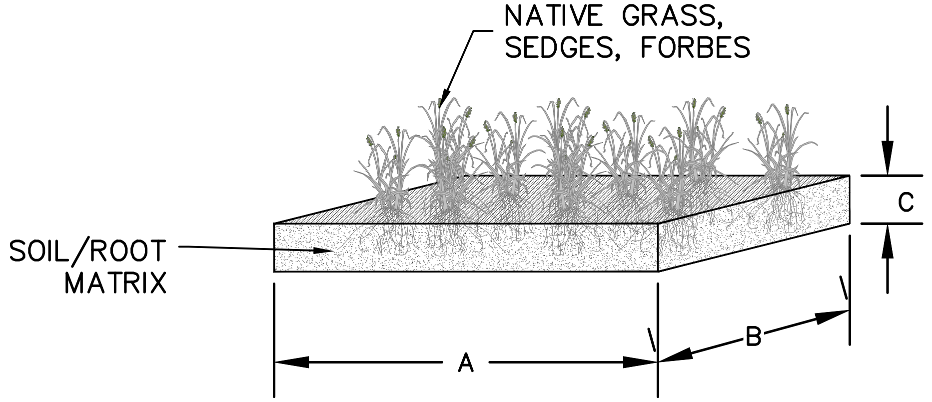
PLOTTED SIZE: ANSI FULL BLEED B (17x11)



CROSS SECTION



STACKED SOD MATTING DETAIL



SOD MAT DETAIL

DIMENSION[1]	NAME	TYPICAL UNIT	VALUE	DESCRIPTION
A	SOD MAT WIDTH	FEET	3-4	WIDTH OF INDIVIDUAL SOD MAT.
B	SOD MAT LENGTH	FEET	3-6	LENGTH OF INDIVIDUAL SOD MAT.
C	SOD MAT THICKNESS	INCHES	12 (MIN)	THICKNESS OF INDIVIDUAL SOD MAT.
D	STACKED SOD MAT SETBACK	FEET, INCHES	N/A	THE DISTANCE BETWEEN THE EDGES OF SOD MATS STACKED TO FORM A SLOPE
E	WIDTH OF STACKED SOD MATS	FEET, INCHES	N/A	WIDTH OF A BANK CREATED BY STACKED SOD MATS
F	HEIGHT OF STACKED SOD MATS	FEET, INCHES	N/A	HEIGHT OF A SLOPE CREATED BY STACKED SOD MATS
G	WIDTH OF SURFACE- APPLIED SOD MATS	FEET, INCHES	10-20	WIDTH OF A SLOPE STABILIZED WITH SURFACE-APPLIED SOD MATS
H	TOP OF BANK SOD MATTING DISTANCE	FEET	VARIES (SEE SHEET 9)	DISTANCE SOD MATTING IS INSTALLED ON THE TOP OF BANK

NOTES:

1. DIMENSION LABELS ARE REFERENCED IN THE DETAIL DRAWINGS.

PHOTO: SOD MATTING W/ TOE WOOD APPLICATION

SOD MAT EXAMPLES

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SOD MATTING DETAIL

ENBRIDGE

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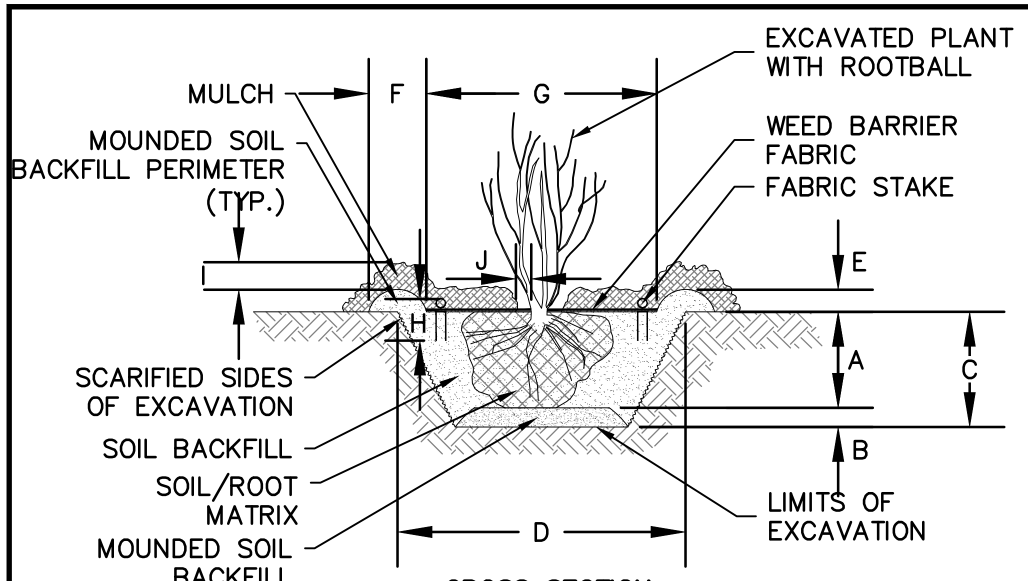


CROSS SECTION

DIMENSION[2]	NAME	TYPICAL UNIT	VALUE	DESCRIPTION
A	PLANTING DEPTH	VARIES	N/A	PLANTING DEPTH OF THE TRANSPLANT.
B	HEIGHT OF MOUNDED SOIL BACKFILL	INCHES	N/A	HEIGHT OF MOUNDED LOOSE SOIL PLACED INTO OVER-EXCAVATED PLANTING PIT.
C	DEPTH OF PLANTING PIT	VARIES	N/A	DEPTH OF THE PLANTING PIT; ACCOMMODATES DIMENSION OF SOIL AND EXCAVATED ROOTS AS WELL AS MOUNDED LOOSE SOIL AT BOTTOM OF PIT.
D	WIDTH OF PLANTING PIT	VARIES	N/A	OVER-EXCAVATED WIDTH OF THE PLANTING PIT; ACCOMMODATES THE WIDTH OF THE EXCAVATED SOIL AND ROOTS.
E	HEIGHT OF MOUNDED SOIL PERIMETER	INCHES	N/A	HEIGHT OF SOIL BERM CONSTRUCTED ALONG THE PERIMETER OF THE PLANTING PIT; HELPS RETAIN WATER.
F	WIDTH OF MOUNDED SOIL PERIMETER	INCHES	N/A	WIDTH OF SOIL BERM CONSTRUCTED ALONG THE PERIMETER OF THE PLANTING PIT; HELPS RETAIN WATER.
G	WIDTH OF WEED BARRIER FABRIC (OPTIONAL)	INCHES	N/A	WIDTH OF FABRIC PLACED ON SURFACE TO CONTROL WEEDS WITHIN THE MOUNDED SOIL PERIMETER; TRANSPLANTS TYPICALLY HAVE GRASSES, LEAF MATTER, ETC. ATTACHED AND DO NOT REQUIRE WEED BARRIER FABRIC.
H	FABRIC STAKE LENGTH (OPTIONAL)	INCHES	N/A	LENGTH OF STAPLES/SPIKES USED TO SECURE WEED BARRIER FABRIC
I	THICKNESS OF MULCH (OPTIONAL)	INCHES	N/A	THICKNESS OF MULCH, IF NECESSARY. TRANSPLANTS TYPICALLY HAVE GRASSES, LEAF MATTER, ETC. ATTACHED AND DO NOT REQUIRE MULCH.
J	GAP BETWEEN MULCH AND PLANT STEM/TRUNK (OPTIONAL)	INCHES	N/A	ROOM BETWEEN PLANT STEM/TRUNK AND MULCH. TRANSPLANTS TYPICALLY HAVE GRASSES, LEAF MATTER, ETC. ATTACHED

NOTES:
1. DATA ARE FOR TRANSPLANTED VEGETATION.
2. DIMENSION LABELS ARE REFERENCED IN THE DETAIL DRAWINGS.

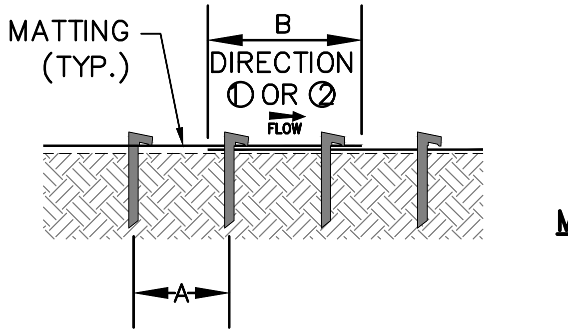

TRANSPLANTS EXAMPLES

TRANSPLANTING DETAIL

DIMENSION[1]	NAME	TYPICAL UNIT	VALUE	DESCRIPTION
A	MATTING STAKE SPACING	FEET	3 O.O.	SPACING BETWEEN EROSION CONTROL MATTING STAKES USED TO FASTEN THE MATTING TO THE SOIL
B	MATTING OVERLAP	INCHES	18	AMOUNT OF EROSION CONTROL MATTING OVERLAP IF MULTIPLE PIECES AND/OR ROLLS OF MATTING ARE USED. OVERLAP VARIES DEPENDING ON THE LOCATION OF THE OVERLAP WITH RESPECT TO POSITION ON THE SLOPE, LOCATION OF THE MATTING (EDGE OR END), AND PRODUCT SPECIFICATIONS.
C	MATTING ANCHOR TRENCH DEPTH	INCHES	6 (MIN)	DEPTH OF TRENCH INTO WHICH EDGE OF EROSION CONTROL MATTING IS ANCHORED AT THE TOP AND/OR TOE OF A SLOPE.
D	MATTING ANCHOR TRENCH WIDTH	INCHES	12	WIDTH OF TRENCH INTO WHICH EDGE OF EROSION CONTROL MATTING IS ANCHORED AT THE TOP AND/OR TOE OF A SLOPE.
E	TOP OF SLOPE ANCHOR TRENCH SETBACK	INCHES	12	TOP OF SLOPE ANCHOR TRENCH DISTANCE FROM THE TOP OF SLOPE. TOP OF SLOPE REFERS TO TOP OF SIDE SLOPE, BANK SLOPE, TERRACE SLOPE, BANKFULL, ETC.
F	MATTING STAKE LENGTH	INCHES	12	LENGTH OF EROSION CONTROL MATTING STAKES OR STAPLES USED TO FASTEN THE MATTING TO THE SOIL

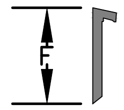
NOTES:
1. DIMENSION LABELS ARE REFERENCED IN THE DETAIL DRAWINGS.
2. O.C. ON CENTER.
3. STAPLES ARE NOT PERMITTED.

EROSION CONTROL MATTING DETAIL



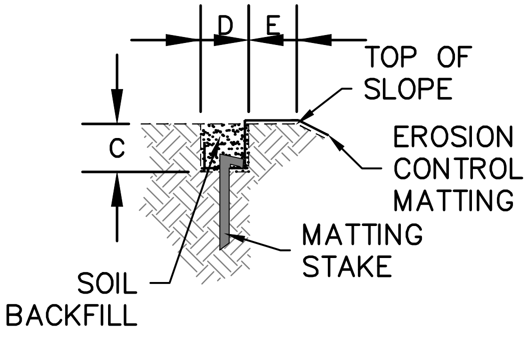
① DIRECTION OF STREAM FLOW
② DIRECTION DOWN THE BANK SLOPE

MATTING OVERLAP DETAIL

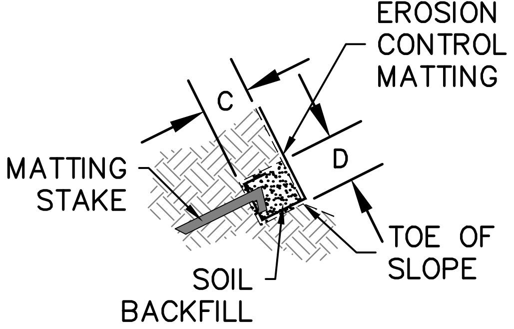


MATTING STAKE DETAIL

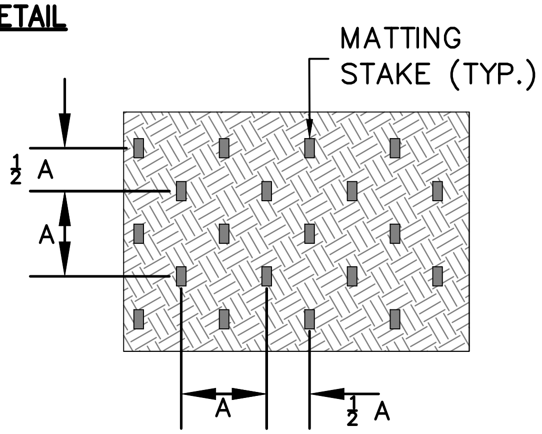
TOP OF SLOPE



TOE OF SLOPE



MATTING ANCHOR DETAIL



MATTING STAKE PATTERN DETAIL

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ENBRIDGE LINE 3 REPLACEMENT PROJECT
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SPRING BROOK – MP 1041.3 – MDNR ID 48
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ENBRIDGE®

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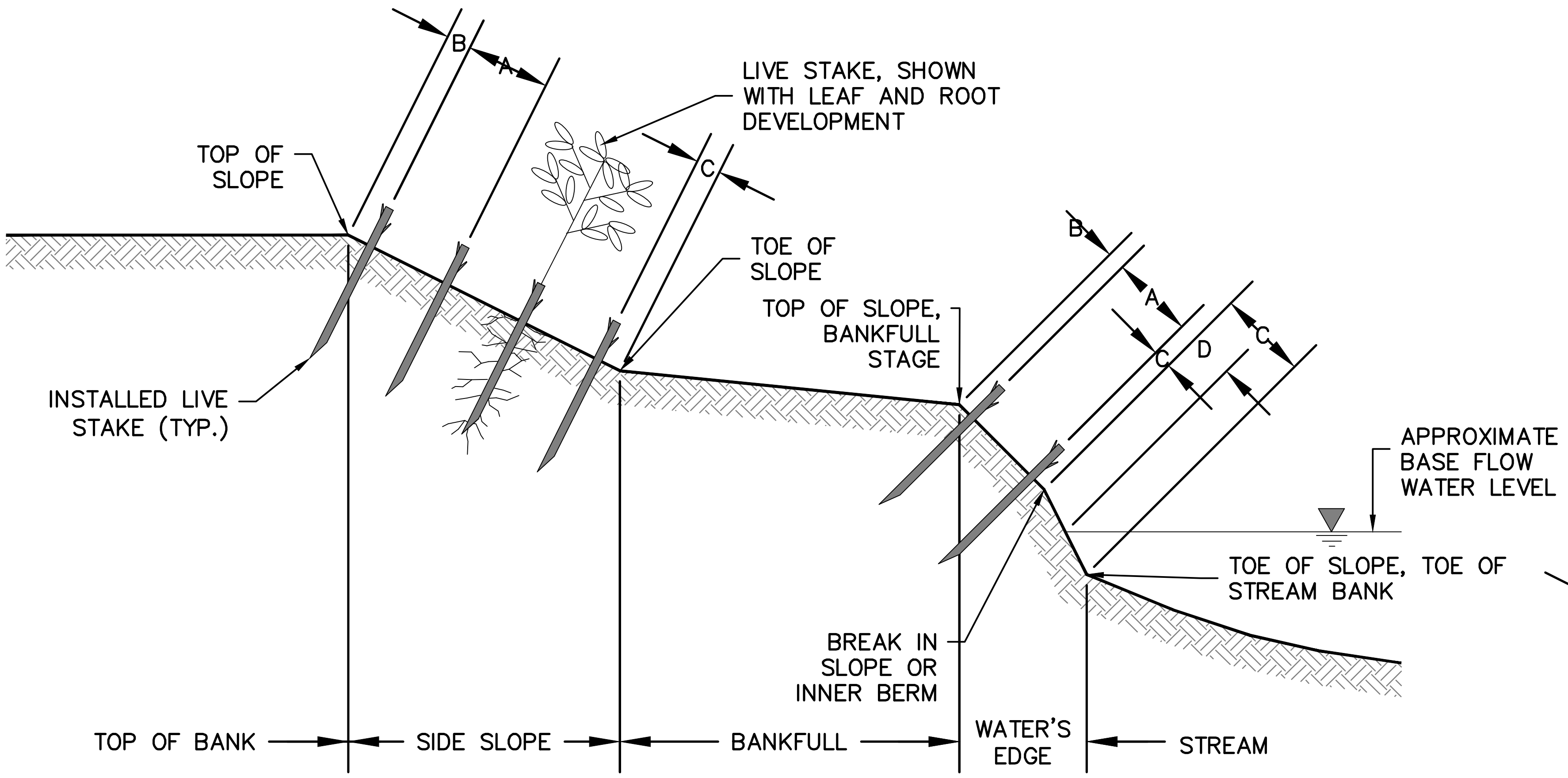
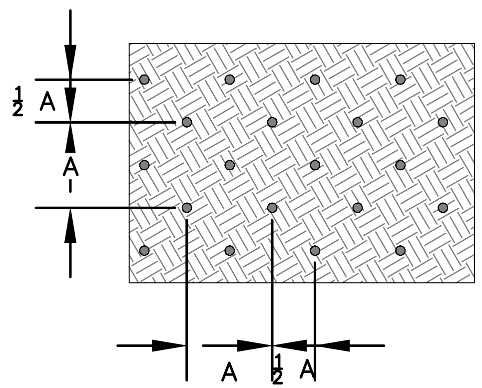
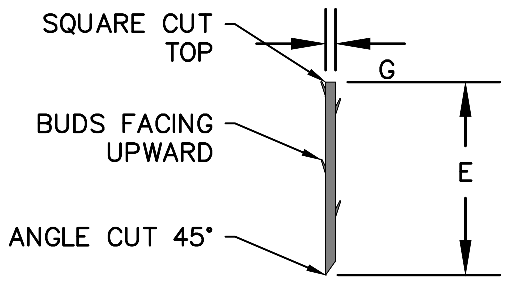
PLOTTED SIZE: ANSI FULL BLEED B (17x11)



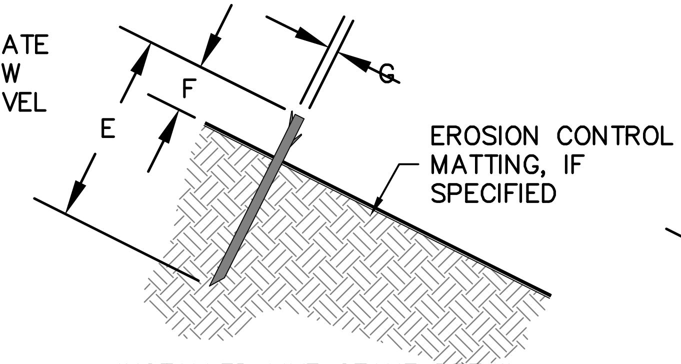
CROSS SECTION



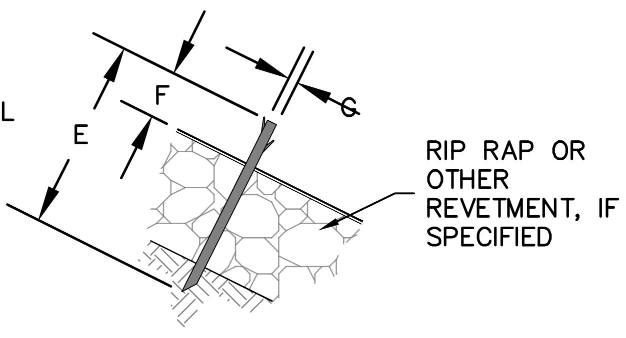
LIVE STAKE PATTERN DETAIL



LIVE STAKE DETAIL



INSTALLED LIVE STAKE DETAIL



INSTALLED JOINT PLANTING DETAIL

LIVE STAKE EXAMPLE

DIMENSION[1]	NAME	TYPICAL UNIT	VALUE	DESCRIPTION
A	LIVE STAKE SPACING	FEET	3 O.O.	SPACING BETWEEN INDIVIDUALLY INSTALLED LIVE STAKES. STAKES CAN BE PLACED IN A TRIANGULAR GRID (NRCS 2007A) OR RANDOMLY (NRCS 2007A, IOWA DNR 2006). RECOMMEND SPECIES DIVERSITY THROUGHOUT PROJECT AREA.
B	LIVE STAKE – TOP OF SLOPE PLACEMENT	INCHES	0.3	POSITION OF LIVE STAKE RELATIVE TO THE TOP OF A SLOPE
C	LIVE STAKE – TOE OF SLOPE PLACEMENT	INCHES	0.3	POSITION OF LIVE STAKE RELATIVE TO THE TOE OF A SLOPE
D	LIVE STAKE – BASE FLOW RELATIONSHIP	FEET	1270.5 +/-	PLACEMENT OF LOWER ROW OF LIVE STAKES RELATIVE TO THE APPROXIMATE BASE FLOW WATER LEVEL WITH CONSIDERATION GIVEN TO DURATION OF INUNDATION DURING BANKFULL AND OTHER HIGH FLOW EVENTS.
E	LIVE STAKE LENGTH	INCHES	24-36	LENGTH OF PREPARED DORMANT LIVE CUTTING FROM WOODY PLANT TO BE USED AS LIVE STAKE. LENGTH SHOULD BE SUFFICIENT TO REACH LOW-FLOW WATER TABLE ELEVATION.
F	LIVE STAKE PROTRUSION	INCHES	3-4	DISTANCE INSTALLED LIVE STAKE SHOULD PROTRUDE ABOUT 20% FROM THE GROUND. AT LEAST TWO BUDS OR BUD SCARS SHOULD BE PRESENT ABOVE THE GROUND IN THE FINAL INSTALLATION, DEPENDING ON THE SURROUNDING VEGETATION HEIGHT.
G	LIVE STAKE DIAMETER	INCHES	1/2- 1 1/2	DIAMETER OF PREPARED DORMANT LIVE CUTTING FROM WOODY PLANT TO BE USED AS LIVE STAKE – TYPICALLY CITE A PERMISSIBLE MINIMUM AND MAXIMUM DIAMETER.

NOTES:

1. DIMENSION LABELS ARE REFERENCED IN THE DETAIL DRAWINGS.

① LIVE STAKE PLANTINGS DETAIL

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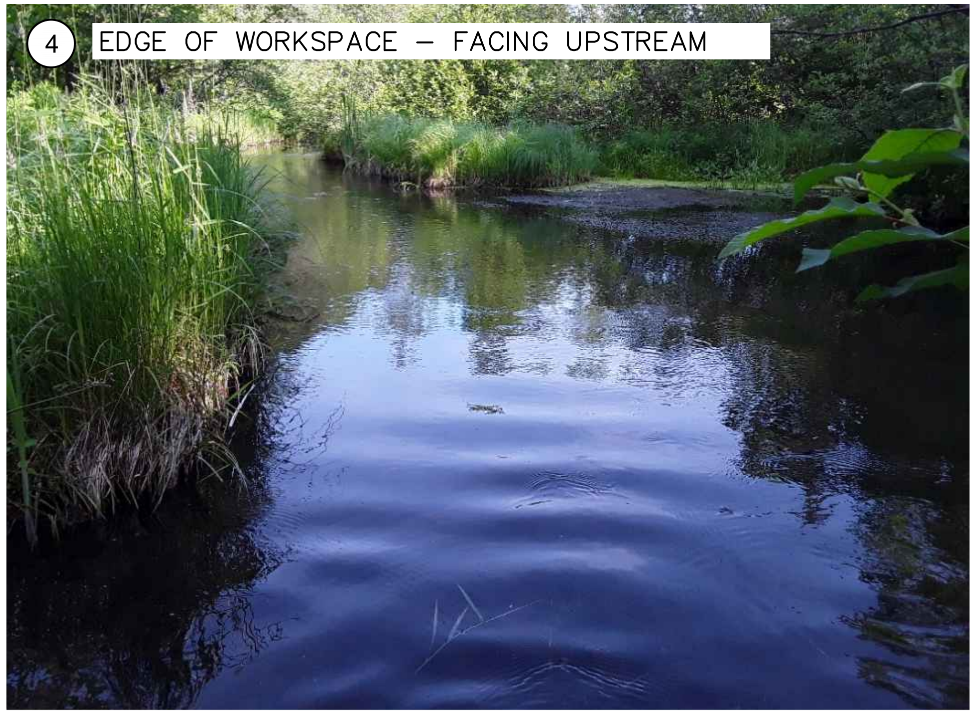
PLOTTED SIZE: ANSI FULL BLEED B (17x11)


1 CENTERLINE – FACING WEST BANK

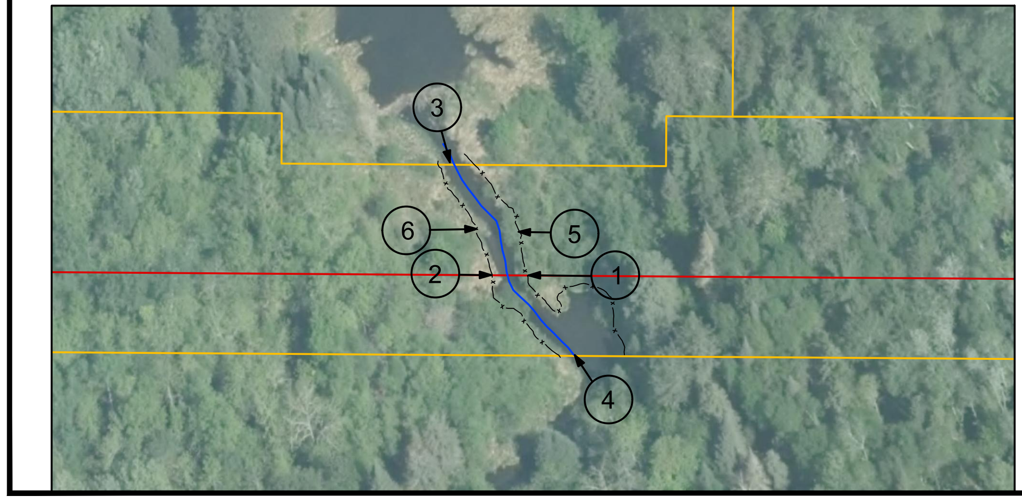

2 CENTERLINE – FACING EAST BANK


3 EDGE OF WORKSPACE – FACING DOWNSTREAM


4 EDGE OF WORKSPACE – FACING UPSTREAM


5 BRIDGE – FACING WEST BANK


6 BRIDGE – FACING EAST BANK



NOTES:

1. AIR PHOTOS ARE FROM 2018 ENBRIDGE AERIAL PHOTOGRAPHY.
2. ADDITIONAL ON–THE GROUND PHOTOS MAY BE TAKEN PRIOR TO CONSTRUCTION AT MDNR REQUEST.
3. PRE–CONSTRUCTION PHOTOS WILL BE USED TO AID IN RESTORATION.

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ENBRIDGE LINE 3 REPLACEMENT PROJECT
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PHOTO PAGE

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GENERAL

1. THE SPECIFICATIONS WITHIN THIS SSRP MAY MODIFY OR REPLACE PROJECT-WIDE STANDARDS PRESENTED IN THE EPP. WHERE MATERIAL WITHIN THESE SSRPS EXCEEDS STANDARD CONSTRUCTION MEASURES IN THE EPP, THESE SSRPS SUPERSEDE THE EPP.

2. CONSTRUCTION AND RESTORATION OF WATERBODY CROSSINGS WILL FOLLOW THESE GENERAL STEPS:

   A. SITE CLEARING
   B. INSTALLATION OF TEMPORARY EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES ("BMPS")
   C. BRIDGE INSTALLATION
   D. EXCAVATION/BACKFILLING OF THE WATERBODY INCLUDING:
      - SOD SAVING TOPSOIL SEGREGATION AT NON-WOODED SITES
      - STREAMBED MATERIAL SEGREGATION
      - PIPE INSTALLATION
      - BACKFILL, INCLUDING IMPLEMENTATION OF CONSTRUCTION-RELATED RESTORATION METHODS (I.E., TOE WOOD)
   E. REPLACEMENT OF STREAMBED MATERIAL AND TOPSOIL/SOD LAYER
   F. RESTORATION OF STREAM BANKS TO PRE-CONSTRUCTION CONTOURS
   G. IF FINAL GRADING NOT POSSIBLE AT THE TIME, TEMPORARY STABILIZATION AND REPLACEMENT/REINFORCEMENT OF TEMPORARY BMPS
   H. AFTER FINAL GRADING, PERMANENT SEEDING AND/OR WOODY VEGETATION RESTORATION, STABILIZATION AND REPLACEMENT/REINFORCEMENT OF TEMPORARY BMPS
   I. BRIDGE REMOVAL DURING FINAL RESTORATION AFTER STABILIZATION AND PERMANENT SEEDING
   J. POST-CONSTRUCTION MONITORING

CROSSING METHODS

1. ALL WATERBODY AND WETLAND CROSSINGS WILL BE CONDUCTED IN COMPLIANCE WITH SECTION 2.0 AND SECTION 3.0 OF THE ENVIRONMENTAL PROTECTION PLAN ("EPP"), RESPECTIVELY. SECTION 2.0 AND 3.0 OF THE WINTER CONSTRUCTION PLAN PRESENTS MODIFICATIONS FOR WATERBODY AND WETLAND CONSTRUCTION METHODS, RESPECTIVELY, IN WINTER CONDITIONS.

2. ENBRIDGE'S SUMMARY OF CONSTRUCTION METHODS AND PROCEDURES (THE "PROCEDURES," APPENDIX A OF THE EPP) OUTLINES THE VARIOUS CONSTRUCTION METHODS THAT ENBRIDGE MAY UTILIZE TO CONSTRUCT THROUGH WATERBODIES AND WETLANDS/BASINS AS PRESENTED ON THESE SITE-SPECIFIC RESTORATION PLANS ("SSRPS").

   A. DRY CROSSING (ISOLATED) METHODS (INCLUDING THE DRY CROSSING AND MODIFIED DRY CROSSING METHOD) ARE DESCRIBED SECTIONS 4.3 OF THE PROCEDURES, AND IN SECTIONS 2.5.2 AND 2.5.3 AND FIGURES 23 AND 24 OF THE EPP.
   B. THE BORE METHOD (NON-PRESSURIZED) IS DESCRIBED IN SECTION 3.5 OF THE PROCEDURES, AND SECTION 4.0 OF THE EPP.
   C. THE MODIFIED UPLAND CONSTRUCTION (WETLAND) METHOD IS DESCRIBED IN SECTION 3.3 OF THE PROCEDURES, AND SECTION 3.0 AND FIGURES 30 TO 34 OF THE EPP.
   D. ALTHOUGH NOT PROPOSED AS A PRIMARY METHOD AT THESE SSRP WATERBODIES, THE OPEN CUT (NON-ISOLATED) WATERBODY CROSSING METHOD IS DESCRIBED IN SECTION 4.1 OF THE PROCEDURES, AND SECTION 2.5.1 AND FIGURE 24 OF THE EPP.
   E. ALTHOUGH NOT PROPOSED AS A PRIMARY METHOD AT THESE SSRP WATERBODIES, THE PUSH-PULL METHOD IS DESCRIBED IN SECTION 3.4 OF THE PROCEDURES, AND SECTION 3.7.1 AND FIGURES 35 AND 36 OF THE EPP.

CLEARING/VEGETATION REMOVAL

1. STUMPS WITHIN THE TRENCH LINE WILL BE COMPLETELY REMOVED, GROUND, AND/OR HAULED OFF-SITE TO AN APPROVED LOCATION. TREE STUMPS OUTSIDE THE TRENCH LINE WILL BE GROUND BELOW NORMAL GROUND SURFACE TO FACILITATE A SAFE WORK AREA AND TO ALLOW TOPSOIL REMOVAL, IF NECESSARY. IN SOME CIRCUMSTANCES, TREE STUMPS OUTSIDE THE TRENCH LINE MAY BE COMPLETELY REMOVED TO ALLOW FOR A SAFE WORK AREA AND HAULED OFF-SITE TO AN APPROVED LOCATION AS OUTLINED IN SECTION 1.8.3 OF THE EPP.

2. CLEARING WILL BE CONDUCTED IN WATERBODIES AND WETLANDS AS OUTLINED IN SECTION 2.2 AND 3.2 OF THE EPP, RESPECTIVELY. CHIPS, MULCH, OR MECHANICALLY CUT WOODY DEBRIS SHALL NOT BE STOCKPILED IN A WETLAND. HYDRO-AX DEBRIS, OR SIMILAR CAN BE LEFT IN THE WETLAND IF SPREAD EVENLY IN THE CONSTRUCTION WORKSPACE TO A DEPTH THAT WILL ALLOW FOR NORMAL REVEGETATION, AS DETERMINED BY THE EI. CHIPPING IS NOT ALLOWED ON PUBLIC LANDS. ON PUBLIC LANDS, MULCH AND MECHANICALLY CUT WOODY DEBRIS MUST BE UNIFORMLY BROADCAST TO LESS THAN 2-INCH THICKNESS AND IN A MANNER THAT MAINTAINS VISIBLE GROUND.

3. ENBRIDGE WILL PROPERLY INSTALL AND MAINTAIN REDUNDANT SEDIMENT CONTROL MEASURES IMMEDIATELY AFTER CLEARING AND PRIOR TO INITIAL GROUND DISTURBANCE AT SURFACE WATERS LOCATED WITHIN 50 FEET OF THE PROJECT AND WHERE STORMWATER FLOWS TO THE SURFACE WATER (REFER TO THE ENVIRONMENTAL PLAN SHEETS IN THE SWPPP), AND WITHIN 100 FEET OF SPECIAL AND IMPAIRED WATERS, INCLUDING TROUT STREAMS.

4. ON PUBLIC LANDS AND WHEREVER PRACTICABLE AT WATERBODY CROSSINGS, ENBRIDGE WILL USE WILDLIFE-FRIENDLY EROSION AND SEDIMENT CONTROL BMPS THAT CONTAIN BIODEGRADABLE NETTING (CATEGORY 3N OR 4N NATURAL FIBER) AND WILL AVOID THE USE OF PLASTIC MESH (SECTIONS 1.17.1 AND 2.6.1 OF THE EPP).

TEMPORARY STABILIZATION

1. ON PORTIONS OF THE PROJECT WHERE WORK WILL BE OCCURRING DURING APPLICABLE "WORK IN WATER RESTRICTIONS" FOR PUBLIC WATERS (REFER TO SECTION 2.1), ALL EXPOSED SOIL AREAS WITHIN 200 FEET OF THE WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE STABILIZED WITHIN 24 HOURS DURING THE RESTRICTION PERIOD. STABILIZATION OF ALL EXPOSED SOILS WITHIN 200 FEET OF THE PUBLIC WATER'S EDGE, AND THAT DRAIN TO THAT WATER, WILL BE INITIATED IMMEDIATELY AND COMPLETED WITHIN 7 CALENDAR DAYS WHENEVER CONSTRUCTION ACTIVITY HAS PERMANENTLY OR TEMPORARILY CEASED ON ANY PORTION OF THE SITE OUTSIDE OF THE RESTRICTION PERIOD. THESE AREAS WILL BE IDENTIFIED ON THE ENVIRONMENTAL PLAN SHEETS ACCOMPANYING THE SWPPP.

2. HYDRO-MULCH AND LIQUID TACKIFIER CAN BE USED IN PLACE OF CERTIFIED WEED-FREE STRAW OR HAY MULCH WITH PRIOR APPROVAL FROM ENBRIDGE. ALL HYDROMULCH AND LIQUID TACKIFIER PRODUCTS USED WILL BE ON THE APPLICABLE STATE DOT PRODUCT LIST. HYDRO-MULCH AND LIQUID TACKIFIER PRODUCTS CONTAINING PLASTIC/POLYPROPYLENE FIBER ADDITIVES AND MALACHITE GREEN (COLORANT) WILL NOT BE UTILIZED ON THIS PROJECT. APPLICATION RATES WILL BE AT THE MANUFACTURER'S RECOMMENDED RATE. ENBRIDGE WILL AVOID THE USE OF HYDROMULCH ON PUBLIC LANDS; HOWEVER, ENBRIDGE MAY USE HYDROMULCH ON STEEP SLOPES TO PREVENT EROSION UNTIL PERMANENT COVER HAS BEEN ESTABLISHED AS OUTLINED IN SECTION 1.8.3 OF THE EPP.

RESTORATION AND STABILIZATION

1. ENBRIDGE WILL RESTORE THE STREAM BANKS AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS UNLESS THAT SLOPE IS DETERMINED TO BE UNSTABLE. IF THE SLOPE IS CONSIDERED UNSTABLE, ENBRIDGE WILL RESHAPE THE BANKS TO PREVENT SLUMPING. FOR PUBLIC WATERS, ENBRIDGE WILL RETURN THE BANK TO PRE-CONSTRUCTION CONTOURS, UNLESS OTHERWISE DIRECTED BY THE SITE-SPECIFIC RESTORATION PLAN. IF ENBRIDGE CANNOT RESTORE TO PRE-CONSTRUCTION CONTOURS AT A PUBLIC WATER, ENBRIDGE WILL CONSULT WITH THE MDNR BEFORE PROCEEDING FURTHER AS OUTLINED IN SECTION 2.6 OF THE EPP.

2. UNSTABLE SOILS AND/OR SITE-SPECIFIC FACTORS SUCH AS STREAM VELOCITY AND FLOW DIRECTION MAY REQUIRE ADDITIONAL RESTORATION EFFORTS, SUCH AS INSTALLATION OF WOODY VEGETATION, GEOTEXTILE FABRIC, OR TREE, LOG, ROOTWAD, OR BOULDER REVETMENTS TO STABILIZE DISTURBED STREAM BANKS (SEE FIGURE 29) AS OUTLINED IN SECTION 2.6.2 OF THE EPP. ENBRIDGE WILL WORK WITH THE MDNR TO ENSURE ALL WORK/ADJUSTMENTS ARE APPROVED AND ARE CONDUCTED WITHIN APPLICABLE TIMING RESTRICTIONS.

3. IN UPLAND AND WETLAND AREAS, CLEANUP AND ROUGH GRADING WILL OCCUR AS OUTLINED IN SECTIONS 1.16 AND 3.9 OF THE EPP. ENBRIDGE WILL BACKFILL THE TRENCH TO AN ELEVATION SIMILAR TO THE ADJACENT AREAS OUTSIDE THE TRENCH LINE AND WILL ADD A SLIGHT CROWN OF APPROXIMATELY 3 TO 6 INCHES (DEPENDING ON SOIL TYPE) OVER THE BACKFILLED TRENCH TO ALLOW FOR SUBSIDENCE. GENERALLY, EXCESS SUBSOIL DISPLACED BY THE PIPE INSTALLATION WILL BE SPREAD ACROSS THE PORTION OF THE CONSTRUCTION WORKSPACE WHERE TOPSOIL REMOVAL HAS OCCURRED. ANY REMAINING EXCESS SUBSOIL WILL BE REMOVED AND DISPOSED OF AT AN APPROVED OFF-SITE LOCATION AS NEEDED TO ENSURE CONTOURS ARE RESTORED TO AS NEAR AS PRACTICABLE TO PRE-CONSTRUCTION CONDITIONS.

4. REVEGETATION ACTIVITIES WILL OCCUR AS OUTLINED IN SECTION 7.0 OF THE EPP. SEED MIXES AT PUBLIC WATERS WILL BE SELECTED AND APPLIED AS INDICATED IN THE PLANTING PLAN, WHICH IS APPENDIX A OF THE POST-CONSTRUCTION VEGETATION MANAGEMENT PLAN FOR PUBLIC LANDS AND WATERS ("VMP"). SEED MIXES RELATIVE TO THESE SSRP CROSSINGS ARE CODED AS FOLLOWS:

A	EMERGENT (34-181)	G	DRY PRAIRIE GENERAL (35-221)
B	RIPARIAN NE (34-361)	H	MESIC PRAIRIE GENERAL (35-241)
C	RIPARIAN S&W (34-261)	I	MESIC PRAIRIE NW (35-441)
D	WET MEADOW NE (34-371)	J	DRY PRAIRIE NORTHWEST (35-421)
E	WET MEADOW S&W (34-271)	K	WOODLAND EDGE NE (36-311)
F	WETLAND REHABILITATION (34-171)	L	NATURAL REVEGETATION

5. ENBRIDGE WILL NOT SEED STANDING WATER OR WOODED (PSS AND PFO) WETLAND COMMUNITIES. NATURAL REVEGETATION WILL TAKE PLACE FROM EXISTING PLANT MATERIAL AND ROOT STOCK IN THESE COMMUNITIES.

6. ALL MATERIALS USED FOR CONSTRUCTION OF THE PROJECT MUST BE REMOVED FROM THE SITE.

7. ENBRIDGE WILL CONDUCT POST-CONSTRUCTION MONITORING IN ACCORDANCE WITH THE POST-CONSTRUCTION MONITORING PLAN FOR WETLANDS AND WATERBODIES, AND IN ACCORDANCE WITH THE VMP FOR THE UPLAND PORTIONS OF THE PROJECT ON PUBLIC LANDS.

ENBRIDGE

B	ISSUED FOR PERMITTING	MJT	10/2020		
NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D

ENBRIDGE LINE 3 REPLACEMENT PROJECT
SITE-SPECIFIC RESTORATION PLAN

CONSTRUCTION NOTES

SCALE
DWG. NO. SSRP-NOTES
PAGE NO.

PLOTTED SIZE: ANSI FULL BLEED B (17x11)

Appendix C

2015 Rosgen Survey Report

(Note that although this report references North Dakota Pipeline Company's Sandpiper Pipeline Project, the data remains relevant for the Line 3 Replacement Project)

Appendix 30. CA147_525a1WB

Spring Brook, Cass County

PM Sean D. Date 4/08/2016

QA/QC J. George Athanasakes Date 4/08/2016

Vicinity Map

Field Survey Checklist

Initials

SDC

Collect the following data at a minimum for each Wadeable Stream Geomorphic Survey (WSGS) crossing site

Crossing CA147_525a1WB

☑ Survey Control – Minnesota North, NAD 83 feet
☑ Identify bankfull per Harrelson et al., 1994
☑ Survey longitudinal profile for a distance of at least 20 times bankfull width (1000' maximum)
☑ Survey Plan Form Measurements
☑ Survey a minimum of two (2) cross-sections (one each at a riffle and pool)
☑ Sample bed material using Wolman pebble count procedure
☑ Sketch site per Harrelson et al., 1994
☑ Photographs / Photo Log

Work Item Checklist

Initials

JGA

Provide the following items for each Wadeable Stream Geomorphic Survey (WSGS) crossing site

Crossing CA147_525a1WB

30.1 Site Narrative

☑ 30.1.1 Location and drainage area description
☑ 30.1.2 Site description
☑ 30.1.3 Geomorphic description and conditions summary
☑ -- Table A30.1 Site summary
☑ -- Figure A30.1 Drainage area map
☑ -- Figure A30.2 Site and surrounding area map

30.2 Exhibits

☑ Exhibit A30.1 Site sketch map
☑ Exhibit A30.2 Photographs and photo log
☑ Exhibit A30.3 Morphological relations, including dimensionless ratios
☑ Exhibit A30.4 Plot of longitudinal profile
☑ Exhibit A30.5 Plot of cross-sections
☑ Exhibit A30.6 Bed Material Characterization
☑ Exhibit A30.7 Bank Erosion Hazard Index (BEHI)
☑ Exhibit A30.8 Near-Bank Stress (NBS)
☑ Exhibit A30.9 BEHI/NBS Summary
☑ Exhibit A30.10 Pfankuch Stability Rating

Glossary

Alluvial	Of or pertaining to deposits formed by flowing water
Anastomosed channel	Stream with multiple channels
Bankfull, bankfull depth, bankfull stage	The elevation on the stream bank where flooding begins. The depth (or stage) of flow that fills the channel to the top of its banks and at a point where the water begins to overflow onto a floodplain
Compound pool	A pool with an undulating stream bed; a pool with multiple low points where the bed rises up (glides), but does not rise up enough to form a riffle, and then descends (runs) into the next low point
Entrenched	Vertically contained relative to the adjacent floodplain
Erosion	The wearing-away of soil by flowing water, wind, or ice
Forb	Herbaceous plant that is not a grass or grass-like
Floodplain	Low land that borders a stream and is inundated periodically by the stream's water
Flood-prone area	The floodplain inundated at a flow depth equal to twice that of bankfull
Geomorphic	Of or pertaining to the origin or evolution of landforms (such as landforms shaped by river processes).
Glide	The downstream end of a pool where the stream bed rises up to the beginning of the next riffle
Hummock	An elevated area rising above the general elevation of a marshland
Morphology	The form or structure of a feature
Near-bank stress	Shear stress exerted by flowing water on the stream bank
Pattern, also planform (or plan form)	Horizontal alignment of a channel. View is perpendicular to the earth's surface
Pavement	The surface materials in a stream bed
Pool	A section of stream where water flow is deeper and slower than in other sections
Riffle	A section of stream where water flow is more shallow and rapid than in other sections
Riparian	Of, pertaining to, or situated (located) adjacent to a river or stream
Run	The downstream end of a riffle where the stream bed descends into the next pool
Sub-pavement	The sub-surface materials in a stream bed
Thalweg	The deepest portion of the channel
Terrace	A level area of land with a more or less abrupt descent to a river, floodplain, or another terrace

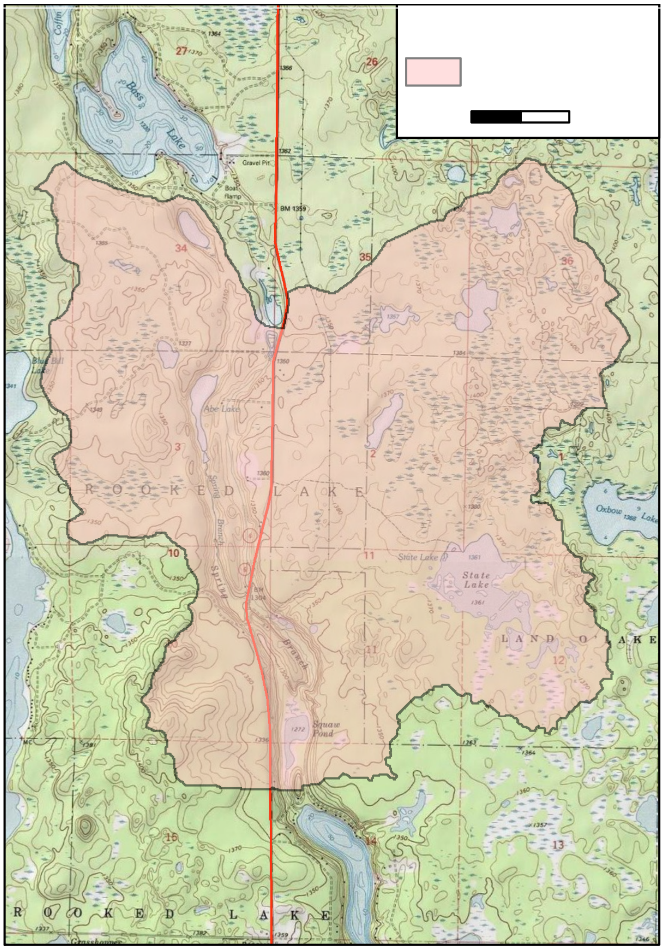
Abbreviations

Abkf	Bankfull cross-sectional area	**LTOB**	Left top of bank, facing downstream
BANK	Streambank	**LTOE**	Left toe of channel, facing downstream
BKF or BKF2	Bankfull	**LV**	Levee
CH	Channel bottom, profile, thalweg	**RB**	Right streambank
D, including D16, D50, D85, etc.	Diameter	**RTOB**	Right top of bank, facing in the downstream direction
DAM	Dam	**RTOE**	Right toe of channel, facing downstream
Dbkf or dbkf	Bankfull depth	**TER**	Terrace
EXPIPE	Exposed pipe	**TOB**	Top of Bank
HB	High bank	**WBKF**	Bankfull width
LB	Left streambank	**WS**	Water surface

1. The definitions and abbreviations provided here are in the context of this report and appendices.
2. In Exhibits where the abbreviations shown here are not used, the different abbreviation is identified.

30.1 SITE NARRATIVE

30.1.1 Location and Drainage Area Description



Crossing CA147_525a1WB is located on Spring Brook just upstream of Andresen Bay Dr. and downstream of Scout Camp Pond north of Outing in Cass County, MN. The crossing has a Public Land Survey System (PLSS) legal description of NW ¼ NW ¼, S14, T139N, R14W. The drainage area is approximately 6 square miles consisting of predominantly forest land with small areas of agricultural land generally along roadways (Figure A30.1). Spring Brook is part of the Crooked Creek watershed that drains into the Pine (hydrologic unit [HU] 07010105). Spring Brook is a perennial stream and is a tributary to a trout lake (Roosevelt Lake). It is also located downstream of a Department of Natural Resources (DNR) Aquatic Management Area.

30.1.2 Site Description

The geomorphic survey site includes an approximately 400-linear foot, wadeable reach of Spring Brook and the adjacent riparian area. The site is mostly downstream of crossing CA147_525a1WB in a wide, gently sloping valley (Figure A30.2). A beaver dam at the outfall of Scout Pond defines the upper limit of the survey reach. The stream is shallow, relatively wide and moderately sinuous with well-defined bed and banks. Stream banks are grassy and floodplain vegetation changes from grasses to woody shrubs and trees as the floodplain transitions to upland slopes. Upland slopes are steep (≈ 1.5(H):1(V), rise more than 50', and are covered with mature trees and shrubs; grasses and understory vegetation are limited. In the lower half of the survey reach a low rock dam, armored channel banks and an actively mowed floodplain are present adjacent to an existing cabin. An ATV ford is located approximately 100' downstream of the Scout Pond beaver dam.

30.1.3 Geomorphic Description and Conditions Summary

Stantec performed a geomorphic survey and conditions assessment at the Crossing CA147_525a1WB Spring Brook site in the summer of 2015. The reach at the site is a stable Rosgen C4c- stream type – a slightly entrenched, low-gradient, meandering, riffle/pool, gravel dominated channel within a well-developed floodplain. The stream meanders through a relatively broad alluvial valley with steep terrace slopes (Rosgen Type VIIIb). The data show the reach is stable. The stream banks are low, well-vegetated, and bank height is close to bankfull depth. Overhanging tree limbs provide minor flow obstructions in addition to the previously discussed beaver dam and low rock dam. The survey reach is located below the outfall of Scout Pond and the Roosevelt Lake (≈ 0.2 miles downstream); the water surface slope remains relatively flat throughout the reach, dropping abruptly at both dam locations. Channel bed materials are fairly dark; sediment deposits are infrequent or absent, small, and comprised of sands and silts. Aquatic vegetation is present along the channel banks, in pools, and areas with slow moving water.

Table A30.1 presents summary information about the site. Morphological parameters, including dimensionless ratios, and other data and analysis follow as Exhibits A30.1 through A30.10. All geomorphic survey data was processed and analyzed using RIVERMorph™.

Table A30.1 Site Summary

Site ID	Crossing CA147_525a1WB Spring Brook
Stantec Survey Protocol [1]	Wadeable stream
Sediment Data Collection Method [1]	Pebble count
Rosgen Valley Type	VIIIb
Rosgen Stream Type	C4c-
Bankfull Elevation (FT)	1271.13
Minnesota Bankfull Regional Curve [2]	N/A
Pfankuch Stability Rating	Good (Stable)
Bank Erosion Hazard Index Adjective	Low
Near-Bank Stress Adjective	Moderate
Estimated Total Bank Erosion	4.8 tons/year
Estimated Unit Bank Erosion Rate	0.01 tons/year/foot
Special Conditions	Beaver dam, rock dam, ATV ford

Notes:

1. Survey and data collection methods are described in the report.
2. Bankfull determination made using field indicators only.

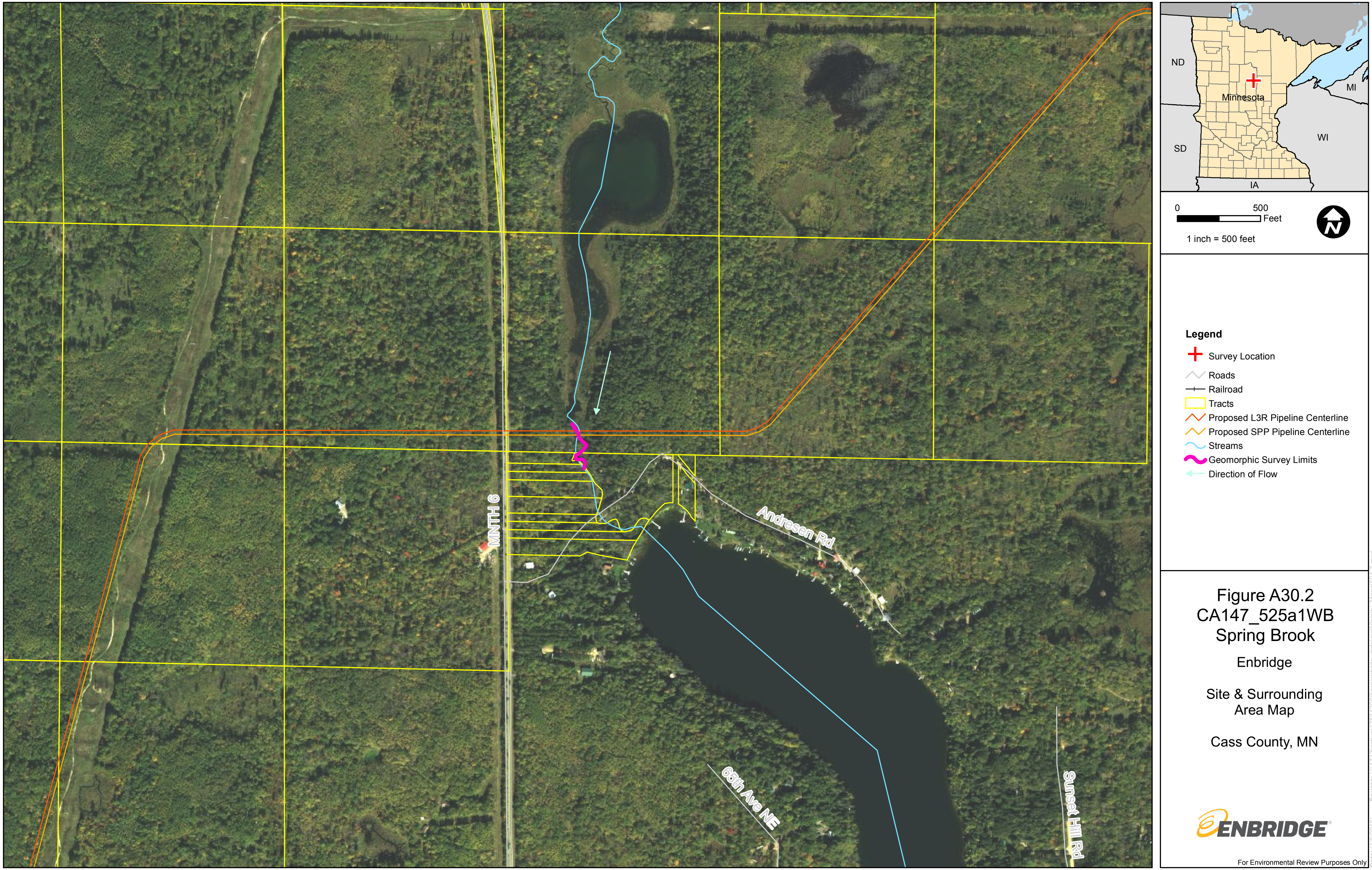


Figure A30.2
CA147_525a1WB
Spring Brook

Enbridge

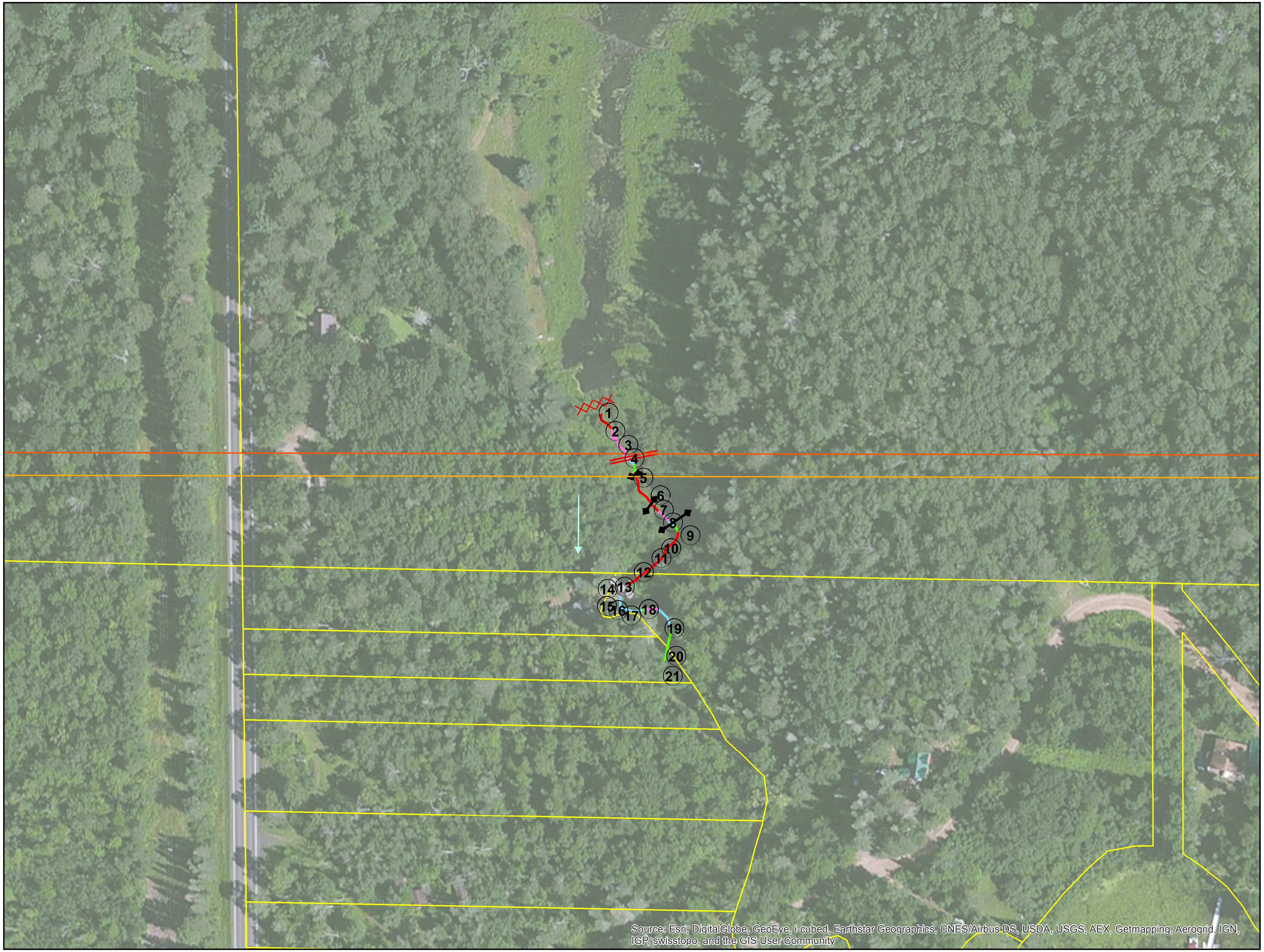
Site & Surrounding Area Map

Cass County, MN

ENBRIDGE

For Environmental Review Purposes Only

Date: (1/8/2016) Source: V:\1713\active\175613060\project\site_data\gis\Vicinity_Maps\504-7.mxd



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 100 Feet

1 inch = 100 feet

N

Legend

- ✚ Survey Location
- ⑮ Photo Points
- Proposed L3R Pipeline Centerline
- Proposed SPP Pipeline Centerline
- ✕✕✕ Beaver dam
- ═ Ford crossing
- ●●● Rock dam
- ◆━◆ Cross Section
- → Direction of Flow

Bed Features

- Riffle
- Run
- Glide
- Pool
- Compound Pool
- ☐ Tracts

Exhibit A30.1
CA147_525a1WB
Spring Brook

Enbridge

Stream Geomorphic
Survey Site Sketch

Clearwater County, MN

ENBRIDGE

For Environmental Review Purposes Only

Date: (1/28/2016) **Source:** V:\1713\active\175613060\project\site_data\gis\SketchMaps\site_sketch_report_504-7_rev.mxd

Exhibit A30.2 Photographs

Photo 1. Center - facing upstream of reach

Photo 2. Center - facing upstream ≈sta. 00+00

Photo 3. Center – facing upstream ≈sta. 00+25

Photo 4. Center - facing upstream ≈sta. 00+50

Photo 5. Center - facing upstream ≈sta. 00+75

Photo 6. Center - facing upstream ≈sta. 01+00 (riffle x-section)


Photo 7. Center -facing upstream ≈sta. 01+25 (riffle x-section)


Photo 8. Center - facing upstream ≈sta. 01+50


Photo 9. Center -facing upstream ≈sta. 01+75 (pool x-section)


Photo 10. Center -facing upstream ≈sta. 02+00


Photo 11. Center - facing upstream ≈sta. 02+20


Photo 12. Center - facing upstream ≈sta. 02+40


Photo 13. Center - facing upstream ≈sta. 02+60


Photo 14. Center - facing upstream ≈sta. 02+80


Photo 15. Center - facing upstream ≈sta. 03+00


Photo 16. Center - facing upstream ≈sta. 03+20


Photo 17. Center - facing upstream ≈sta. 03+40


Photo 18. Center - facing upstream ≈sta. 03+60

Photo 19. Center - facing upstream ≈sta. 03+80

Photo 20. Center - facing upstream ≈sta. 04+00

Photo 21. Center - facing downstream ≈sta. 04+00

Exhibit A30.3 Morphological Relations, including Dimensionless Ratios

Stream: **Spring Brook** Location: **CA147_525a1WB**

Observers: **SC, RM, BR** Date: **07/01/15** Valley Type: **VIIIb** Stream Type: **C 4c-**

Riffle Width (W_{bkf})				ft	Riffle Cross-Sectional Area (A_{bkf}) (ft^2)			
Mean Riffle Depth (d_{bkf})				ft	Riffle Width/Depth Ratio (W_{bkf} / d_{bkf})			
Maximum Riffle Depth (d_{max})				ft	Max Riffle Depth to Mean Riffle Depth (d_{max} / d_{bkf})			
Width of Flood-Prone Area (W_{fpa})				ft	Entrenchment Ratio (W_{fpa} / W_{bkf})			

Pool Width (W_{bkfp})				ft	Pool Width to Riffle Width (W_{bkfp} / W_{bkf})			
Mean Pool Depth (d_{bkfp})				ft	Mean Pool Depth to Mean Riffle Depth (d_{bkfp} / d_{bkf})			
Pool Cross-Sectional Area (A_{bkfp})				ft	Pool Area to Riffle Area (A_{bkfp} / A_{bkf})			
Maximum Pool Depth (d_{maxp})				ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})			

*Riffle–Pool system (i.e., C, E, F stream types) bed features include riffles, runs, pools and glides.

**Step–Pool system (i.e., A, B, G stream types) bed features include riffles, rapids, chutes, pools and steps (note: include rapids and chutes in riffle category).

***Convergence-Divergence system (i.e., D stream types) bed features include riffles and pools; cross-sections taken at riffles for classification purposes.

****Mean values are used as the normalization parameter for all dimensionless ratios; e.g., minimum pool width to riffle width ratio uses the *mean* riffle width value.

Exhibit A30.3 Morphological Relations, including Dimensionless Ratios, continued

Stream: **Spring Brook** Location: **CA147_525a1WB**

Observers: **SC, RM, BR** Date: **07/01/15** Valley Type: **VIIIb** Stream Type: **C 4c-**

Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})		ft/sec	Estimation Method		
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})		cfs	Drainage Area		mi^2

Stream Meander Length (L_m)				ft	Stream Meander Length Ratio (L_m / W_{bkf})			
Radius of Curvature (R_c)				ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})			
Belt Width (W_{blt})				ft	Meander Width Ratio (W_{blt} / W_{bkf})			
Riffle Length (L_r)				ft	Riffle Length to Riffle Width (L_r / W_{bkf})			
Individual Pool Length (L_p)				ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})			
Pool to Pool Spacing (P_s)				ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})			

Valley Slope (S_{val})		ft/ft	Average Water Surface Slope (S)		ft/ft	Sinuosity (S_{val} / S)	
Stream Length (SL)		ft	Valley Length (VL)		ft	Sinuosity (SL / VL)	

Low Bank Height (LBH)	start		ft	Max Depth (d_{max})	start		ft	Bank-Height Ratio (BHR) (LBH / d_{max})	start	
	end		ft		end		ft		end	

Riffle Slope (S_{rif})				ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)			
Run Slope (S_{run})				ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)			
Pool Slope (S_p)				ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)			
Glide Slope (S_g)				ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)			
Step Slope (S_s)				ft/ft	Step Slope to Average Water Surface Slope (S_s / S)			

Max Riffle Depth (d_{maxrif})				ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})			
Max Run Depth (d_{maxrun})				ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})			
Max Pool Depth (d_{maxp})				ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})			
Max Glide Depth (d_{maxg})				ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})			
Max Step Depth (d_{maxs})				ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})			

% Silt/Clay				D_{16}					mm
% Sand				D_{35}					mm
% Gravel				D_{50}					mm
% Cobble				D_{84}					mm
% Boulder				D_{95}					mm
% Bedrock				D_{100}					mm

[a] Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.

[b] Composite sample of riffles and pools within the designated reach.

[c] Active bed of a riffle.

[d] Height of roughness feature above bed.

Exhibit A30.4 Longitudinal Profile

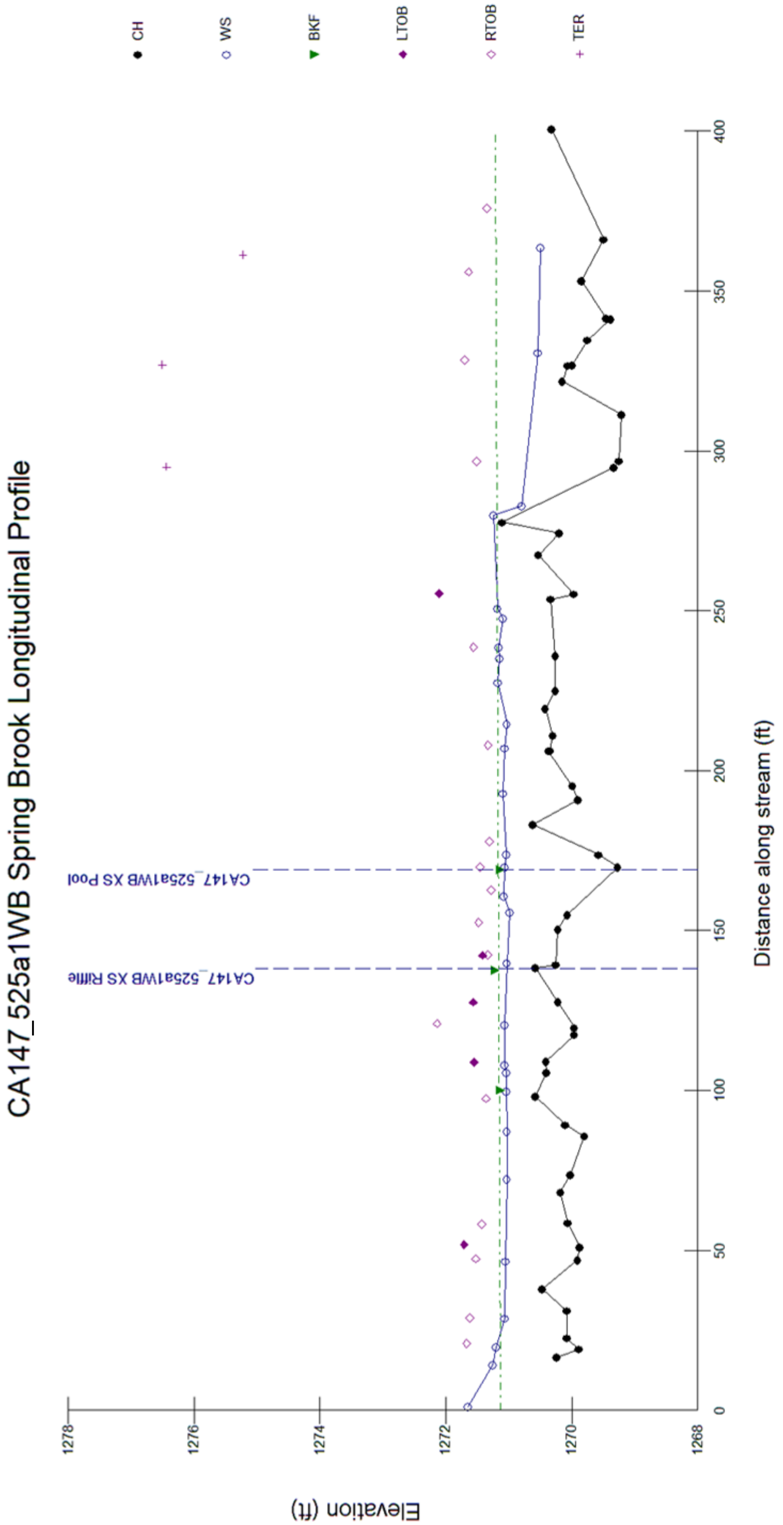


Exhibit A30.5 Plot of Cross Section - Riffle

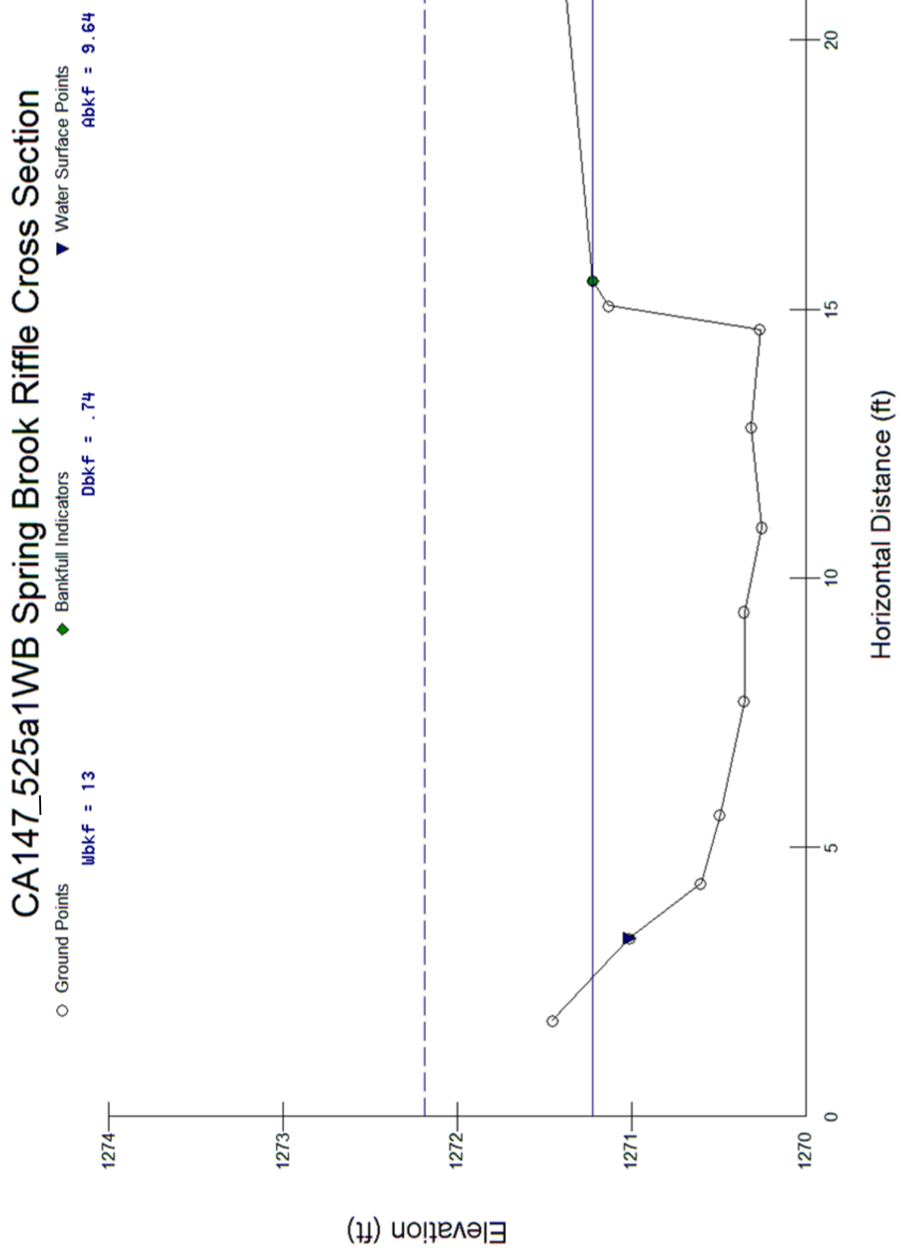


Exhibit A30.5 Plot of Cross Section - Pool

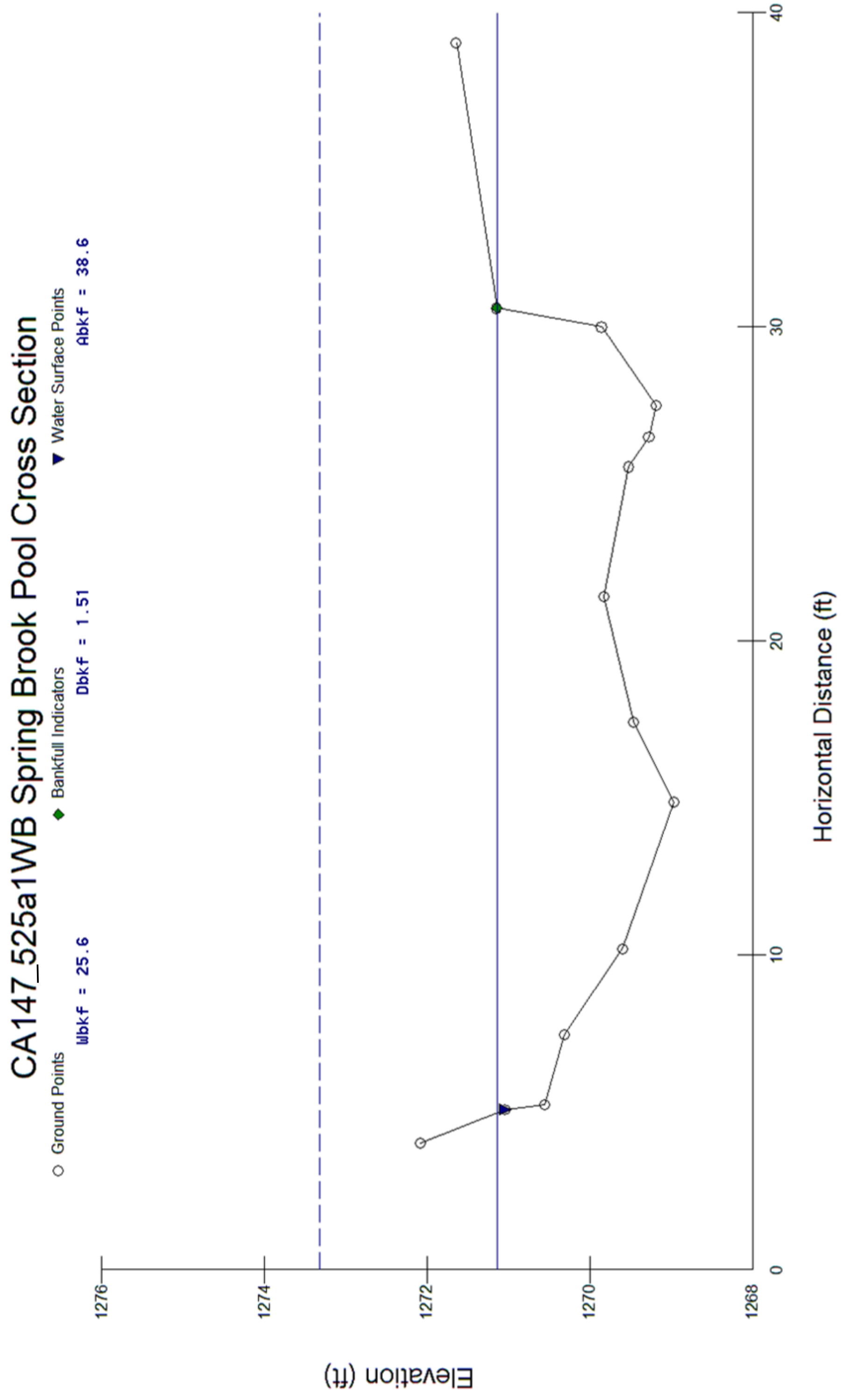
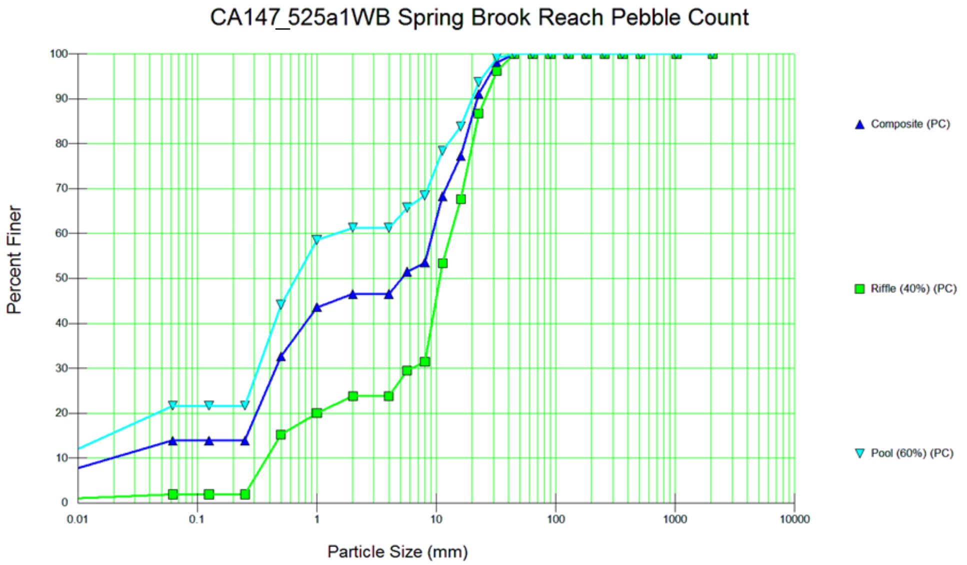
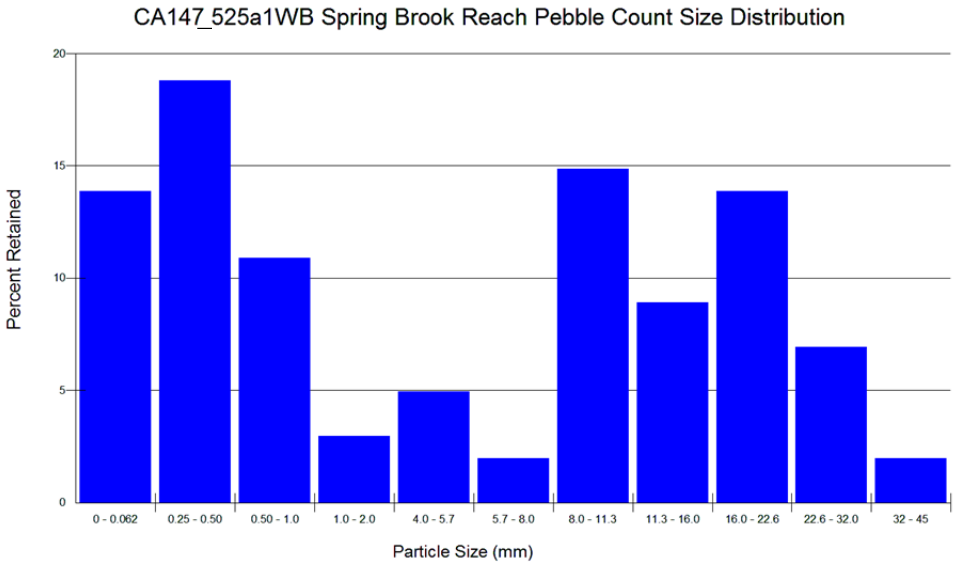
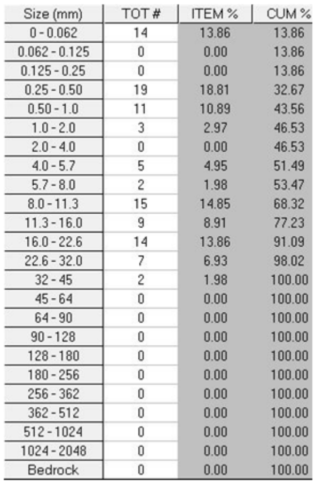


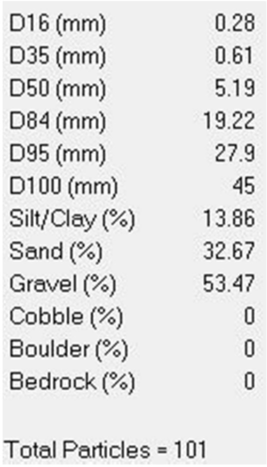
Exhibit A9.6 Bed Material







Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	14	13.86	13.86
0.062 - 0.125	0	0.00	13.86
0.125 - 0.25	0	0.00	13.86
0.25 - 0.50	19	18.81	32.67
0.50 - 1.0	11	10.89	43.56
1.0 - 2.0	3	2.97	46.53
2.0 - 4.0	0	0.00	46.53
4.0 - 5.7	5	4.95	51.49
5.7 - 8.0	2	1.98	53.47
8.0 - 11.3	15	14.85	68.32
11.3 - 16.0	9	8.91	77.23
16.0 - 22.6	14	13.86	91.09
22.6 - 32.0	7	6.93	98.02
32 - 45	2	1.98	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00



D16 (mm)	0.28
D35 (mm)	0.61
D50 (mm)	5.19
D84 (mm)	19.22
D95 (mm)	27.9
D100 (mm)	45
Silt/Clay (%)	13.86
Sand (%)	32.67
Gravel (%)	53.47
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 101

Exhibit A30.7 Bank Erosion Hazard Index (BEHI)

Stream: **Spring Brook** Location: **CA147_525a1WB**

Station: **Average Banks** Observers: **NR, RM, SC**

Date: **7/1/15** Stream Type: **C 4c-** Valley Type: **VIIIb**

BEHI Score (Fig. 3-7)

Study Bank Height / Bankfull Height (C)

Study Bank Height (ft) =	1.7 (A)	Bankfull Height (ft) =	1.1 (B)	(A) / (B) =	1.55 (C)	5.8

Root Depth / Study Bank Height (E)

Root Depth (ft) =	2 (D)	Study Bank Height (ft) =	1.7 (A)	(D) / (A) =	1.18 (E)	0.6

Weighted Root Density (G)

Root Density as % =	90 (F)	(F) × (E) =	105.882 (G)	0.7

Bank Angle (H)

Bank Angle as *Degrees* =	70 (H)	4.9

Surface Protection (I)

Surface Protection as % =	80 (I)	1.9

Bank Material Adjustment:

Bedrock (Overall Very Low BEHI)

Boulders (Overall Low BEHI)

Cobble (Subtract 10 points if uniform medium to large cobble)

Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt/Clay (no adjustment)

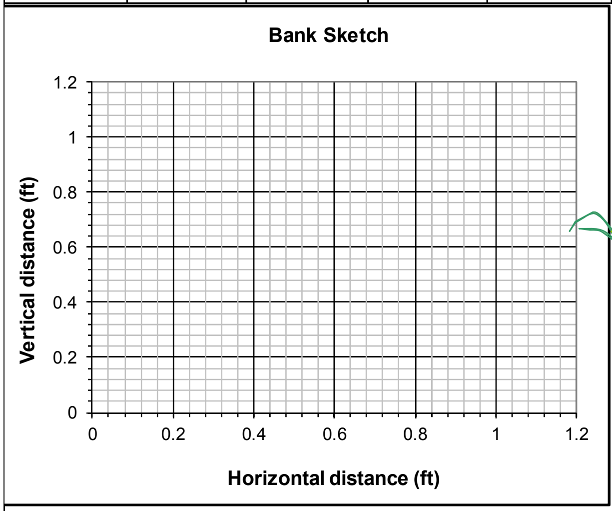
Bank Material Adjustment 0

Stratification Adjustment

Add 5–10 points, depending on position of unstable layers in relation to bankfull stage 0

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and **Total Score**: **Low** **13.9**



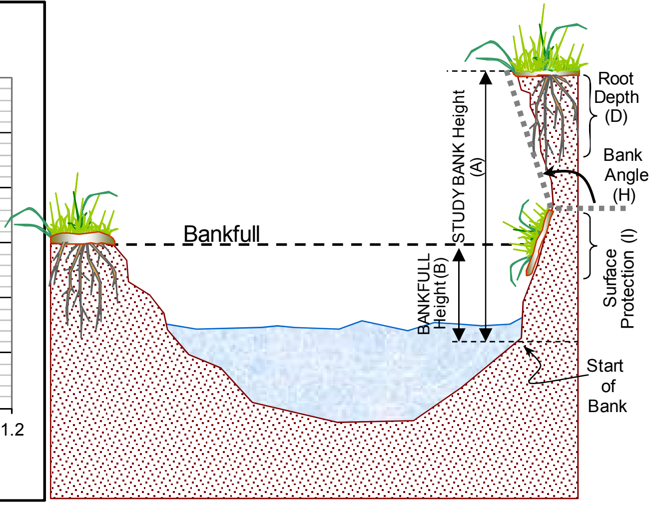


Exhibit A30.8 Near Bank Stress (NBS)

Estimating Near-Bank Stress (NBS)

Stream: **Spring Brook** Location: **CA147_525a1WB**

Station: **Average Banks** Stream Type: **C 4c-** Valley Type: **VIIIb**

Observers: **RM, NR, SC** Date: **7/1/15**

Methods for Estimating Near-Bank Stress (NBS)

(1)	Channel pattern, transverse bar or split channel/central bar creating NBS	Level I	Reconaissance
(2)	Ratio of radius of curvature to bankfull width (R_c / W_{bkf})	Level II	General prediction
(3)	Ratio of pool slope to average water surface slope (S_p / S)	Level II	General prediction
(4)	Ratio of pool slope to riffle slope (S_p / S_{rif})	Level II	General prediction
(5)	Ratio of near-bank maximum depth to bankfull mean depth (d_{nb} / d_{bkf})	Level III	Detailed prediction
(6)	Ratio of near-bank shear stress to bankfull shear stress (τ_{nb} / τ_{bkf})	Level III	Detailed prediction
(7)	Velocity profiles / Isovels / Velocity gradient	Level IV	Validation

Level I

(1)

Transverse and/or central bars-short and/or discontinuous………...……………...….NBS = High / Very High

Extensive deposition (continuous, cross-channel)……………..……………...…..…………....NBS = Extreme

Chute cutoffs, down-valley meander migration, converging flow……………………….……….NBS = Extreme

Level II

(2)

Radius of Curvature R_c (ft)	Bankfull Width W_{bkf} (ft)	*Ratio* R_c / W_{bkf}	Near-Bank Stress (NBS)

(3)

Pool Slope S_p	Average Slope S	*Ratio* S_p / S	Near-Bank Stress (NBS)

(4)

Pool Slope S_p	Riffle Slope S_{rif}	*Ratio* S_p / S_{rif}	Near-Bank Stress (NBS)

Dominant Near-Bank Stress

Moderate

Level III

(5)

Near-Bank Max Depth d_{nb} (ft)	Mean Depth d_{bkf} (ft)	*Ratio* d_{nb} / d_{bkf}	Near-Bank Stress (NBS)
1.7	**1.1**	**1.55**	**Moderate**

(6)

Near-Bank Max Depth d_{nb} (ft)	Near-Bank Slope S_{nb}	Near-Bank Shear Stress τ_{nb} (lb/ft^2)	Mean Depth d_{bkf} (ft)	Average Slope S	Bankfull Shear Stress τ_{bkf} (lb/ft^2)	Ratio τ_{nb} / τ_{bkf}	Near-Bank Stress (NBS)

Level IV

(7)

Velocity Gradient (ft / sec / ft)	Near-Bank Stress (NBS)
0	**0**

Converting Values to a Near-Bank Stress (NBS) Rating

Near-Bank Stress (NBS) ratings	**Method number**						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Very Low	N/A	> 3.00	< 0.20	< 0.40	< 1.00	< 0.80	< 0.50
Low	N/A	2.21 – 3.00	0.20 – 0.40	0.41 – 0.60	1.00 – 1.50	0.80 – 1.05	0.50 – 1.00
Moderate	N/A	2.01 – 2.20	0.41 – 0.60	0.61 – 0.80	1.51 – 1.80	1.06 – 1.14	1.01 – 1.60
High	See	1.81 – 2.00	0.61 – 0.80	0.81 – 1.00	1.81 – 2.50	1.15 – 1.19	1.61 – 2.00
Very High	(1)	1.50 – 1.80	0.81 – 1.00	1.01 – 1.20	2.51 – 3.00	1.20 – 1.60	2.01 – 2.40
Extreme	Above	< 1.50	> 1.00	> 1.20	> 3.00	> 1.60	> 2.40

Overall Near-Bank Stress (NBS) rating **Moderate**

Exhibit A30.9 BEHI/NBS Summary

Stream: **Spring Brook** Location: **CA147_525a1WB**

Graph Used: **Colorado** Total Stream Length (ft): **400** Date: **7/1/2015**

Observers: **RM, NR, SC** Valley Type: **VIIIb** Stream Type: **C 4c-**

(1) Station (ft)	(2) BEHI rating (Worksheet 3-11) (adjective)	(3) NBS rating (Worksheet 3-12) (adjective)	(4) Bank erosion rate (Figure 3-9 or 3-10) (ft/yr)	(5) Length of bank (ft)	(6) Study bank height (ft)	(7) Erosion subtotal [(4)×(5)×(6)] (ft^3/yr)	(8) Erosion Rate (tons/yr/ft) {[(7)/27] × 1.3 / (5)}
1. Average Banks	Low	Moderate	0.073	800.0	1.7	98.60	0.00590
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							

Sum erosion subtotals in Column (7) for each BEHI/NBS combination	Total Erosion (ft^3/yr)	98.60
Convert erosion in ft^3/yr to yds^3/yr {divide Total Erosion (ft^3/yr) by 27}	Total Erosion (yds^3/yr)	3.65
Convert erosion in yds^3/yr to tons/yr {multiply Total Erosion (yds^3/yr) by 1.3}	Total Erosion (tons/yr)	4.75
Calculate erosion per unit length of channel {divide Total Erosion (tons/yr) by total length of stream (ft) surveyed}	Unit Erosion Rate (tons/yr/ft)	0.0119

Exhibit A30.10 Pfankuch (1975) modified Rosgen (1996, 2001b)

Stream: Spring Brook **Location:** CA147_525a1WB **Valley Type:** VIIIb **Observers:** NR, SC, RM **Date:** 7/1/2015

Loca-tion	Key	Category	Excellent		Good		Fair		Poor	
			Description	Rating	Description	Rating	Description	Rating	Description	Rating
Upper banks	1	Landform slope	Bank slope gradient <30%.	[✓ 2]	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	[✓ 3]	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	[✓ 4]	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense soil-binding root mass.	[✓ 3]	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species and less vigor indicating poor, discontinuous and shallow root mass.	12
Lower banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	[✓ 1]	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank-Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; over-bank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio > 1.4. Bank-Height Ratio (BHR) > 1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	[✓ 8]
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	[✓ 4]	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	[✓ 4]	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	[✓ 4]	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	[✓ 4]
	11	Brightness	Surfaces dull, dark or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	[✓ 2]	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	[✓ 4]	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	[✓ 8]	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	[✓ 12]	30–50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water too.	[✓ 1]	Common. Algae forms in low velocity and pool areas. Moss here too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4
			Excellent total =	18	Good total =	34	Fair total =	0	Poor total =	12

Stream type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+
Stream type	**DA3**	**DA4**	**DA5**	**DA6**	**E3**	**E4**	**E5**	**E6**	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**		
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107		
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120		
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+		

Grand total =	64
Existing stream type =	C 4c-
*Potential stream type =	C4c-
Modified channel stability rating = Good (Stable)	

*Rating is adjusted to potential stream type, not existing.

Appendix D

2015 Spring Survey Report

(Note that although this report references North Dakota Pipeline Company's Sandpiper Pipeline Project, the data remains relevant for the Line 3 Replacement Project)

Spring Survey Report

Spring Creek / Spire Valley Spring Survey
Cass County, Minnesota
Stantec Project #: 175613060

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July 27, 2015

Sign-off Sheet

This document entitled Spring Survey Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of North Dakota Pipeline Company LLC (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

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1.0 INTRODUCTION

The North Dakota Pipeline Company (NDPC), in consultation with the Minnesota Department of Natural Resources ("MNDNR"), identified potential spring activity located south of the Spire Valley Aquatic Management Area and hatchery. Due to potential spring activity NDPC agreed to conduct a spring investigation to catalog the springs on land owned by NDPC.

Stantec Consulting Services Inc. (Stantec) performed a spring survey and inventory of the Spring Creek / Spire Valley study area (the "Study Area") on behalf of NDPC. The Study Area is approximately 80 acres in size and located in Section 14, Township 139 North, Range 26 East, Township of Crook Lake, Cass County, Minnesota. Specifically, the Study Area is located around Scout Camp Pond on the east and west sides of Minnesota Trunk Highway (MNTH) 6 (Figure 1).

The purpose and objective of the spring survey was to identify the extent and spatial arrangement of springs within the Study Area. The spring survey was completed by Jake Fahrenkrog and Julia Millet of Stantec on June 15th, 16th and 17th, 2015. Eighteen (18) springs were identified within the Study Area.

2.0 METHODS

2.1 SPRING SURVEY

Stantec obtained and reviewed existing U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) county soil surveys, aerial photography, U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) mapping, topographic information including LiDAR and U.S. Geological Survey (USGS) topographic maps, and MNDNR Protected/Public Waters mapping for the project site prior to conducting the field data collection. This information was utilized to help understand the locations of potential springs and to gain a better understanding of the site's water resources. The data obtained was used to generate field maps as well as subsequent report figures, located in Appendix A.

Spring surveys were based on guidance received from the MNDNR and the Wisconsin Geological and Natural History Survey Inventory of Wisconsin's Springs (Macholl, 2007). Specifically, a spring survey protocol was adapted from the Desert Research Institute Spring Inventory and Monitoring Protocol (Sada and Pohlman, 2004). This document and associated datasheets were adapted as necessary for use in Minnesota.

On-site surveys were conducted and the following spring attributes were collected at each spring identified on-site: spring type and arrangement, disturbed status, spring channel dimensions and substrate composition, approximate discharge rates, vegetation notes, and water physical and chemical parameters. The following sections further describe the attributes and how they were collected. Spring-specific data forms are located in Appendix B. Representative photographs were taken for each spring and the surrounding area and are located in Appendix C. Springs observed outside of the Study Area were not mapped. Springs that continued outside of the Study Area were not mapped beyond the property boundary. Spring type determinations and flowpath delineations were made using sound scientific judgement and the equipment and methods approved in the scope of services which does not include groundwater investigations.

2.1.1 Types of Spring

Spring types were classified based upon the surficial geology present for each spring as well as landscape location.

Three types of springs were predicted to be identified during the subject survey: helocrene, rheocrene and limnocrene. These spring types are defined as follows:

Helocrene: Marshy wet meadows; no discrete source;

Rheocrene: Flowing spring; emerges into one or more stream channels;

Limnocrene: Emergence of groundwater; forms a pool.

After pre-survey discussions with the MNDNR, it was decided that in addition to the general classification, a more specific classification based on site conditions would also be used. This more specific spring type classification is based upon a distinct elevation in the Study Area where springs could be expected to emerge from the ground. Therefore, typical spring type terminology was not used to classify springs identified during this survey. The abovementioned distinct elevation was 1300 feet above sea level (msl). Springs stemming from the 1300 foot msl contour line were defined as 'upper springs' and could generally be seen as divots in the LIDAR which was reviewed prior to the survey. Springs stemming from the foot of an upper terrace were defined as 'intermediate till-unit contact springs'. Springs that created littoral seeps or that were plainly visible along the shoreline of Scout Camp Pond were defined as 'lower, water-table springs'.

2.1.2 Spring Arrangement

Spring arrangement specifies whether the spring is isolated or clustered. If clustered, the number of outlets within the cluster was counted. All defined branches of each cluster were mapped and given the same name. Branches that were identified as seeps, or springs at the ground surface without flow, were not mapped as there was no defined flow path to map.

2.1.3 Disturbed Status

Disturbed status noted the presence of ground or vegetation disturbance around the springs, and whether the disturbance was relic or active. Disruption of the substrate in or around a spring has the potential to affect vegetation growing in the area. As such, vegetative indicators of springs may or may not be present. This parameter was taken into consideration in cases where vegetation was atypical of what one would expect to see around a spring.

2.1.4 Spring Channel Dimensions

The spring channel dimensions were recorded and mapped with a handheld Global Positioning System (GPS) unit. Features were mapped as lines representing the channel formed by the spring's flow. An average water width and depth were noted on the data form. For springs over 25 feet wide, both banks were mapped and labeled according to cardinal direction. In cases where the spring continued off property, the spring was mapped only until the Study Area boundary line, and no further.

2.1.5 Substrate Composition

Substrate composition focused on soil texture class dominance. In-depth soil sampling was not conducted, nor was hydric soil status noted during the field investigation.

2.1.6 Surface Flow

Presence or absence of surface flow was noted and the approximate discharge rate was collected using the float method when there was sufficient flow. The identified spring flow paths were surveyed with a Global Positioning System capable of sub-meter accuracy and mapped using Geographical Information System (GIS) software. Springs were differentiated from conveyance/erosional features based upon soil saturation, vegetation present, and best scientific judgement.

2.1.7 Vegetation

Vegetation notes include a general description of dominant vegetation in each stratum. Marsh marigold (*Caltha palustris*) was utilized as a potential spring indicator species, as the plant is purportedly found by the MNDNR around springs in the area. Absence of marsh marigold did not prevent an area from being identified as a spring.

2.1.8 Physical and Chemical Parameters

Physical and chemical parameters of the water included: water color, odor, dissolved oxygen, pH, conductivity, and temperature. These parameters were measured using a hand-held, field water quality sampling meter (YSI meter) when there was sufficient water flow and depth to do so. Calibration and cleaning of the meter before and after sampling was done using commercially available spring water.

3.0 RESULTS

3.1 SITE DESCRIPTION

The 80-acre Study Area is bisected from north to south by MNTH 6. Approximately 40 acres of the 80-acre site fall to each half of MNTH 6 (Figure 1). The eastern half (eastern 40 acres) is further bisected from north to south by Scout Camp Pond and its associated tributary, which flows to the south out of the Study Area. Scout Camp Pond lies at the base of a valley created by moderately to steeply sloping topography on either side of the pond (Figure 1). A hydric soil map (Figure 2) and NWI map (Figure 3) were reviewed to determine possible wetlands within the Study Area, as these wetlands may be spring-fed. On-site, wetland areas were observed around the pond, in association with the springs, and in the natural valleys within the forest.

3.2 SPRINGS – EASTERN 40 ACRES

The topography varies from lows around the pond of approximately 1,272 feet msl to highs around 1,300 feet msl (Figure 2). The lower topography around the pond has a predominately herbaceous shrub/wet meadow community, whereas the higher topographic areas are forested with a hardwood canopy and herbaceous undergrowth.

Desktop research and pre-survey discussions with MNDNR had indicated most springs would be found along the 1300 feet above sea level elevation or lower. These springs were classified in the field as having clear, flowing water. This made in situ differentiation between springs and intermittent streams more consistent, as streams were observed to have more turbid water with high levels of aquatic vegetative growth.

Eighteen (18) springs were identified and delineated within the Study Area, all of which were found on the eastern 40 acres. Spring data forms were completed for 18 sample points within these springs and are contained within Appendix B. Photographs of the springs and adjacent lands are contained in Appendix C. The spring boundaries and sample point locations are shown on Figure 4 (Appendix A). The springs are summarized in Table 1 and described in detail in the following sections.

Table 1. Summary of Springs Identified within the Study Area

Spring	Spring Type – Site Specific	Spring Type - General	Clustered or Isolated	Water Flow Observed	Delineated Length
Spring 1 (SP-1)	Upper spring	Rheocrene	Clustered	Yes	401 LF
Spring 2 (SP-2)	Lower, water-table spring	Helocrene	Isolated	No	54 LF

Spring 3 (SP-3)	Lower, water-table spring	Helocrene	Clustered	No	266 LF
Spring 4 (SP-4)	Lower, water-table spring	Helocrene	Isolated	Yes	55 LF
Spring 5 (SP-5)	Lower, water-table spring	Helocrene	Isolated	Yes	38 LF
Spring 6 (SP-6)	Lower, water-table spring	Helocrene	Isolated	Yes	27 LF
Spring 7 (SP-7)	Lower, water-table spring	Rheocrene	Clustered	Yes	24 LF
Spring 8 (SP-8)	Lower, water-table spring	Helocrene	Clustered	Yes	33 LF
Spring 9 (SP-9)	Lower, water-table spring	Rheocrene	Clustered	Yes	21 LF
Spring 10 (SP-10)	Lower, water-table spring	Rheocrene	Isolated	Yes	20 LF
Spring 11 (SP-11)	Lower, water-table spring	Helocrene	Clustered	No	54 LF
Spring 12 (SP-12)	Lower, water-table spring	Helocrene	Clustered	No	28 LF
Spring 13 (SP-13)	Upper spring	Helocrene	Clustered	No	243 LF
Spring 14 (SP-14)	Intermediate till-unit contact spring	Helocrene	Clustered	No	98 LF
Spring 15 (SP-15)	Intermediate till-unit contact spring	Helocrene	Clustered	No	92 LF
Spring 16 (SP-16)	Intermediate till-unit contact spring	Helocrene	Clustered	No	173 LF
Spring 17 (SP-17)	Intermediate till-unit contact spring	Helocrene	Clustered	No	101 LF
Spring 18 (SP-18)	Intermediate till-unit contact spring	Helocrene	Clustered	No	95 LF

3.2.1 Spring 1 (SP-1)

Spring 1 (SP-1) is located in the northeast corner of the eastern 40 acres and is best classified as an upper spring. This spring appears to originate at an elevation of 1300 feet msl, and flows southwest before turning to flow northwest into Scout Camp Pond. The spring is situated in a ravine area with steep slopes (5-20%). SP-1 is a cluster of multiple springs with flows that form an intermittent stream. At the foot of the valley, the stream enters a wetland and loses definition, before emerging again to the northwest and flowing into the pond.

3.2.2 Spring 2 (SP-2)

Spring 2 (SP-2) is located in the northeast corner of the eastern 40 acres and is best classified as a lower, water-table spring. The spring is located in a depressional area in a cedar forest where the water table is at the surface, but flow was not observed. Evidence of past flow indicates SP-2 connects to Scout Camp Pond.

3.2.3 Spring 3 (SP-3)

Spring 3 (SP-3) is located in the northeast corner of the eastern 40 acres and is best classified as a lower, water-table spring. The spring is located in a toe-slope area where the water table is at the surface. Pockets of standing water were observed; however, water flow was absent. Evidence of past flow indicates SP-3 connects to Scout Camp Pond.

3.2.4 Springs 4-12 (SP-4, -5, -6, -7, -8. -9, -10, -11, -12)

Springs 4-12 were located in the south-central portion of the eastern 40 acres, on the southeastern bank of Scout Camp Pond. The springs were best classified as lower, water-table springs and were located in a toe-slope or side-slope area where the water table was at the surface. Springs 4-12 had defined channels that cut through an emergent wet meadow at the base of a steep slope, and discharged into the pond. Flowing water was observed in springs 4-10 at the time of inspection.

3.2.5 Spring 13 (SP-13)

Spring 13 (SP-13) was located in the southwest corner of the eastern 40 acres, on the southwestern bank of Scout Camp Pond. The spring was best classified as an upper spring and was located at an elevation of 1300 feet msl. SP-13 was a cluster of springs that converged and formed one central flow way. Soils associated with the spring were saturated within eight inches of the surface. SP-13 extended from a forested wetland and based on evidence of a flow path, it appears to discharge into the pond. Water flow was not observed during the site visit.

3.2.6 Springs 14-18 (SP-14, -15, -16, -17, -18)

Springs 14-18 were located in the northwest corner of the eastern 40 acres, near the west bank of Scout Camp Pond. The springs were best classified as intermediate, till-unit springs. Analogous to SP-13, each spring was made up of a cluster of springs that appeared to converge and form one respective central flow way. The springs channels discharge into Scout Camp Pond, though water flow was not observed during the site visit.

3.3 SPRINGS – WESTERN 40 ACRES

The western half of the Study Area (western 40 acres) has less variable elevation with gently sloped topography ranging from 1,340 to 1,384 feet msl, and several mapped NWI wetlands. The vegetative community is best classified as a mesic hardwood forest. Pockets of forested wetland were observed within the western 40 acres.

Springs were not observed on the western 40 acres of the Study Area. This was an expected result, as the elevation of the western 40 acres was above the 1300 msl contour line. Some forested wetlands were observed at topographic lows within the site, and were generally consistent with the wetlands mapped by the NWI.

3.4 OTHER ENVIRONMENTAL CONSIDERATIONS

3.4.1 Beavers

Initial desktop research and aerial photograph review revealed many inlets around Scout Camp Pond. Based upon guidance from the MNDNR and aerial signatures, these inlets were assumed to be spring outflows connecting to the pond. As such, special attention was paid to examining these areas during the field visit. During the field investigation, it was determined that few of these inlets were actually spring outflows; instead, the inlets appeared to be beaver access trails from the pond to the surrounding woods. This determination was made based upon the frequency of beaver stumps in the area, as well as the presence of beaver dams.

3.5 ON-SITE MEETING WITH THE MNDNR

On July 17, 2014 Stantec ecologists in addition to representatives from Enbridge and Merjent, met on-site with agents from the MNDNR. The purpose of this meeting was to review the locations of the springs mapped within the Study Area. Representative springs from each area within the eastern 40 acres were examined. The protocol and reasoning used to identify these springs was discussed in the field with the MNDNR representatives. At the decision of the MNDNR, the western 40 acres was not examined because springs had not been located on-site.

4.0 CONCLUSION

Stantec performed a spring survey and inventory of the Spring Creek / Spire Valley Study Area on behalf of North Dakota Pipeline Company LLC. The Study Area is approximately 80 acres in size and located in Section 14, Township 139 North, Range 26 East, Township of Crook Lake, Cass County, Minnesota. The purpose and objective of the spring survey was to identify the extent and spatial arrangement of springs within the Study Area to further inform construction and permitting plans.

Eighteen springs were identified and delineated on the eastern 40 acres of the Study Area in accordance with MNDNR guidance, were surveyed with GPS, and mapped using GIS software. Springs were classified as one of three potential spring types. No springs were discovered or subsequently mapped on the western 40 acres of the Study Area. These results were consistent with the MNDNR's expectations, and correlated with what was anticipated during preliminary research of the Study Area.

The information provided by Stantec regarding spring locations is a scientific-based analysis of the spring configurations present within the Study Area at the time of the fieldwork. The mapping was performed by experienced and qualified professionals using standard practices and sound professional judgment. The physical characteristics of the Study Area can change over time, depending on the climate, vegetation patterns, drainage activities on adjacent parcels, or other events. Any of these factors can change the nature and extent of springs located on the site.

5.0 REFERENCES

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Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed [06/02/2015].

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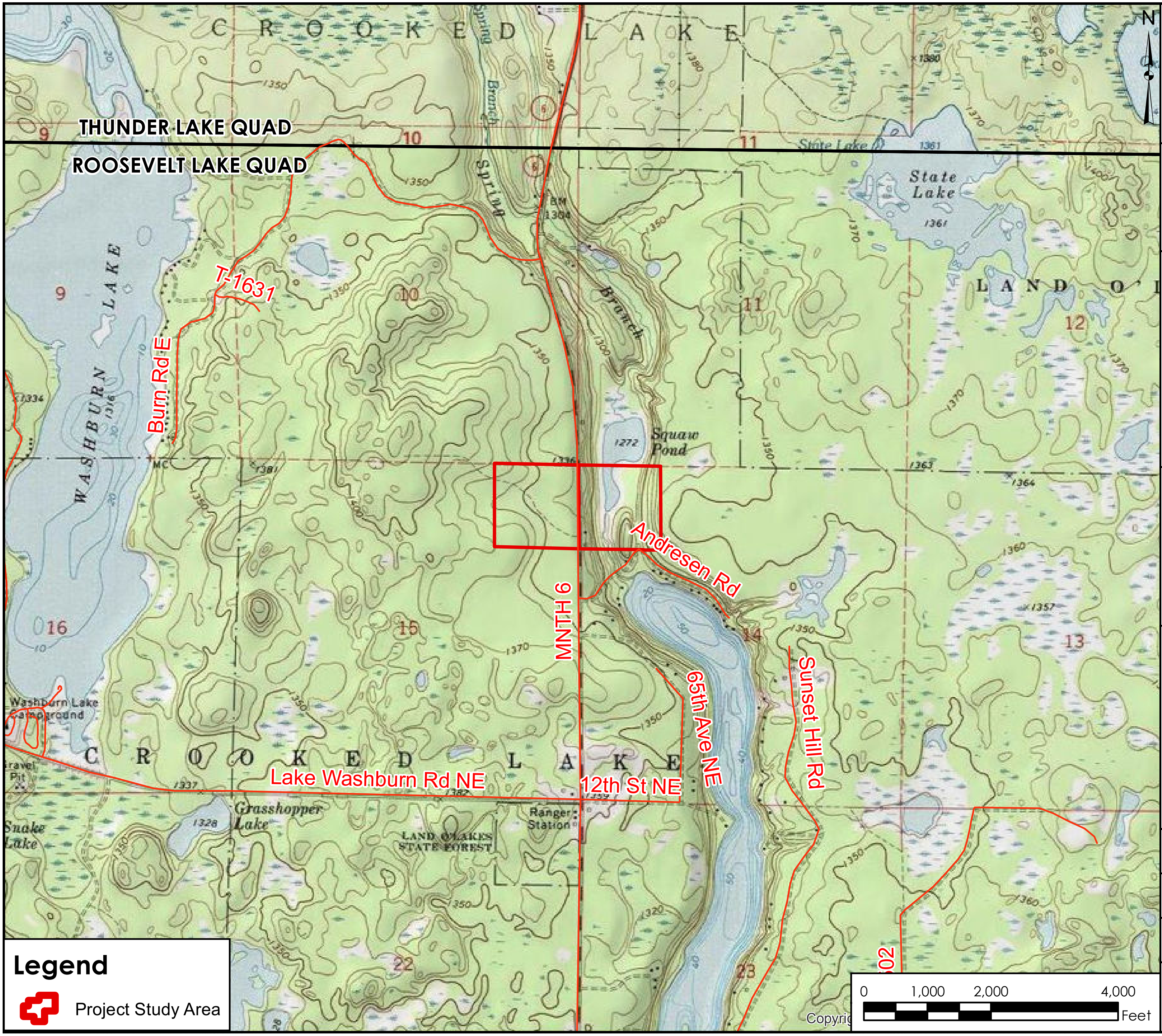
Appendix A – Figures



Stantec

Client:

Project:

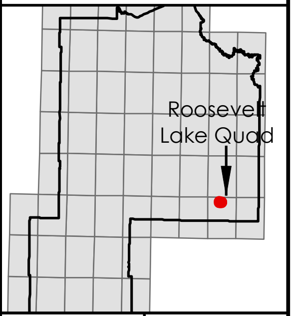
Spring Survey

Cass County, MN

Title:

USGS TOPOGRAPHY MAP

Ref. USGS 7.5 Minute Topography Map Roosevelt Lake, MN Quadrangle

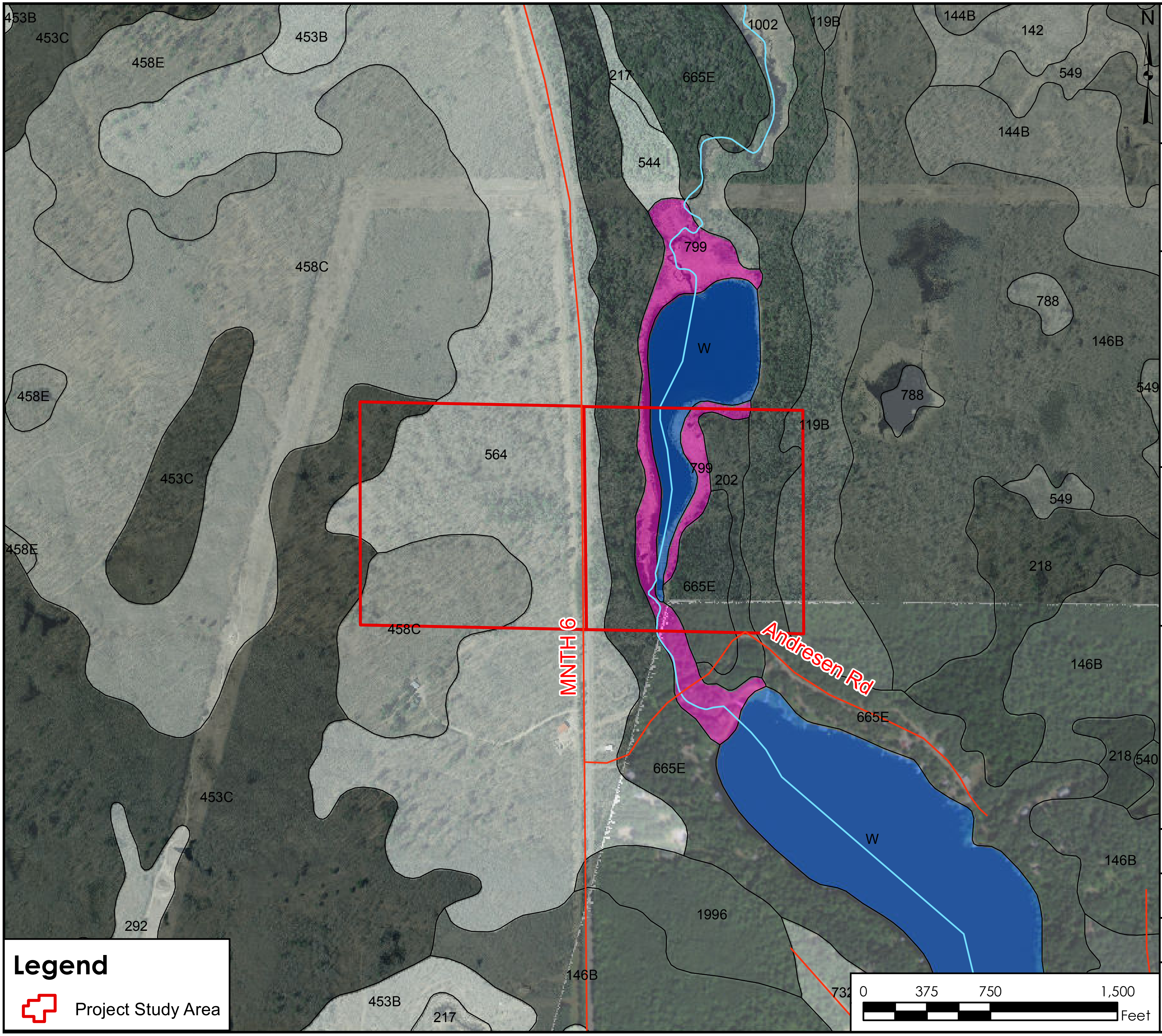


Drawn By:	QA/QC Review:
AEB	MR
Peer Review:	Date:
ALC	6/12/2015

Stantec Projec Number:

175613071

FIGURE 1



Legend

Project Study Area

Stantec

Client:

Project:

Spring Survey

Cass County, MN

Title:

NRCS SOIL SERIES MAP

Ref. NRCS Soil Series Data
Cass County, MN (1975)

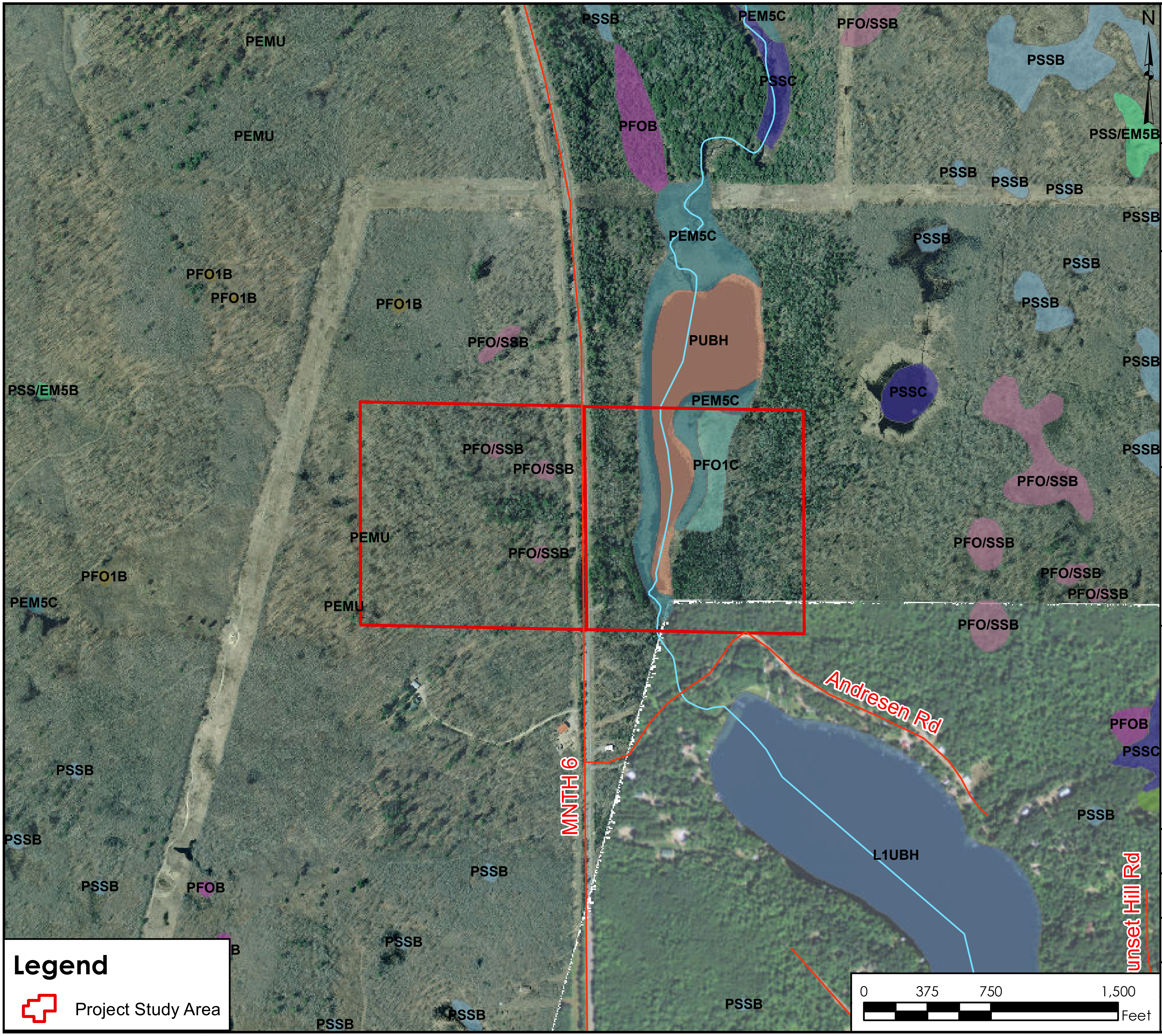
Mapped Soil Units Within the PSA

- ▨ 119B - Pomroy loamy sand, 3-8%
- ▨ 202 - Meehan loamy sand,
- ▨ 453C - DeMontreville loamy sand, 8-15%
- ▨ 458C - Menahga loamy sand, 8-15%
- ▨ 564 - Friendship loamy sand
- ▨ 665E - Menahga loamy sand, moraine, 15-40%
- ▨ 799 - Bowstring-Seelyville complex [HYDRIC]
- ▨ W - Water

Drawn By:	QA/QC Review:
AEB	**MR**
Peer Review:	**Date:**
ALC	**6/12/2015**

Stantec Project Number:
175613071

FIGURE 2



Stantec

Client:

Project:

Spring Survey

Cass County, MN

Title:

NRCS SOIL SERIES MAP

Ref. NRCS Soil Series Data
Cass County, MN (1975)

Mapped NWI Polygons Within the PSA

🟦	PEM5C - Palustrine Emergent Phragmites australis Seasonally Flooded
🟩	PEMU - Palustrine Emergent Seasonally Flooded
🟪	PFO/SSB - Palustrine Forested/Scrub-shrub Saturated
🟩	PFO1C - Palustrine Forested Broad-Leaved Deciduous Seasonally Flooded
🟧	PUBH - Palustrine Unconsolidated Bottom Permanently Flooded

Drawn By:	QA/QC Review:
AEB	MR
Peer Review:	Date:
ALC	6/12/2015

Stantec Project Number:
175613071

FIGURE 3

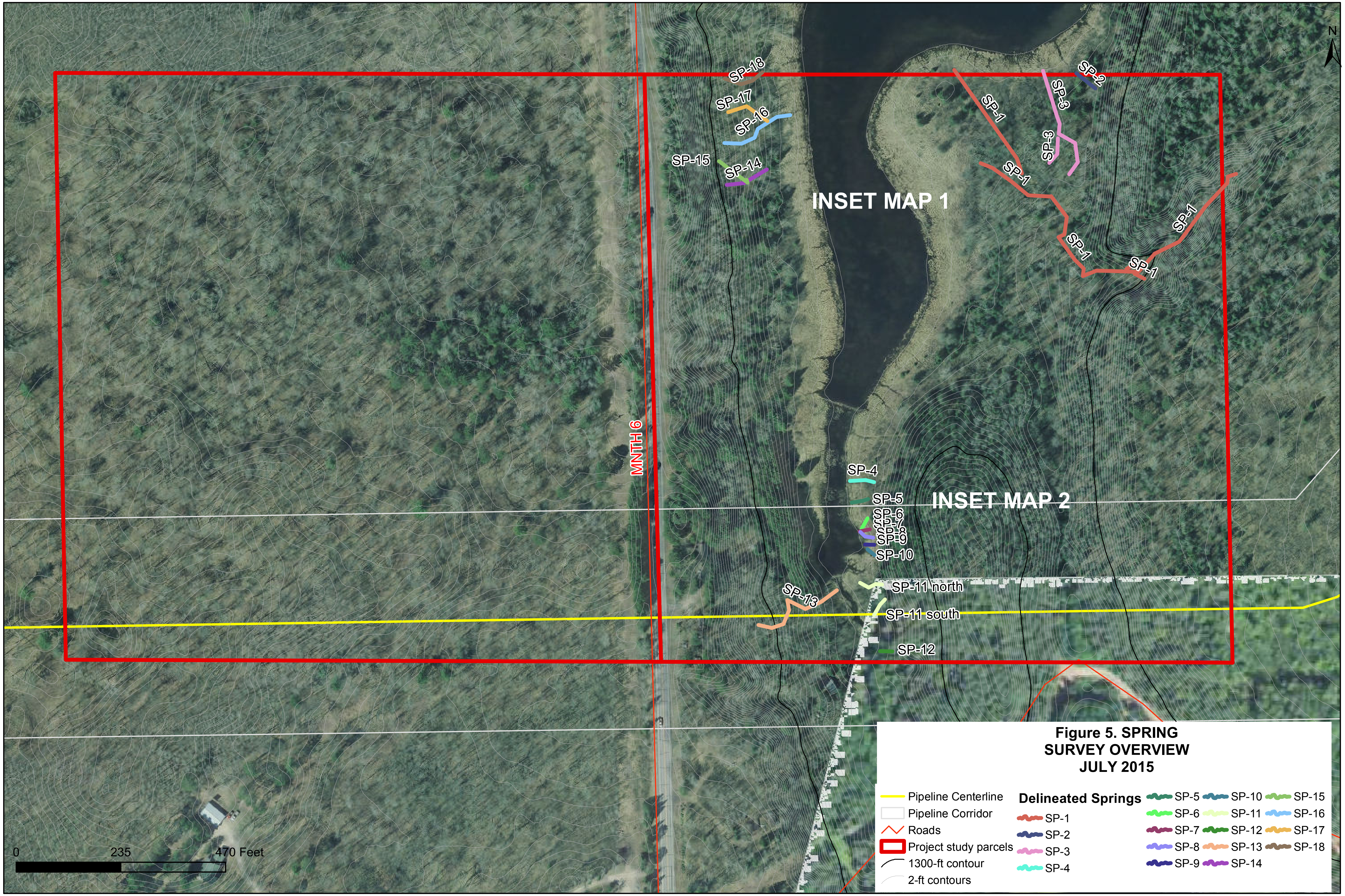


Figure 5. SPRING SURVEY OVERVIEW JULY 2015

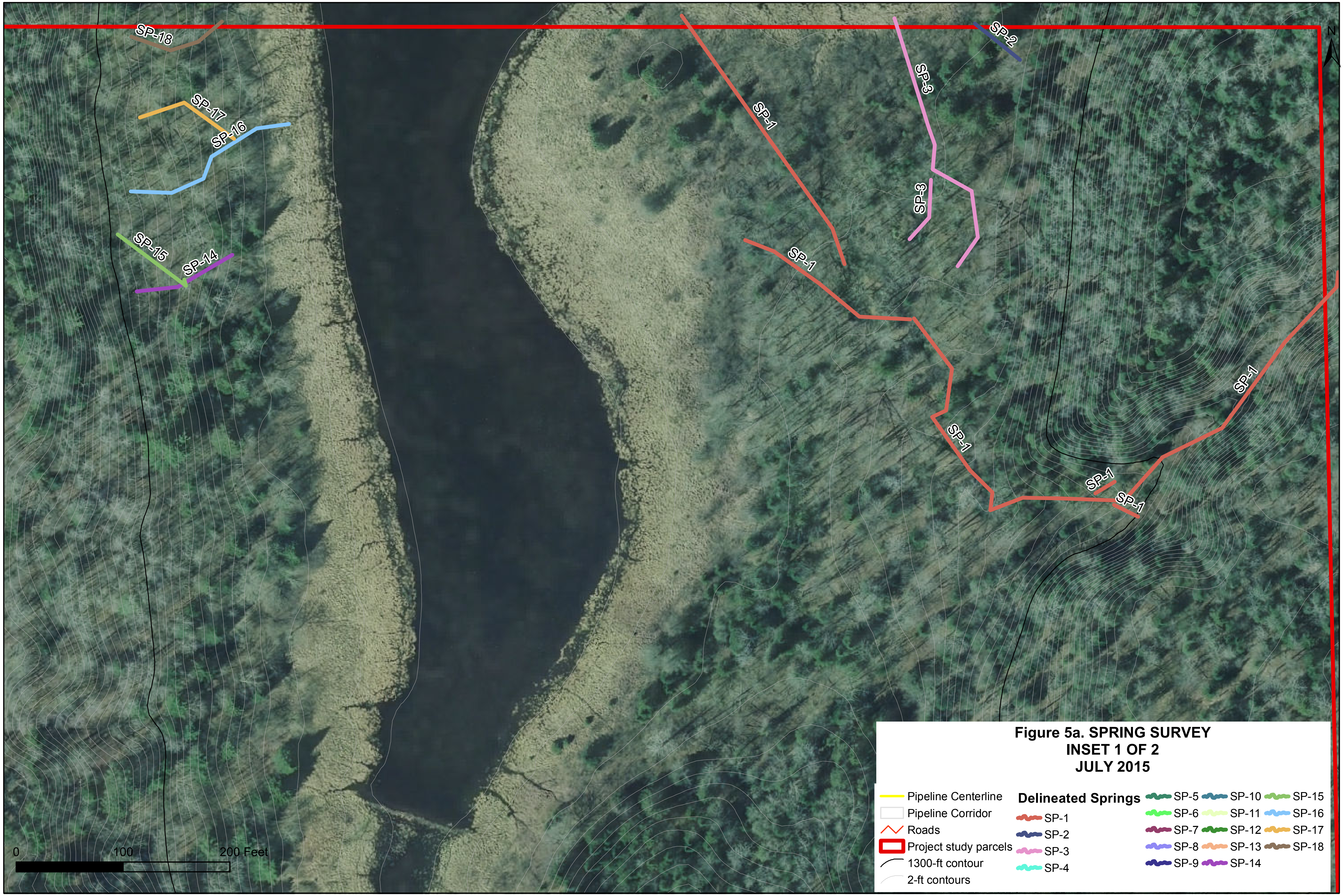


Figure 5a. SPRING SURVEY
INSET 1 OF 2
JULY 2015

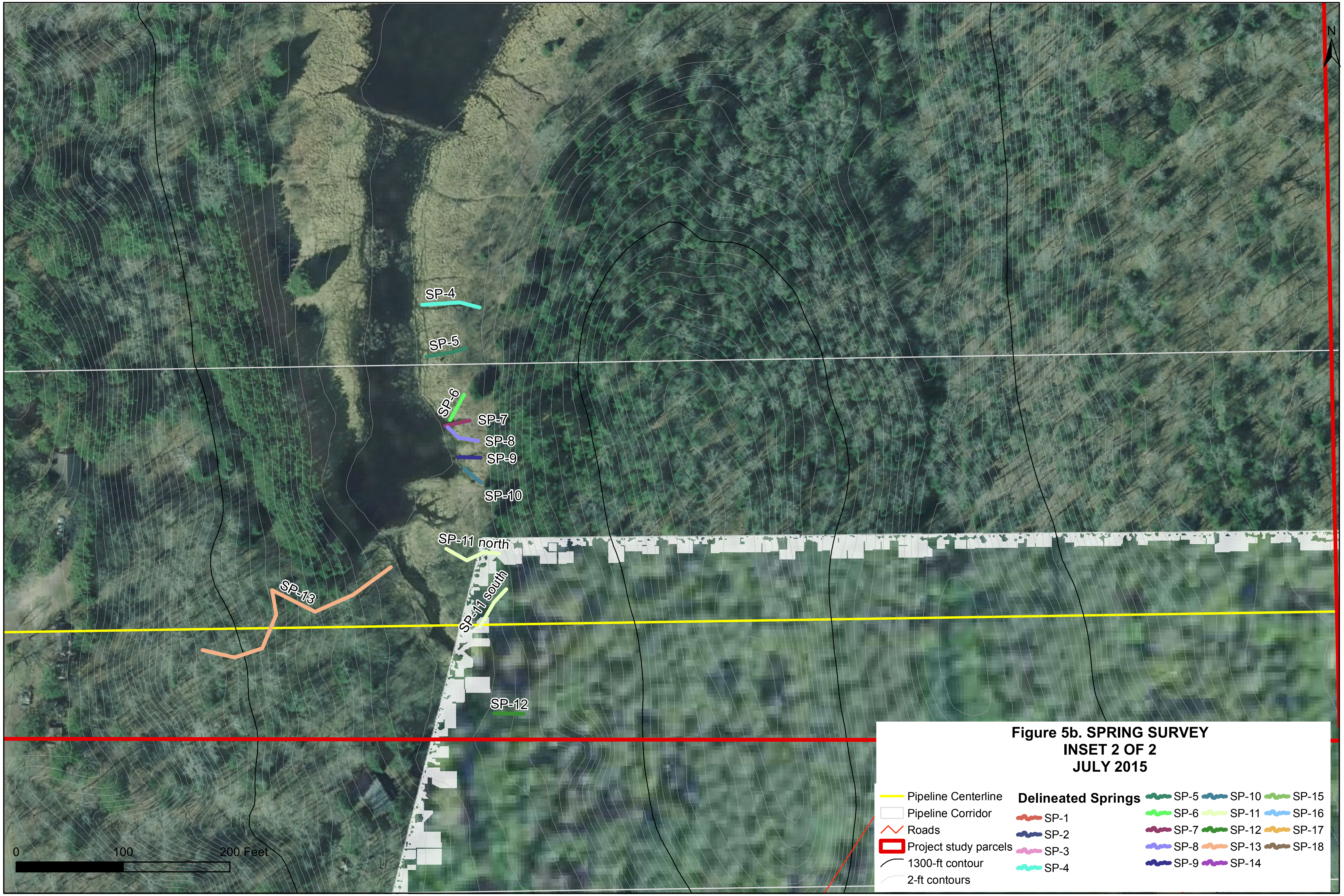


Figure 5b. SPRING SURVEY
INSET 2 OF 2
JULY 2015

Appendix B – Spring Survey Data Forms

Stantec

Spring Inventory Data Form

SPRING ID: SP1
DATE: 06/16/2015
PROJECT/SITE: Spring Creek - Spire Valley
APPLICANT: North Dakota Pipeline Company LLC
STATE: Minnesota
COUNTY: Cass
TOWNSHIP: Crook Lake
LATITUDE: 46.86111
LONG: 93.93889
TOWNSHIP: 139 N
RANGE: 26W
SECTION: 14
PROPERTY OWNER:
INVESTIGATOR #1: Jake Fahrenkrog
INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Swale/Ravine
LOCAL RELIEF: concave
SLOPE (%): 5 - 20%
SITE CONDITION:
DISTURBANCE:
DISTURBANCE:
NOTES:

Spring located in ravine with steep slopes adjacent. SP1 originates as an intermittent stream with the flow at 1300ft. Multiple spring outlets discharge water to create flow.

SPRING / STREAM DATA

SPRING TYPE: l
SPRING ARRANGEMENT: ○ Isolated ○ Clustered
NUMBER OF OUTLETS OBSERVED: 10
ESTIMATED DISCHARGE (CFS.): 0.5'
SPRING BROOK LENGTH (FT): 401' flowing, 260' non-flowing
AVERAGE WATER DEPTH (FT): 0.5'
AVERAGE WATER WIDTH (FT): 1' - 2'
DO (MG/L): 6.34
TEMPERATURE (°C): 8.64
ORP: 72.1
CONDUCTIVITY (mS/c cm): 0.223
pH: 7.44
EMERGENT COVER (%): 15%
VEGETATIVE BANK COVER (%): 85%
SUBSTRATE COMPOSITION: 40% sand, 30% cobble/gravel, 30% boulder

VEGETATION

WETLAND COMMUNITY PRESENT: Yes
COMMUNITY ID: PFO

DOMINANT VEGETATION

TREE STRATUM: Fraxinus nigra, Abies balsam, Acer saccharinum
SAPLING/SHRUB STRATUM: Corylus cornuta, Abies balsam
HERBACEOUS STRATUM: Equisetum arvense, Heracleum maximum , Thalictrum dasycarpum , Dryopteris carthusiana, Carex woodii

GENERAL NOTES:

The spring flow path exists in a well-defined stream and flow west into a low undefined braided / stream complex.

Stantec

Spring Inventory Data Form

SPRING ID: SP2 DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Depression LOCAL RELIEF: Convace SLOPE (%): 0-4%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP2 is a depressional area where a spring water source. Water expelling form the ground surface was not observed although the water table was at the surface.

SPRING / STREAM DATA

SPRING TYPE: ne

SPRING ARRANGEMENT: ● Isolated ○ Clustered NUMBER OF OUTLETS OBSERVED: 1

ESTIMATED DISCHARGE (CFS.): 0 SPRING BROOK LENGTH (FT): 54'

AVERAGE WATER DEPTH (FT): 0.5' AVERAGE WATER WIDTH (FT): DO (MG/L):

TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:

EMERGENT COVER (%): 100% VEGETATIVE BANK COVER (%):

SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PFO - PSS

DOMINANT VEGETATION

TREE STRATUM: Thuja occidentalis

SAPLING/SHRUB STRATUM: Alnus incana, Salix interior

HERBACEOUS STRATUM: Impatiens capensis, Phalaris arundinacea, Carex striata

GENERAL NOTES:

SP2 is a wetland seep extending from a cedar forest into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

Stantec

Spring Inventory Data Form

SPRING ID: SP3 DATE: 06/16/2015
PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC
STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake
LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14
PROPERTY OWNER:
INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Toe slope LOCAL RELIEF: Concave SLOPE (%): 0 - 5%
SITE CONDITION: DISTURBANCE: DISTURBANCE:
NOTES:

Spring exists in a low area along steep slopes adjacent to Scout Camp Pond.

SPRING / STREAM DATA

SPRING TYPE:
SPRING ARRANGEMENT: ○ Isolated ○ Clustered NUMBER OF OUTLETS OBSERVED: 5
ESTIMATED DISCHARGE (CFS.): 0 SPRING BROOK LENGTH (FT): 266'
AVERAGE WATER DEPTH (FT): 0 AVERAGE WATER WIDTH (FT): 3' DO (MG/L): 2.12
TEMPERATURE (°C): 11.56 ORP: CONDUCTIVITY (mS/c cm): 0.326 pH: 7.19
EMERGENT COVER (%): 75% VEGETATIVE BANK COVER (%): 85%
SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PFO

DOMINANT VEGETATION

TREE STRATUM: Thuja occidentalis, Abies balsamea, Betula alleghaniensis, Fraxinus nigra
SAPLING/SHRUB STRATUM: Betula alleghaniensis, Fraxinus nigra
HERBACEOUS STRATUM: Caltha palustris, Impatiens capensis, Onoclea sensibilis

GENERAL NOTES:

SP3 exists as a seep feature. Surface water is not observed throughout although the water table is at the surface with pockets of standing water. The spring extends into the large ponded wetland complex.

Spring Inventory Data Form

SPRING ID: SP4 DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Toe slope LOCAL RELIEF: Concave SLOPE (%): 0 - 5%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP4 is a wetland seep extending from an emergent wet meadow at the base of a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

SPRING / STREAM DATA

SPRING TYPE: ne

SPRING ARRANGEMENT: ● Isolated ○ Clustered NUMBER OF OUTLETS OBSERVED:

ESTIMATED DISCHARGE (CFS.): 0.01 SPRING BROOK LENGTH (FT): 55'

AVERAGE WATER DEPTH (FT): 2" AVERAGE WATER WIDTH (FT): 1 DO (MG/L):

TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:

EMERGENT COVER (%): 0% VEGETATIVE BANK COVER (%): 100%

SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PEM

DOMINANT VEGETATION

TREE STRATUM:

SAPLING/SHRUB STRATUM: Alnus incana

HERBACEOUS STRATUM: Onoclea sensibilis, Rubus idaeus, Impatiens capensis, Carex stricta

GENERAL NOTES:

SP4 contains minimal discharge although high water table at the surface. Beavers have influenced area due to hauling trails.

Spring Inventory Data Form

SPRING ID: SP5 DATE: 06/16/2015
PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC
STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake
LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14
PROPERTY OWNER:
INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Toe slope LOCAL RELIEF: Concave SLOPE (%): 0 - 5%
SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP5 is a wetland seep extending from an emergent wet meadow at the base of a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

SPRING / STREAM DATA

SPRING TYPE: ne
SPRING ARRANGEMENT: ● Isolated ○ Clustered NUMBER OF OUTLETS OBSERVED:
ESTIMATED DISCHARGE (CFS.): 0.01 SPRING BROOK LENGTH (FT): 38'
AVERAGE WATER DEPTH (FT): 2" AVERAGE WATER WIDTH (FT): 1 DO (MG/L):
TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:
EMERGENT COVER (%): 0% VEGETATIVE BANK COVER (%): 100%
SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PEM

DOMINANT VEGETATION

TREE STRATUM:
SAPLING/SHRUB STRATUM: Alnus incana
HERBACEOUS STRATUM: Onoclea sensibilis, Rubus idaeus, Impatiens capensis, Carex stricta

GENERAL NOTES:

SP5 contains minimal discharge although high water table at the surface. Beavers have impacted area due to hauling trails.

Stantec

Spring Inventory Data Form

SPRING ID: SP6

DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley

APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Toe slope LOCAL RELIEF: Concave SLOPE (%): 0 - 5%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP6 is a wetland seep extending from an emergent wet meadow at the base of a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

SPRING / STREAM DATA

SPRING TYPE: ne

SPRING ARRANGEMENT: ● Isolated ○ Clustered NUMBER OF OUTLETS OBSERVED:

ESTIMATED DISCHARGE (CFS.): 0.01 SPRING BROOK LENGTH (FT): 27'

AVERAGE WATER DEPTH (FT): 2" AVERAGE WATER WIDTH (FT): 1 DO (MG/L):

TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:

EMERGENT COVER (%): 0% VEGETATIVE BANK COVER (%): 100%

SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PEM

DOMINANT VEGETATION

TREE STRATUM:

SAPLING/SHRUB STRATUM: Alnus incana

HERBACEOUS STRATUM: Onoclea sensibilis, Rubus idaeus, Impatiens capensis, Carex stricta

GENERAL NOTES:

SP6 contains minimal discharge although high water table at the surface. Beavers have impacted area due to hauling trails.

Stantec

Spring Inventory Data Form

SPRING ID: SP7 DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Toe slope LOCAL RELIEF: Concave SLOPE (%): 0 - 5%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP7 is a wetland seep extending from an emergent wet meadow at the base of a steep slope into the wetland pond feature. Water was observed expelling from ground surface at an adequate rate to sample physical/chemical characteristics.

SPRING / STREAM DATA

SPRING TYPE: ne

SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED: 2

ESTIMATED DISCHARGE (CFS.): 0.05 SPRING BROOK LENGTH (FT): 24'

AVERAGE WATER DEPTH (FT): 2" AVERAGE WATER WIDTH (FT): 1 DO (MG/L):

TEMPERATURE (°C): 7.53 ORP: 15.6 CONDUCTIVITY (mS/c cm): 0.234 pH: 7.85

EMERGENT COVER (%): 60% VEGETATIVE BANK COVER (%): 100%

SUBSTRATE COMPOSITION: Sand

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PEM

DOMINANT VEGETATION

TREE STRATUM:

SAPLING/SHRUB STRATUM: Alnus incana

HERBACEOUS STRATUM: Onoclea sensibilis, Rubus idaeus, Impatiens capensis, Carex stricta, Carex lacustris

GENERAL NOTES:

SP7 contains minimal discharge although high water table at the surface. Beavers have impacted area due to hauling trails.

Spring Inventory Data Form

SPRING ID: SP8 DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Toe slope LOCAL RELIEF: Concave SLOPE (%): 0 - 5%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP8 is a wetland seep extending from an emergent wet meadow at the base of a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

SPRING / STREAM DATA

SPRING TYPE: ne

SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED: 2

ESTIMATED DISCHARGE (CFS.): 0.05 SPRING BROOK LENGTH (FT): 33'

AVERAGE WATER DEPTH (FT): 2" AVERAGE WATER WIDTH (FT): 1 DO (MG/L):

TEMPERATURE (°C): 7.53 ORP: 15.6 CONDUCTIVITY (mS/c cm): 0.234 pH: 7.85

EMERGENT COVER (%): 60% VEGETATIVE BANK COVER (%): 100%

SUBSTRATE COMPOSITION: Sand

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PEM

DOMINANT VEGETATION

TREE STRATUM:

SAPLING/SHRUB STRATUM: Alnus incana

HERBACEOUS STRATUM: Onoclea sensibilis, Rubus idaeus, Impatiens capensis, Carex stricta, Carex lacustris

GENERAL NOTES:

SP8 contains minimal discharge although high water table at the surface. Beavers have impacted area due to hauling trails.

Spring Inventory Data Form

SPRING ID: SP9 DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Toe slope LOCAL RELIEF: Concave SLOPE (%): 0 - 5%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP9 is a wetland seep extending from an emergent wet meadow at the base of a steep slope into the wetland pond feature. Water was observed expelling from ground surface at an adequate rate to sample physical/chemical characteristics.

SPRING / STREAM DATA

SPRING TYPE: ne

SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED: 2

ESTIMATED DISCHARGE (CFS.): 0.05 SPRING BROOK LENGTH (FT): 21'

AVERAGE WATER DEPTH (FT): 2" AVERAGE WATER WIDTH (FT): 1 DO (MG/L): 3.39

TEMPERATURE (°C): 8.38 ORP: -14.1 CONDUCTIVITY (mS/c cm): 0.364 pH: 7.72

EMERGENT COVER (%): 10% VEGETATIVE BANK COVER (%): 100%

SUBSTRATE COMPOSITION: Sand

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PEM

DOMINANT VEGETATION

TREE STRATUM:

SAPLING/SHRUB STRATUM: Alnus incana

HERBACEOUS STRATUM: Onoclea sensibilis, Rubus idaeus, Impatiens capensis, Carex stricta, Carex lacustris

GENERAL NOTES:

SP9 contains minimal discharge although high water table at the surface. Beavers have impacted area due to hauling trails.

Stantec

Spring Inventory Data Form

SPRING ID: SP10 DATE: 06/16/2015
PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC
STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake
LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14
PROPERTY OWNER:
INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Toe slope LOCAL RELIEF: Concave SLOPE (%): 0 - 5%
SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP10 is a wetland seep extending from an emergent wet meadow at the base of a steep slope into the wetland pond feature. Water was observed expelling from ground surface at an adequate rate to sample physical/chemical characteristics.

SPRING / STREAM DATA

SPRING TYPE: ıe
SPRING ARRANGEMENT: ● Isolated ○ Clustered NUMBER OF OUTLETS OBSERVED:
ESTIMATED DISCHARGE (CFS.): 0.05 SPRING BROOK LENGTH (FT): 20'
AVERAGE WATER DEPTH (FT): 2" AVERAGE WATER WIDTH (FT): 8" DO (MG/L): 6.5
TEMPERATURE (°C): 9.49 ORP: 2.7 CONDUCTIVITY (mS/c cm): 0.241 pH: 7.73
EMERGENT COVER (%): 10% VEGETATIVE BANK COVER (%): 100%
SUBSTRATE COMPOSITION: Sand

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PEM

DOMINANT VEGETATION

TREE STRATUM: ____
SAPLING/SHRUB STRATUM: __________________________________
HERBACEOUS STRATUM: Onoclea sensibilis, Rubus idaeus, Impatiens capensis, Carex stricta, Carex lacustris

GENERAL NOTES:

SP10 contains minimal discharge although high water table at the surface. Beavers have impacted area due to hauling trails.

Spring Inventory Data Form

SPRING ID: SP11 DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: Side slope LOCAL RELIEF: linear SLOPE (%): 5-10%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP11 is a wide seep without surface water, though the water table is at the ground surface.

SPRING / STREAM DATA

SPRING TYPE: ne

SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED: unknown

ESTIMATED DISCHARGE (CFS.): 0 SPRING BROOK LENGTH (FT): 54'

AVERAGE WATER DEPTH (FT): AVERAGE WATER WIDTH (FT): DO (MG/L):

TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:

EMERGENT COVER (%): 65% VEGETATIVE BANK COVER (%): 65%

SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PSS - PFO

DOMINANT VEGETATION

TREE STRATUM: Fraxinus nigra

SAPLING/SHRUB STRATUM: Alnus incana

HERBACEOUS STRATUM: Onoclea sensibilis, Carex woodii, Impatiens capensis, Carex stricta, Carex lacustris

GENERAL NOTES:

SP11 is a wetland seep extending from shrub-carr/forested wetland complex at the base of a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

Stantec

Spring Inventory Data Form

SPRING ID: SP12 DATE: 06/16/2015
PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC
STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake
LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14
PROPERTY OWNER:
INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: foot slope LOCAL RELIEF: concave SLOPE (%): 0-5%
SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP12 has a water table at the surface, but no flowing surface water was present.

SPRING / STREAM DATA

SPRING TYPE:
SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED: 2
ESTIMATED DISCHARGE (CFS.): 0.02 SPRING BROOK LENGTH (FT): 28'
AVERAGE WATER DEPTH (FT): 0.2 AVERAGE WATER WIDTH (FT): 6 DO (MG/L):
TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:
EMERGENT COVER (%): VEGETATIVE BANK COVER (%):
SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PSS - PFO

DOMINANT VEGETATION

TREE STRATUM: Fraxinus nigra, Betula alleghaniensis
SAPLING/SHRUB STRATUM: Alnus incana
HERBACEOUS STRATUM: Caltha palustris, Impatiens capensis, Matteuccia struthiopteris

GENERAL NOTES:

SP12 is a wetland seep extending from an emergent wet meadow at the base of a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

Stantec

Spring Inventory Data Form

SPRING ID: SP13 DATE: 06/16/2015
PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC
STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake
LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14
PROPERTY OWNER:
INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: side slope LOCAL RELIEF: linear SLOPE (%): 15-20%
SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP13 soils are saturated within 8 inches of the surface. Hydric vegetation is present, and flow paths are present from the 1300' topographic contour.

SPRING / STREAM DATA

SPRING TYPE: springline
SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED:
ESTIMATED DISCHARGE (CFS.): 0 SPRING BROOK LENGTH (FT): 243'
AVERAGE WATER DEPTH (FT): 0 AVERAGE WATER WIDTH (FT): 4 DO (MG/L):
TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:
EMERGENT COVER (%): 70% VEGETATIVE BANK COVER (%): 80%
SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PFO

DOMINANT VEGETATION

TREE STRATUM: Fraxinus nigra, Betula alleghaniensis
SAPLING/SHRUB STRATUM: Alnus incana, Fraxinus nigra
HERBACEOUS STRATUM: Caltha palustris, Impatiens capensis, Matteuccia struthiopteris

GENERAL NOTES:

SP13 is a wetland seep extending from a forested wetland at approximately 1300’ elevation (mean sea level) on a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

Stantec

Spring Inventory Data Form

SPRING ID: SP14 DATE: 06/16/2015
PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC
STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake
LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14
PROPERTY OWNER:
INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: side slope LOCAL RELIEF: linear SLOPE (%): 15-20%
SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP14 soils are saturated within 8 inches of the surface. Hydric vegetation is present, and flow paths are present from the 1300' topographic contour.

SPRING / STREAM DATA

SPRING TYPE: springline
SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED:
ESTIMATED DISCHARGE (CFS.): 0 SPRING BROOK LENGTH (FT): 98'
AVERAGE WATER DEPTH (FT): 0 AVERAGE WATER WIDTH (FT): 4 DO (MG/L):
TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:
EMERGENT COVER (%): 70% VEGETATIVE BANK COVER (%): 80%
SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PFO

DOMINANT VEGETATION

TREE STRATUM: Fraxinus nigra, Betula alleghaniensis
SAPLING/SHRUB STRATUM: Alnus incana, Fraxinus nigra
HERBACEOUS STRATUM: Caltha palustris, Impatiens capensis, Matteuccia struthiopteris, Lycopus americanus

GENERAL NOTES:

SP14 is a wetland seep extending from a forested wetland at approximately 1300’ elevation (mean sea level) on a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

Stantec

Spring Inventory Data Form

SPRING ID: SP15 DATE: 06/16/2015
PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC
STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake
LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14
PROPERTY OWNER:
INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: side slope LOCAL RELIEF: linear SLOPE (%): 15-20%
SITE CONDITION: DISTURBANCE: DISTURBANCE:
NOTES:

SP15 soils are saturated within 8 inches of the surface. Hydric vegetation is present, and flow paths are present from the 1300' topographic contour.

SPRING / STREAM DATA

SPRING TYPE: springline
SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED:
ESTIMATED DISCHARGE (CFS.): 0 SPRING BROOK LENGTH (FT): 92'
AVERAGE WATER DEPTH (FT): 0 AVERAGE WATER WIDTH (FT): 4 DO (MG/L):
TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:
EMERGENT COVER (%): 70% VEGETATIVE BANK COVER (%): 80%
SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PFO

DOMINANT VEGETATION

TREE STRATUM: Fraxinus nigra, Betula alleghaniensis, Acer saccharinum
SAPLING/SHRUB STRATUM: Alnus incana, Fraxinus nigra
HERBACEOUS STRATUM: Caltha palustris, Impatiens capensis, Matteuccia struthiopteris, Lycopus americanus

GENERAL NOTES:

SP15 is a wetland seep extending from a forested wetland at approximately 1300’ elevation (mean sea level) on a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

Stantec

Spring Inventory Data Form

SPRING ID: SP16 DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: side slope LOCAL RELIEF: linear SLOPE (%): 15-20%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP16 soils are saturated within 8 inches of the surface. Hydric vegetation is present, and flow paths are present from the 1300' topographic contour.

SPRING / STREAM DATA

SPRING TYPE: springline

SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED:

ESTIMATED DISCHARGE (CFS.): 0 SPRING BROOK LENGTH (FT): 173'

AVERAGE WATER DEPTH (FT): 0 AVERAGE WATER WIDTH (FT): 4 DO (MG/L):

TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:

EMERGENT COVER (%): 70% VEGETATIVE BANK COVER (%): 80%

SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PFO

DOMINANT VEGETATION

TREE STRATUM: Fraxinus nigra, Betula alleghaniensis, Acer saccharinum

SAPLING/SHRUB STRATUM: Alnus incana, Fraxinus nigra

HERBACEOUS STRATUM: Caltha palustris, Impatiens capensis, Matteuccia struthiopteris, Lycopus americanus, Ribes cynosbati

GENERAL NOTES:

SP16 is a wetland seep extending from a forested wetland at approximately 1300’ elevation (mean sea level) on a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

Stantec

Spring Inventory Data Form

SPRING ID: SP17 DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: side slope LOCAL RELIEF: linear SLOPE (%): 15-20%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP17 soils are saturated within 8 inches of the surface. Hydric vegetation is present, and flow paths are present from the 1300' topographic contour.

SPRING / STREAM DATA

SPRING TYPE: I pringline

SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED:

ESTIMATED DISCHARGE (CFS.): 0 SPRING BROOK LENGTH (FT): 101'

AVERAGE WATER DEPTH (FT): 0 AVERAGE WATER WIDTH (FT): 4 DO (MG/L):

TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:

EMERGENT COVER (%): 70% VEGETATIVE BANK COVER (%): 80%

SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PFO

DOMINANT VEGETATION

TREE STRATUM: Fraxinus nigra, Betula alleghaniensis, Acer saccharinum

SAPLING/SHRUB STRATUM: Alnus incana, Fraxinus nigra

HERBACEOUS STRATUM: Caltha palustris, Impatiens capensis, Matteuccia struthiopteris, Lycopus americanus, Ribes cynosbati

GENERAL NOTES:

SP17 is a wetland seep extending from a forested wetland at approximately 1300’ elevation (mean sea level) on a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

Stantec

Spring Inventory Data Form

SPRING ID: SP18 DATE: 06/16/2015

PROJECT/SITE: Spring Creek - Spire Valley APPLICANT: North Dakota Pipeline Company LLC

STATE: Minnesota COUNTY: Cass TOWNSHIP: Crook Lake

LATITUDE: 46.86111 LONG: 93.93889 TOWNSHIP: 139 N RANGE: 26W SECTION: 14

PROPERTY OWNER:

INVESTIGATOR #1: Jake Fahrenkrog INVESTIGATOR #2: Julia Millet

SITE DESCRIPTION

LANDFORM: side slope LOCAL RELIEF: linear SLOPE (%): 15-20%

SITE CONDITION: DISTURBANCE: DISTURBANCE:

NOTES:

SP18 exists on a forested side slope with surface water present throughout the entirety of the spring flow course.

SPRING / STREAM DATA

SPRING TYPE: l pringline

SPRING ARRANGEMENT: ○ Isolated ● Clustered NUMBER OF OUTLETS OBSERVED:

ESTIMATED DISCHARGE (CFS.): 0 SPRING BROOK LENGTH (FT): 95'

AVERAGE WATER DEPTH (FT): 0 AVERAGE WATER WIDTH (FT): 4 DO (MG/L):

TEMPERATURE (°C): ORP: CONDUCTIVITY (mS/c cm): pH:

EMERGENT COVER (%): 70% VEGETATIVE BANK COVER (%): 80%

SUBSTRATE COMPOSITION: Muck

VEGETATION

WETLAND COMMUNITY PRESENT: Yes COMMUNITY ID: PFO

DOMINANT VEGETATION

TREE STRATUM: Fraxinus nigra, Betula alleghaniensis, Acer saccharinum, Quercus macrocarpus

SAPLING/SHRUB STRATUM: Alnus incana, Fraxinus nigra

HERBACEOUS STRATUM: Caltha palustris, Impatiens capensis, Matteuccia struthiopteris, Lycopus americanus, Ribes cynosbati

GENERAL NOTES:

SP18 is a wetland seep extending from a forested wetland at approximately 1300’ elevation (mean sea level) on a steep slope into the wetland pond feature. Water was not observed expelling from ground surface, and the physical/chemical characteristics were not taken since the water depth was not sufficient.

Appendix C – Site Photographs

Photo 1. Upland side slopes on eastern property boundary, view south

Photo 2. Intermittent portion of SP1 above 1300' elevation, view northeast

Photo 3. SP1 spring cluster at 1300' elevation, view north

Photo 4. SP1 upper spring component, view north

Photo 5. SP1 upper spring component, view southeast

Photo 6. SP2 emerging from cedar swamp flowing towards Scout Camp Pond, view south

Photo 7. SP3, view east

Photo 8. SP1 braded wetland area at base of slope, view east

Photo 9. SP1 braided wetland area outlet to Scouts Camp Pond, view northwest

Photo 10. Beaver trail/ entrance to Scout Camp Pond, view west

Photo 11. SP4, view west

Photo 12. SP5, view west

Photo 13. SP6, view east

Photo 14. SP7 spring origin, view east

Photo 15. Confluence of SP8 (center) and SP9 (right), view east

Photo 16. SP10, view east

Photo 17. SP11clustered spring flowage area, view north

Photo 18. SP12 flowing towards Spring Creek, view west

Photo 19. SP13 spring emergence and wetland area at the 1300' elevation location, view south

Photo 20. SP13 flowage/seep down slope to Scout Camp Pond, view east

Photo 21. SP14 and SP15 origins at the 1300' elevation location, view southeast

Photo 22. SP16 and SP17 origins at the 1300' elevation location, view southeast

Photo 23. SP18 at base of slope flowing into Scout Camp Pond, view east

Photo 24. Western upland slopes of Scout Camp Pond, view northeast

Photo 25. Upland forest community west of MNTH 6, view north

Photo 26. Wetland forest east of MNTH 6, no evidence of spring influence, view east

Photo 27. Wetland forest east of MNTH 6, no evidence of spring influence, view north

Photo 28. Wet meadow wetland community east of MNTH 6, no evidence of spring influence, view west

Photo 29. Culvert outlet crossing under MNTH 6 from wet meadow wetland west of MNTH 6, no evidence of spring influence, view southeast

Photo 30. Drainage from the MNTH 6 culvert outlet through the forest between Scout Camp Pond and MNTH 6, no evidence of spring influence, view southeast

Appendix E

2019 Thermal Imaging Survey Report

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
31101 Hampshire Avenue S
Minneapolis, Minnesota 55438

Phone: 952.995.2000
Fax: 953.995.2020
Web: braunintertec.com

March 29, 2019

Mr. Ben Bouska
Engineer, MP US Facilities Project Delivery
Enbridge Energy
26 East Superior Street, Suite 309
Duluth, MN 55802

Project #B1901260

Re: Evaluation of Spring Flow Potential by Thermal Drone Flight
Line 3 Replacement
2.6 Miles North of Outing
East of Hwy 6, along Spring Branch

Dear Mr. Bouska:

The purpose of this letter is to provide a summary of a high resolution thermal imaging survey of the area crossing Spring Branch, 2.6 Miles North of Outing, immediately downstream from Scout Camp Pond (Figure 1). The thermal imaging survey was conducted during cool conditions to give the best opportunity for identifying spring discharge as the temperature contrast between groundwater and surface conditions are significant. Thermal imaging was chosen as the best technology for showing spring flow activity, as traditional geophysical methods are limited by site topography, wooded conditions, and a narrow range of contrasting geologic materials. The goal of the thermal flight was to aid in understanding the conceptual hydrogeologic model of the shallow unconfined materials which included the possibility of significant spring discharge at the site.

Site Conceptual Model

At the time of the field effort, the site consisted of open space, heavily wooded, covered in part by a thin layer of snow. The Site topography is significant, sloping steeply down from the west to Spring Branch, dropping in elevation from 1,344 to approximately 1,272 feet mean sea level (msl), returning to an elevation of approximately 1,322 feet msl on the east side of Spring Branch. As such, from the access point, the elevation dropped approximately 75 feet in lateral distance of less than 250 feet. The project area and topographic map are shown on Figure 2.

The geologic conditions are defined by a number of wells completed in the area with the addition of boring 504 West completed by Enbridge (attached). The regional geology is glacial in origin composed of varying compositional layers of clays, silts, sands, and gravels. The clay layers in the area are discontinuous within the geologic section ranging in elevation between 1,272 and 1,347 feet msl. The topographic low area on site corresponds to the Spring Branch discharging from Scout Camp Pond at an approximate elevation of 1,270 feet msl.

The depth to groundwater varies with topography, but generally falls between an elevation of 1,272 and 1,309 feet msl. As such, it appears that groundwater is either coincidental to Spring Branch, or is expressed within the topographic expression of the site. It is likely that based on the groundwater elevations noted and the steep topographic expression of the site area, as an expression of the water table, groundwater would seep from the hillside into the Spring Branch as shown on the diagrammatic cross section (Figure 3). The cross section was developed based on previous efforts, projecting the top of clay into the section based on contouring the results defined by the available well data.

The persistence of seeps in this environment would be significantly less as compared to spring discharge fed from discrete geologic or hydrologic conditions. Additionally, within the immediate site area, the topography is divided, isolating the immediate area from the broader upward topography extending east. The topographic divide would limit the regional continuity of groundwater flowing to the site area from the east bank of Spring Branch.

Thermal Drone Flight Evaluation

On March 19, 2019, Bob Day, Braun Intertec Geospatial Operations Manager and Ben Bouska, Enbridge Project Lead, visited the site to conduct the thermal drone flight evaluation. The drone and camera used to map the thermal signature of the site was a DJI Inspire Aircraft with a FLIR Zenmuse XT camera capable of detecting a spectral band ranging between 7.5 and 13.5 micrometers and thermal range of -13 to 275 degrees Fahrenheit. A thermal scan of the hillside areas, coincidental to the site, was completed to show if groundwater was discharging along the hillside toward Spring Branch. Persistent spring discharge would manifest as a strong high temperature compared to the surrounding conditions, as the temperature of groundwater is approximately 54 degrees Fahrenheit.

The entire site area was flown as shown on the photo mosaic on Figure 4. The flight was conducted articulating the camera to shoot both vertically and horizontally at the hillsides in areas of suspected spring discharge. A summary of thermal images by location is shown on Figure 5. Additionally, thermal images of the hillside along the east and west bank of Spring Branch are provided in the attached photo log. The thermal images show changes in temperature with yellow and red as warm and blue as cold.

Thermal Image Conclusions

Based on the thermal images collected during this effort, it does not appear that there is persistent spring discharge contributing to the flow of Spring Branch within the study area. This is supported by the following (images presented on Figure 4 and photo log):

- No indication of spring discharge at a suspected location along the west hillside bank of Spring Branch as shown on photo 21 and 22
- No indication of spring discharge at a suspected location along the east hillside bank of Spring Branch as shown on photo 12, 15, 16, 17, 19, 25, and looking upstream per photos 23, and 27.

Based on the thermal scan of the hillside areas coincidental to the site, there was no evidence of persistent spring discharge noted as a strong high temperature signature at previously identified suspect areas. As such, water discharging into Spring Branch from the hillsides coincidental to the site area, if any, is likely an expression of the water table with the topographic expression capturing and routing water at discrete locations.

We appreciate the opportunity to provide professional services for you on this project. If you have questions regarding the contents of this report, please call Dan Barrett at 952-995-2098.

Sincerely,

BRAUN INTERTEC CORPORATION

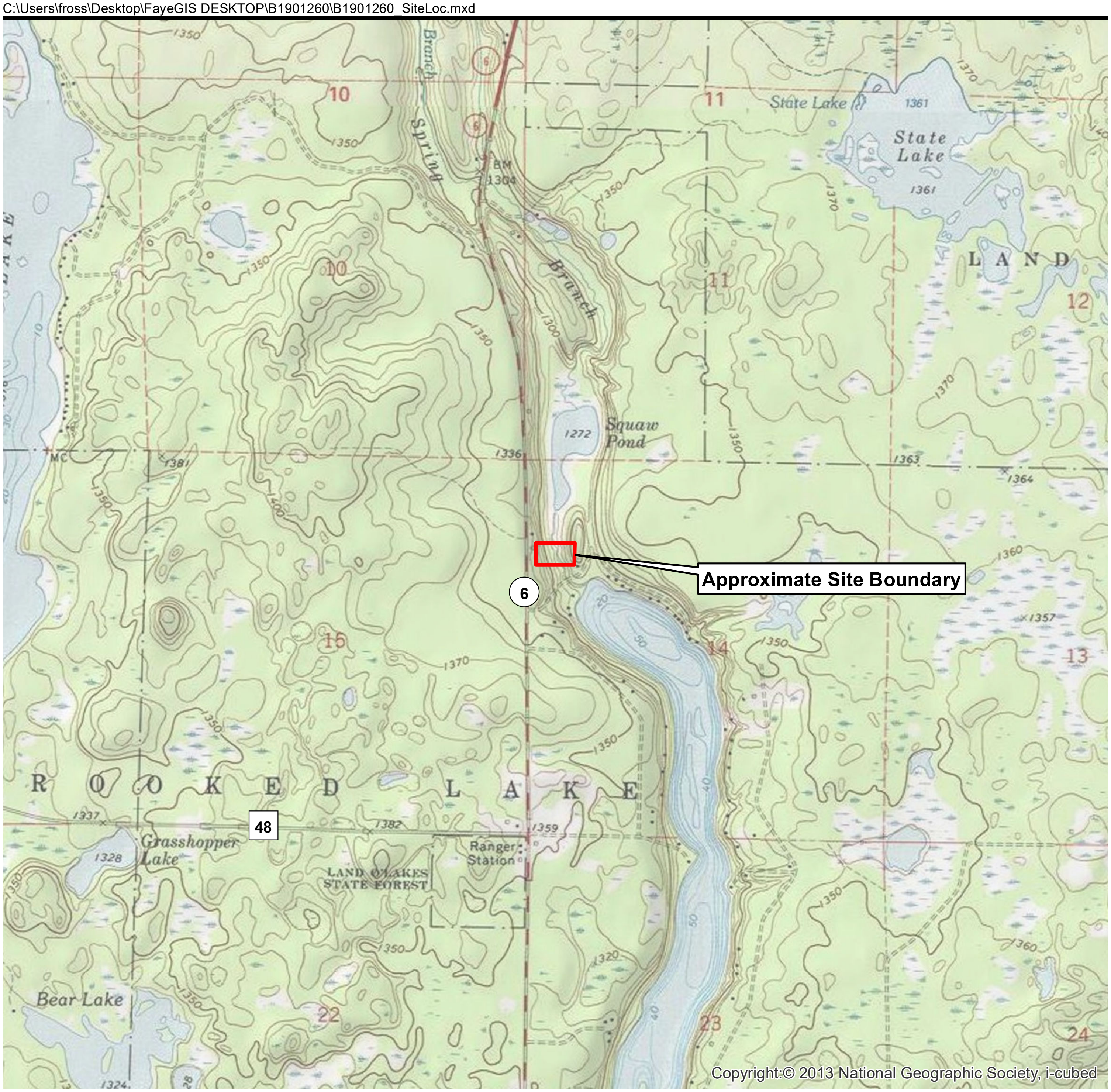
Dan Barrett, PG
Principal Scientist

Michael J Beck
For

Robert Day
UAS Manager, Associate Principal

Attachments:

Figure 1	Site Location
Figure 2	Topography of Line Alignment
Figure 3	Diagrammatic Cross Section
Figure 4	Drone Flight Photo Mosaic
Figure 5	Thermal Image Summary
	Photo Log



🟥 Approximate Site Boundary

Data Source:
USGS Quadrangle

N

0 1,000 2,000
Feet

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Minneapolis, MN 55438
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braunintertec.com

Project No:
B1901260

Drawing No:
B1901260_SiteLoc

Drawn By:	FER
Date Drawn:	3/26/2019
Checked By:	DPB
Last Modified:	3/28/2019

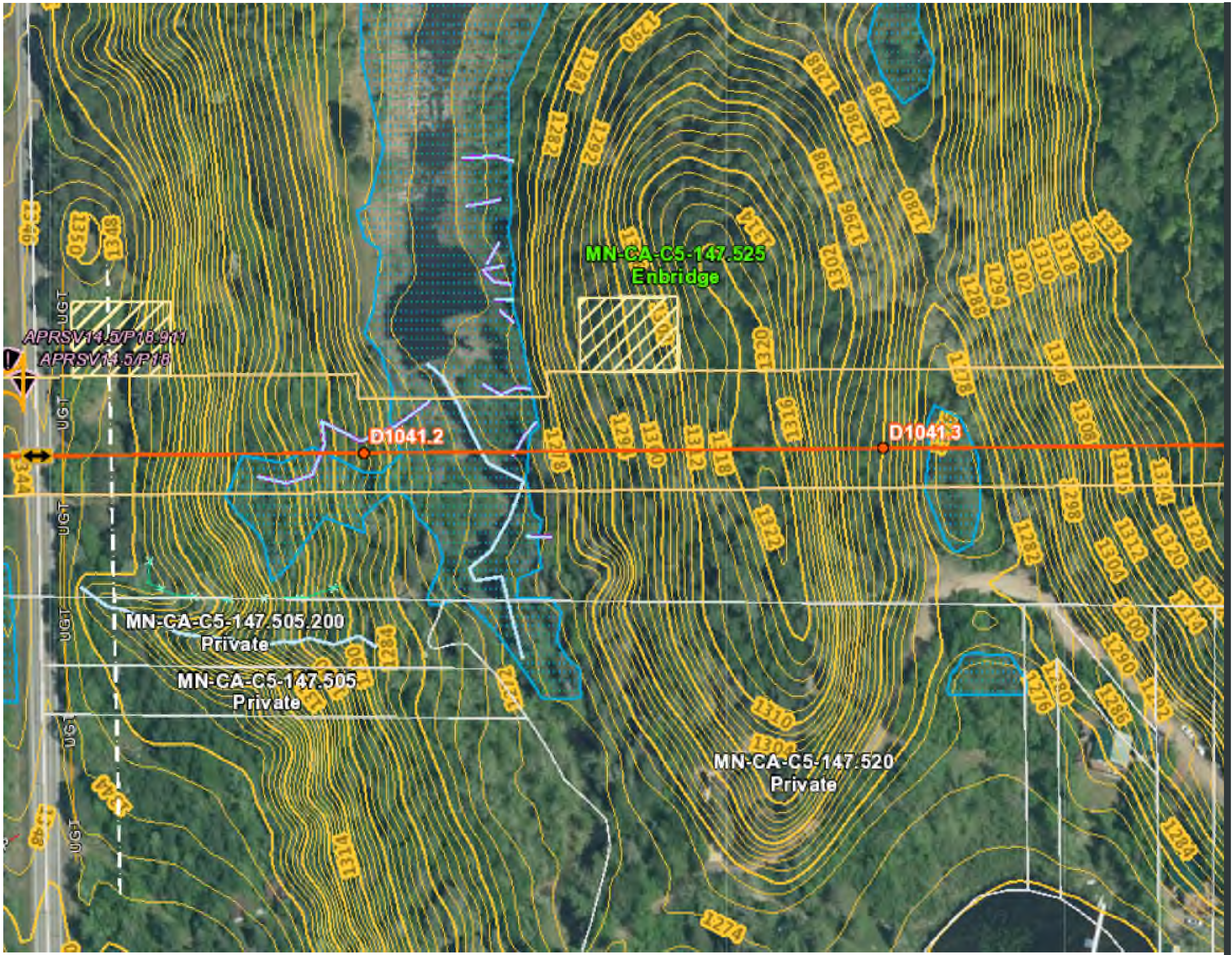
Enbridge

Line 3 Replacement

Outing, Minnesota

Site Location Map

Figure 1



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11001 Hampshire Avenue S
Minneapolis, MN 55438
PH (952) 995-2000
FAX (952) 995-2020

Base Drawing Provided By

Drawing Information

Project No:
B1900000

Drawing No::

Drawn By:
Drawn Drawn:
Checked By:
Last Modified:

Project Information

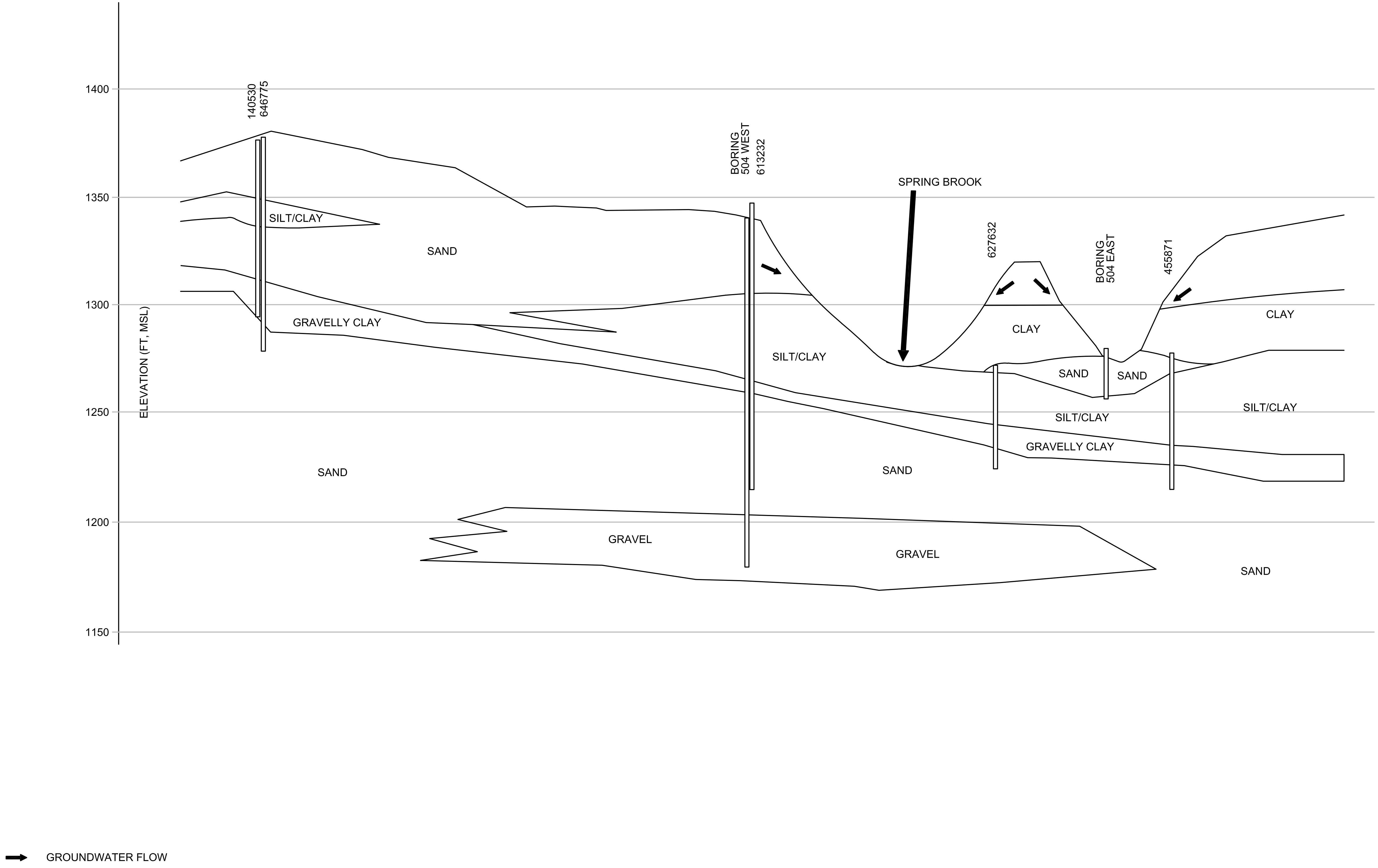
Enbridge Line 3
Replacement

Thermal Survey
Evaluation

Outing, MN

Topography of Site

Figure 2



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Drawing Information

Project No:
B1901260

Drawing No:
B1901260

Drawn By:	LAO
Date Drawn:	3/27/19
Checked By:	DB
Last Modified:	3/28/19

Project Information

Outing Spring Study

Enbridge Line 3
Replacement

Outing, Minnesota

Cross Section

Figure 3

F:\2019\B1901260.dwg,Cross,3/29/2019 1:52:39 PM

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11001 Hampshire Avenue S
Minneapolis, MN 55438
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FAX (952) 995-2020

Base Drawing Provided By

Drawing Information

Project No:
B1900000

Drawing No::

Drawn By:
Drawn Drawn:
Checked By:
Last Modified:

Project Information

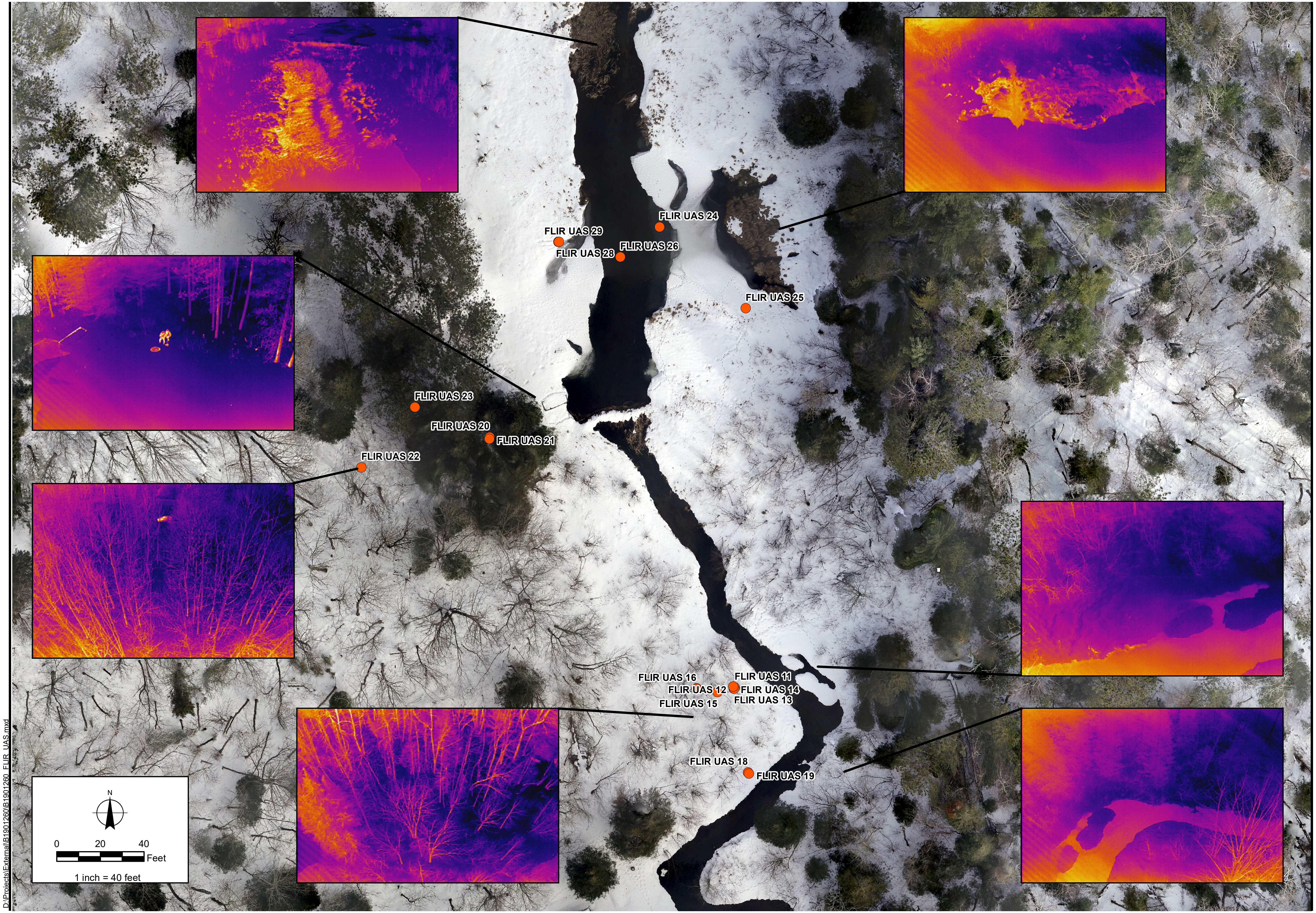
Enbridge Line 3
Replacement

Thermal Survey
Evaluation

Outing, MN

Photo Mosaic of Drone
Flight

Figure 3



D:\Projects\External\B1901260\B1901260_FLIR_UAS.mxd

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Minneapolis, MN 55438
952.995.2000
braunintertec.com

Base Drawing Provided By

Provider

Drawing Information

Project No:
B1901260

Drawing No:
B1901260_FLIR_UAS

Drawn By:	RHD
Drawn Drawn:	3/21/19
Checked By:	DB
Last Modified:	3/28/2019

Project Information

Enbridge Line 3
Replacement

Spring Study

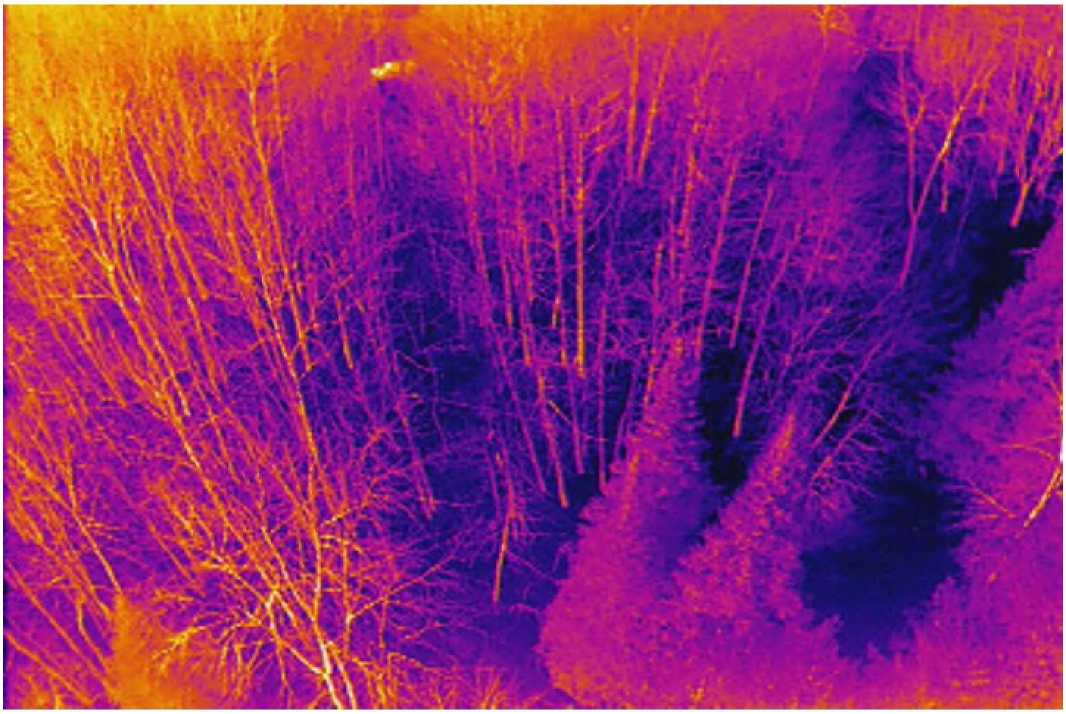
Outing, MN

FLIR UAS

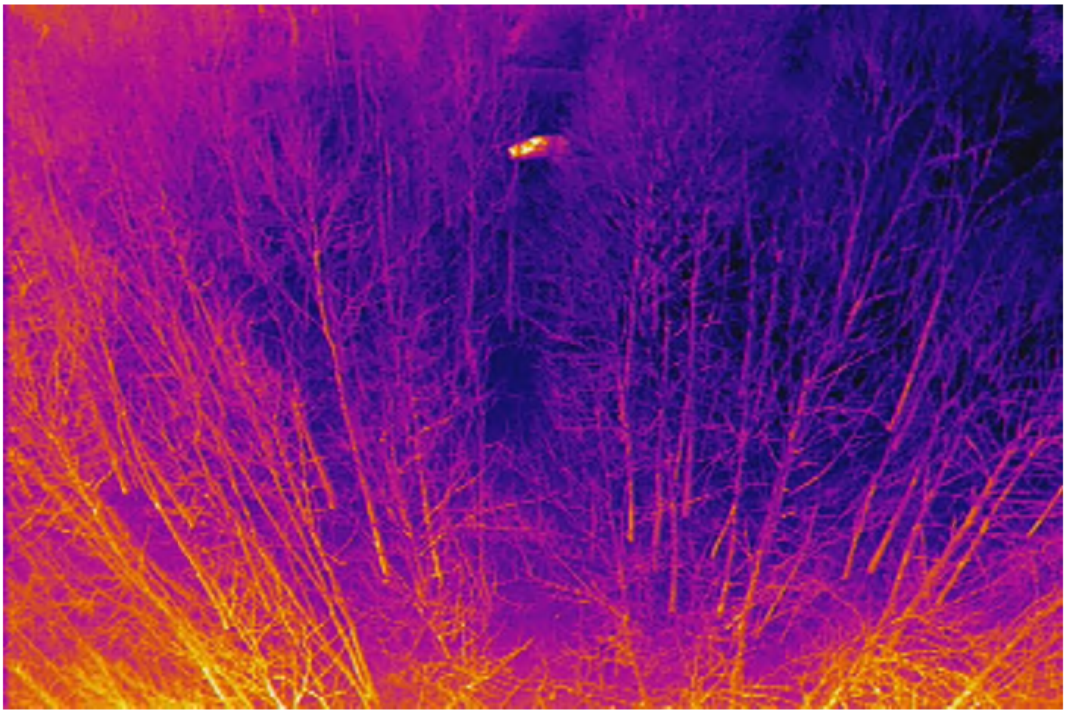
Figure 5

PHOTO LOG

Enbridge Line 3 Replacement

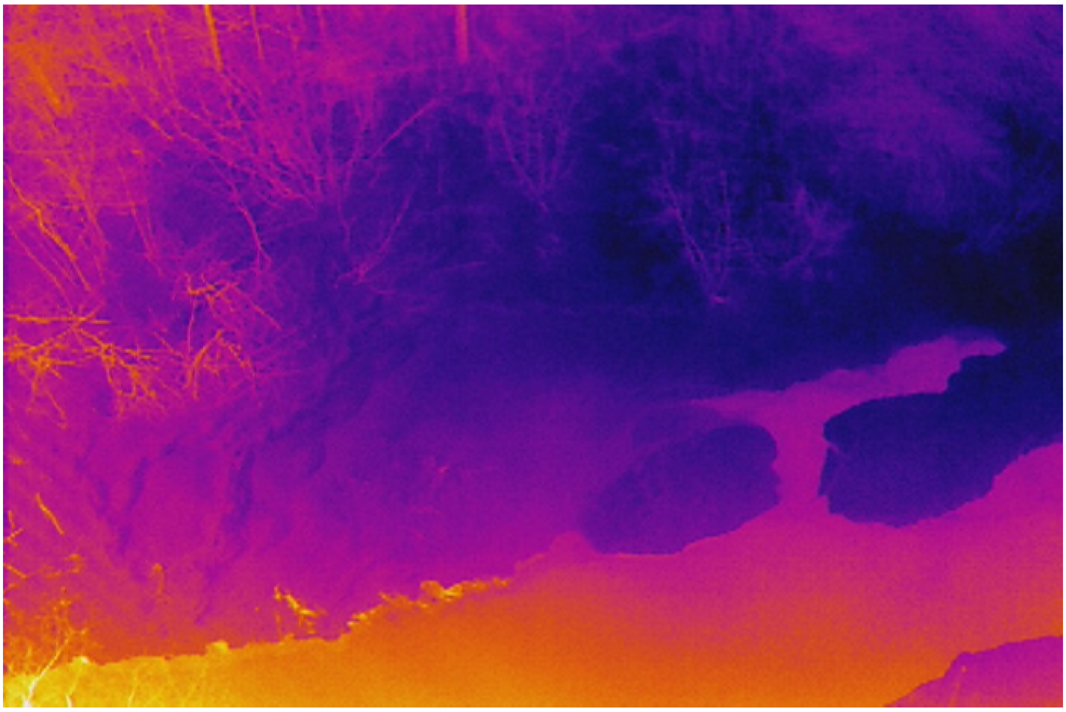


Photograph #21	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	BRAUN INTERTEC
Direction:	West Side Creek Hillside	
Subject:	No indication of noted spring location	

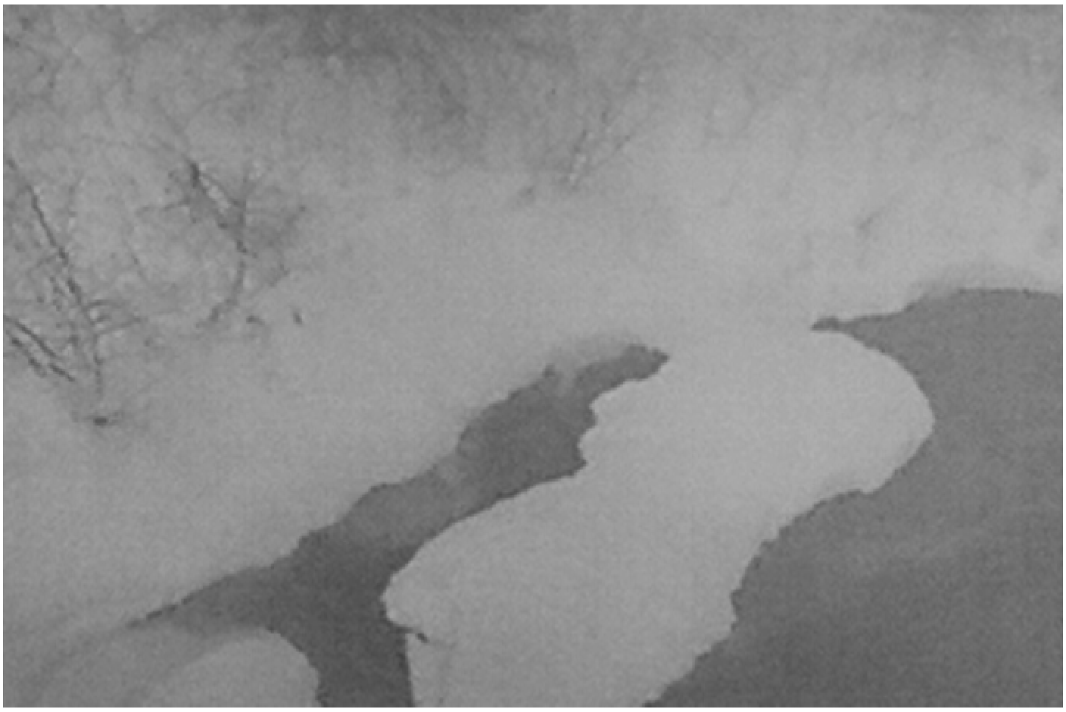


Photograph #22	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	BRAUN INTERTEC
Direction:	West Side Creek Hillside	
Subject:	No indication of noted spring location	

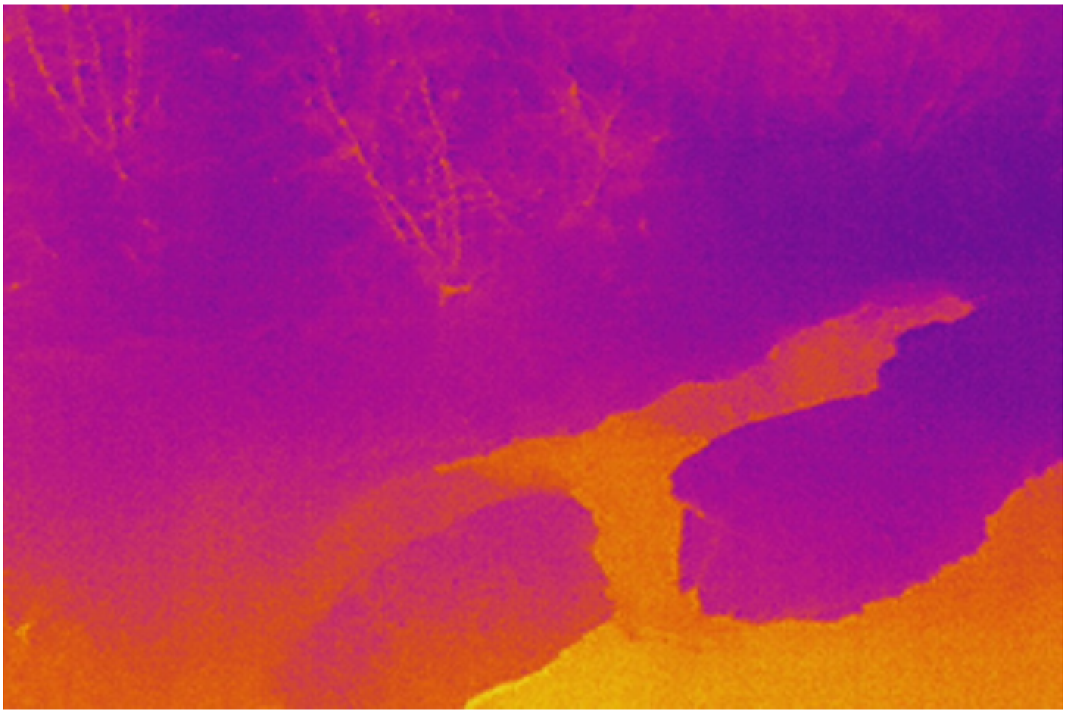
Photograph #11	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	BRAUN INTERTEC
Direction:	East Side Creek	
Subject:		



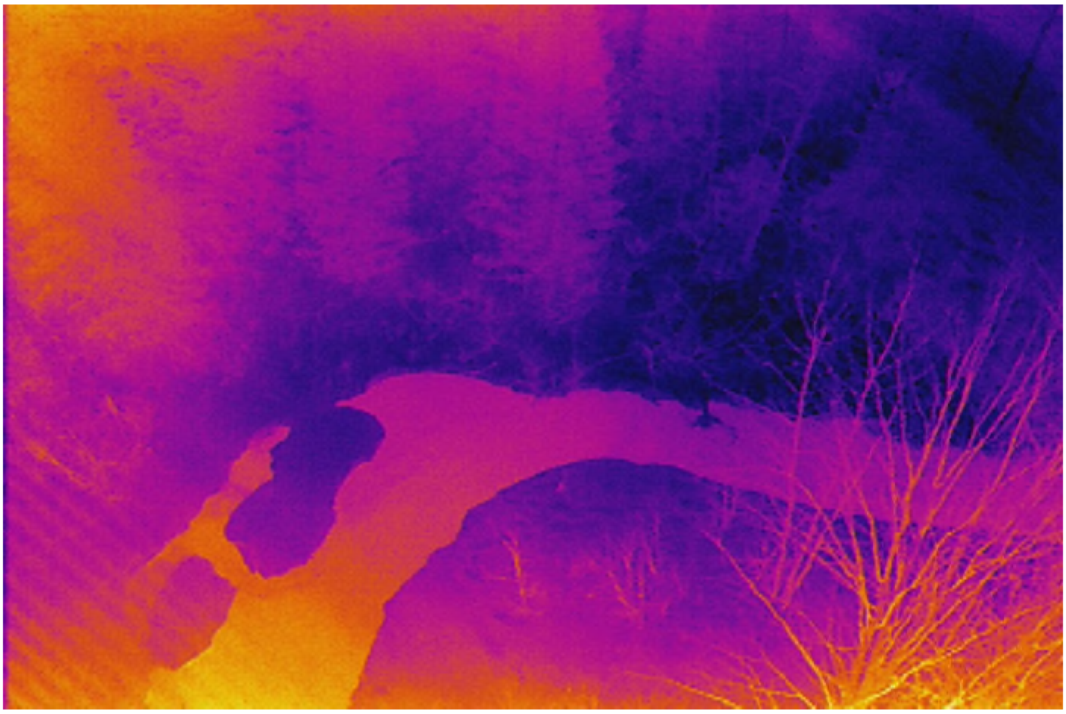
Photograph #12	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	BRAUN INTERTEC
Direction:	East Side Creek Hillside	
Subject:	No indication of noted spring location	



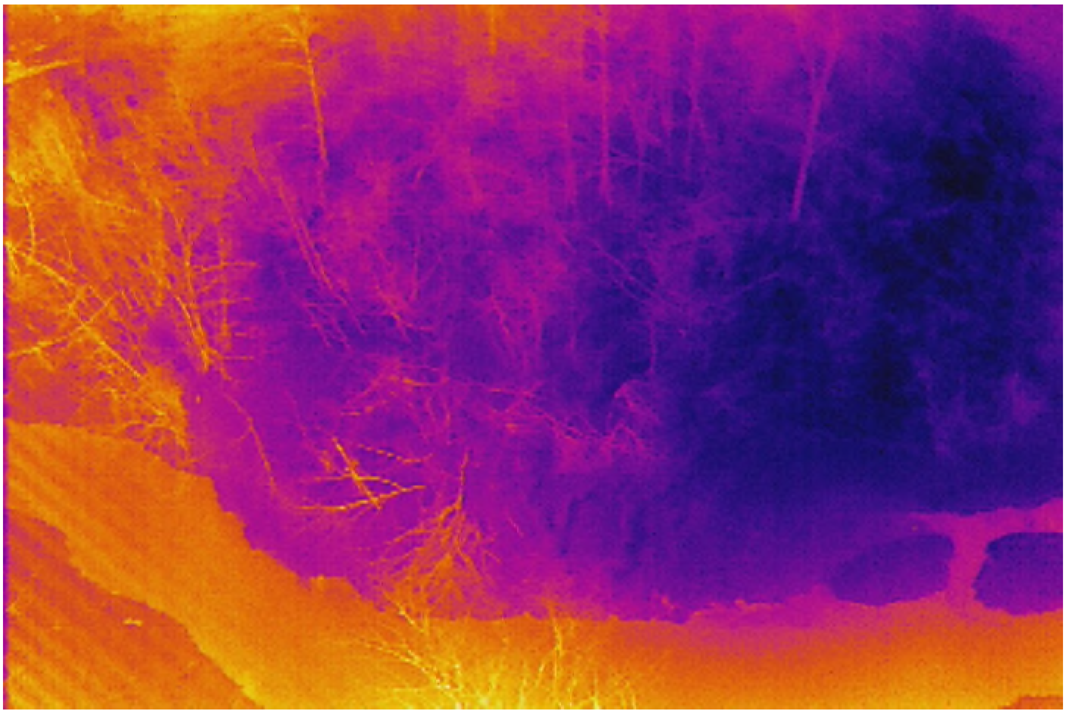
Photograph #14	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	BRAUN INTERTEC
Direction:	East Side Creek	
Subject:		



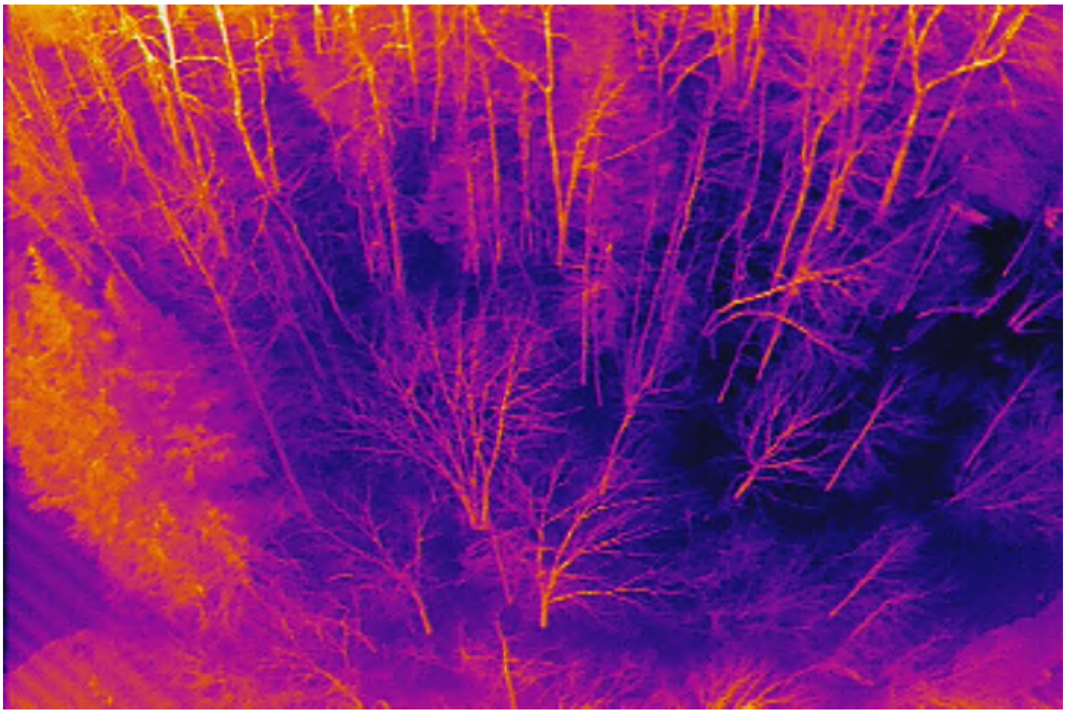
Photograph #15	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	BRAUN INTERTEC
Direction:	East Side Creek Hillside	
Subject:	No indication of noted spring location	



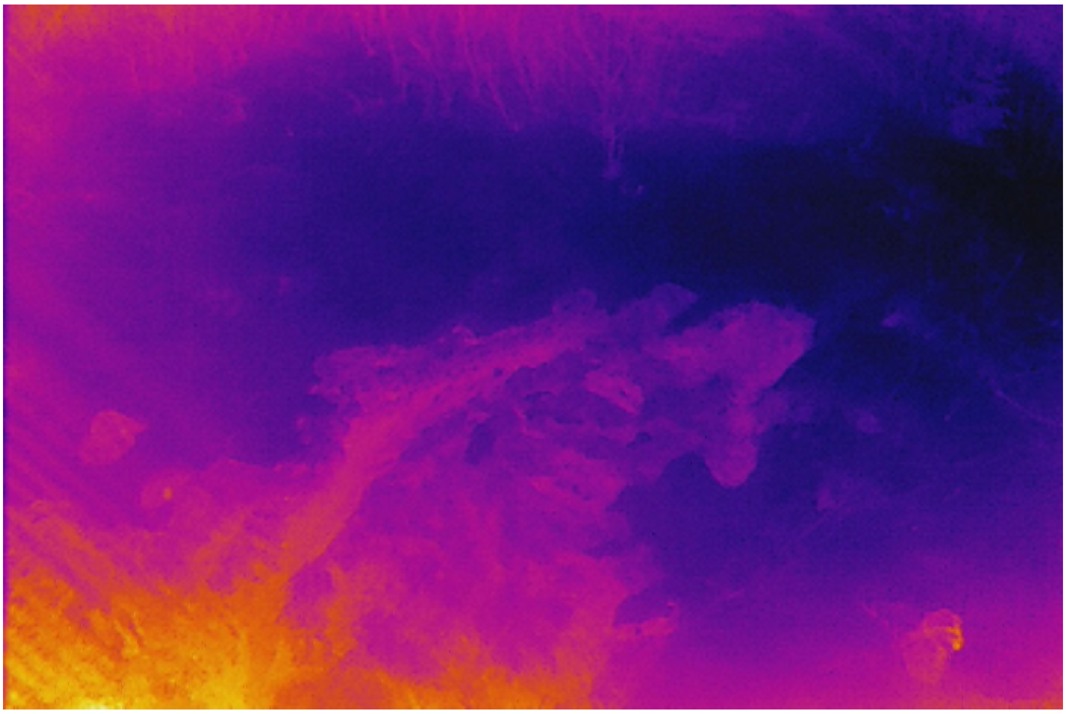
Photograph #16	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	
Direction:	East Side Creek Hillside	
Subject:	No indication of noted spring location	



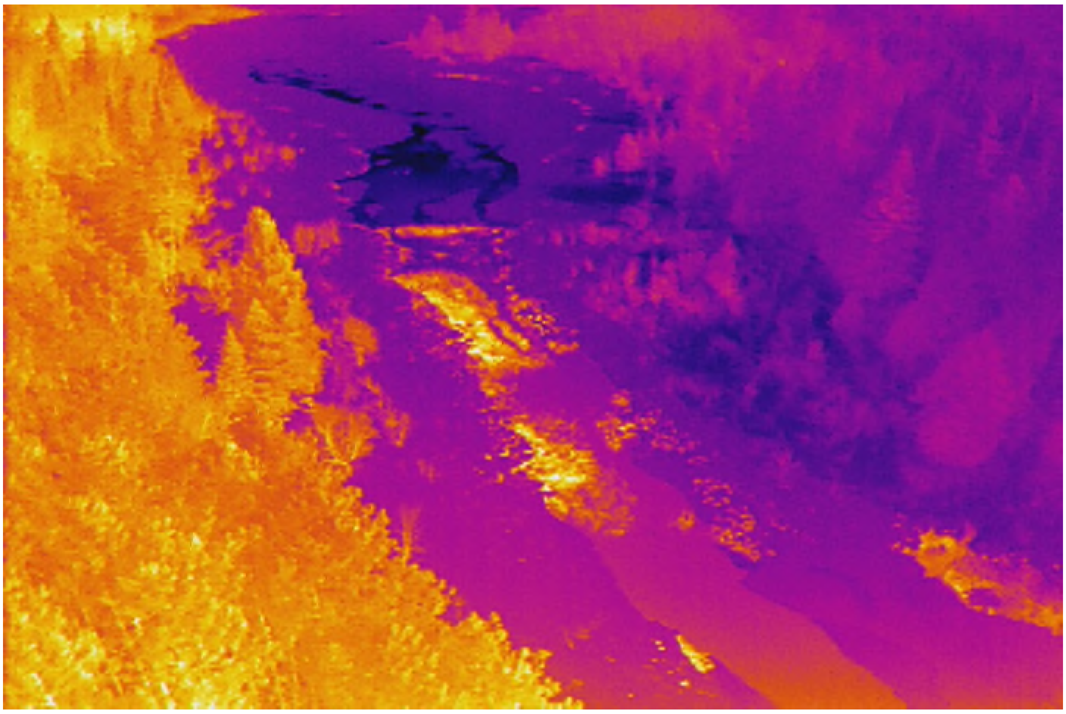
Photograph #17	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	
Direction:	East Side Creek Hillside	
Subject:	No indication of noted spring location	



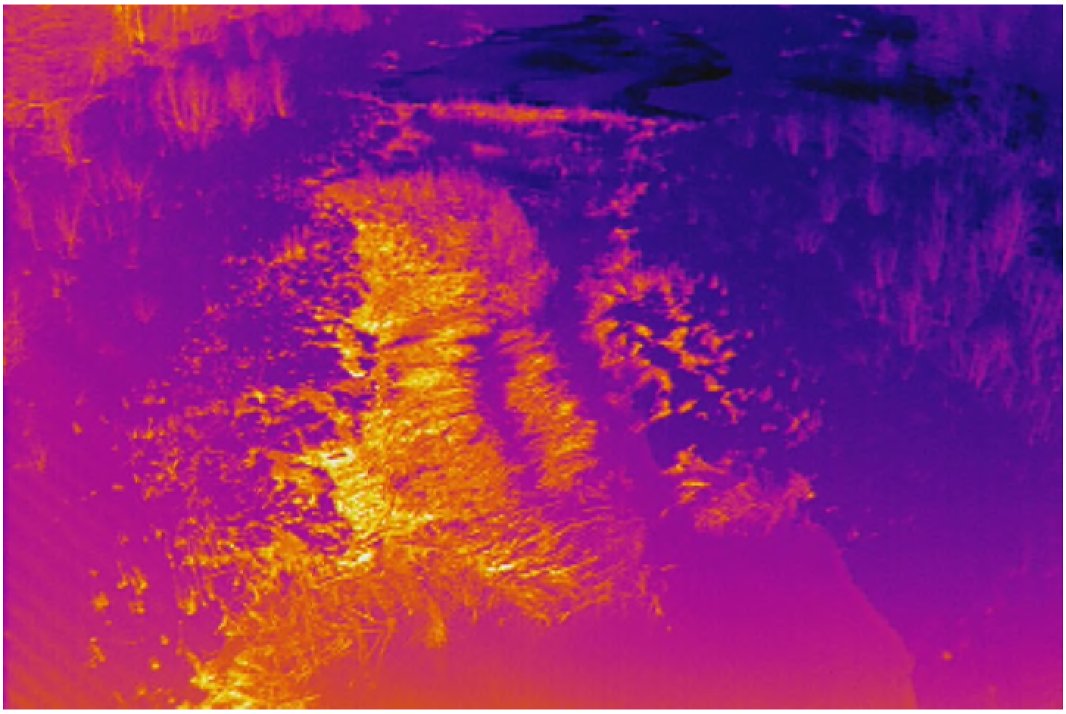
Photograph #19	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	BRAUN INTERTEC
Direction:	East Side Creek Hillside	
Subject:	No indication of noted spring location	



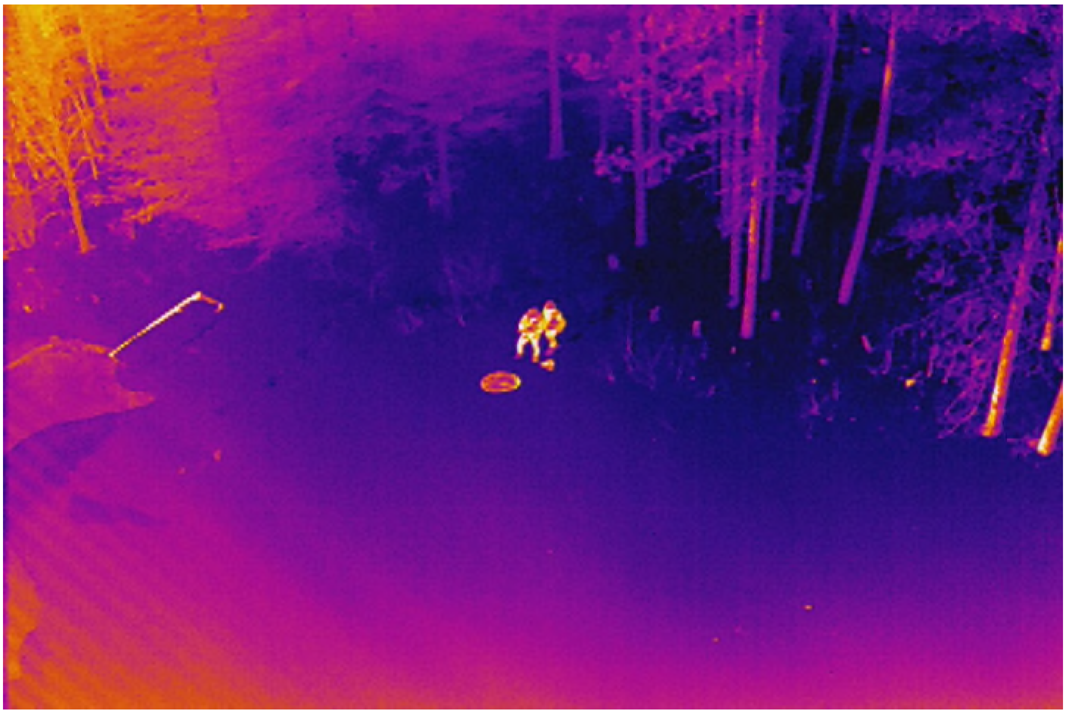
Photograph #25	Enbridge Line 3 Replacement, Emily, MN	B1901260
Date:	March 19, 2019	BRAUN INTERTEC
Direction:	East Side Creek Hillside	
Subject:	No indication of noted spring location	



Photograph #23	Enbridge Line 3 Replacement, Emily, MN	B1900956
Date:	March 19, 2019	
Direction:	North – East Bank Stream	
Subject:	No indication of noted spring location	



Photograph #27	Enbridge Line 3 Replacement, Emily, MN	B1900956
Date:	March 19, 2019	
Direction:	North – East Bank Stream	
Subject:	No indication of noted spring location	



Photograph #28	Enbridge Line 3 Replacement, Emily, MN	B1900956
Date:	March 19, 2019	
Direction:	West Side Creek	
Subject:	Field Staff and Drone Pad	

Photograph #	Enbridge Line 3 Replacement, Emily, MN	
Date:		
Direction:		
Subject:	Drone Used for Flight	

Appendix F

Geotechnical Data Report (Updated as of March 2020)

memo

Date: March 25, 2020

To: Vanessa Perry, MDNR Policy Analyst

From: Bobby Hahn, Enbridge

Re: **Enbridge Energy, Limited Partnership**
Line 3 Replacement Project
Spire Valley Crossing Method

The purpose of this memo is to transmit the March 2020 Spire Valley Geotechnical Report (the "Spire Valley Report") prepared by Barr Engineering, Inc. to support Enbridge Energy, Limited Partnership's ("Enbridge") Line 3 Replacement Project ("L3R" or "the Project"). The Spire Valley Report presents the data collected during the most recent geotechnical investigation requested by the Minnesota Department of Natural Resources ("MDNR"), as well as the conclusions from the investigation. The secondary purpose of this memo is to confirm Enbridge's proposed standard open cut crossing method at Spire Valley and present the preferred pipeline depth, following Enbridge's review of the data gathered at MDNR's request.

Enbridge's initial proposal for the Spire Valley crossing along the western hillslope consisted of a standard open cut construction method with a trench depth of approximately 7 feet to allow for a standard 4-foot depth of cover. Federal regulation requires a minimum of three feet of cover above the pipeline[1]. During our January 29, 2020 meeting with you, Enbridge presented an alternate, shallow construction option where the pipeline would be installed in a 4-foot-deep excavation, with 1-foot depth of cover to grade. To provide for the required additional depth of cover, Enbridge would need to build a mounded "soil cap" over the pipeline using native and imported soil. The Spring Brook Construction Proposal submitted to the MDNR on February 3, 2020 outlines this proposal.

Environmental investigations and data collection efforts that Enbridge has conducted at Spire Valley have yielded data that concludes it is unlikely that artesian groundwater conditions will be encountered during construction. The most recent data gathering effort, completed in March 2020 at the MDNR's request following our meeting on January 29, 2020, included five additional borings along the western hillslope advanced to a depth of 10 feet. The results of this investigation confirm the absence of artesian conditions. See Figures 1 and 2 that present both the shallow and proposed pipeline construction, the interpolated water table along the recently completed borings. Therefore, it is Enbridge's preference that the pipeline be buried and installed in accordance with its initial construction proposal but instead of four feet of cover we'd propose the minimum allowable cover at three feet to minimize the excavation depth. Further it is Enbridge's preference that the alternate, shallower mounded construction method not be

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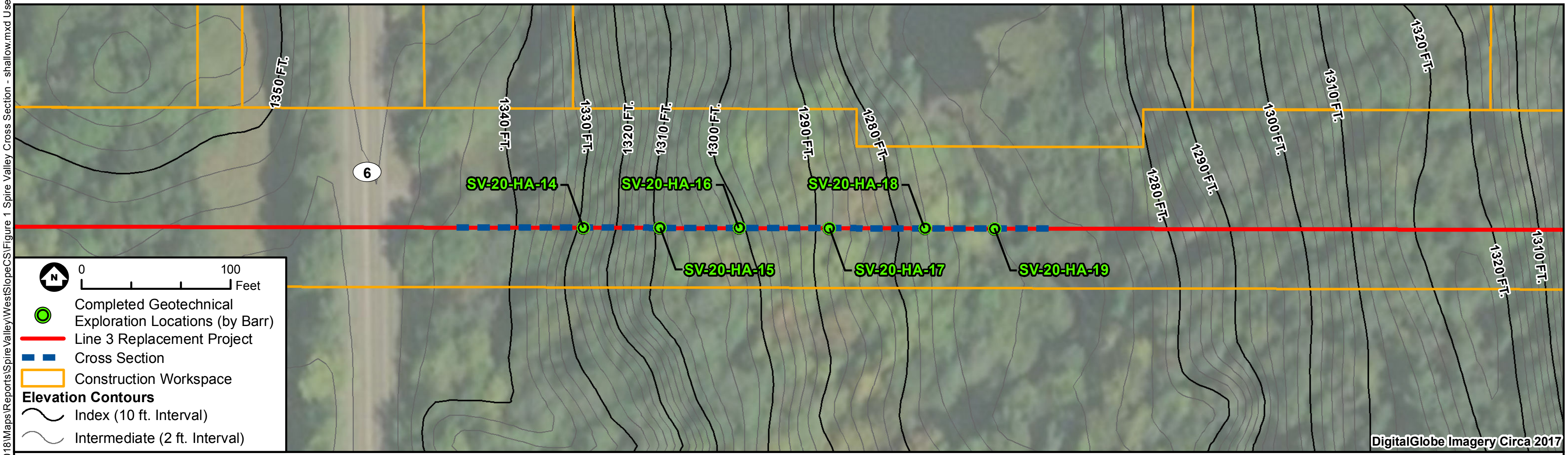
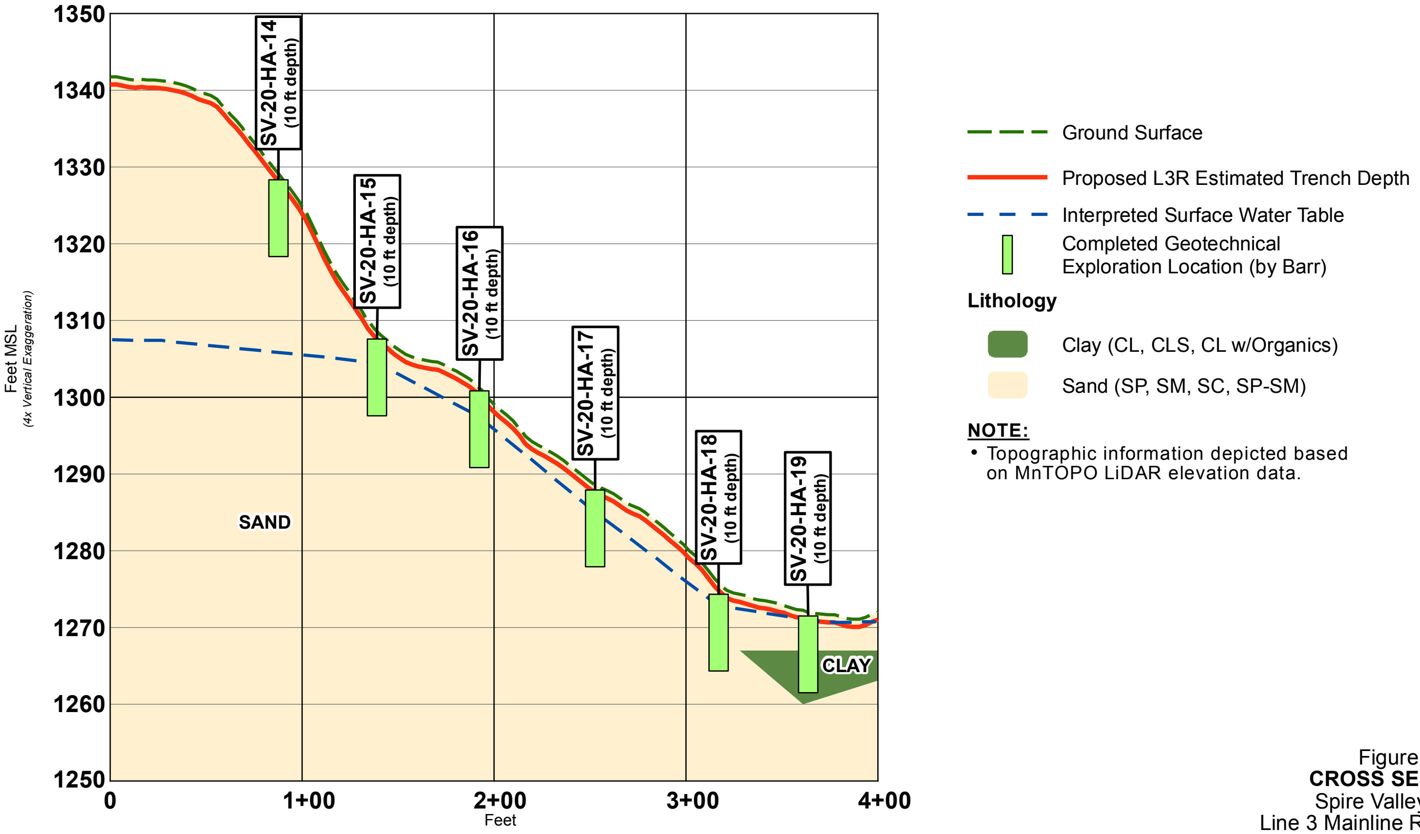
[1] 49 Code of Federal Regulation 195.248

further pursued. Although seepage into the trench is expected it will likely be low and manageable. This investigation did not find any groundwater conditions that would necessitate the need to manage for high flows during construction or unusual flows into the backfilled excavation after construction.   Enbridge's Spire Valley/Spring Brook Construction Plan submitted with the December 20, 2019 License to Cross Public Waters application presents detailed construction and post-construction water management techniques that can adequately manage the volume of water expected during construction.

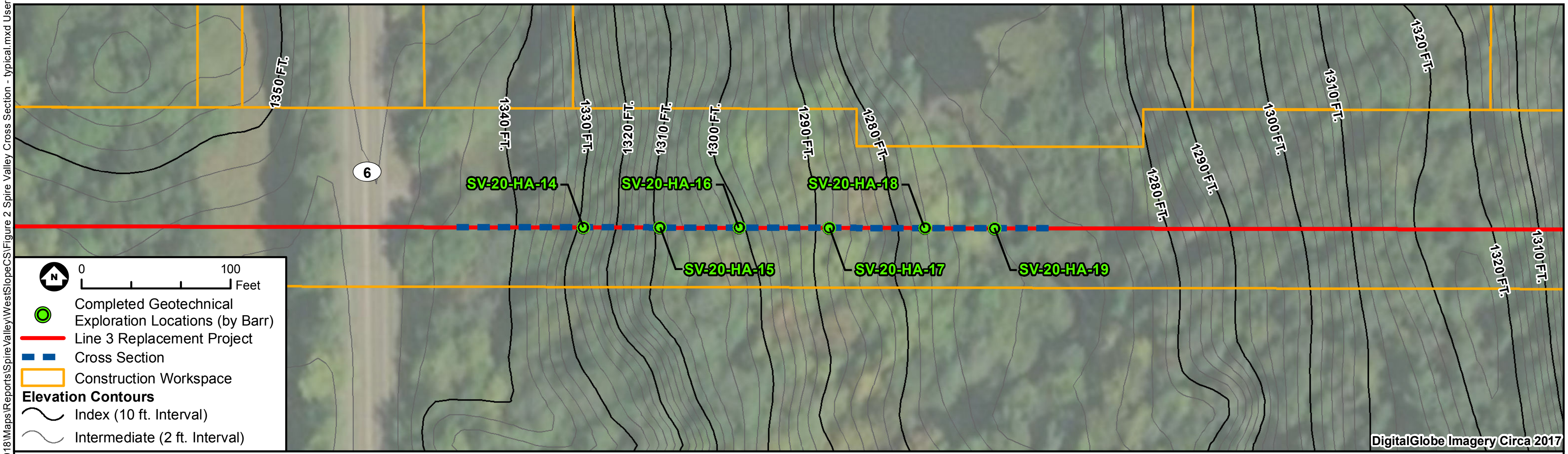


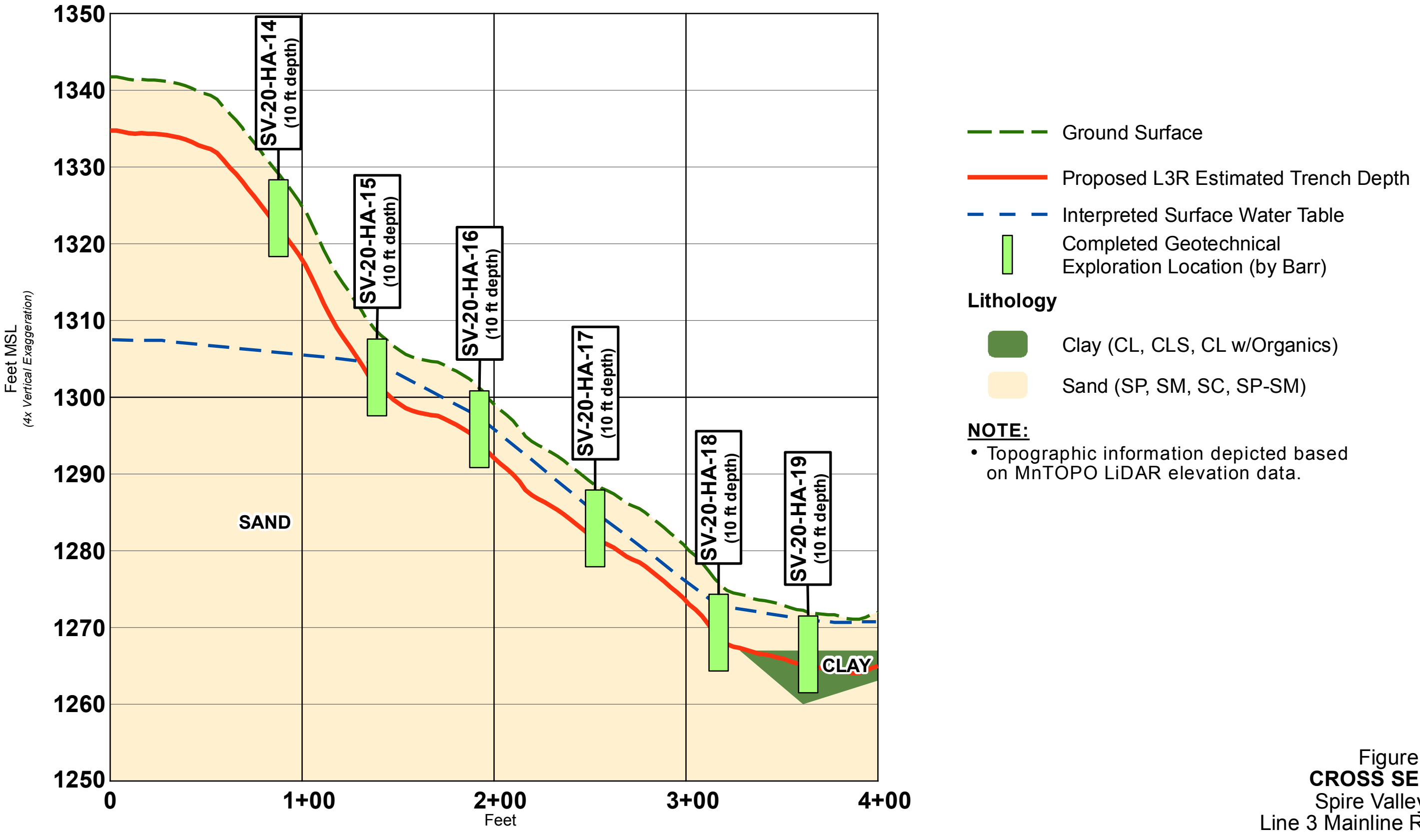


NOTE:
- Topographic information depicted based on MnTOPO LiDAR elevation data.

Figure 1
CROSS SECTION
Spire Valley HDD
Line 3 Mainline Replacement
Cass County, MN

ENBRIDGE





NOTE:
- Topographic information depicted based on MnTOPO LiDAR elevation data.

Figure 2
CROSS SECTION
Spire Valley HDD
Line 3 Mainline Replacement
Cass County, MN

Geotechnical Data Report

Line 3 Replacement
Spire Valley

Cass County, Minnesota

Prepared for
Enbridge Energy, Limited Partnership

October 2019

Revised March 2020

Geotechnical Data Report

Line 3 Replacement
Spire Valley

Cass County, Minnesota

Prepared for
Enbridge Energy, Limited Partnership

October 2019

Revised March 2020

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Geotechnical Data Report
Line 3 Replacement
Spire Valley

October 2019
Revised March 2020

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Certifications

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota

Peter M. Demshar

March 20, 2020

Peter M. Demshar, PE
Minnesota PE #: 57139

Date

Reviewed by:

March 20, 2020

Robert W. Olah, PE
Minnesota PE #: 50619

Date

1 Introduction

Barr Engineering Company (Barr), under contract with Enbridge Energy, Limited Partnership (Enbridge), completed a geotechnical evaluation for a section of the proposed Line 3 Replacement (L3R) Pipeline Spring Brook crossing, located approximately 2.5 miles north of Outing, Minnesota. This report has been revised to include the results of the December 2019 and March 2020 exploration programs.

Barr performed a geotechnical investigation and evaluation of site conditions. Soil boring logs are presented in Appendix A, and laboratory results are presented in Appendix B. This report describes the investigation and testing performed, presents the results of this work, and provides geotechnical analyses and conclusions to aid in the design of the pipeline alignment and prepare for pipeline construction. Our work at this site was performed in conjunction with other crossing locations for the proposed pipeline; results for these other crossings are provided in separate reports.

1.1 Project Information

The planned L3R pipeline at this site will cross below Spring Brook and adjacent wetlands. The Spring Brook pipeline crossing is to be located approximately 2.5 miles north of Outing, Minnesota in eastern Cass County, in Section 14 of Township 139 North, Range 26 West (Figure 1). The L3R project design and permitting is ongoing, but the pipeline is expected to be a 36-inch diameter carbon steel pipe for transmission of crude oil.

1.2 Site Geology

A review of regional geology indicates the underlying site conditions generally consist of glacial till of the Rainy Lobe/ St. Croix end moraine, underlain by Cretaceous age rock. The upper bedrock unit of the site can generally be considered shale and sandstone of the Coleraine Formation. The glacial till generally consists of a mixture of clay, silt, sand, and gravel with occasional cobbles and boulders and was deposited beneath, at the side, or at the lower limit of a glacier. The investigation indicated the glacial till deposits are present to at least the termination depths of the borings of up to 162 feet below the ground surface (elevation 1179.1). Surficial and bedrock site geology maps are provided in Figure 2 and Figure 3. A geologic cross-section is also provided as Figure 4.

1.3 Surface Observations

The following observations were made during drilling in September and December 2019 as well as March 2020. The proposed Spring Brook crossing site was observed to be in undeveloped wooded land in an area known as Spire Valley approximately 2.5 miles north of Outing, Minnesota, where the Spring Brook has a general north-south alignment. The site is located approximately 1 mile south of an existing Minnesota Department of Natural Resources (DNR) fish hatchery. The topography in the general vicinity of the Spring Brook slopes steeply up on either side of Spire Valley.

1.4 Previous Investigations

Barr previously prepared a Geotechnical Data Report for the Milepost 504 section of the previously planned Sandpiper Pipeline Project, near the proposed Spring Brook crossing (Barr, 2015). In order to provide additional subsurface information for the Spring Brook crossing, historic soil boring logs and laboratory data are provided in Appendix C and Appendix D, respectively. Historic borings are also shown on the attached Figure 1 and Figure 4.

2 Geotechnical Investigation Methods

2.1 Geotechnical Investigation

Two standard penetration test (SPT) boring and nineteen (19) hand auger (HA) borings were performed proximal to the L3R alignment for the Spring Brook crossing. The boring locations were selected by Enbridge, field adjusted by Barr, and are indicated on Figure 1. The coordinates and elevations for the boring locations, provided by the project surveyor Northwestern Surveying & Engineering, Inc. of Bemidji, Minnesota, are shown in Table 2-1.

Table 2-1 Soil Boring Locations

Borehole ID	Date Completed	Northing (ft)	Easting (ft)	Ground Surface Elevation (ft)
SV-19-Middle	September 13, 2019	459699.1	2414369.0	1282.5
SV-19-West	December 6, 2019	459893.4	2413563.8	1339.2
SV-19-HA-1	December 4, 2019	459881.8	2413626.9	1334.5
SV-19-HA-2	December 4, 2019	459885.7	2413661.9	1309.7
SV-19-HA-3	December 5, 2019	459900.8	2413721.8	1295.6
SV-19-HA-4	September 14, 2019	459885.1	2413779.2	1286.3
SV-19-HA-5	December 4, 2019	459792.4	2414027.5	1284.1
SV-19-HA-6	December 4, 2019	459792.3	2414117.6	1306.1
SV-19-HA-7	December 4, 2019	459792.3	2414207.5	1322.0
SV-19-HA-8	December 4, 2019	459792.4	2414297.5	1293.6
SV-19-HA-9	December 5, 2019	459795.1	2414466.1	1285.2
SV-19-HA-10	December 5, 2019	459785.1	2414549.7	1310.9
SV-19-HA-11	December 5, 2019	459804.9	2414639.1	1329.9
SV-19-HA-12	December 5, 2019	459795.2	2414816.8	1339.4
SV-19-HA-13	December 5, 2019	459805.5	2414980.4	1345.8
SV-20-HA-14	March 4, 2019	459817.4	2413613.4	1328.3
SV-20-HA-15	March 4, 2019	459817.3	2413664.7	1307.6
SV-20-HA-16	March 4, 2019	459817.2	2413717.9	1300.8
SV-20-HA-17	March 5, 2019	459817.1	2413778.4	1287.9
SV-20-HA-18	March 5, 2019	459817.0	2413842.5	1274.3
SV-20-HA-19	March 5, 2019	459816.6	2413889.2	1271.5

Elevations reference NAVD88
Minnesota State Plane North, Coordinate System FIPS 2201 NAD83 (US feet)

The SPT borings (SV-19-Middle and SV-19-West) were performed under subcontract to Barr by Coleman Engineering Company of Iron Mountain, Michigan. The test boring was performed with a Diedrich D-120 track-mounted drill rig using mud-rotary drilling techniques with a tricone roller bit diameter of 3-7/8 inches. Because of the potential for pressurized groundwater conditions in SV-19-Middle, this boring was completed using heavy (weighted) drilling mud. Standard weight drilling mud was used for boring SV-19-West. The drill rig was equipped with an automatic drop hammer for collection of split spoon samples.

To document the relative density of the formation and collect soil samples for laboratory testing, sampling with a standard split-spoon sampler was performed continuously throughout the boring. SPT borings were performed in general accordance with ASTM D1586 “Standard Methods for Penetration Test and Split-Barrel Sampling of Soils”.

The thirteen (13) hand auger borings completed in 2019 were performed using a 3-1/4 inch diameter bucket auger by both Barr and Coleman. The borings were sampled continuously, and bulk samples were retrieved for laboratory testing.

The six (6) supplementary hand auger borings completed in 2020 were performed using a 2-1/2 inch diameter bucket auger by both Barr and Twin Ports Testing of Superior, Wisconsin. The borings were sampled continuously, and bulk samples were retrieved for laboratory testing.

Nests of three vibrating wire piezometers were installed in SV-19-Middle and SV-19-West. One vibrating wire piezometer was installed in hand augers SV-19-HA-3, SV-19-HA-4, SV-19-HA-5, SV-19-HA-8, SV-19-HA-9, SV-19-HA-11, SV-19-HA-12, and SV-19-HA-13 (8 total) prior to abandonment. 1-inch diameter PVC standpipes were installed in hand augers SV-19-HA-1, SV-19-HA-2, SV-19-HA-6, SV-19-HA-7, and SV-19-HA-9 (5 total) prior to abandonment. All boreholes were backfilled with neat cement grout and bentonite slurry upon completion of drilling. Samples were reviewed by Barr field staff during collection and were then sealed and labeled in glass jars, brass liners, or plastic bags. The samples were again reviewed by a Barr geotechnical engineer in Duluth, and samples from SV-19-Middle and SV-19-HA-4 were then delivered to Twin Ports Testing II, Inc. (TPT) of Superior, Wisconsin for laboratory testing. Soil boring logs can be found in Appendix A.

2.2 Soil Testing

Laboratory testing was performed on samples from boring SV-19-Middle, SV-19-HA-4, and SV-20-HA-14 through SV-20-HA-19 to aid in documenting soil properties for the Spring Brook crossing site. Soil samples that were not submitted to TPT have been retained to allow Enbridge or their contractor(s) to perform additional testing as they require. Soil testing results, in combination with boring logs and site observations, will aid in the selection of construction methods and equipment. The soil samples will be stored for 12 months after the issuance of this report until they are discarded, unless written direction is otherwise provided.

Laboratory test results are provided in Appendix B (recent) and Appendix D (historic).

- Moisture content was determined in accordance with ASTM D2216, “Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.”
- Unit weight of soil samples was determined in accordance with ASTM D7263, “Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens.”
- The soil particle size distribution was determined in accordance with ASTM D422, “Standard Test Method for Particle Size Analysis of Soils.”
- Visual soil classification in accordance with ASTM D-2488, “Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).”
- Atterberg Limits were determined in accordance with ASTM D-4318, “Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.”

The results of moisture content, dry unit weight, Atterberg Limits, and grain size distribution tests of the soils, are included on the test boring logs adjacent to the tested sample. Table 2-2 provides a summary of all the laboratory test results (current and historic) for the site.

Table 2-2 Laboratory Test Results

Boring ID	Top of Sample Depth (ft)	USCS Soil Type	Sample Type	Sample No.	N Value	Atterberg Limits			Moisture Content (%)	Grain Size Analyses			Dry Density (pcf)	Moist Density (pcf)
						Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)		Gravel Content (%)	Sand Content (%)	% Passing #200 Sieve		
SV-19-West-HA	2	CL-ML	HA	1	-	23	17	6	21.3	0.2	33.7	66.1	-	-
	3	SM	HA	2	-	-	-	-	18.0	5.2	67.9	26.9	-	-
	6	ML	HA	3	-	-	-	-	20.2	1.2	37.3	61.4	-	-
SV-19-Middle	4	SP	SS	3	3	-	-	-	14.7	6.8	90.0	3.2	-	-
	16	SM	SS	9	14	-	-	-	23.1	0.0	55.4	44.6	-	-
	28	ML	SS	15	33	-	-	-	20.2	0.6	47.2	52.3	-	-
	34	SM	SS/Liners	18	30	-	-	-	15.1	-	-	-	106.9	123.0
	36	CL-ML	SS	19	27	22	18	4	23.4	0.0	6.5	93.5	-	-
	52	SM	SS	27	28				20.4	0.0	81.8	18.2	-	-
	72	CL	SS	37	25	27	16	11	22.2	0.0	26.9	73.1	-	-
	88	SM	SS	45	28	-	-	-	16.4	1.0	85.4	13.6	-	-
SV-20-HA-14	3.5	SM	HA	6	-	-	-	-	10.1	5.8	75.0	19.2	-	-
	5.0	SM	HA	9	-	-	-	-	11.5	16.5	64.2	19.3	-	-
	6.5	SM	HA	12	-	16	14	2	10.0	10.7	68.1	21.2	-	-
SV-20-HA-15	2.5	SC	HA	6	-	31	13	18	15.4	4.3	67.9	27.8	-	-
	5.5	SM	HA	12	-	-	-	-	14.3	16.2	57.6	26.2	-	-
	8.5	SM	HA	18	-	-	-	-	16.8	2.8	70.1	27.1	-	-
SV-20-HA-16	1.5	SC	HA	4	-	27	12	15	20.1	2.5	73.1	24.4	-	-
	4.5	SC-SM	HA	10	-	18	13	5	12.3	11.1	66.4	22.5	-	-
	9.0	SM	HA	19	-	-	-	-	11.8	9.7	62.3	28.0	-	-
SV-20-HA-17	2.5	SM	HA	6	-	21	19	2	24.1	1.7	77.8	20.5	-	-
	4.0	PT	HA	9	-	-	-	-	111.3	0.1	17.3	82.6	-	-
	8.0	SP-SM	HA	17	-	-	-	-	9.9	49.2	43.0	7.8	-	-
SV-20-HA-18	1.5	SM	HA	4	-	-	-	-	32.2	0.0	87.2	12.8	-	-
	5.0	SM	HA	11	-	-	-	-	23.8	6.2	78.6	15.2	-	-
	7.0	SM	HA	15	-	42	40	2	67.5	1.9	50.9	47.2	-	-
	9.5	SM	HA	20	-	-	-	-	16.3	10.1	74.4	15.5	-	-
SV-20-HA-19	2.5	SM	HA	6	-	-	-	-	30.0	9.3	66.3	24.4	-	-
	6.0	CL	HA	13	-	49	NP	-	89.0	0.4	39.9	59.7	-	-
	8.0	CL	HA	17	-	50	NP	-	87.0	0.4	27.5	72.1	-	-
MP 504-West	10.0	SM	SS	3	8	-	-	-	11.2	-	-	23.0	-	-
	20.0	SM	SS	5	19	-	-	-	8.7	8.3	63.8	27.9	-	-
	30.0	SM	SS/Liners	7	21	-	-	-	8.3	-	-	21.8	120.5	130.5
	40.0	SM	SS/Liners	9	12	-	-	-	10.3	-	-	-	134.4	148.2
	50.0	CL	SS	11	27	20	12	8	9.8	3.8	39.5	56.7	-	-
	60.0	SM	SS	13	15	-	-	-	12.1	4.0	70.0	26.0	-	-
	70.0	SP-SM	SS	15	33	-	-	-	13.8	-	-	5.8	-	-
	80.0	SM	SS	17	49	-	-	-	8.4	26.4	54.0	19.6	-	-
	95.0	SM	SS	20	95	-	-	-	11.7	-	-	14.0	-	-
	115.0	SM	SS	24	75	-	-	-	12.5	3.5	77.4	19.1	-	-
	125.0	SP-SM	SS	26	81	-	-	-	11.8	-	-	8.1	-	-
	145.0	SP-SM	SS	30	50/4"	-	-	-	8.9	27.8	61.9	10.3	-	-
	155.0	SP-SM	SS	32	80	-	-	-	20.8	-	-	8.5	-	-
MP 504-East	4.0	SM	SS	3	6	-	-	-	19.5	21.1	63.5	15.4	-	-
	8.0	SP	SS	5	3	-	-	-	19.2	1.0	96.8	2.2	-	-
	12.0	SP	SS	7	5	-	-	-	19.4	1.1	96.9	2.0	-	-
	16.0	SP-SM	SS	9	8	-	-	-	18.1	0.7	92.6	6.7	-	-
	20.0	SP	SS	11	8	-	-	-	21.2	0.7	97.7	1.6	-	-

3 Results

3.1 Soil Lithology

The results of the recent geotechnical soil borings and laboratory tests were compiled to obtain an understanding of the lithology of the study area. As determined from field and laboratory data, the existing soil conditions generally consist of topsoil deposits underlain by glacial till to the termination depths of the borings.

Detailed information for soil strata and groundwater conditions are contained in the following sections. Complete laboratory testing results for samples from the recently performed test borings are provided in Appendix B.

3.1.1 Topsoil/Organics

Topsoil was encountered at the test borings to depths of 0.2 to 1.5 feet; however, a 2-foot thickness of topsoil (possible fill) was encountered in boring SV-19-West, which was completed near the location of a demolished former residence. Topsoil thickness should be expected to vary across the site with differing vegetation cover, topography, and depositional environments.

A layer of peat was encountered in hand auger boring SV-20-HA-17 from 4 to 6 feet BGS. Organic lean clay was also encountered in hand auger boring SV-20-HA-19 at 4.5 feet BGS extending to the termination depth of the boring of 10 feet. Organics encountered at these locations were likely deposited by Spring Brook. A total of 3 grain size distribution analyses were performed on samples of the peat and organic lean clay. The results of the testing indicated no gravel content, sand contents ranging from 17 to 40 percent, and percent fines (passing the #200 sieve) ranging from 60 to 83 percent. Laboratory testing also indicated moisture content in the peat of 111.3 percent, and moisture content ranging from 87 to 89 percent in the organic clay. Atterberg limits testing on the organic clay indicated liquid limits ranging from 49 to 50. Plastic limits could not be determined and are therefore reported as non-plastic (NP).

3.1.2 Glacial Till

Glacial till deposits were encountered beneath the topsoil deposits extending to the termination depths of the borings ranging from 4 to 162 feet below ground surface (BGS). The till composition varies from sands classified as silty sand (SM), clayey sand (SC), poorly graded sand with silt (SP-SM), and poorly graded sand (SP), sandy silt (ML), lean clay with varying amounts of sand (CL), sandy lean clay (CL), and silty clay (CL-ML). One discrete seam of poorly graded gravel (GP) was encountered in test boring SV-19-Middle from approximately 50.5 to 52.0 feet BGS.

A total of 26 grain size distribution analyses were performed on samples of the till. Seventeen grain size distribution analyses have been included from historic borings for a total of 43 tests. The results of the testing indicated gravel contents ranging from 0 to 49.2 percent, sand contents ranging widely from 6.5 to 97.7 percent, and percent fines (passing the #200 sieve) ranging widely from 1.6 to 93.5 percent. Laboratory testing on the till indicated moisture contents ranging from 8.3 to 67.5 percent.

N-values in the till ranged from 3 to 95 blow per foot (BPF), with typical values around 25 BPF. The SPT results indicate that the till soils vary in relative density from very loose to dense and generally increase with depth.

3.1.3 Bedrock

Bedrock was not encountered within the depths of exploration at the borings. Based on publically available published data by the U.S. Geologic Survey (USGS), the bedrock at the site consists of Cretaceous age shale and sandstone of the Coleraine Formation. The USGS data indicates the depth to bedrock in this area is generally 250 to 350 feet below the ground surface.

3.2 Groundwater Conditions

Groundwater was observed in the test borings SV-19-Middle, SV-19-West, SV-19-HA-2, SV-19-HA-4, SV-19-HA-5, SV-19-HA-13, SV-20-HA-15, SV-20-HA-16, SV-20-HA-17, SV-20-HA-18, and SV-20-HA-19 during drilling at depths ranging from approximately 0.5 feet BGS to 37.9 feet BGS, which ranges in elevation from 1271.0 to 1340.8. Results of the vibrating wire piezometer data indicate that pressurized groundwater conditions do not exist at the SV-19-Middle and SV-19-West borings or within any of the hand auger borings installed with vibrating wire piezometers (SV-19-HA-3, SV-19-HA-4, SV-19-HA-5, SV-19-HA-8, SV-19-HA-9, SV-19-HA-11, SV-19-HA-12, and SV-19-HA-13). The nests of three piezometers in SV-19-Middle and SV-19-West indicate normal phreatic surface with groundwater reported at about 6 feet for all three piezometers in SV-19-Middle and about 36.8 feet in SV-19-West, which is consistent with the phreatic surface observed during drilling. Various groundwater depths were encountered in the hand auger piezometers. Groundwater was only encountered in the standpipe piezometer SV-19-HA-2 at a depth of 5.4 feet.

Many factors such as heavy rainfall events, dry periods, and differences in soil permeability contribute to water level fluctuations. Observed groundwater levels are shown on Figure 4. Groundwater levels should be expected to fluctuate over time, and differences in groundwater elevation along the pipeline alignment should be considered during design of the crossing.

Groundwater pump-down tests were conducted on SV-20-HA-15 through SV-20-HA-19. Pump-down tests were treated as slug tests and the results were analyzed using the program AQTESOLV. The results and analyses for the five borings are included in Appendix E. The analyses were performed using the Bouwer and Rice method for slug tests, which accounts for partial penetration of the aquifer and unconfined conditions with the phreatic surface intersecting the screen. An anisotropy ratio of 0.1 was assumed. The range of horizontal hydraulic conductivity values calculated for the five borings is 0.074 ft/day (SV-20-HA-15) to 0.300 ft/day (SV-20-HA19), with a mean value of 0.140 ft/day. These values are characteristic of a fine silt to clayey sand and are representative of deposits with moderately low permeability. This suggests that seepage inflows during construction will not be very significant along this stretch.

4 Construction Considerations

Results of the field and laboratory investigation have been presented in Section 3. Based on these results, Section 4 provides design and construction considerations for the project.

4.1 Construction Access/Staging Areas

The drill crews reported relatively easy access to the two SPT boring locations during drilling in September and December of 2019. The hand augers were located in moderately to heavily wooded areas. The site was relatively dry in September 2019 with heavy snow cover during work in December 2019. Considering the presence of surficial organic soils within the vicinity of the borings, considerations should be made for soft ground surface conditions in construction areas, particularly after heavy rain and during the spring thawing period.

4.2 Soil Parameters

The soil parameters presented in Table 4-1, Table 4-2, and Table 4-3 can be considered for design of the pipeline, as well as other contractor-designed excavations. These parameters are applicable to undisturbed soils.

Table 4-1 Estimated Unit Weight and Strength Parameters

Soil Type$^{(1)}$	N-Value Range $^{(2)}$	Moist Unit Weight (pcf)	Submerged Unit Weight (pcf)	Angle of Internal Friction, Undrained$^{(3)}$ (degrees)	Cohesion, Undrained (psf)
Sand in upper 20 ft.	3 - 29	125$^{(4)}$	63	28	0
Sand below 20 ft.	12 – 50+	134	72	32	0
Sandy Silt (ML)	20 - 33	125$^{(5)}$	63	30	0
Sandy Lean Clay (CL)	17 – 27	120$^{(5)}$	58	0	750$^{(6)}$
Silty Clay (CL-ML)	N/A	120$^{(5)}$	58	0	250$^{(7)}$

Note(s):
1. Sand refers to poorly graded sand, poorly graded sand with silt, and silty sand
2. N-Values not likely influenced by the presence of cobbles and boulders
3. Estimate from Peck, et al, 1974
4. Estimate from NAVFAC DM7.01 Figures 3 and 7
5. Estimate from Coduto , et al, 2011 Table 4.1
6. Estimate from pocket penetrometer reading
7. Estimate from NAVFAC DM7.01 Table 4

Table 4-2 Estimated Poisson's Ratio and Modulus of Elasticity Parameters

Soil Type[1]	N-Value Range	Poisson's Ratio, ν[2]		Modulus of Elasticity, E_s [2] (psi)
		Drained[3]	Undrained[3]	
Sand in upper 20 ft.	3 - 29	0.2 – 0.4		1,500 – 3,500
Sand below 20 ft.	12 – 50+	0.25 – 0.45		2,500 – 8,000
Sandy Silt (ML)	20 - 33	0.2 – 0.4		2,500 – 4,000
Sandy Lean Clay (CL)	17 – 27	0.2 – 0.5	0.5	850 – 2,000
Silty Clay (CL-ML)	N/A	0.15 – 0.25	0.25	250 - 500

Note(s):
1. Sand refers to poorly graded sand, poorly graded sand with silt, and silty sand
2. Estimate from Das (1997) and (1998)
3. Undrained applies to short term, construction conditions and drained applies to long term conditions.

Table 4-3 Lateral Earth Pressure Coefficients

Soil Type[1]	N-Value Range	Coefficients of Lateral Earth Pressure[2]		
		Active (Ka)	At Rest (Ko) [3]	Passive (Kp)
Sand in upper 20 ft.	3 - 14	0.36	0.53	2.77
Sand below 20 ft.	15 – 45	0.31	0.47	3.25
Sandy Silt (ML)	20 - 33	0.33	0.5	3.00
Sandy Lean Clay (CL)	17 – 27	1	1	1
Silty Clay (CL-ML)	N/A	1	1	1

Note(s):
1. Sand refers to poorly graded sand, poorly graded sand with silt, and silty sand.
2. Ultimate Values
3. Estimation of at-rest coefficients of lateral earth pressure is very difficult due to the unknown overconsolidation ratios of the soil unit. The values provided in the table are based on estimation of the undrained friction angle and the assumption that the overconsolidation ratio is no less than 1 (the soil is normally consolidated), and is less than 3 to 5, and that pore pressures in the estimated soil are not in excess of the earth pressure. If this soil parameter value is required with more certainty, additional in-situ testing is required.

4.3 Soil Corrosivity

Soil electrical resistivity, pH, and soluble sulfates and chlorides are some of the primary factors in evaluating the rate and amount of corrosion of buried structures. A field and laboratory testing program was not conducted as part of this report. However, historic laboratory data exists for a previous investigation at this site, and will be used to evaluate these factors. It should be noted that soil corrosivity is also influenced by other variables including the amount of moisture, drainage, and soil particle size/oxygen content, which were not evaluated as part of this investigation.

Sulfate and chloride ions present in the subsurface may result in accelerated corrosion of steel. A sulfate concentration of 1,000 parts per million (ppm) or greater is a generally accepted indication of corrosive conditions. Similarly, a chloride concentration of 500 ppm or greater is a generally accepted indication of corrosive conditions. As historic laboratory test results for sulfate ion contents were 76 ppm, special consideration for corrosion potential with specific regard to sulfate ion contents do not appear necessary for this site. Since historic laboratory test results indicate the soils have chloride ion content of 3 ppm, special consideration for corrosion potential with specific regard to chloride ion contents do not appear necessary for this site either. Historic laboratory testing results are provided in Appendix D.

The results of the laboratory testing indicate that the soils at the project site can generally be classified as non-corrosive for steel in direct contact with the fine grained soils.

4.4 Groundwater Flow

The investigation finds that it is very unlikely that artesian groundwater conditions will be encountered during pipeline construction.

Near Spring Brook, some groundwater seepage will likely be encountered during construction as this is an area where the phreatic surface is near the ground surface. Along this portion of the proposed pipeline route, five borings were advanced to a depth of 10 feet, the depth to water was measured, and a pump-down test was performed in each boring for purposes of estimating the hydraulic conductivity of the saturated deposits. The pump-down tests were analyzed using methods similar to slug tests. The resulting values of hydraulic conductivity calculated from these tests are low – indicative of lower permeability deposits of clayey silt and clayey sand. Based on the results of this investigation, groundwater seepage into the trench during construction will likely be low and manageable. This investigation did not find any groundwater conditions that would necessitate managing for high flows during construction or unusual flows into the backfilled excavation after construction.

5 Limitations

The recommendations provided in this report are based on the results of fieldwork which focused on investigation of the area near the proposed pipeline alignment. Barr's evaluation, analyses, and recommendations were developed from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from borings continuously with depth, and therefore strata boundaries and thicknesses must be inferred to some extent. Strata boundaries may also be gradual transitions, and can be expected to vary in depth, elevation, and thickness away from the boring locations. Boulders and cobbles also cannot be recovered with typical geotechnical drilling equipment.

Variations in subsurface conditions present among borings or test pits may not be revealed until additional exploration work is completed, or construction commences. If any such variations are revealed, our recommendations should be re-evaluated. Such variations could increase construction costs, and a contingency should be provided to accommodate them.

The analysis and conclusions provided are based on the results of fieldwork from recent investigations. Using generally accepted engineering methods and practices, the investigations performed have made every reasonable effort to characterize the site. However, the likelihood that conditions may vary from any specific location tested is still possible, and careful attention to soil conditions should be undertaken during the time of construction by qualified personnel.

6 Standard of Care

This report is for the exclusive use of the parties to which it has been addressed. Without written approval, Barr assumes no responsibility to other parties regarding this report. The evaluation, analyses and recommendations may not be appropriate for other parties or projects.

Barr Engineering Company's services for this project were performed in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is made.

7 References

1. Ralph B. Peck, Walter E. Hanson, Thomas H. Thornburn (1974). Foundation Engineering, 2nd Edition. John Wiley & Sons.

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11. ASTM International. Volume 04.08 Soil and Rock (I) D429 to D5876; Volume 4.09 Soil and Rock (II) D5877 – Latest (2010).

12. Roberge, P.R. (2006). Corrosion Basics: An Introduction, 2nd Edition. NACE Press Book.

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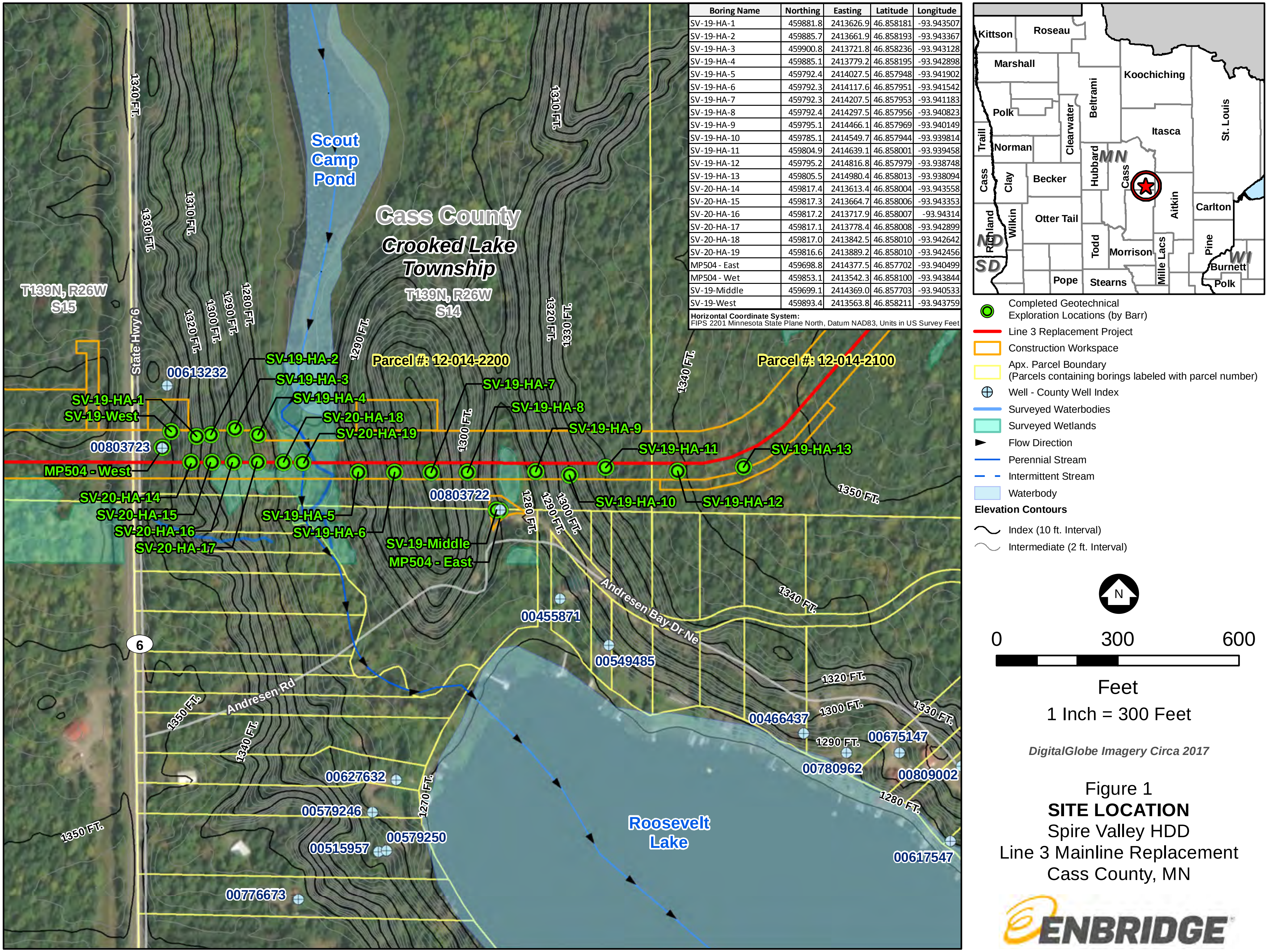
Figures



Boring Name	Northing	Easting	Latitude	Longitude
SV-19-HA-1	459881.8	2413626.9	46.858181	-93.943507
SV-19-HA-2	459885.7	2413661.9	46.858193	-93.943367
SV-19-HA-3	459900.8	2413721.8	46.858236	-93.943128
SV-19-HA-4	459885.1	2413779.2	46.858195	-93.942898
SV-19-HA-5	459792.4	2414027.5	46.857948	-93.941902
SV-19-HA-6	459792.3	2414117.6	46.857951	-93.941542
SV-19-HA-7	459792.3	2414207.5	46.857953	-93.941183
SV-19-HA-8	459792.4	2414297.5	46.857956	-93.940823
SV-19-HA-9	459795.1	2414466.1	46.857969	-93.940149
SV-19-HA-10	459785.1	2414549.7	46.857944	-93.939814
SV-19-HA-11	459804.9	2414639.1	46.858001	-93.939458
SV-19-HA-12	459795.2	2414816.8	46.857979	-93.938748
SV-19-HA-13	459805.5	2414980.4	46.858013	-93.938094
SV-20-HA-14	459817.4	2413613.4	46.858004	-93.943558
SV-20-HA-15	459817.3	2413664.7	46.858006	-93.943353
SV-20-HA-16	459817.2	2413717.9	46.858007	-93.94314
SV-20-HA-17	459817.1	2413778.4	46.858008	-93.942899
SV-20-HA-18	459817.0	2413842.5	46.858010	-93.942642
SV-20-HA-19	459816.6	2413889.2	46.858010	-93.942456
MP504 - East	459698.8	2414377.5	46.857702	-93.940499
MP504 - Wet	459853.1	2413542.3	46.858100	-93.943844
SV-19-Middle	459699.1	2414369.0	46.857703	-93.940533
SV-19-West	459893.4	2413563.8	46.858211	-93.943759

Horizontal Coordinate System:
FIPS 2201 Minnesota State Plane North, Datum NAD83, Units in US Survey Feet

● Completed Geotechnical Exploration Locations (by Barr)
🟥 Line 3 Replacement Project
🟧 Construction Workspace
🟨 Apx. Parcel Boundary (Parcels containing borings labeled with parcel number)
⊕ Well - County Well Index
— Surveyed Waterbodies
🟩 Surveyed Wetlands
► Flow Direction
— Perennial Stream
-- Intermittent Stream
▨ Waterbody

Elevation Contours

~ Index (10 ft. Interval)
~ Intermediate (2 ft. Interval)

Feet

1 Inch = 300 Feet

DigitalGlobe Imagery Circa 2017

Figure 1

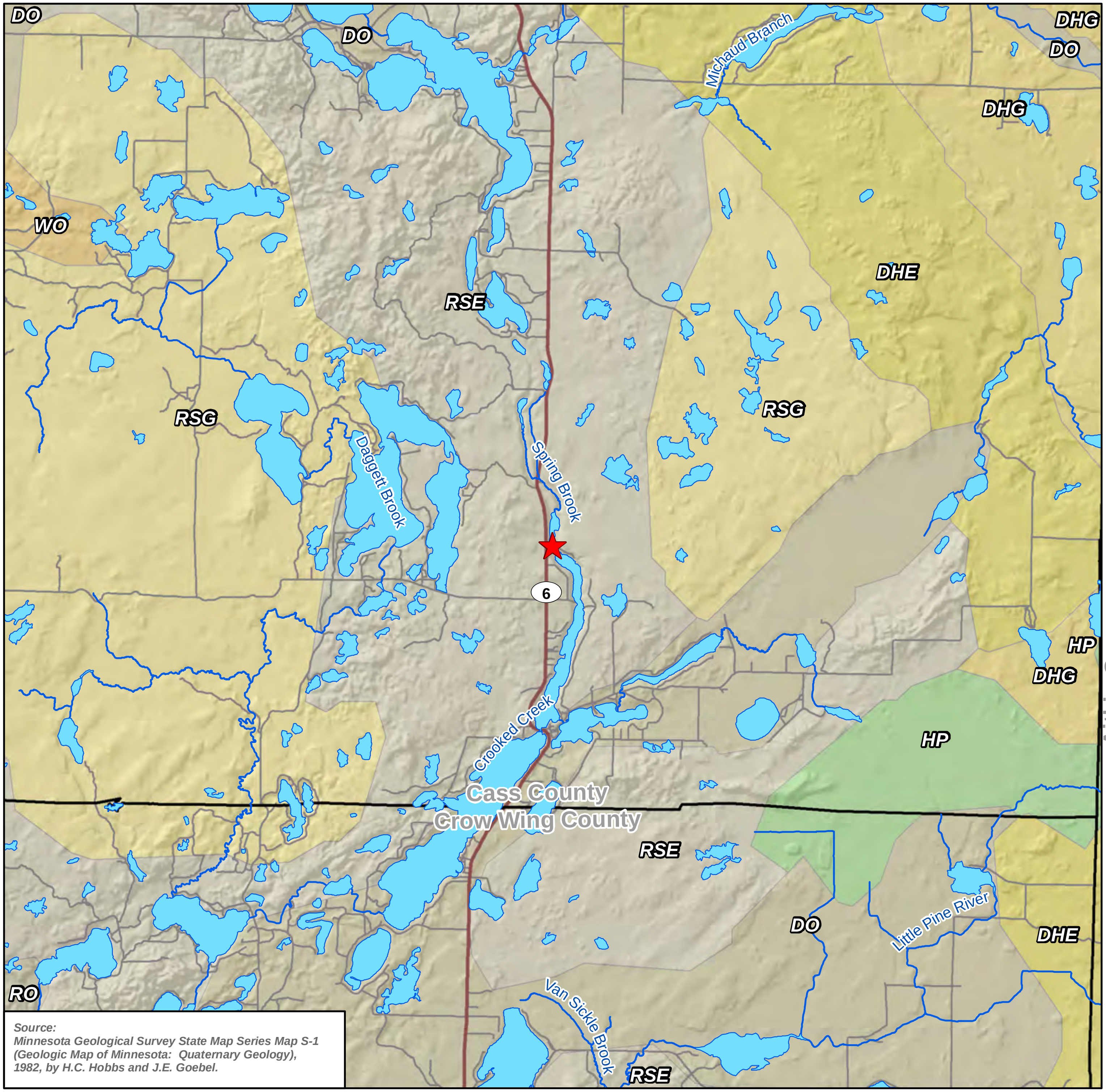
SITE LOCATION

Spire Valley HDD

Line 3 Mainline Replacement

Cass County, MN

ENBRIDGE



Source:
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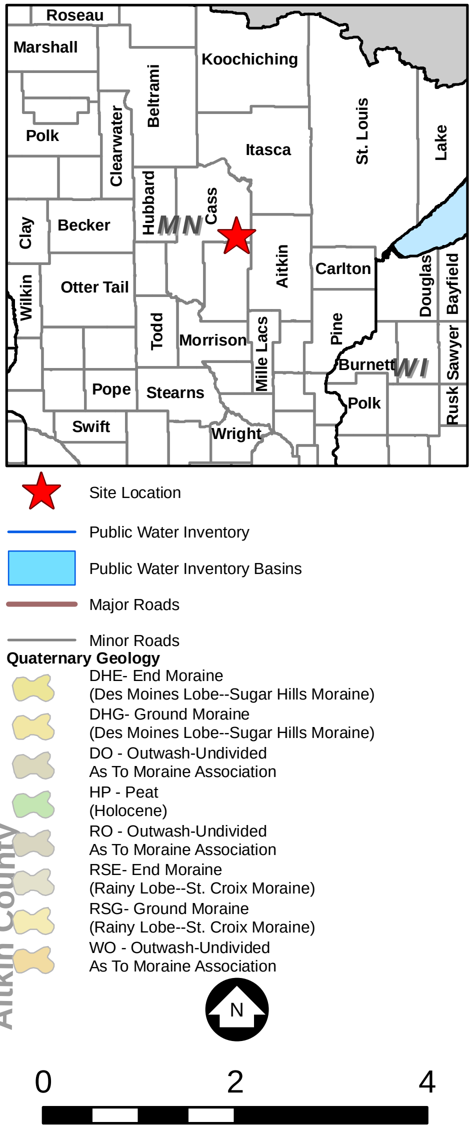
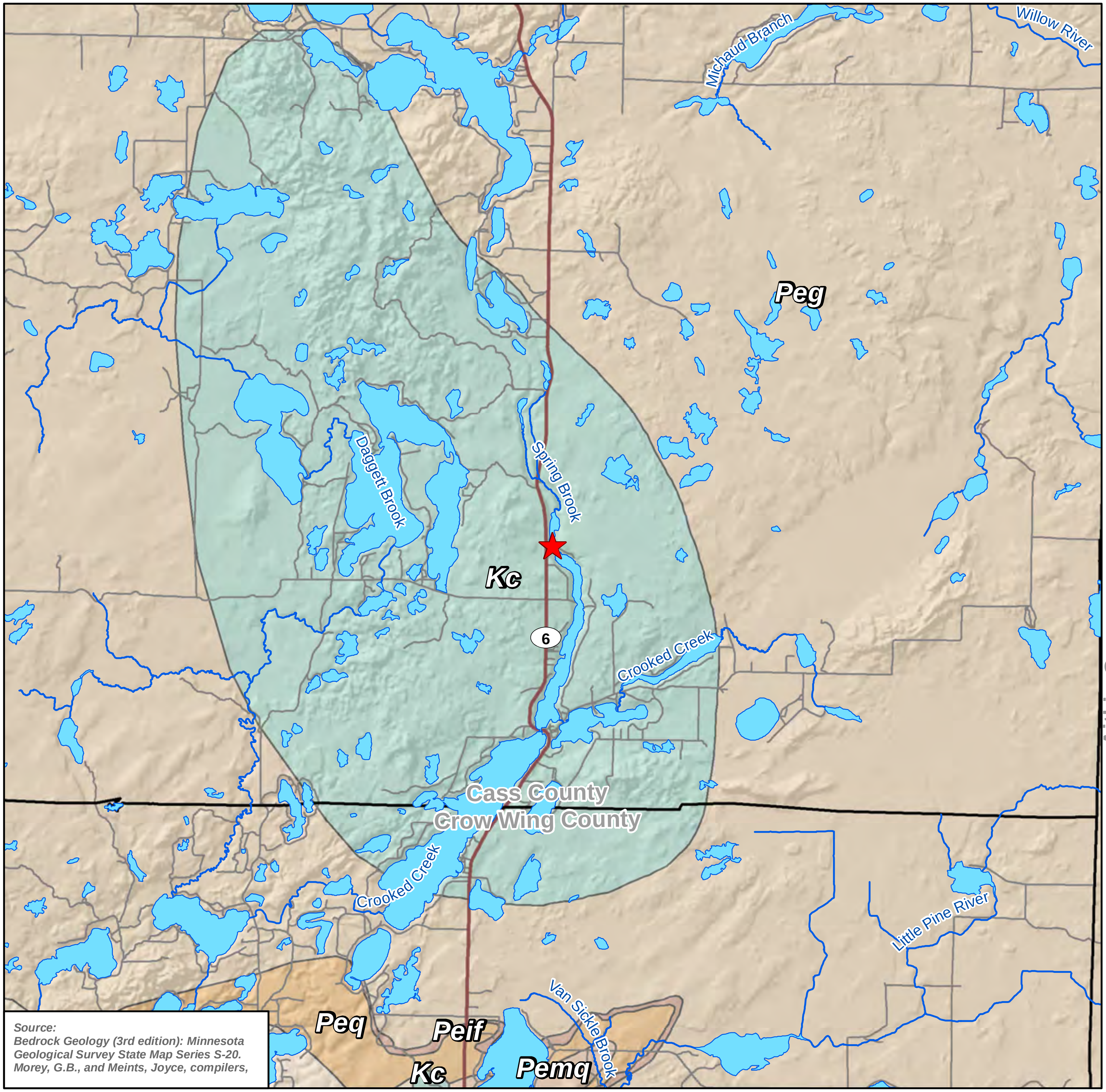
(Geologic Map of Minnesota: Quaternary Geology),
1982, by H.C. Hobbs and J.E. Goebel.



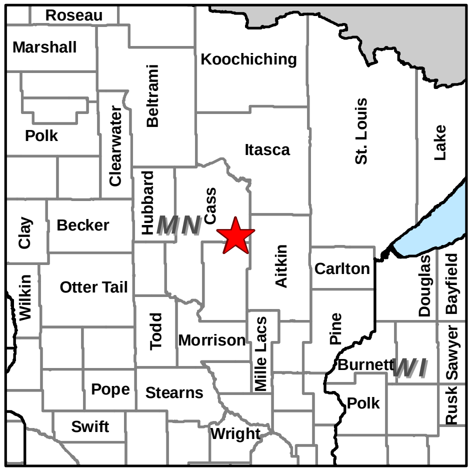
1 Inch = 2 Miles

Figure 2
SURFICIAL GEOLOGY
Spire Valley HDD
Line 3 Mainline Replacement
Cass County, MN

ENBRIDGE



Source:
Bedrock Geology (3rd edition): Minnesota Geological Survey State Map Series S-20. Morey, G.B., and Meints, Joyce, compilers,



★ Site Location

Public Water Inventory

🟦 Public Water Inventory Basins

Major Roads

Minor Roads

Bedrock Geology

Aqz, L.Arch. felsic-inter. volcanic

Kc - Cretaceous-Coleraine Formation

Peg - Animikie Group

Peif, Iron-formation; Paleoproteroz.

Pemq, Trout Lake Fm;Mille Lacs Group

Peq, Pokegama Quartzite

N

0 2 4

Miles

1 Inch = 2 Miles

Figure 3

BEDROCK GEOLOGY

Spire Valley HDD

Line 3 Mainline Replacement

Cass County, MN

ENBRIDGE

Barr Footer: ArcGIS 10.7.1, 2019-10-17 09:14 File: I:\Client\Enbridge_Energy\Work_Orders\Mainline_Permitting\49161299\Work_Orders\Line3_Geotech_HDD_2018\Maps\Reports\SpireValley\Figure 3 Spire Valley Bedrock Geology.mxd User: MAC2

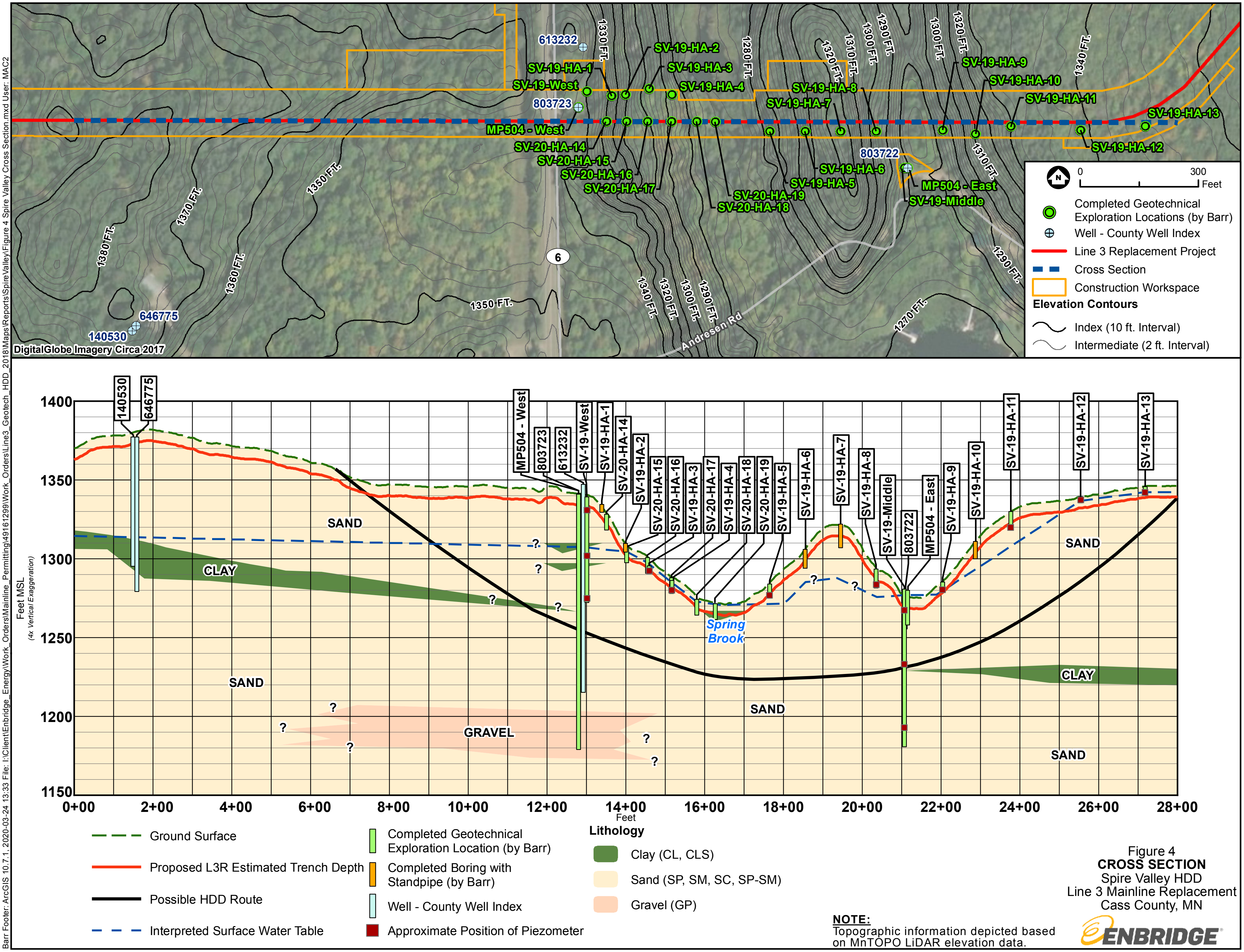


Figure 4
CROSS SECTION
Spire Valley HDD
Line 3 Mainline Replacement
Cass County, MN

NOTE:
Topographic information depicted based on MnTOPO LiDAR elevation data.

Barr Footer: ArcGIS 10.7.1, 2020-03-24 13:33 File: I:\Client\Enbridge_Energy\Work_Orders\Mainline_Permitting\49161299\Work_Orders\Line3_Geotech_HDD_2018\Maps\Reports\SpireValley\Figure 4 Spire Valley Cross Section.mxd User: MAC2

Appendices

Appendix A

Soil Boring Logs

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-19-HA-1

Sheet 1 of 1

Project:	Line 3 Replacement Spire Valley	Location:	Cass County, MN	Client:	Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1334.5 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft (10 20 30 40)	WATER CONTENT % PL ⊢×⊣ LL (20 40 60)	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES (20 40 60 80)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0.0	TOPSOIL.												
1333.5	1.0	POORLY GRADED SAND WITH SILT (SP-SM): brown; moist.												
1328.5	6.0	Bottom of Boring at 6.0 feet												

Elevation scale: 1332.5, 1330.0
Depth scale: 0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0

Completion Depth:	6.0
Date Boring Started:	12/4/19
Date Boring Completed:	12/4/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1334.5
Coordinates:	N 459,881.8 ft E 2,413,626.9 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

▽ At Time of Drilling
Dry

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-19-HA-2

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley

Location: Cass County, MN

Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1309.7 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	
	0.0	~~1309.4~~ TOPSOIL.	0.3
		POORLY GRADED SAND WITH SILT (SP-SM): brown; wet.	
1307.5	2.5	1306.9	2.8
		CLAYEY SAND (SC): brown; wet.	
		1305.7	4.0
		SANDY CLAY: brown; moist.	
1305.0	5.0	1304.7	5.0
		CLAYEY SAND (SC): brown; wet.	
		1303.7	6.0
		Bottom of Boring at 6.0 feet	
	7.5		
	10.0		
	12.5		
	15.0		

Graphic Log

Sample Type & Rec.

STANDARD PENETRATION TEST DATA

N in blows/ft

10 20 30 40

WATER CONTENT %

PL ⊢—×—⊣ LL

20 40 60

SIEVE ANALYSIS

GRAVEL SAND SILT CLAY

FINES

20 40 60 80

Physical Properties

WC	γ_d	ϕ	Q_u	Q_p	Gs	RQD
%	pcf	°	tsf	tsf		%

Completion Depth:	6.0
Date Boring Started:	12/4/19
Date Boring Completed:	12/4/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1309.7
Coordinates:	N 459,885.7 ft E 2,413,661.9 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

▽ At Time of Drilling 2.8

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-19-HA-3

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1295.6 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Depth	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft (10 20 30 40)	WATER CONTENT % PL ⊢ × ⊣ LL (20 40 60)	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES (20 40 60 80)	WC %	γ d pcf	ϕ °	Qu tsf	Qp tsf	Gs	RQD %
1295.5	0.0	TOPSOIL.	0.1												
1295.0		CLAYEY SAND (SC): brown; moist.													
1293.6		POORLY GRADED SAND WITH SILT (SP-SM): fine grained; brown; saturated.	2.0												
1292.5	2.5														
1291.6		SILT WITH SAND (ML): brown.	4.0												
1290.1	5.0	Bottom of Boring at 5.5 feet	5.5												
	7.5														
	10.0														
	12.5														
	15.0														

Completion Depth:	5.5
Date Boring Started:	12/5/19
Date Boring Completed:	12/5/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1295.6
Coordinates:	N 459,900.8 ft E 2,413,721.8 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES	WATER LEVELS (ft)	LEGEND
	▽ At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-19-HA-4

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley

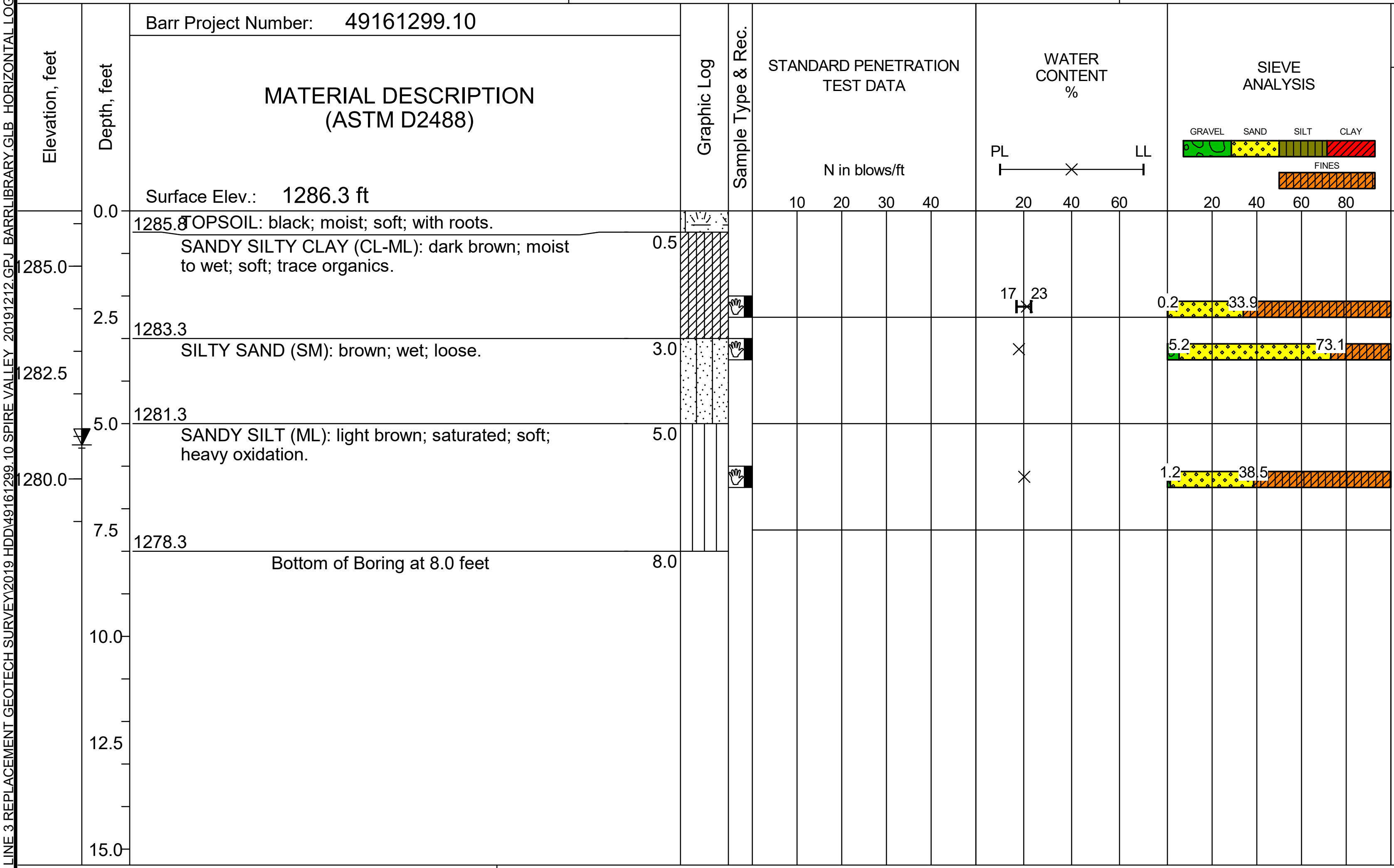
Location: Cass County, MN

Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1286.3 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Bottom depth	WC %
1285.8	0.0	TOPSOIL: black; moist; soft; with roots.		
		SANDY SILTY CLAY (CL-ML): dark brown; moist to wet; soft; trace organics.	0.5	21.3
1283.3		SILTY SAND (SM): brown; wet; loose.	3.0	18
1281.3		SANDY SILT (ML): light brown; saturated; soft; heavy oxidation.	5.0	20.2
1278.3		Bottom of Boring at 8.0 feet	8.0	



Physical Properties

WC %	γd pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
21.3						
18						
20.2						

Completion Depth:	8.0
Date Boring Started:	9/14/19
Date Boring Completed:	9/14/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1286.3
Coordinates:	N 459,885.1 ft E 2,413,779.2 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

✋ GRAB SAMPLE

WATER LEVELS (ft)

▽ At Time of Drilling 5.5
Dry

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-5

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley

Location: Cass County, MN

Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1284.1 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft (10 20 30 40)	WATER CONTENT % PL ⊢×⊣ LL (20 40 60)	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES (20 40 60 80)	WC %	γd pcf	ϕ °	Qu tsf	Qp tsf	Gs	RQD %
	0.0	TOPSOIL: 1-in frost.												
1283.1	1.0	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel.												
1282.5														
	2.5													
1280.0														
	5.0													
1277.5														
	7.5													
1275.0 ▽														
1274.1	10.0	Bottom of Boring at 10.0 feet												
	12.5													
	15.0													

Completion Depth:	10.0
Date Boring Started:	12/4/19
Date Boring Completed:	12/4/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1284.1
Coordinates:	N 459,792.4 ft E 2,414,027.5 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

▽ At Time of Drilling 9.0

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-6

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1306.1 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Depth
	0.0	TOPSOIL: black; 2-in frost; contains roots.	
1305.1	1.0	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel.	1.0
1294.1	12.0	Bottom of Boring at 12.0 feet	12.0

Elevation scale: 1305.0, 1302.5, 1300.0, 1297.5, 1295.0

Depth scale: 0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA
N in blows/ft
10 20 30 40

WATER CONTENT %
PL ├──×──┤ LL
20 40 60

SIEVE ANALYSIS
GRAVEL 🟩 SAND 🟨 SILT ▨ CLAY 🟥
FINES ▨
20 40 60 80

Physical Properties

WC	γ_d	ϕ	Q_u	Q_p	Gs	RQD
%	pcf	°	tsf	tsf		%

Completion Depth:	12.0
Date Boring Started:	12/4/19
Date Boring Completed:	12/4/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1306.1
Coordinates:	N 459,792.3 ft E 2,414,117.6 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

$\underline{\nabla}$ At Time of Drilling
Dry

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-7

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley

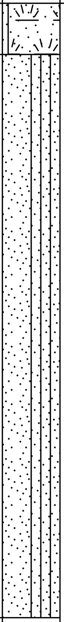
Location: Cass County, MN

Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1322.0 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft (10, 20, 30, 40)	WATER CONTENT % PL ⊢ × ⊣ LL (20, 40, 60)	SIEVE ANALYSIS GRAVEL, SAND, SILT, CLAY, FINES (20, 40, 60, 80)	WC %	γd pcf	ϕ °	Qu tsf	Qp tsf	Gs	RQD %
	0.0	TOPSOIL: 2-in frost.												
1321.0	1.0	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel.												
1320.0	2.5													
1317.5	5.0													
1315.0	7.5													
1312.5	10.0													
1310.0	12.0	Bottom of Boring at 12.0 feet												
	12.5													
	15.0													



Completion Depth:	12.0
Date Boring Started:	12/4/19
Date Boring Completed:	12/4/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1322.0
Coordinates:	N 459,792.3 ft E 2,414,207.5 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

▽ At Time of Drilling
Dry

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-8

Sheet 1 of 1

Project:	Line 3 Replacement Spire Valley	Location:	Cass County, MN	Client:	Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1293.6 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft (10 20 30 40)	WATER CONTENT % PL — LL (20 40 60)	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES (20 40 60 80)	WC %	γ d pcf	ϕ °	Q u tsf	Q p tsf	Gs	RQD %
	0.0	TOPSOIL.												
1292.6	1.0	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; moist; trace gravel.												
1281.6	12.0	Bottom of Boring at 12.0 feet												

Elevation scale: 1292.5, 1290.0, 1287.5, 1285.0, 1282.5

Depth scale: 0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0

Completion Depth:	12.0
Date Boring Started:	12/4/19
Date Boring Completed:	12/4/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1293.6
Coordinates:	N 459,792.4 ft E 2,414,297.5 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

▽ At Time of Drilling
Dry

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-9

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley
Location: Cass County, MN
Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1285.2 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft 10 20 30 40	WATER CONTENT % PL —×— LL 20 40 60	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES 20 40 60 80	WC %	γd pcf	ϕ °	Qu tsf	Qp tsf	Gs	RQD %
1285.2	0.0	TOPSOIL: 2-in frost.												
1284.2	1.0	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel; refusal on rock; more gravel sized rock 6-6.5-ft.												
1278.7	6.5	Bottom of Boring at 6.5 feet												

Elevation scale: 1285.0, 1282.5, 1280.0
Depth scale: 0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0

Completion Depth:	6.5
Date Boring Started:	12/5/19
Date Boring Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1285.2
Coordinates:	N 459,795.1 ft E 2,414,466.1 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

▼ At Time of Drilling
Dry

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-10

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1310.9 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft 10 20 30 40	WATER CONTENT % PL ├──×──┤ LL 20 40 60	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES 20 40 60 80	WC %	γd pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0.0	TOPSOIL: 1-in frost.													
1309.9		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel; refusal on rock.	1.0												
1299.9		Bottom of Boring at 11.0 feet	11.0												

Elevation, feet: 1310.0, 1307.5, 1305.0, 1302.5, 1300.0

Depth, feet: 0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0

Completion Depth:	11.0
Date Boring Started:	12/5/19
Date Boring Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1310.9
Coordinates:	N 459,785.1 ft E 2,414,549.7 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES	WATER LEVELS (ft)
	▽ At Time of Drilling Dry

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-11

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley | Location: Cass County, MN | Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1329.9 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft	WATER CONTENT %	SIEVE ANALYSIS	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0.0	TOPSOIL: 1-in frost.													
1328.9	1.0	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel.	1.0												
1327.5	2.5														
1325.0	5.0														
1322.5	7.5														
1320.0	10.0														
1317.9	12.0	Bottom of Boring at 12.0 feet	12.0												
	12.5														
	15.0														

Standard penetration test data scale: 10 20 30 40

Water content: PL ├──×──┤ LL; scale: 20 40 60

Sieve analysis: 🟩 GRAVEL 🟨 SAND ▨ SILT 🟥 CLAY; ▨ FINES; scale: 20 40 60 80

Physical Properties

Completion Depth:	12.0
Date Boring Started:	12/5/19
Date Boring Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1329.9
Coordinates:	N 459,804.9 ft E 2,414,639.1 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

$\underline{\nabla}$ At Time of Drilling
Dry

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-12

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley

Location: Cass County, MN

Client: Enbridge Energy

Barr Project Number: 49161299.10

MATERIAL DESCRIPTION (ASTM D2488)

Surface Elev.: 1339.4 ft

Elevation, feet	Depth, feet	Material Description	Graphic Log	Sample Type & Rec.	Standard Penetration Test Data (N in blows/ft)	Water Content % (PL, LL)	Sieve Analysis (Gravel, Sand, Silt, Clay, Fines)	WC %	γd pcf	ϕ °	Qu tsf	Qp tsf	Gs	RQD %
	0.0	TOPSOIL: contains cobbles; no frost.												
1338.4	1.0	CLAYEY SAND (SC): fine grained; brown; moist to wet.												
1337.5	2.5													
1335.4	4.0	Bottom of Boring at 4.0 feet												
	5.0													
	7.5													
	10.0													
	12.5													
	15.0													

Standard Penetration scale: 10 20 30 40

Water Content scale: 20 40 60

Sieve Analysis scale: 20 40 60 80

Completion Depth:	4.0
Date Boring Started:	12/5/19
Date Boring Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1339.4
Coordinates:	N 459,795.2 ft E 2,414,816.8 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

▽ At Time of Drilling
Dry

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-13

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley
Location: Cass County, MN
Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1345.8 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Depth to base
1345.3	0.0	TOPSOIL: black; organics.	0.5
1343.8		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist.	2.0
1339.3		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel; water at 5-ft.	6.5
		Bottom of Boring at 6.5 feet 5.5 cave-in	

Elevation scale: 1345.0, 1342.5, 1340.0
Depth scale: 0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA
N in blows/ft
10 20 30 40

WATER CONTENT %
PL LL
20 40 60

SIEVE ANALYSIS
GRAVEL SAND SILT CLAY
FINES
20 40 60 80

Physical Properties

WC	γ d	ϕ	Qu	Qp	Gs	RQD
%	pcf	°	tsf	tsf		%

Completion Depth:	6.5
Date Boring Started:	12/5/19
Date Boring Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Ground Surface Elevation:	1345.8
Coordinates:	N 459,805.5 ft E 2,414,980.4 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

SAMPLE TYPES

WATER LEVELS (ft)

▽ At Time of Drilling 5.0

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-Middle

Sheet 1 of 3

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1282.5 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)
1282.3	0.3	TOPSOIL: black; moist.
1270.5	12.0	POORLY GRADED SAND (SP): fine to coarse grained; brown; moist to wet; very loose to medium dense; with trace gravel. Saturated 2" thick silt seam with oxidation at 6'. 10': pushed rock, no sample.
1264.7	17.8	POORLY GRADED SAND (SP): very fine to fine grained; brown; saturated; loose to medium dense.
1264.5	18.0	SILTY SAND (SM): fine to medium grained; brown; saturated.
1248.5	34.0	SANDY SILT (ML): brown; saturated; loose to dense. 2" clay (CL) layer at 23'. 2" silt layer at 25'.
1245.5	37.0	SILTY SAND (SM): fine to medium grained; brown; saturated; dense.
1244.5	38.0	SILTY CLAY (CL-ML): brown; wet; very stiff.

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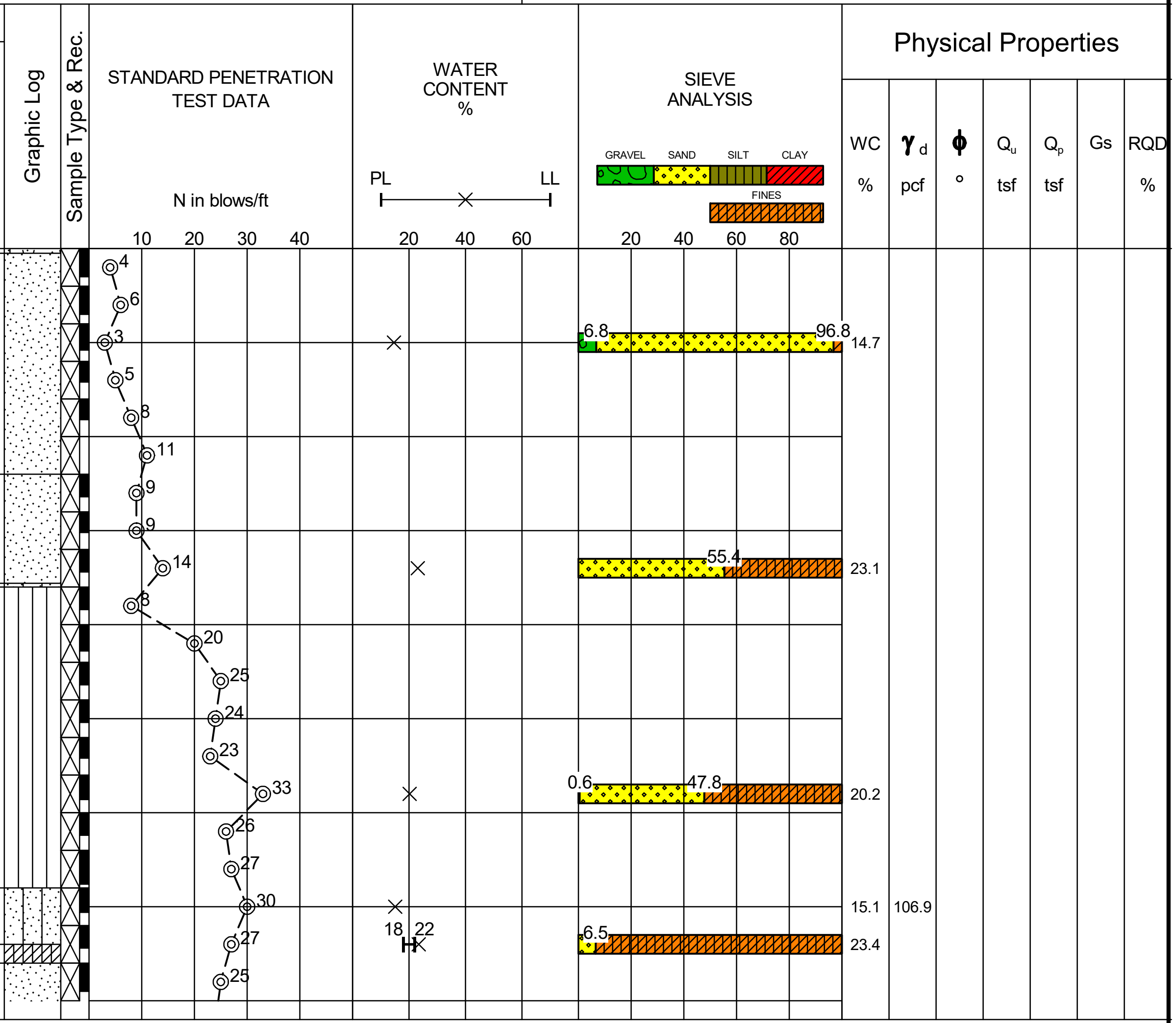

Completion Depth:	100.0
Date Boring Started:	9/10/19
Date Boring Completed:	9/13/19
Logged By:	PMD/RWO
Drilling Contractor:	Coleman
Drilling Method:	MRO
Ground Surface Elevation:	1282.5
Coordinates:	N 459,699.1 ft E 2,414,369.0 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Plezometers installed at 15, 49.5, and 89.5 feet. Hole caved at 72 feet and redrilled. Boring terminated at 100 feet as planned.

SAMPLE TYPES	WATER LEVELS (ft)	LEGEND
☒ SPLIT SPOON	▼ At Time of Drilling 5.5	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

O:\GINT\PROJECTS\49161299 LINE 3 REPLACEMENT GEOTECH SURVEY\2019 HDD\49161299.10 SPIRE VALLEY 20191212.GPJ BARR\LIBRARY.GLB HORIZONTAL LOG REPORT BARR GEOTECH TEMP

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LOG OF BORING SV-19-Middle

Sheet 2 of 3

Project: Line 3 Replacement Spire Valley
Location: Cass County, MN
Client: Enbridge Energy

Barr Project Number: 49161299.10

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)
	40	POORLY GRADED SAND (SP): fine to medium grained; brown; wet; medium dense to dense. *(Continued)* 1" coarse sand layer at 41'.
1238.5	44.0	POORLY GRADED SAND (SP): coarse grained; multicolored; wet; medium dense to dense; with gravel.
1232.0	50.5	POORLY GRADED GRAVEL (GP): medium dense.
1230.5	52.0	SILTY SAND (SM): fine to coarse grained; brown; wet; medium dense to dense. 0.5" layer of black fine sand at 63.5'.
1209.0	73.5	LEAN CLAY WITH SAND (CL): brown; moist; very stiff.
1208.0	74.5	SILTY SAND (SM): fine to coarse grained; brown; moist; medium dense to dense; little gravel.

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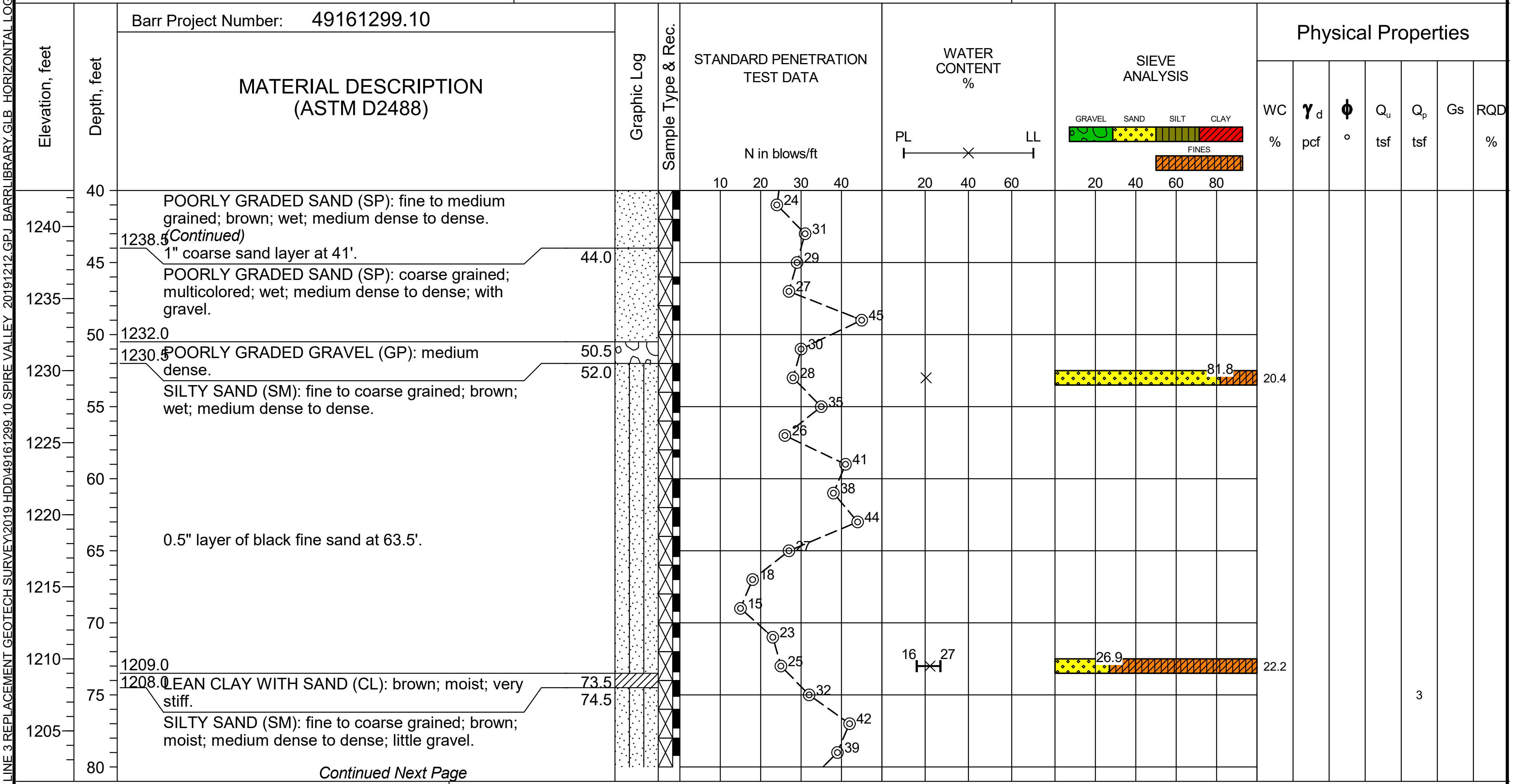

Completion Depth:	100.0
Date Boring Started:	9/10/19
Date Boring Completed:	9/13/19
Logged By:	PMD/RWO
Drilling Contractor:	Coleman
Drilling Method:	MRO
Ground Surface Elevation:	1282.5
Coordinates:	N 459,699.1 ft E 2,414,369.0 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Plezometers installed at 15, 49.5, and 89.5 feet. Hole caved at 72 feet and redrilled. Boring terminated at 100 feet as planned.

SAMPLE TYPES

☒ SPLIT SPOON

WATER LEVELS (ft)

▼ At Time of Drilling 5.5

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-Middle

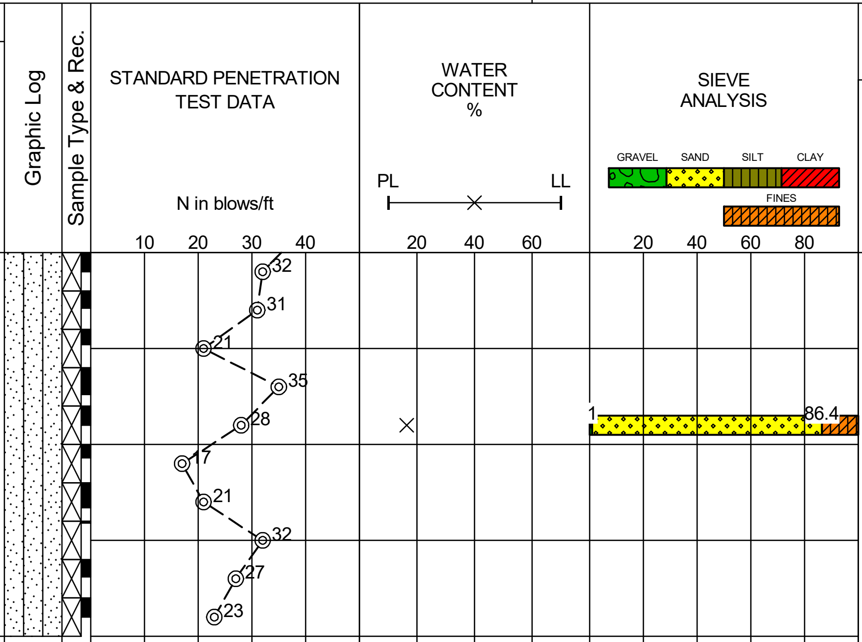
Sheet 3 of 3

Project:	Line 3 Replacement Spire Valley	Location:	Cass County, MN	Client:	Enbridge Energy

Barr Project Number: 49161299.10

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	80	SILTY SAND (SM): fine to coarse grained; brown; moist; medium dense to dense; little gravel. *(Continued)*								
1200										
	85									
1195				16.4						
	90									
1190										
	95									
1185										
1182.5	100	Bottom of Boring at 100.0 feet	100.0							
	105									
	110									
	115									
	120									

Physical Properties



Completion Depth:	100.0
Date Boring Started:	9/10/19
Date Boring Completed:	9/13/19
Logged By:	PMD/RWO
Drilling Contractor:	Coleman
Drilling Method:	MRO
Ground Surface Elevation:	1282.5
Coordinates:	N 459,699.1 ft E 2,414,369.0 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Plezometers installed at 15, 49.5, and 89.5 feet. Hole caved at 72 feet and redrilled. Boring terminated at 100 feet as planned.

SAMPLE TYPES	WATER LEVELS (ft)	LEGEND			
☒ SPLIT SPOON	▼ At Time of Drilling 5.5	MC	Moisture Content	Q_u	Unconfined Compression
		γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
		ϕ	Friction Angle	Gs	Specific Gravity
				RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

BARR
Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-19-West

Sheet 1 of 2

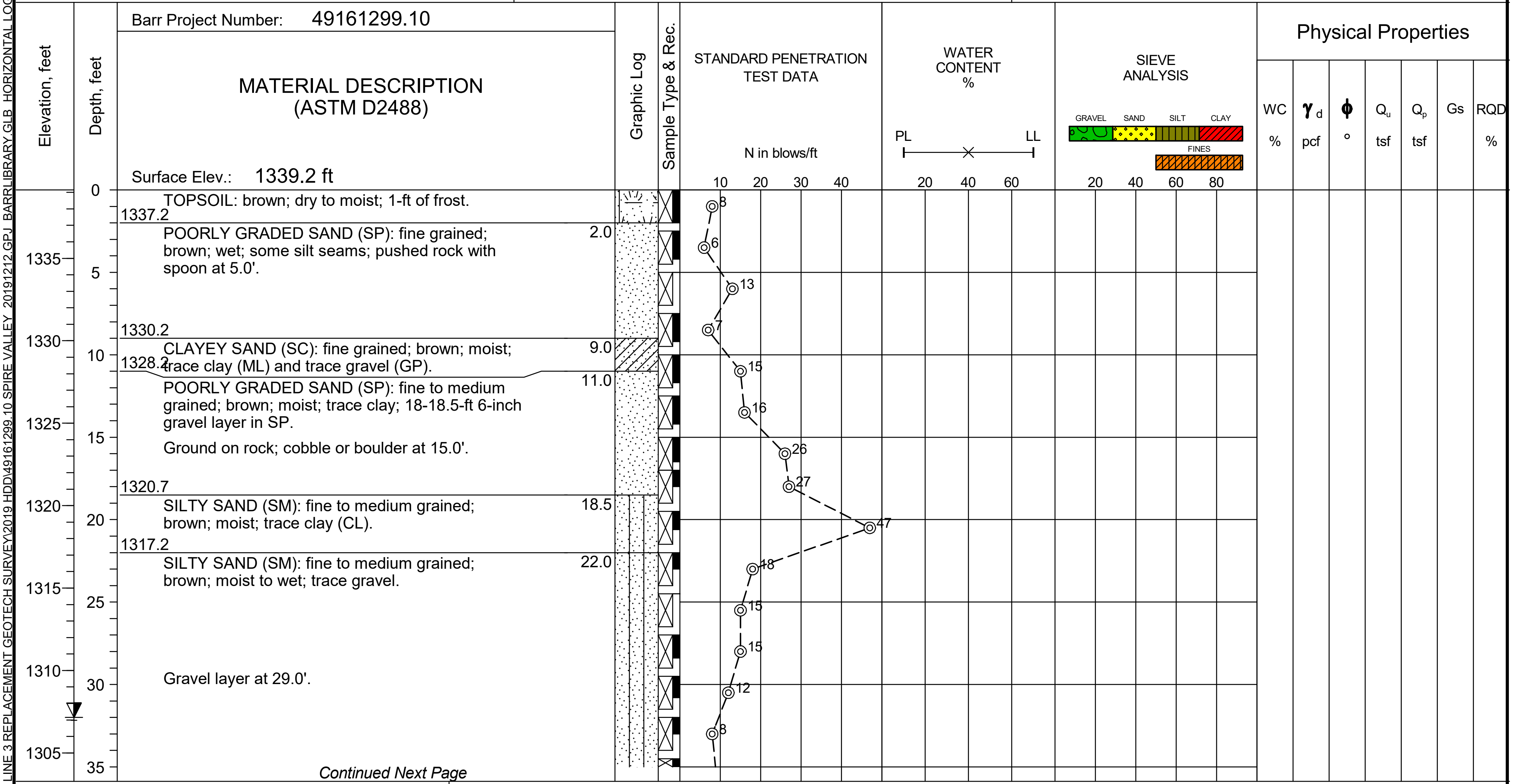
Project: Line 3 Replacement Spire Valley
Location: Cass County, MN
Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1339.2 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)
	0	TOPSOIL: brown; dry to moist; 1-ft of frost.
1337.2	2.0	POORLY GRADED SAND (SP): fine grained; brown; wet; some silt seams; pushed rock with spoon at 5.0'.
1330.2	9.0	CLAYEY SAND (SC): fine grained; brown; moist; trace clay (ML) and trace gravel (GP).
1328.2	11.0	POORLY GRADED SAND (SP): fine to medium grained; brown; moist; trace clay; 18-18.5-ft 6-inch gravel layer in SP. Ground on rock; cobble or boulder at 15.0'.
1320.7	18.5	SILTY SAND (SM): fine to medium grained; brown; moist; trace clay (CL).
1317.2	22.0	SILTY SAND (SM): fine to medium grained; brown; moist to wet; trace gravel. Gravel layer at 29.0'.

Continued Next Page



Completion Depth:	66.5
Date Boring Started:	12/3/19
Date Boring Completed:	12/5/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	MRO
Ground Surface Elevation:	1339.15
Coordinates:	N 459,893.4 ft E 2,413,563.8 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed with 4 1/4-in HSA from 0-15 ft. Boring completed with 3 7/8-in tricone and mud rotary from 15-66.5 ft. Boring located in wooded area.

SAMPLE TYPES

☒ SPLIT SPOON

WATER LEVELS (ft)

▼ At Time of Drilling 32.0

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
φ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

BARR
Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-19-West

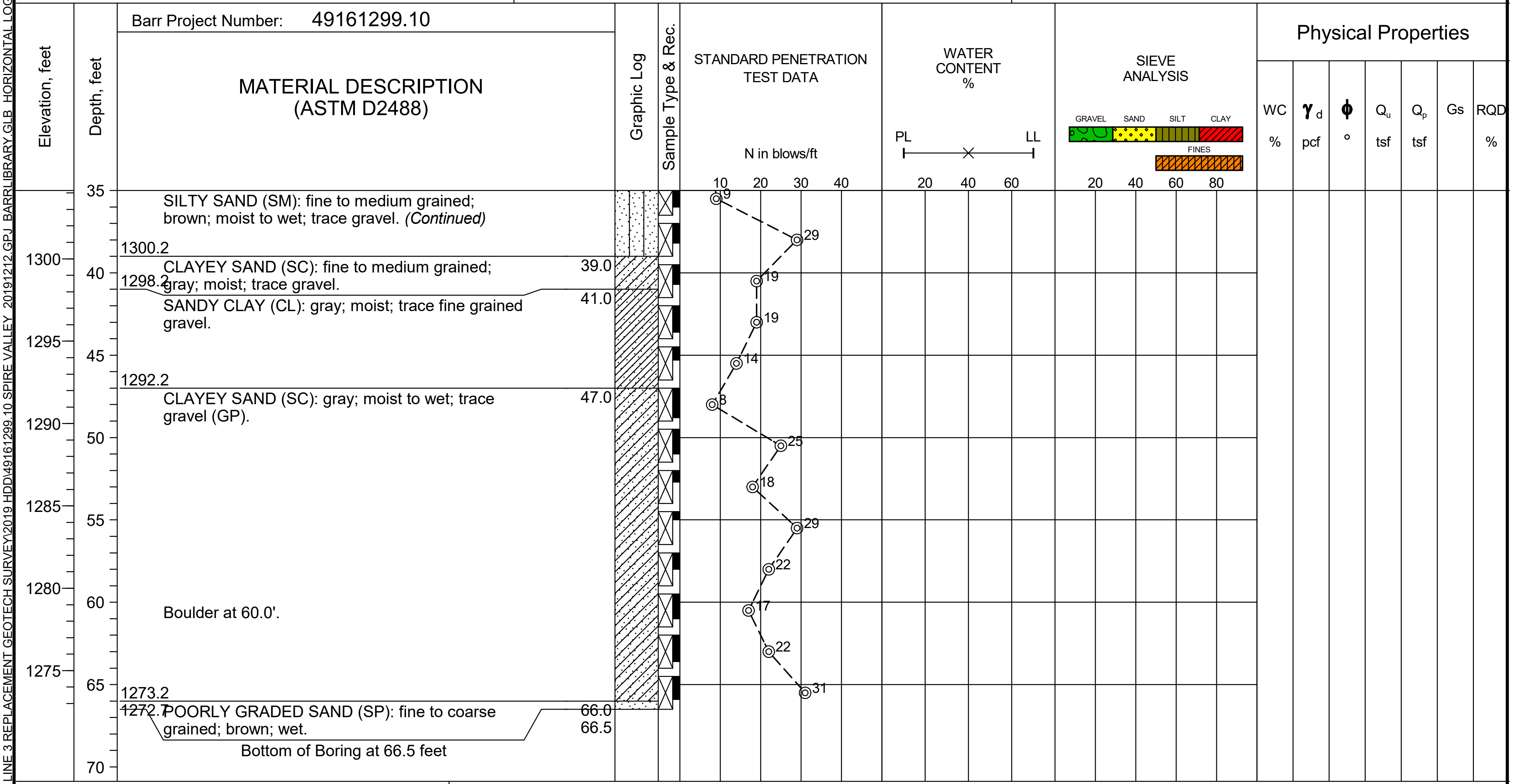
Sheet 2 of 2

Project: Line 3 Replacement Spire Valley
Location: Cass County, MN
Client: Enbridge Energy

Barr Project Number: 49161299.10

MATERIAL DESCRIPTION (ASTM D2488)

Elevation, feet	Depth, feet	Material description
	35	SILTY SAND (SM): fine to medium grained; brown; moist to wet; trace gravel. *(Continued)*
1300.2	39.0	CLAYEY SAND (SC): fine to medium grained; gray; moist; trace gravel.
1298.2	41.0	SANDY CLAY (CL): gray; moist; trace fine grained gravel.
1292.2	47.0	CLAYEY SAND (SC): gray; moist to wet; trace gravel (GP). Boulder at 60.0'.
1273.2	66.0	POORLY GRADED SAND (SP): fine to coarse grained; brown; wet.
1272.7	66.5	Bottom of Boring at 66.5 feet



Completion Depth:	66.5
Date Boring Started:	12/3/19
Date Boring Completed:	12/5/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	MRO
Ground Surface Elevation:	1339.15
Coordinates:	N 459,893.4 ft E 2,413,563.8 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed with 4 1/4-in HSA from 0-15 ft. Boring completed with 3 7/8-in tricone and mud rotary from 15-66.5 ft. Boring located in wooded area.

SAMPLE TYPES

☒ SPLIT SPOON

WATER LEVELS (ft)

▼ At Time of Drilling 32.0

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

O:\GINT\PROJECTS\49161299 LINE 3 REPLACEMENT GEOTECH SURVEY\2019 HDD\49161299.10 SPIRE VALLEY 20191212.GPJ BARRLIBRARY.GLB HORIZONTAL LOG REPORT BARR GEOTECH TEMP

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-20-HA-14

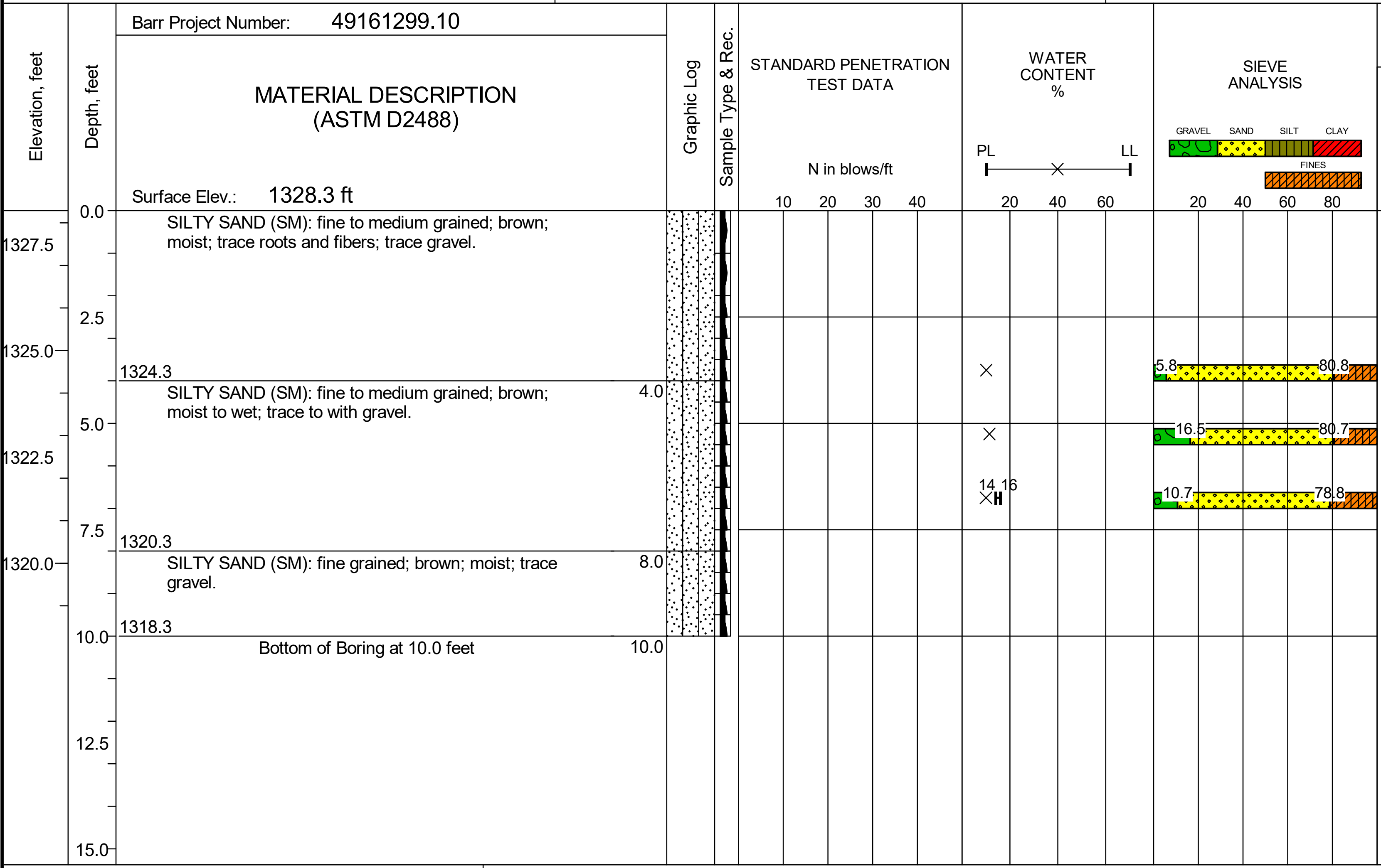
Sheet 1 of 1

Project: Line 3 Replacement Spire Valley
Location: Cass County, MN
Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1328.3 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	WC %	γ d pcf	ϕ °	Qu tsf	Qp tsf	Gs	RQD %
	0.0	SILTY SAND (SM): fine to medium grained; brown; moist; trace roots and fibers; trace gravel.							
1324.3	4.0	SILTY SAND (SM): fine to medium grained; brown; moist to wet; trace to with gravel.	10.1 11.5 10						
1320.3	8.0	SILTY SAND (SM): fine grained; brown; moist; trace gravel.							
1318.3	10.0	Bottom of Boring at 10.0 feet							



Completion Depth:	10.0
Date Boring Started:	3/4/20
Date Boring Completed:	3/4/20
Logged By:	MLH2
Drilling Contractor:	TPT
Drilling Method:	HA
Ground Surface Elevation:	1328.293
Coordinates:	N 459,817.4 ft E 2,413,613.4 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 2.5-in bucket auger. Refusal at 5.5 feet, offset 1 foot east. Boring abandoned with neat cement grout.

SAMPLE TYPES	WATER LEVELS (ft)	LEGEND			
▮ Auger Cuttings	▽ At Time of Drilling Dry	MC	Moisture Content	Q_u	Unconfined Compression
		γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
		ϕ	Friction Angle	Gs	Specific Gravity
				RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-20-HA-15

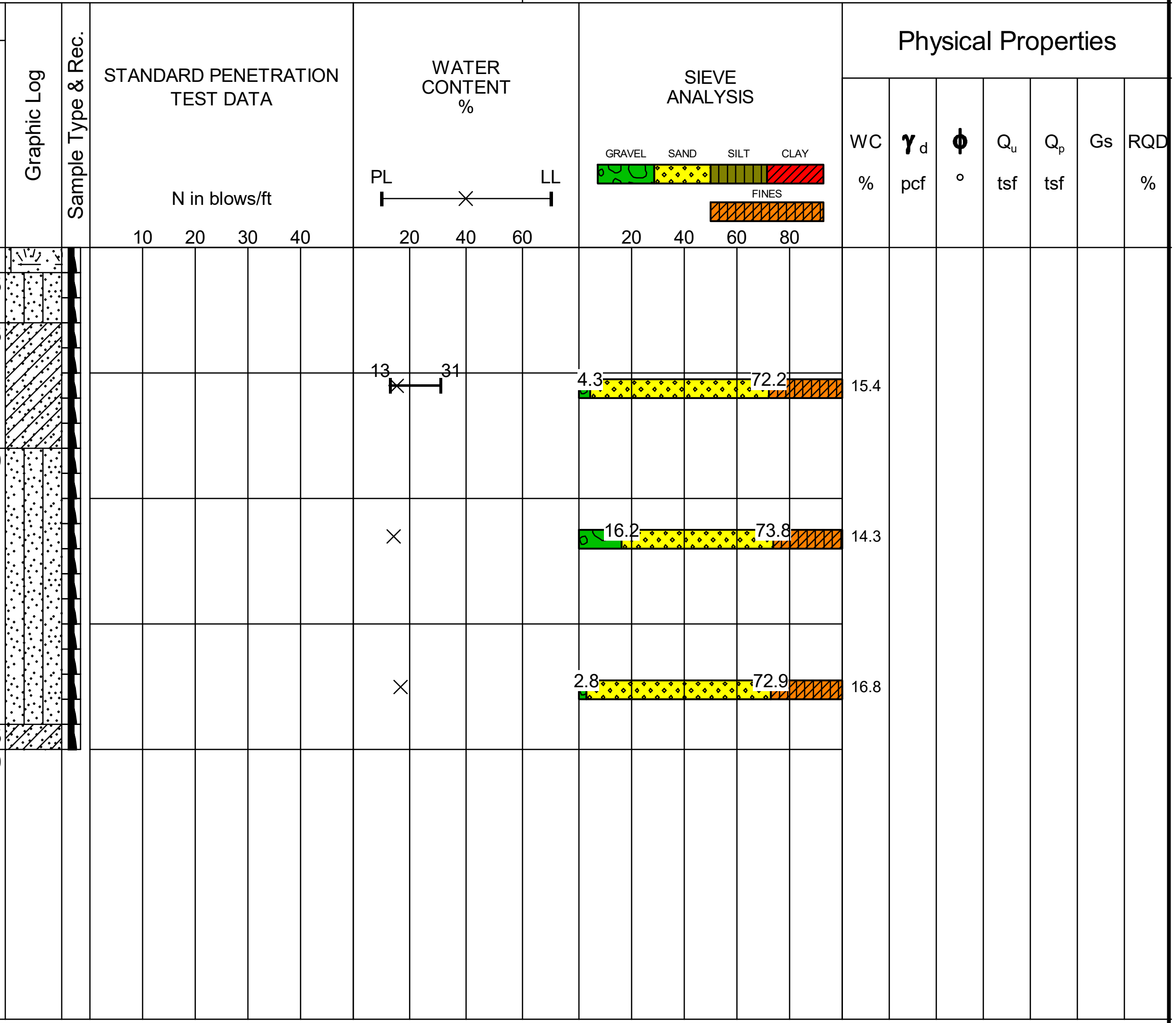
Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1307.6 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Depth, feet
	0.0		
1307.1		TOPSOIL (SM): fine to medium grained; dark brown to black; moist; with organics.	0.5
1306.1		SILTY SAND (SM): fine to medium grained; brown; wet; trace gravel, trace roots and fibers.	1.5
1305.0	2.5	CLAYEY SAND (SC): fine to medium grained; greyish brown; wet; trace roots and fibers.	
1303.6			
		SILTY SAND (SM): fine to medium grained; greyish brown; saturated; trace to with gravel.	4.0
1302.5	5.0		
1300.0	7.5		
1298.1			
1297.6		CLAYEY SAND (SC): fine to medium grained; grey; wet; trace gravel.	9.5
	10.0		10.0
		Bottom of Boring at 10.0 feet	
	12.5		
	15.0		



Completion Depth:	10.0
Date Boring Started:	3/4/20
Date Boring Completed:	3/4/20
Logged By:	MLH2
Drilling Contractor:	TPT
Drilling Method:	HA
Ground Surface Elevation:	1307.630
Coordinates:	N 459,817.3 ft E 2,413,664.7 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 2.5-in bucket auger. Drawdown test performed at 10 feet. Boring abandoned with neat cement grout.

SAMPLE TYPES

▮ Auger Cuttings

WATER LEVELS (ft)

▼	0 hrs At Time of Drilling	3.1
▽	2 hrs After Drilling	2.8

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-20-HA-16

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley

Location: Cass County, MN

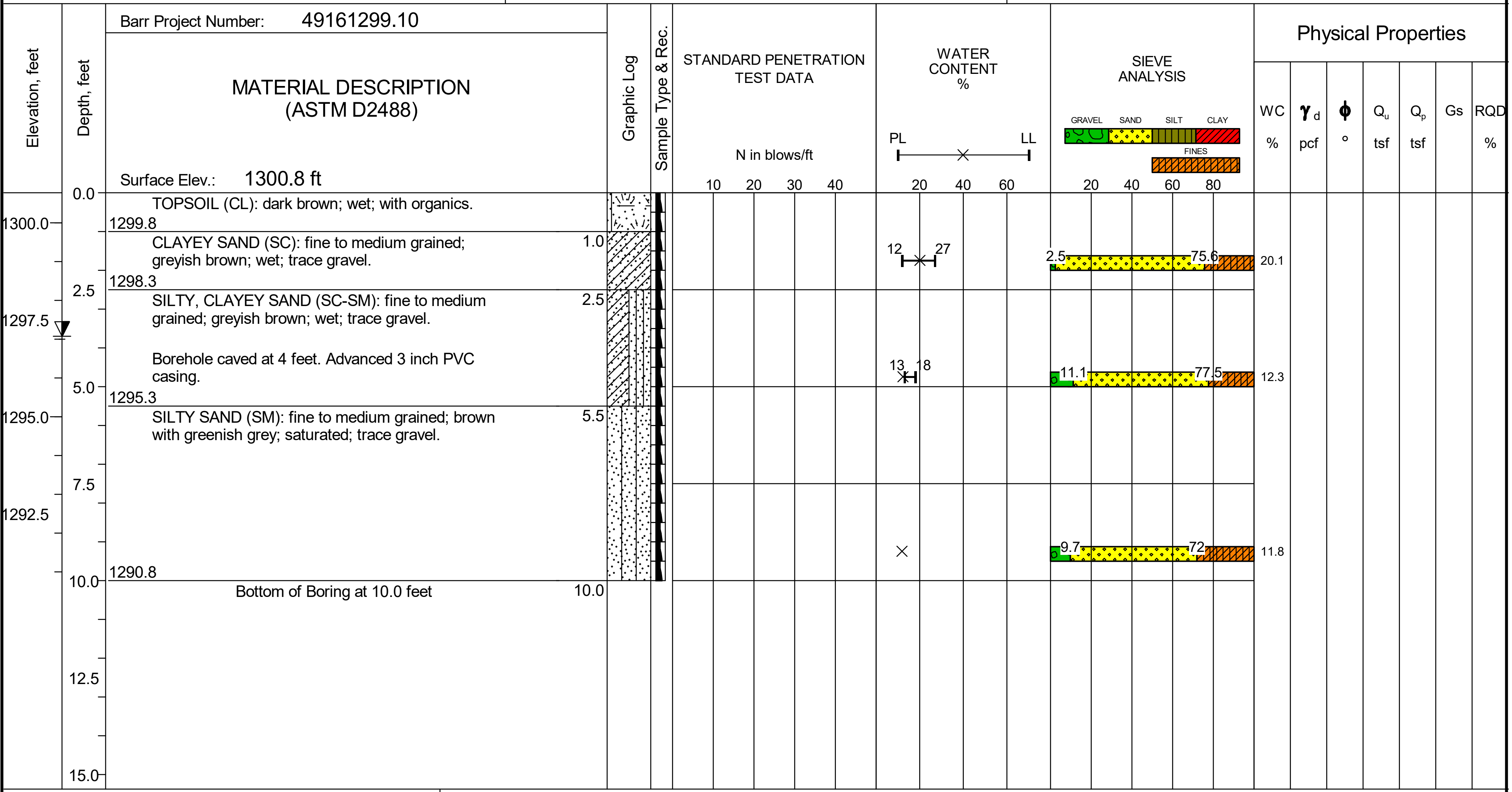
Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1300.8 ft

MATERIAL DESCRIPTION (ASTM D2488)

Elevation, feet	Depth, feet	Material Description	Bottom Depth	Water Content % (PL / WC / LL)	Sieve Analysis	WC %
1300.8	0.0	TOPSOIL (CL): dark brown; wet; with organics.				
1299.8	1.0	CLAYEY SAND (SC): fine to medium grained; greyish brown; wet; trace gravel.	1.0	12 / × / 27	2.5 / 75.6	20.1
1298.3	2.5	SILTY, CLAYEY SAND (SC-SM): fine to medium grained; greyish brown; wet; trace gravel. Borehole caved at 4 feet. Advanced 3 inch PVC casing.	2.5	13 / × / 18	11.1 / 77.5	12.3
1295.3	5.5	SILTY SAND (SM): fine to medium grained; brown with greenish grey; saturated; trace gravel.	5.5	×	9.7 / 72	11.8
1290.8	10.0	Bottom of Boring at 10.0 feet	10.0			



Completion Depth: 10.0
Date Boring Started: 3/4/20
Date Boring Completed: 3/4/20
Logged By: MLH2
Drilling Contractor: TPT
Drilling Method: HA
Ground Surface Elevation: 1300.773
Coordinates: N 459,817.2 ft E 2,413,717.9 ft
Datum: MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 2.5-in bucket auger. Drawdown test performed at 10 feet. Boring abandoned with neat cement grout.

SAMPLE TYPES	WATER LEVELS (ft)	LEGEND
▮ Auger Cuttings	▽ At Time of Drilling 3.7	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-20-HA-17

Sheet 1 of 1

Project:	Line 3 Replacement Spire Valley	Location:	Cass County, MN	Client:	Enbridge Energy

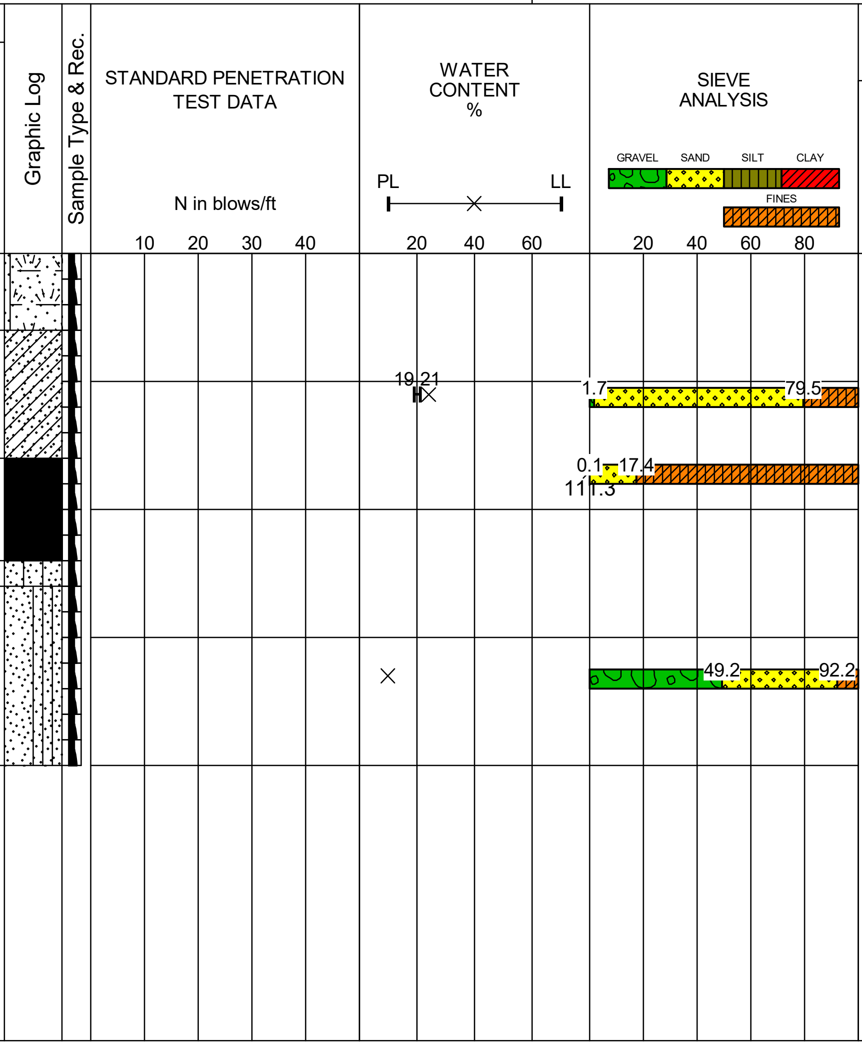
Barr Project Number: 49161299.10

Surface Elev.: 1287.9 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	WC %
1286.4	1.5	TOPSOIL (SC): dark brown; wet; with organics.	
1283.9	4.0	CLAYEY SAND (SC): fine to medium grained; brown; wet; trace roots and fibers.	24.1
1281.9	6.0	PEAT (PT): brown; wet; trace sand.	111.3
1281.4	6.5	SILTY SAND (SM): fine to medium grained; greyish brown; saturated; trace gravel.	
1277.9	10.0	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM): fine to medium grained; brown; saturated.	9.9
	10.0	Bottom of Boring at 10.0 feet	

Elevation scale: 1287.5, 1285.0, 1282.5, 1280.0
Depth scale: 0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0

Physical Properties: WC %, γ_d pcf, ϕ °, Q_u tsf, Q_p tsf, Gs, RQD %



Completion Depth:	10.0
Date Boring Started:	3/5/20
Date Boring Completed:	3/5/20
Logged By:	MLH2
Drilling Contractor:	TPT
Drilling Method:	HA
Ground Surface Elevation:	1287.918
Coordinates:	N 459,817.1 ft E 2,413,778.4 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 2.5-in bucket auger. Refusal at 3.5 feet, offset 18 inches north. Drawdown test performed at 10 feet. Boring abandoned with neat cement grout.

SAMPLE TYPES	WATER LEVELS (ft)	LEGEND
▮ Auger Cuttings	▽ At Time of Drilling 2.5	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-20-HA-18

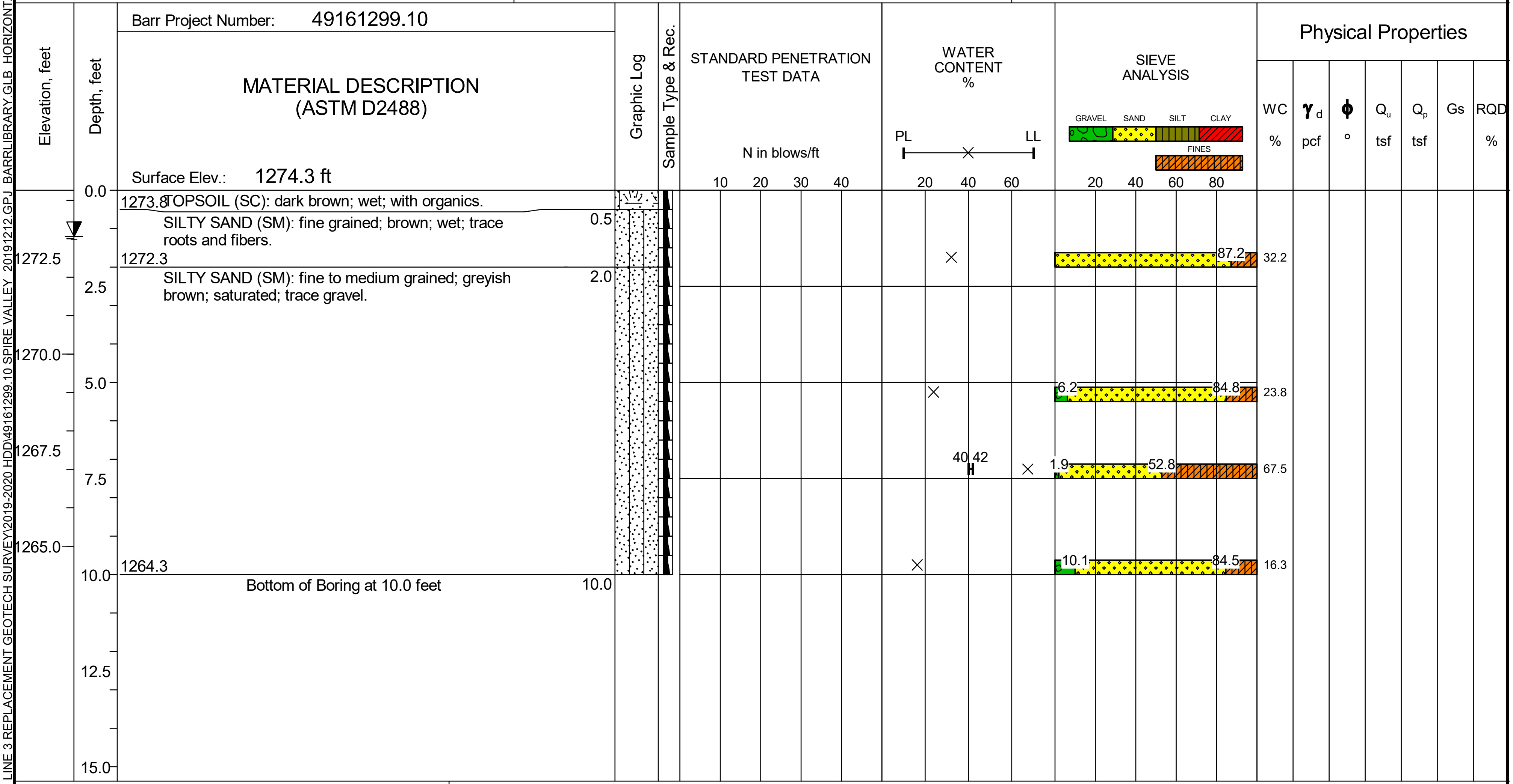
Sheet 1 of 1

Project: Line 3 Replacement Spire Valley
Location: Cass County, MN
Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1274.3 ft

Elevation, feet	MATERIAL DESCRIPTION (ASTM D2488)	Depth, feet
1273.8	TOPSOIL (SC): dark brown; wet; with organics.	0.5
1272.3	SILTY SAND (SM): fine grained; brown; wet; trace roots and fibers.	2.0
1264.3	SILTY SAND (SM): fine to medium grained; greyish brown; saturated; trace gravel.	10.0
	Bottom of Boring at 10.0 feet	10.0



Completion Depth:	10.0
Date Boring Started:	3/5/20
Date Boring Completed:	3/5/20
Logged By:	MLH2
Drilling Contractor:	TPT
Drilling Method:	HA
Ground Surface Elevation:	1274.258
Coordinates:	N 459,817.0 ft E 2,413,842.5 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 2.5-in bucket auger. Drawdown test performed at 10 feet. Boring abandoned with neat cement grout.

SAMPLE TYPES
▮ Auger Cuttings

WATER LEVELS (ft)
▼ At Time of Drilling 1.2

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

BARR

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Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-20-HA-19

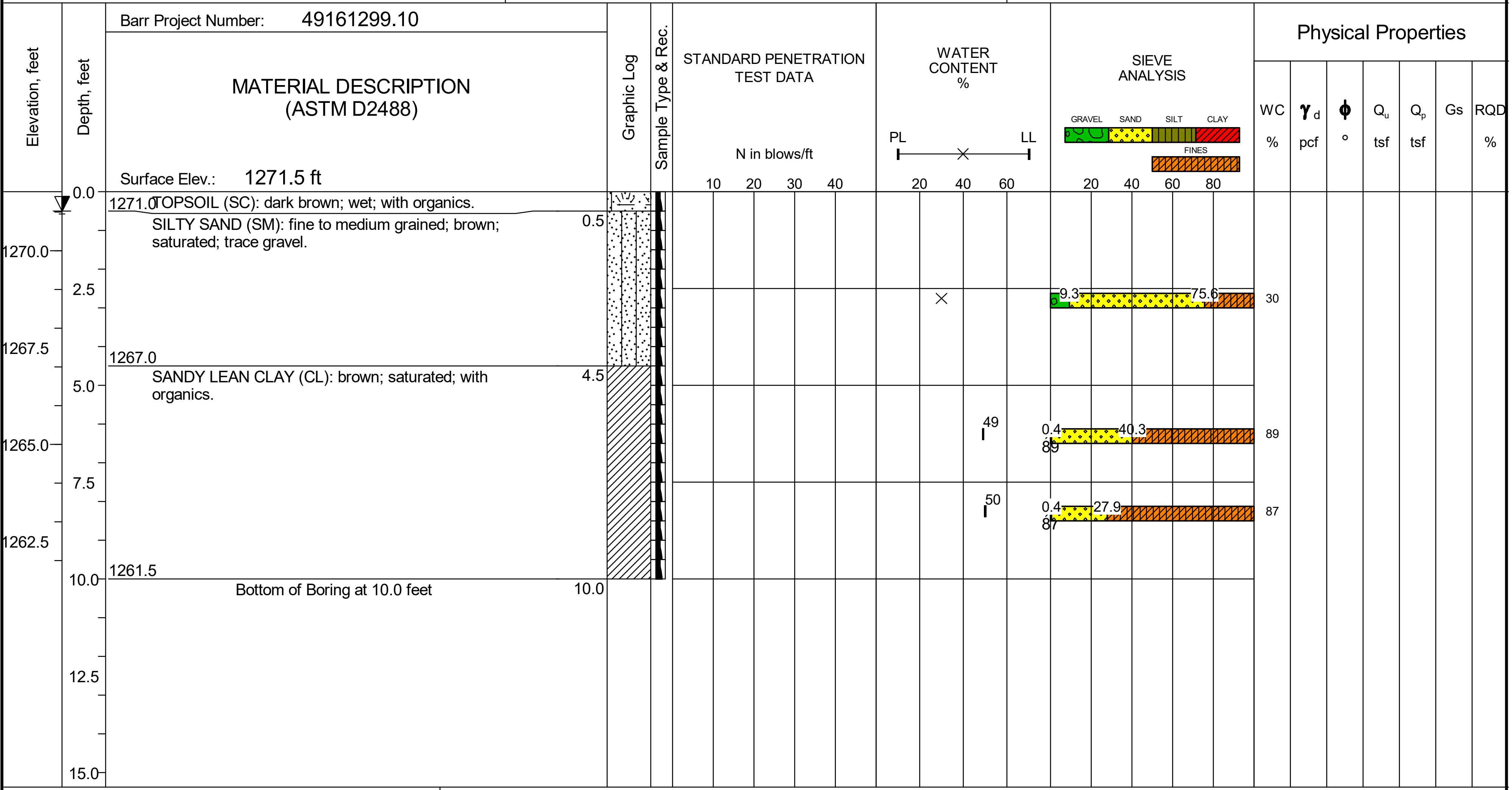
Sheet 1 of 1

Project: Line 3 Replacement Spire Valley
Location: Cass County, MN
Client: Enbridge Energy

Barr Project Number: 49161299.10

Surface Elev.: 1271.5 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	
	0.0	TOPSOIL (SC): dark brown; wet; with organics.	
1271.0		SILTY SAND (SM): fine to medium grained; brown; saturated; trace gravel.	0.5
1267.0		SANDY LEAN CLAY (CL): brown; saturated; with organics.	4.5
1261.5		Bottom of Boring at 10.0 feet	10.0



Completion Depth:	10.0
Date Boring Started:	3/5/20
Date Boring Completed:	3/5/20
Logged By:	MLH2
Drilling Contractor:	TPT
Drilling Method:	HA
Ground Surface Elevation:	1271.526
Coordinates:	N 459,816.6 ft E 2,413,889.2 ft
Datum:	MN State Plane NAD83, NAVD88

Remarks: Boring completed using a 2.5-in bucket auger. Drawdown test performed at 10 feet. Boring abandoned with neat cement grout.

SAMPLE TYPES

▮ Auger Cuttings

WATER LEVELS (ft)

▼ At Time of Drilling 0.5

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Appendix B

Laboratory Results

Twin Ports Testing
Twin Ports Testing, Inc.
1301 North 3rd Street
Superior, WI 54880
p: 715-392-7114
p: 800-373-2562
f: 715-392-7163
www.twinportstesting.com

Material Test Report

Report No: MAT:W319-0584-S1
Issue No: 1
This report replaces all previous issues of report no 'MAT:W319-0584-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

This laboratory is accredited in accordance with AASHTO.

1914

Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)
Date of Issue: 10/24/2019
THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: W319-0584-S1
Field Sample: Bulk #1
Date Sampled: 9/10/2019
Source: SV-19-West-HA 24"-30"
Material: (CL-ML) Sandy silty clay
Specification: Informational
Sampling Method: Bulk Sample

Atterberg Limit:

Liquid Limit: 23
Plastic Limit: 17
Plasticity Index: 6
Linear Shrinkage (%): N/A

Sample Description:

(CL-ML) Sandy silty clay

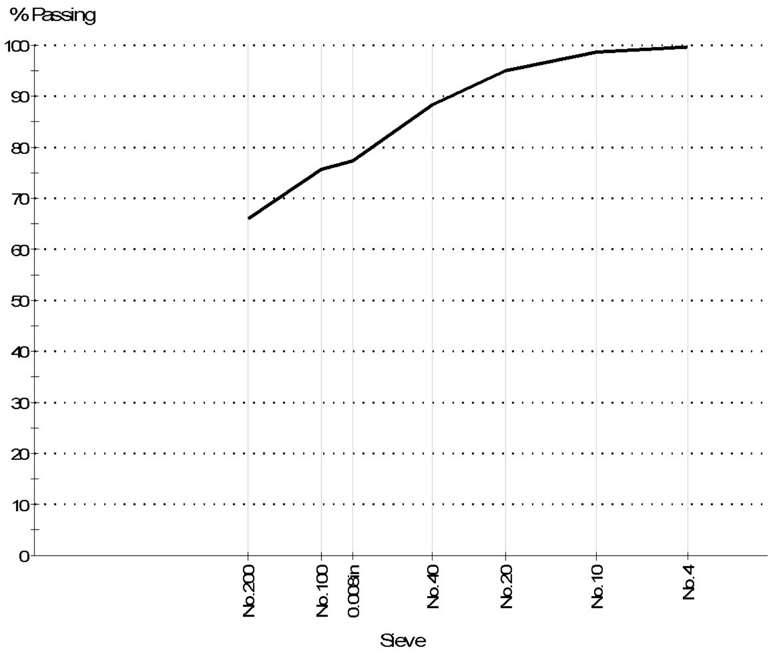
Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
No.4	100
No.10	99
No.20	95
No.40	88
0.008in	77
No.100	76
No.200	66

D85: 0.3392 D60: 0.0477 D50: 0.0229
D30: 0.0052 D15: 0.0017 D10: 0.0012

Particle Size Distribution



FINES (66.1%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (22.2%)	Medium (10.4%)	Coarse (1.1%)	Fine (0.2%)	Coarse (0.0%)	(0.0%)

Twin Ports Testing, Inc.
1301 North 3rd Street
Superior, WI 54880
p: 715-392-7114
p: 800-373-2562
f: 715-392-7163
www.twinportstesting.com

Material Test Report

Report No: MAT:W319-0584-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

1914

This laboratory is accredited in accordance with AASHTO.

Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	W319-0584-S1
Field Sample:	Bulk #1
Date Sampled:	9/10/2019
Source:	SV-19-West-HA 24"-30"
Material:	(CL-ML) Sandy silty clay
Specification:	Informational
Sampling Method:	Bulk Sample

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	21.3
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	23
Method		Method A
Plastic Limit		17
Plasticity Index		6
Sample history		Oven-dried
Material retained on 425µm (No. 40) (%)		11.7

Comments

N/A

Twin Ports Testing, Inc.
1301 North 3rd Street
Superior, WI 54880
p: 715-392-7114
p: 800-373-2562
f: 715-392-7163
www.twinportstesting.com

Material Test Report

Report No: MAT:W319-0584-S2
Issue No: 1
This report replaces all previous issues of report no 'MAT:W319-0584-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

This laboratory is accredited in accordance with AASHTO.

1914

Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

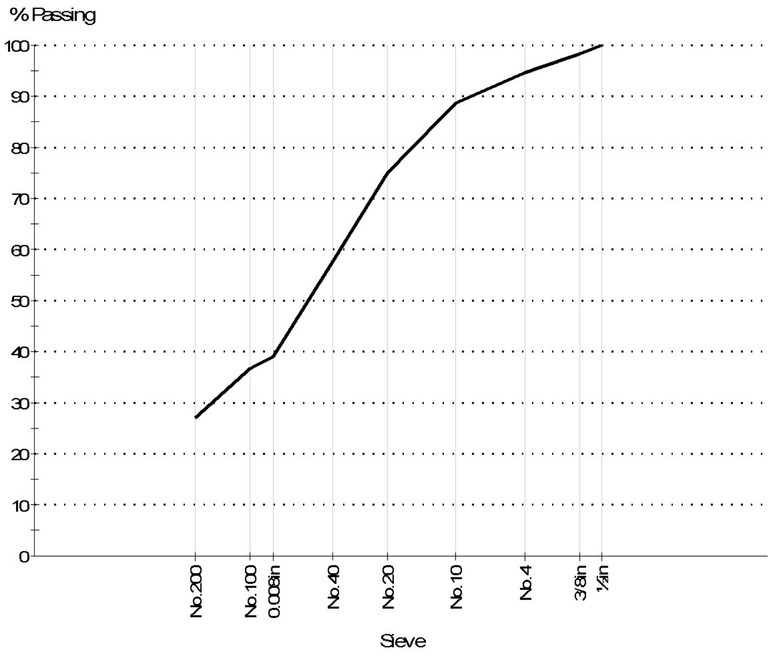
Sample Details

Sample ID: W319-0584-S2
Field Sample: Bulk #2
Date Sampled: 9/10/2019
Source: SV-19-West-HA 3.0'-3.5'
Material: (SM) Silty sand
Specification: Informational
Sampling Method: Bulk Sample

Sample Description:

(SM) Silty sand

Particle Size Distribution



FINES (26.9%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (30.9%)	Medium (30.9%)	Coarse (6.1%)	Fine (5.2%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
½in	100
3/8in	98
No.4	95
No.10	89
No.20	75
No.40	58
0.008in	39
No.100	37
No.200	27

D85: 1.5917 D60: 0.4643 D50: 0.3104
D30: 0.0936 D15: 0.0321 D10: 0.0225

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Material Test Report

Report No: MAT:W319-0584-S2

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S2
Field Sample:	Bulk #2
Date Sampled:	9/10/2019
Source:	SV-19-West-HA 3.0'-3.5'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Bulk Sample

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	18.0
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A

Comments

N/A

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Material Test Report

Report No: MAT:W319-0584-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
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Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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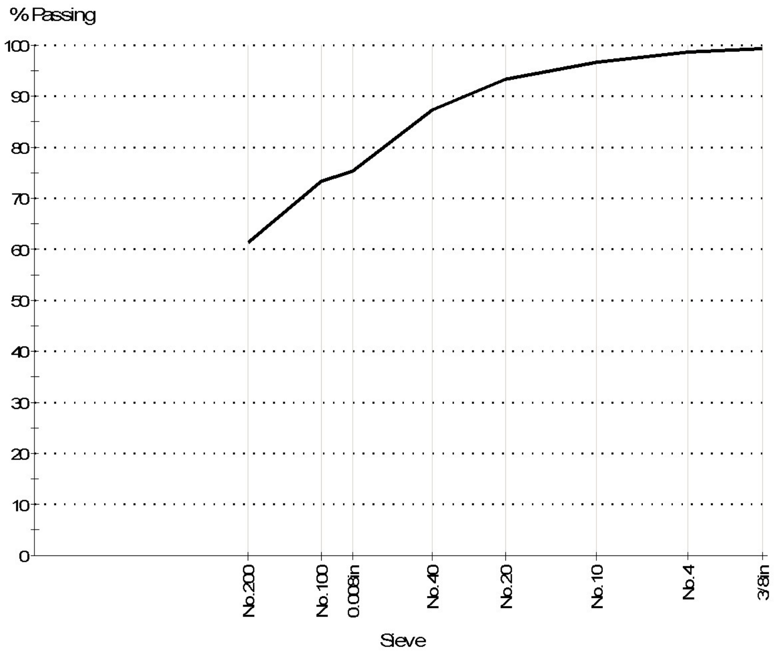
Sample Details

Sample ID:	W319-0584-S3
Field Sample:	Bulk #3
Date Sampled:	9/10/2019
Source:	SV-19-West-HA 6.0'-6.5'
Material:	(ML) Sandy silt
Specification:	Informational
Sampling Method:	Bulk Sample

Sample Description:

(ML) Sandy silt

Particle Size Distribution



FINES (61.4%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (25.9%)	Medium (9.3%)	Coarse (2.1%)	Fine (1.2%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
3/8in	99
No.4	99
No.10	97
No.20	93
No.40	87
0.008in	75
No.100	73
No.200	61

D85: 0.3676 D60: 0.0691 D50: 0.0387
D30: 0.0122 D15: 0.0051 D10: 0.0038

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Material Test Report

Report No: MAT:W319-0584-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S3'.

Client: Barr Engineering Company
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Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S3
Field Sample:	Bulk #3
Date Sampled:	9/10/2019
Source:	SV-19-West-HA 6.0'-6.5'
Material:	(ML) Sandy silt
Specification:	Informational
Sampling Method:	Bulk Sample

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	20.2
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A

Comments

N/A

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Material Test Report

Report No: MAT:W319-0584-S4

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S4'.

Client: Barr Engineering Company
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Project: 19M8522 Enbridge L3R Spire Valley

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Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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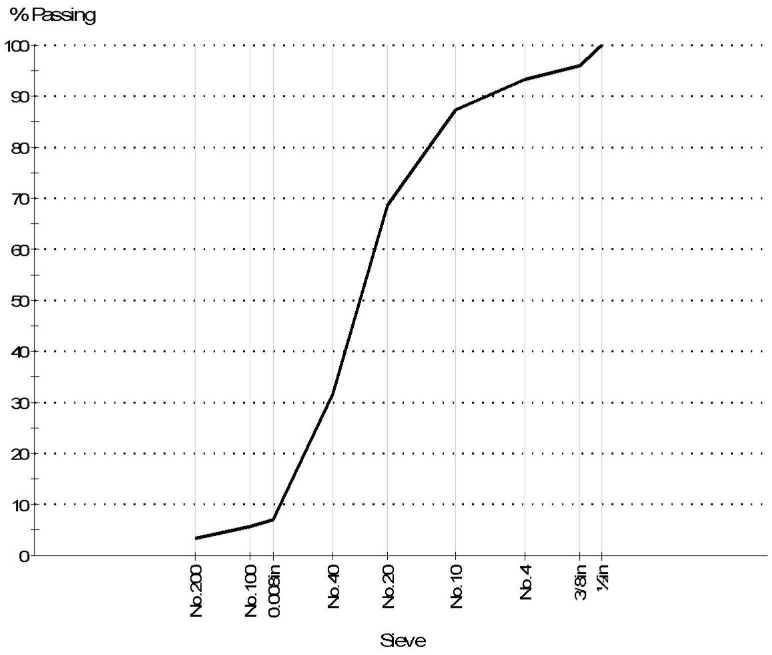
Sample Details

Sample ID:	W319-0584-S4
Field Sample:	3
Date Sampled:	9/10/2019
Source:	SV-19-Middle 4'-6'
Material:	(SP) Poorly graded sand
Specification:	Informational
Sampling Method:	Split Spoon

Sample Description:

(SP) Poorly graded sand

Particle Size Distribution



FINES (3.2%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (28.5%)	Medium (55.8%)	Coarse (5.7%)	Fine (6.8%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
½in	100
3/8in	96
No.4	93
No.10	87
No.20	69
No.40	32
0.008in	7
No.100	6
No.200	3.2

D85: 1.7880 D60: 0.7231 D50: 0.5994
D30: 0.4038 D15: 0.2550 D10: 0.2187
Cu: 3.31 Cc: 1.03

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Material Test Report

Report No: MAT:W319-0584-S4

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S4'.

Client: Barr Engineering Company
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Sample Details

Sample ID:	W319-0584-S4
Field Sample:	3
Date Sampled:	9/10/2019
Source:	SV-19-Middle 4'-6'
Material:	(SP) Poorly graded sand
Specification:	Informational
Sampling Method:	Split Spoon

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	14.7
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A

Comments

N/A

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Material Test Report

Report No: MAT:W319-0584-S5

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S5'.

Client: Barr Engineering Company
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Project: 19M8522 Enbridge L3R Spire Valley

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Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S5
Field Sample:	9
Date Sampled:	9/10/2019
Source:	SV-19-Middle 16'-18'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Split Spoon

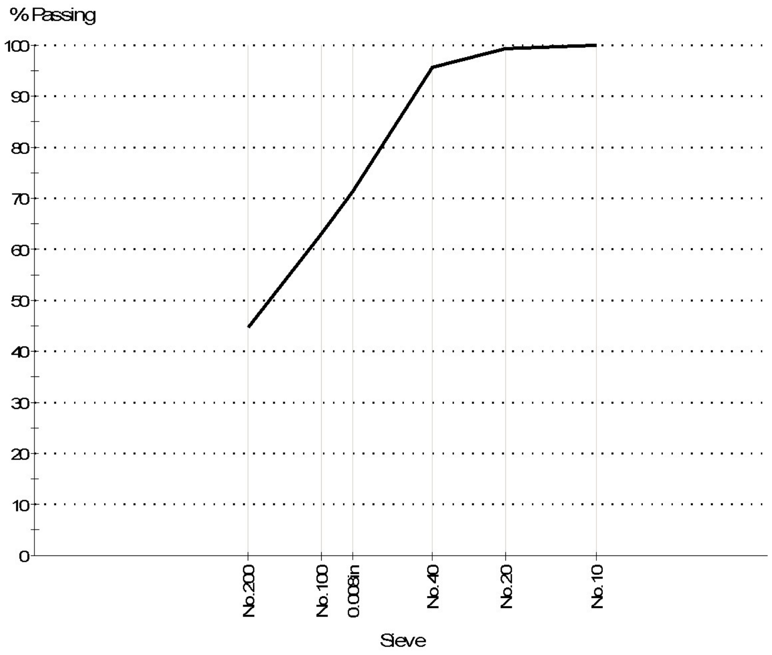
Atterberg Limit:

Liquid Limit:	N/A
Plastic Limit:	NP
Plasticity Index:	NP
Linear Shrinkage (%):	N/A

Sample Description:

(SM) Silty sand

Particle Size Distribution



FINES (44.6%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (51.2%)	Medium (4.2%)	Coarse (0.0%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
No.10	100
No.20	99
No.40	96
0.008in	71
No.100	63
No.200	45

D85: 0.3042 D60: 0.1335 D50: 0.0918
D30: 0.0435 D15: 0.0248 D10: 0.0206

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Material Test Report

Report No: MAT:W319-0584-S5

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S5'.

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Sample Details

Sample ID:	W319-0584-S5
Field Sample:	9
Date Sampled:	9/10/2019
Source:	SV-19-Middle 16'-18'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Split Spoon

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	23.1
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	N/A
Method		Method B
Plastic Limit		NP
Plasticity Index		NP
Sample history		Oven-dried
Material retained on 425µm (No. 40) (%)		4.2

Comments

N/A

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Material Test Report

Report No: MAT:W319-0584-S6

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S6'.

Client: Barr Engineering Company
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Joe Berger

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Date of Issue: 10/24/2019

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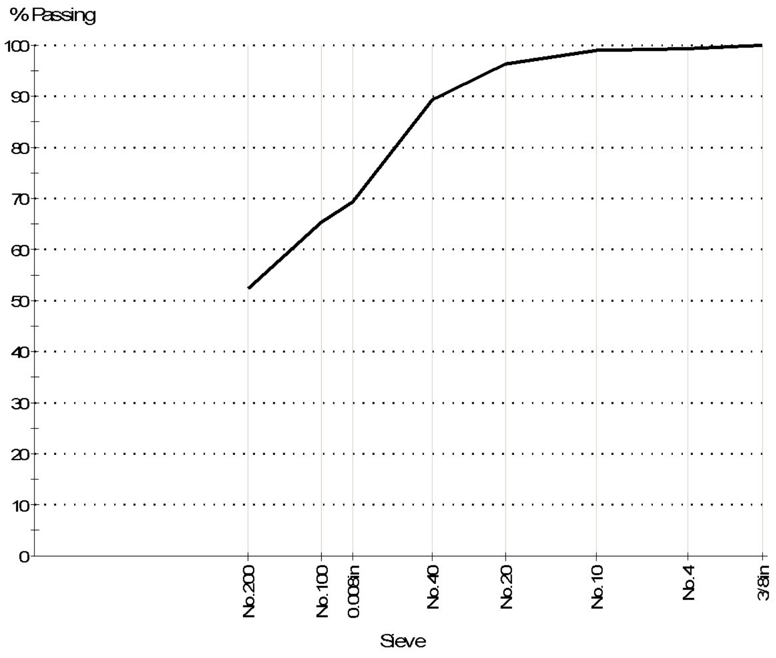
Sample Details

Sample ID:	W319-0584-S6
Field Sample:	15
Date Sampled:	9/11/2019
Source:	SV-19-Middle 28'-30'
Material:	(ML) Sandy silt
Specification:	Informational
Sampling Method:	Split Spoon

Sample Description:

(ML) Sandy silt

Particle Size Distribution



FINES (52.3%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (37.2%)	Medium (9.4%)	Coarse (0.6%)	Fine (0.6%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
3/8in	100
No.4	99
No.10	99
No.20	96
No.40	89
0.008in	69
No.100	65
No.200	52

D85: 0.3593 D60: 0.1134 D50: 0.0663
D30: 0.0226 D15: 0.0101 D10: 0.0077

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Material Test Report

Report No: MAT:W319-0584-S6
Issue No: 1
This report replaces all previous issues of report no 'MAT:W319-0584-S6'.

Client: Barr Engineering Company
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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S6
Field Sample:	15
Date Sampled:	9/11/2019
Source:	SV-19-Middle 28'-30'
Material:	(ML) Sandy silt
Specification:	Informational
Sampling Method:	Split Spoon

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	20.2
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A

Comments

N/A

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Material Test Report

Report No: MAT:W319-0584-S7

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S7'.

Client: Barr Engineering Company
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Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S7
Field Sample:	18
Date Sampled:	9/11/2019
Source:	SV-19-Middle 34'-36'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Split Spoon

Test Results

Description	Method	Result
Moisture Content (%)	ASTM D 2216 - 05	15.1
Wet Density (lb/ft³)		123.0
Dry Density (lb/ft³)		106.9

Comments

N/A

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Material Test Report

Report No: MAT:W319-0584-S8
Issue No: 1
This report replaces all previous issues of report no 'MAT:W319-0584-S8'.

Client: Barr Engineering Company
325 South Lake Avenue
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Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)
Date of Issue: 10/24/2019
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Sample Details

Sample ID:	W319-0584-S8
Field Sample:	19
Date Sampled:	9/11/2019
Source:	SV-19-Middle 36'-38'
Material:	(CL-ML) Silty clay
Specification:	Informational
Sampling Method:	Split Spoon

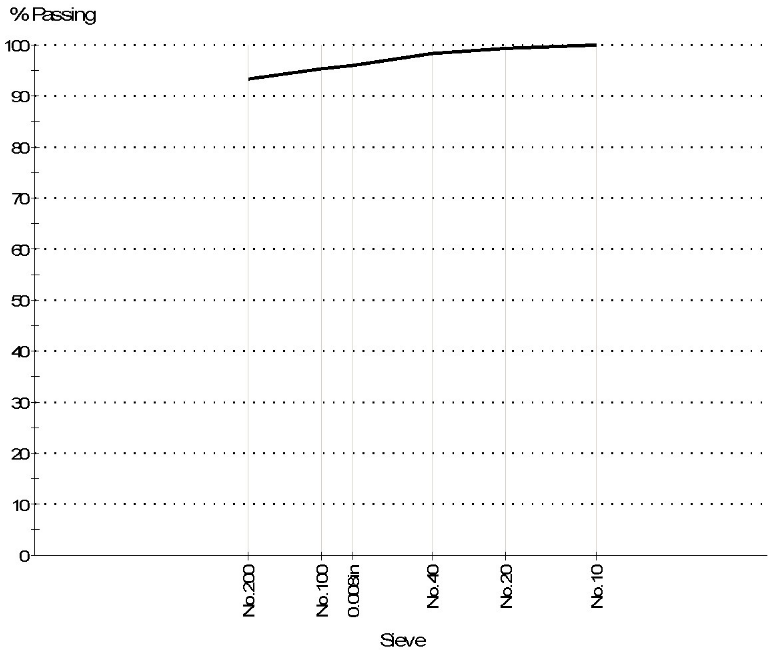
Atterberg Limit:

Liquid Limit:	22
Plastic Limit:	18
Plasticity Index:	4
Linear Shrinkage (%):	N/A

Sample Description:

(CL-ML) Silty clay

Particle Size Distribution



FINES (93.5%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (4.8%)	Medium (1.7%)	Coarse (0.0%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
No.10	100
No.20	99
No.40	98
0.008in	96
No.100	95
No.200	93

D85: 0.0033 D60: 0.0000 D50: 0.0000
D30: 0.0000 D15: 0.0000 D10: 0.0000

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Material Test Report

Report No: MAT:W319-0584-S8

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S8'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S8
Field Sample:	19
Date Sampled:	9/11/2019
Source:	SV-19-Middle 36'-38'
Material:	(CL-ML) Silty clay
Specification:	Informational
Sampling Method:	Split Spoon

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	23.4
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	22
Method		Method A
Plastic Limit		18
Plasticity Index		4
Sample history		Oven-dried
Material retained on 425µm (No. 40) (%)		1.7

Comments

N/A

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Material Test Report

Report No: MAT:W319-0584-S9

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S9'.

Client: Barr Engineering Company
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Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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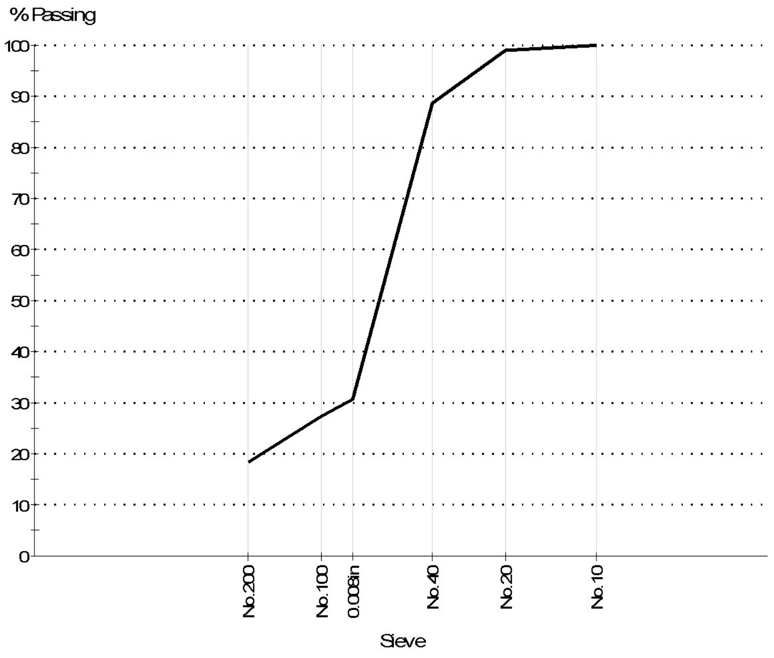
Sample Details

Sample ID:	W319-0584-S9
Field Sample:	27
Date Sampled:	9/11/2019
Source:	SV-19-Middle 52'-54'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Split Spoon

Sample Description:

(SM) Silty sand

Particle Size Distribution



FINES (18.2%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (70.3%)	Medium (11.4%)	Coarse (0.1%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
No.10	100
No.20	99
No.40	89
0.008in	31
No.100	27
No.200	18

D85: 0.4060 D60: 0.2932 D50: 0.2574
D30: 0.1896 D15: 0.0586 D10: 0.0400

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Material Test Report

Report No: MAT:W319-0584-S9

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S9'.

Client: Barr Engineering Company
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Project: 19M8522 Enbridge L3R Spire Valley

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Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S9
Field Sample:	27
Date Sampled:	9/11/2019
Source:	SV-19-Middle 52'-54'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Split Spoon

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	20.4
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A

Comments

N/A

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Material Test Report

Report No: MAT:W319-0584-S10
Issue No: 1
This report replaces all previous issues of report no 'MAT:W319-0584-S10'.

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Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S10
Field Sample:	37
Date Sampled:	9/12/2019
Source:	SV-19-Middle 72'-74'
Material:	(CL) Lean clay with sand
Specification:	Informational
Sampling Method:	Split Spoon

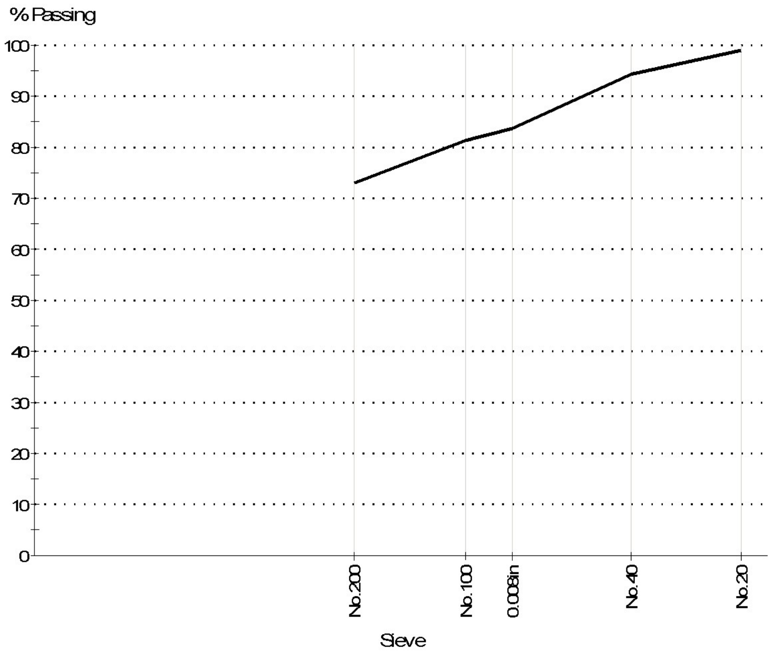
Atterberg Limit:

Liquid Limit:	27
Plastic Limit:	16
Plasticity Index:	11
Linear Shrinkage (%):	N/A

Sample Description:

(CL) Lean clay with sand

Particle Size Distribution



FINES (73.1%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (21.1%)	Medium (5.8%)	Coarse (0.0%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
No.20	99
No.40	94
0.008in	84
No.100	81
No.200	73

D85: 0.2198 D60: 0.0249 D50: 0.0107
D30: 0.0020 D15: 0.0006 D10: 0.0004

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Material Test Report

Report No: MAT:W319-0584-S10

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S10'.

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S10
Field Sample:	37
Date Sampled:	9/12/2019
Source:	SV-19-Middle 72'-74'
Material:	(CL) Lean clay with sand
Specification:	Informational
Sampling Method:	Split Spoon

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	22.2
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	27
Method		Method A
Plastic Limit		16
Plasticity Index		11
Sample history		Oven-dried
Material retained on 425μm (No. 40) (%)		5.8

Comments

N/A

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Material Test Report

Report No: MAT:W319-0584-S11
Issue No: 1
This report replaces all previous issues of report no 'MAT:W319-0584-S11'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

1914

This laboratory is accredited in accordance with AASHTO.

Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S11
Field Sample:	45
Date Sampled:	9/12/2019
Source:	SV-19-Middle 88'-90'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Split Spoon

Sample Description:

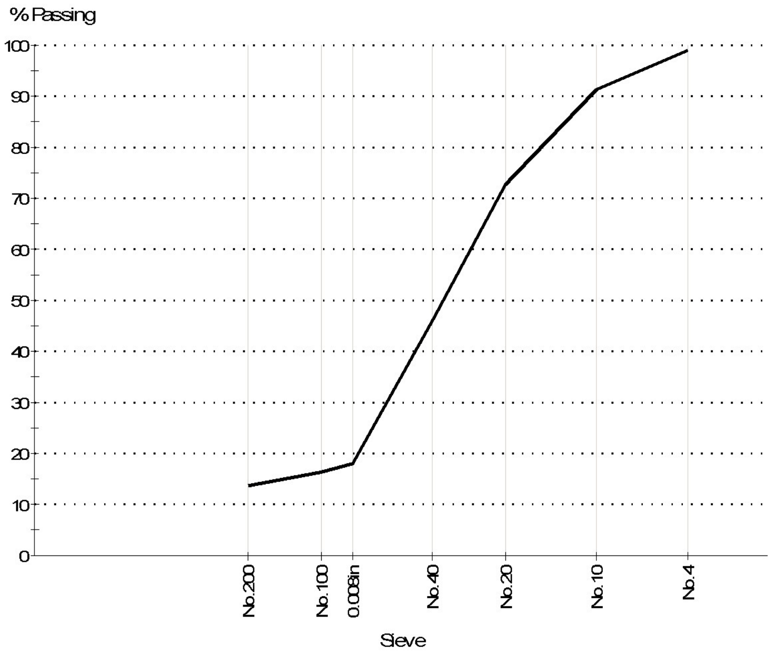
(SM) Silty sand

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
No.4	99
No.10	91
No.20	73
No.40	46
0.008in	18
No.100	16
No.200	14

Particle Size Distribution



FINES (13.6%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (32.4%)	Medium (45.2%)	Coarse (7.8%)	Fine (1.0%)	Coarse (0.0%)	(0.0%)

D85: 1.4999 D60: 0.6111 D50: 0.4713
D30: 0.2767 D15: 0.1047 D10: 0.0314

TwinPortsTesting

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Material Test Report

Report No: MAT:W319-0584-S11

Issue No: 1

This report replaces all previous issues of report no 'MAT:W319-0584-S11'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 10/24/2019

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Sample Details

Sample ID:	W319-0584-S11
Field Sample:	45
Date Sampled:	9/12/2019
Source:	SV-19-Middle 88'-90'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Split Spoon

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	16.4
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A

Comments

N/A

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Material Test Report

Report No: MAT:W320-0063-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0063-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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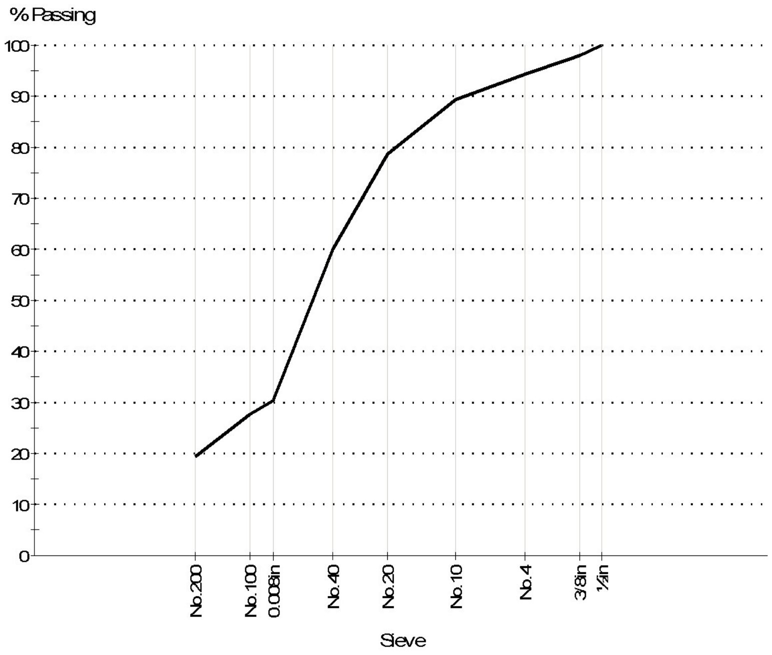
Sample Details

Sample ID:	W320-0063-S1
Field Sample:	63-1
Date Sampled:	3/4/2020
Source:	SV-20-HA-14 3.5'-4'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Sample Description:

(SM) Silty sand

Particle Size Distribution



FINES (19.2%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (40.7%)	Medium (29.3%)	Coarse (5.0%)	Fine (5.8%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
½in	100
3/8in	98
No.4	94
No.10	89
No.20	79
No.40	60
0.008in	30
No.100	28
No.200	19

D85: 1.4169 D60: 0.4273 D50: 0.3301
D30: 0.1912 D15: 0.0532 D10: 0.0352

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Material Test Report

Report No: MAT:W320-0063-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0063-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID: W320-0063-S1
Field Sample: 63-1
Date Sampled: 3/4/2020
Source: SV-20-HA-14 3.5'-4'
Material: (SM) Silty sand
Specification: Informational
Sampling Method: Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	10.1
Method		Method B

Comments

N/A

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Material Test Report

Report No: MAT:W320-0063-S2

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0063-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/17/2020

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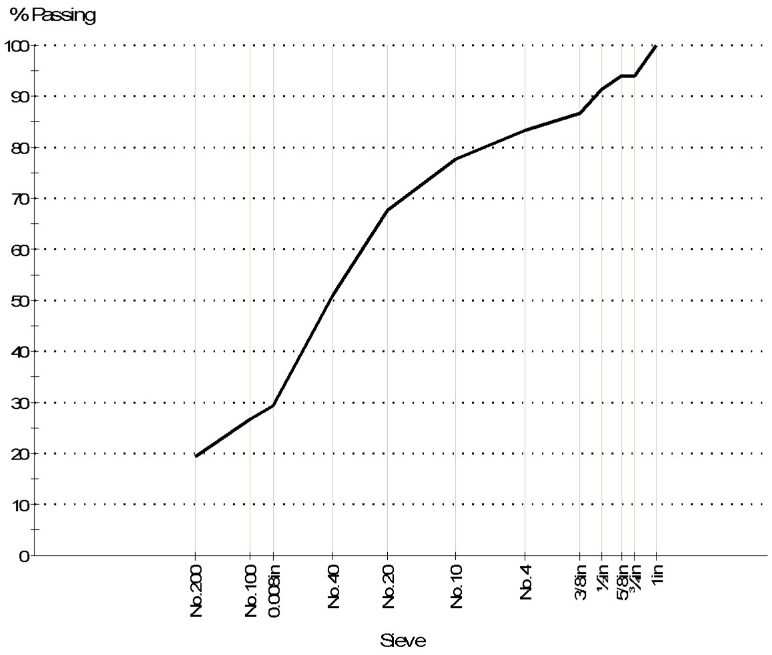
Sample Details

Sample ID:	W320-0063-S2
Field Sample:	63-2
Date Sampled:	3/4/2020
Source:	SV-20-HA-14 5'-5.5'
Material:	(SM) Silty Sand with Gravel
Specification:	Informational
Sampling Method:	Hand Auger

Sample Description:

(SM) Silty Sand with Gravel

Particle Size Distribution



FINES (19.3%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (31.8%)	Medium (26.7%)	Coarse (5.7%)	Fine (10.5%)	Coarse (6.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
1in	100
¾in	94
5/8in	94
½in	91
3/8in	87
No.4	83
No.10	78
No.20	68
No.40	51
0.008in	29
No.100	27
No.200	19

D85: 6.5347 D60: 0.6186 D50: 0.4090
D30: 0.2053 D15: 0.0500 D10: 0.0313

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Material Test Report

Report No: MAT:W320-0063-S2

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0063-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/17/2020

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Sample Details

Sample ID:	W320-0063-S2
Field Sample:	63-2
Date Sampled:	3/4/2020
Source:	SV-20-HA-14 5'-5.5'
Material:	(SM) Silty Sand with Gravel
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	11.5
Method		Method B

Comments

N/A

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Material Test Report

Report No: MAT:W320-0063-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0063-S3'.

Client:	Barr Engineering Company 325 South Lake Avenue Duluth MN 55802
Project:	19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID:	W320-0063-S3
Field Sample:	63-3
Date Sampled:	3/4/2020
Source:	SV-20-HA-14 6.5'-7'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

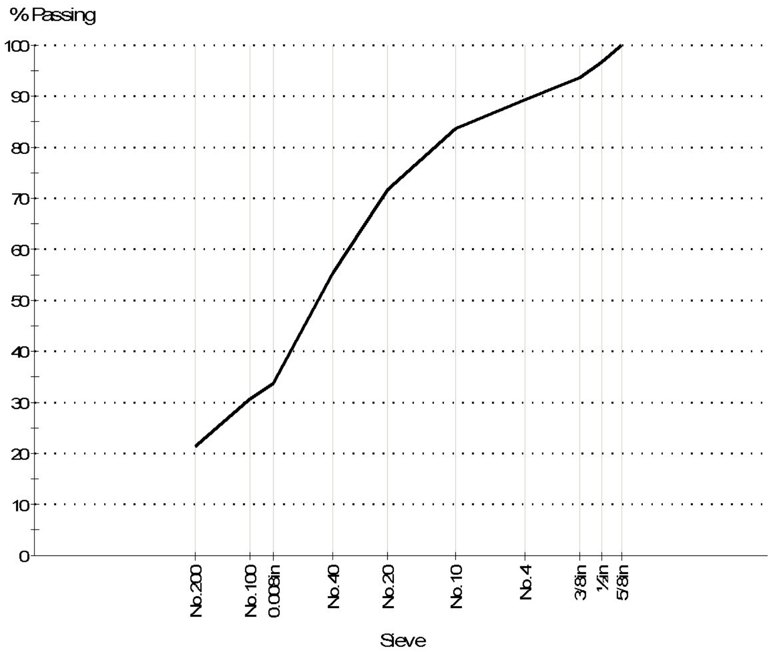
Atterberg Limit:

Liquid Limit:	16
Plastic Limit:	14
Plasticity Index:	2
Linear Shrinkage (%):	N/A

Sample Description:

(SM) Silty sand

Particle Size Distribution



<table>
<tr><th colspan="2">FINES (21.2%)</th><th colspan="3">SAND</th><th colspan="2">GRAVEL</th><th>COBBLES</th></tr>
<tr><td>Clay</td><td>Silt</td><td>Fine
(34.1%)</td><td>Medium
(28.5%)</td><td>Coarse
(5.5%)</td><td>Fine
(10.7%)</td><td>Coarse
(0.0%)</td><td>(0.0%)</td></tr>
</table>

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
5/8in	100
½in	97
3/8in	94
No.4	89
No.10	84
No.20	72
No.40	55
0.008in	34
No.100	31
No.200	21

D85: 2.4088 D60: 0.5184 D50: 0.3533
D30: 0.1440 D15: 0.0472 D10: 0.0325

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Material Test Report

Report No: MAT:W320-0063-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0063-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Date of Issue: 3/15/2020

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Sample Details

Sample ID:	W320-0063-S3
Field Sample:	63-3
Date Sampled:	3/4/2020
Source:	SV-20-HA-14 6.5'-7'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	10.0
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	16
Method		Method A
Plastic Limit		14
Plasticity Index		2
Sample history		Air-dried
Material retained on 425µm (No. 40) (%)		44.7

Comments

N/A

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Material Test Report

Report No: MAT:W320-0064-S1
Issue No: 1
This report replaces all previous issues of report no 'MAT:W320-0064-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID:	W320-0064-S1
Field Sample:	64-1
Date Sampled:	3/4/2020
Source:	SV-20-HA-15 2.5'-3'
Material:	(SC) Clayey Sand
Specification:	Informational
Sampling Method:	Hand Auger

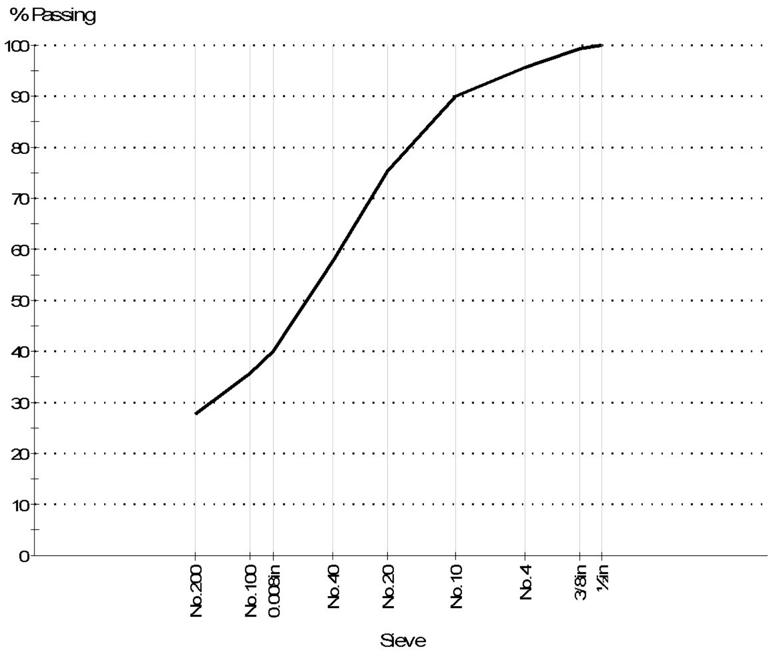
Atterberg Limit:

Liquid Limit:	31
Plastic Limit:	13
Plasticity Index:	18
Linear Shrinkage (%):	N/A

Sample Description:

(SC) Clayey Sand

Particle Size Distribution



FINES (27.8%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (30.0%)	Medium (32.3%)	Coarse (5.6%)	Fine (4.3%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
½in	100
3/8in	99
No.4	96
No.10	90
No.20	75
No.40	58
0.008in	40
No.100	36
No.200	28

D85: 1.4856 D60: 0.4633 D50: 0.3053
D30: 0.0912 D15: 0.0243 D10: 0.0156

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Material Test Report

Report No: MAT:W320-0064-S1
Issue No: 1
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Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)
Date of Issue: 3/15/2020
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Sample Details

Sample ID: W320-0064-S1
Field Sample: 64-1
Date Sampled: 3/4/2020
Source: SV-20-HA-15 2.5'-3'
Material: (SC) Clayey Sand
Specification: Informational
Sampling Method: Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	15.4
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	31
Method		Method A
Plastic Limit		13
Plasticity Index		18
Sample history		Air-dried
Material retained on 425µm (No. 40) (%)		0.0

Comments

N/A

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Material Test Report

Report No: MAT:W320-0064-S2

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0064-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

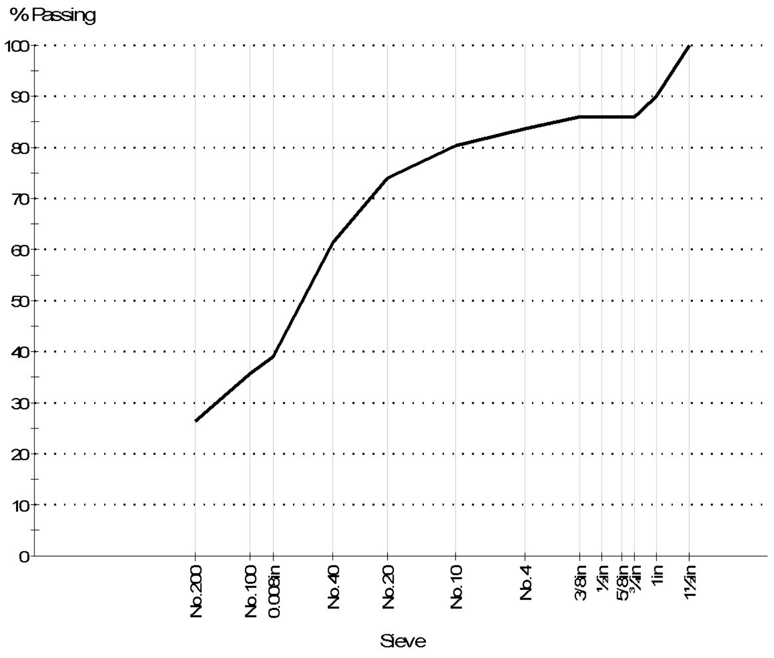
Sample Details

Sample ID:	W320-0064-S2
Field Sample:	64-2
Date Sampled:	3/4/2020
Source:	SV-20-HA-15 5.5'-6'
Material:	(SM) Silty Sand with Gravel
Specification:	Informational
Sampling Method:	Hand Auger

Sample Description:

(SM) Silty Sand with Gravel

Particle Size Distribution



FINES (26.2%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (35.2%)	Medium (19.1%)	Coarse (3.3%)	Fine (2.2%)	Coarse (14.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
1½in	100
1in	90
¾in	86
5/8in	86
½in	86
3/8in	86
No.4	84
No.10	80
No.20	74
No.40	61
0.008in	39
No.100	36
No.200	26

D85: 9.4502 D60: 0.4057 D50: 0.2902
D30: 0.0988 D15: 0.0330 D10: 0.0229

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Material Test Report

Report No: MAT:W320-0064-S2

Issue No: 1

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Client: Barr Engineering Company
325 South Lake Avenue
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Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	W320-0064-S2
Field Sample:	64-2
Date Sampled:	3/4/2020
Source:	SV-20-HA-15 5.5'-6'
Material:	(SM) Silty Sand with Gravel
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	14.3
Method		Method B

Comments

N/A

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Material Test Report

Report No: MAT:W320-0064-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0064-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	W320-0064-S3
Field Sample:	64-3
Date Sampled:	3/4/2020
Source:	SV-20-HA-15 8.5'-9'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

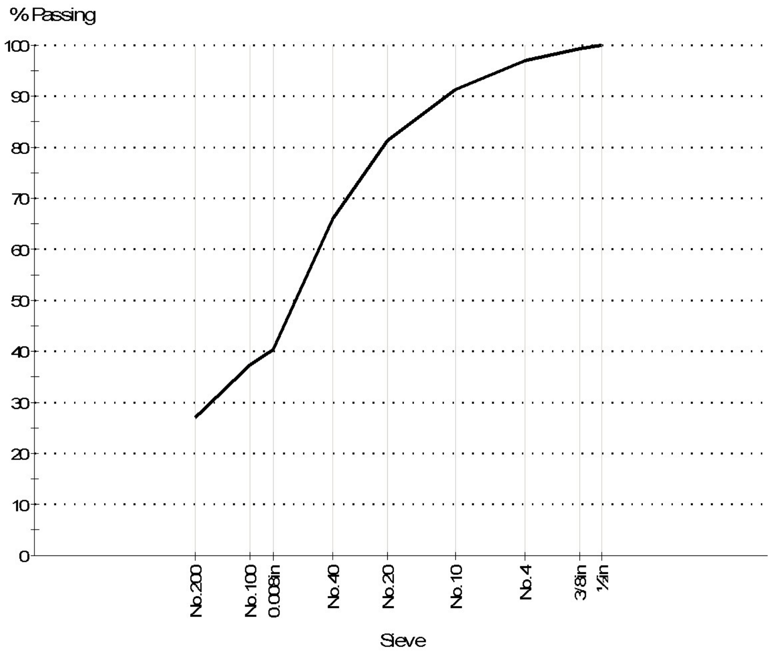
Sample Description:

(SM) Silty sand

Grading: ASTM D 422 - 07

Drying by: Oven

Particle Size Distribution



Sieve Size	% Passing
½in	100
3/8in	99
No.4	97
No.10	91
No.20	81
No.40	66
0.008in	40
No.100	37
No.200	27

FINES (27.1%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (38.8%)	Medium (25.3%)	Coarse (5.9%)	Fine (2.8%)	Coarse (0.0%)	(0.0%)

D85: 1.1742 D60: 0.3569 D50: 0.2659
D30: 0.0913 D15: 0.0326 D10: 0.0231

Twin Ports Testing

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Material Test Report

Report No: MAT:W320-0064-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0064-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID:	W320-0064-S3
Field Sample:	64-3
Date Sampled:	3/4/2020
Source:	SV-20-HA-15 8.5'-9'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	16.8
Method		Method B

Comments

N/A

Twin Ports Testing, Inc.
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Material Test Report

Report No: MAT:W320-0065-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0065-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: W320-0065-S1
Field Sample: 65-1
Date Sampled: 3/4/2020
Source: SV-20-HA-16 1.5'-2'
Material: (SC) Clayey Sand
Specification: Informational
Sampling Method: Hand Auger

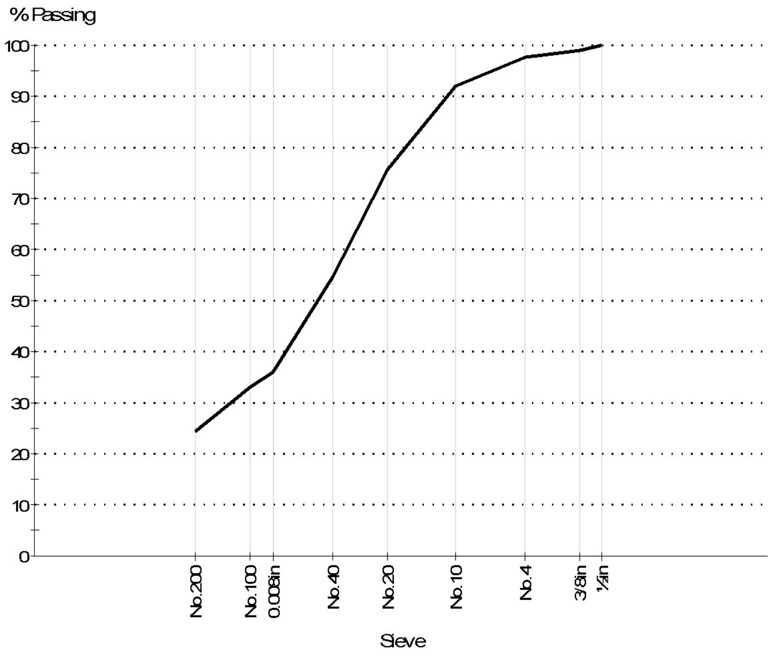
Atterberg Limit:

Liquid Limit: 27
Plastic Limit: 12
Plasticity Index: 15
Linear Shrinkage (%): N/A

Sample Description:

(SC) Clayey Sand

Particle Size Distribution



FINES (24.4%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (30.2%)	Medium (37.4%)	Coarse (5.6%)	Fine (2.5%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
½in	100
3/8in	99
No.4	98
No.10	92
No.20	76
No.40	55
0.008in	36
No.100	33
No.200	24

D85: 1.3871 D60: 0.5084 D50: 0.3539
D30: 0.1183 D15: 0.0352 D10: 0.0235

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Material Test Report

Report No: MAT:W320-0065-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0065-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID:	W320-0065-S1
Field Sample:	65-1
Date Sampled:	3/4/2020
Source:	SV-20-HA-16 1.5'-2'
Material:	(SC) Clayey Sand
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	20.1
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	27
Method		Method A
Plastic Limit		12
Plasticity Index		15
Sample history		Air-dried
Material retained on 425μm (No. 40) (%)		45.5

Comments

N/A

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Material Test Report

Report No: MAT:W320-0065-S2
Issue No: 1
This report replaces all previous issues of report no 'MAT:W320-0065-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)
Date of Issue: 3/15/2020
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Sample Details

Sample ID:	W320-0065-S2
Field Sample:	65-2
Date Sampled:	3/4/2020
Source:	SV-20-HA-16 4.5'-5'
Material:	(SC-SM) Silty, clayey sand
Specification:	Informational
Sampling Method:	Hand Auger

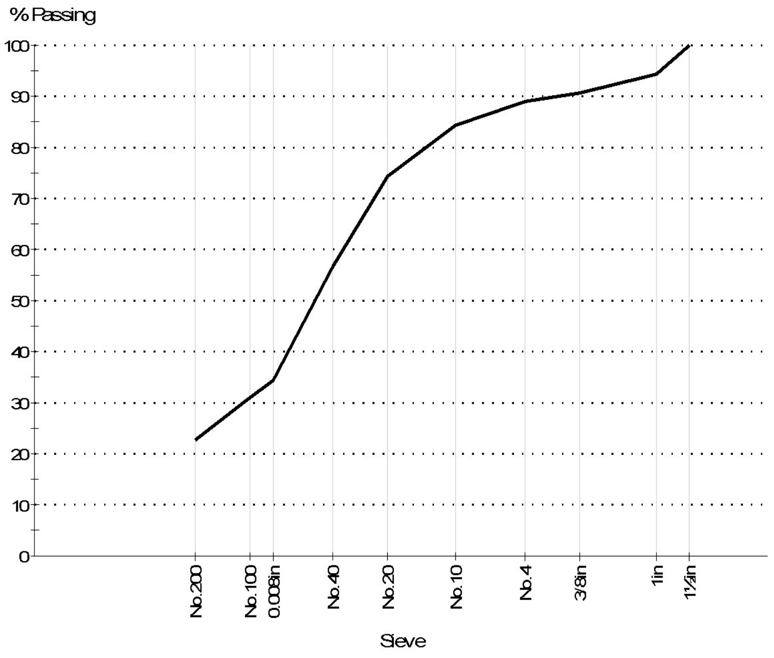
Atterberg Limit:

Liquid Limit:	18
Plastic Limit:	13
Plasticity Index:	5
Linear Shrinkage (%):	N/A

Sample Description:

(SC-SM) Silty, clayey sand

Particle Size Distribution



FINES (22.5%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (34.0%)	Medium (27.9%)	Coarse (4.5%)	Fine (3.9%)	Coarse (7.2%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
1½in	100
1in	94
3/8in	91
No.4	89
No.10	84
No.20	74
No.40	57
0.008in	34
No.100	31
No.200	23

D85: 2.2294 D60: 0.4866 D50: 0.3402
D30: 0.1369 D15: 0.0410 D10: 0.0274

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Material Test Report

Report No: MAT:W320-0065-S2

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0065-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID:	W320-0065-S2
Field Sample:	65-2
Date Sampled:	3/4/2020
Source:	SV-20-HA-16 4.5'-5'
Material:	(SC-SM) Silty, clayey sand
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	12.3
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	18
Method		Method A
Plastic Limit		13
Plasticity Index		5
Sample history		Oven-dried
Material retained on 425µm (No. 40) (%)		43.5

Comments

N/A

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Material Test Report

Report No: MAT:W320-0065-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0065-S3'.

Client:	Barr Engineering Company 325 South Lake Avenue Duluth MN 55802
Project:	19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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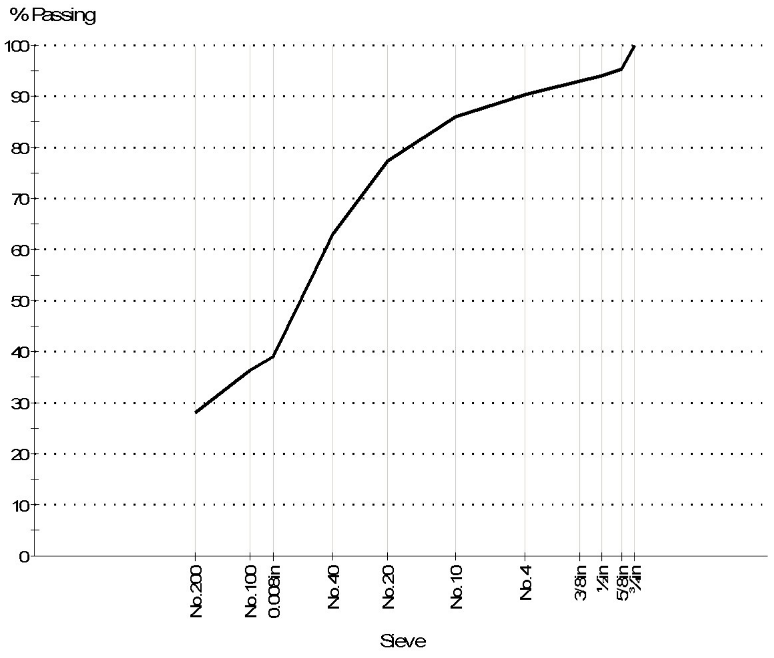
Sample Details

Sample ID:	W320-0065-S3
Field Sample:	65-3
Date Sampled:	3/4/2020
Source:	SV-20-HA-16 9'-9.5'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Sample Description:

(SM) Silty sand

Particle Size Distribution



<table>
<tr><td colspan="2">FINES (28.0%)</td><td colspan="3">SAND</td><td colspan="2">GRAVEL</td><td>COBBLES</td></tr>
<tr><td>Clay</td><td>Silt</td><td>Fine
(34.9%)</td><td>Medium
(23.0%)</td><td>Coarse
(4.4%)</td><td>Fine
(9.7%)</td><td>Coarse
(0.0%)</td><td>(0.0%)</td></tr>
</table>

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
¾in	100
5/8in	95
½in	94
3/8in	93
No.4	90
No.10	86
No.20	77
No.40	63
0.008in	39
No.100	36
No.200	28

D85: 1.8310 D60: 0.3879 D50: 0.2836
D30: 0.0889 D15: 0.0253 D10: 0.0166

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Material Test Report

Report No: MAT:W320-0065-S3

Issue No: 1

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Client: Barr Engineering Company
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Project: 19M8522 Enbridge L3R Spire Valley

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Date of Issue: 3/15/2020

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Sample Details

Sample ID:	W320-0065-S3
Field Sample:	65-3
Date Sampled:	3/4/2020
Source:	SV-20-HA-16 9'-9.5'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	11.8
Method		Method B

Comments

N/A

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Material Test Report

Report No: MAT:W320-0066-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0066-S1'.

Client:
Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/16/2020

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Sample Details

Sample ID:	W320-0066-S1
Field Sample:	66-1
Date Sampled:	3/5/2020
Source:	SV-20-HA-17 2.5'-3'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

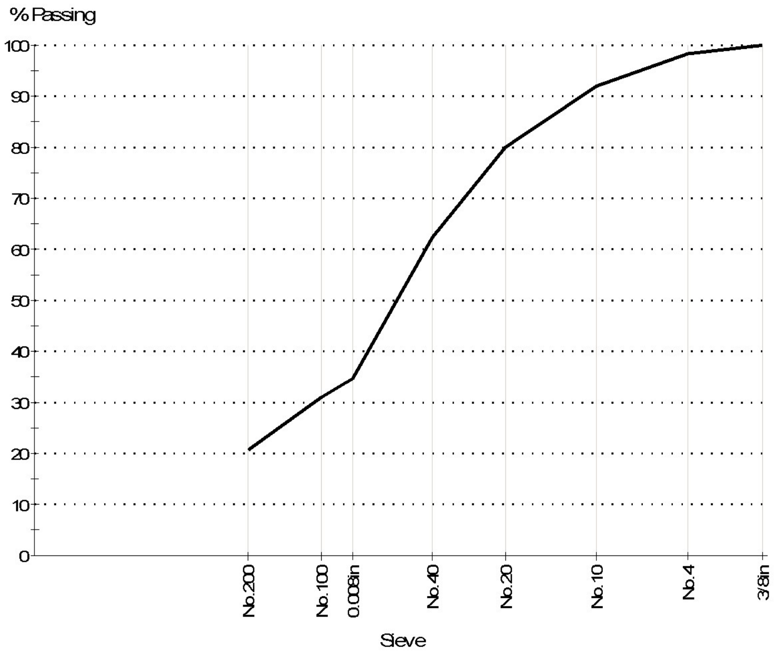
Atterberg Limit:

Liquid Limit:	21
Plastic Limit:	19
Plasticity Index:	2
Linear Shrinkage (%):	N/A

Sample Description:

(SM) Silty sand

Particle Size Distribution



<table>
<tr><th colspan="2">FINES (20.5%)</th><th colspan="3">SAND</th><th colspan="2">GRAVEL</th><th>COBBLES</th></tr>
<tr><td>Clay</td><td>Silt</td><td>Fine
(41.7%)</td><td>Medium
(29.9%)</td><td>Coarse
(6.2%)</td><td>Fine
(1.7%)</td><td>Coarse
(0.0%)</td><td>(0.0%)</td></tr>
</table>

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
3/8in	100
No.4	98
No.10	92
No.20	80
No.40	62
0.008in	35
No.100	31
No.200	21

D85: 1.2080 D60: 0.3998 D50: 0.3037
D30: 0.1410 D15: 0.0519 D10: 0.0372

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Material Test Report

Report No: MAT:W320-0066-S1

Issue No: 1

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Sample Details

Sample ID:	W320-0066-S1
Field Sample:	66-1
Date Sampled:	3/5/2020
Source:	SV-20-HA-17 2.5'-3'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	24.1
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	21
Method		Method A
Plastic Limit		19
Plasticity Index		2
Sample history		Oven-dried
Material retained on 425µm (No. 40) (%)		37.8

Comments

N/A

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Material Test Report

Report No: MAT:W320-0066-S2

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0066-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/16/2020

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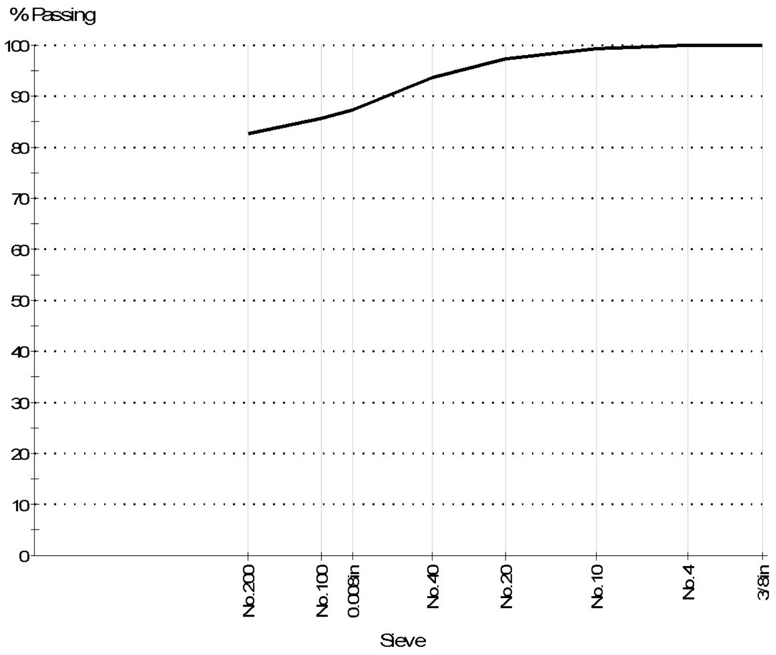
Sample Details

Sample ID:	W320-0066-S2
Field Sample:	66-2
Date Sampled:	3/5/2020
Source:	SV-20-HA-17 4'-4.5'
Material:	(PT) Peat
Specification:	Informational
Sampling Method:	Hand Auger

Sample Description:

(PT) Peat

Particle Size Distribution



FINES (82.6%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (11.0%)	Medium (5.8%)	Coarse (0.6%)	Fine (0.1%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
3/8in	100
No.4	100
No.10	99
No.20	97
No.40	94
0.008in	87
No.100	86
No.200	83

D85: 0.1294 D60: 0.0005 D50: 0.0001
D30: 0.0000 D15: 0.0000 D10: 0.0000

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Material Test Report

Report No: MAT:W320-0066-S2
Issue No: 1
This report replaces all previous issues of report no 'MAT:W320-0066-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/16/2020

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Sample Details

Sample ID: W320-0066-S2
Field Sample: 66-2
Date Sampled: 3/5/2020
Source: SV-20-HA-17 4'-4.5'
Material: (PT) Peat
Specification: Informational
Sampling Method: Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	111.3
Method		Method B

Comments

Organic content pet ASTM D2974 = 18.0%

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Material Test Report

Report No: MAT:W320-0066-S3
Issue No: 1
This report replaces all previous issues of report no 'MAT:W320-0066-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/17/2020

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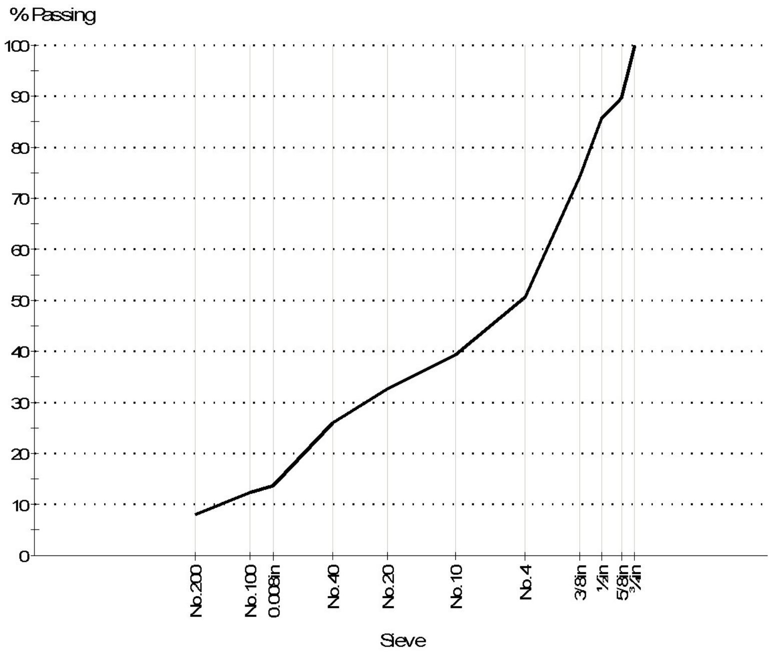
Sample Details

Sample ID:	W320-0066-S3
Field Sample:	66-3
Date Sampled:	3/5/2020
Source:	SV-20-HA-17 8'-8.5'
Material:	(SP-SM) Poorly Graded Sand with Silt and Gravel
Specification:	Informational
Sampling Method:	Hand Auger

Sample Description:

(SP-SM) Poorly Graded Sand with Silt and Gravel

Particle Size Distribution



FINES (7.8%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (18.0%)	Medium (13.6%)	Coarse (11.4%)	Fine (49.2%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
¾in	100
5/8in	90
½in	86
3/8in	74
No.4	51
No.10	39
No.20	33
No.40	26
0.008in	14
No.100	12
No.200	7.8

D85: 12.3489 D60: 6.2381 D50: 4.4669
D30: 0.6511 D15: 0.2153 D10: 0.1051
Cu: 59.34 Cc: 0.65

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Material Test Report

Report No: MAT:W320-0066-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0066-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/17/2020

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Sample Details

Sample ID: W320-0066-S3
Field Sample: 66-3
Date Sampled: 3/5/2020
Source: SV-20-HA-17 8'-8.5'
Material: (SP-SM) Poorly Graded Sand with Silt and Gravel
Specification: Informational
Sampling Method: Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	9.9
Method		Method B

Comments

N/A

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Material Test Report

Report No: MAT:W320-0067-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0067-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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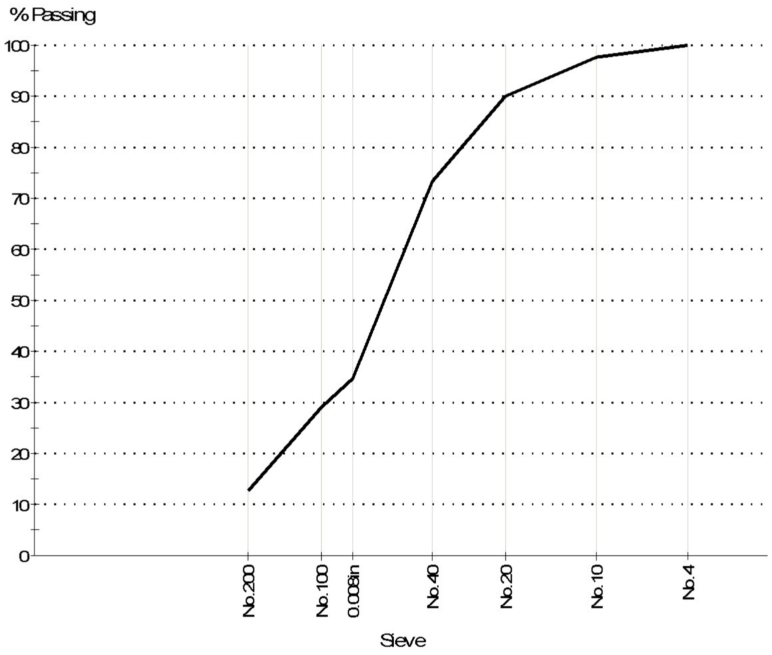
Sample Details

Sample ID:	W320-0067-S1
Field Sample:	67-1
Date Sampled:	3/5/2020
Source:	SV-20-HA-18 1.5'-2'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Sample Description:

(SM) Silty sand

Particle Size Distribution



FINES (12.8%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (60.6%)	Medium (24.2%)	Coarse (2.4%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
No.4	100
No.10	98
No.20	90
No.40	73
0.008in	35
No.100	29
No.200	13

D85: 0.6904 D60: 0.3279 D50: 0.2701
D30: 0.1572 D15: 0.0824 D10: 0.0666

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Material Test Report

Report No: MAT:W320-0067-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0067-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID:	W320-0067-S1
Field Sample:	67-1
Date Sampled:	3/5/2020
Source:	SV-20-HA-18 1.5'-2'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	32.2
Method		Method B

Comments

N/A

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Material Test Report

Report No: MAT:W320-0067-S2

Issue No: 1

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Client: Barr Engineering Company
325 South Lake Avenue
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Project: 19M8522 Enbridge L3R Spire Valley

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Date of Issue: 3/15/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	W320-0067-S2
Field Sample:	67-2
Date Sampled:	3/5/2020
Source:	SV-20-HA-18 5'-5.5'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

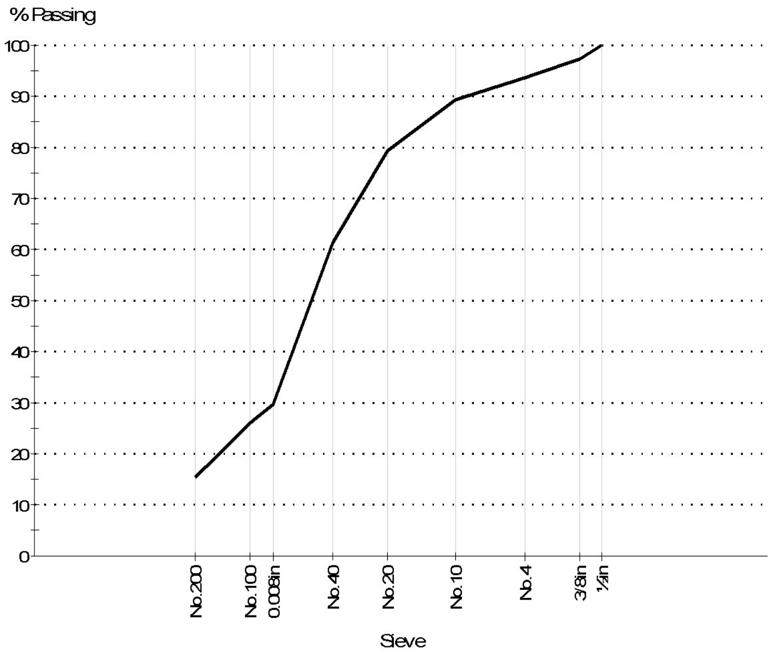
Sample Description:

(SM) Silty sand

Grading: ASTM D 422 - 07

Drying by: Oven

Particle Size Distribution



Sieve Size	% Passing
½in	100
3/8in	97
No.4	94
No.10	89
No.20	79
No.40	61
0.008in	30
No.100	26
No.200	15

FINES (15.2%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (46.0%)	Medium (27.9%)	Coarse (4.6%)	Fine (6.2%)	Coarse (0.0%)	(0.0%)

D85: 1.3876 D60: 0.4122 D50: 0.3248
D30: 0.2017 D15: 0.0739 D10: 0.0536

Twin Ports Testing

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Material Test Report

Report No: MAT:W320-0067-S2
Issue No: 1
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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID: W320-0067-S2
Field Sample: 67-2
Date Sampled: 3/5/2020
Source: SV-20-HA-18 5'-5.5'
Material: (SM) Silty sand
Specification: Informational
Sampling Method: Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	23.8
Method		Method B

Comments

N/A

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Material Test Report

Report No: MAT:W320-0067-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0067-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

This laboratory is accredited in accordance with AASHTO.

Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID:	W320-0067-S3
Field Sample:	67-3
Date Sampled:	3/5/2020
Source:	SV-20-HA-18 7'-7.5'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

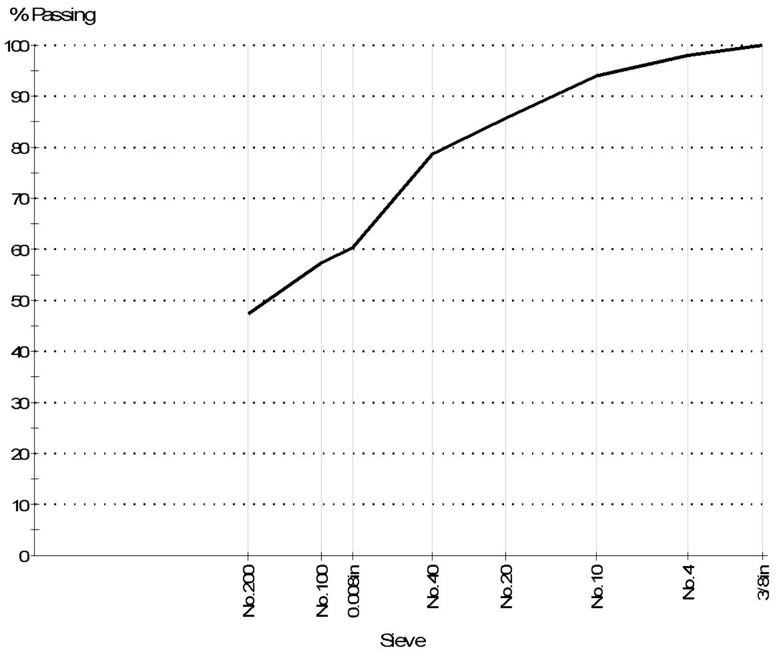
Atterberg Limit:

Liquid Limit:	42
Plastic Limit:	40
Plasticity Index:	2
Linear Shrinkage (%):	N/A

Sample Description:

(SM) Silty sand

Particle Size Distribution



FINES (47.2%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (31.5%)	Medium (15.3%)	Coarse (4.1%)	Fine (1.9%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
3/8in	100
No.4	98
No.10	94
No.20	86
No.40	79
0.008in	60
No.100	57
No.200	47

D85: 0.7944 D60: 0.1922 D50: 0.0909
D30: 0.0225 D15: 0.0079 D10: 0.0056

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Material Test Report

Report No: MAT:W320-0067-S3

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0067-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

This laboratory is accredited in accordance with AASHTO.

Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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Sample Details

Sample ID: W320-0067-S3
Field Sample: 67-3
Date Sampled: 3/5/2020
Source: SV-20-HA-18 7'-7.5'
Material: (SM) Silty sand
Specification: Informational
Sampling Method: Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	67.5
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	42
Method		Method A
Plastic Limit		40
Plasticity Index		2
Sample history		Air-dried
Material retained on 425µm (No. 40) (%)		0.0

Comments

Significant organics observed in sample.

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Material Test Report

Report No: MAT:W320-0067-S4

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0067-S4'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

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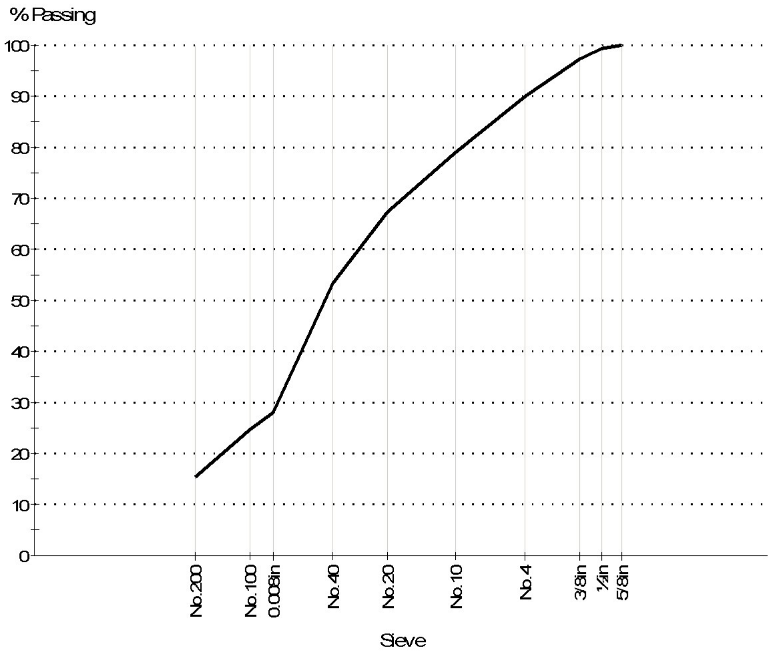
Sample Details

Sample ID:	W320-0067-S4
Field Sample:	67-4
Date Sampled:	3/5/2020
Source:	SV-20-HA-18 9.5'-10'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Sample Description:

(SM) Silty sand

Particle Size Distribution



FINES (15.5%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (37.9%)	Medium (25.7%)	Coarse (10.8%)	Fine (10.1%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
5/8in	100
½in	99
3/8in	97
No.4	90
No.10	79
No.20	67
No.40	53
0.008in	28
No.100	25
No.200	15

D85: 3.2103 D60: 0.5893 D50: 0.3849
D30: 0.2132 D15: 0.0722 D10: 0.0493

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Material Test Report

Report No: MAT:W320-0067-S4
Issue No: 1
This report replaces all previous issues of report no 'MAT:W320-0067-S4'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/15/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: W320-0067-S4
Field Sample: 67-4
Date Sampled: 3/5/2020
Source: SV-20-HA-18 9.5'-10'
Material: (SM) Silty sand
Specification: Informational
Sampling Method: Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	16.3
Method		Method B

Comments

N/A

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Material Test Report

Report No: MAT:W320-0068-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0068-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

This laboratory is accredited in accordance with AASHTO.

Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/16/2020

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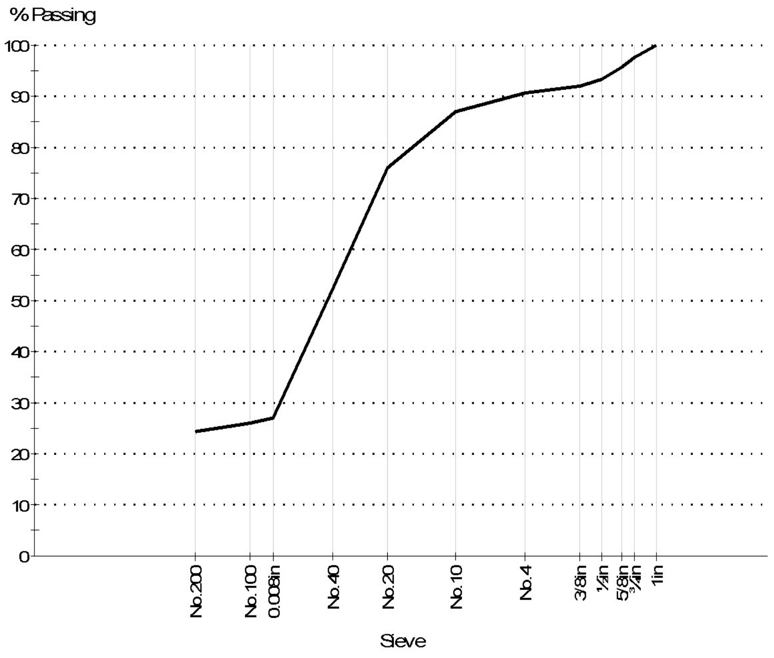
Sample Details

Sample ID:	W320-0068-S1
Field Sample:	68-1
Date Sampled:	3/5/2020
Source:	SV-20-HA-19 2.5'-3'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Sample Description:

(SM) Silty sand

Particle Size Distribution



FINES (24.4%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (27.8%)	Medium (34.7%)	Coarse (3.9%)	Fine (6.9%)	Coarse (2.4%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
1in	100
¾in	98
5/8in	96
½in	93
3/8in	92
No.4	91
No.10	87
No.20	76
No.40	52
0.008in	27
No.100	26
No.200	24

D85: 1.7233 D60: 0.5326 D50: 0.3978
D30: 0.2193 D15: 0.0010 D10: 0.0001

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Material Test Report

Report No: MAT:W320-0068-S1

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0068-S1'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/16/2020

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Sample Details

Sample ID:	W320-0068-S1
Field Sample:	68-1
Date Sampled:	3/5/2020
Source:	SV-20-HA-19 2.5'-3'
Material:	(SM) Silty sand
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	30.0
Method		Method B

Comments

N/A

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Material Test Report

Report No: MAT:W320-0068-S2

Issue No: 1

This report replaces all previous issues of report no 'MAT:W320-0068-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/16/2020

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Sample Details

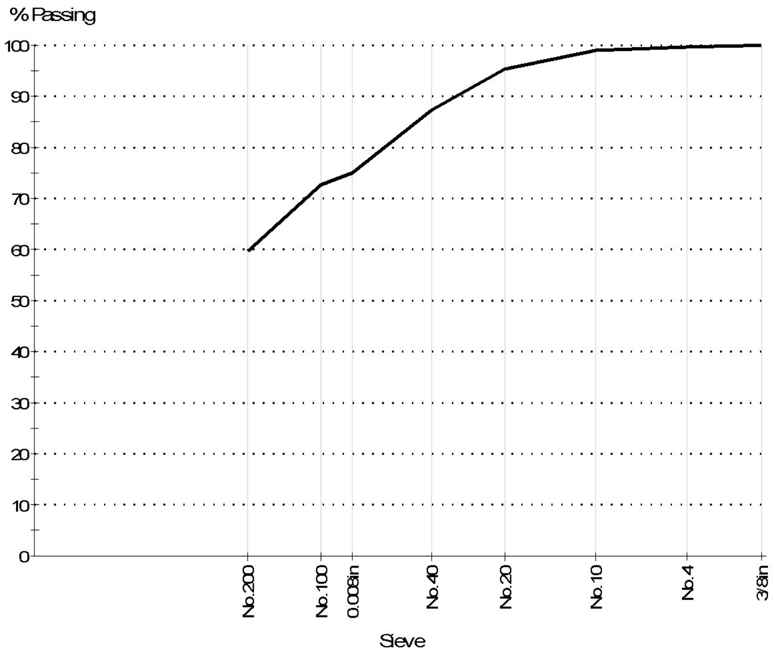
Sample ID:	W320-0068-S2
Field Sample:	68-2
Date Sampled:	3/5/2020
Source:	SV-20-HA-19 6'-6.5'
Material:	
Specification:	Informational
Sampling Method:	Hand Auger

Atterberg Limit:

Liquid Limit:	49
Plastic Limit:	NP
Plasticity Index:	NP
Linear Shrinkage (%):	N/A

Sample Description:

Particle Size Distribution



FINES (59.7%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (27.6%)	Medium (11.6%)	Coarse (0.8%)	Fine (0.4%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
3/8in	100
No.4	100
No.10	99
No.20	95
No.40	87
0.008in	75
No.100	73
No.200	60

D85: 0.3700 D60: 0.0764 D50: 0.0447
D30: 0.0153 D15: 0.0069 D10: 0.0052

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Material Test Report

Report No: MAT:W320-0068-S2
Issue No: 1
This report replaces all previous issues of report no 'MAT:W320-0068-S2'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Approved Signatory: Joe Berger (Laboratory Supervisor)
Date of Issue: 3/16/2020
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Sample Details

Sample ID: W320-0068-S2
Field Sample: 68-2
Date Sampled: 3/5/2020
Source: SV-20-HA-19 6'-6.5'
Material:
Specification: Informational
Sampling Method: Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	89.0
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	49
Method		Method A
Plastic Limit		NP
Plasticity Index		NP
Sample history		Air-dried
Material retained on 425µm (No. 40) (%)		12.7

Comments

Results of ASTM D4316 inconclusive, significant amount of fine particle organics observed in sample.

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Material Test Report

Report No: MAT:W320-0068-S3
Issue No: 1
This report replaces all previous issues of report no 'MAT:W320-0068-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/16/2020

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

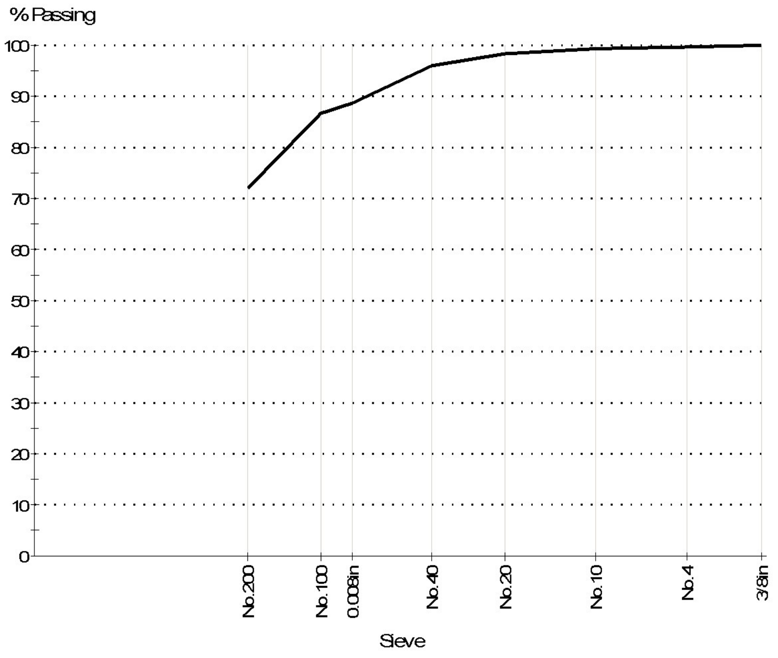
Sample ID:	W320-0068-S3
Field Sample:	68-3
Date Sampled:	3/5/2020
Source:	SV-20-HA-19 8'-8.5'
Material:	
Specification:	Informational
Sampling Method:	Hand Auger

Atterberg Limit:

Liquid Limit:	50
Plastic Limit:	NP
Plasticity Index:	NP
Linear Shrinkage (%):	N/A

Sample Description:

Particle Size Distribution



FINES (72.1%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (24.0%)	Medium (3.3%)	Coarse (0.2%)	Fine (0.4%)	Coarse (0.0%)	(0.0%)

Grading: ASTM D 422 - 07

Drying by: Oven

Sieve Size	% Passing
3/8in	100
No.4	100
No.10	99
No.20	98
No.40	96
0.008in	89
No.100	87
No.200	72

D85: 0.1380 D60: 0.0424 D50: 0.0264
D30: 0.0103 D15: 0.0051 D10: 0.0040

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Material Test Report

Report No: MAT:W320-0068-S3
Issue No: 1
This report replaces all previous issues of report no 'MAT:W320-0068-S3'.

Client: Barr Engineering Company
325 South Lake Avenue
Duluth MN 55802

Project: 19M8522 Enbridge L3R Spire Valley

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Joe Berger

Approved Signatory: Joe Berger (Laboratory Supervisor)

Date of Issue: 3/16/2020

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Sample Details

Sample ID:	W320-0068-S3
Field Sample:	68-3
Date Sampled:	3/5/2020
Source:	SV-20-HA-19 8'-8.5'
Material:	
Specification:	Informational
Sampling Method:	Hand Auger

Other Test Results

Description	Method	Result
Moisture content (%)	ASTM D 2216 - 05	87.0
Method		Method B
Dispersion device	ASTM D 422 - 07	N/A
Dispersion time (min)		N/A
Shape		N/A
Hardness		N/A
Liquid Limit	ASTM D 4318 - 05	50
Method		Method A
Plastic Limit		NP
Plasticity Index		NP
Sample history		Oven-dried
Material retained on 425µm (No. 40) (%)		3.9

Comments

Results of ASTM D4316 inconclusive, significant amount of fine particle organics observed in sample.

Appendix C

Historic Soil Boring Logs

O:\GINT\PROJECTS\49161244 SANDPIPER MAINLINE GEOTECH\SANDPIPER MAINLINE GEOTECH.GPJ BARRLIBRARY.GLB HORIZONTAL LOG REPORT BARR GEOTECH TEMPLATE.GDT

BARR

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING MP 504-East

Sheet 1 of 1

Project: Sandpiper Mainline Geotech Survey
Location: Sandpiper Mainline
Client: North Dakota Pipeline Co., LLC

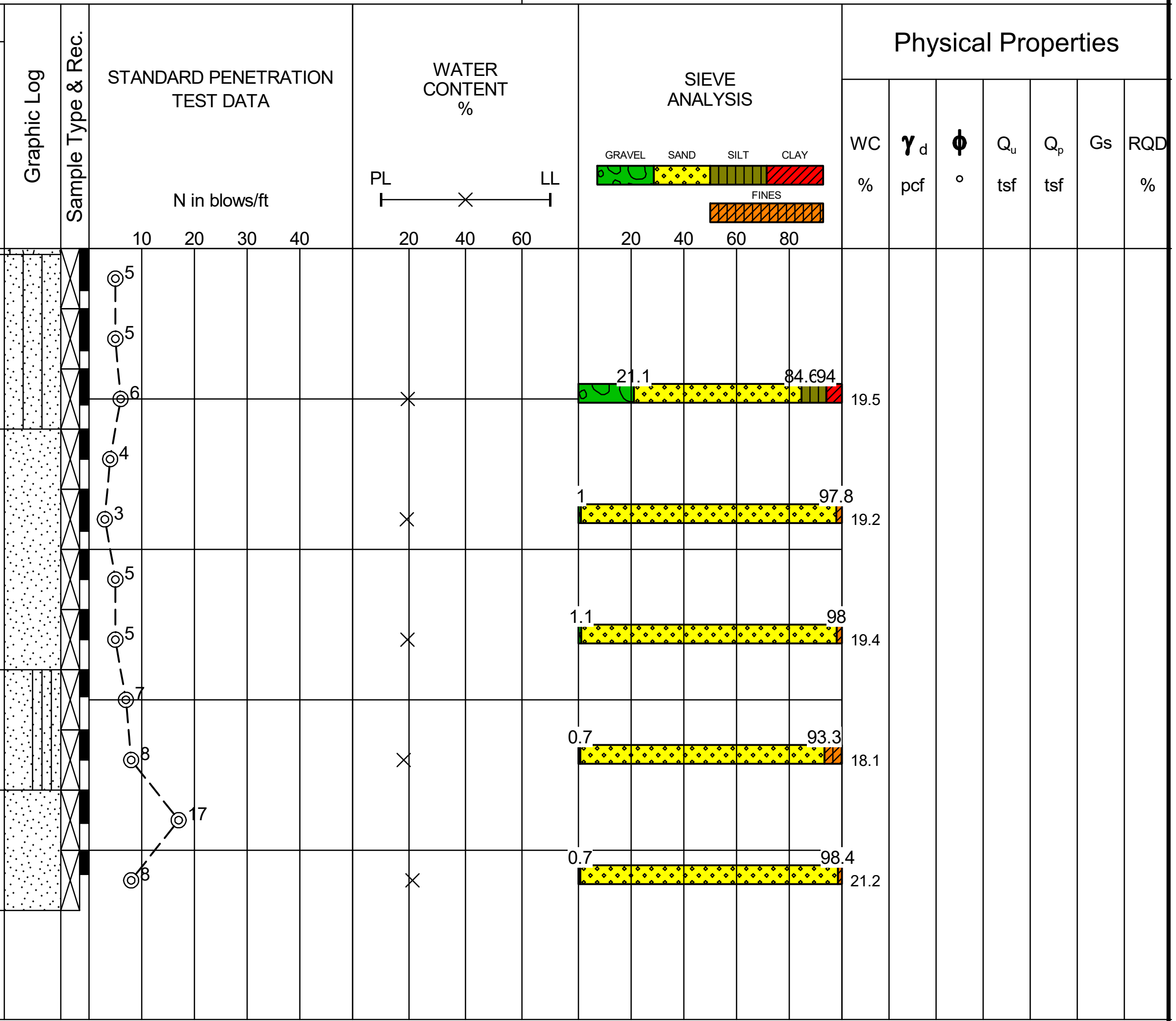
Barr Project Number: 49/16-1244

MATERIAL DESCRIPTION (ASTM D2488)

Surface Elev.: 1280.0 ft

Elevation, feet	Depth, feet	Material Description	Depth
1279.8	0	Silty topsoil with roots.	0.2
1274.0		SILTY SAND WITH GRAVEL (SM): fine to medium grained; light brown; moist; loose. 6-inch layer of dark brown, silty sand, trace clay.	6.0
1266.0		POORLY GRADED SAND (SP): fine to medium grained; light brown to brown; moist; loose; trace gravel. Possible fill to 14 feet.	14.0
1262.0		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; wet; loose.	18.0
1258.0		POORLY GRADED SAND (SP): fine to medium grained; brown; wet; loose; trace clay. 2-inch thick silt layer at 19 feet.	22.0
		Bottom of Boring at 22.0 feet	22.0

Elevation, feet	Depth, feet
	0
1275	5
1270	10
1265	15
1260	20
	25



Completion Depth:	22.0
Date Boring Started:	11/21/14
Date Boring Completed:	11/21/14
Logged By:	IGM/RWO
Drilling Contractor:	Coleman
Drilling Method:	HSA
Ground Surface Elevation:	1280.0
Coordinates:	N 459,698.8 ft E 2,414,377.5 ft
Datum:	MN State Plane North NAD83; NAVD88

Remarks: 4-1/4 inch HSA from 0 to 12 feet. Mud rotary from 12 to 20 feet. Borehole was backfilled with neat cement grout from 0.5 to 22 feet and native soil from 0 to 0.5 feet.

SAMPLE TYPES

☒ SPLIT SPOON

WATER LEVELS (ft)

▼ At Time of Drilling 7.7

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

BARR

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING MP 504-West

Sheet 1 of 4

Project: Sandpiper Mainline Geotech Survey

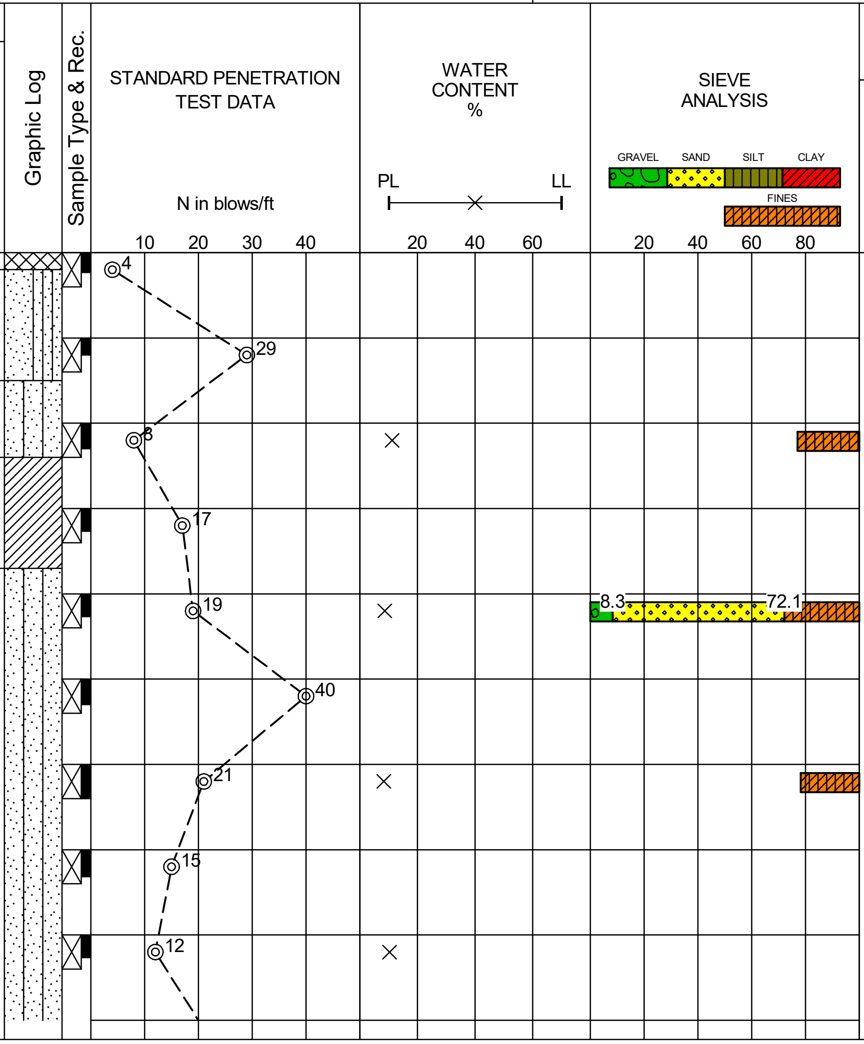
Location: Sandpiper Mainline

Client: North Dakota Pipeline Co., LLC

Barr Project Number: 49/16-1244

Surface Elev.: 1341.1 ft

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)
1340.1	1.0	SILTY SAND: dark brown; with gravel, trace organics.
1333.6	7.5	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; loose to medium dense. Cobbles encountered from 2.5 to 4 feet.
1329.1	12.0	SILTY SAND (SM): medium grained; brown; moist; loose to medium dense; trace clay and gravel.
1322.6	18.5	SANDY LEAN CLAY (CL): brown; moist; very stiff.
		SILTY SAND (SM): fine to medium with trace coarse grained; brown; moist to wet; medium dense to dense; little gravel.



Physical Properties

	WC %	γd pcf	φ °	Qu tsf	Qp tsf	Gs	RQD %
10	11.2						
15					0.75		
20	8.7						
30	8.3	120.5					
40	10.3	134.4					

Continued Next Page

Completion Depth:	162.0
Date Boring Started:	10/28/14
Date Boring Completed:	10/30/14
Logged By:	BJL2
Drilling Contractor:	Coleman
Drilling Method:	HSA
Ground Surface Elevation:	1341.1
Coordinates:	N 459,853.1 ft E 2,413,542.3 ft
Datum:	MN State Plane North NAD83; NAVD88

Remarks: 4-1/4 inch HSA 0 to 40 feet. Mud rotary with 3-7/8 inch tricone from 40 to 160 feet. Borehole was backfilled with neat cement grout and bentonite slurry.

SAMPLE TYPES

☒ SPLIT SPOON

WATER LEVELS (ft)

▼ At Time of Drilling 37.9
▼ 2.5 hrs At Time of Drilling 33.3

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING MP 504-West

Sheet 2 of 4

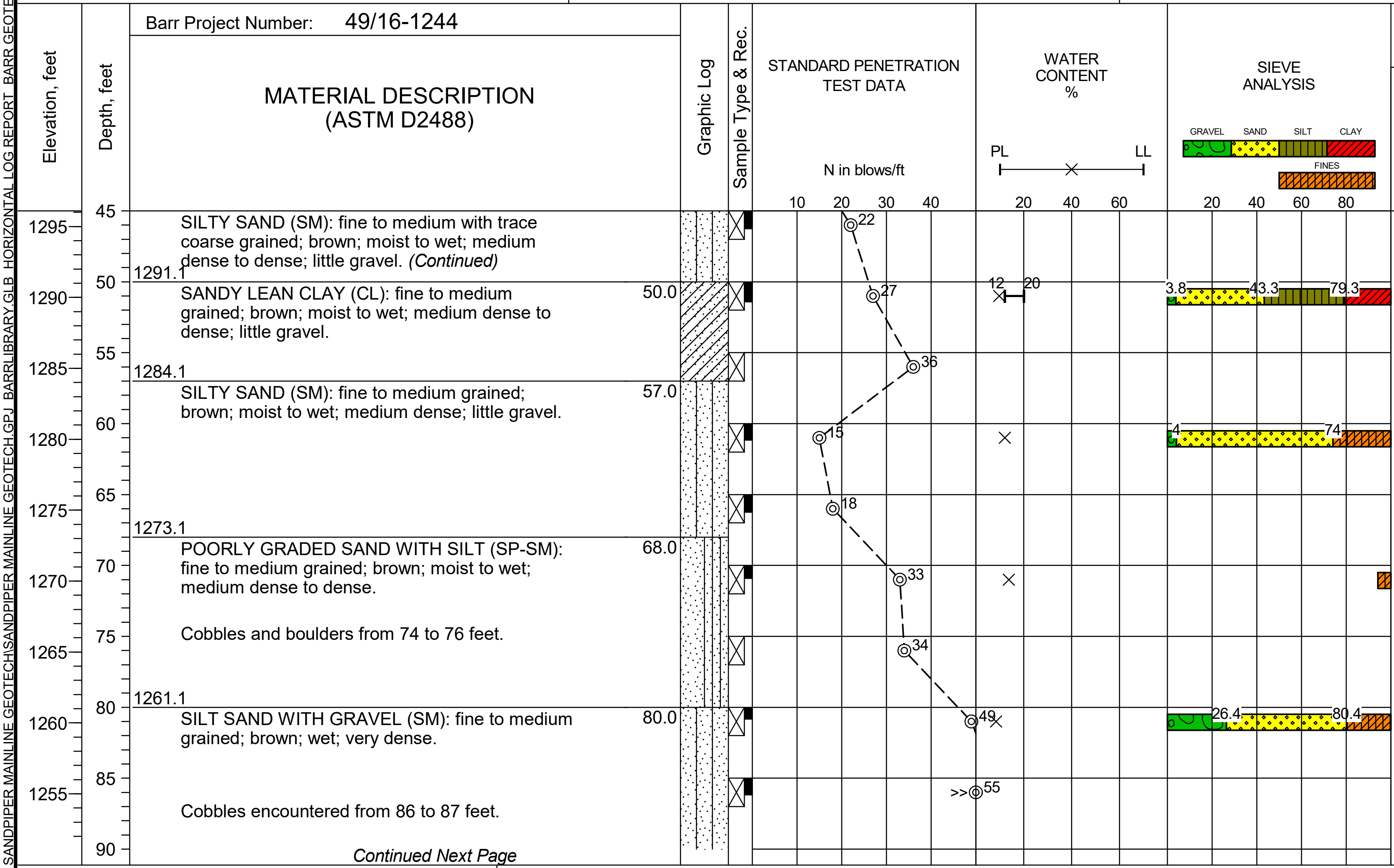
Project: Sandpiper Mainline Geotech Survey
Location: Sandpiper Mainline
Client: North Dakota Pipeline Co., LLC

Barr Project Number: 49/16-1244

MATERIAL DESCRIPTION (ASTM D2488)

Elevation, feet	Depth, feet	Material Description	
	45	SILTY SAND (SM): fine to medium with trace coarse grained; brown; moist to wet; medium dense to dense; little gravel. *(Continued)*	
1291.1	50.0	SANDY LEAN CLAY (CL): fine to medium grained; brown; moist to wet; medium dense to dense; little gravel.	50.0
1284.1	57.0	SILTY SAND (SM): fine to medium grained; brown; moist to wet; medium dense; little gravel.	57.0
1273.1	68.0	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist to wet; medium dense to dense. Cobbles and boulders from 74 to 76 feet.	68.0
1261.1	80.0	SILT SAND WITH GRAVEL (SM): fine to medium grained; brown; wet; very dense. Cobbles encountered from 86 to 87 feet.	80.0

Continued Next Page



Physical Properties

Depth, feet	WC %	γd pcf	ϕ °	Qu tsf	Qp tsf	Gs	RQD %
50	9.8				4.5		
60	12.1						
70	13.8						
80	8.4						

Completion Depth:	162.0
Date Boring Started:	10/28/14
Date Boring Completed:	10/30/14
Logged By:	BJL2
Drilling Contractor:	Coleman
Drilling Method:	HSA
Ground Surface Elevation:	1341.1
Coordinates:	N 459,853.1 ft E 2,413,542.3 ft
Datum:	MN State Plane North NAD83; NAVD88

Remarks: 4-1/4 inch HSA 0 to 40 feet. Mud rotary with 3-7/8 inch tricone from 40 to 160 feet. Borehole was backfilled with neat cement grout and bentonite slurry.

SAMPLE TYPES

☒ SPLIT SPOON

WATER LEVELS (ft)

At Time of Drilling	37.9
2.5 hrs At Time of Drilling	33.3

LEGEND

MC	Moisture Content	Qu	Unconfined Compression
γ	Dry Unit Weight	Qp	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

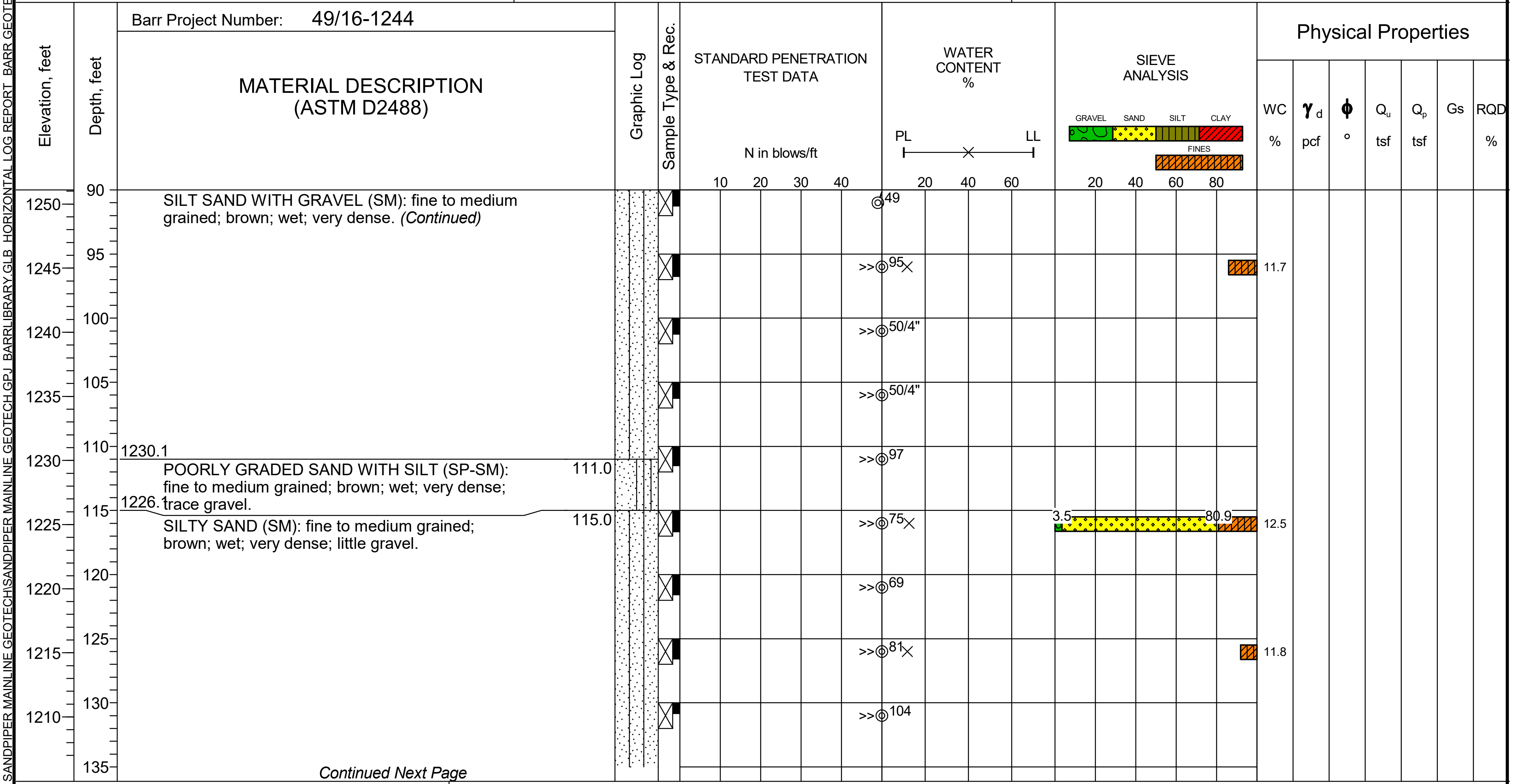
Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING MP 504-West

Sheet 3 of 4

Project: Sandpiper Mainline Geotech Survey
Location: Sandpiper Mainline
Client: North Dakota Pipeline Co., LLC

Barr Project Number: 49/16-1244



SILT SAND WITH GRAVEL (SM): fine to medium grained; brown; wet; very dense. *(Continued)*

1230.1 — 111.0
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; wet; very dense; trace gravel.

1226.1 — 115.0
SILTY SAND (SM): fine to medium grained; brown; wet; very dense; little gravel.

Continued Next Page

Completion Depth:	162.0
Date Boring Started:	10/28/14
Date Boring Completed:	10/30/14
Logged By:	BJL2
Drilling Contractor:	Coleman
Drilling Method:	HSA
Ground Surface Elevation:	1341.1
Coordinates:	N 459,853.1 ft E 2,413,542.3 ft
Datum:	MN State Plane North NAD83; NAVD88

Remarks: 4-1/4 inch HSA 0 to 40 feet. Mud rotary with 3-7/8 inch tricone from 40 to 160 feet. Borehole was backfilled with neat cement grout and bentonite slurry.

SAMPLE TYPES

☒ SPLIT SPOON

WATER LEVELS (ft)

▽ At Time of Drilling 37.9
▽ 2.5 hrs At Time of Drilling 33.3

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING MP 504-West

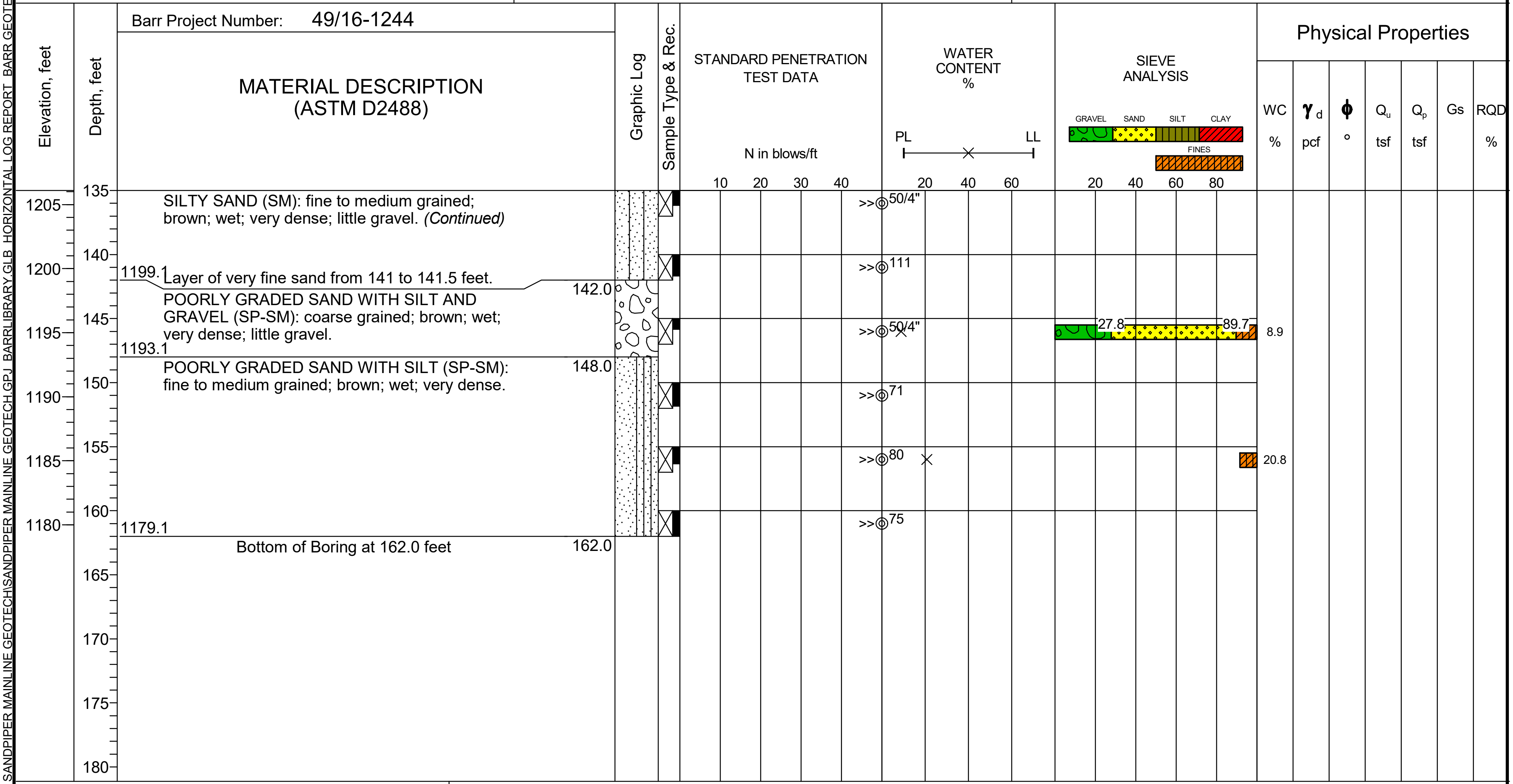
Sheet 4 of 4

Project:	Sandpiper Mainline Geotech Survey	Location:	Sandpiper Mainline	Client:	North Dakota Pipeline Co., LLC

Barr Project Number: 49/16-1244

MATERIAL DESCRIPTION (ASTM D2488)

Elevation, feet	Depth, feet	Material Description	Bottom depth
	135	SILTY SAND (SM): fine to medium grained; brown; wet; very dense; little gravel. *(Continued)*	
1199.1		Layer of very fine sand from 141 to 141.5 feet.	142.0
		POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM): coarse grained; brown; wet; very dense; little gravel.	
1193.1		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; wet; very dense.	148.0
1179.1		Bottom of Boring at 162.0 feet	162.0



Completion Depth:	162.0
Date Boring Started:	10/28/14
Date Boring Completed:	10/30/14
Logged By:	BJL2
Drilling Contractor:	Coleman
Drilling Method:	HSA
Ground Surface Elevation:	1341.1
Coordinates:	N 459,853.1 ft E 2,413,542.3 ft
Datum:	MN State Plane North NAD83; NAVD88

Remarks: 4-1/4 inch HSA 0 to 40 feet. Mud rotary with 3-7/8 inch tricone from 40 to 160 feet. Borehole was backfilled with neat cement grout and bentonite slurry.

SAMPLE TYPES

☒ SPLIT SPOON

WATER LEVELS (ft)

At Time of Drilling 37.9

2.5 hrs At Time of Dr83.3ng

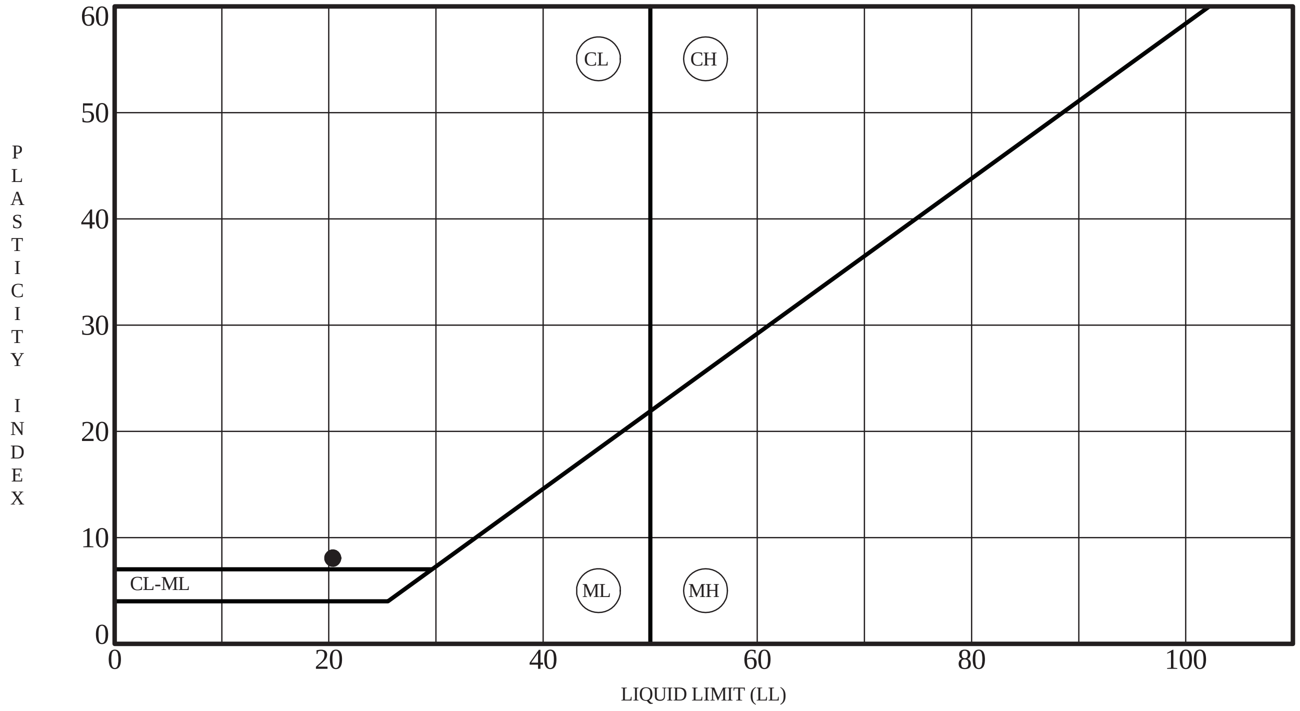
LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

Appendix D

Historic Laboratory Results



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**MP 504W**	**50.0**	**20**	**12**	**8**	**56.7**	**Sandy Lean Clay, a little gravel (CL)**

PROJECT **Sandpiper Mainline Phase III; Barr Project No. 49/16-1244; North Dakota, Minnesota, Wisconsin**

JOB NO. **01-05986/07-05937**

DATE

AMERICAN
ENGINEERING
TESTING, INC.

ATTERBERG LIMITS' RESULTS

Summary of Laboratory Chemical Analysis

SANDPIPER MAINLINE PHASE III
BARR PROJECT NO. 49/16-1244
ND, MN, WI

BARR ENGINEERING
ATTN: ROB OLAH

AET FIELDWORK NO: 01-5986
AET LABORATOY NO: 07-05937

DECEMBER 19, 2014

The following test results for pH, sulfate, and chloride were provided to AET by ERA Laboratory for the requested soil samples. The ERA Laboratory report has been attached for your reference.

Boring Number	Depth (ft)	pH	Sulfate (mg/Kg)	Chloride (mg/Kg)
MP 504W	95-97	7.4	76	<3

Era Laboratories, Inc.
4730 Oneota Street Duluth MN 55807 Telephone: (218)727-6380 Fax: (218)727-3049

Laboratory Report

Project Number: 083046
COC Number: 083046
Date Received: 11/24/2014
Report Date: 12/5/2014
ReportNumber: 129386

Client: JONATHAN GABRIEL
AMERICAN ENGINEERING TESTING, INC
P O BOX 16008
DULUTH MN 55816

Sample ID: 07-05937 PHASE III 504 WEST 95-97' Grab **Sample Date:** 10/29/2014 **SampleTime:** 13:00 **Matrix:** Solids

Era Project Number: 083046-1

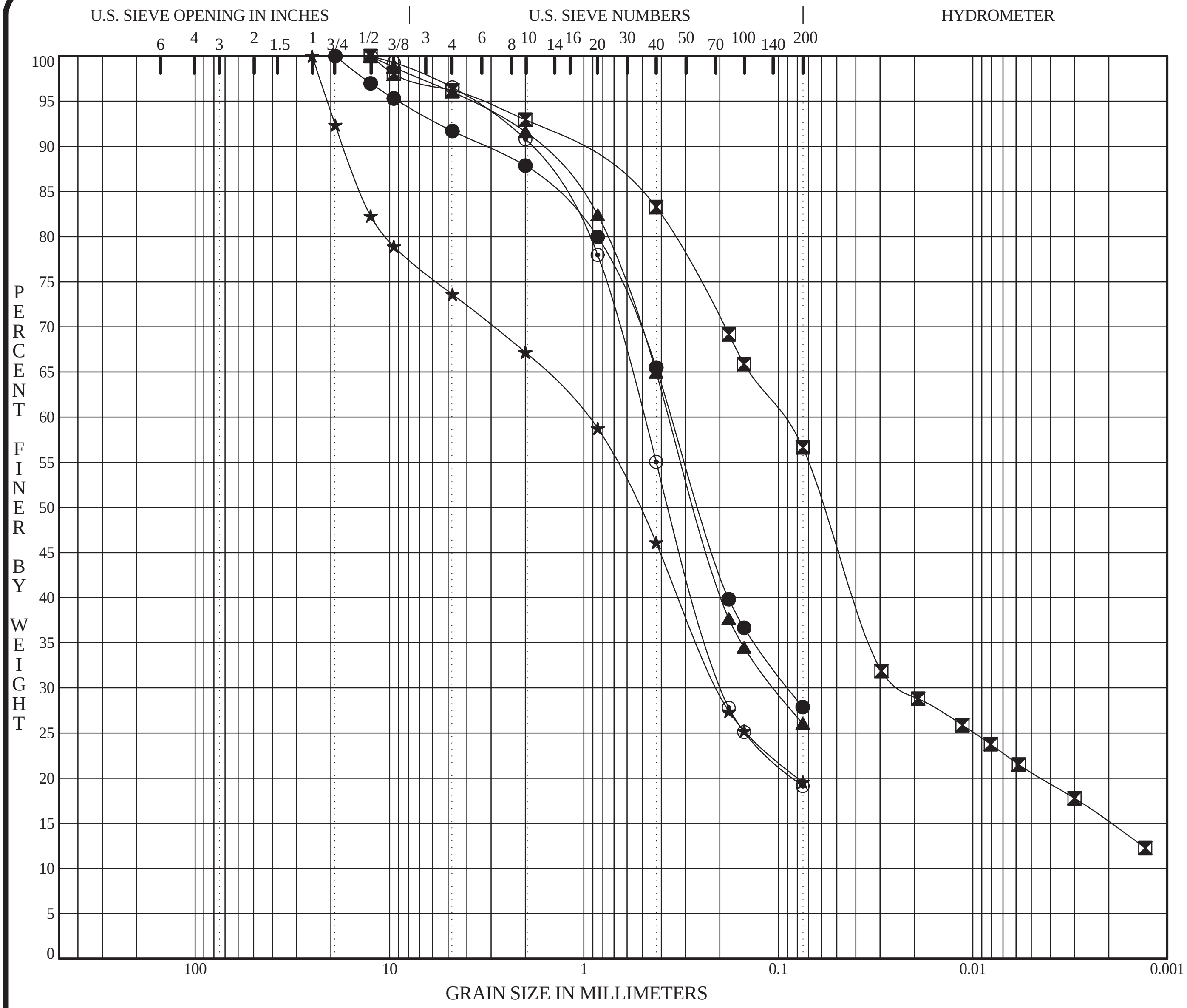
Parameter:		Results:	Units:	Analysis Date/Time:		Method:	DF:	LOD:	LOQ:	QC Comments:
Chloride	<	3	mg/Kg DWB	12/3/2014	0:57	EPA 300.0 Rev. 2.1	10	3	7	HA
pH - Lab		7.4	SU	11/26/2014	14:03	EPA 9045D	1			
Sulfate		76	mg/Kg DWB	12/3/2014	0:57	EPA 300.0 Rev 2.1	10	5	20	HA

DWB = Dry weight basis.

<	Not detected. Less than LOD.
HA	Analyzed out of holding time.

Report Approved By:
For Robert D. Magnuson
Lab Director
MN Certification # 027-137-152

Temperature upon arrival (°C): 17.0



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**MP 504W**	**20.0**	**Silty Sand, a little gravel (SM)**	**9**					
⧗	**MP 504W**	**50.0**	**Sandy Lean Clay, a little gravel (CL)**	**10**	**20**	**12**	**8**		
▲	**MP 504W**	**60.0**	**Silty Sand, a little gravel (SM)**	**12**					
★	**MP 504W**	**80.0**	**Silty Sand with Gravel (SM)**	**8**					
⊙	**MP 504W**	**115.0**	**Silty Sand, a little gravel (SM)**	**13**					

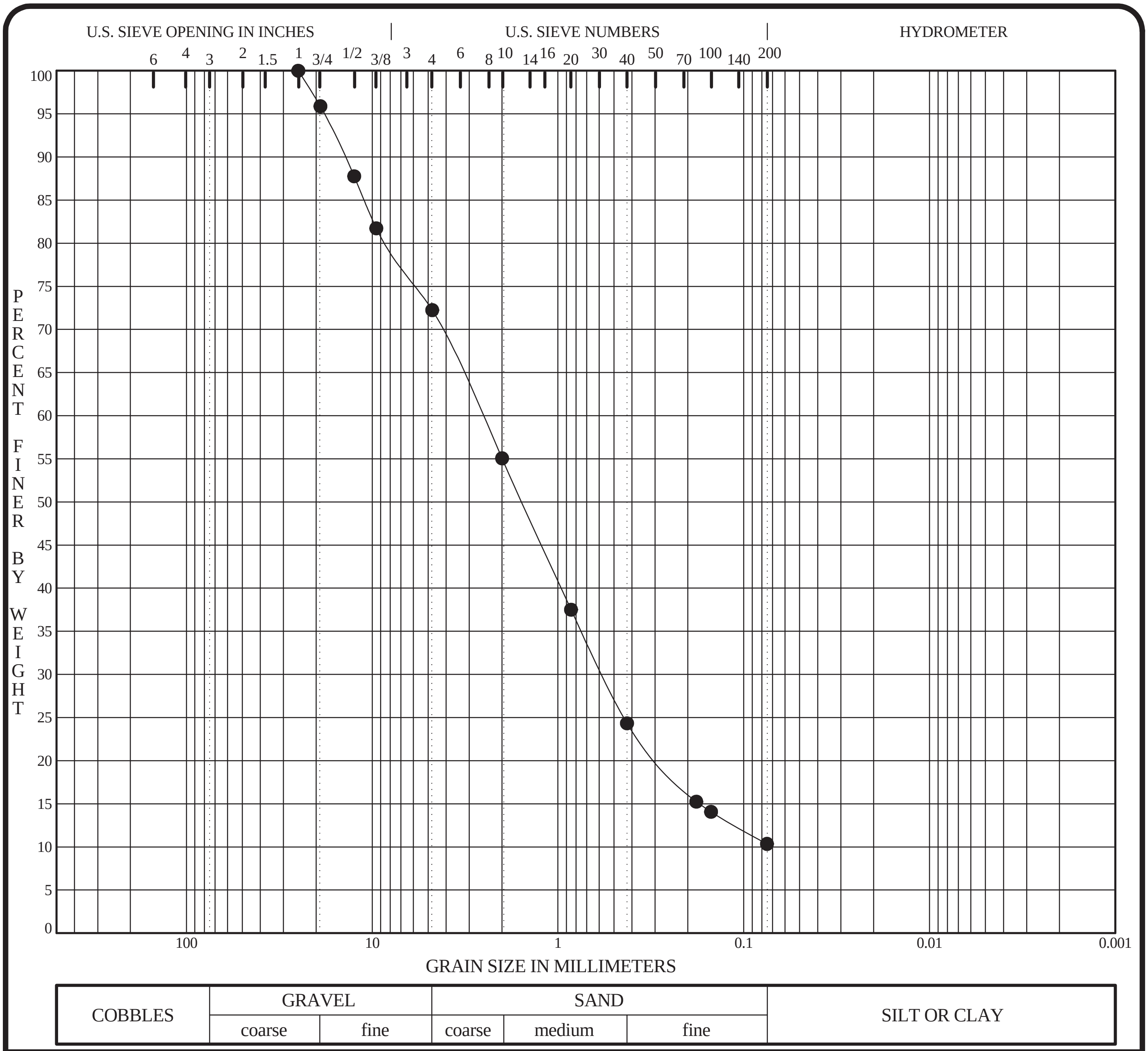
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**MP 504W**	**20.0**	**19.00**	**0.35**	**0.089**		**8.3**	**63.8**	**27.9**	
⧗	**MP 504W**	**50.0**	**12.50**	**0.10**	**0.023**		**3.8**	**39.5**	**36.0**	**20.7**
▲	**MP 504W**	**60.0**	**12.50**	**0.36**	**0.104**		**4.0**	**70.0**	**26.0**	
★	**MP 504W**	**80.0**	**25.00**	**0.96**	**0.203**		**26.4**	**54.0**	**19.6**	
⊙	**MP 504W**	**115.0**	**12.50**	**0.49**	**0.193**		**3.5**	**77.4**	**19.1**	

PROJECT **Sandpiper Mainline Phase III; Barr Project No. 49/16-1244; North Dakota, Minnesota, Wisconsin**

JOB NO. **01-05986/07-05937**
DATE

AMERICAN
ENGINEERING
TESTING, INC.

GRADATION CURVES



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**MP 504W 145.0**	**Sand with Silt and Gravel (SP-SM)**	**9**				**1.82**	**36.5**

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**MP 504W 145.0**	**25.00**	**2.56**	**0.573**		**27.8**	**61.9**	**10.3**	

PROJECT **Sandpiper Mainline Phase III; Barr Project No. 49/16-1244; North Dakota, Minnesota, Wisconsin**

JOB NO. **01-05986/07-05937**
DATE

AMERICAN
ENGINEERING
TESTING, INC.

GRADATION CURVES

Report of Moisture Content, Dry Density, and P200

SANDPIPER MAINLINE PHASE III
BARR PROJECT NO. 49/16-1244
ND, MN, WI

BARR ENGINEERING
ATTN: ROB OLAH

AET FIELDWORK NO: 01-05986
AET LABORATORY NO: 07-05937

DECEMBER 19, 2014

Boring Number	Depth (feet)	Moisture Content	Dry Density	Hand Penetrometer	P200	Classification
MP 504W	10-12	11.2	--	--	23.0	SM w/G
MP 504W	20-22	8.7	--	--	27.9	SM, a little G
MP 504W	30-32	8.3	120.5	--	21.8	SM, a little G
MP 504W	40-42	10.3	134.4	--	--	SM w/G
MP 504W	50-52	9.8	--	--	56.7	Sandy CL, a little G
MP 504W	60-62	12.1	--	--	26.0	SM, a little G
MP 504W	70-72	13.8	--	--	5.8	SP-SM, a little G
MP 504W	80-82	8.4	--	--	19.6	SM w/G
MP 504W	95-97	11.7	--	--	14.0	SM w/G
MP 504W	115-117	12.5	--	--	19.1	SM, a little G
MP 504W	125-127	11.8	--	--	8.1	SP-SM, a little G
MP 504W	145-147	8.9	--	--	10.3	SP-SM w/G
MP 504W	155-157	20.8	--	--	8.5	SP-SM

Report of Moisture Content, Dry Density, and P200

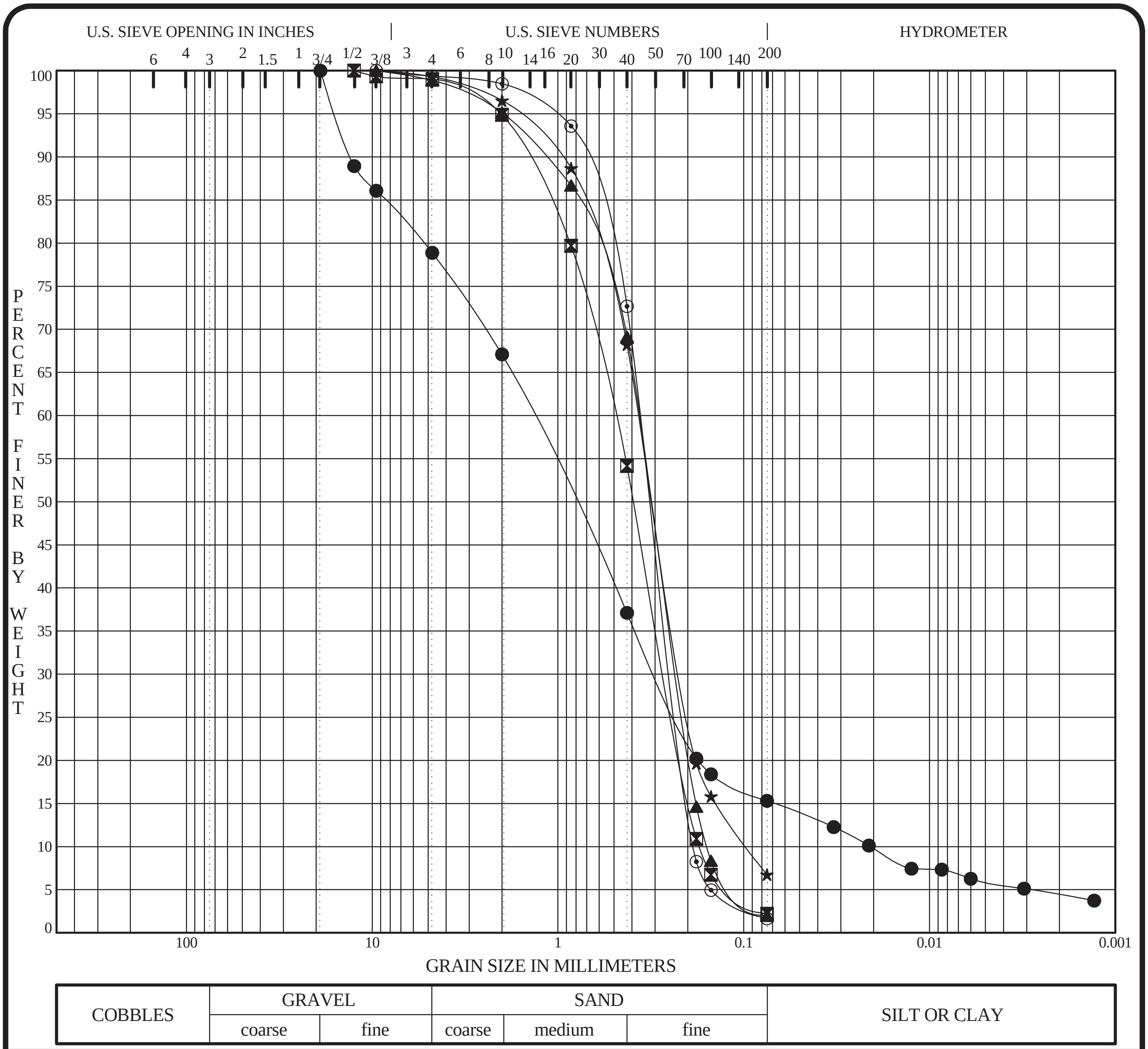
SANDPIPER MAINLINE PHASE III
BARR PROJECT NO. 49/16-1244
ND, MN, WI

BARR ENGINEERING
ATTN: ROB OLAH

AET FIELDWORK NO: 01-05986
AET LABORATORY NO: 07-05937

JANUARY 13, 2015

Boring Number	Depth (feet)	Moisture Content	Dry Density	Hand Penetrometer	P200	Classification
Spire Valley E	4-6	19.5	--	--	15.4	SM w/G
Spire Valley E	8-10	19.2	--	--	2.2	SP
Spire Valley E	12-14	19.4	--	--	2.0	SP
Spire Valley E	16-18	18.1	--	--	6.7	SP-SM
Spire Valley E	20-22	21.2	--	--	1.6	SP



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **Spire Valley E 4.0**	**Silty Sand with Gravel (SM)**	**19**				**3.05**	**66.9**
☒ **Spire Valley E 8.0**	**Sand (SP)**	**19**				**0.80**	**2.9**
▲ **Spire Valley E12.0**	**Sand (SP)**	**19**				**0.91**	**2.3**
★ **Spire Valley E16.0**	**Sand with Silt (SP-SM)**	**18**				**1.32**	**3.8**
⊙ **Spire Valley E20.0**	**Sand (SP)**	**21**				**0.88**	**1.9**

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **Spire Valley E 4.0**	**19.00**	**1.39**	**0.296**	**0.0207**	**21.1**	**63.5**	**9.4**	**6.0**
☒ **Spire Valley E 8.0**	**12.50**	**0.50**	**0.263**	**0.1731**	**1.0**	**96.8**	**2.2**	
▲ **Spire Valley E12.0**	**9.50**	**0.37**	**0.229**	**0.1574**	**1.1**	**96.9**	**2.0**	
★ **Spire Valley E16.0**	**9.50**	**0.37**	**0.216**	**0.0961**	**0.7**	**92.6**	**6.7**	
⊙ **Spire Valley E20.0**	**9.50**	**0.36**	**0.241**	**0.1843**	**0.7**	**97.7**	**1.6**	

PROJECT **Sandpiper Mainline Phase III; Barr Project No. 49/16-1244; North Dakota, Minnesota, Wisconsin**

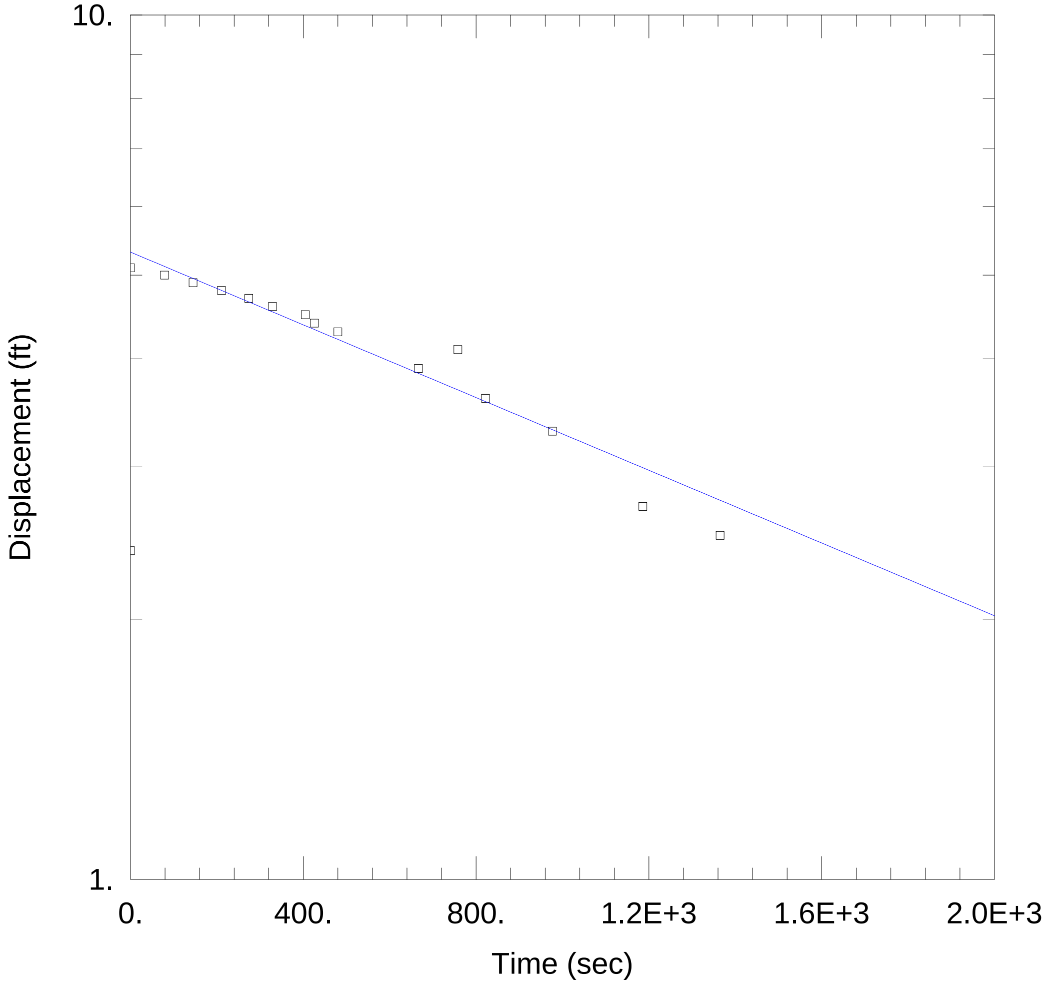
JOB NO. **01-05986/07-05937**
DATE **12/26/14**

A
AMERICAN
ENGINEERING
TESTING, INC.

GRADATION CURVES

Appendix E

Drawdown Test Results



WELL TEST ANALYSIS

Data Set: V:\23\69\1530\Spire Valley\Aqtesolv\SV_20_HA_15.aqt
Date: 03/11/20 Time: 10:50:48

PROJECT INFORMATION

Company: Barr
Client: Enbridge
Project: 23691530
Location: Spire Valley
Test Well: SV-20-HA-19-alt
Test Date: 03-05-2020

AQUIFER DATA

Saturated Thickness: 15. ft
Anisotropy Ratio (Kz/Kr): 0.1

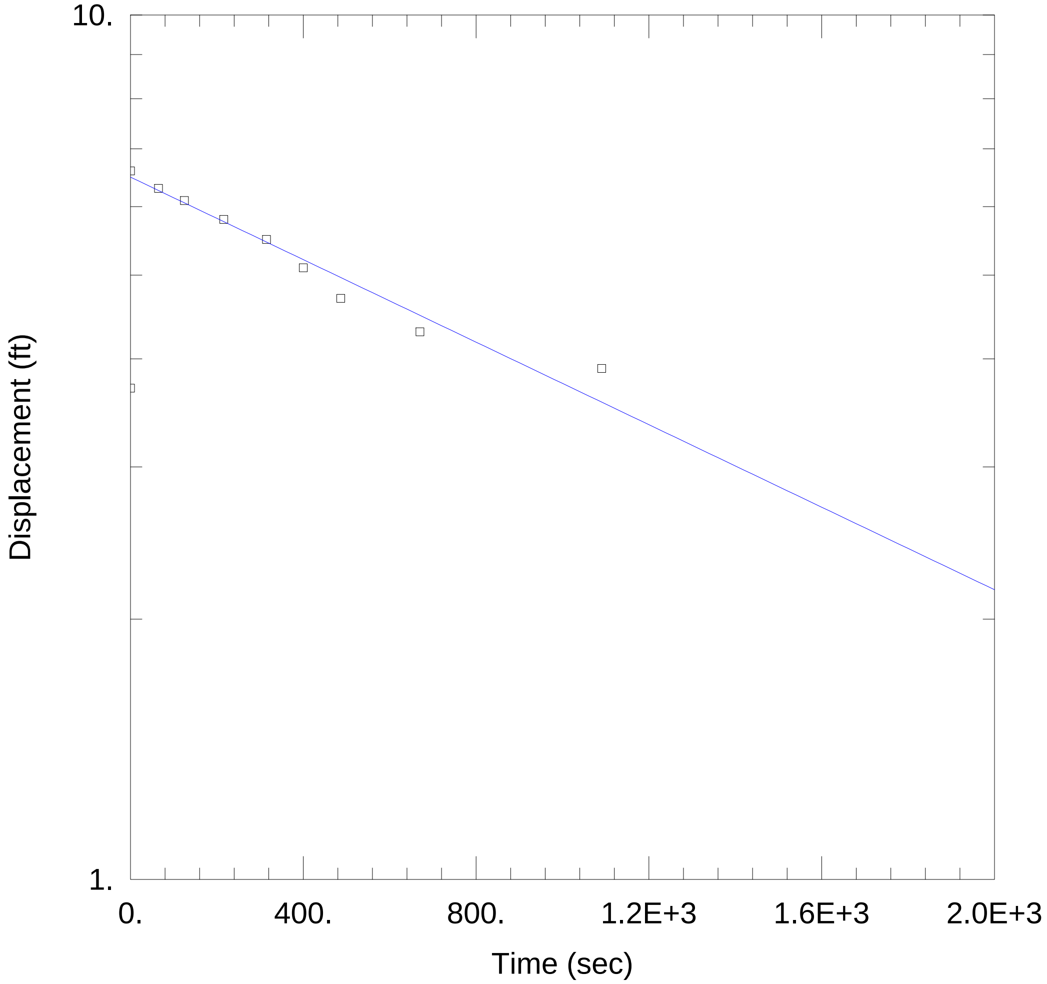
WELL DATA (SV-20-HA-15)

Initial Displacement: 2.4 ft
Static Water Column Height: 7.6 ft
Total Well Penetration Depth: 7.6 ft
Screen Length: 7.6 ft
Casing Radius: 0.083 ft
Well Radius: 0.1 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.07355 ft/day
y0 = 5.316 ft



WELL TEST ANALYSIS

Data Set: V:\23\69\1530\Spire Valley\Aqtesolv\SV_20_HA_16_alt.aqt
Date: 03/11/20 Time: 10:26:28

PROJECT INFORMATION

Company: Barr
Client: Enbridge
Project: 23691530
Location: Spire Valley
Test Well: SV-20-HA-19-alt
Test Date: 03-05-2020

AQUIFER DATA

Saturated Thickness: 15. ft
Anisotropy Ratio (Kz/Kr): 0.1

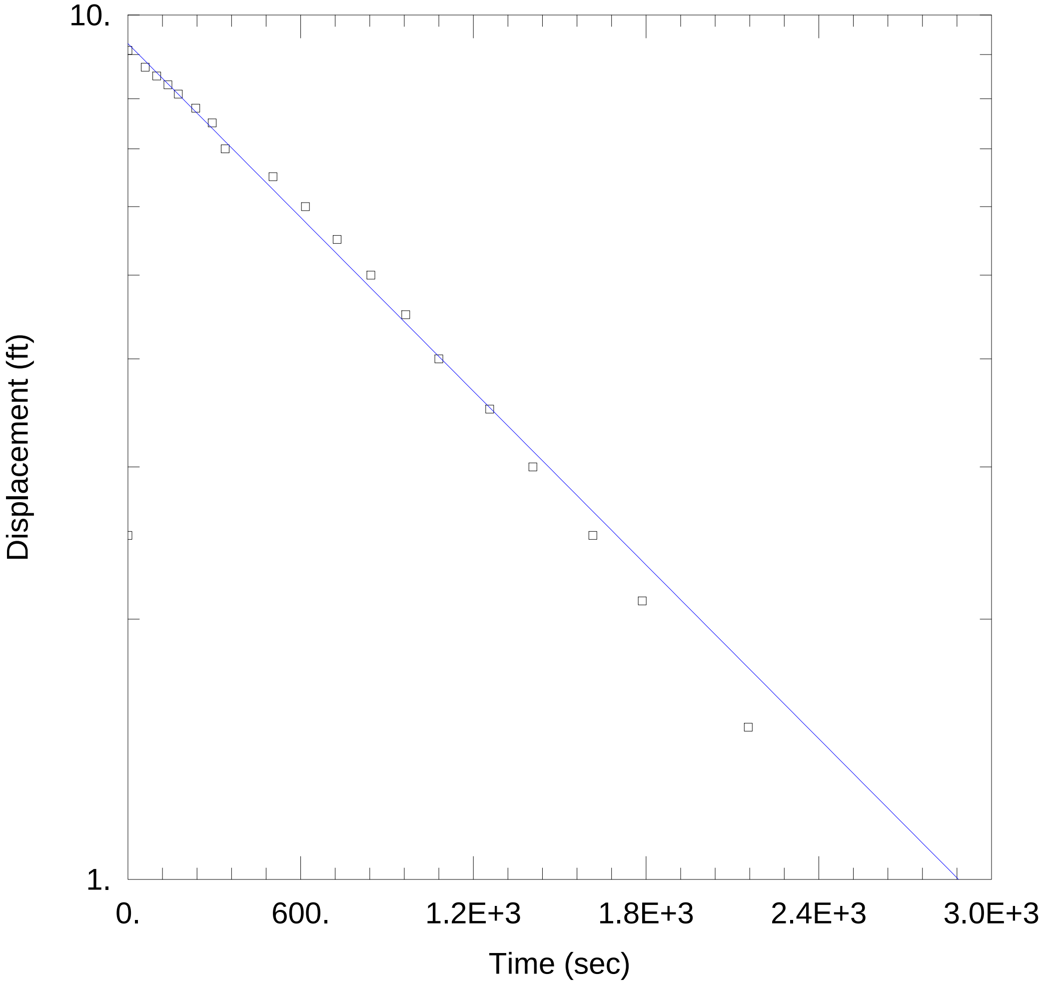
WELL DATA (SV-20-HA-16)

Initial Displacement: 3.7 ft
Static Water Column Height: 9.5 ft
Total Well Penetration Depth: 6.3 ft
Screen Length: 6.3 ft
Casing Radius: 0.083 ft
Well Radius: 0.1 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.09584 ft/day
y0 = 6.492 ft



WELL TEST ANALYSIS

Data Set: V:\23\69\1530\Spire Valley\Aqtesolv\SV_20_HA_17t.aqt
Date: 03/11/20 Time: 10:34:21

PROJECT INFORMATION

Company: Barr
Client: Enbridge
Project: 23691530
Location: Spire Valley
Test Well: SV-20-HA-19-alt
Test Date: 03-05-2020

AQUIFER DATA

Saturated Thickness: 15. ft
Anisotropy Ratio (Kz/Kr): 0.1

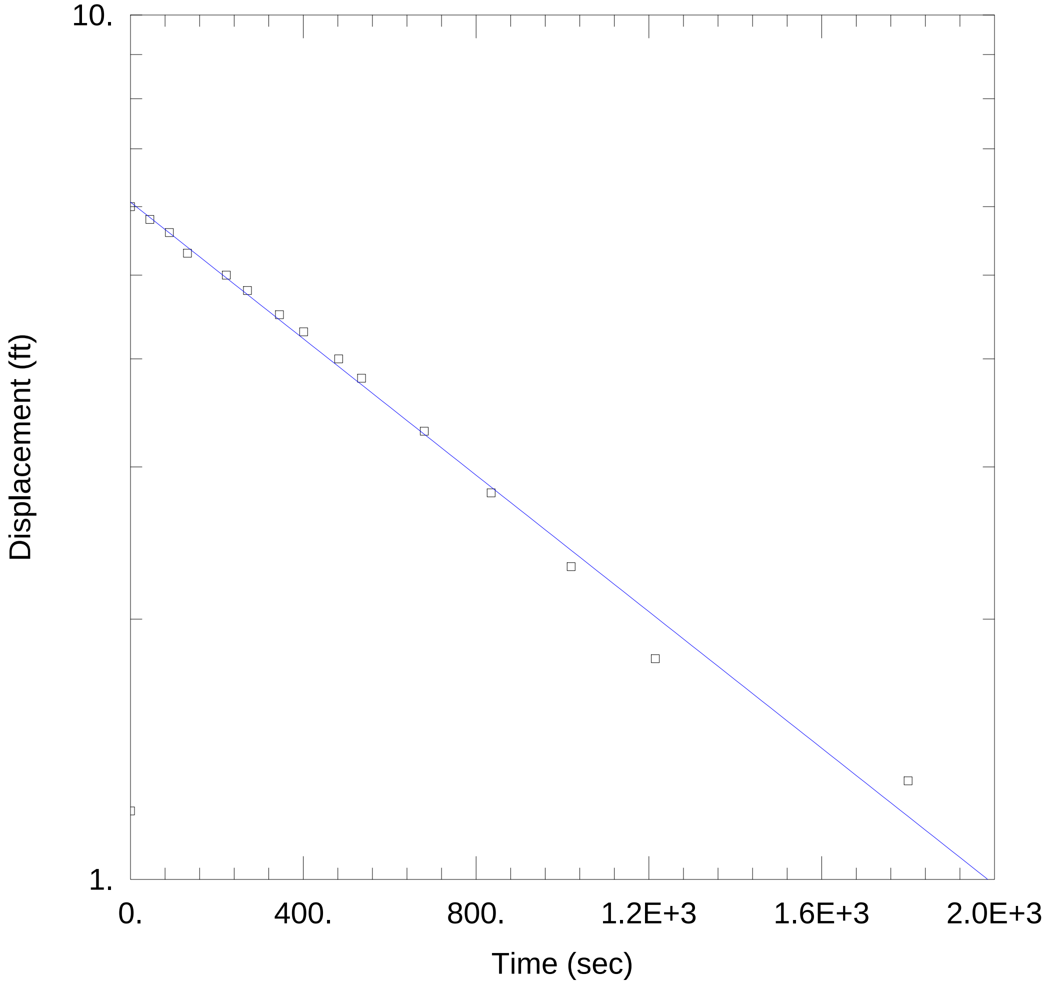
WELL DATA (SV-20-HA-17)

Initial Displacement: 2.5 ft
Static Water Column Height: 7.5 ft
Total Well Penetration Depth: 10. ft
Screen Length: 7.5 ft
Casing Radius: 0.083 ft
Well Radius: 0.1 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.1242 ft/day
y0 = 9.265 ft



WELL TEST ANALYSIS

Data Set: V:\23\69\1530\Spire Valley\Aqtesolv\SV_20_HA_18.aqt
Date: 03/11/20 Time: 10:40:43

PROJECT INFORMATION

Company: Barr
Client: Enbridge
Project: 23691530
Location: Spire Valley
Test Well: SV-20-HA-19-alt
Test Date: 03-05-2020

AQUIFER DATA

Saturated Thickness: 15. ft
Anisotropy Ratio (Kz/Kr): 0.1

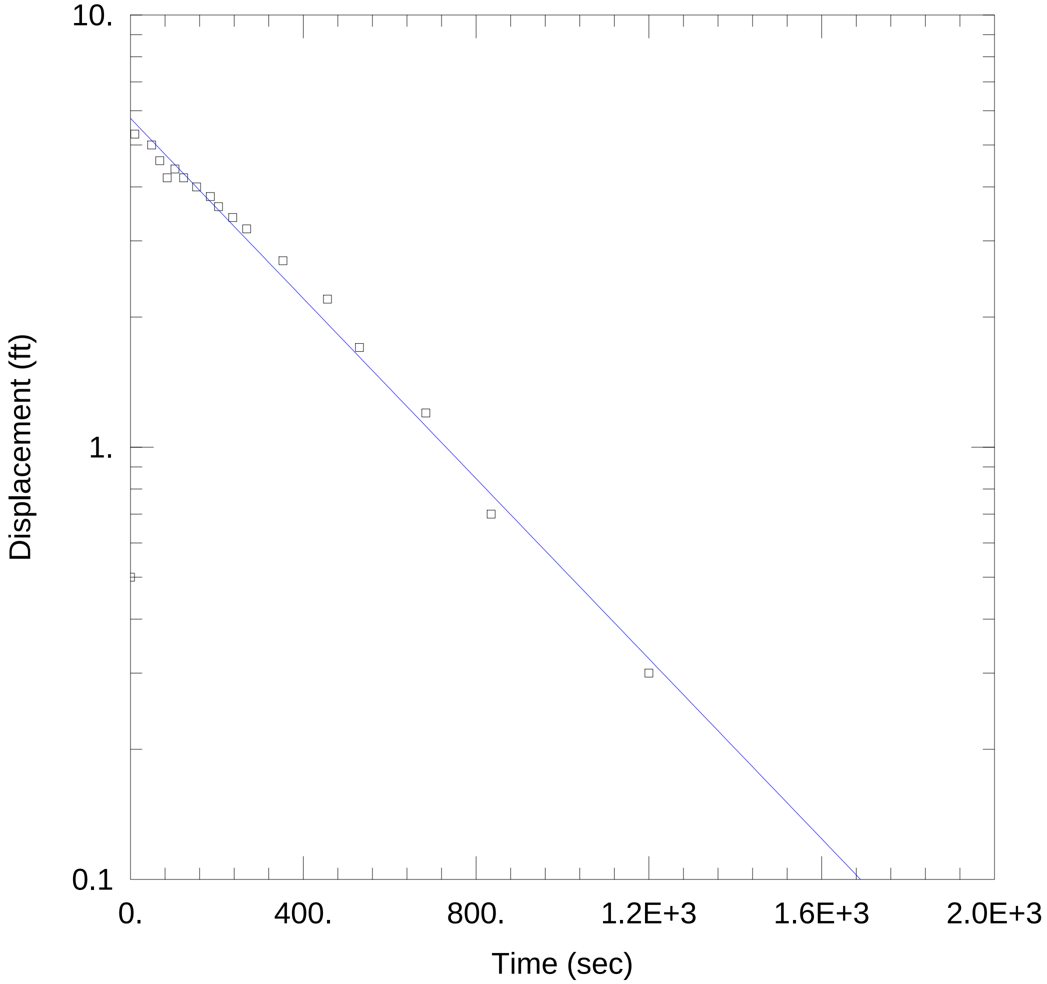
WELL DATA (SV-20-HA-18)

Initial Displacement: 1.2 ft
Static Water Column Height: 8.8 ft
Total Well Penetration Depth: 8.8 ft
Screen Length: 8.8 ft
Casing Radius: 0.083 ft
Well Radius: 0.1 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.124 ft/day
y0 = 6.073 ft



WELL TEST ANALYSIS

Data Set: V:\23\69\1530\Spire Valley\Aqtesolv\SV_20_HA_19_alt.aqt
Date: 03/11/20 Time: 10:13:05

PROJECT INFORMATION

Company: Barr
Client: Enbridge
Project: 23691530
Location: Spire Valley
Test Well: SV-20-HA-19-alt
Test Date: 03-05-2020

AQUIFER DATA

Saturated Thickness: 15. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (SV-20-HA-19-alt)

Initial Displacement: 0.5 ft
Static Water Column Height: 9.5 ft
Total Well Penetration Depth: 10. ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.1 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.2984 ft/day
y0 = 5.764 ft

Appendix G

Groundwater Monitoring Memorandum (December 2019)

resourceful. naturally.
engineering and environmental consultants
BARR

Memorandum

To: Julianne Motis, PE (Enbridge)
From: Ray Wuolo, PE, PG (Barr), Robert Olah, PE (Barr) and Peter Demshar, PE (Barr)
Subject: Geotechnical Investigation Spring Brook, Spire Valley
Date: December 16, 2019
Project: Line 3 Replacement Project
c: Megan Behrends (Enbridge), Russ Fischer (Enbridge), Trevor Lindblom (Enbridge)

Barr Engineering Company (Barr) under contract with Enbridge Energy, Limited Partnership (Enbridge), completed an additional geotechnical investigation in support of the proposed Line 3 Replacement (L3R) pipeline Spring Brook (Spire Valley) crossing in Outing, Minnesota. The purpose of this memorandum is to provide the results of the recently completed investigation and our interpretation of the subsurface soil and groundwater conditions.

Two standard penetration test (SPT) borings and thirteen (13) hand auger borings were performed proximal to the planned L3R pipeline alignment at this site between September and December, 2019. The boring locations were reviewed by the Minnesota Department of Natural Resources (MDNR) and shown in Figure 1. The coordinates and elevations for the boring locations, provided by the project surveyor Northwestern Surveying & Engineering, Inc. of Bemidji, Minnesota, are shown in Table 1 below:

Table 1 Monitoring Locations

Borehole ID	Northing (ft)	Easting (ft)	Elevation (ft)
SV-Fishery	464149.5	2413294.1	1332.9
SV-19-Middle	459699.1	2414369.0	1282.5
SV-19-West	459893.4	2413563.8	1345.7
SV-19-HA-1	459881.8	2413626.9	1334.5
SV-19-HA-2	459885.7	2413661.9	1309.7
SV-19-HA-3	459900.8	2413721.8	1295.5
SV-19-HA-4	459885.1	2413779.2	1287.8
SV-19-HA-5	459792.4	2414027.5	1284.1
SV-19-HA-6	459792.3	2414117.6	1306.1
SV-19-HA-7	459792.3	2414207.5	1322.0
SV-19-HA-8	459792.4	2414297.5	1293.6
SV-19-HA-9	459795.1	2414466.1	1285.2
SV-19-HA-10	459785.1	2414549.7	1310.9
SV-19-HA-11	459804.9	2414639.1	1329.9
SV-19-HA-12	459795.2	2414816.8	1339.4
SV-19-HA-13	459805.5	2414980.4	1345.8

Coordinate system FIPS 2201
Minnesota State Plane North, Datum Nad83

The SPT boring was completed with equipment owned and operated by Coleman Engineering Company of Iron Mountain, Michigan using a Diedrich D-120 track-mounted drill rig. Because of the potential for pressurized groundwater conditions, the boring was completed to a depth of 100 feet using mud rotary techniques with heavy (weighted) drilling mud. To evaluate the presence of confining layers, SPT sampling was completed continuously throughout the depth of the boring. The hand auger boring was completed to a depth of 10 feet below existing grade and continuously sampled with the hand auger.

Three nested vibrating wire piezometers were installed in the SV-19-Middle prior to abandonment. One vibrating wire piezometer was installed at the bottom of the SV-19-West boring prior to abandonment. All boreholes were backfilled with neat cement grout and bentonite slurry upon completion of drilling, in accordance with Minnesota Department of Health (MDH) requirements. Additionally, one vibrating wire piezometer was installed in an existing well (Well No. 00686229) at the MDNR fishery, located approximately 0.9 mile to the north-northwest.

Subsurface Conditions

The results of the geotechnical soil borings were compiled to obtain an understanding of the lithology and groundwater hydrogeology of the study area. The existing soil conditions generally consist of poorly graded sands (SP) throughout the depth of the SPT boring; however, a lens of silty sand (SM) was encountered between 17.8 and 18 feet, a layer of silty clay (CL-ML) was encountered between 37 and 38 feet, and a layer of lean clay (CL) was encountered between 73.5 and 74.5 feet below existing grade. Based on Minnesota Rules parts 4725.2020, 4725.3050, 4725.3450, and 4725.3850 these fine grained layers do not qualify as confining layers.

Groundwater was observed in the SPT boring at a depth of 5.5 feet during drilling (elevation 1277.0). Groundwater was not observed in the hand auger boring during the investigation. Long-term monitoring of the groundwater was completed through the use of automated vibrating wire piezometers installed in both borings. Results of the long term monitoring are discussed in subsequent sections. Boring logs are provided in Attachment 1.

Instrumentation

Vibrating wire piezometers were installed in the SPT and hand auger borings. Three nested vibrating wire piezometers were installed in the SPT boring to evaluate the presence of pressurized groundwater above the normal phreatic surface. Vibrating wire piezometers were installed in the SPT boring at depths of 15 feet (elevation 1267.5), 49.5 feet (elevation 1233), and 89.5 feet (elevation 1193) below existing grade. The vibrating wire piezometer in the hand auger boring was installed at a depth of 7.5 feet (elevation 1280.3) below existing grade. Vibrating wire piezometer in the existing MDNR well was installed just above the pump at a depth of about 64.5 feet (elevation 1332.9) to evaluate if a hydraulic connection exists between the sites. Piezometer locations and associated depths/elevations are shown on the Instrumentation Logs provided in Attachment 2.

A fully automated monitoring system was installed following piezometer installation to provide near-real-time monitoring of all instrumentation at 4-hour intervals. A weather station was also installed in order to evaluate vibrating wire piezometer data with associated rain events.

Results of the vibrating wire piezometer data indicate that pressurized groundwater conditions do not exist at the SPT boring or within the hand auger boring. The three nested piezometers in SV-19-Middle indicate normal phreatic surface with groundwater reported at about 6 feet for all three piezometers, which is consistent with the phreatic surface observed during drilling. Barometric corrections will be completed on the results to clean up the very minor inconsistencies between the piezometer readings following the next reporting cycle; however, it is expected that the correction will further clarify the data and indicate normal phreatic conditions. We have requested pumping rates and dates for the existing MDNR well to evaluate if a hydraulic connection exists. Results will be forwarded upon receipt of the information from the MDNR and Barr's evaluation.

Interpretations of the vibrating wire piezometer data as well as the raw instrument data are provided in Attachment 2.

Discussion

The monitoring, to date, indicates that potentiometric heads at depth do not respond to short-term (daily) precipitation events. SV-19-HA-4 does however respond to the rain events and indicates that this piezometer installed in a shallow, unconfined surficial hydrogeologic unit. All remaining shallow piezometers were installed following freeze up and cannot be compared to any rain events. None of the piezometers appear to be responding to short-term changes in pumping at the Fish Hatchery.

The artesian pressures and flowing well conditions that have been reported in wells adjacent to Roosevelt Lake were not encountered in SV-19-Middle or SV-19-West. There was no evidence of upward vertical gradients or low-permeability confining layers that would result in artesian conditions.

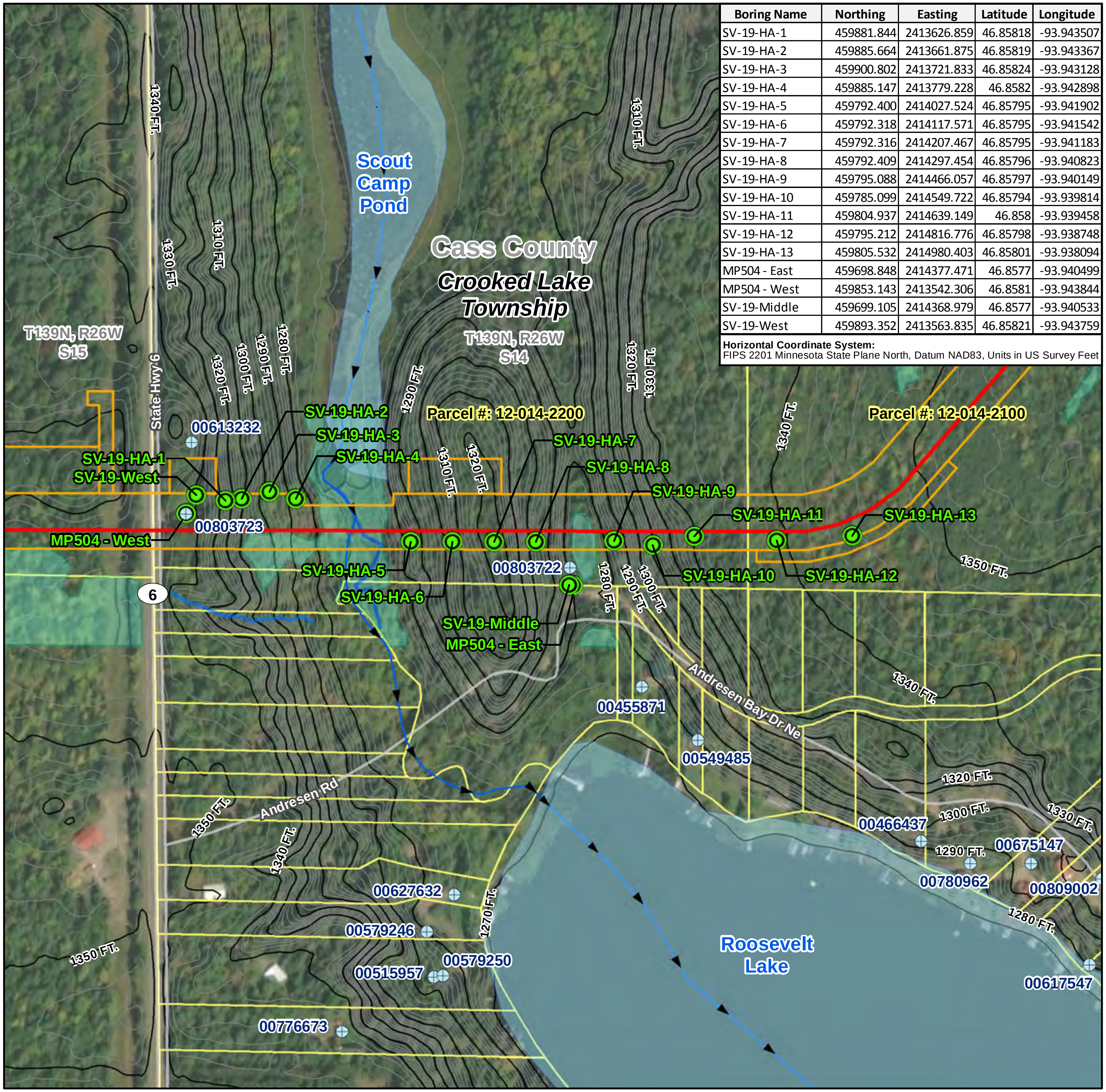
Figures

Figure 1	Site Location Map – Spire Valley
Figure 2	Site Location Map – DNR Fishery
Figure 3	Cross Section

Attachments

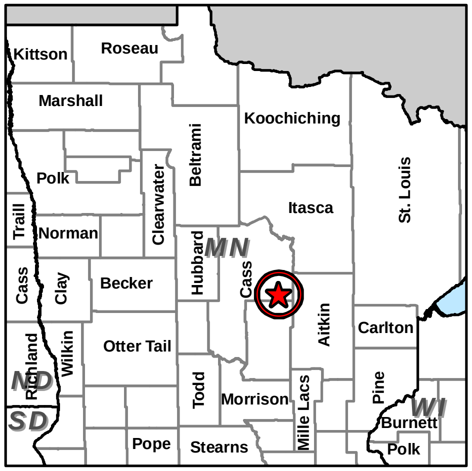
Attachment 1	Instrumentation Logs
Attachment 2	Vibrating Wire Piezometer Data

Figures



Boring Name	Northing	Easting	Latitude	Longitude
SV-19-HA-1	459881.844	2413626.859	46.85818	-93.943507
SV-19-HA-2	459885.664	2413661.875	46.85819	-93.943367
SV-19-HA-3	459900.802	2413721.833	46.85824	-93.943128
SV-19-HA-4	459885.147	2413779.228	46.8582	-93.942898
SV-19-HA-5	459792.400	2414027.524	46.85795	-93.941902
SV-19-HA-6	459792.318	2414117.571	46.85795	-93.941542
SV-19-HA-7	459792.316	2414207.467	46.85795	-93.941183
SV-19-HA-8	459792.409	2414297.454	46.85796	-93.940823
SV-19-HA-9	459795.088	2414466.057	46.85797	-93.940149
SV-19-HA-10	459785.099	2414549.722	46.85794	-93.939814
SV-19-HA-11	459804.937	2414639.149	46.858	-93.939458
SV-19-HA-12	459795.212	2414816.776	46.85798	-93.938748
SV-19-HA-13	459805.532	2414980.403	46.85801	-93.938094
MP504 - East	459698.848	2414377.471	46.8577	-93.940499
MP504 - West	459853.143	2413542.306	46.8581	-93.943844
SV-19-Middle	459699.105	2414368.979	46.8577	-93.940533
SV-19-West	459893.352	2413563.835	46.85821	-93.943759

Horizontal Coordinate System:
FIPS 2201 Minnesota State Plane North, Datum NAD83, Units in US Survey Feet



● Completed Geotechnical Exploration Locations (by Barr)
Line 3 Replacement Project
Construction Workspace
Apx. Parcel Boundary (Parcels containing borings labeled with parcel number)
⊕ Well - County Well Index
Surveyed Waterbodies
Surveyed Wetlands
► Flow Direction
Perennial Stream
Intermittent Stream
Waterbody

Elevation Contours

Index (10 ft. Interval)
Intermediate (2 ft. Interval)

N

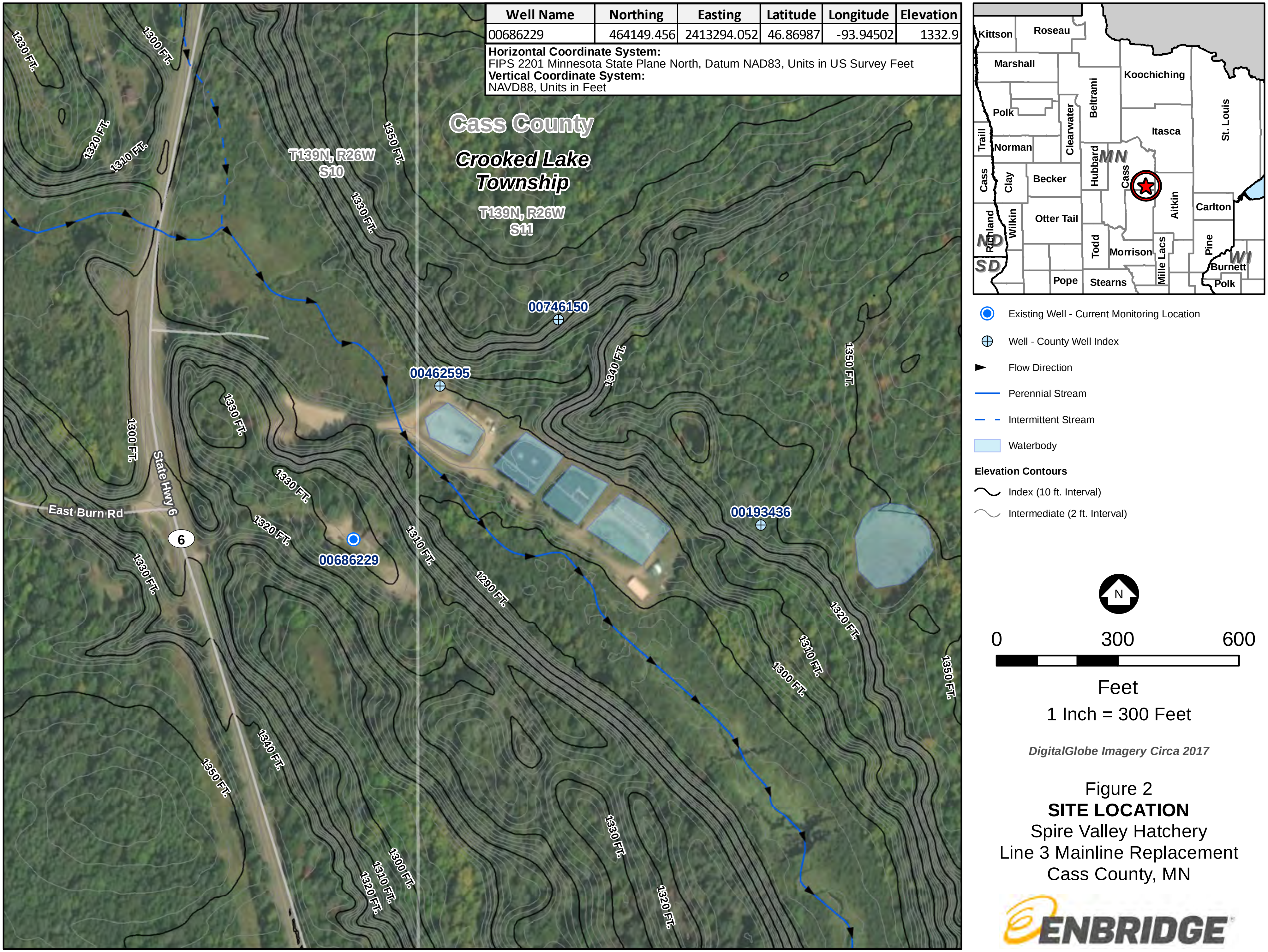
0 300 600
Feet
1 Inch = 300 Feet

DigitalGlobe Imagery Circa 2017

Figure 1
SITE LOCATION
Spire Valley HDD
Line 3 Mainline Replacement
Cass County, MN

ENBRIDGE

Barr Footer: ArcGIS 10.7.1, 2019-12-10 17:43 File: I:\Client\Enbridge_Energy\Work_Orders\Mainline_Permitting\49161299\Work_Orders\Line3_Geotech_HDD_2018\Maps\Reports\SpireValley\Figure 1 Spire Valley Site Location.mxd User: MAC2



Well Name	Northing	Easting	Latitude	Longitude	Elevation
00686229	464149.456	2413294.052	46.86987	-93.94502	1332.9

Horizontal Coordinate System:
FIPS 2201 Minnesota State Plane North, Datum NAD83, Units in US Survey Feet
Vertical Coordinate System:
NAVD88, Units in Feet

◉	Existing Well - Current Monitoring Location
⊕	Well - County Well Index
►	Flow Direction
—	Perennial Stream
– –	Intermittent Stream
▭	Waterbody

Elevation Contours

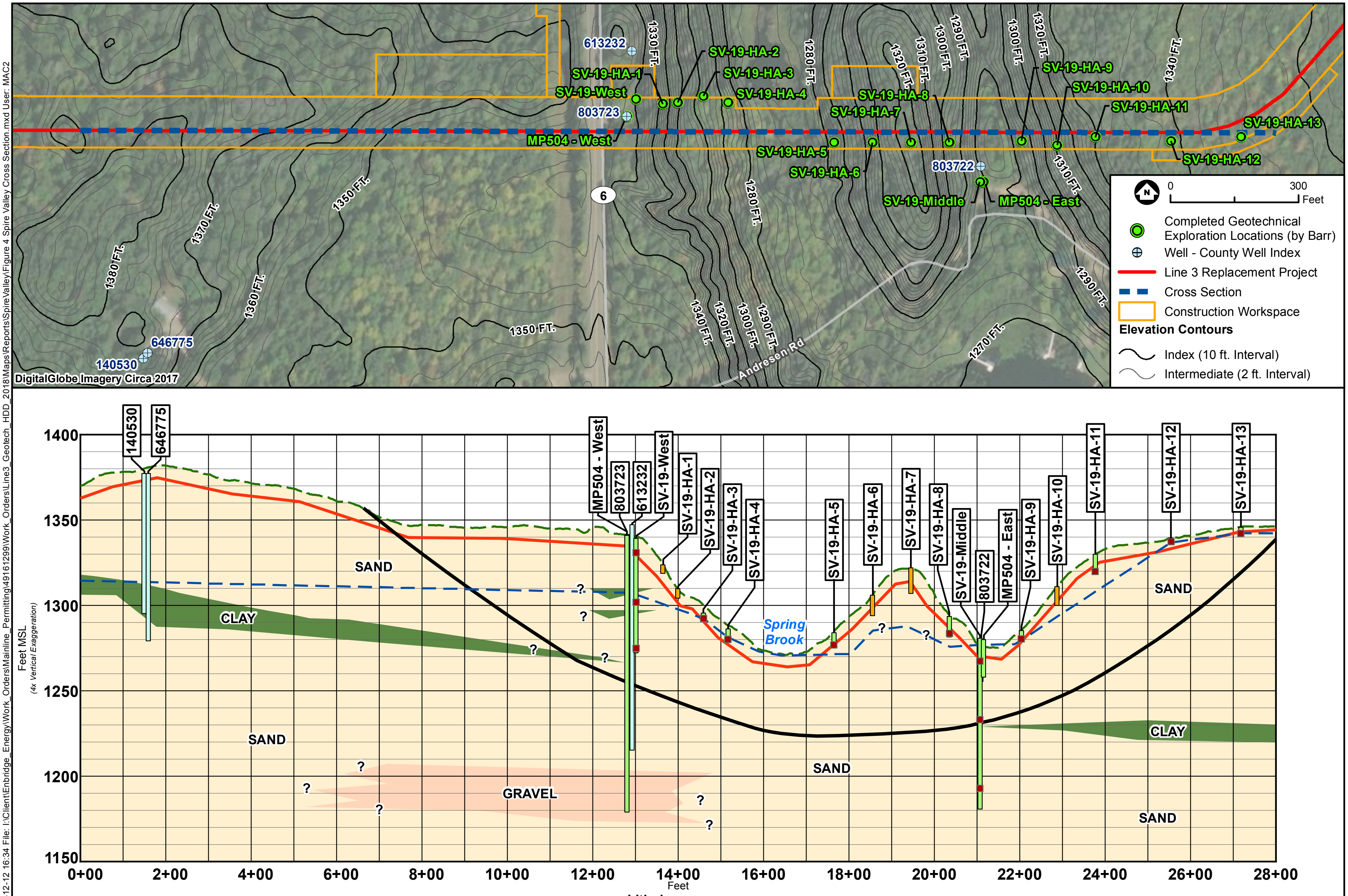
∼	Index (10 ft. Interval)
∼	Intermediate (2 ft. Interval)

0 300 600
Feet
1 Inch = 300 Feet

DigitalGlobe Imagery Circa 2017

Figure 2
SITE LOCATION
Spire Valley Hatchery
Line 3 Mainline Replacement
Cass County, MN

ENBRIDGE



Ground Surface	Completed Geotechnical Exploration Location (by Barr)
Approximate Depth of L3R Pipeline	Completed Boring with Standpipe (by Barr)
Possible HDD Route	Well - County Well Index
Interpreted Surface Water Table	🟥 Approximate Position of Piezometer

Lithology

- Clay (CL, CLS)
- Sand (SP, SM, SC, SP-SM)
- Gravel (GP)

NOTE:
Topographic information depicted based on MnTOPO LiDAR elevation data.

Figure 3
CROSS SECTION
Spire Valley HDD
Line 3 Mainline Replacement
Cass County, MN

ENBRIDGE

Attachments

Attachment 1

Soil Boring Logs

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

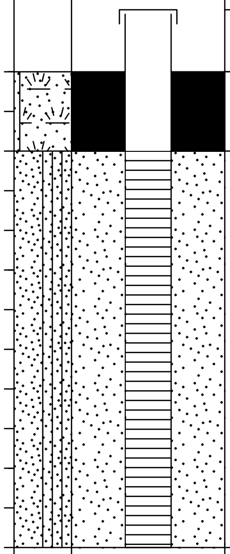
LOG OF BORING SV-19-HA-1

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1334.5 ft	Top of Casing Elevation: 1338.5

STRATA

DESCRIPTION	DEPTH, ft
	0.0
TOPSOIL. 1333.5 ft	
POORLY GRADED SAND WITH SILT (SP-SM): brown; moist.	2.5
	5.0
1328.5 ft	
Bottom of Boring at 6.0 feet	



DEPTH, ft		ELEVATION, ft
-4.0	TRC	**1338.5**
0.0	GS	**1334.5**
1.0	TSC	1333.5
6.0	TD	1328.5

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

RISER CASING
Diameter: **1"**
Type: **PVC**
Interval: **-4 - 1 ft**

GROUT
Type: **N/A**
Interval: **N/A**

SEAL
Type: **Bentonite Chips**
Interval: **0 - 1 ft**

SANDPACK
Type: **Filter Sand**
Interval: **1 - 6 ft**

SCREEN
Diameter: **1"**
Type: **Slotted PVC**
Interval: **1 - 6 ft**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	6.0 ft
Date Started:	12/4/19
Date Completed:	12/4/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,881.8 ft E 2,413,626.9 ft

LEGEND

⁘	FILTER PACK
■	BENTONITE
▧	CEMENT GROUT
▩	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

⊻ At Time of Drilling
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-19-HA-2

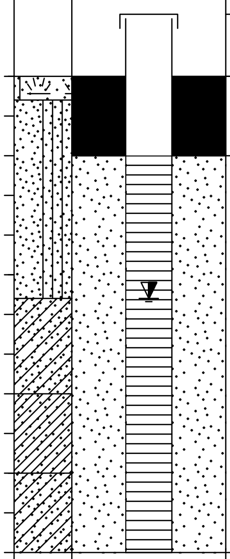
Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1309.7 ft	Top of Casing Elevation: 1313.7

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL. 1309.4 ft	0.0
POORLY GRADED SAND WITH SILT (SP-SM): brown; wet. 1306.9 ft	2.5
CLAYEY SAND (SC): brown; wet. 1305.7 ft	
SANDY CLAY: brown; moist. 1304.7 ft	5.0
CLAYEY SAND (SC): brown; wet. 1303.7 ft	
Bottom of Boring at 6.0 feet	

SYMBOL / PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
-4.0	TRC	**1313.7**
0.0	GS	**1309.7**
1.0	TSC	1308.7
6.0	TD	1303.7

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

RISER CASING
Diameter: **1"**
Type: **PVC**
Interval: **-4 - 1 ft**

GROUT
Type: **N/A**
Interval: **N/A**

SEAL
Type: **Bentonite Chips**
Interval: **0 - 1 ft**

SANDPACK
Type: **Filter Sand**
Interval: **1 - 6 ft**

SCREEN
Diameter: **1"**
Type: **Slotted PVC**
Interval: **1 - 6 ft**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	6.0 ft
Date Started:	12/4/19
Date Completed:	12/4/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,885.7 ft E 2,413,661.9 ft

LEGEND

░	FILTER PACK
■	BENTONITE
▨	CEMENT GROUT
▦	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling 2.8

The stratification lines represent approximate boundaries. The transition may be gradual.

O:\GINTPROJECTS\49161299 LINE 3 REPLACEMENT GEOTECH SURVEY\2019 HDD\49161299.10 SPIRE VALLEY_20191212.GPJ BARRLIBRARY.GLB INSTRUMENT LOG REPORT BARR TEMPLATE.GDT

BARR
Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-19-HA-3

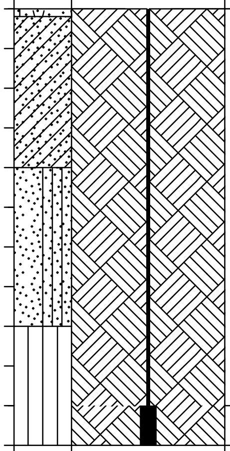
Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1295.5 ft	

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL. 1295.4 ft	0.0
CLAYEY SAND (SC): brown; moist. 1293.5 ft	
POORLY GRADED SAND WITH SILT (SP-SM): fine grained; brown; saturated. 1291.5 ft	2.5
SILT WITH SAND (ML): brown. 1290.0 ft	5.0
Bottom of Boring at 5.5 feet	

SYMBOL / PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
0.0	GS	**1295.5**
5.0	TVT	1290.5
5.5	TD	1290.0

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING

Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

GROUT

Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 5.5 ft**

VIBRATING-WIRE TIP

Diameter: **25.4mm**
Type: **Geokon 4500AL - 170kPa**
Serial No.: **VW1944497**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	5.5 ft
Date Started:	12/5/19
Date Completed:	12/5/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,900.8 ft E 2,413,721.8 ft

LEGEND

⁘	FILTER PACK
■	BENTONITE
▧	CEMENT GROUT
▨	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

BARR
Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

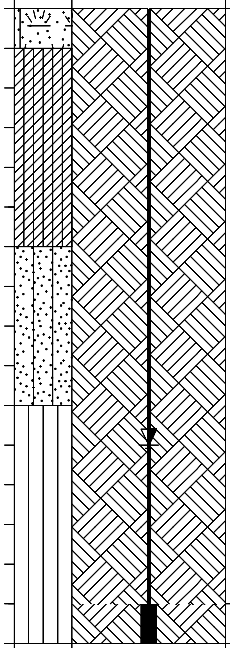
LOG OF BORING SV-19-HA-4

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1287.8 ft	

STRATA DESCRIPTION	DEPTH, ft
TOPSOIL: black; moist; soft; with roots. 1287.3 ft	0.0
SANDY SILTY CLAY (CL-ML): dark brown; moist to wet; soft; trace organics. 1284.8 ft	2.5
SILTY SAND (SM): brown; wet; loose. 1282.8 ft	
SANDY SILT (ML): light brown; saturated; soft; heavy oxidation. 1279.8 ft	5.0 7.5
Bottom of Boring at 8.0 feet	

SYMBOL / PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
0.0	GS	**1287.8**
7.5	TVT	1280.3
8.0	TD	1279.8

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING
Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

GROUT
Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 8 ft**

VIBRATING-WIRE TIP
Diameter: **25.4mm**
Type: **Geokon 4500AL - 170kPa**
Serial No.: **VW1930859**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	8.0 ft
Date Started:	9/14/19
Date Completed:	9/14/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,885.1 ft E 2,413,779.2 ft

LEGEND

▒	FILTER PACK
■	BENTONITE
▨	CEMENT GROUT
▦	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

⊻ At Time of Drilling 5.5
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

O:\GINT\PROJECTS\49161299 LINE 3 REPLACEMENT GEOTECH SURVEY\2019 HDD\49161299.10 SPIRE VALLEY_20191212.GPJ BARRLIBRARY.GLB INSTRUMENT LOG REPORT BARR TEMPLATE.GDT

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

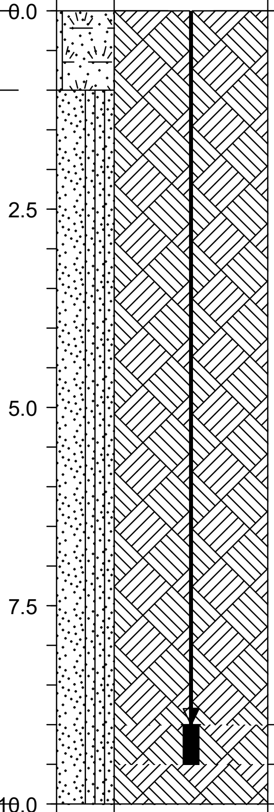
LOG OF BORING SV-19-HA-5

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1284.1 ft	

STRATA

DESCRIPTION	DEPTH, ft
	0.0
TOPSOIL: 1-in frost. 1283.1 ft	
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel.	2.5
	5.0
	7.5
1274.1 ft	10.0
Bottom of Boring at 10.0 feet	



DEPTH, ft		ELEVATION, ft
0.0	GS	**1284.1**
9.0	TVT	1275.1
9.5	BVT	1274.6
10.0	TD	1274.1

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING

Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

GROUT

Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 10 ft**

VIBRATING-WIRE TIP

Diameter: **25.4mm**
Type: **Geokon 4500AL - 170kPa**
Serial No.: **VW1944494**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	10.0 ft
Date Started:	12/4/19
Date Completed:	12/4/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,792.4 ft E 2,414,027.5 ft

LEGEND

⁘	FILTER PACK
■	BENTONITE
▨	CEMENT GROUT
▦	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling 9.0

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

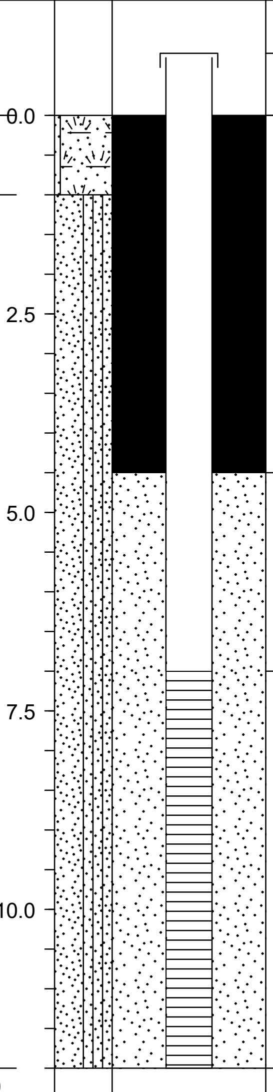
LOG OF BORING SV-19-HA-6

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1306.1 ft	Top of Casing Elevation: 1309.1

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL: black; 2-in frost; contains roots. 1305.1 ft	0.0
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel. 1294.1 ft	
Bottom of Boring at 12.0 feet	



DEPTH, ft		ELEVATION, ft
-3.0	TRC	**1309.1**
0.0	GS	**1306.1**
4.5	BS	1301.6
7.0	TSC	1299.1
12.0	TD	1294.1

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

RISER CASING
Diameter: **1"**
Type: **PVC**
Interval: **-3 - 7 ft**

GROUT
Type: **N/A**
Interval: **N/A**

SEAL
Type: **Bentonite Chips**
Interval: **0 - 4.5 ft**

SANDPACK
Type: **Filter Sand**
Interval: **4.5 - 12 ft**

SCREEN
Diameter: **1"**
Type: **Slotted PVC**
Interval: **7 - 12 ft**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	12.0 ft
Date Started:	12/4/19
Date Completed:	12/4/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,792.3 ft E 2,414,117.6 ft

LEGEND

- ⁘ FILTER PACK
- ■ BENTONITE
- ▧ CEMENT GROUT
- ▦ CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

⊻ At Time of Drilling
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

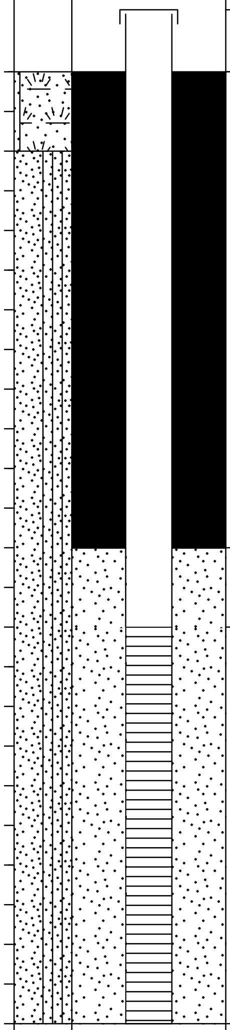
Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

LOG OF BORING SV-19-HA-7

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1322.0 ft	Top of Casing Elevation: 1325.0

STRATA DESCRIPTION	DEPTH, ft
TOPSOIL: 2-in frost. 1321.0 ft	0.0
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel. 1310.0 ft	2.5 5.0 7.5 10.0
Bottom of Boring at 12.0 feet	



DEPTH, ft		ELEVATION, ft
-3.0	TRC	**1325.0**
0.0	GS	**1322.0**
6.0	BS	1316.0
7.0	TSC	1315.0
12.0	TD	1310.0

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

RISER CASING
Diameter: **1"**
Type: **PVC**
Interval: **-3 - 7 ft**

GROUT
Type: **N/A**
Interval: **N/A**

SEAL
Type: **Bentonite Chips**
Interval: **0 - 6 ft**

SANDPACK
Type: **Filter Sand**
Interval: **6 - 12 ft**

SCREEN
Diameter: **1"**
Type: **Slotted PVC**
Interval: **7 - 12 ft**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	12.0 ft
Date Started:	12/4/19
Date Completed:	12/4/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,792.3 ft E 2,414,207.5 ft

LEGEND

░	FILTER PACK
■	BENTONITE
▧	CEMENT GROUT
▦	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

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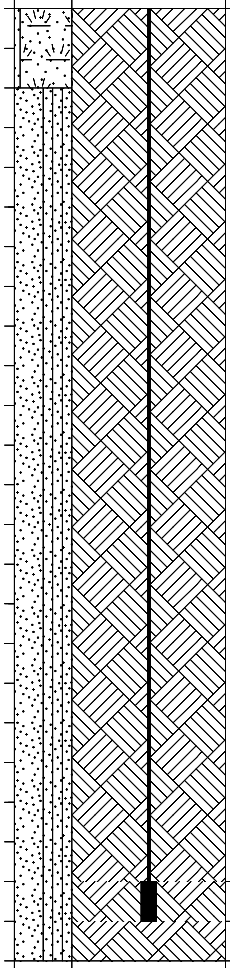
LOG OF BORING SV-19-HA-8

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1293.6 ft	

STRATA DESCRIPTION	DEPTH, ft
TOPSOIL.	0.0
1292.6 ft	
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; moist; trace gravel.	
	2.5
	5.0
	7.5
	10.0
1281.6 ft	
Bottom of Boring at 12.0 feet	

SYMBOL / PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
0.0	GS	**1293.6**
11.0	TVT	1282.6
11.5	BVT	1282.1
12.0	TD	1281.6

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING

Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

GROUT

Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 12 ft**

VIBRATING-WIRE TIP

Diameter: **25.4mm**
Type: **Geokon 4500AL - 170kPa**
Serial No.: **VW1944499**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	12.0 ft
Date Started:	12/4/19
Date Completed:	12/4/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,792.4 ft E 2,414,297.5 ft

LEGEND

⁙	FILTER PACK
■	BENTONITE
▨	CEMENT GROUT
▩	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

O:\GINT\PROJECTS\49161299 LINE 3 REPLACEMENT GEOTECH SURVEY\2019 HDD\49161299.10 SPIRE VALLEY_20191212.GPJ BARRLIBRARY.GLB INSTRUMENT LOG REPORT BARR TEMPLATE.GDT

LOG OF BORING SV-19-HA-9

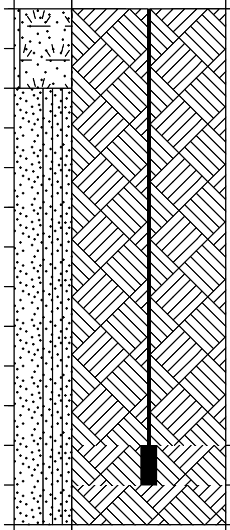
Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1285.2 ft	

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL: 2-in frost. 1284.2 ft	0.0
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel; refusal on rock; more gravel sized rock 6-6.5-ft. 1278.7 ft	2.5 5.0
Bottom of Boring at 6.5 feet	

SYMBOL | PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
0.0	GS	**1285.2**
5.5	TVT	1279.7
6.0	BVT	1279.2
6.5	TD	1278.7

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING

Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

GROUT

Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 6.5 ft**

VIBRATING-WIRE TIP

Diameter: **25.4mm**
Type: **Geokon 4500AL - 170kPa**
Serial No.: **VW1944498**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	6.5 ft
Date Started:	12/5/19
Date Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,795.1 ft E 2,414,466.1 ft

LEGEND

⁙	FILTER PACK
■	BENTONITE
▨	CEMENT GROUT
▦	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

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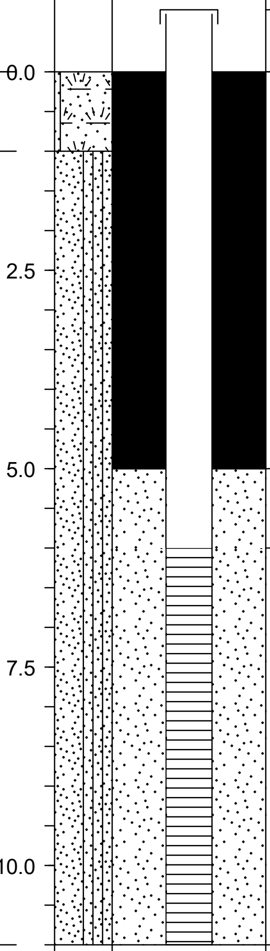
LOG OF BORING SV-19-HA-10

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1310.9 ft	Top of Casing Elevation: 1314.9

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL: 1-in frost.	0.0
1309.9 ft	
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel; refusal on rock.	
1299.9 ft	
Bottom of Boring at 11.0 feet	



DEPTH, ft		ELEVATION, ft
-4.0	TRC	**1314.9**
0.0	GS	**1310.9**
5.0	BS	1305.9
6.0	TSC	1304.9
11.0	TD	1299.9

PIEZOMETER CONSTRUCTION DETAILS FOR STANDPIPE PIEZOMETER

PROTECTIVE CASING
Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

RISER CASING
Diameter: **1"**
Type: **PVC**
Interval: **-4 - 6 ft**

GROUT
Type: **N/A**
Interval: **N/A**

SEAL
Type: **Bentonite Chips**
Interval: **0 - 5 ft**

SANDPACK
Type: **Filter Sand**
Interval: **5 - 11 ft**

SCREEN
Diameter: **1"**
Type: **Slotted PVC**
Interval: **6 - 11 ft**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	11.0 ft
Date Started:	12/5/19
Date Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,785.1 ft E 2,414,549.7 ft

LEGEND

░ FILTER PACK
■ BENTONITE
▨ CEMENT GROUT
▩ CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
BS	BENTONITE SEAL
FP	FILTER PACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH

WATER LEVELS(ft)

⊻ At Time of Drilling
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

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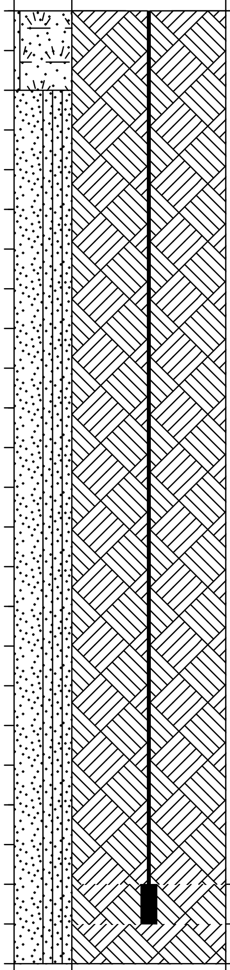
LOG OF BORING SV-19-HA-11

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1329.9 ft	

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL: 1-in frost. 1328.9 ft	0.0
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel. 1317.9 ft	2.5 5.0 7.5 10.0
Bottom of Boring at 12.0 feet	



DEPTH, ft		ELEVATION, ft
0.0	GS	**1329.9**
11.0	TVT	1318.9
11.5	BVT	1318.4
12.0	TD	1317.9

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING
Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

GROUT
Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 12 ft**

VIBRATING-WIRE TIP
Diameter: **25.4mm**
Type: **Geokon 4500AL - 170kPa**
Serial No.: **VW1944495**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	12.0 ft
Date Started:	12/5/19
Date Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,804.9 ft E 2,414,639.1 ft

LEGEND

⁘	FILTER PACK
■	BENTONITE
▧	CEMENT GROUT
▦	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

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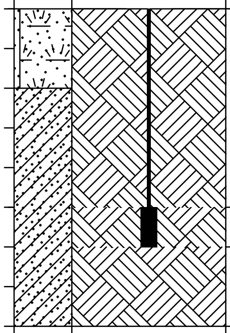
LOG OF BORING SV-19-HA-12

Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1339.4 ft	

STRATA

DESCRIPTION	DEPTH, ft
	0.0
TOPSOIL: contains cobbles; no frost. 1338.4 ft	
CLAYEY SAND (SC): fine grained; brown; moist to wet.	2.5
1335.4 ft	
Bottom of Boring at 4.0 feet	



DEPTH, ft		ELEVATION, ft
0.0	GS	**1339.4**
2.5	TVT	1336.9
3.0	BVT	1336.4
4.0	TD	1335.4

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING
Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

GROUT
Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 4 ft**

VIBRATING-WIRE TIP
Diameter: **25.4mm**
Type: **Geokon 4500AL - 170kPa**
Serial No.: **VW1944493**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	4.0 ft
Date Started:	12/5/19
Date Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,795.2 ft E 2,414,816.8 ft

LEGEND

⁘ FILTER PACK
■ BENTONITE
▨ CEMENT GROUT
▦ CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

⊻ At Time of Drilling
Dry

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-HA-13

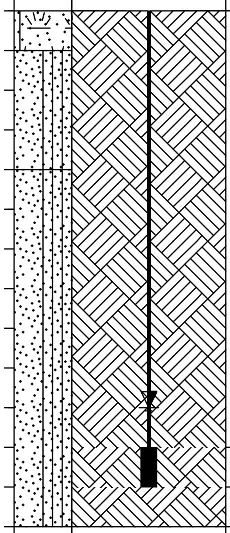
Sheet 1 of 1

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1345.8 ft	

STRATA

DESCRIPTION	DEPTH, ft
	0.0
TOPSOIL: black; organics. 1345.3 ft	
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist. 1343.8 ft	2.5
POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; brown; moist; trace gravel; water at 5-ft.	5.0
1339.3 ft	
Bottom of Boring at 6.5 feet	

SYMBOL — PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
0.0	GS	**1345.8**
5.5	TVT	1340.3
6.0	BVT	1339.8
6.5	TD	1339.3

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING

Diameter: **N/A**
Type: **N/A**
Interval: **N/A**

GROUT

Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 6 ft**

VIBRATING-WIRE TIP

Diameter: **25.4mm**
Type: **Geokon 4500AL - 170kPa**
Serial No.: **VW1944492**

Remarks: Boring completed using a 3-in bucket auger. Boring located in wooded area.

Completion Depth:	6.5 ft
Date Started:	12/5/19
Date Completed:	12/5/19
Logged By:	DAP
Drilling Contractor:	Coleman
Drilling Method:	HA
Datum:	NAD83, NAVD88
Coordinates:	N 459,805.5 ft E 2,414,980.4 ft

LEGEND

▒	FILTER PACK
■	BENTONITE
▨	CEMENT GROUT
▦	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling 5.0

The stratification lines represent approximate boundaries. The transition may be gradual.

O:\GINTPROJECTS\49161299 LINE 3 REPLACEMENT GEOTECH SURVEY\2019 HDD\49161299.10 SPIRE VALLEY_20191212.GPJ BARRLIBRARY.GLB INSTRUMENT LOG REPORT BARR TEMPLATE.GDT

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LOG OF BORING SV-19-Middle

Sheet 1 of 3

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1282.5 ft	Top of Casing Elevation: 1286.5 ft

STRATA

DESCRIPTION

TOPSOIL: black; moist.
1282.3 ft

POORLY GRADED SAND (SP): fine to coarse grained; brown; moist to wet; very loose to medium dense; with trace gravel.

1270.5 ft

POORLY GRADED SAND (SP): very fine to fine grained; brown; saturated; loose to medium dense.

1264.7 ft

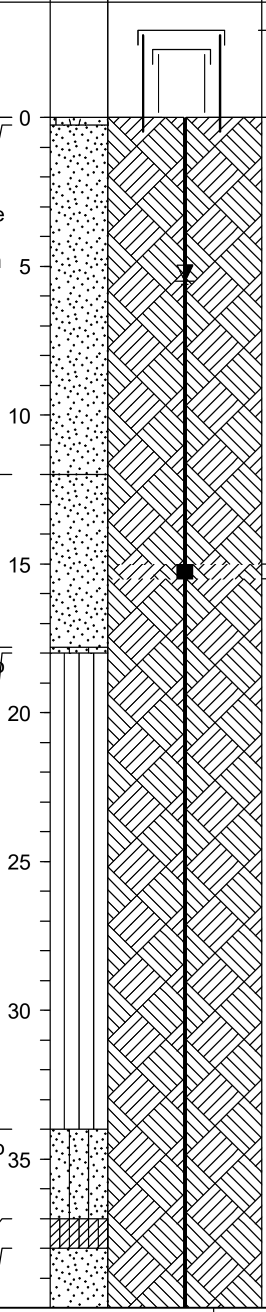
SILTY SAND (SM): fine to medium grained; brown; saturated.
1264.5 ft

SANDY SILT (ML): brown; saturated; loose to dense.

1248.5 ft

SILTY SAND (SM): fine to medium grained; brown; saturated; dense.
1245.5 ft

SILTY CLAY (CL-ML): brown; wet; very stiff.
1244.5 ft



DEPTH, ft		ELEVATION, ft
-4.0	TPC	1286.5
0.0	GS	1282.5
15.0	TVT	1267.5
15.5	BVT	1267.0

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING
Diameter: **4"**
Type: **Steel**
Interval: **-4 - 2 ft**

GROUT
Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 100 ft**

VIBRATING-WIRE TIP
Diameter: **19.1mm**
Type: **Geokon 4500S - 350kPa/700kPa**
Serial No.: **15ft: VW1930705, SV19_MiddleC**
49.5ft: VW1930704, SV19_MiddleB
89.5ft: VW1930857, SV19_MiddleA

Remarks: Drilled installation of vibrating wire piezometers.

Completion Depth:	100.0 ft
Date Started:	9/10/19
Date Completed:	9/13/19
Logged By:	PMD/RWO
Drilling Contractor:	Coleman
Drilling Method:	MRO
Datum:	NAD83, NAVD88
Coordinates:	N 459,699.1 ft E 24,104,369.0 ft

LEGEND

⁙ FILTER PACK
■ BENTONITE
▨ CEMENT GROUT
▦ CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

⊻ At Time of Drilling 5.5

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING SV-19-Middle

Sheet 2 of 3

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1282.5 ft	Top of Casing Elevation:

STRATA

POORLY GRADED SAND (SP): fine to medium grained; brown; wet; medium dense to dense. *(Continued)*

1238.5 ft

POORLY GRADED SAND (SP): coarse grained; multicolored; wet; medium dense to dense; with gravel.

1232.0 ft

POORLY GRADED GRAVEL (GP): medium dense.

1230.5 ft

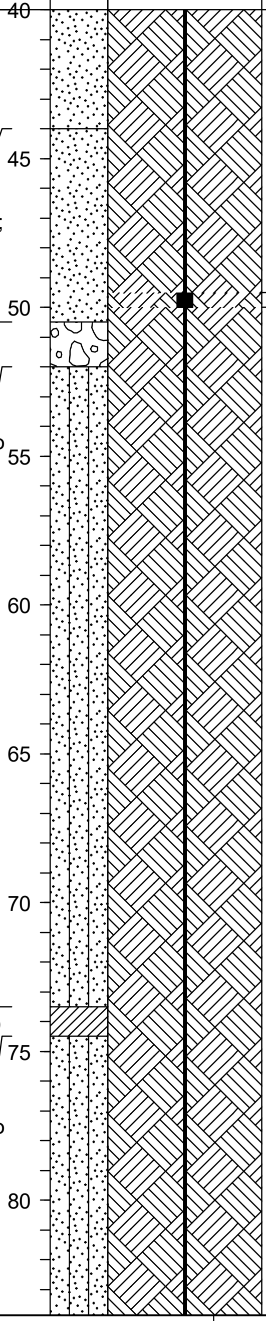
SILTY SAND (SM): fine to coarse grained; brown; wet; medium dense to dense.

1209.0 ft

LEAN CLAY WITH SAND (CL): brown; moist; very stiff.

1208.0 ft

SILTY SAND (SM): fine to coarse grained; brown; moist; medium dense to dense; little gravel.



DEPTH, ft		ELEVATION, ft
49.5	TVT	1233.0
50.0	BVT	1232.5

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING

Diameter: **4"**
Type: **Steel**
Interval: **-4 - 2 ft**

GROUT

Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 100 ft**

VIBRATING-WIRE TIP

Diameter: **19.1mm**
Type: **Geokon 4500S - 350kPa/700kPa**
Serial No.: **15ft: VW1930705, SV19_MiddleC**
49.5ft: VW1930704, SV19_MiddleB
89.5ft: VW1930857, SV19_MiddleA

Remarks: Drilled installation of vibrating wire piezometers.

Completion Depth:	100.0 ft
Date Started:	9/10/19
Date Completed:	9/13/19
Logged By:	PMD/RWO
Drilling Contractor:	Coleman
Drilling Method:	MRO
Datum:	NAD83, NAVD88
Coordinates:	N 459,699.1 ft E 24,104,369.0 ft

LEGEND

- ⁘ FILTER PACK
- ■ BENTONITE
- ▨ CEMENT GROUT
- ▩ CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling 5.5

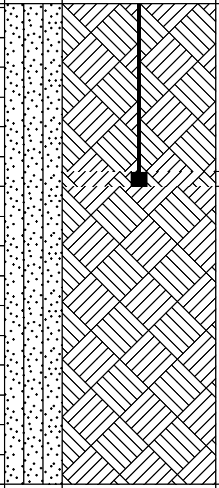
The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING SV-19-Middle

Sheet 3 of 3

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1282.5 ft	Top of Casing Elevation:

STRATA DESCRIPTION	DEPTH, ft	DEPTH, ft		ELEVATION, ft
SILTY SAND (SM): fine to coarse grained; brown; moist; medium dense to dense; little gravel. *(Continued)*	85			
		89.5	TVT	1193.0
	90	90.0	BVT	1192.5
	95			
1182.5 ft	100	100.0	TD	1182.5
Bottom of Boring at 100.0 feet				



PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING

Diameter: **4"**
Type: **Steel**
Interval: **-4 - 2 ft**

GROUT

Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 100 ft**

VIBRATING-WIRE TIP

Diameter: **19.1mm**
Type: **Geokon 4500S - 350kPa/700kPa**
Serial No.: **15ft: VW1930705, SV19_MiddleC**
49.5ft: VW1930704, SV19_MiddleB
89.5ft: VW1930857, SV19_MiddleA

Remarks: Drilled installation of vibrating wire piezometers.

Completion Depth:	100.0 ft
Date Started:	9/10/19
Date Completed:	9/13/19
Logged By:	PMD/RWO
Drilling Contractor:	Coleman
Drilling Method:	MRO
Datum:	NAD83, NAVD88
Coordinates:	N 459,699.1 ft E 24,104,369.0 ft

LEGEND

⁙ FILTER PACK
■ BENTONITE
▨ CEMENT GROUT
▩ CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling 5.5

The stratification lines represent approximate boundaries. The transition may be gradual.

LOG OF BORING SV-19-West

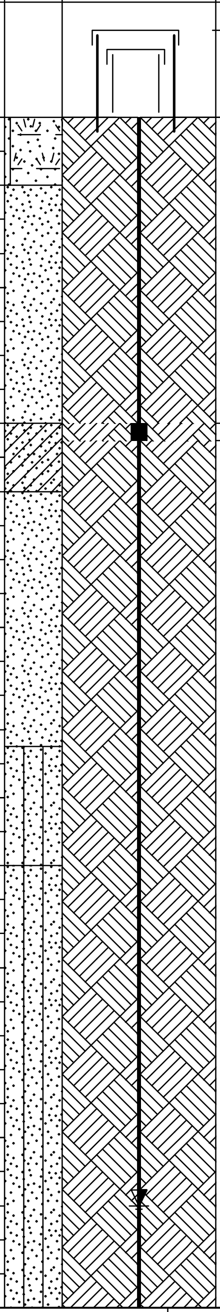
Sheet 1 of 2

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1345.8 ft	Top of Casing Elevation: 1349.8 ft

STRATA

DESCRIPTION	DEPTH, ft
TOPSOIL: brown; dry to moist; 1-ft of frost. 1343.8 ft	0
POORLY GRADED SAND (SP): fine grained; brown; wet; some silt seams; pushed rock with spoon at 5.0'. 1336.8 ft	5
CLAYEY SAND (SC): fine grained; brown; moist; trace clay (ML) and trace gravel (GP). 1334.8 ft	10
POORLY GRADED SAND (SP): fine to medium grained; brown; moist; trace clay; 18-18.5-ft 6-inch gravel layer in SP. 1327.3 ft	15
SILTY SAND (SM): fine to medium grained; brown; moist; trace clay (CL). 1323.8 ft	20
SILTY SAND (SM): fine to medium grained; brown; moist to wet; trace gravel.	25
	30

SYMBOL / PIEZOMETER DETAILS



DEPTH, ft		ELEVATION, ft
-4.0	TPC	1349.8
0.0	GS	1345.8
9.0	TVT	1336.8
9.5	BVT	1336.3

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING

Diameter: **6"**
Type: **Steel**
Interval: **-4 - 2 ft**

GROUT

Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 66.5 ft**

VIBRATING-WIRE TIP

Diameter: **19.1mm**
Type: **Geokon 4500S - 350kPa/700kPa**
Serial No.: **9ft: VW1943892, SV19_West C**
38ft: VW1943964, SV19_WestB
66ft: VW1943963, SV19_WestA

Remarks: Drilled installation of vibrating wire piezometers.

Completion Depth:	66.5 ft
Date Started:	12/3/19
Date Completed:	12/5/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	MRO
Datum:	NAD83, NAVD88
Coordinates:	N 459,893.4 ft E 2,413,563.8 ft

LEGEND

⁘	FILTER PACK
■	BENTONITE
▨	CEMENT GROUT
▦	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

▽ At Time of Drilling 32.0

The stratification lines represent approximate boundaries. The transition may be gradual.

Barr Engineering Company
325 South Lake Avenue, Suite 700
Duluth, MN 55802
Telephone: 218-529-8200

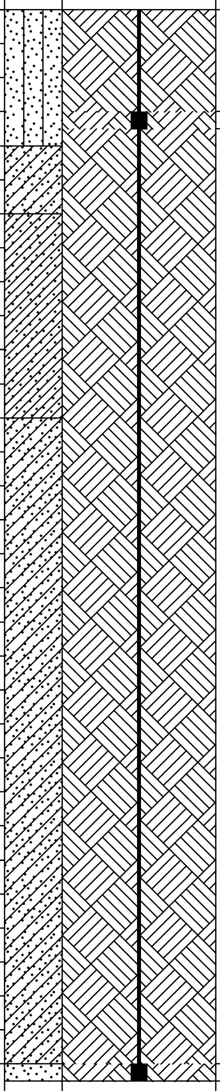
LOG OF BORING SV-19-West

Sheet 2 of 2

Project: Line 3 Replacement Spire Valley	Location: Cass County, MN	Client: Enbridge Energy
Barr Project Number: 49161299.10	Surface Elevation: 1345.8 ft	Top of Casing Elevation:

STRATA

DESCRIPTION	DEPTH, ft
SILTY SAND (SM): fine to medium grained; brown; moist to wet; trace gravel. *(Continued)*	35
1306.8 ft	
CLAYEY SAND (SC): fine to medium grained; gray; moist; trace gravel.	40
1304.8 ft	
SANDY CLAY (CL): gray; moist; trace fine grained gravel.	45
1298.8 ft	
CLAYEY SAND (SC): gray; moist to wet; trace gravel (GP).	50 55 60 65
1279.8 ft	
POORLY GRADED SAND (SP): fine to coarse grained; brown; wet.	
1279.3 ft	
Bottom of Boring at 66.5 feet	



DEPTH, ft		ELEVATION, ft
38.0	TVT	1307.8
38.5	BVT	1307.3
66.0	TVT	1279.8
66.5	TD	1279.3

PIEZOMETER CONSTRUCTION DETAILS FOR FULLY GROUTED VIBRATING-WIRE SENSOR

PROTECTIVE CASING

Diameter: **6"**
Type: **Steel**
Interval: **-4 - 2 ft**

GROUT

Type: **Bentonite Cement Grout**
Mix: **Cement (1.0) - Water (0.7) - Bentonite (0.04)**
Interval: **0 - 66.5 ft**

VIBRATING-WIRE TIP

Diameter: **19.1mm**
Type: **Geokon 4500S - 350kPa/700kPa**
Serial No.: **9ft: VW1943892, SV19_West C**
38ft: VW1943964, SV19_WestB
66ft: VW1943963, SV19_WestA

Remarks: Drilled installation of vibrating wire piezometers.

Completion Depth:	66.5 ft
Date Started:	12/3/19
Date Completed:	12/5/19
Logged By:	PMD
Drilling Contractor:	Coleman
Drilling Method:	MRO
Datum:	NAD83, NAVD88
Coordinates:	N 459,893.4 ft E 2,413,563.8 ft

LEGEND

⁘	FILTER PACK
■	BENTONITE
▨	CEMENT GROUT
▦	CUTTINGS / BACKFILL

TPC	TOP OF PROTECTIVE CASING
TRC	TOP OF RISER CASING
BPC	BASE PROTECTIVE CASING
GS	GROUND SURFACE
TVT	TOP VIBRATING-WIRE TIP
BVT	BOTTOM VIBRATING-WIRE TIP
TD	TOTAL DEPTH

WATER LEVELS(ft)

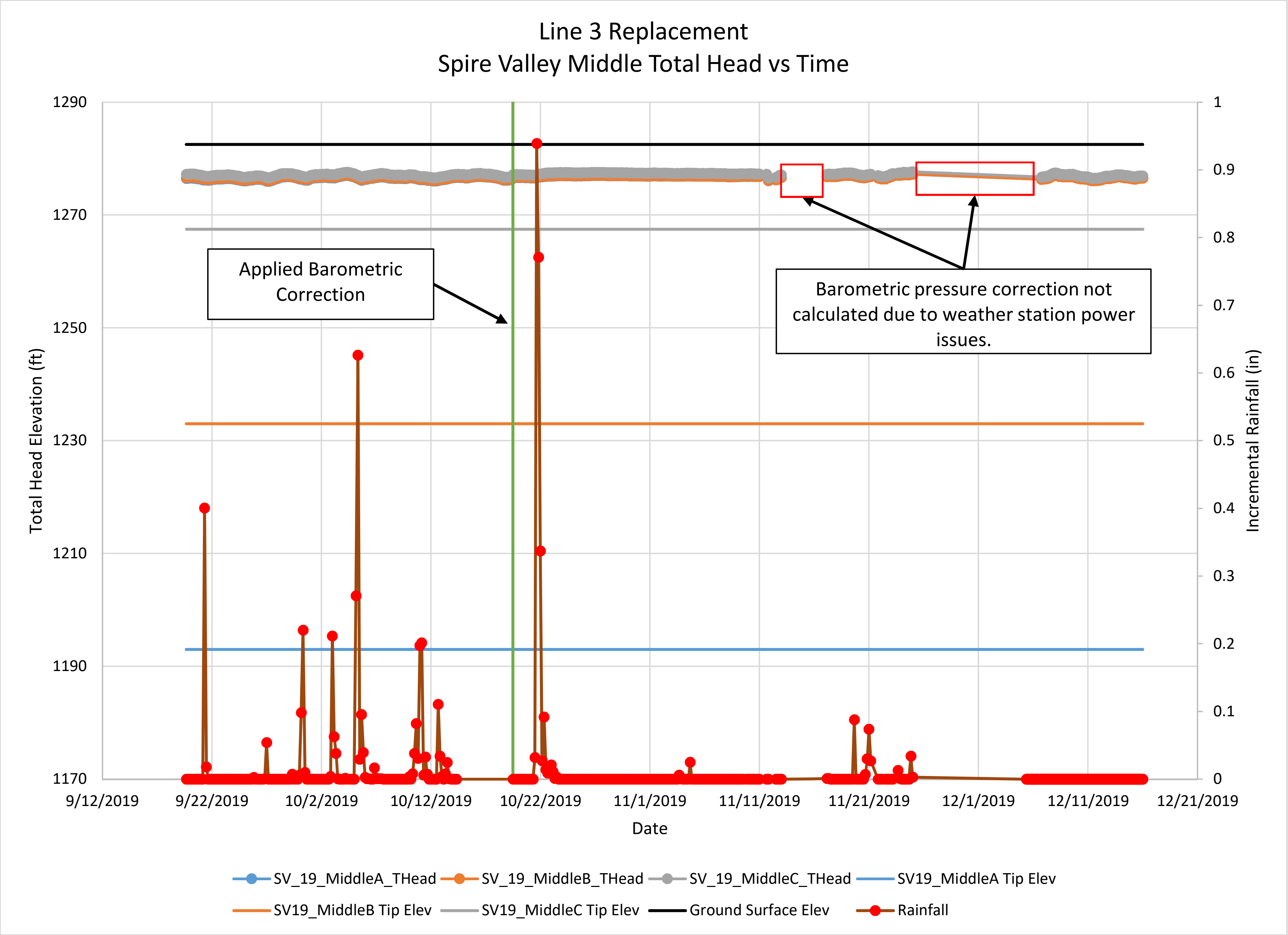
▽ At Time of Drilling 32.0

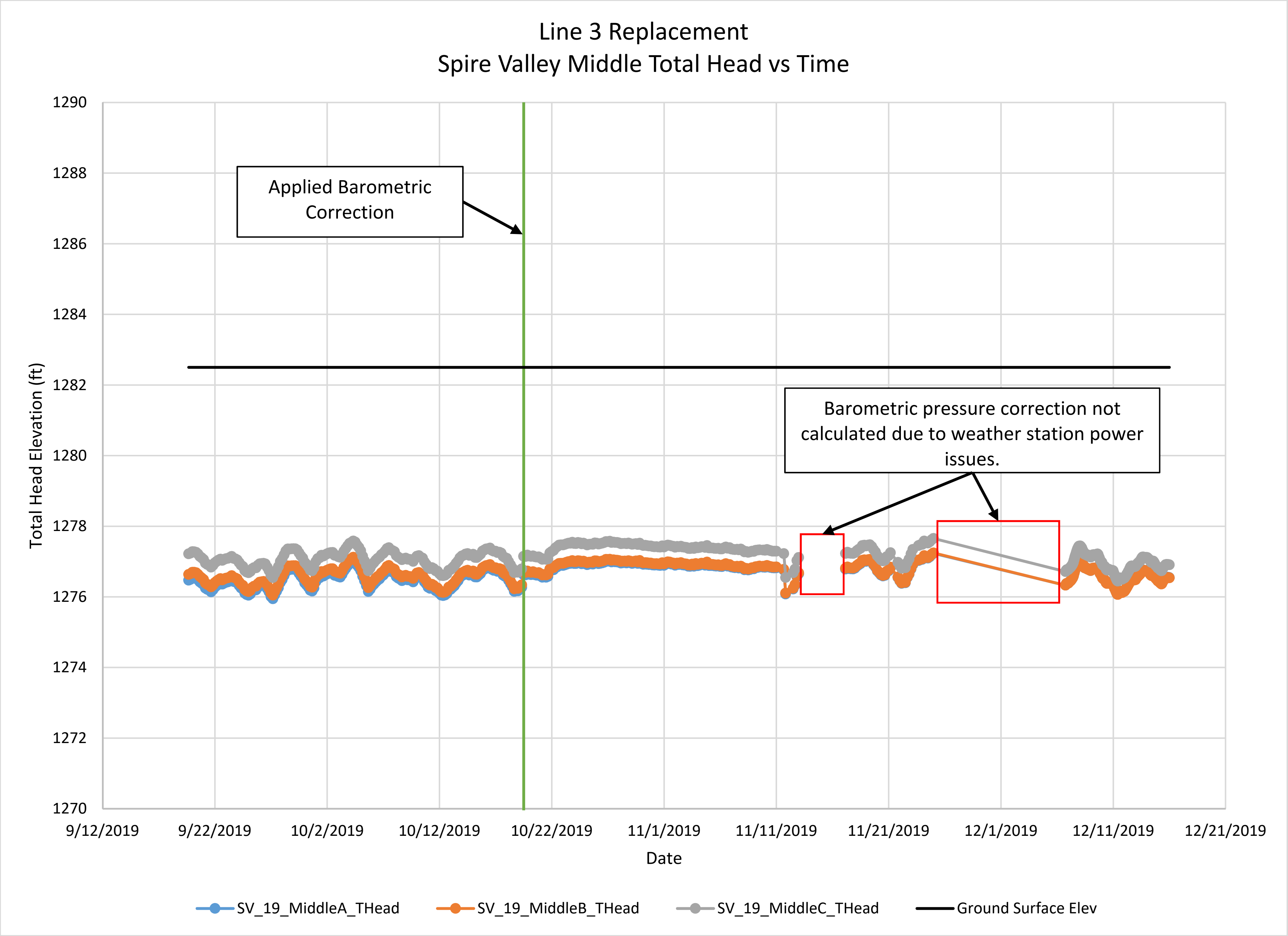
The stratification lines represent approximate boundaries. The transition may be gradual.

O:\GINT\PROJECTS\49161299 LINE 3 REPLACEMENT GEOTECH SURVEY\2019 HDD\49161299.10 SPIRE VALLEY_20191212.GPJ BARRLIBRARY.GLB INSTRUMENT LOG REPORT BARR TEMPLATE.GDT

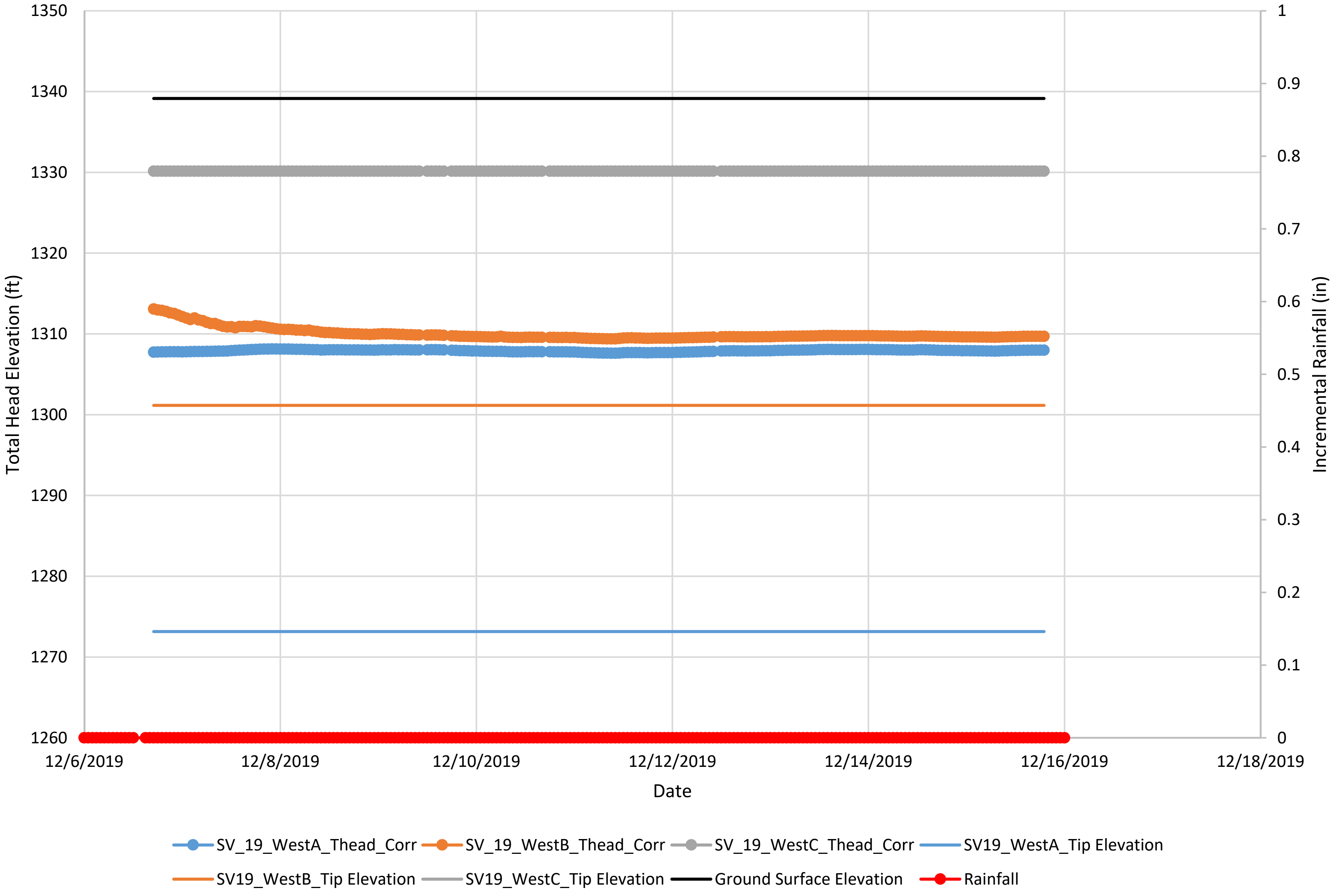
Attachment 2

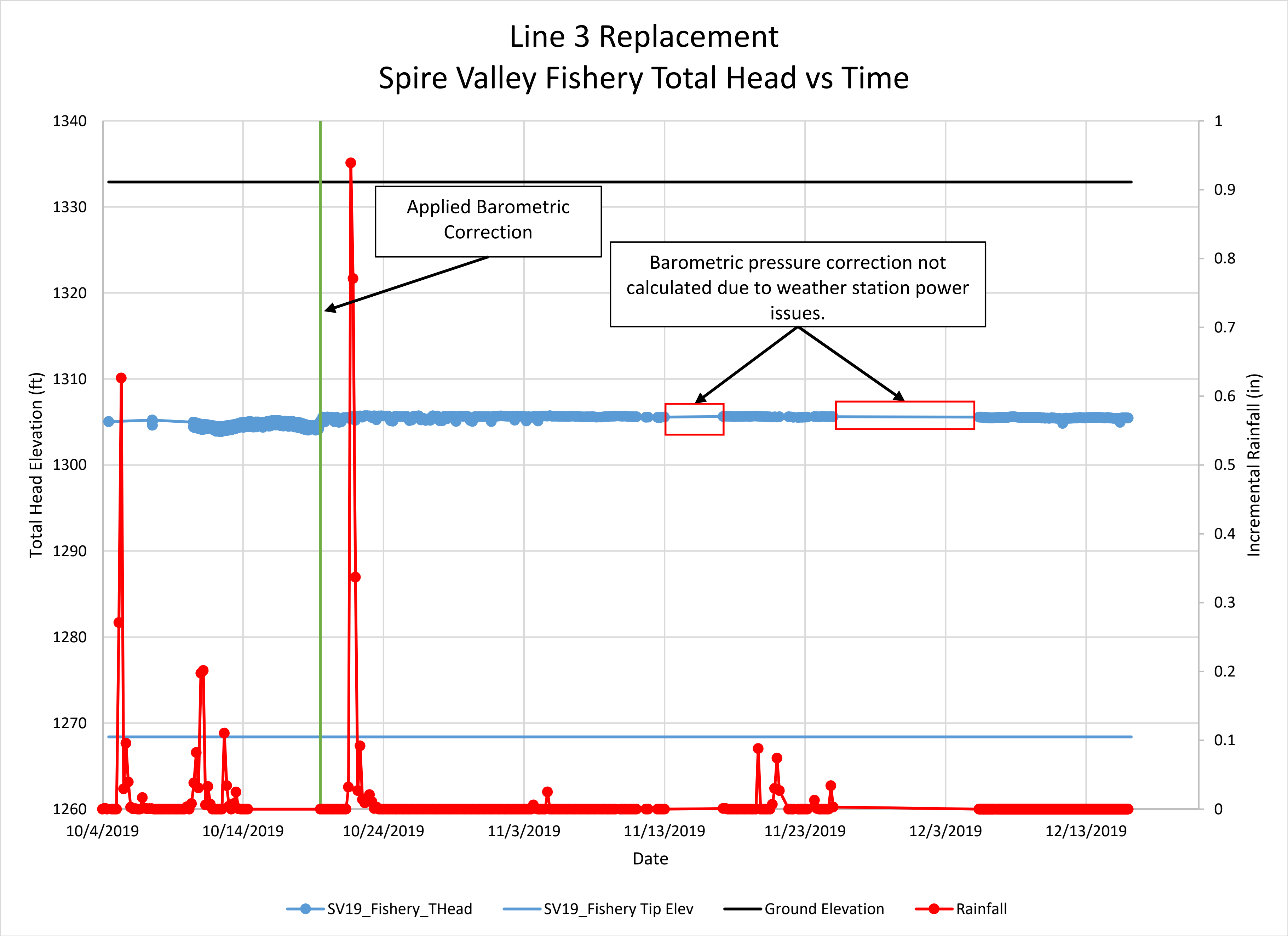
Instrumentation Logs

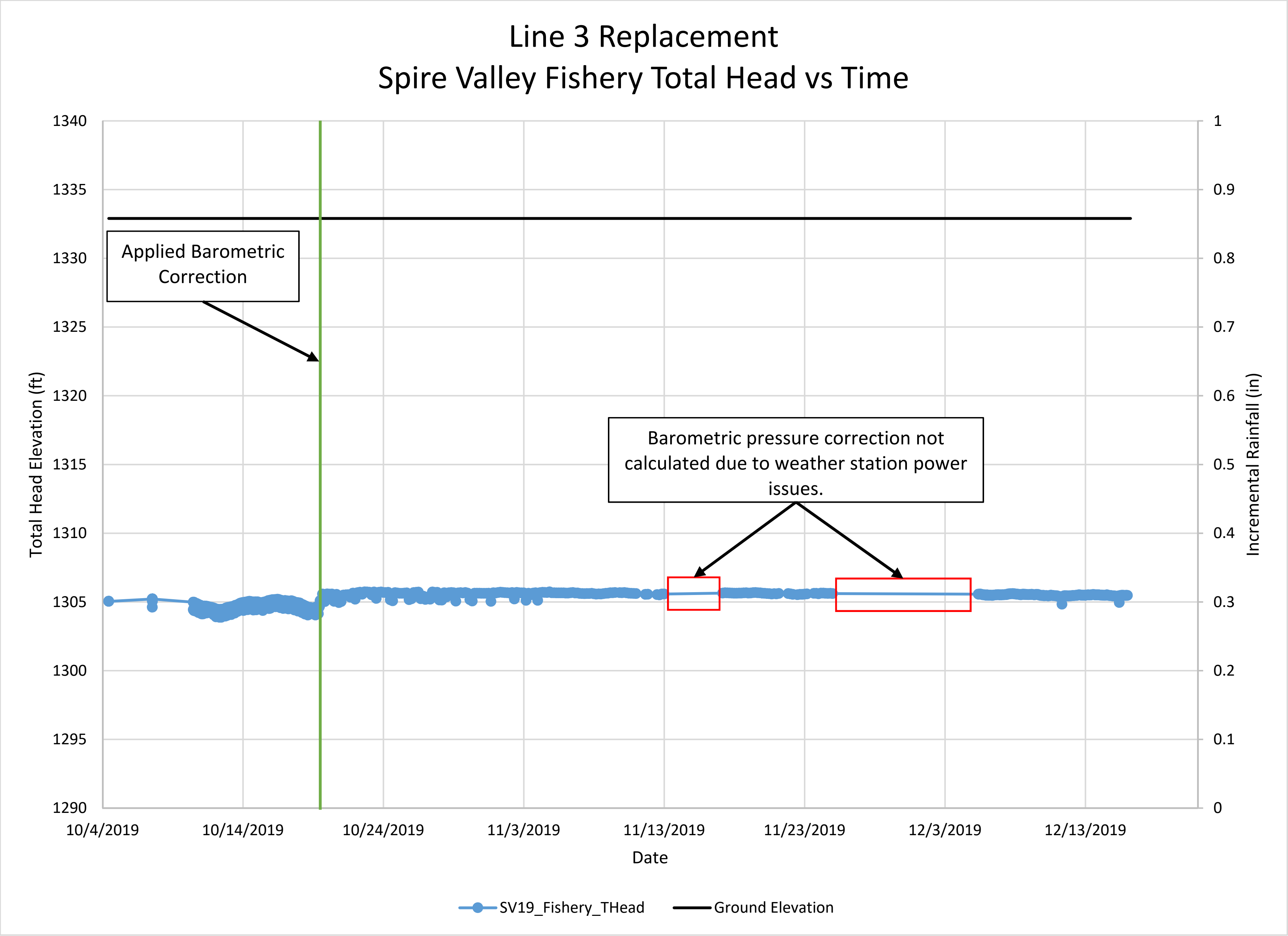

Line 3 Replacement
Spire Valley Middle Total Head vs Time
Total Head Elevation (ft)
1290
1270
1250
1230
1210
1190
1170
Incremental Rainfall (in)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
9/12/2019
9/22/2019
10/2/2019
10/12/2019
10/22/2019
11/1/2019
11/11/2019
11/21/2019
12/1/2019
12/11/2019
12/21/2019
Date
Applied Barometric Correction
Barometric pressure correction not calculated due to weather station power issues.
SV_19_MiddleA_THead
SV_19_MiddleB_THead
SV_19_MiddleC_THead
SV19_MiddleA Tip Elev
SV19_MiddleB Tip Elev
SV19_MiddleC Tip Elev
Ground Surface Elev
Rainfall

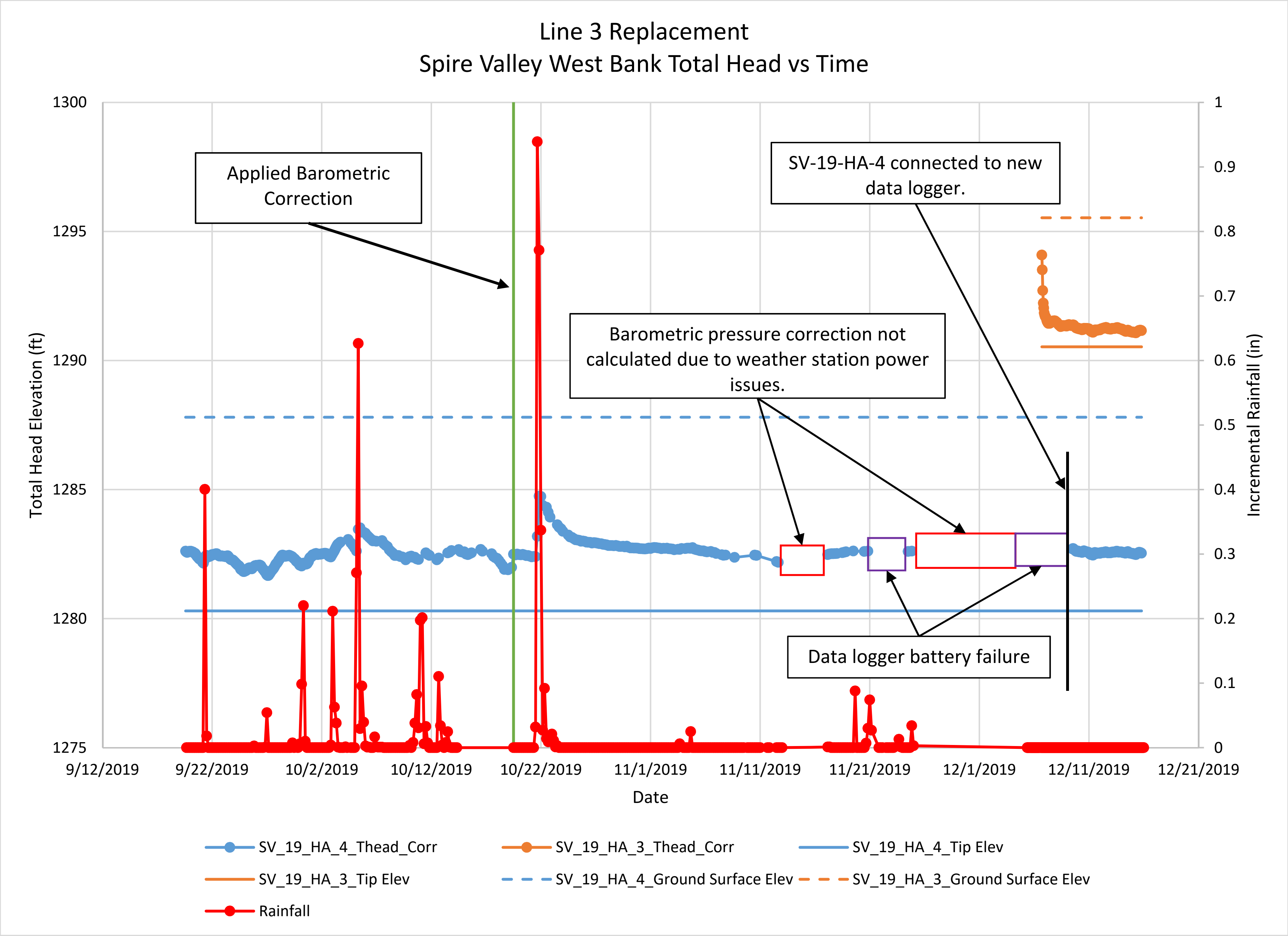

Line 3 Replacement
Spire Valley Middle Total Head vs Time
Applied Barometric Correction
Barometric pressure correction not calculated due to weather station power issues.
Total Head Elevation (ft)
1290
1288
1286
1284
1282
1280
1278
1276
1274
1272
1270
9/12/2019
9/22/2019
10/2/2019
10/12/2019
10/22/2019
11/1/2019
11/11/2019
11/21/2019
12/1/2019
12/11/2019
12/21/2019
Date
SV_19_MiddleA_THead
SV_19_MiddleB_THead
SV_19_MiddleC_THead
Ground Surface Elev

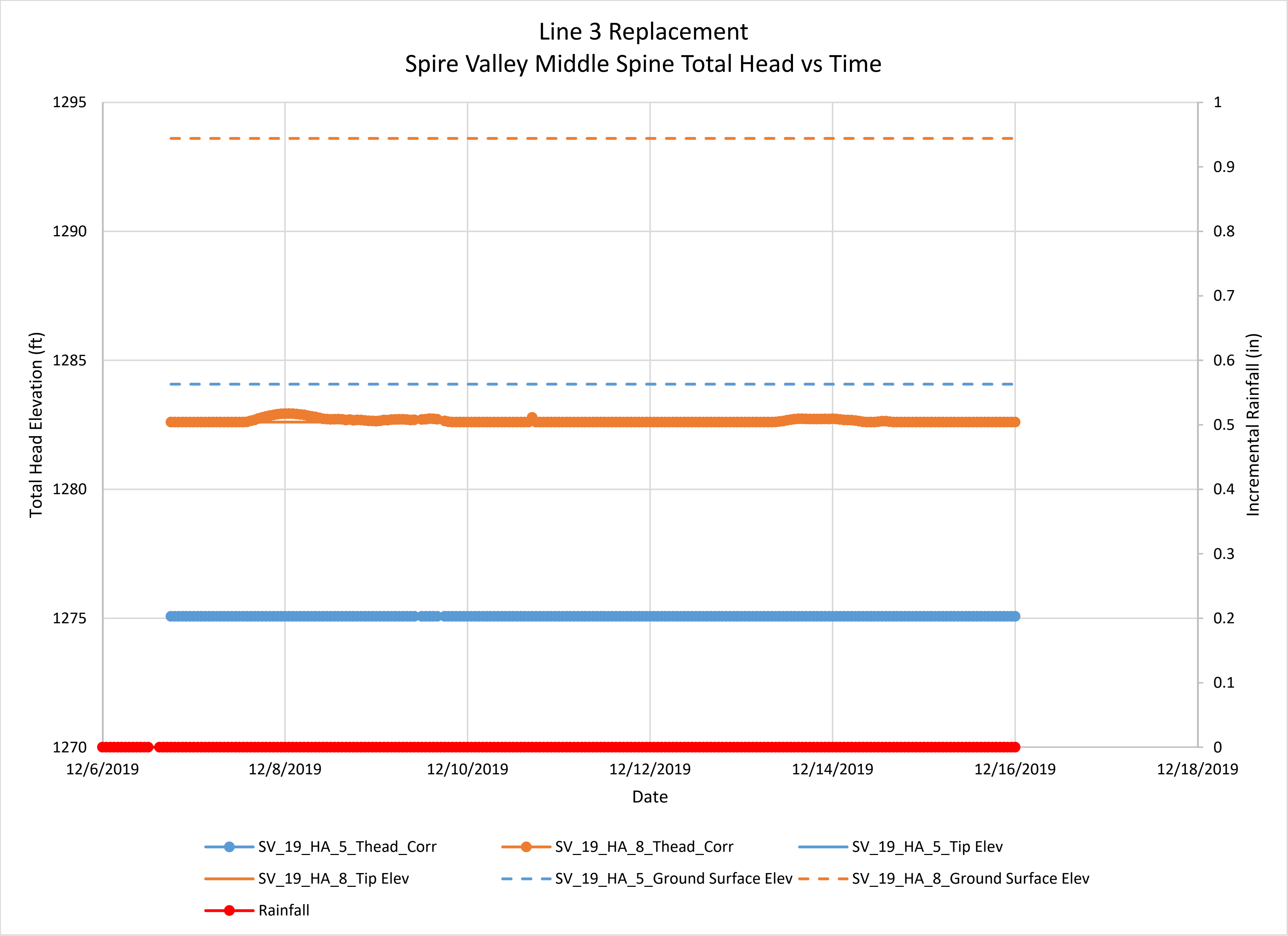
Line 3 Replacement
Spire Valley West Total Head vs Time



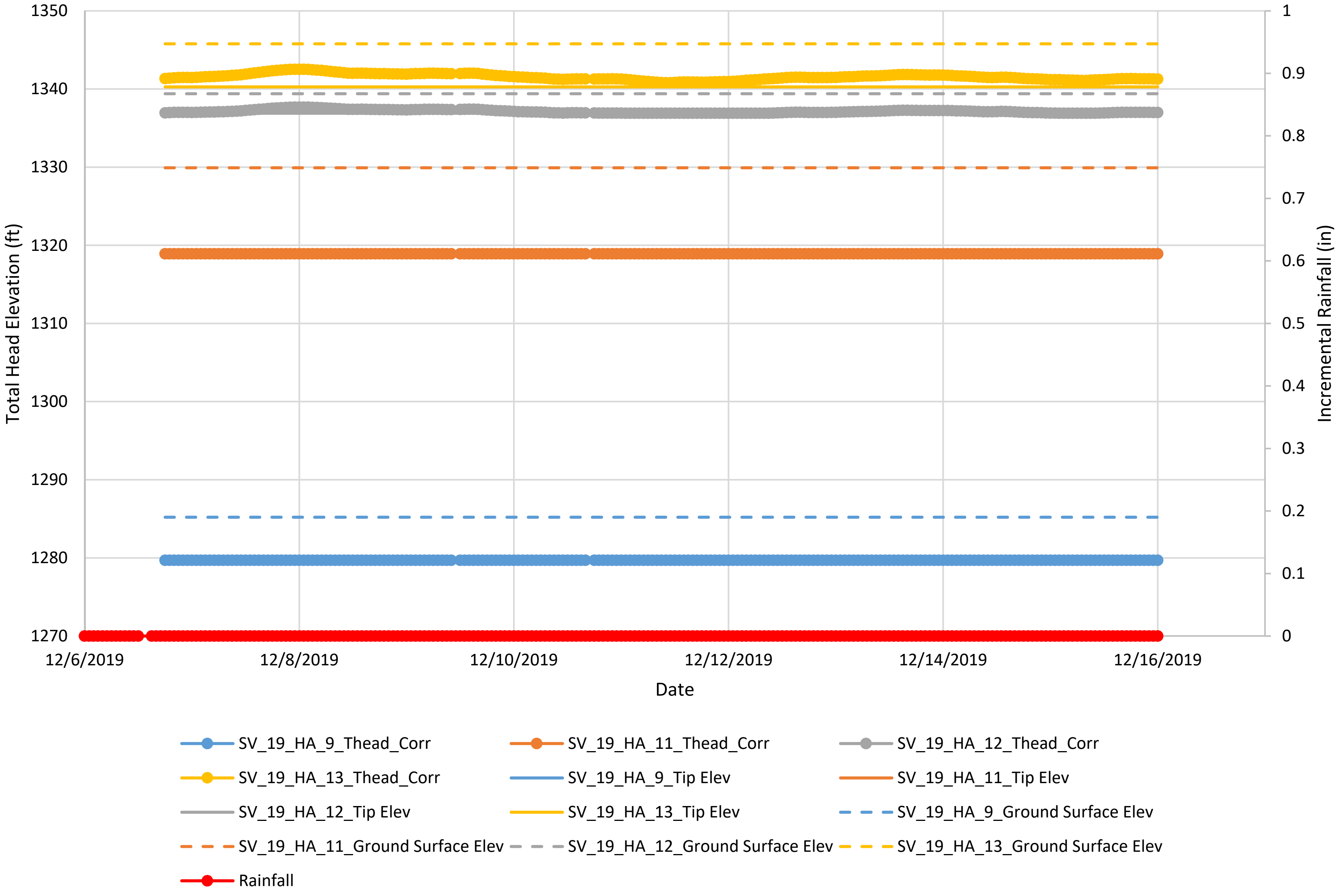

Line 3 Replacement
Spire Valley Fishery Total Head vs Time
Applied Barometric Correction
Barometric pressure correction not calculated due to weather station power issues.
Total Head Elevation (ft)
1340
1330
1320
1310
1300
1290
1280
1270
1260
Incremental Rainfall (in)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10/4/2019
10/14/2019
10/24/2019
11/3/2019
11/13/2019
11/23/2019
12/3/2019
12/13/2019
Date
SV19_Fishery_THead
SV19_Fishery Tip Elev
Ground Elevation
Rainfall


Line 3 Replacement
Spire Valley Fishery Total Head vs Time
Total Head Elevation (ft)
1340
1335
1330
1325
1320
1315
1310
1305
1300
1295
1290
Incremental Rainfall (in)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10/4/2019
10/14/2019
10/24/2019
11/3/2019
11/13/2019
11/23/2019
12/3/2019
12/13/2019
Date
Applied Barometric Correction
Barometric pressure correction not calculated due to weather station power issues.
SV19_Fishery_THead
Ground Elevation


Line 3 Replacement
Spire Valley West Bank Total Head vs Time
Applied Barometric Correction
SV-19-HA-4 connected to new data logger.
Barometric pressure correction not calculated due to weather station power issues.
Data logger battery failure
Total Head Elevation (ft)
1300
1295
1290
1285
1280
1275
Incremental Rainfall (in)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
9/12/2019
9/22/2019
10/2/2019
10/12/2019
10/22/2019
11/1/2019
11/11/2019
11/21/2019
12/1/2019
12/11/2019
12/21/2019
Date
SV_19_HA_4_Thead_Corr
SV_19_HA_3_Thead_Corr
SV_19_HA_4_Tip Elev
SV_19_HA_3_Tip Elev
SV_19_HA_4_Ground Surface Elev
SV_19_HA_3_Ground Surface Elev
Rainfall


Line 3 Replacement
Spire Valley Middle Spine Total Head vs Time
Total Head Elevation (ft)
1295
1290
1285
1280
1275
1270
Incremental Rainfall (in)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12/6/2019
12/8/2019
12/10/2019
12/12/2019
12/14/2019
12/16/2019
12/18/2019
Date
SV_19_HA_5_Thead_Corr
SV_19_HA_8_Thead_Corr
SV_19_HA_5_Tip Elev
SV_19_HA_8_Tip Elev
SV_19_HA_5_Ground Surface Elev
SV_19_HA_8_Ground Surface Elev
Rainfall

Line 3 Replacement
Spire Valley East Bank Total Head vs Time



Appendix H

Groundwater Management Contingency Plan

resourceful. naturally.
engineering and environmental consultants
BARR

Technical Memorandum

To: Julianne Motis
From: Ray Wuolo, PE, PG; Peter Demshar, PE
Subject: Line 3 Replacement – Spire Valley (Spring Brook) Groundwater Management Contingency
Date: August 14, 2020
Project: Line 3 Replacement
c: Megan Behrends and Russ Fischer

1.0 Project Background

The route of the proposed Line 3 Replacement project (L3R) crosses Spring Brook in Spire Valley, located north of Roosevelt Lake in Cass County, Minnesota. The area directly northeast of Roosevelt Lake is a location where artesian flowing conditions have been encountered during surface excavations. Previous investigations along the proposed L3R project in the Spire Valley area have been directed at identifying the potential for similar artesian flowing conditions along the project route and informing pipeline construction. Investigations have included the installation of shallow borings and piezometers, multi-level, deep piezometers, and monitoring of groundwater levels (via vibrating wire piezometers). These investigations did not encounter artesian conditions along the project route and did not identify a low-permeability zone that would act as a confining layer. Previous investigations did find groundwater seeps along the west-bank slope of Spring Brook that are consistent with a phreatic (i.e. water table) surface that intersects the ground surface topography near Spring Brook. Monitoring of the shallow and deep piezometers over several months shows that the shallow piezometers respond to rainfall events and short-term snow melting, whereas the deeper piezometers do not. These observations further reinforce the conclusion that shallow groundwater conditions are not under artesian pressure.

The purpose of this plan is to outline the groundwater management contingency steps that will be taken to control flow if unexpected flowing conditions are encountered during construction and what steps will be taken to monitor the conditions during construction.

2.0 Coordination and Preparation

Prior to beginning construction at the Spring Brook crossing, a drilling contractor with demonstrated experience in controlling flowing conditions will be engaged to discuss the details of the site, including the collected groundwater pressure and the geotechnical data. A supplemental sheetpile installation plan will be developed with the sheetpile contractor to contain unexpected flow. Barr staff familiar with the crossing plan and investigations will be engaged to review onsite conditions and current data prior to construction of the crossing.

Drilling Contractor Aquifer Drawdown and Grouting Plan

A specialty drilling contractor (Traut Companies of Waite Park, MN) will make a site visit prior to construction to develop a site specific plan based on the current conditions. This plan will identify the following items:

- Drill rig specification (hollow stem auger with capability for mud rotary)
- Accessibility and staging location
- Temporary well screen length, slot size, installation methodology
- Materials for installation
- Grout piping details
- Proposed injection pump
- Materials required for grouting including: Packers, hose, piping, power, water, etc.
- Grouting materials (MDH/MDNR approved).
- Dewatering discharge sediment management equipment

Supplemental Sheetpile Installation Plan

Prior to mobilization, the contractor responsible for the installation of the sheetpile at the crossing will submit a supplemental sheetpile plan to install additional sheeting around an area with uncontrolled flow, should unexpected flows be encountered. This plan is required to identify the following items:

- Sheetpile installation equipment
- Length and quantity of sheets available for installation
- Proposed method to build an access platform for the drilling contractor

Barr Premobilization Planning and Assistance

A professional geotechnical engineer or geologist from Barr that is familiar with the site will review the site-specific plans for both the drilling contractor and the sheetpile installer and provide comments prior to construction commencing. Additionally, this representative will review the current groundwater monitoring data and seepage at the site to develop action levels and establish conditions that would require action during construction.

3.0 Excavation Observation

A professional geotechnical engineer or geologist from Barr will be present during construction to monitor for signs of potential artesian conditions. Additional observation of the springs and seeps present at the site will occur during the installation of crossing piping. Near real-time monitoring of the groundwater pressure sensors will continue through construction with action levels to alert field staff of rises in pressure.

4.0 Contingency Planning

Evaluation of the area for soil piping and liquefaction will be ongoing throughout construction. If signs of increased groundwater seepage are observed, steps will be evaluated to determine what remediation method will be most effective to control the seepage. Some of the options include supplemental sheet pile installation (lateral isolation of work area), artesian aquifer depressurization, and grout injection to seal the artesian flow pathways. Actions that may be undertaken will depend on the conditions that develop and will be undertaken in consultation with the MDNR staff and Traut staff. These actions may include the following:

- Development of a work surface for well installation (if a temporary well is identified as a response). Drilling rig access to the proximity of increased seepage attributable to artesian flows will be constructed and a stable platform for the drilling operations will be established The development of the work surface will likely involve the use of mats in conjunction with minor surface grading.
- Artesian depressurization via installation of a temporary well. The well driller will set up the drilling rig at the prepared workspace and will advance a temporary dewatering well to a depth sufficient for pumping to depressurize artesian conditions and stop upward groundwater flow into the pipeline excavation and/or vicinity. A high-capacity pump will be installed in the well and pumped. Pumped water will be discharged through energy dissipation and sediment settling equipment and discharge to the ground surface at a location selected in consultation with MDNR staff. Dual roll-off frac tanks, piped in series, will be used. Energy dissipation of discharged water to the ground surface will likely include mats and temporary riprap to prevent erosion. Sustainable pumping rates required for depressurization will be established through informal specific capacity tests.
- Grout injection will begin when artesian pressures are controlled sufficiently to allow grout to set up. Grout will be injected into small-diameter borings in and around the area of uncontrolled seepage and given sufficient time to set up. Grouting depts will begin at the depth where artesian conditions were encountered and tremied upward to the ground surface. The goal of the injection is to fill preferential flow paths and higher conductivity zones within the strata overlying the artesian zone such that when well pumping ceases, there will no longer be seepage in excavations or ground surface. A grouting pattern will be executed from the outside perimeter towards the area of uncontrolled flow, followed by a set-up period and then the pumping in the well cease. Seepage conditions will then be monitored. If seepage is observed, the well pumping will recommence and additional grouting will take place.

- During the response, monitoring will continue in the on-site piezometers. Flow in Spring Creek will be monitored both upstream and downstream of the response action area using both stream gauging and stage monitoring. Pumping rate/duration will be monitored and recorded. Volume and rate of grout injection will be recorded. Visual inspection of the ground in the area around the response action will regularly occur to identify ground seepage and grout frac-outs.

The above response actions are anticipated to be sufficient to permanently stop artesian seepage, should it be encountered during construction. If the above response actions are not effective, the drilling contractor will be prepared to install a large diameter temporary well directly into the area of greatest seepage and inject grout directly into the well while pumping to depressurize. Grouting will continue until flows cease and the well will be grouted in place with the top of casing cut off below ground surface.

5.0 Site Restoration and Documentation

Upon successful completion of the response action, the response action site will be restored, as required in the Construction Plan, A technical memorandum will be prepared that includes the monitoring data and a detailed description of the response action and follow-up monitoring. Recommendations to changes in the long-term monitoring plan will be described, based on the observations made during the response action.