



# memo

Date: August 17, 2021

To: Minnesota Department of Natural Resources

From: Enbridge Line 3 Replacement Team

Re: **LaSalle Crossing Groundwater Investigation Plan – Revision 1**

This Groundwater Investigation Plan (GIP) outlines the work proposed to complete five (5) test borings for soil evaluation and groundwater pressure monitoring instrumentation installation near the alignment for Line 3R between MP 946.1 and 946.3, which is located south and east of the LaSalle Creek crossing, located in Hubbard County. Limited existing groundwater pressure data exists in this area, especially at depths that penetrate the confining layer. This GIP is intended to be responsive to requests contained in the August 6, 2021 email from Randall Doneen (DNR CAR Section Manager). The purpose of this plan is to provide an overview of the GIP goals and approaches for drilling in known artesian groundwater conditions.

As noted above, Enbridge's proposed scope of work includes the advancement of five (5) borings in locations proximal to the new pipeline alignment and adjacent to seeps observed at sheet pile installations (Figure 1). As described in subsequent sections, each of the borings are planned to penetrate through the confining layer into the likely artesian groundwater conditions, with up to two (2) additional borings to be terminated within or above the confining layer to provide vertical gradient information. Alternatively, multiple instruments may be placed within a single boring, depending on site conditions.

Instrumentation will be installed in each boring to evaluate and monitor groundwater pressure over time (both above and below the confining layer), as summarized below.

## 2021 Soil Boring and Pressure Monitoring Locations

The proposed boring locations and depths are outlined in Table 1 and are shown on the attached Figure 2. A cross section showing the prior boring data and proposed boring locations is included as Figure 3.

**Table 1 Boring Location Summary**

Borehole ID	Approximate Boring Depth (ft)	Boring Use	Sampling
LS-21-GIP-1, 2, 3, 4 & 5 <sup>(1)</sup>	Estimated 35' – Goal is 5 feet below bottom of confining layer	Define native stratigraphy interfaces and confined groundwater pressure	Continuous, minimally disturbed samples with targeted undisturbed sampling

(1) Offset borings may be completed for instrumentation installation. Offset borings would be blind drilled.

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## Drilling Approach

Based on the previous investigations and review of nearby water well logs, artesian conditions are anticipated at each boring location. As a result, the drilling fluid used for the planned borings will be designed to mitigate artesian pressures. A licensed and experienced contractor familiar with dealing with artesian conditions will be hired to complete the borings in accordance with Minnesota Rules, part 4725.3450 (Flowing Well or Boring).

Locations for borings were selected along this linear feature by consideration of spatial distribution and relative position to the groundwater expressions. Borings LS-21-GIP-1, LS-21-GIP-2 and LS-21-GIP-3 are located near seepage point 1 identified in Figure 2. LS-21-GIP-4 is located between seepage point 1 and seepage point 2 and LS-21-GIP-5 is located adjacent to seepage point 2 shown on Figure 2.

For each boring, a casing will be installed approximately 5 to 10 feet into the confining layer; the actual depth will be determined in the field. A casing affixed with a gate valve located at the ground surface will be cement grouted in place and allowed to cure for at least 24 hours. Following curing, the casing will be reamed out and the boring will be advanced using heavy drilling mud designed to prohibit artesian groundwater flow to the surface from developing. Following the completion of drilling, a vibrating wire piezometer will be placed in each boring, or with multiple piezometers installed in a single boring, at depths specified in Table 2. The full depth of the borehole will subsequently be backfilled with neat cement grout using tremie pipe methodology. The grout used will be higher density than the drilling mud to ensure displacement during injection of the neat cement grout.

## Instrumentation

Vibrating Wire (VW) piezometers will be installed in the borings at depths identified in Table 2. The VWs will be installed by being taped to a 1-inch diameter sacrificial grout rod and lowered into the borehole. All borings will be grouted in accordance with Minnesota Department of Health requirements or variances will be submitted, if required.

In addition to the existing weather station and existing piezometers LS-20-VW1 and LS-20-VW2; each a 3-piezometer observation nest, approximately 7 additional piezometers will be installed. They will be monitored with near-real-time collection of pressure head via cellular telephone modems powered by a solar panel array installed near the borings. The VWs and weather station will be connected to a fully automated monitoring system with telemetry to provide remote monitoring of all instrumentation at a 15-minute interval after installation and setup. This frequency may be increased for critical tasks, such as during sealing activities, or decreased for longer-term monitoring.

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**Table 2 Instrumentation Summary**

Borehole ID	Instrumentation Depth	Instrumentation Goal
LS-21-1, 2, 3, 4 & 5	At least 2 feet into the confined layer and 5 feet above the base of the confining layer <sup>(1)</sup>	Confined layer pressure and gradient within the confined layer

<sup>(1)</sup> Nested VWs or offset borings are planned in at least 2 of the borings

The goal of the instrumentation installation is to:

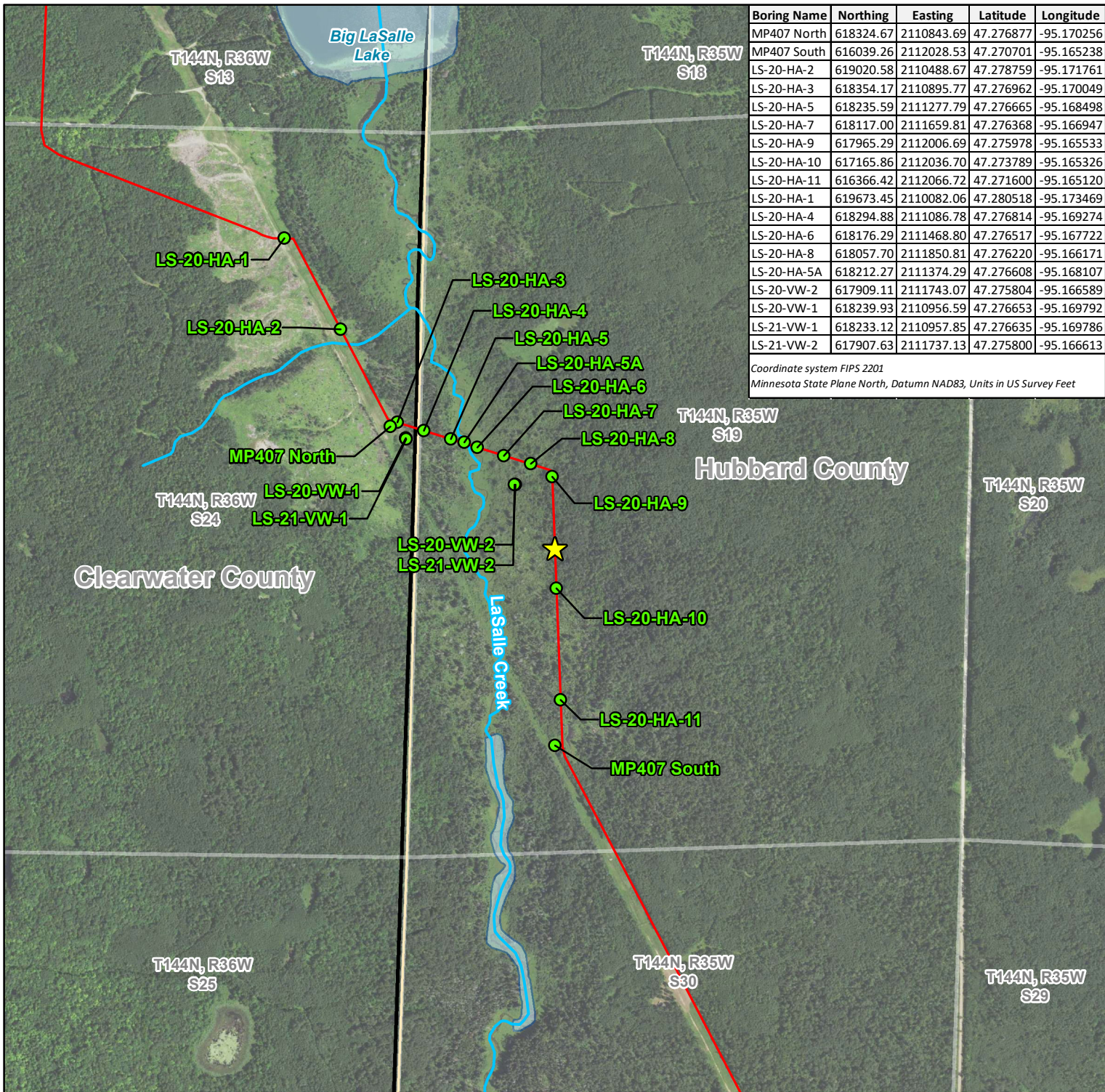
- Evaluate the pressure in the confined layer
- Evaluate the gradient within the confining layer
- Evaluate the differences in confining layer presence along the length of observed seepage
- Evaluate the effectiveness of future remediation
- Provide data necessary to develop a sealing plan

## Figures

Figure 1 LaSalle Creek Previous Boring Locations  
Figure 2 LaSalle Creek Proposed Boring Locations  
Figure 3 LaSalle Creek Cross Section

## Figures





Boring Name	Northing	Easting	Latitude	Longitude
MP407 North	618324.67	2110843.69	47.276877	-95.170256
MP407 South	616039.26	2112028.53	47.270701	-95.165238
LS-20-HA-2	619020.58	2110488.67	47.278759	-95.171761
LS-20-HA-3	618354.17	2110895.77	47.276962	-95.170049
LS-20-HA-5	618235.59	2111277.79	47.276665	-95.168498
LS-20-HA-7	618117.00	2111659.81	47.276368	-95.166947
LS-20-HA-9	617965.29	2112006.69	47.275978	-95.165533
LS-20-HA-10	617165.86	2112036.70	47.273789	-95.165326
LS-20-HA-11	616366.42	2112066.72	47.271600	-95.165120
LS-20-HA-1	619673.45	2110082.06	47.280518	-95.173469
LS-20-HA-4	618294.88	2111086.78	47.276814	-95.169274
LS-20-HA-6	618176.29	2111468.80	47.276517	-95.167722
LS-20-HA-8	618057.70	2111850.81	47.276220	-95.166171
LS-20-HA-5A	618212.27	2111374.29	47.276608	-95.168107
LS-20-VW-2	617909.11	2111743.07	47.275804	-95.166589
LS-20-VW-1	618239.93	2110956.59	47.276653	-95.169792
LS-21-VW-1	618233.12	2110957.85	47.276635	-95.169786
LS-21-VW-2	617907.63	2111737.13	47.275800	-95.166613

Coordinate system FIPS 2201  
Minnesota State Plane North, Datum NAD83, Units in US Survey Feet



- ★ Site Location
- Previous Geotechnical Exploration Locations
- Proposed Line 3 Replacement
- Rivers & Streams
- Waterbodies
- County Boundary

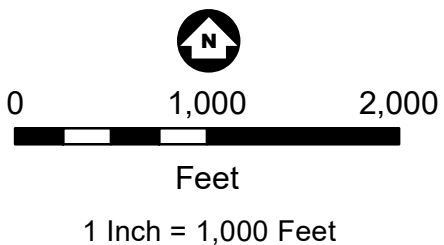
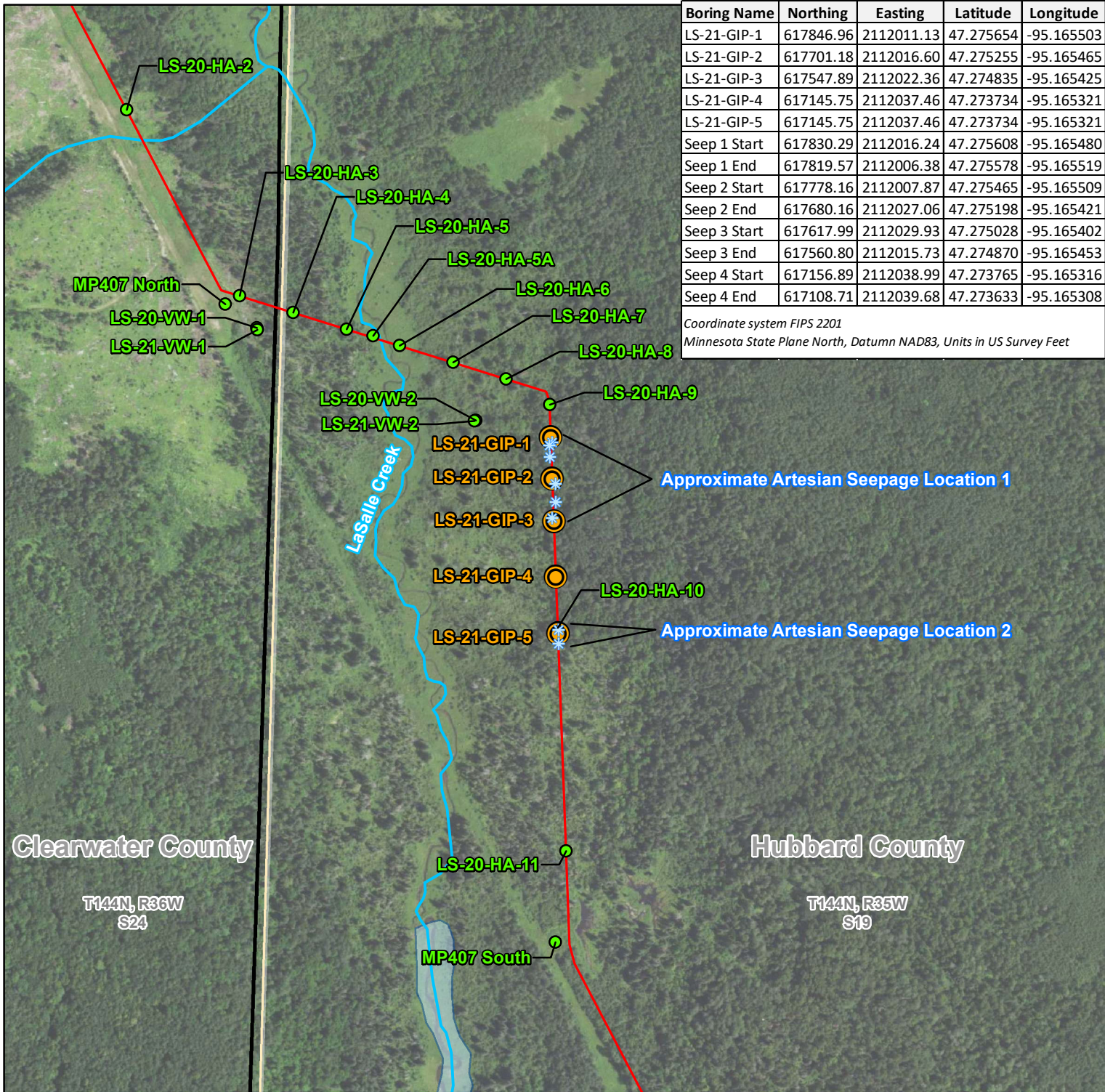


Figure 1  
**LASALLE CREEK  
EXISTING BORING LOCATIONS**  
Enbridge Energy, L.P.  
Hubbard County, Minnesota

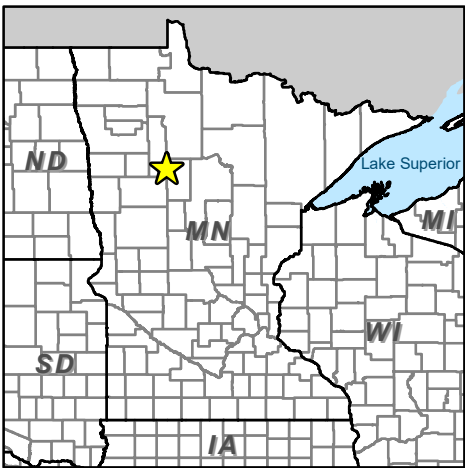






Boring Name	Northing	Easting	Latitude	Longitude
LS-21-GIP-1	617846.96	2112011.13	47.275654	-95.165503
LS-21-GIP-2	617701.18	2112016.60	47.275255	-95.165465
LS-21-GIP-3	617547.89	2112022.36	47.274835	-95.165425
LS-21-GIP-4	617145.75	2112037.46	47.273734	-95.165321
LS-21-GIP-5	617145.75	2112037.46	47.273734	-95.165321
Seep 1 Start	617830.29	2112016.24	47.275608	-95.165480
Seep 1 End	617819.57	2112006.38	47.275578	-95.165519
Seep 2 Start	617778.16	2112007.87	47.275465	-95.165509
Seep 2 End	617680.16	2112027.06	47.275198	-95.165421
Seep 3 Start	617617.99	2112029.93	47.275028	-95.165402
Seep 3 End	617560.80	2112015.73	47.274870	-95.165453
Seep 4 Start	617156.89	2112038.99	47.273765	-95.165316
Seep 4 End	617108.71	2112039.68	47.273633	-95.165308

Coordinate system FIPS 2201  
Minnesota State Plane North, Datum NAD83, Units in US Survey Feet



- ★ Site Location
- LaSalle Creek Proposed Borings
- Previous Geotechnical Exploration Locations
- ★ Inventoried Flow Locations
- Proposed Line 3 Replacement
- Rivers & Streams
- Waterbodies
- County Boundary

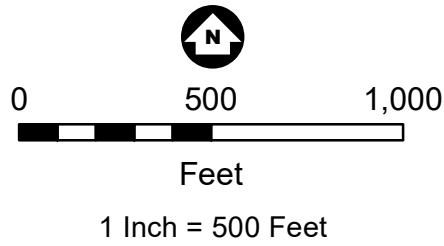
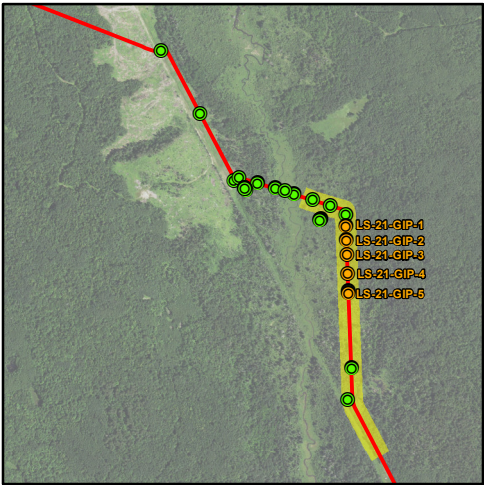
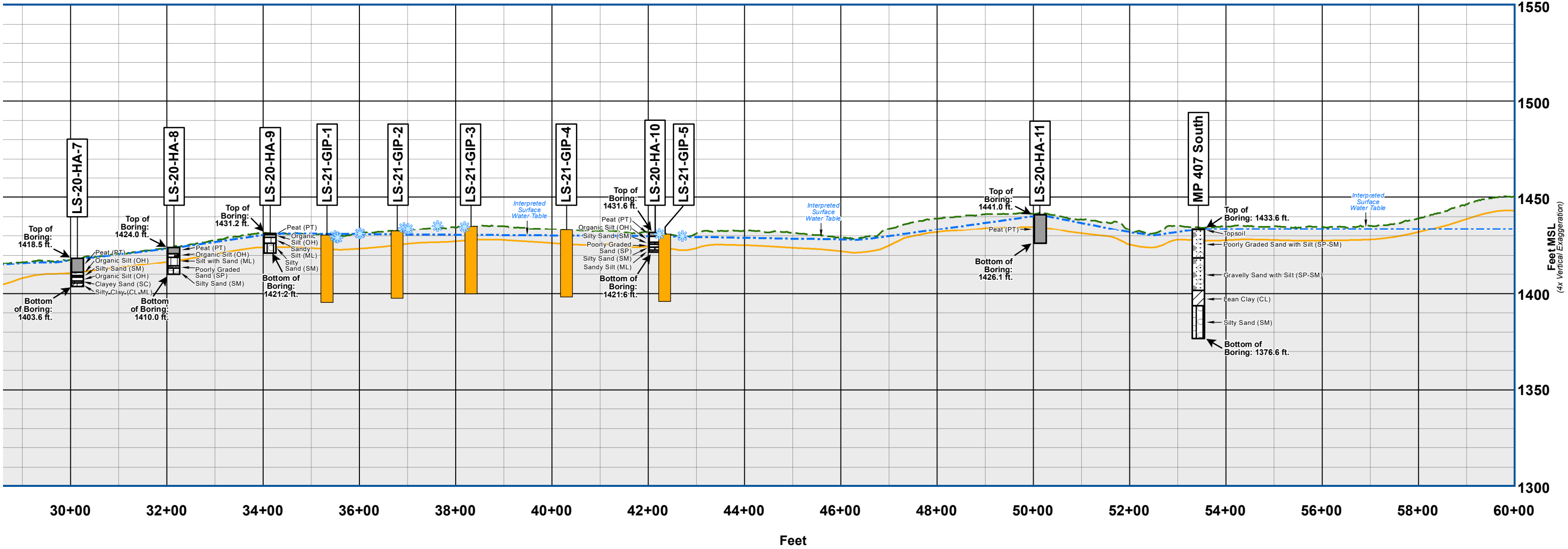


Figure 2  
**LASALLE CREEK  
PROPOSED BORING LOCATIONS**  
Enbridge Energy, L.P.  
Hubbard County, Minnesota







**NOTE:**  
Topographic information depicted based on MnTOPO LiDAR elevation data.

Figure 3  
**CROSS SECTION**  
LaSalle Creek  
Line 3 Mainline Replacement  
Clearwater & Hubbard Counties, MN

**ENBRIDGE**