

**ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
GEOHAZARD ASSESSMENT PROGRAM
NORTH CENTRAL REGION – ATHABASCA &
FORT MCMURRAY DISTRICTS
2023 SITE INSPECTION**



Site #	Location	Name	Hwy	km
NC008	15.6 Km North of Hwy 63 & 55 Intersection	La Biche River (0.8 to 0.9 km North of Bridge)	63:02	15.6
Legal Description		UTM Co-ordinates (NAD 83)		
3-69-17 W4		12	N 6089536	E 403480

	Date	PF	CF	Total
Previous Inspection:	June 07, 2022	10	4	40 (New Landslide)
Current Inspection:	May 17, 2023	11	4	44 (New Landslide)
Road WAADT:	3,960		Year:	2022
Inspected By:	José Pineda, Tarek Abdelaziz (Thurber) Arthur Kavulok, Kristen Tappenden (TEC)			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

Primary Site Issue	An Active landslide within the western side slope of the highway southbound lanes, causing severe drop and deterioration to western half of the highway southbound lanes
Dimensions:	About 90 m wide (parallel to the highway alignment) and 40 m long (perpendicular to the highway alignment)
Site History:	<p>The current landslide area (NC008-2) is to the south of the NC08-1 landslide site, which was repaired in the fall of 1997.</p> <p>Available information suggests that this stretch of the highway (along previous Highway 63 lanes prior to the implementation of the twinning project) has been showing slide movements since 1987. Initial attempts in the year 1990 to improve the highway condition consisted of the installation of a cut-off drain along the east side of the highway with the intention of intercepting the seepage from the swampy area to the east. However, after some time this drain was covered with silt and became non-functional. A subsequent attempt to repair the slide consisted of the installation of a centre line culvert in 1996 to allow runoff water from the east swampy area to drain out toward the oxbow lake.</p> <p>During the fall of 1997, additional repairs were conducted at the NC008-1 site. The repair consisted of (a) excavating and replacing a 100 m long section of the roadway with compacted clay and granular backfill, (b) placing a 600 mm thick granular drainage layer below replacement zone to reduce pore pressure build up, (c) constructing a 230 m long toe berm along the toe of the slope to the south of the ALPAC road , (d) regarding the east ditch and installing a 900 mm diameter culvert across ALPAC road to the north of the site, and (e) abandoning centre line culverts below original highway 63.</p> <p>The highway was twinned between 2014 and 2015 and the old highway, where previous and current instabilities took place, became the new southbound lanes of the current highway. There is a new centerline culvert (Culvert C2) below the southbound lanes that may</p>

	<p>have been installed during the highway twinning projects. It also appears that the OH powerlines may have been relocated to the west side of the southbound lanes during the implementation of the highway twinning project.</p> <p>A geotechnical investigation, consisting of drilling three test holes along with the installation of a slope inclinometer and four piezometers, was completed in 2020. The test holes indicated that the stratigraphy within the slope consists of 3 to 4 m of high plastic clay fill underlain by a high plastic firm clay foundation to 21 m depth. The native clay was noted to be stiffer 14 to 16 m below existing ground surface.</p>	
Maintenance/Repairs:	<p>Cracks were spray patched by TEC in 2020; the beaver dam to the north of the culvert C1 outlet location and beaver dam 1 to the east of the culvert inlet location were cleared by the County in 2020.</p> <p>ACP patch was placed in 2022 along the section of the highway being impacted by landslide movement.</p>	
Observations:	Description	Worse?
<input checked="" type="checkbox"/> Pavement Distress	<p>New landslide (NC008-2): reflective landslide cracks up to 50 mm wide and up to 10 mm drop in the western half of the highway south bound lane for a distance of about 90 m; pothole up to 900 mm long x 400 mm wide x 100 mm deep near the south end of the landslide</p> <p>Old landslide repaired in 2007 (NC008-1): up to 400 mm wide x 90 mm deep reflective cracks with no significant drop in pavement; multiple potholes on highway driving lanes</p>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	New landslide (NC008-2): Multiple reflective head scarp cracks (up to 50 mm wide reappeared shortly after the 2022 ACP patch); toe bulge in the oxbow lake continues to narrow the oxbow lake at the landslide location	<input type="checkbox"/>
<input type="checkbox"/> Erosion		<input type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	Oxbow lake downslope of the highway; low water level in the oxbow lake by the highway	<input type="checkbox"/>
<input type="checkbox"/> Bridge/Culvert Distress		<input type="checkbox"/>
<input checked="" type="checkbox"/> Other	<p>Three beaver dams were previously noted within the Oxbow Lake. Beaver dam 1 was cleared in 2020; beaver dam 2 was breached at the NE corner in 2022; beaver dam 3 has been exposed since 2022.</p> <p>Previously submerged Culvert C1 below the ALPAC road was visible due to the removal of the beaver dam to the north of the culvert outlet location. Water was free flowing into the culvert to drain the Oxbow Lake and flooded area noted in 2020; continuous heavy flow from culvert C2 below highway 63 south bound lanes.</p>	<input type="checkbox"/>

Instrumentation Readings (2SIs, 1 SPs, 2VWs; Spring 2023):

SI1B did not show discernable movement since the fall of 2022 readings. SI20-2 showed a rate of movement of 0.7 mm/yr over 3.8 m to 7.4 m depth since the fall of 2022.

Standpipe piezometers SP20-1 showed groundwater depth of 1.77 m corresponding to a decrease in groundwater level of 0.31 m since the piezometers were last read in the fall of 2022.

Vibrating wire piezometers VW20-2A and VW20-2B showed groundwater depths of 3.15 m and 3.11 m, respectively, corresponding to decreases in groundwater level of 0.68 m and 0.6 m, respectively, since they were last read in the fall of 2022.

Assessment and Observations (Refer to attached Figures and Photos):

Fill placement on the top of the weak high plastic clay foundation and high groundwater levels within the clay fill and native clay are the main triggers for the landslide movement. It is likely that the presence of beaver dams within the oxbow lake resulted in high ground water levels within the landslide mass and aggravated the situation in the past.

The observed water levels in the oxbow lake in 2022 and 2023 were much lower than in the past, and this appears to have reduced the rate of movement of the landslide over the last couple of years.

The ACP patch placed in 2022 improved the highway driving condition within the NC008-2 landslide area. However, landslide cracks reflected on the highway surface and these cracks are expected to get worse and will contribute to faster deterioration of the highway surface condition until long-term repairs take place.

Although the new landslide is currently creeping, accelerated landslide movement may occur in the future resulting in a partial road closure and a major detour. Power and phone services may also get impacted by additional landslide movements.

The flooded area, noted in 2020 within the northern limit of the site, drained through Culvert C1 after the removal of the beaver dams. This helped reducing water levels within the oxbow lake and the likelihood of flooding the ALPAC road. If the beaver dams are not kept under control, progressive rise in water levels in future years could result in washout of the ALPAC road and saturation of highway 63 embankment fills (depending on the beaver dam's height and water levels in the oxbow lake).

The highway surface is in a bad condition within the limits of the NC008-1 site, and this continued to create a rough ride to motorists.

Recommendations:

This site should be visited again in the spring of 2024.

In the short term, the local MCI should:

- (a) Monitor the highway surface periodically for signs of distress and watch closely for the development of additional cracks and highway dip (particularly after prolonged rainfall events). The highway surface cracks at NC008-1 and NC008-2 locations should be sealed to prevent surface water infiltration into the landslide masses. The potholes along the highway surface should also be filled with ACP to prevent further deterioration of the highway surface conditions.
- (b) Consideration should be given to placing ACP patch within the limits of the NC008-1 (old landslide) location to improve highway rideability.
- (c) Consider removing all beaver dams within the oxbow lake to further reduce water levels within the highway embankment.

The long-term repair may include any of the following options:

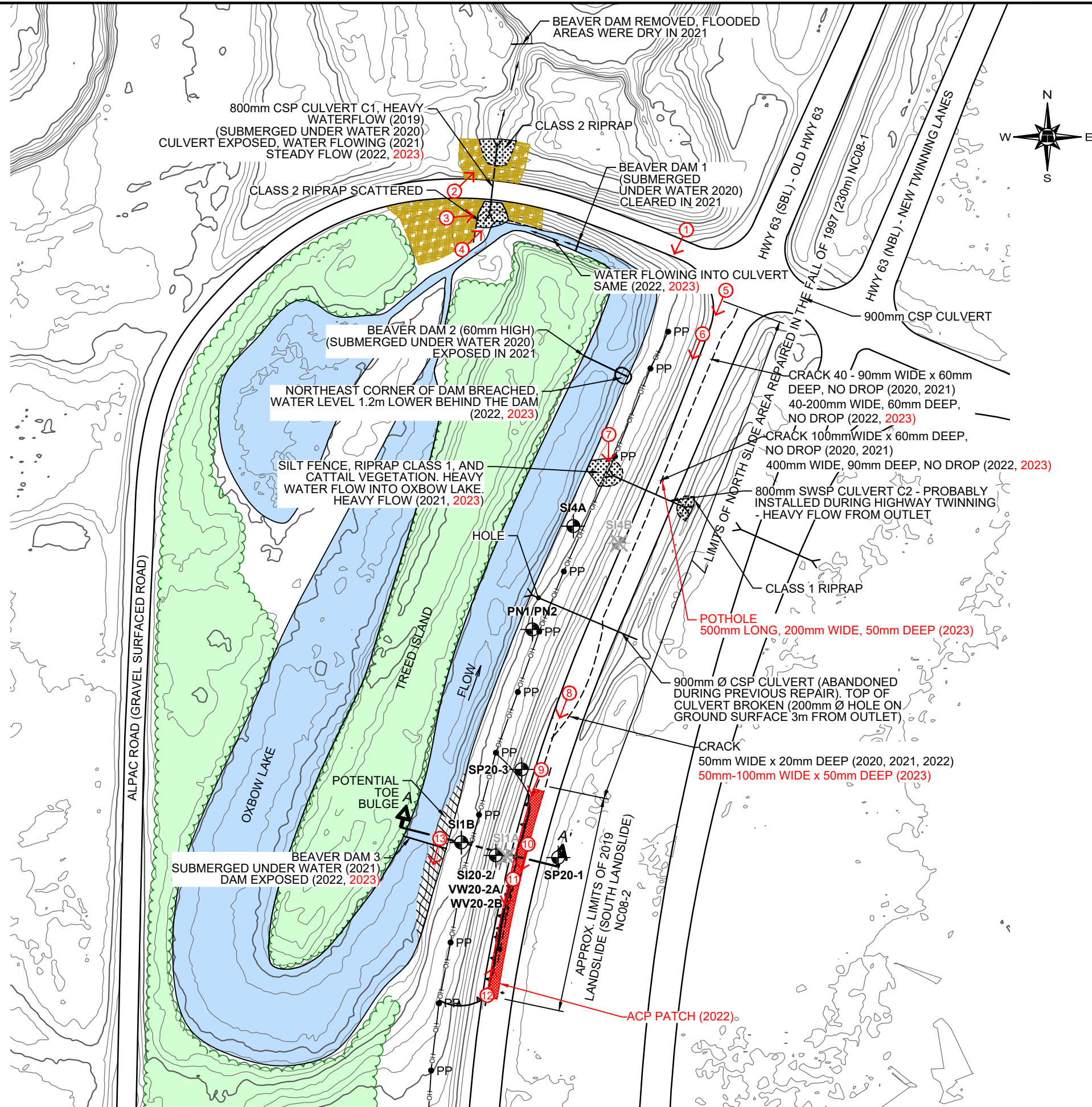
- a) Re-align the highway to the east of its current location outside the limits of the active landslide and excavate the current embankment at NC008-2 location to unload the active landslide mass. The estimated cost of this option would be in the range of \$1,100,000 (excluding engineering, assuming 250 to 300 m of new alignment and including extension of centerline culvert). However, this option would need to be investigated further because two horizontal curves would need to be established in a short distance at a travelling speed of 110 Km/hr.
- b) Unload the landslide through partial removal and replacement of the highway fill with lightweight fill (e.g., EPS foam). A drainage blanket along with subdrains will need to be installed below the foam to prevent flotation. The estimated cost of this option would range of \$2,200,000 (excluding Engineering) and this may require one lane closure or a temporary detour to complete the construction.
- c) Reinforce the slip surface of the landslide by constructing a cast-in-place pile wall within the SBL west side slope. The estimated cost of a pile wall would be in the range of \$ 2,200,000.

Closure

It is a condition of this letter report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

Yours very truly,
Thurber Engineering Ltd.
Tarek Abdelaziz, Ph. D., P.Eng.
Principal | Geotechnical Review Engineer

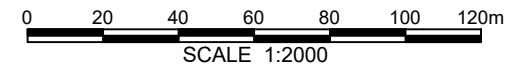
José Pineda, M.Eng., P.Eng.
Associate | Senior Geotechnical Engineer



LEGEND

- APPROXIMATE TEST HOLE LOCATION
- SLOPE INCLINOMETER
- VIBRATING WIRE PIEZOMETER
- STANDPIPE PIEZOMETER
- DESTROYED INSTRUMENT
- ACTIVE LANDSLIDE SCARP CRACK
- CRACK
- GROUND SURFACE CONTOUR
- OVERHEAD POWERLINE
- POWER POLE
- CULVERT
- EROSION CONTROL BLANKET
- APPROXIMATE DIRECTION AND NUMBER OF PHOTO

- NOTES:**
1. SITE FEATURES ARE APPROXIMATE
 2. TOPOGRAPHY IS BASED ON 2008 LIDAR DATA
 3. **MAY 16, 2023 OBSERVATIONS SHOWN IN RED**
 4. OVERHEAD POWERLINES WERE RELOCATED TO THE WEST SIDE OF THE OLD HIGHWAY 63 DURING HIGHWAY TWINNING PROJECT



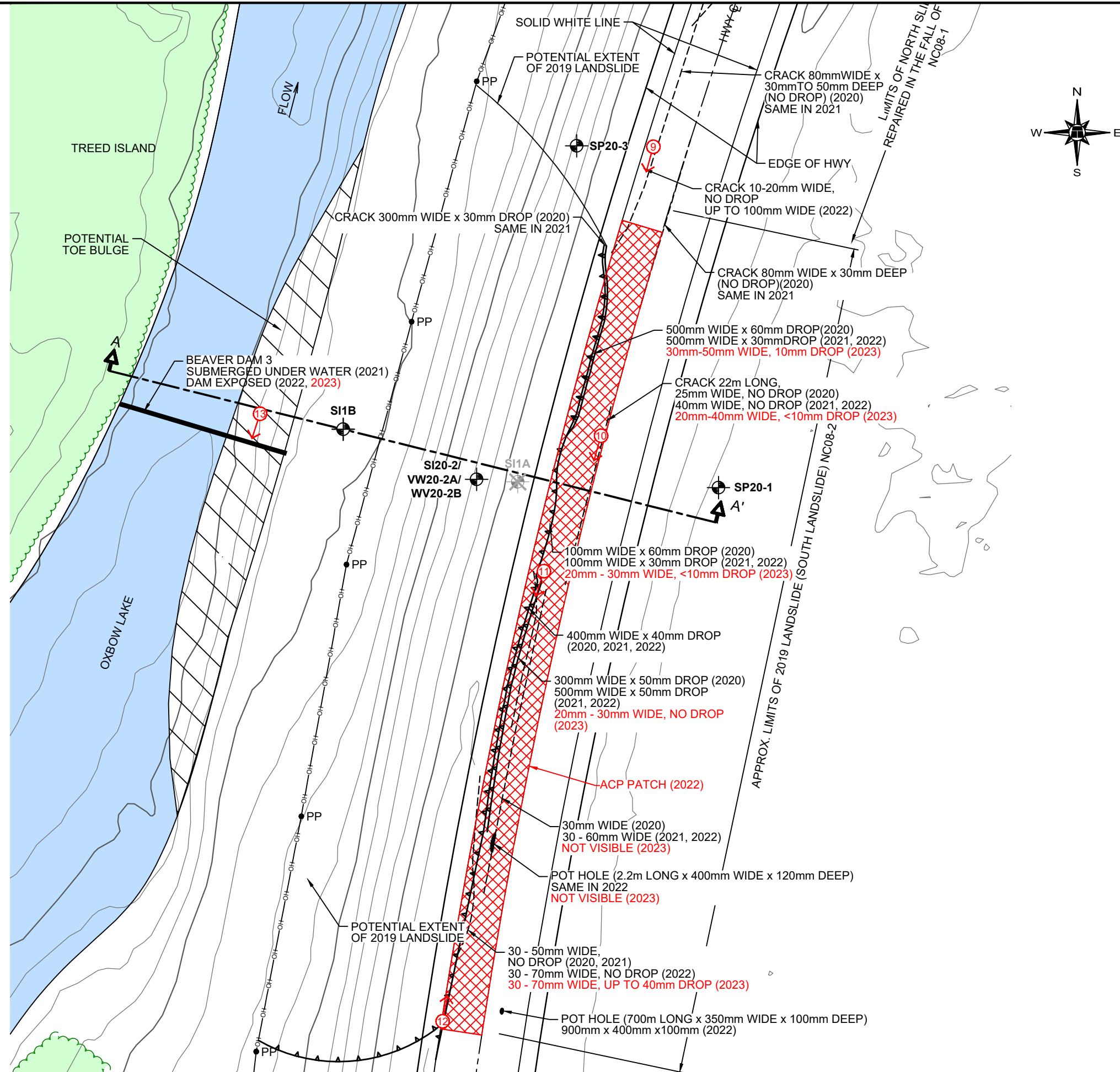
**NORTH CENTRAL REGEON
(ATHABASCA AND FORT McMURRAY DISTRICTS)
2023 GEOHAZARD ASSESSMENT**

**NC008: HWY 63:02 LA BICHE RIVER (km 15.6)
SITE PLAN SHOWING EXISTING FEATURES**

FIGURE NC008-A

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:2000
DATE	MAY 2023
FILE No.	32122

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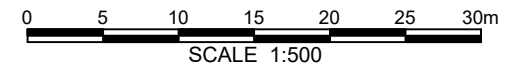


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NOTES:

1. SITE FEATURES ARE APPROXIMATE
2. TOPOGRAPHY IS BASED ON 2008 LIDAR DATA
3. **MAY 16, 2023 OBSERVATIONS SHOWN IN RED**
4. OVERHEAD POWERLINES WERE RELOCATED TO THE WEST SIDE OF THE OLD HIGHWAY 63 DURING HIGHWAY TWINNING PROJECT
5. CRACKS WERE SPRAY PATCHED IN 2020.



**NORTH CENTRAL REGEON
(ATHABASCA AND FORT McMURRAY DISTRICTS)
2023 GEOHAZARD ASSESSMENT**

**NC008: HWY 63:02 LA BICHE RIVER (km 15.6)
SITE PLAN SHOWING THE SOUTH SLIDE AREA**

FIGURE NC008-B

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:500
DATE	MAY 2023
FILE No.	32122

THURBER ENGINEERING LTD.



Photo No. 1 – Looking south at Oxbow Lake. NE corner of Beaver Dam 2 was breached; water levels dropped by at least 1.2 m behind the dam



Photo No. 2 – Looking northeast at Culvert C1 outlet; water continues to flow freely along the channel



Photo No. 3 – Looking east towards CSP culvert C1 outlet



Photo No. 4 – Looking northeast at Culvert C1 inlet location



Photo No. 5 – Looking south at highway open cracks within the limits of the repaired area in 1997 (previously known as NC08-1)



Photo No. 6 – Looking south at highway open cracks and potholes within the limits of the NC08-1 repaired area



Photo No. 7 – Looking at 900 mm diameter SWSP Culvert C2 outlet; heavy flow in 2023



Photo No. 8 – Looking south at the southern flank cracks of the NC08-1 repaired landslide



Photo No. 9 – Looking south at the northern flank of the new landslide (NC08-2); note new ACP patched placed in 2022 already showing reflecting cracks



Photo No. 10 – Looking south at reflective cracks within the central portion of the NC08-2 landslide



Photo No. 11 – Looking south at reflective cracks near the southern flank of the NC08-2 landslide



Photo No. 12 – Looking north at reflective cracks near the southern flank of the NC08-2 landslide



Photo No. 13 – Looking south at Beaver Dam 3