

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
NORTH CENTRAL REGION – ATHABASCA &
FORT MCMURRAY DISTRICTS
2021 SITE INSPECTION**



Site Number	Location	Name	Hwy	km
NC102 (previously known as NC24B and NC24D)	Adjacent to Hwy 41, N. of Junction Hwy 29 at km 8.8	Kehiwin Lake	41:23	8.7
Legal Description		UTM Co-ordinates (NAD 83)		
SW-31-58-6-W4M		12U N 507240	E 5989184	

	Date	PF	CF	Total
Previous Inspection:	May 9, 2018	7	3	21
Current Inspection:	June 25, 2021	6	3	18
Road AADT:	1,230	Year:		2020
Inspected By:	José Pineda, Tarek Abdelaziz (Thurber) Kristen Tappenden, Bernard Ching (Alberta Transportation)			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input checked="" type="checkbox"/> Maintenance Items			

Site History/Existing Information	<p>A landslide occurred at this location in 2010 and the landslide head scarp crack encroached into the highway southbound lane. The landslide was repaired in 2011 using a 112 m long cantilever cast-in-place concrete pile wall (NC24B pile wall), installed on the west side of the highway, approximately 3 m downslope of the guardrail location. Three slope inclinometers (SI11-1 to SI11-3) were installed in the pile wall to assess the effectiveness of the remedial measure.</p> <p>A dip developed suddenly on the highway SBL to the south of NC24B pile wall in May 2014. Geotechnical instruments, consisting of slope inclinometers and piezometers, were installed in 2015 to the south of the NC24B pile wall to monitor the landslide movement rates and determine soil and groundwater conditions.</p>
Primary Site Issue	Pavement distress on the highway SBL to the south of the NC24B pile wall, creating a bump/twist near the south end of the guardrail
Dimensions:	About 35 m long along the highway SBL to the south end of the existing wall
Date of any remediation:	A cast-in-place concrete pile wall (i.e., NC24D pile wall) was constructed in the fall of 2016 to retain the landslide movement. NC24D pile wall is an extension to the original wall completed in 2011 (i.e., NC24B wall). Two slope inclinometers (SI16-1 and SI16-2) were installed in the NC24D pile wall to assess the effectiveness of the remedial measure.
Maintenance:	Crack sealing took place fall 2014; ACP patch in 2015 to smoothen the bump within the south end of the dip; ACP patch was completed in October 2017

Observations:	Description	Worse?
<input checked="" type="checkbox"/> Pavement Distress	N/A	<input type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	5 to 50 mm wide reflective cracks with no drop on the highway surface above NC24B and NC24D pile walls	<input type="checkbox"/>
<input type="checkbox"/> Erosion		<input type="checkbox"/>
<input type="checkbox"/> Seepage		<input type="checkbox"/>
<input type="checkbox"/> Bridge/Culvert Distress		<input type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>
<p>Instrumentation: (11 SIs, 9 PNs, 4SPs)</p> <p>The total pile head deflection, since construction completion, in the NC24B and NC24D pile walls ranges from zero to 6 mm.; no discernable movements in SI15-1 and SI10-1 (located in the east ditch of the highway); the rate of movement in SI15-2, SI15-3, SI10-3 (located downslope of the pile walls) is 1.3 mm/yr, 2.6 mm/yr, and 1.2 mm/yr, respectively; SI15-4, located to the south of the NC24D pile wall, is moving at 1.1 mm per year.</p> <p>Between the fall of 2020 and the spring of 2021, the variation in groundwater levels ranged from an increase of 1.2 m to a decrease of 0.2 m.</p>		
<p>Assessment (Refer to attached Figure):</p> <p>The NC24B and NC24D pile walls have been effective in stabilizing the landslide movements. The reflective landslide cracks appeared on the highway surface above both walls will continue to open and widen over time until the pile walls mobilize the full magnitudes of the landslide stabilizing forces.</p>		
<p>Recommendations:</p> <p>The site visit could be skipped next year; however, instrumentation monitoring should be continued at this site.</p> <p>The local MCI should watch for the development of any new cracks on the highway lanes, particularly upslope of SI15-4 location. Open cracks above the pile walls should be sealed to reduce groundwater infiltration into the landslide masses.</p>		
<p>Closure</p> <p>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.</p> <p>Tarek Abdelaziz, Ph.D., P.Eng. Principal Senior Geotechnical Engineer</p> <p> </p> <p>José Pineda, M.Eng., P.Eng. Senior Geotechnical Engineer</p>		



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

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3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

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5. INTERPRETATION OF THE REPORT

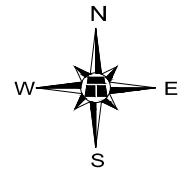
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

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KEHIWIN LAKE

EDGE OF WATER

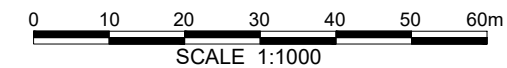
EDGE OF SURVEYED AREA

LEGEND

- o-o-o-o-o-o-o-o-o-o km 8.8 PILE WALL
- x FENCE LINE
- ~ BUSH LINE
- ACTIVE SLIDE CRACKS ON HIGHWAY
- - - INACTIVE SLIDE CRACKS ON HIGHWAY
- ⊙ TEST HOLE LOCATION
- SI SLOPE INCLINOMETER
- PN PNEUMATIC PIEZOMETER
- PB POORBOY / STANDPIPE
- ⊗ DAMAGED/BLOCKED INSTRUMENT
- 550— GROUND SURFACE CONTOUR
- P - OVERHEAD POWER LINE (APPROXIMATE)
- T - TELUS LINE (APPROXIMATE)
- s - SILT FENCE
- GUARD RAIL
- ▨ HIGHWAY DIP AREA
- ▧ ACP PATCH
- (P04) PILE NUMBER
- ① PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION

NOTES:

1. JUNE 25, 2021 OBSERVATIONS SHOWN IN RED
2. CONTOUR INTERVAL IS 0.5m.
3. CONTOURS INSIDE SURVEYED AREA WERE SURVEYED BY WSP. ELEVATION CONTOURS OUTSIDE SURVEYED AREA WERE DERIVED FROM LIDAR DATA.
4. NC24D PILE WALL IS AN EXTENSION TO THE ORIGINAL NC24B PILE WALL CONSTRUCTED IN 2011.



**NORTH CENTRAL REGION
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
2021 GEOHAZARD ASSESSMENT**

**NC102: HWY 41:23 KEHIWIN LAKE (km8.8)
SITE PLAN SHOWING FEATURES AND
INSTRUMENT LOCATIONS**

DWG NO. 32122-NC102-1

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:1000
DATE	AUGUST 2021
FILE No.	32122





Photo No.1 - Looking north at the 2017 ACP patch placed on the highway surface at the NC24D pile wall location; no visible dip on highway surface



Photo No.2 - Looking north at up to 20 mm wide reflective cracks, no drop on the SBL at the NC24D pile wall location



Photo No.3 - Looking north at up to 30 to 40 mm wide reflective cracks on the highway surface at the NC24D pile wall location



Photo No.4 - Looking south at longitudinal open cracks (10 to 40 mm wide) on the highway at the NC24D pile wall location



Photo No. 5 – Looking north at 11 m long x 50 mm wide reflective crack on the highway at the NC24B pile wall location



Photo No. 6 – Looking south from the northern flank of the NC24B landslide location at open reflective cracks (20 to 50 mm wide with no drop)