ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
NORTH CENTRAL REGION – ATHABASCA
2019 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
NC024-2 (NC24D)	Adjacent to Hwy 41, N. of Junction Hwy 29 at km 8.8	Kehiwin Lake SBL Pavement Distress to the South of NC24B Pile Wall	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 12, 2019	7	3	21
Road AADT:	1540		**Year:**	2018
Inspected By:	Tarek Abdelaziz, José Pineda (Thurber) Arthur Kavulok, Rishi Adhikari, Calvin Kissel (TRANS)			
Report Attachments:	☑ Photographs ☑ Plans ☑ Maintenance Items			

Site History/Existing Information	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. 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.	
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?**
☑ Pavement Distress	N/A	☐
☑ Slope Movement	5 to 10 mm wide reflective cracks on the highway surface above NC24B and NC24D pile walls	☐
☐ Erosion		☐

☐ Seepage		☐
☐ Bridge/Culvert Distress		☐
☐ Other		☐

Instrumentation: (NC24D: 6 SIs, 4 PNs)

The total pile head deflection for NC24D, between the fall of 2016 and the spring of 2019, in SI16-1 and SI16-2 is 2.6 mm and 2.7 mm, respectively; no discernable movement in SI15-1 (located in the ditch upslope of the pile wall location); The rate of movement in SI15-2 and SI15-3 (located downslope of the pile wall location) is 0.6 mm/yr. and 1.0 mm/yr. respectively; SI15-4, located to the south of the pile wall, is moving at 0.6 mm per year.

Between the fall of 2018 and the spring of 2019, pneumatic piezometers PN15-1, PN15-2, PN15-3 and PN15-4 showed decreases in groundwater level ranging from 0.03 m to 0.64 m.

Assessment (Refer to attached Figure)**:**

The NC24B and NC24D pile walls have been effective in stabilizing the landslide movements. The reflective landslide cracks appeared above both walls will continue to open and widen over time until the pile walls mobilize the full magnitudes of the landslide stabilizing forces.

Recommendations:

The site visit could be skipped next year; however, instrumentation monitoring should be continued at this site.

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.

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W E
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KEHIWIN LAKE

NC24B PILE WALL (2011)

RIGHT OF WAY BOUNDARY

NC24D PILE WALL (2016)

EDGE OF WATER

SI11-3
PB10-3
REFLECTIVE CRACKS
5-10mm WIDE, NO DROP
PB10-1
3+100
PN10-2A/B
SI/PN10-3
SI11-2
SI/PN10-1
PN10-5
5
PB10-4
SI11-1
PN10-6
PB10-2
3
ACP PATCH (OCTOBER 2017)
10 mm WIDE, NO DROP
SI/PN15-3
SI/PN15-2
SI16-1 (P04)
REFLECTIVE CRACK
10mm WIDE, NO DROP
3+000
SI/PN15-1
4
5mm WIDE, NO DROP (2018)
10mm WIDE, NO DROP (2019)
SI16-2 (P08)
2A
5-10mm WIDE, NO DROP (2016)
CRACK EXTENDED SOUTH
10-20mm WIDE, NO DROP (2018)
SAME IN 2019
SI/PN15-4
2
1
℄ HWY 41:23
EDGE OF SURVEYED AREA

RIGHT OF WAY BOUNDARY
(PLAN 3697RS)
OVERHEAD POWER LINE R.O.W.
SW 31-58-6-4

LEGEND

- km 8.8 PILE WALL
- 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 12, 2019 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.

0 10 20 30 40 50 60m
SCALE 1:1000

Alberta

NORTH CENTRAL REGION - ATHABASCA AREA
2019 GEOHAZARD ASSESSMENT

NC024-2 (NC24B & D): HWY 41:23 SLIDE (km8.8)
SITE PLAN SHOWING FEATURES AND INSTRUMENT LOCATIONS

DWG NO. 13357-NC024-2

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:1000
DATE	AUGUST 2019
FILE No.	13357

THURBER ENGINEERING LTD.

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

Photo No.2 - Looking north at up to 10 mm wide reflective crack on the SBL at NC24D location

Photo No.2A - Looking north at up to 10 mm wide reflective crack on the SBL at NC24D location

Photo No.3 - Looking south at reflective longitudinal open cracks (10 to 20 mm wide) at NC24D location

Photo No.4 - Looking north at the highway side slope downslope at NC24D location; no signs of cracking or bulging noted on the side slope

Photo No. 5 – Reflective cracks along the highway above NC24 B Pile Wall