GEOHAZARD ASSESSMENT PROGRAM

NORTH CENTRAL REGION – ATHABASCA

2015 INSPECTION

Site Number	Location	Name	Hwy	km
NC 58 (Eastbound lane Landslide) 58A (Westbound lane Landslide)	6.5 km west of the junction between Hwy 881 and 858 to the north of Lac La Biche	North of Lac La Biche	858:02	45.85
Legal Description		**UTM Co-ordinates (NAD 83)**		
SW- 30-68-13-W4M		12 N 6085029 E 436771		

	Date	PF	CF	Total
Previous Inspection:	NC58- May 22, 2014 NC58A- May 22, 2014	8 13	3 4	24 52
Current Inspection:	NC58- May 13, 2015 NC58A- May 13, 2015	8 13	3 4	24 52
Road AADT:	260		**Year:**	2014
Inspected By:	Tarek Abdelaziz, Don Proudfoot (Thurber) Roger Skirrow, Jake Knudslein, Calvin Kissel, Brandon Sandford, Arthur Kavulok (TRANS)			
Report Attachments:	☑ Photographs ☑ Plans ☐ Maintenance Items			

Primary Site Issue:	Active landslides occurred between 2008 and 2013 after heavy rainfall events, causing pavement distress on the eastbound and westbound lanes of the highway. **NC58** (eastbound lane landslide) was first noticed in 2008 and **NC58A** (westbound lane landslide) was first noticed in 2013.	
Dimensions:	**NC58:** About 80 m along the highway and 30 m perpendicular to the highway centerline **NC58A:** About 95 m along the highway and 35 m perpendicular to the highway centerline	
Date of any remediation:	**NC58:** The remedial measure, completed in July 2011 to stabilize the eastbound lane landslide, involved the construction of a 90 m long pile wall to retain the landslide mass. The pile wall consisted of 15 m long driven steel H piles (HP 310x110 piles), installed at a center-to-center spacing of 0.62 m. **NC58A:** None	
Maintenance:	ACP patch was placed on the highway eastbound lane in July 2011 after construction completion; highway eastbound and westbound cracks sealed in spring 2012; both highway lanes patched again in fall 2012; WBL open cracks sealed in spring 2012; ACP patch placed on the highway WBL surface in fall 2012 and fall 2013; ACP patch placed on the EBL and WBL in fall 2014	
Observations:	**Description**	**Worse?**
☑ Pavement Distress	**NC58-** 5 to 10 mm dip in the highway east bound lane, bounded by the landslide cracks; up to 600 mm thick ACP patch was placed in the highway WBL since 2013. **NC58A-** 10 to 20 mm dip in the highway WBL, bounded by the landslide cracks; dip is more pronounced within the eastern limit of the landslide	☑

☑ Slope Movement	**NC58-** 5 to 15 mm wide reflective cracks with 10 mm differential height in the eastbound lane surface **NC58A-** 15 to 20 mm wide cracks with up to 20 mm differential height across the crack surfaces; development of a graben feature, titling power pole; toe roll within tree line, tilting trees, and hummocky terrain to the north of the tree line	☑
☐ Erosion		☐
☐ Seepage		☐
☐ Bridge/Culvert Distress		☐
☑ Other	**NC58-** The voids formed at three locations along the pile wall alignment became wider than last year **NC58A-** Muskeg ditch is dry and blocked; wet muskeg ground	☐

Instrumentation: (NC58: 5 PNs; NC58A: 3PNs and 2SIs)

NC58- The slope inclinometers installed at this site were sheared off prior to the implementation of the remedial measure. At present, there are five operational pneumatic piezometers, which were not read after construction completion.

NC58A- Slope inclinometers SI14-1 and SI14-2 showed zones of movements over 4.3 m to 6.7 m depth and over 2.3 m to 7.2 m depth, respectively. The current rates of movements in SI14-1 and SI14-2 are 30 mm/yr and 2.6 mm/yr, respectively. The rates of movements reduced by 250 mm/yr and 0.4 mm/yr in SI14-1 and SI14-2, respectively between the fall of 2014 and the spring of 2015. Ground water levels varied by +/-0.2 m, and ranged from 0.8 m to 1.8 m below existing ground surface.

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

NC58: The site observations indicated that the implemented remedial measure has been effective in stabilizing the landslide mass. Existing landslide reflective cracks on the highway eastbound lane are indicative of the progressive lateral deflection of the pile wall. Further opening of reflective cracks should be anticipated over time until the pile wall mobilizes the full magnitude of the landslide stabilizing force.

NC58A: Despite being patched last year after the completion of the 2014 site visit, the site condition appears to have deteriorated. The landslide has continued to movie at high rates as evidenced from the re-appearance and opening of highway cracks, the more pronounced dip in the highway surface, and the formation of the graben feature. In addition, the eastern half of the landslide appears to be more active than the western half. The highway surface within the eastern half of the landslide continued to drop and had to be overlaid for three consecutive years since the landslide first occurrence. This observation is consistent with the instrumentation monitoring results (i.e. SI14-1, located within the eastern half of the landslide is moving at much higher rates than SI14-2, located within the western half of the landslide).

Based on our experience with the eastbound lane landslide, it is likely that this landslide will continue to move, causing repeated deterioration of the highway condition. Frequent patching of the highway surface (once or twice a year) will be needed to provide a smooth ride to travelers along the highway until the landslide is repaired.

Recommendations:

NC58: This site should be visited again to conclude the effectiveness of the repair measure on the south side of the highway. In the short term, the MCI should seal any open cracks on the highway lane. It is anticipated that the highway will need to be patched again within the next couple of years. Existing voids along the top of the piles should be filled with compacted clay or gravel to prevent exposure of the pile tops.

NC58A: This site should be visited again in the spring of 2016. In the short term, the MCI should seal all open cracks and watch closely for new cracks, extension of existing cracks, and drop in the highway surface particularly after a prolonged heavy rain fall event. Consideration should be given for patching the highway westbound lane, particularly within the eastern half of the landslide where the dip is more pronounced, to provide a smooth ride to motorists.

In the long term, a remedial measure similar to the one implemented at the south side of the highway could be considered. The ballpark cost of a pile wall could be in the range of $600,000 to $700,000. If possible, it is recommended to construct the pile wall in late 2015/early 2016 since the landslide movement at this site becomes more pronounced between the spring and the fall seasons.