GEOHAZARD RISK MANAGEMENT PROGRAM
North Central Region – Edson / Stony Plain Area

2020 Inspection Report

Site Number	Site Name		Hwy	km
NC37	South of Whitecourt		32:10	34.6
Legal Land Description	NW 27-59-12-W5M			
UTM Coordinates (NAD 83)	Zone 11U	N5999427	E583507	
Operational Site Instrumentation	**Slope Inclinometers (SI)**		8	
	Pneumatic Piezometers		4	
	Vibrating Wire Piezometers		4	
	Standpipe Piezometers		4	
Date of Last Instrumentation Readings	May 22, 2020			

Risk Assessment	Date	PF	CF	Risk Ranking
Current Inspection	May 25, 2020	7	4	28 (Powerline Site)
Previous Inspection	May 15, 2019	7	4	28 (Powerline Site)
Report Attachments	☒ Photographs (18 photos)	☒ Site Plans (1 page)		

	Stantec	Alberta Transportation
Inspected By	Leslie Cho	Kristen Tappenden and Kathleen Davis
Date of Remediation	2011 – two berms constructed at Main Slide Site	

	Stantec	**Alberta Transportation**	
Recent Maintenance	Patching of westbound lane in 2012. Westbound lane patched in 2017 and 2018		
Primary Site Issue	Slope instability due to raised groundwater level caused by embankment construction together with weak foundation soils.		
Observations	**Description and Location**	**Change from Previous Inspection**	
☒ Pavement Distress	- Pavement cracks reflecting through 2018 patch. - Circular cracks at Station 34+850 and 34+900.	☐ Yes	☒ No
☒ Culvert Distress	- Sinkhole along culvert alignment at station 34+450. Possibly related to culvert.	☐ Yes	☒ No
☐ Bridge Distress		☐ Yes	☐ No
☒ Slope Movement	- Back scarp at approximately Sta 34+700 on south side of highway - Toe bulge extends across drainage ditch - Ongoing slumping at Power Line Site backslope - Power poles have 2˚ lean.	☐ Yes	☒ No
☒ Erosion	- Erosion gullies at the toe of slope at about station 34+400 - Erosion gully in south ditch at about station 35+000	☐ Yes	☒ No
☐ Seepage		☐ Yes	☐ No
☐ Other		☐ Yes	☐ No

Discussion	Power Line Site: The westbound lane was overlaid in 2017 and patched again in 2018. Similar pavement cracking patterns were observed again during the 2018 annual inspection and does not appear to have changed significantly since. Generally, the pavement cracks were up to 10 mm wide with no vertical differential. The pavement is shown in Photos 1 to 3. The scarp at approximately Station 34+700 appeared to be unchanged from 2019 and is shown in Photo 4. Slope movement in the backscarp from approximately Station 34+750 to 34+950 is ongoing with indication of fresh scarps, especially closer to the powerline as shown in Photo 5. Localized ponding along the base of the scarps was also observed. Potential seepage zones were observed within the toe bulge as shown in Photo 6. The toe bulge at the base of the slide was about 1.2 m high and encroached further into the drainage ditch to the point of contact with the sign as shown in Photo 7. No change was observed to the leaning power pole north of the highway. Both power poles were measured to have a 2˚ lean towards the east. The erosion gully east of the power line near Station 35+000 increased in size to about 2.5 m wide by 30 m long by 0.8 m deep as shown in Photo 8. Toe bulging continues to be progressing into the south ditch as shown in Photo 9. Wet/saturated ground was observed in the ditch. Main Slide (Berm) Site: The upper and lower toe berms appear unchanged since the previous inspection. The west culvert outlet at approximately Station 34475 was observed to be flowing as shown in Photo 10. Water flow was again coming out in waves as documented during the 2018 inspection. Immediately upslope and southwest of the culvert outlet, the vegetated gully has grown to approximately 1 m deep as shown in Photo 11. A small scarp about 300 mm high was also observed west of the culvert outlet as shown in Photo 12. Approximately midway upslope from the culvert a sinkhole feature was observed along the culvert alignment as shown in Photos 13 and 14. The sinkhole appeared to have increased in size towards the north compared to the 2019 inspection. Scarps up to about 1 m high were observed about 40 m west of the culvert outlet at Station 34+475 as shown in Photo 15. This scarp appears unchanged from previous inspection. Longitudinal cracking and along with minor potholes were observed along Highway 32 as shown in Photos 16 to 18.

Assessment	Power Line Site: Existing SI's (SI10-8 and 10-9) indicated slip surface between 3 and 6 m in the upper clay/silt. However, the rate of movement was slow, at less than 1 mm/yr. The pavement cracks reflecting through the new overlay at Station 34+875 also suggests that slope movements are on-going. The SI installed in 2018 have not recorded any movement since installation which may be due to slope movements being localized to the area upslope from SI10-8 and SI10-9. It is believed that slope movements are the result of groundwater level rise in the foundation soil as well as embankment fill. Furthermore, toe bulges appear to be blocking surface water drainage along the south ditch and the tension cracks within the backslope may be allowing water to infiltrate into the slope. Typical of embankment construction on a hill side or natural slopes, the embankment fill will block the surface water runoff and therefore raise the groundwater level in the foundation soil, the upslope, and also the embankment fill unless a proper drainage blanket (grids) is placed underneath the embankment. Even with the use of drainage ditches and culvert, some surface water will seep into the ground and raise the groundwater level. The situation will get worse with time when the culvert becomes non-functioning. This eventually leads to slope movement/creep in the long run. Seepage observed at the Power Line Site suggests a high ground water table south of Highway 32. These seepage areas seem to correspond to locations of on-going slope movement. Main Slide Site: An initial failure plane based in the high plastic clay layer at a depth from 4.5 m to 9.5 m was described by Thurber in the 2006 Thurber Geotechnical Report. The movement zones were clearly identified from the SI installed at the Main Slide Site. At that time, a perched water table above the high plastic clay layer was considered to be a contributing factor to the failure mechanism. Two berms (upper and lower berms) were designed by Thurber and constructed in 2011 to remediate the slope. Slope movements (at a slower rate) have been identified from the SI readings at the Main Slide Site after the two berms were built in 2011. The rate of slope movements appeared to have slowed down after the toe berm construction with about 5 mm of movement at a depth of about 7 m in SI10-6 measured between 2011 and 2016. From 2016 onwards, SI10-6 showed an additional 5 mm of lateral movement at the same depth. Moreover, pavement cracking upslope from the berms started to be observed again in 2015. It appears that the two existing berms may have slowed down the slope movements along the original slip plane. It is possible a new slip surface has developed above the upper berm between the crest of the highway embankment and the top of the upper berm. A high groundwater table likely being recharged from the south side of the highway may also be a contributing factor to the on-going slope movements at the Main Slide Site. It is inferred that there is a break within the west culvert at Station 34+475 leading to the sinkhole feature observed.

Assessment (continued)	The toe bulges appear to be blocking surface water drainage along the south ditch and may be allowing water to infiltrate into the slope. The more significant slope movements appear to be occurring south of the highway along the back slope. Although pavement distresses were observed, the nature of the distress suggests they may be due to traffic loading instead of slope instabilities.
Recommendations	Short term recommendations include sealing any new cracks to reduce surface water infiltration into the slope and pavement structure. Regrading of the south ditch should be completed to improve positive drainage. Stantec completed a remedial design for Site NC37. The proposed design consists of constructing finger drains and interceptor drains to improve slope drainage and possibly extending the existing toe berms, if warranted. Given that the upper clay/silt was underlain by a continuous layer of sand and gravel, it might be possible to drain the upper clay/silt into the underlying sand and gravel via vertical drains. This includes forming a series of sand drains under the south ditch and connecting the top via a granular trench. The granular trench will help collect the surface runoff, and the sand drains will drain the surface water and the surrounding clay towards the underlying sand and gravel. It is recommended that a CCTV inspection be completed for the culvert at station 34+475 so that remedial measures can be developed for the culvert. This may require additional boreholes to support culvert remediation. Instrumentation readings at the site should continue to be collected semi-annually, with site inspections completed annually.

BH BOREHOLE
SP STANDPIPE PIEZOMETER
PN PNEUMATIC PIEZOMETER
CULVERT
OVERHEAD POWERLINES
BURIED TELEPHONE LINES
FENCE LINES
TREE LINES
PREVIOUS OBSERVATION
2020 OBSERVATION

1 WEST LANDSLIDE
2 EAST LANDSLIDE
3 BERMS
4 GULLY / EROSION AREA
5 TENSION CRACKS
6 SEEPAGE AREA
7 CULVERT / DITCH
PROJECT LIMIT

ALL DIMENSIONS AND ELEVATIONS ARE EXPRESSED IN METRES AND DECIMALS THEREOF

STATIONING DISTANCES ARE GRID DISTANCES.

1:1000 0 10 30 50m

Stantec

STANTEC CONSULTING
400-10220 103 AVENUE NW
EDMONTON, ALBERTA, CANADA
T5J 0K4

ALBERTA TRANSPORTATION
GEOHAZARD MONITORING PROGRAM
NC37 SOUTH OF WHITECOURT
MAIN SITE PLAN

DRAWN	WW / MK	CHECK	XL	APPROVE	LC
DATE	19 JUN 2020	SCALE	AS SHOWN	PROJECT #	123312435

FIGURE -1 | -

Reference: 2020 Annual Inspection Photographs at NC37 – South of Whitecourt
File Number: 123312435

Photo 1: Circular crack observed in 2018 directly under powerline. Looking east.

Photo 2: Pavement cracking at about Sta 34875 Looking east.

<u>Photo 3:</u> Pavement cracking at about Sta 34+850. Looking east.

<u>Photo 4:</u> Scarp south of the highway at approximately Sta 34+700. Looking south.

Photo 5: Fresh scarps and slumping on backslope. Ponding along base of scarp. Looking east.

Photo 6: Potential spring or seepage with water flowing from top of toe bulge southeast of photoradar sign. Looking west.

Photo 7: Toe bulge encroaching onto south ditch and signpost. Looking west.

Photo 8: Erosion gully east of sign in Photo 6. Looking east.

<u>Photo 9:</u> Toe bulging at "other businesses" sign. Looking east.

<u>Photo 10:</u> Culvert outlet adjacent to west extents of upper toe berm. Slumping immediately upslope of culvert. Looking south.

Stantec

Photo 11: Vegetated gully immediately upslope of culvert in Photo 10. Looking north.

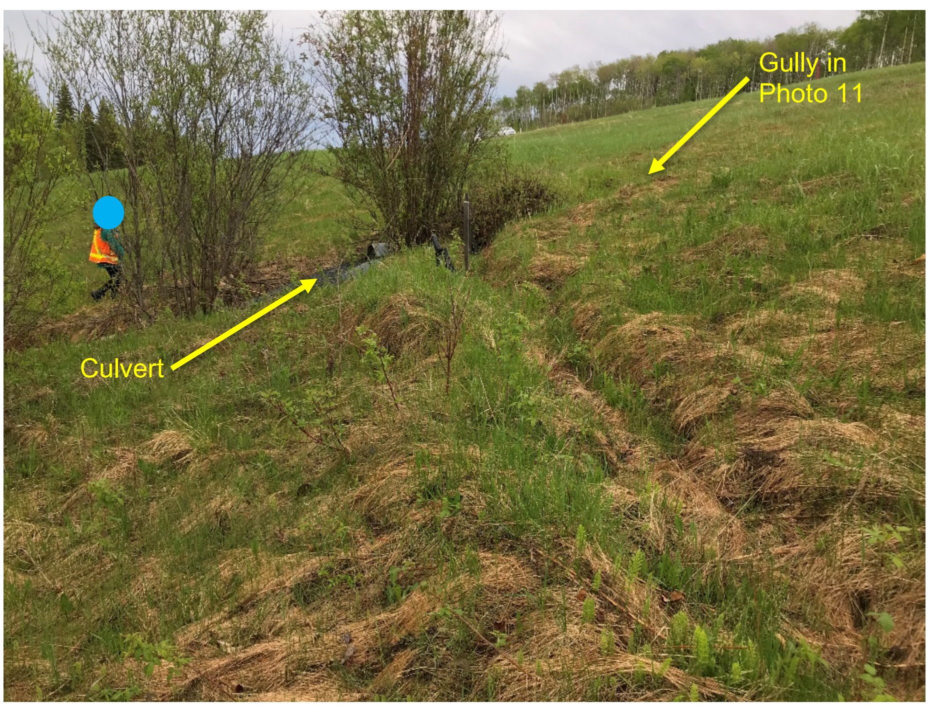

Photo 12: Small scarp west of culvert. Looking east.

Photo 13: Slump/sinkhole along culvert alignment further upslope of culvert from Photos 10 and 11. Looking south.

Photo 14: Erosion gully leading from sinkhole in Photo 12. Looking north.

Photo 15: Tension crack/slump about 40 m west of Photo 12. Scarp up to about 1 m high. Looking south.

Photo 16: Pavement distress at west culvert alignment (approx. Sta 34+475). Looking west.

Reference: 2020 Annual Inspection Photographs at NC37 – South of Whitecourt
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Photo 17: Highway condition at about Sta 34+675. Looking west.

Photo 18: Pavement distress at about Sta 34+700. Looking east.