ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS GRMP NORTH CENTRAL (ATHABASCA AND FORT McMURRAY DISTRICTS) 2025 SITE INSPECTION

Site Number	Location	Name	Hwy	km
NC071	1 km east of Colinton	Little Pine Creek Slide	663:04	6.98
Legal Description		**UTM Co-ordinates (NAD 83)**		
S.E.15&S.W.14& N.E.10-65-22-W4M		12U N 6054582 E 355785		

	Date	PF	CF	Total
Previous Inspection:	June 3, 2024	11	5	55 (for highway)
Current Inspection	May 13, 2025	11	5	55 (for highway)
Road WAADT:	700		**Year:**	2024
Inspected By:	José Pineda, Bruce Nestor (Thurber) Arthur Kavulok, Rishi Adhikari (TEC)			
Report Attachments:	☒ Photographs	☒ Plans	☒ Maintenance Items	

Primary Site Issue	Slowly creeping deep-seated translational landslide, resulting in diagonal cracks and slight depression along both highway lanes; depression is more pronounced along the flanks of the slide.
Dimensions:	Approximately 150 m wide (parallel to highway) by approximately 300 m long to the south of the highway.
Site History / Available Information:	The highway was constructed as a side-hill cut and fill section at this location; the road section was upgraded in the 70's and raised by 2 m; original landslide occurred prior to 1978 and extended from the uphill ditch of the highway to the existing bridge over the Little Pine Creek located approximately 300 m to the south of the highway; test holes (completed with 2 slope inclinometers and 3 standpipe piezometers) were drilled downslope of the highway prior to 1978; Drainage pipes were installed on May 12, 1980 to reduce groundwater levels; slope inclinometers were sheared off in December 1980; slope inclinometers and piezometers were installed by Thurber in 2012.
Maintenance/ Repairs:	TEC placed ACP patches at the flanks of the slide for a few years prior to 2019. In 2019 the highway surface was milled, and overlaid; re-grading of the north ditch, and the installation of a HTCB on the south side of the highway also took place in 2019; Culvert C3 was grouted by others and a new 760 mm diameter replacement pipe was auger bored 26.2 m from the original location. A 9 m long half pipe was welded to the culvert C3 outlet to convey the water down the side slope to the tree line. Riprap was provided around and at the outlet of the half pipe extension. ACP patch was placed in 2023 on a previous 50 mm dip on the highway WBL shoulder and driving lane above the inlet of the C3 Culvert.

Observations:		Description	Worse?
☐	Pavement Distress	A bit of twist on the highway surface near the flanks of the landslide; 20 mm dip on the eastbound lane by the eastern flank of the landslide	☒
☒	Slope Movement	Western flank crack is showing reflective cracks 30 to 40 mm wide, 5 mm drop; 10 to 30 mm wide cracks within the middle section of the landslide; eastern flank cracks are up to 50 mm wide with a 20 mm drop, and a new tension crack 10-20 mm in width has opened at the east side of the site; a 30 mm wide tension crack has also developed in the access road near the intersection with the highway.	☒
☒	Erosion	Erosion gully (18 m long x 1 m wide x 0.5 m deep) which developed in 2022 within the north ditch upstream of culvert C3 remains unchanged; sinkhole 0.5 m long, 1.3 m wide and 0.6 m deep was noted at east end of the erosion gully during current inspection; erosion rills along the highway side slope to the west of the access road; sink hole (800 mm long x 500 mm wide x 400 mm deep) to the west of C3 inlet location was wet on the bottom (partially filled with sediment since the last inspection).	☐
☐	Seepage		☐
☒	Bridge/Culvert Distress	A void was noted under the half pipe extension of C3 outlet location; Culvert C1 is sagging, and water is ponding inside the culvert.	☐
☐	Other		☐

Instrumentation: (3 SIs, 8 PNs, 4 SPs)

SI12-3 and SI12-9 were found to have sheared off at 13.4 m and 8.5 m depth, respectively, during the fall of 2024 readings.

Between the fall of 2024 and the spring of 2025: No discernible movement was noted in SI12-4 (located near the bottom of the slope); SI12-1 (located in the north highway ditch) showed a rate of movement of 7.5 mm/yr and SI12-2 (south of highway) showed a rate of movement of 11.9 mm/yr.

The operational piezometers showed changes in groundwater levels ranging between a decrease of 0.11 m in PN12-4B to an increase of 0.56 m in PN12-8.

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

The site condition did not change significantly since the 2024 site visit. However, reflective cracks as a result of landslide movement continue to get wider and more extensive.

The landslide will continue to cause progressive deterioration to the highway condition with time. The deterioration may take place quickly between the spring and the fall seasons since the landslide tends to move at high rates within this period based on historical data.

The existing twist on the highway surface near the flanks of the landslide still creates a rough ride to motorists.

The absence of vegetation in the highway north side slope and ditches, to the west of the access road, has resulted in the development of an erosion gully around and upstream of culvert C3 inlet location and erosion rills on the highway north side slope.

The sink hole and the previously noted crack in the vicinity of the inlet of C3 culvert replacement pipe reflect poor compaction of the reception pit, and this may result in stability issues of the slope and impact the performance of the new pipe.

It is suspected that a void exists below the highway's WBL/shoulder and the north side slope surface upslope of the C3 culvert inlet location. Inadequate grouting of old pipe is likely the main cause of the void and the previously dip noted in the highway surface. The ACP patch placed by TEC between 2023 and 2024 to eliminate the dip on the highway surface above the void is an interim measure. It is anticipated that the dip will re-occur and become worse with time, due to the progressive collapse of the existing void, and this may cause a severe future distress on the highway WBL surface.

Culvert C1, located under the access road, is separated and hence this will likely impede the surface drainage within the north ditch, resulting in elevated groundwater levels within the landslide mass.

The void below the half pipe downstream of C3 outlet location is due to improper subgrade preparation. The surface flow around the pipe may undermine the subgrade, potentially resulting in the development of a severe erosion gully below and around the extension pipe.

Recommendations:

This site should be visited again in Spring of 2026.

Short-Term

The local MCI should continue to monitor the site (particularly between the spring and the fall seasons) and seal any open cracks to reduce surface water infiltration into the highway fill. Consideration should be given in the future to placing an ACP patch near the flanks of the landslide to provide a smooth ride to motorists.

The following items should also be dealt with in the short-term:

- The north ditch to the west of the access road should be properly graded to eliminate the erosion gully. The side slope should also be track-packed to fill erosion rills. After the ditch/side slope repairs are completed, all disturbed areas within the north ditch should be topsoiled and seeded. The ditch bottom and side slopes should be covered with Type C TRM to reduce future erosion potential.
- The distressed area above C3 culvert should be excavated to properly fill the existing void in this area. Care should be taken during the excavation to avoid damaging the new culvert. An excavator with a ripper tooth attachment may be needed to complete the excavation. Once the void is located, the base of the excavation should be inspected to remove damaged/collapsed section of the old pipe, debris, and soft /loose materials. Attempts should be made to re-grout the old pipe if the inspection reveals that the exposed section of the pipe has not been filled with grout. The excavation should then be backfilled with compacted crushed gravel to ground surface to re-build the highway surface and the side slope. The side slope should be capped with at least 300 mm of clay at ground surface. The closure of the highway WBL will likely be required to complete this repair.
- The area around Culvert C3 inlet should also be scarified, repacked, and contoured to eliminate the existing crack, and the sinkhole to the west of the culvert should be backfilled with compacted fill.
- Culvert C1 should also be replaced to reduce the amount of ponding water within the highway ditch. Consideration should be given to using a smooth wall steel pipe culvert to be more resistant to ongoing landslide movements.
- The void below the half pipe culvert, downstream of the outlet of the C3 culvert, should be filled with fillcrete.

Long-Term

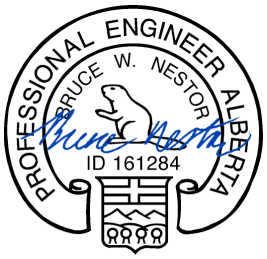
In the long-term, the following options may be considered to remediate the landslide:

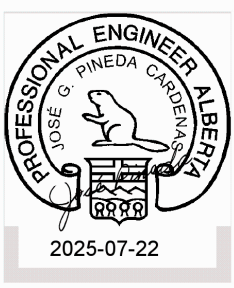
a) Unload the landslide through partial removal of highway fill, either by lowering the highway profile or replacing highway embankment fill with lightweight fill (e.g., EPS foam). The estimated cost of this option would range from $3,000,000 for the grade lowering option to $4,500,000 for the EPS foam replacement option.
b) Re-align the highway to the north of its current location outside the limits of the active landslide. The estimated cost of this option would be in the range of $2,000,000.
c) Reinforce the slip surface of the landslide by constructing a tied-back pile wall within the eastbound lane side slope. The estimated cost of a pile wall would be in the range of $9,000,000.

Closure:

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

Yours very truly,
Thurber Engineering Ltd.
José Pineda, M.Eng., P.Eng.
Associate | Senior Geotechnical Engineer





PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: _____
RM APEGA ID #: 91085
DATE: July 23, 2025
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Bruce Nestor, M.Eng., P.Eng.
Geotechnical Engineer

THURBER

STATEMENT FOR USE AND INTERPRETATION OF REPORT

1. STANDARD OF CARE

This Report has been prepared in a manner consistent with that degree of care and skill ordinarily exercised by members of the same profession currently practicing under similar circumstances at the same time and in the same or similar locality and in compliance with all applicable laws.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment, including this Statement For Use and Interpretation of Report, 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.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT, AS DESCRIBED ABOVE. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TOTHE WHOLE OF THE REPORT.

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

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client for the development, design objectives, and/or purposes described to Thurber by the Client. **NO OTHER PARTY MAY USE OR RELY ON THE REPORT OR ANY PORTION THEREOF FOR OTHER THAN THE CLIENT'S BENEFIT IN CONNECTION WITH THE PURPOSES DESCRIBED IN THE REPORT**. Any use which a third party makes of the Report is the sole responsibility of such third party and is always subject to this Statement for Use and Interpretation of Report. Thurber accepts no liability or responsibility for damages suffered by any third party resulting from use of the Report for purposes outside the reasonable contemplation of Thurber at the time it was prepared or in any manner unintended by Thurber.

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 is inherently judgement-based. 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 parties making use of such documents or records with or without our express written consent need to 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 parties. Some conditions are subject to change over time and those making use of the Report need to be aware of this possibility and understand that the Report only presents the interpreted conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client must 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 based on conditions in evidence at the time of site inspections and based on 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 resulting from misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other parties 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 is recommended to 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 need to 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 to confirm and document that the site conditions do not materially differ from those 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. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or other parties who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes, but is not limited to, decisions made to develop, purchase, or sell land, unless such decisions expressly form part of the stated purpose of the Report as described in Paragraph 3.

G:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\CAD\2025 GEO HAZARD\32122 NC071-1.dwg - 1 - Jul. 22, 2025

TO COLINTON

THE DITCH AND THE SLOPES AND ARE BARE OF VEGETATION (SAME 2025)
DITCH BLOCK (2020, 2022)
SEE DETAIL NO. 1

SINK HOLE (800 mm LONG, 500 mm WIDE, 400 mm DEEP); WET ON BOTTOM (2025)

760mm CSP CULVERT (C3)
OLD C3 GROUTED AND REPLACED WITH A 600mm SWSP (2022)

C3 OUTLET EXTENDED DOWN THE SIDE SLOPE TO THE TREE LINE WITH A HALF SMOOTH WALL CULVERT. RIPRAP PROTECTION PROVIDED AROUND AND AT THE OUTLET OF THE HALF PIPE. VOID WAS NOTED BELOW THE HALF PIPE EXTENSION. A SILT FENCE WAS INSTALLED BEYOND THE RIPRAP LINING (2022)
SAME (2023, 2024, 2025)

SAG POND

1-2m DEEP SCOUR
SAME IN 2012, 2013, 2014
2.2m DEEP SCOUR IN 2020; HEAVY FLOW (NOT VISIBLE), 0.55 m DEEP SCOUR (2025)

CRACK
20-30mm WIDE (2018)
10-20mm WIDE (2022)

GRABEN FEATURE

TRANSVERSE CRACKS
5-10mm WIDE; NO DROP - SAME
10-15mm WIDE, NO DROP (2022, 2024)
15-20 mm WIDE, NO DROP (2025)

CRACK, 7m EAST FROM APPROACH
10-15mm WIDE, NO DROP (2025)

5-15mm DROP WITHIN PATCHED AREA
CRACK, 20-30 mm WIDE (2022, 2023); 15-20 mm WIDE, 5 mm DROP (2024); 30-40 mm WIDE, 5 mm DROP (2025)

SINKHOLE AT START OF DITCH EROSION, 1.3 m WIDE, 0.5 m LONG AND 0.6 m DEEP (2025)
EROSION RILLS (SAME 2024, 2025)
WATER FLOWING FROM C1 OUTLET TO C3 INLET - DRY IN (2021, 2023)
TENSION CRACK 30 mm WIDE, NO DROP (2025)
INLET PLUGGEDCULVERT (C2); NOT VISIBLE IN 2020. THIS CULVERT MAY HAVE BEEN GROUTED OR COMPLETELY PLUGGED BY OTHERS AT THE INLET. - SAME IN 2021

600mm CSP CULVERT (C1)
WATER PONDING INSIDE THE CULVERT (2022, 2023); SAGGING (2023, 2024, 2025)

CREST OF BACKSLOPE (APPROX.)

NORTH DITCH REGRADED BY OTHERS; WATER DRAINING INTO C1 (2020) - DRY IN 2021, 2022, 2023, 2025

5-30mm WIDE, NO DROP (2021)
20-25mm WIDE, NO DROP (2022)

10-20mm WIDE, 5mm DROP
5-15mm, NO DROP (2021)
20-25mm WIDE, NO DROP (2022, 2023)
10-20mm WIDE, 5mm DROP
5-20mmWIDE, NO DROP (2021)
25-40mm WIDE, NO DROP (2022, 2023)
20-25mm WIDE, 5mm DROP
NOT VISIBLE (2020, 2021)
30mm WIDE, 10mm DROP (2024)
50mm WIDE, 20mm DROP (2025)

5-10 mm WIDE, NO DROP (2025)

10-20 mm WIDE, NO DROP (2025)

10mm DIP
SAME (2024)

10-20mm, 15mm DROP (2018)
NOT VISIBLE (2020)
10-20mm WIDE, NO DROP (2022)
20-30mm WIDE, NO DROP (2023)
20-30mm WIDE, 5-10mm DROP (2024)
20-50mm WIDE, 20mm DROP (2025)

PN12-8
PN12-5
PN12-6 5-10mm WIDE, NO DROP (2024); 10-20 mm WIDE, NO DROP (2025)

SILT FENCE
SI/2PN12-1
SI/PN12-9
SI/2PN12-2
SI/2PN12-3
SI/2PN12-4

10-20mm WIDE; NO DROP (2018)
10-15mm WIDE (2022, 2023)
20mm WIDE, NO DROP (2024, 2025)

10-30mm WIDE, NO DROP (2024, 2025)

HAIRLINE CRACKS (2020)
5mm WIDE, NO DROP (2021)
10-20mm WIDE (2022, 2023)

HTCB INSTALLED BY OTHERS IN 2019

16° @ 9m HEIGHT
19° @ 9m HEIGHT
20° @ 7.5m HEIGHT

HWY 663:04

900mm CSP CULVERT (C2)

PRIVATE LAND

HOMMOCKY TERRAIN

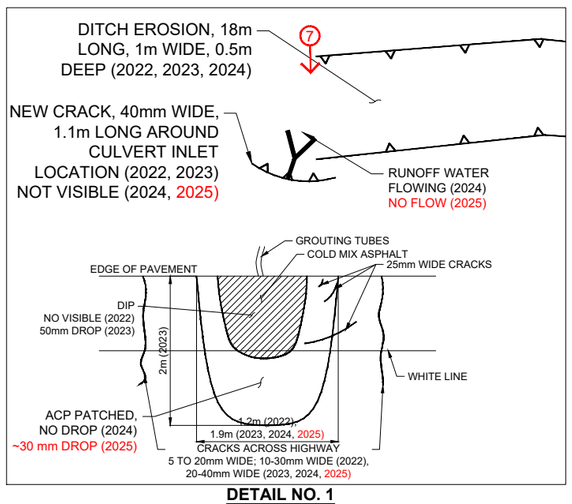
SP1 (WATER @ 4m B.G.S.)
SI1 (SHEARED OFF IN 1980 @ 12.0m B.G.S.)
SP12-7
SP2 (WATER @ 3m B.G.S.)
SI2 (SHEARED OFF IN 1980 @ 9.5m B.G.S.)
SP12-11 (20m)
SP3 (WATER @ 2.2m B.G.S.) COULD NOT BE LOCATED

EASTERN FLANK OF LANDSLIDE

R.R. 222

BRIDGE DECK AND SUPPORTS REMOVED. FAILED HEADSLOPE REGRADED AND COVERED WITH EROSION CONTROL BLANKET. WILLOW STAKES INSERTED INTO REGRADED HEADSLOPES. SILT FENCES PLACE BY CONTOURED SLOPE. ACCUMULATED DEBRIS IN CREEK CHANNEL REMOVED (2019)

BEAVER DAM
TOE EROSION
LITTLE PINE CREEK



DETAIL NO. 1
SCALE: 1:80

INSTRUMENT	GPS COORIDINATES (UTM ZONE 12)	
	NORTHING	EASTING
SI1	6054538	355878
SP1	6054544	355879
SI2	6054461	355838
SP2	6054481	355821

N
W E
S

LEGEND

- APPROXIMATE LOCATION OF2012 INSTRUMENTS
- SI — SLOPE INCLINOMETER
- PN — PNEUMATIC PIEZOMETER
- SP — STANDPIPE PIEZOMETER
- SP — STANDPIPE PIEZOMETER INSTALLED IN THE 1970's
- SI — SLOPE INCLINOMETER INSTALLED IN THE 1970's
- ACP OVERLAY
- SCARP CRACK
- POWER POLE
- P — OVERHEAD POWER LINE (APPROXIMATE)
- G — GAS LINE (APPROXIMATE)
- X — APPROXIMATE LOCATION OF FENCE LINE
- HIGH TENSION CABLE BARRIER (HTCB)
- BUSH LINE (APPROXIMATE)
- APPROXIMATE LOCATION OF EXISTING TRAILS
- 1 — PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION
- GROUND SURFACE SCARCE OF VEGETATION

NOTES

1. WATER LEVELS IN STANDPIPE PIEZOMETERS ARE BASED ON THE AVAILABLE INFORMATION PROVIDED BY TRANS
2. MAY 13, 2025 SITE OBSERVATIONS ARE SHOWN IN RED.

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

Alberta

NORTH CENTRAL REGION
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
2025 GEOHAZARD ASSESSMENT

NC071: HWY 663:04 LITTLE PINE CREEK SLIDE (km 6.98)

DWG NO. 32122-NC071-1

DRAWN BY	ML
DESIGNED BY	JGP / BWN
APPROVED BY	TSA
SCALE	1:1000
DATE	JUNE 2025
FILE No.	32122

THURBER

Photo 1. Looking east at a sinkhole that has developed at the start of the erosion gully in the highway north ditch. The sinkhole is 1300 mm wide, 500 mm long and 600 mm deep.

Photo 2. Highway north ditch east of the approach (facing east).

Photo 3. Looking north at a transverse crack (15-20 mm wide with no drop).

Photo 4. Looking northwest at the eastern flank reflective diagonal cracks (up to 50 mm wide with 20 mm drop).

Photo 5. Looking northwest at diagonal cracks about 15 m east of the landslide eastern flank (up to 50 mm wide with 20 mm drop).

Photo 6. Looking west at the section of the north ditch regraded in 2019; side slopes and sections of the ditch bottom are still bare of vegetation; note the presence of erosion rills along the side slope and a deep erosion gully in the ditch.

Photo 7. Looking south at the inlet of culvert C3 – No flow noted in 2025. The 1.9 m wide ACP patch on the highway surface dropped by 30 mm.

Photo 8. C3 inlet; side slope still is bare of vegetation; erosion developing upstream of the inlet within the ditch.

Photo 9. Sinkhole (800 mm long x 500 mm wide x 400 mm deep) west of the C3 culvert inlet.

Photo 10. Outlet of culvert C3, installed in 2021. There is a void below the half pipe extension piece.

Photo 11 (drone shot). Looking west from beyond the eastern limits of the landslide. Little Pine Creek is visible on the left side of the photo. Hummocky terrain is visible downslope of the highway. Note fill section along the highway notably higher within landslide area.

Photo 12 (drone shot). Highway west of access road. Erosion on the ditch slope is visible. Inlet of culvert C3, sinkhole area and ACP patch, and C3 culvert outlet and half pipe extension is visible on the left of the photo.

Photo 13 (drone shot). Highway east of access road showing the eastern flank of the highway and cracking pattern in the ACP.

Photo 14. Possible backscarp crack 30 mm wide, no drop