ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION GRANDE PRAIRIE DISTRICT - NORTH
2024 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
GP031	South slope of the Peace River Valley near the Shaftesbury ferry crossing	Shaftesbury Slide, South Site	740:02	49.3
Legal Description		**UTM Co-ordinates (NAD 83)**		
LSD 4-9-82-23-W5M		11U N 6 216 300 E 466 120		

	Date	PF	CF	Total
Previous Inspection:	May 19, 2023	11	3	33
Current Inspection:	May 6, 2024	11	3	33
Road AADT:	80		**Year:**	2023
Inspected By:	Don Proudfoot, Nicole Wilder (Thurber) Robert Senior, Rocky Wang(TEC)			
Report Attachments:	☒ Photographs ☒ Plans ☒ Maintenance			

Primary Site Issue:	A landslide was affecting the original alignment of the highway over a 70 m width. A pile wall, which had been constructed along the shoulder of the road, failed and the highway was shifted onto a detour around the backscarp of the slide. The slide extended down the slope to the terrace where Range Road No.234 is located 35 m below the highway. The backslope, which was about 7 m high, had also been subject to slumping.	
Dimensions:	The main slide was 70 m wide along the highway. Three slumps were affecting the backslope over a combined width of about 80m, west of the main slide.	
History and Date of any Remediation:	The original slide occurred in 2007. A pile wall was completed in 2009. It consisted of 114 driven steel HP310x79 piles and 45 screw anchors (Chance anchors). The piles along the main section of the wall were 22 m long while the “wing wall” piles at each end were 15 m long. The tie-back anchors were 25 m long. Prior to the slide the highway had dropped and was built back up behind the wall with a MSE zone against the wall and granular subbase further away from the wall. The wall failed in July 2014 due to loss of soil support on the downslope side and the highway was shifted onto a gravel detour behind the backscarp of the slide. In 2018 and 2019, remediation was carried out and consisted of a realignment of the highway into the hillside, cutting back the backslope to a flatter inclination, constructing a toe berm to buttress the highway slope and constructing a concrete tangent pile wall along the downslope shoulder of the highway. The piles were 900 mm in diameter and 17.2 m long connected across the top by a 1.5 m deep by 1.1 m wide reinforced concrete waler.	
Maintenance:	Maintenance has not been required since the construction of the latest stabilization measures	
Observations:	**Description**	**Worse?**
☒ Pavement Distress	Some diagonal cracks have developed in the pavement surface near the east end of the wall and a dip is present in the road surface further to the east. Several arc shaped cracks were observed in the westbound lane	☒

	shoulder possibly due to settlement along a poorly packed shoulder, a transverse crack just west of the culvert was also observed.	
☒ Slope Movement	A small slump is present in the cut slope above the west riprap channel but has not changed for a few years. A slide crack was noted in the valley slope downslope of the pile wall, which appears to be the backscarp of the original landslide. There is an active landslide in the bush west of the toe berm which appeared to be very active and is potentially associated with cracking of the road surface above this area.	☒
☒ Erosion	There is evidence of erosion outside the project limits resulting in silt accumulating in a low spot in the southwest highway ditch which now has vegetation growing on top of the silt. There is an erosion gully at the outlet of a centreline culvert at the same location.	☒
☒ Seepage	There was a steady drip coming from the drainpipe indicating the presence of groundwater, indicating that the drainpipe is performing as per design.	☐
☒ Bridge/Culvert	The inlet and outlet of a centreline culvert are blocked by silt and erosion /slumping, respectively	☒
☐ Other		☐

Instrumentation:

4 slope inclinometers were installed in the pile wall and by spring 2023 have measured deflections as follows:

- SI18-P10 = 1.5 mm of pile head deflection
- SI18-P30 = 3.1 mm of pile head deflection
- SI18-P50 = 3.0 mm of pile head deflection
- SI18-P70 = 6.6 mm of pile head deflection

Assessment:

The previous failure occurred because the slope below the original pile wall slid away leaving the wall unsupported. This resulted in a catastrophic failure of the steel piles, which were severely bent over. High groundwater levels were also a factor. In addition, the backslope inclination was too steep for the clayey soils that were present in it.

The new design added a large toe berm and cut back the backslope to reduce the overall inclination of the combined fill and backslope. A drainage blanket was constructed under the berm to prevent a buildup of groundwater behind the new berm fill. The pile wall was added to protect the new road surface from the existing landslide scarp that was located at the edge of the temporary detour fill. Surface drainage was also controlled by draining the upslope ditch water into a welded SWSP drop pipe, and precipitation and groundwater seepage from the slide mass into a riprap lined swale, both of which were extended down to the terrace at the toe of the valley slope.

The remedial measures appear to be performing well to date. Pile deflections are all within expected ranges and the global stability of the toe berm and backslope slopes look good. Grass growth is well established on the site and the erosion prevention measures appear to be working.

The slide crack downslope of the wall appears to be near the same location as the backscarp of the original slide. In its failed state the slide mass was broken and loose and it is believed that the slide mass has crept downslope as it tightens and consolidates against the toe berm. The piles were designed to protect the road from this creep movement if a significant gap and differential across the crack do not occur. The design assumed a maximum unsupported cantilever of 4m from the top of waler to the slip

surface of the slide. However, the wall was designed to accommodate tie-backs, in case the cantiliever height is more than 4m.

There is an active landslide within the bush area to the east of the repair. More details about this slide were recorded during the recent visit and it appears to be very active. The new cracks in the highway at the east end of the wall and the dip in the road at Station 49+170 are located above this active slide and might indicate that the slope above the slide is straining due to the loss of support in the slope, which might ultimately lead to the slope failure extending to the road level at this location in the future. For this reason, the risk level for the site was increased previously.

The slump located above the west riprap channel is likely located in weak native material that had been pre-sheared during landslide events prior to construction. This slump has not changed since the previous visit in 2023.

Recommendations:

Monitoring

Given the appearance of the new slide cracks downslope of the pile wall and the new cracks and dip in the pavement east of the previous repair, it is recommended that the inspection frequency for this site be changed to annually. It is also recommended to install two new slope inclinometers at the site to help monitor these areas, with one downslope of the scarp crack below the middle of the wall and another on the north side of the north highway ditch at about Sta. 49+220.

Maintenance

If further deformation of the slope below the wall occurs it would be beneficial to due some grooming of the area to avoid ponding of surface water and to fill the scarp crack with some clay or topsoil to limit seepage of precipitation runoff into the slip surface of the slide.

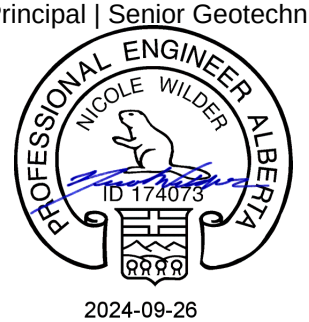
Remediation

If the active landslide in the bush to the east of the repair continues to affect the road some future remedial measures will be required and might involve extending the width of the toe to the east and potentially shifting the highway into the backslope at this location. Excess material from the previous repair was stockpiled over the former gravel pit north of Range Road No. 234 and could be used for the toe berm extension.

CLOSURE

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.

Yours very truly,
Thurber Engineering Ltd.
Don Proudfoot, P.Eng.
Principal | Senior Geotechnical Engineer



2024-09-26

Nicole Wilder, M.Eng., P.Eng.
Geotechnical Engineer

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: September 26, 2024
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

THURBER

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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.

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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.

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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.

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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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Photo 1. Looking west from Sta. 49+250.

Photo 2. Looking west at pile wall alignment.

Photo 3. Looking at landslide backscarp crack downslope of pile wall.

Photo 4. Looking west at diagonal cracks in road pavement.

Photo 5a. Looking southeast at diagonal cracks in road pavement.

Photo 6. Looking northwest at west riprap channel.

Photo 7. Looking at steady drip from drain pipe.

Photo 8. Looking west at slump in cut slope. It hasn't changed since the last inspection.

Photo 9. Looking southwest along the county road on the toe berm.

Photo 10. Looking north at drop pipe outlet.

Photo 11. Looking southeast at the active landslide in the bush east of the toe berm.

Photo 12. Looking east along the backscarp of the slide in the bush.

Photo 13. Looking west at arc shaped cracks in highway shoulder.

Photo 14. Looking north at eroded/slumping outlet of centreline culvert

Photo 15. Looking south at the silted-up inlet area of the centreline culvert near Sta. 49+460.

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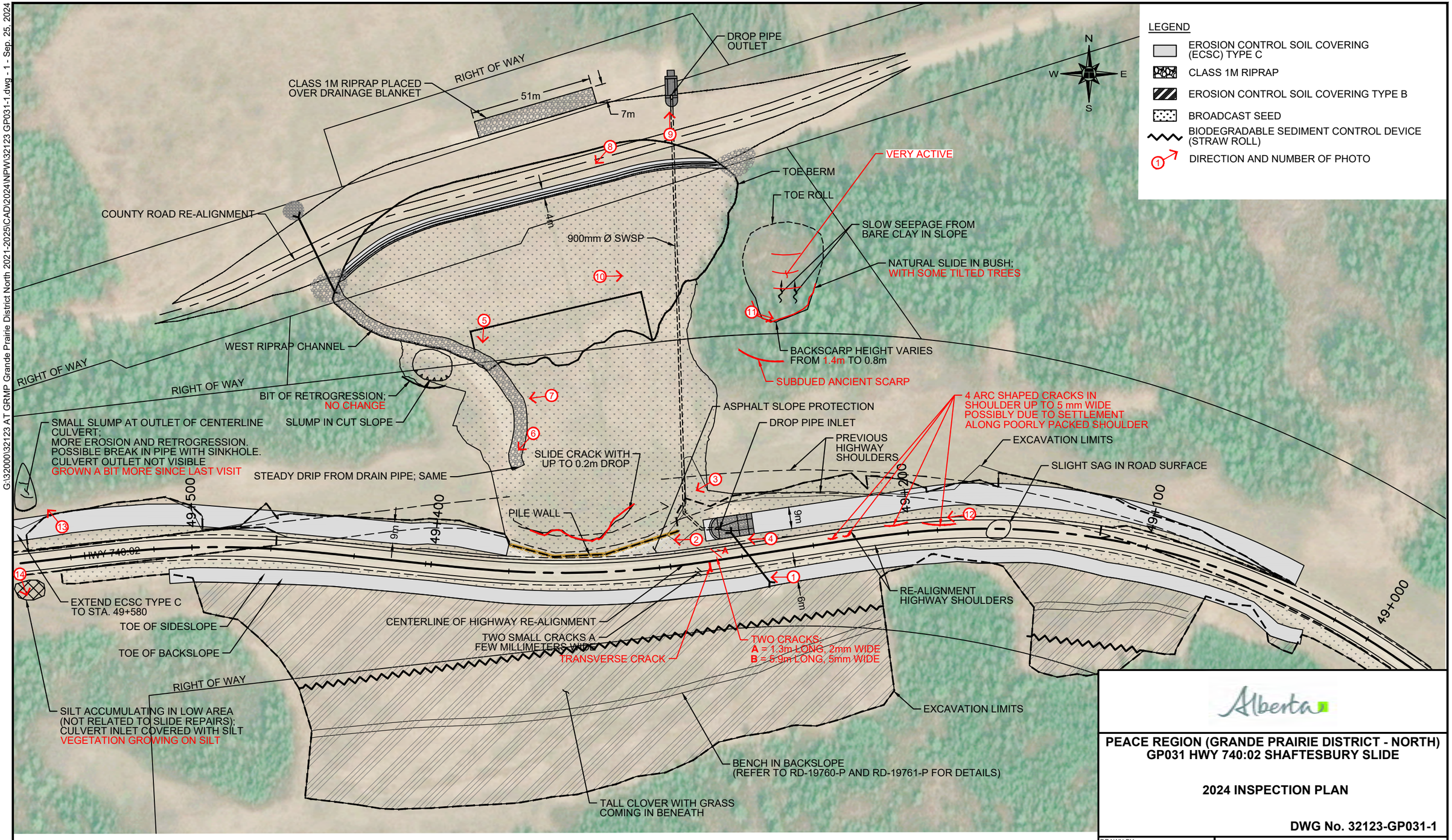

NOTES:

1. MAY 6, 2024 FEATURES SHOWN IN RED
2. AIR PHOTO FROM ESRI WORLD IMAGERY EXPORTED ON SEPTEMBER 6, 2024

0 20 40 60 80 m

SCALE 1:1500

Alberta

PEACE REGION (GRANDE PRAIRIE DISTRICT - NORTH)
GP031 HWY 740:02 SHAFTESBURY SLIDE

2024 INSPECTION PLAN

DWG No. 32123-GP031-1

DRAWN BY	ML
DESIGNED BY	NPW
APPROVED BY	DWP
SCALE	1:1500
DATE	SEPTEMBER 2024
FILE No.	32123

THURBER ENGINEERING LTD.