ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION –
GRANDE PRAIRIE DISTRICT – NORTH
2022 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
PH036	Dunvegan	Dunvegan South Elephant Trunk	2:68	16.216
Legal Description		**UTM Co-ordinates**		
NW¼ 06-080-04 W6M		11U E 398549	N 6196741	

	Date	PF	CF	Total
Previous Inspection:	July 15, 2021	10	4	40
Current Inspection:	May 20, 2022	10	4	40
Road WAADT:	2,360		**Year:**	2021
Inspected By:	Kristen Tappenden, TRANS Ed Szmata, TRANS Max Shannon, TRANS Jason Parr, TRANS		Don Proudfoot, Thurber José Pineda, Thurber	
Report Attachments:	☑ Photographs ☑ Plans		☑ Maintenance Items	

Primary Site Issue:	Band couplings on surface of 900 mm corrugated plastic pipe had failed, allowing water to drain onto the slope. Slope failures occurred in the gully through which the drain was routed, because of the additional water and dislocated the pipe. Large landslides formed along the alignment of the drainpipe.	
Dimensions:	The head of the gully is 100 m wide and is showing signs of on-going slide movement. The length of dislocated pipe was approximately 200 m prior to its repair in 2020, with a further 450 m of pipe beyond the mouth of the gully.	
Maintenance/Remedial Measures:	The dislocated pipe was replaced with a 760 mm diameter smooth wall steel pipe (SWSP) in 2020. The upper portion of the SWSP, from the highway to the backscarp, as well as the portion of the pipe which crossed the landslide backscarp, was trenched below the ground surface and backfilled with excavated clay to secure the pipe. The portion of the pipe running down the valley slope was placed on an approximately 3 m wide fill pad. Once the welded SWSP reached the lower intact portion of the original elephant trunk pipe (900 mm big O pipe), it was inserted into the big O pipe. The contractor then secured seven of the pipe elbows, as well as the insertion point of the SWSP into the CPP, with mounds of excavated clay.	
Observations:	**Description**	**Worsened?**
☐ Pavement Distress		☐
☑ Slope Movement	There is continuing shallow and deep slide movement through the gully along which the Elephant Trunk was routed. Slope movements extend to near the head of the gully, with a significant scarp as shown in Photo 1. Scarps continue to develop across the head of the gully, with additional scarps extending south towards the 2+500 slide – The backscarp of the larger slide area is now up to 10 m high (Photo 3). The landslide mass that the new SWSP drainpipe	☑

	alignment crosses is still moving and has removed some of the subgrade support below the pipe.	
☑ Erosion	There is ongoing erosion of the bare landslide debris due to precipitation that is not related to the flow that is now contained within the pipe.	☑
☑ Seepage	Wet ground and seepage were noted at the landslide scarp near the upper portion of the elephant trunk (See Photos 2 and 6)	☑
☑ Bridge/Culvert Distress	No signs of structural damage were noted in the new SWSP. However, the steel pipe shows signs of lateral movement up to 120 mm due to thermal effects. In addition, vertical gaps under the SWSP up to 1.3 m gap were also noted due to ongoing movement of the landslide mass. Ongoing creek bank erosion at the big O pipe outlet has resulted in multiple dislocations.	☐
☑ Other	The trench backfill over the portion of the SWSP extending between the highway and the pipe vent has settled.	☑

Instrumentation:

SI-30A	Installed near the Elephant Trunk at 2+300 and shows creep movement rates ranging from 0.3 to 5.5 mm/year over 5 m to 10 m depth and over 17 m to 22 m depth with 100 mm of overall cumulative downslope movement. The overall downslope movement has increased by 10 mm/yr since the fall 2021 readings.
SI-30B	Installed near the crest of the slope above the original Dunvegan Slide, near the head of the gully with the Elephant Trunk, shows ongoing creep movement ranging from 1 mm/yr to 7 mm/yr at 12.1 m to 17 m depth. The overall downslope movement has increased by up to 3.0 mm/yr since the fall 2021 readings.

Assessment:

Surficial soil at this location is very sensitive to moisture content and the rupture of the old elephant trunk resulted in all upslope drainage flowing into the head of the gully. This excessive water flowing in an uncontrolled manner had been soaking and eroding the valley slope which in turn resulted in accelerated slide movement.

Flow slide movement has expanded to the south, with the development of a scarp running between the Elephant Trunk and the 2+500 slide. The SWSP installed in 2020 can now transfer runoff from the east ditch of the highway down to the big O pipe section located on the flat ground below the valley slope, without leaking water onto the slope. This should continue to allow the slope to dry out a bit and should significantly reduce the amount of erosion compared to the condition prior to replacing the elephant trunk. However, the ongoing flow slide movements have created vertical gaps up to 1.3 m below the SWSP which may lead to structural stress and damage to the recently installed pipe unless additional maintenance and erosion control measures are implemented at this location.

Recommendations:

The surface of the trench backfill over the SWSP alignment between the highway and the backscarp should be topped up with topsoil, smoothed out and re-seeded.

Local regrading of the subgrade along/under the section of the pipe that descends the valley slope over the landslide mass should be carried out when required to maintain support to the pipe to avoid long unsupported gaps that could overstress the pipe. There is a piece of old big o pipe that was used to drain a gully under the new SWSP. This section of big o and the gully channel leading to and from it should also be improved while doing the subgrade repairs.

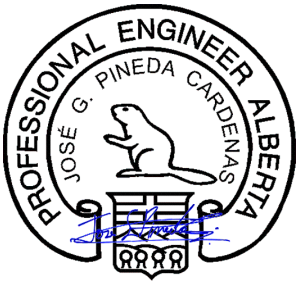
In the future, consideration should be given to using screw piles with crossbeams to support the portions of the SWSP that have been developing gaps under the pipe, if the required grading repairs become too significant.

In the future, if an opportunity presents itself, consideration should be given to improving the stability of the landslide mass using bio-engineering techniques such as live staking to vegetate the landslide mass to increase the roughness of the slopes, reduce runoff flow velocities and help dry the slope through evapotranspiration, thus decreasing the erosion potential and shallow slope failures.

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.

Don Proudfoot, P.Eng.
Principal | Senior Geotechnical Engineer



October 17, 2022
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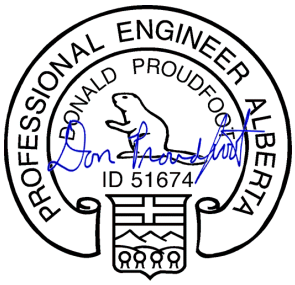

October 17, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: October 17, 2022
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

José Pineda, P.Eng.
Associate | Geotechnical Engineer

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

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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.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment 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.

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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.

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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 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.

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 should 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 detailed in the contract documents should 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 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.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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.

7. 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 others 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.

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BIG O PIPE DISLOCATED DUE TO ONGOING EROSION AT THE CREEK'S BANK (2021)

HORIZONTAL JOINTS

SOIL BERM OVER CONNECTION OF STEEL PIPE INTO EXISTING 1040 mm O.D. CPP PIPE (2021)

ANCHOR BERM
PIPE SHOWING THERMAL MOVEMENT 120mm VERTICAL CRACKS IN SOIL BERM (2021

HORIZONTAL JOINTS

STRAIGHT JOINTS

SINKHOLE

760mm DIA SWSP OUTFALL PIPE

MOVEMENT OF LANDSLIDE UNDER PIPE RESULTED IN UP TO 1m GAP UNDER THE PIPE (2021, 2022)

WET GROUND (2022)

BIG O PIPE USED AS A CULVERT UNDER SWSP

SI-7

SI01-2

SI01-1

DESICCATION CRACKS

RECENT SHALLOW SLIDE ACTIVITY

BEND / JOINT IN PIPE

EROSION GULLY:
1.6m WIDE x 1.6 m DEEP (2002)

SI-30

SI-30B

SCARP CRACK

SI-29A

SI-28

SI-28A

SI-28B

HWY 2681

2+100

2+200

2+300

END OF UNSUPPORTED PIPE

VENT PIPE

SI-30A

SEVERELY CRACKED AND FLOWING DOWN SLOPE (SAME 2022)

PIPE BRIDGING GROUND WHICH HAS SETTLED 1.3m (2021, 2022)

SURFACE OF TRENCH BACKFILL HAS SETTLED (2021)

BURIED PORTION OF OUTFALL PIPE

30" Ø SWSP

LEGEND

- SLOPE INDICATOR
- SLOPE INDICATOR (INACTIVE/DESTROYED)
- (1) DIRECTION AND NUMBER OF PHOTO
- LANDSLIDE SCARP 2018, 2019, 2021
- LANDSLIDE SCARP 2022

NOTES:

1. LOCATION DATA RECORDED USING HAND HELD GPS RECEIVER. ALL LOCATIONS ARE APPROXIMATE AND ARE FOR ILLUSTRATIVE PURPOSES ONLY.
2. MAY 20, 2022 OBSERVATIONS SHOWN IN RED

0 20 40 60 80 100 120m
SCALE 1:2000

Alberta

PEACE REGION (GRANDE PRAIRIE DISTRICT - NORTH)
PH036 DUNVEGAN SOUTH - ELEPHANT TRUNK

2022 PH036 INSPECTION PLAN

FIGURE 1

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	DWP
SCALE	1:2000
DATE	OCTOBER 2022
FILE No.	32123

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	**Photo D1.** Overall view of elephant trunk looking west with a drone
	**Photo D2.** Oblique drone view of elephant trunk on upper slope

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	**Photo D3.** Oblique drone view of elephant trunk alignment on mid slope
	**Photo D4.** Oblique drone view of elephant trunk on lower slope

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	**Photo 1.** Looking northeast from Sta. 2+320 towards the Dunvegan Elephant Trunk consisting of a 760 mm diameter smooth wall steel pipe installed in 2020.
	**Photo 2.** Looking west from the crest of the valley bench. Note seepage on the bottom left of the photo

	**Photo 3.** Looking south from 2+200, about 110m west of Hwy 2:68. Overall increase in slide activity along the backscarp in the upper portion of the Elephant Trunk drainpipe since 2021. Note up to 1.3 m of settlement of slide mass under the SWSP downslope of where it exits the fill cover.
	**Photo 4.** Close up of the settlement gap mentioned in Photo 3.

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	**Photo 5.** Looking west at the upper most pipe bend. Note the pipe shifted by about 250 mm at this location due to thermal effects
	**Photo 6.** Looking west at the middle pipe bend. Note how the movement of the landslide under the pipe results in a gap approximately 1 m high. Trickle of water noted under the gap below the pipe

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	**Photo 7.** Looking upstream at SWSP middle bend and soil berm.
	**Photo 8.** Looking downslope at SWSP lower bend and soil berm.