

**ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION - SWAN HILLS
2024 INSPECTION**



Site Number	Location	Name	Hwy	km
SH006-1	North of Swan Hills	Klumph Creek	33:14	18.1-18.6
Legal Description		UTM Co-ordinates		
NE28/SE33-70-9-W5M		11U E 608,502	N 6,107,107	

	Date	PF	CF	Total
Previous Inspection:	30-May-2022	10	4	40
Current Inspection:	5-Jun-2024	10	4	40
Road AADT:	680		Year:	2023
Inspected By:	Rishi Adhikari, TEC Robert Senior, TEC		Ken Froese, Thurber Roger Skirrow, Thurber	
Report Attachments:	<input checked="" type="checkbox"/> Photographs		<input checked="" type="checkbox"/> Plans	<input checked="" type="checkbox"/> Maintenance

Primary Site Issue:	The highway crosses an active slide area approximately 700 m in width over an overall slope height of 57 m. Movement appears to be 6 m to 13 m deep, seated in weathered bedrock or the base of clay overburden at the bedrock contact. The slide was likely triggered initially by high water levels within the slope and toe erosion by the highly mobile Swan River. Movement is manifested on the highway at each end of the scarp: transverse cracking at the north and culvert distress at the south. Persistent creep movements continue to produce pavement distress.
Dimensions:	500 m of highway length with an embankment fill height between 4 m to 10 m in height (north to south).
Date of Remediation:	1988: 40 m wide portion of west portion of embankment near the tributary to the Swan River failed damaging both culverts which was repaired. 2001: Construction of toe berm (600 m long) with sand subdrains using excavated material (390,000 m ³) from upslope areas for off-loading. Outlets of 1200 mm and 900 mm culverts at Klumph Creek were repaired and extended.
Maintenance:	2016: ACP patch placed over cracks at north end of site. 2017: Overhead powerline installed on east side of highway. 2020: Patching at north end of site.

Observations:	Description	Worsened?
<input checked="" type="checkbox"/> Pavement Distress	Crack pattern at north end of site continued to reflect through patch. Deterioration of driving surface observed over most of the highway length within the slide area.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	Ongoing movement observed in instruments and confirmed by pavement distress. The rate of movement appears to be relatively stable.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	Erosion at outlet of north culvert riprap apron noted in 2014 deepened in 2017 and again in 2019.	<input type="checkbox"/>

<input checked="" type="checkbox"/> Seepage	Numerous depressions with ponded water observed downslope of highway.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert	Sinkhole (3 m by 2 m) first observed in 2013 has become wider and deeper.	<input checked="" type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>

Instrumentation (Spring 2024):	
SI18-30 to -35	SI18-30 has a cumulative movement of 28 mm at 14 m depth representing an increase of 2.1 mm since Spring 2023. SI18-31 has a cumulative movement of 27 mm at 13.2 m depth. SI18-32 has a cumulative movement of 12 mm at 15.5 m depth., SI18-33 has a cumulative movement of 23 mm at 16.4 m depth. SI18-34 shows no discernible movement. SI18-35 has cumulative movement of 5 mm at 5.4 m depth.
SP00-2, SP00-6A, SP00-6B	SP00-2, SP00-6A and SP00-6B have decreased in the last year after reaching historical high water levels.
PN18-30 to -35	Water levels increased to historical highs in Fall 2019 or Spring 2020 and have now begun to decrease with PN18-34 and -35 below initial measured water levels. PN18-32 has been relatively stable over the last two years. PN18-30, -31, and 33 increased in Spring 2024.
Damaged/ Destroyed	SI10 (11 m depth), SI11 (5.7 m depth), SI00-5, SI00-6, SP00-5 (unable to locate)
Assessment:	
<p>The landslide is still active and moving at a very slow rate. Instrumentation installed in March 2018 initially measured slow movements near the highway at about 13 m to 14 m depth and has now, as of 2022, identified movement zones in all inclinometers, including those further downslope from the highway, except for SI18-34. Asphalt milling and patching (latest in 2022) is still required about every three to four years to maintain the roadway at the north end of the site where it crosses the landslide scarp. Milling may be required in the next couple of years to reduce the humps that will likely form at the north end of the site. The highway was patched in 2022 and a few more of the cracks have reflected through since, with minor vertical displacement.</p> <p>The instrumentation installed in early 2018 has revealed ongoing creep movement which is impacting the highway surface. Based on Dwg, No. 32121-SH006-1-2, attached, it appears that the large-scale landslide is toeing out near the top of the toe berm. Given the large size of the landslide and slow movement rate, periodic patching of the asphalt at each flank appears to be the most cost-effective method of dealing with the landslide movements. However, continued monitoring of the site (visual and instrumentation) is recommended to manage the risks.</p>	
Recommendations:	
Short-Term:	
<ul style="list-style-type: none"> ▪ Short-term road maintenance (patching and milling to provide a safe, smooth surface) should continue as required. Longer term options align with the short term maintenance recommendations. Enlargement of the toe berm might further slow movement rates, however there are now significant wetlands adjacent the toe berm that would have to be accounted for. 	
Ongoing Investigation:	
<ul style="list-style-type: none"> ▪ It is recommended that the biennial geohazard inspection and twice-annual instrumentation readings schedule be maintained. 	

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.

Roger Skirrow, P.Eng.
Senior Geotechnical Engineer

Mark Gallego, P.Eng.
Geotechnical Engineer



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE 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. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

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.

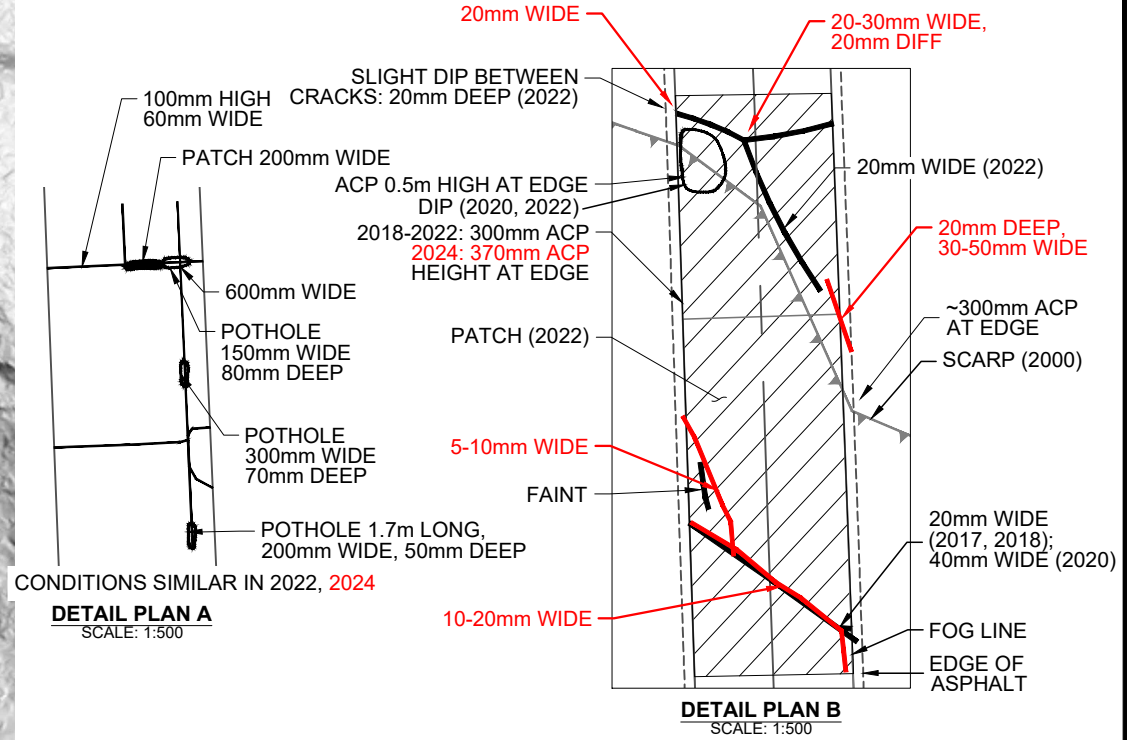
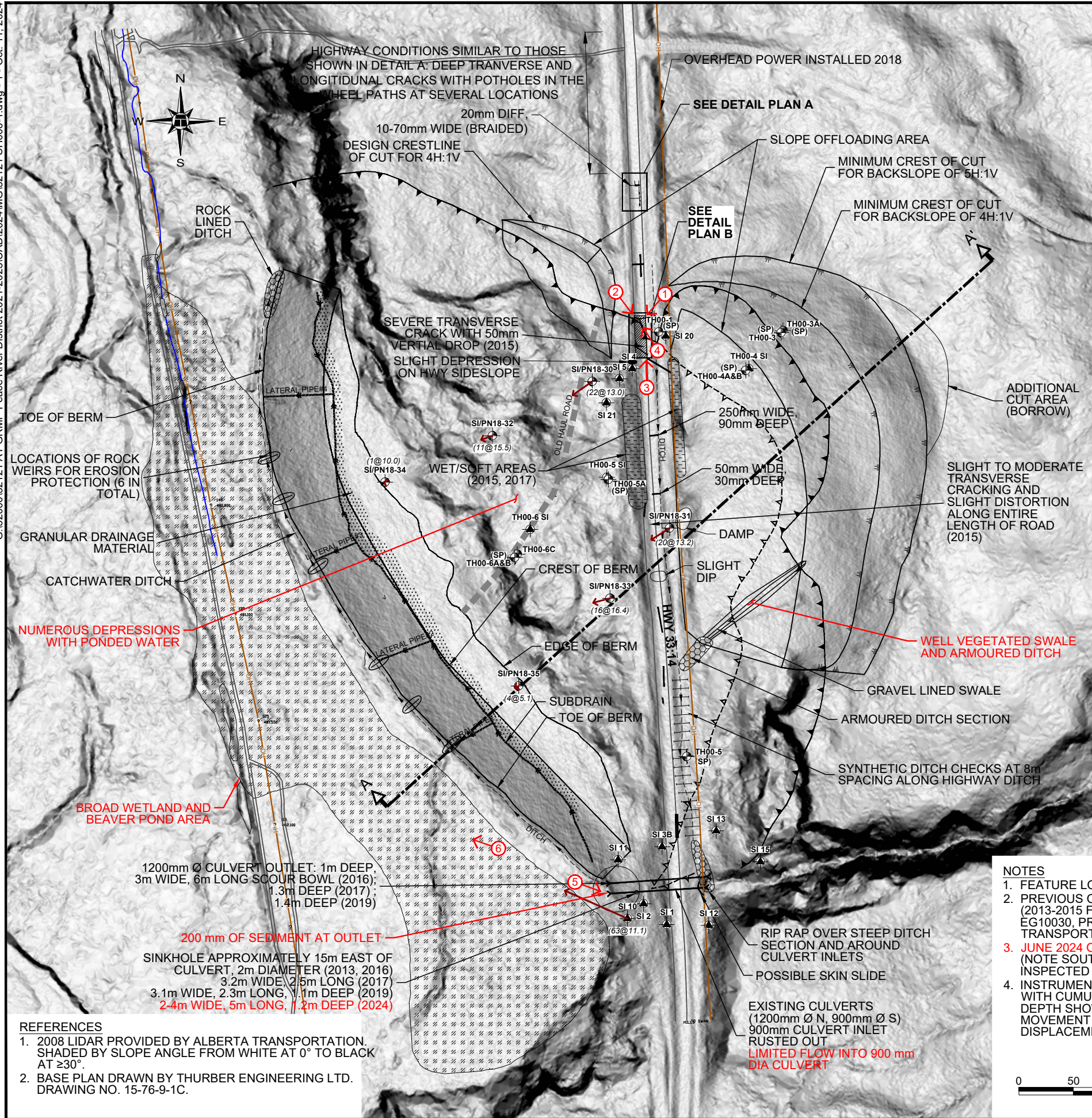
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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

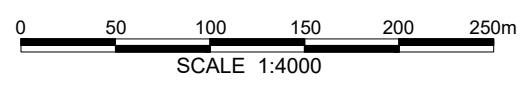
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or 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.

G:\32000\32121\AT GRMP Peace River District 2021-2025\CAD\2024\IMG\32121 SH006-1.dwg - 1 - Oct. 11, 2024



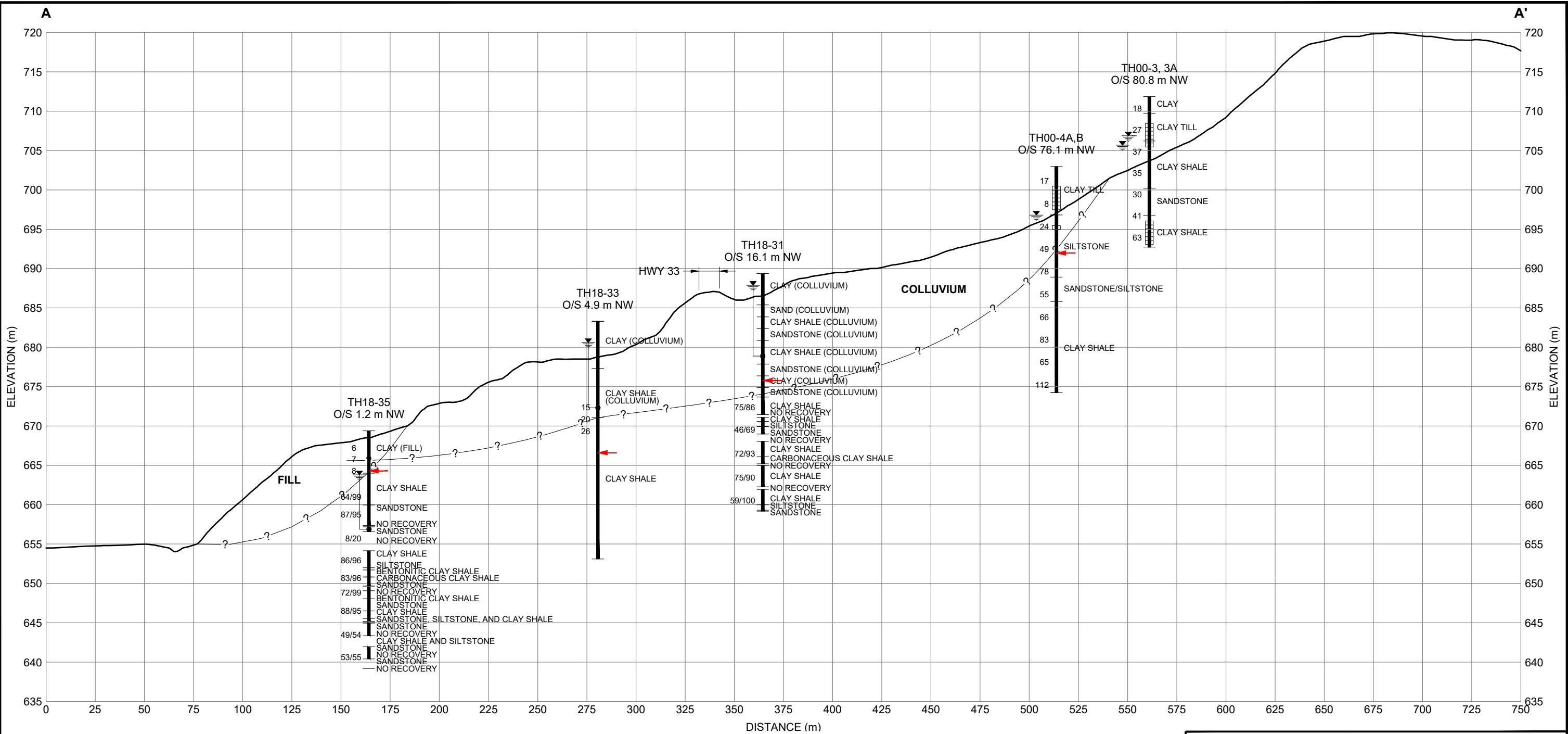
- LEGEND
APPROXIMATE TEST HOLE LOCATION
STANDPIPE PIEZOMETER
APPROXIMATE SLOPE INCLINOMETER LOCATION
MOVEMENT VECTOR DIRECTION
MAJOR SCARP (CHECKED IN FIELD) (2000)
MINOR SCARP (ESTIMATED FROM AIR PHOTOS) (2000)
DITCH
SUBDRAIN
OVERHEAD POWER LINE
DIRECTION AND NUMBER OF PHOTO
WETLAND AREA

- NOTES
1. FEATURE LOCATIONS ARE APPROXIMATE.
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK (2013-2015 FROM AMEC FIGURE 1, PROJECT EG10030, PROVIDED BY ALBERTA TRANSPORTATION).
3. JUNE 2024 OBSERVATIONS SHOWN IN RED. (NOTE SOUTH PORTION OF SITE WAS NOT INSPECTED IN 2018 OR IN 2020).
4. INSTRUMENTS SHOWN IN RED ARE ACTIVE WITH CUMULATIVE DEFLECTION AT MOVEMENT DEPTH SHOWN FOR INCLINOMETERS. MOVEMENT DIRECTIONS AND CUMULATIVE DISPLACEMENT UPDATED FALL 2022.



- REFERENCES
1. 2008 LIDAR PROVIDED BY ALBERTA TRANSPORTATION. SHADED BY SLOPE ANGLE FROM WHITE AT 0° TO BLACK AT ≥30°.
2. BASE PLAN DRAWN BY THURBER ENGINEERING LTD. DRAWING NO. 15-76-9-1C.

Alberta logo, PEACE REGION (SWAN HILLS), SH006-1: KLUMPH CREEK SLIDE ON HWY 33:14 2024 SITE INSPECTION PLAN, DWG No. 32121-SH006-1-1, DRAWN BY ML, DESIGNED BY MG, APPROVED BY RKS, SCALE 1:4000, DATE OCTOBER 2024, FILE No. 32121, THURBER ENGINEERING LTD. logo.



LEGEND

- 15 | SPT N VALUE
- ☼ WATER LEVEL IN PIEZOMETER
- PIEZOMETER TIP LOCATION
- ▤ STANDPIPE PIEZOMETER SCREENED INTERVAL
- ZONE OF MOVEMENT IN SLOPE INCLINOMETER

NOTES

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.
2. VERTICAL SHIFT OF +172m REQUIRED TO MATCH ORIGINAL GROUND (FROM THURBER DRAWING 15-76-9-1, MAY 2000) TO GEODETIC ELEVATION.



PEACE REGION (SWAN HILLS)

**SH006-1: KLUMPH CREEK SLIDE ON HWY 33:14
CROSS - SECTION A - A'**

DWG No. 32121-SH006-1-2

DRAWN BY	ML
DESIGNED BY	MG
APPROVED BY	RKS
SCALE	H 1:2000 V 1:500
LAST UPDATED	OCTOBER 2024
FILE No.	32121





Photo 1 – Looking south from east shoulder at main scarp crack and patch at north end of site.



**Photo 2 – Looking south from west shoulder at main scarp crack and patch at north end of site.
Note powerline installed on east side of highway since 2017 visit.**



Photo 3: Looking north at hump over main scrap crack at north end of the site.



Photo 4: Looking south at crack at south end of patch at north end of the site.



Photo 5: Looking at south culvert which had build up of sediment at outlet.



Photo 6: Looking at broad beaver pond and wetland area downslope of the highway.