THURBER ENGINEERING LTD.

November 29, 2021 File No.: 32121

Alberta Transportation
Provincial Building
9621 – 96 Avenue
Peace River, Alberta
T8S 1T4

Attention: Mr. Ed Szmata

GEOHAZARD RISK MANAGEMENT PROGRAM (CON0022164)
PEACE REGION (PEACE RIVER DISTRICT)

SECTION D CALLOUT REPORT
SITE SH022-5: HWY 744:02 km 19.00 – 19.14

Dear Mr. Szmata:

This report presents the results of a call-out for the above-noted site located on Hwy 744:02 between km 19.00 and 19.14. Mr. Ken Froese, P.Eng., of Thurber Engineering Ltd. (Thurber) undertook a callout inspection on October 28, 2021, in the presence of Mr. Ed Szmata of Alberta Transportation (AT).

It is a condition of this report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

1. BACKGROUND

A slump occurred in the side slope of Highway 744:02 at km 19.07. The legal description of this site is SW21-76-22-W5M. The 2021 AADT on the highway is 230 vehicles per day (as of 2021). The site is located within a portion of Hwy 744 which is constructed on the side of the north slope of the Little Smoky River valley. The north valley slope is moving as several separate slide blocks in response to the toe erosion and downcutting by two different rivers resulting in numerous scarps, sag ponds, and differential movement zones going in slightly different directions. The highway intersects the scarps of these blocks at several locations resulting in an uneven highway surface and cracking. These sites of movement have been numbered sequentially from south to north with Site #3 near the bottom of the valley and Sites #14 and #15 at the top (Sites #1 and 2 are on the other side of the river). This Site #5 had been relatively stable for a few years and not subject to some of the significant vertical deformation noted at sites higher up the valley. The risk level was 27 prior to 2020 when it was increased to 33 after a slide occurred in the shoulder at this same location.

A new slide in the side of the highway embankment was first observed on June 2, 2020, during the routine annual inspection. The scarp was at the edge of pavement and had obstructed the culvert outlet. A second brief visit was undertaken by Thurber on June 24, 2020, to confirm that efforts were underway to maintain highway safety. At that time, the emergency fill had also

slumped downward. It is not known what additional measures were taken in 2020 to remediate this slide. It re-occurred in October 2021 at the same location (Maintenance Contract Inspector photos were dated October 21); however, a new culvert had been installed in Summer 2021 as part of an overall overlay and grading contract. The call-out inspection was done on October 28, 2021.

The following information was obtained from Mr. Kevin Riewe of McIntosh Perry on November 23, 2021, who was involved with the Hwy 744:02 overlay and improvements during the summer of 2021. The overlay and reprofiling was done between km 17.170 and km 22.016.

- There was a 50 mm overlay with Mix Type M1 (PG 52-34). No vertical profile adjustment was made at this site.
- Pavement width through the site was 8.3 m.
- As per the May 2021 photo (see attachments), the slide had not been repaired before the overlay work took place and the contractor was directed to not repair it, only install the culvert.

2. OBSERVATIONS

Observations made during the site visit are illustrated on the Drawing, attached. Selected photographs of the site visit are also included at the end of this letter.

At the time of the call-out inspection, the slump had dropped noticeably since the October 21 photos provided by the MCI: the scarp was between 0.9 m and 1.2 m high and as close as 0.9 m to the fog line. The location is almost the same as in 2020. The embankment is about 4 m high at this location. The 11 m wide scarp had about 5 m intercepting the new asphalt shoulder. There was a narrow graben at the bottom of the backscarp about 0.5 m lower than the top of the slumped surface. The toe roll at the bottom of the approximately 4 m-high embankment was between 0.9 m and 1.3 m in height. The overall width of the slide is about 13 m and is 12 m in length (measured from scarp to edge of toe roll). Sideslopes adjacent to the slumped area where on the order of 20° or 2.7H:1V. The outlet of the culvert was not obstructed by toe roll.

There was some minor seepage noted in the lower half of the west portion of scarp where the gravel was wetter. Seepage was also observed along the sideslope at the base of the gravel on both the west and east sides of the slide. The culvert outlet was still exposed although the new riprap was somewhat disturbed. At the inlet, it was noted that minor material excavated during installation had been pulled away to the north essentially damming the flow into the culvert.

Based on the absence of significant disturbance at the inlet, it is assumed the culvert was bored through the highway from the outlet. Thus, a portion of the slumped area will have been excavated for the equipment to install the culvert. It was observed that the gravel and fill at the surface of the slump were relatively soft and loose.

There is a retrogressive scarp about 5 m in width located further downslope and just west of the culvert outlet that was likely triggered by erosion. It was first observed in 2019 and is located at the top of a gully leading down to a sag pond. There was concern that this feature would retrogress

toward the highway; however, although it widened somewhat in 2020, it did not appear to have advanced closer to the highway. The extents of this feature appeared unchanged in Fall 2021 with no apparent signs of retrogression or further movement.

There was a silt fence installed during construction at the top of this feature presumably to intercept sediment from the culvert flow. The fence is 5.7 m long. On either side of the fence, there were cracks, and it was not apparent if they were the result of a cut for installing the silt fence or if the silt fence had been installed into a tension crack. This crack extended 1.5 m further west and 1.9 m further east of the silt fence. The silt fence is about 2.6 m to the north of the scarp at the top of the gully.

3. INSTRUMENTATION

There is no instrumentation at this site.

4. ASSESSMENT

The crack pattern that had been seen in the pavement on previous visits was not visible during the call-out inspection as the cracks had not reflected through the recent overlay (four months previous). Given the overall valley condition, continued creep movement is expected which will almost certainly result in cracks reflecting through the patch, although vertical pavement distortion at this site is more subdued compared to other locations on the valley slope.

There are a few potential, and inter-related, triggers for the movement at this site. First, there was existing disturbance of the embankment due to the movement that occurred in 2020. Second, at least a portion of this material would have been excavated during the culvert installation and the fill placed back appears to have been inadequately compacted. Third, seepage appears to be a driving factor.

5. RISK LEVEL

Based on the AT's Risk level rating system, the risk level for this site has been assessed as follows:

Risk (33) = PF (11) x CF (3)

This risk level was based on a Probability Factor (PF) of 11 (active with moderate but increasing rate of movement) and a Consequence Factor (CF) of 3 (site with risk between "moderate fills and cuts" and "fills and cuts associated with. culverts or other structures. where partial closure of the road or significant detours would be a direct and unavoidable result of slide occurrence"). This rating is the same as applied in 2020 when the slump first occurred, and the probability and consequence are unchanged from that occurrence.

6. RECOMMENDATIONS

The site is scheduled for an annual Geohazard inspection in the spring or summer of 2022.

In the short term, the roadway surface should be monitored for the development of new cracks resulting from retrogression of the scarp. Additional warning signs or barriers may be necessary to warn motorists of the hazard particularly if its growths in length or moves further into the roadway.

Previous attempts to repair the embankment by placing additional fill material have been unsuccessful. It is recommended that a full excavation of the slide mass be undertaken, and the embankment reconstructed using granular fill with geogrid reinforcement and non-woven geotextile used as a separator between the granular fill and native clay soils.

On a preliminary basis, the recommendations for the repair are:

- The excavation should extend at least 1 m beyond the edges of the slumped material including into the roadway surface.
- A temporary excavation cut face of 1H:1V is acceptable for this low-height embankment.
- Pit-run gravel is suitable for backfill except for the granular base course portion of the pavement surfacing.
- Non-woven geotextile should be placed along the base and three sides of the excavation.
- Three layers of uniaxial geogrid should be placed within the gravel: one at about 150 mm above the base, one at the 1/3 height, and one at the 2/3 height. The geogrid layers should extend from the back and sides of the excavation to the face of the fill.
- The material that is blocking drainage near the inlet of the culvert should be smoothed out to allow the ditch to drain freely into the culvert.

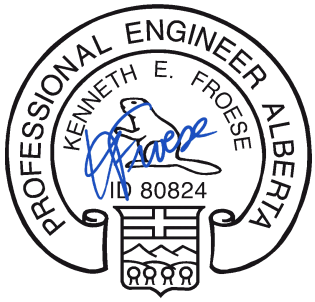
The above measures would replace the poor-quality embankment fill with stronger compacted granular fill which would also provide some drainage for the seepage noted in the area. The ballpark cost to complete the repair listed above will be in the order of $50,000 (excluding engineering).

A potential longer term issue at this site is that water from the culvert drains onto the unstable area further downslope. The risk of this instability retrogressing close to the road could be reduced if the flow from the SWSP could be directed via a riprap lined ditch into the bush further away from the downslope instability. This might add another $15,000 to the cost.

7. CLOSURE

We trust that this information is sufficient for your present requirements. We would be pleased to answer any questions that you may have regarding this letter report.

Yours very truly,
Thurber Engineering Ltd.
Don Proudfoot, M.Eng., P. Eng.
Review Principal



November 29, 2021

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: November 29, 2021
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Ken Froese, M.Eng., P. Eng.
Geotechnical Engineer
/jf

Attachments:

- Statement of Limitations and Conditions
- Drawing 32121-SH022-CALLOUT-1
- Selected Photos

THURBER

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.

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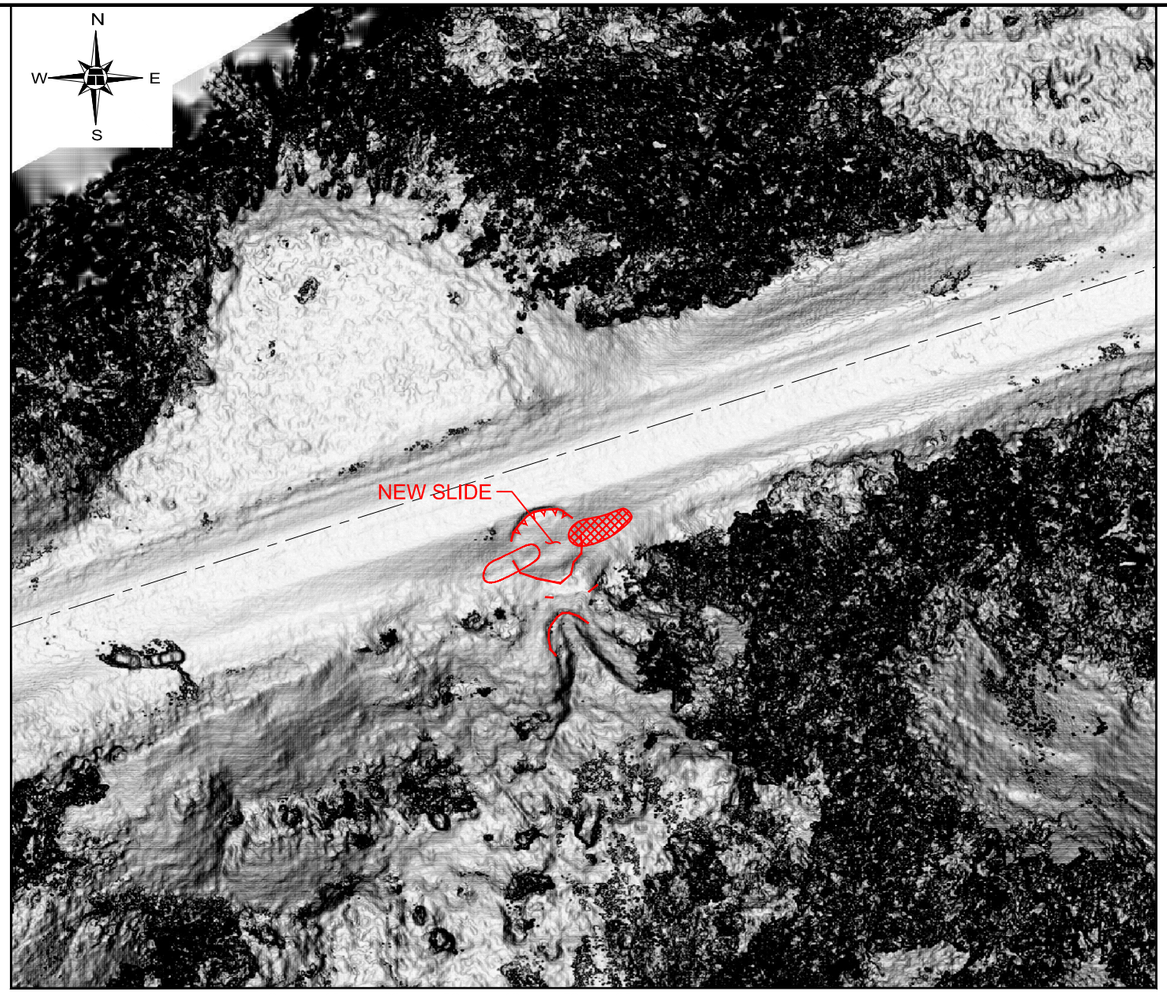
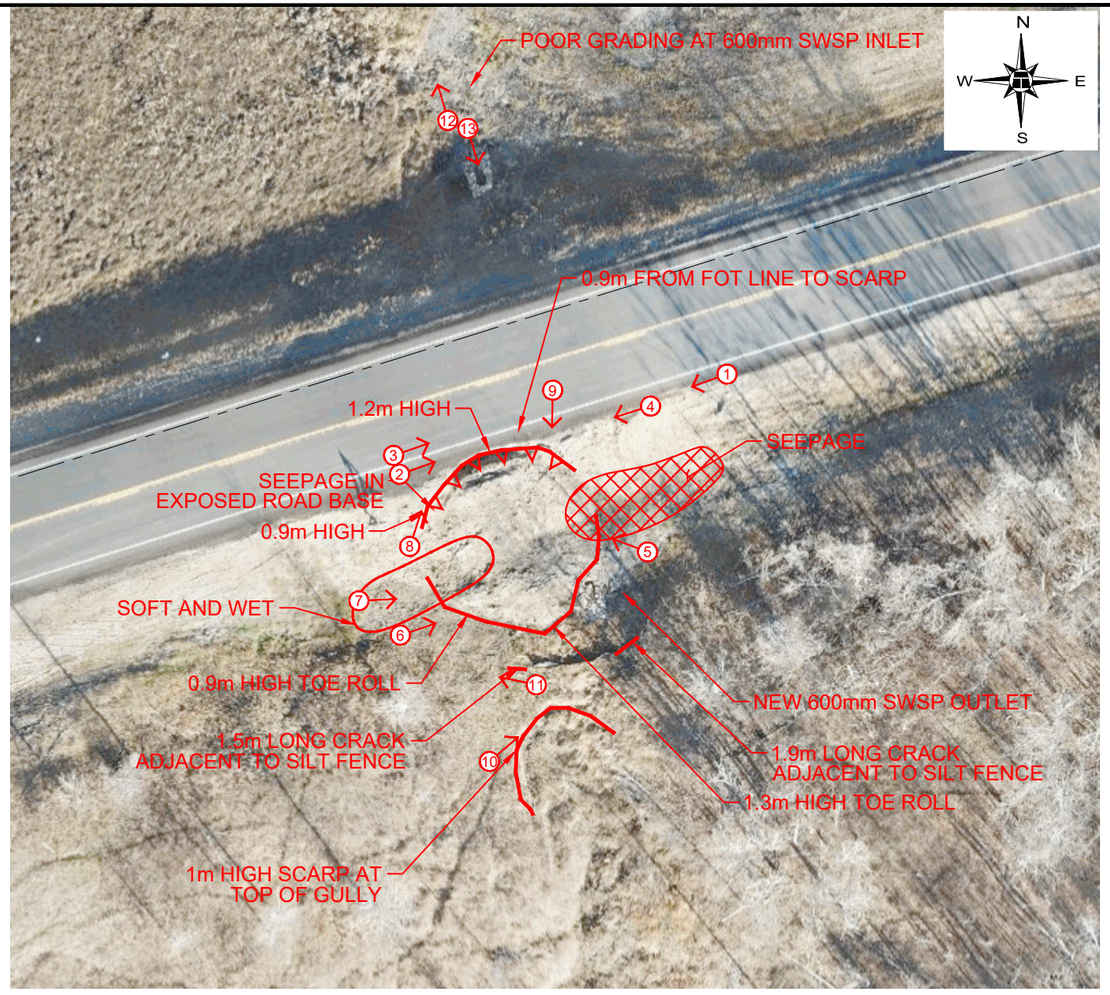


DETAILED SITE PLAN
SCALE 1:1000

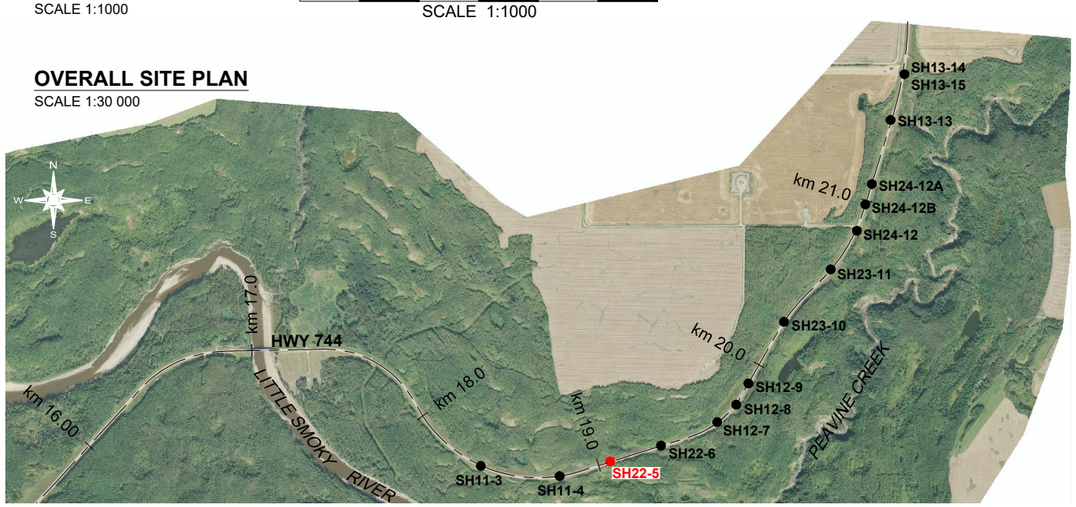
0 10 20 30 40 50 60m
SCALE 1:1000



DETAILED SITE PLAN
SCALE 1:400

0 5 10 15 20 25m
SCALE 1:400

OVERALL SITE PLAN
SCALE 1:30 000



LEGEND

① DIRECTION AND NUMBER OF PHOTO

NOTES
1. FEATURE LOCATIONS ARE APPROXIMATE.
2. PREVIOUS OBSERVATIONS NOT SHOWN AS HIGHWAY WAS OVERLAID IN SUMMER 2021.
3. OCTOBER 28, 2021 OBSERVATIONS SHOWN IN RED.

ORTHOIMAGE DERIVED FROM UAV PHOTOGRAPHS (THURBER 2021)
DIGITAL ELEVATION SURFACE GENERATED FROM UAV IMAGERY (THURBER 2021)

Alberta

PEACE REGION (SWAN HILLS)

SH022-5: HWY 744:02 LITTLE SMOKY RIVER VALLEY 2021 CALLOUT

DWG No.32121-SH022-CALLOUT-1

DRAWN BY	ML
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	NOVEMBER 2021
FILE No.	32121

THURBER ENGINEERING LTD.

Photo 1 (McIntosh Perry, May 16, 2021) - Looking east at slump with stake at new culvert outlet.

Photo 2 (MCI, Oct. 13) – Looking west at crest of slump

Photo 3 (Oct. 28) – Looking west at crest of slump

Photo 4 (Oct. 28) – Looking east at slump.

Photo 5 (Oct. 28) – Toe roll around culvert outlet

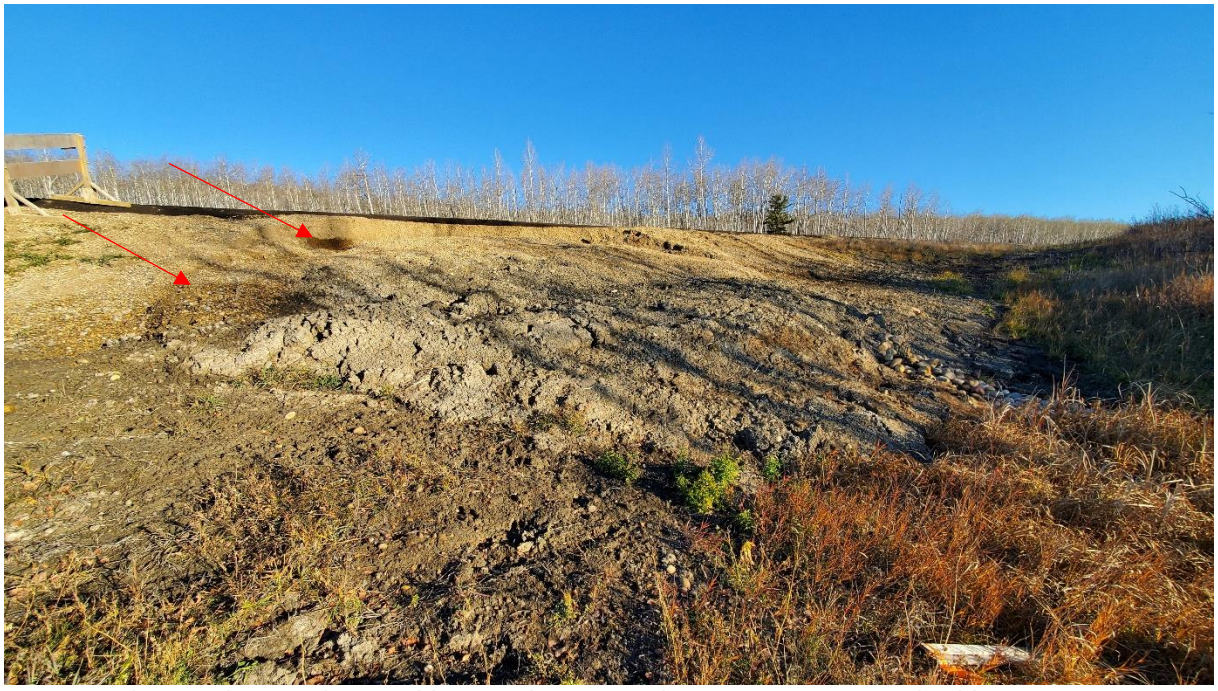


Photo 6 (Oct. 28) – Looking northwest at slump. Seepage marked by arrows.

Photo 7 (Oct. 28) – Looking west at profile of the slide.

Photo 8 (Oct. 28) – Closer view of the scarp. Note the seepage on the left hand side and the depth of the footprints in the loose material.

Photo 9 (Oct. 28) – Looking south down the slump towards the silt fence at the top of the gully to the sag pond below.

Photo 10 (Oct. 28) – Crest of the slump at the top of the gully.

Photo 11 (Oct. 28) – Crack or trench on the west side of the silt fence. Also, note the soft, wet area toward the top of the photo.

Photo 12 (Oct. 28) – New culvert inlet. Note that inlet seems a bit high.

Photo 13 (Oct. 28) – Mound of material upstream/upslope of the culvert inlet blocking drainage from the slough.

June 24, 2020 - UAV Photo

October 28, 2021 - UAV Photo of slide and new culvert. Sag pond is to the right.

October 28, 2021 - UAV Oblique Photo of slump, gully, and sag pond.