



THURBER ENGINEERING LTD.

October 18, 2022

File No.: 32121

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

Attention: Mr. Max Shannon

**GEOHAZARD RISK MANAGEMENT PROGRAM (CON0022164)
PEACE REGION (PEACE RIVER DISTRICT)
SECTION D CALL-OUT REPORT
PRAIRIE ECHO: HWY 679:06 km 8.18 to 8.24**

Dear Mr. Shannon:

This report presents the results of a call-out for the above-noted site located on Hwy 679:06 between km 8.18 and 8.24, near to the Prairie Echo Community Hall, about 21 km northeast of the Town of High Prairie, Alberta. The legal description of this site is SW26-76-16-W5M. The AADT (average annual daily traffic) on the highway is 375 vehicles per day (verified in October 2022).

Mr. Ken Froese, P.Eng., and Mr. Mark Gallego, P.Eng., of Thurber Engineering Ltd. (Thurber) undertook a call-out inspection on May 30, 2022, in the presence of Messrs. Rishi Adhikari, P.Eng., Max Shannon, Ed Szmata, and Rodney Johnston (Maintenance Contractor Inspector, MCI) 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

This site has not had historical issues and the cracks in the pavement were first noticed in Spring 2022. The highway in this area was overlaid in the last couple of years. The MCI requested a call-out during the annual Geohazard Risk Management Program (GRMP) tour in late May and early June 2022, so the site was added to the itinerary.

A brief review of publicly available mapping indicates that the bedrock at this site is in the order of 20 m deep (Alberta Geological Survey DIG 2020 0023) and consists of marine clay shale and siltstone of the Puskwaskau Formation (Alberta Geological Survey Map 236). The bedrock surface slopes southwest toward an east-west oriented pre-glacial valley thalweg situated just north of the town of High Prairie (Alberta Geological Survey Digital Map DIG_2020_0022, 2020). A surficial geology map indicates that the site is located on a glaciolacustrine plain (clay, silt, and sand) oriented roughly northwest-southeast. To the northeast, this plain becomes a veneer over a moraine deposit. To the south is a colluvial deposit from historical instability along the meltwater channel which has become the present-day Lesser Slave Lake and associated low-lands and



ivers. To the southwest, there are more glaciolacustrine deposits. About 1.5 km south of this site is a low-lying area with fluvial deposits (stratified gravel, sand, and silt) and organics (Alberta Geological Survey Digital Map DIG_2008_0353, 2008) in what is likely a poorly-drained remnant of a post-glaciation meltwater channel. To the north and south of the site, there is evidence on satellite imagery of extensive groundwater seepage locations. There is a strip of trees and vegetation oriented southwest-northeast about 250 m southeast of the site which may indicate a zone of drainage that hasn't been cleared during agricultural activities in the area.

AT Maps information indicates that the pavement structure consists of 240 mm of ACP over 250 mm of GBC.

2. OBSERVATIONS

Observations made during the site visit are illustrated in DWG No. 32121-HWY 679:06-CALL-OUT-1, attached. Selected photographs of the site visit are also included at the end of this letter.

The highway embankment measures about 3.2 m in height on the south side with a sideslope inclination of 2.7H:1V. The farmland on either side of the highway slopes approximately toward the southwest and appears to be mainly pasture. On the north side, the embankment was slightly lower. There are no culverts or bridge file structures in the vicinity of this site. The highway slopes downward from east to west flattening out beyond the township road at the Prairie Echo Community Hall access. The site is located just west of a shallow cut as the highway descends from higher to lower terrain.

At the time of the call-out inspection, there was an arc-shaped, 31 m-long crack cutting across the east-bound lane (EBL) and partway into the west-bound lane (WBL) at the east side of the site. There was a hairline crack extending 5 m further west; however, the arc back to the south across the EBL was not observed at the time but may develop in the future. Possible toe rolls were observed downslope of the main crack north of the fence and south of the fence.

There is a dugout or pond located downhill about 130 m southwest of the site where the water level was less than 1 m below ground surface. There were two old culvert-style wells observed on the south side of the highway as shown on the Drawing. The first was near the east end of the crack and had a water level 0.47 m below ground surface which appeared to be controlled by a drain pipe whose outlet was located about 7 m southwest of the well. The second was about 70 m east, slightly higher in elevation, and the water level was at ground surface and was visible around the outside of the well. There was also a spring located in the backslope cut on the north side of the highway in this same area. These two older wells could indicate that past remediation has been attempted at this site by use of deeper dewatering.

3. INSTRUMENTATION

There is no instrumentation at this site.



4. ASSESSMENT

The instability has occurred where the highway is transitioning from a shallow cut in the east to low fills in the west, so the embankment is relatively high in this transition area. Based on a line of groundwater seeps noted on satellite imagery and the presence of groundwater at or near surface adjacent to the highway, this transition area is also located along the line of these seeps (approximately northwest-southeast alignment). Thus, the instability is likely driven by a high groundwater table. This may have been further exacerbated by the recent overlay and recent increases in annual precipitation that have been observed anecdotally in this area which has triggered instability at several locations in the High Prairie and Swan Hills region. This instability may have commenced a few years ago as creep movement but has now had sufficient deformation to be visible on the highway surface especially with the recent overlay. With the landslide mass now mobilized, the distress will likely get worse and could result in a deterioration of the highway surface requiring milling and patching to maintain.

5. RISK LEVEL

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

$$\text{Risk (32)} = \text{PF (8)} \times \text{CF (4)}$$

This risk level was based on a Probability Factor (PF) of eight (between "active with perceptible movement rate" and "active with moderate steady rate of movement") and a Consequence Factor (CF) of four (as "partial closure of the road or significant detours would be a direct and unavoidable result of slide occurrence"). Continued deformation has the potential to close the EBL.

6. RECOMMENDATIONS

There have been several slumps likely driven, in part at least, by higher-than-average groundwater conditions over the last few years: SH030, SH031, East of Gunn's Creek, and the East of Arcadia call-out on Hwy 2:50. Typically, slope flattening, or a toe berm would be suitable for a slump of this relatively low height and extents. However, as this site appears to be primarily driven by high groundwater, these solutions may not be effective if there are not drainage measures also included. If undertaken early, it is possible that a local reduction in the groundwater table may be sufficient to stabilize the site on its own and this should be considered as an option. A pile wall would also be a potential solution but is likely too expensive for this low-volume highway unless the other options prove unacceptable. Gravel replacement of the slide mass would provide drainage and thus stabilize the highway but is likely not economical.

It is recommended that drainage measures be implemented first and that if the slide continues to deform, that a toe berm be considered as the second stage. Subexcavation of the slide mass might require the removal of significant material – it may be more economical to just construct the toe berm and use routine patching to maintain the highway surface until the slide "tightens up."



On a preliminary basis, the recommendations for drainage measures are:

- Survey the site as far west as the township road and as far south as the dugout to determine the potential to use gravity drainage;
- Excavate a subdrain in the upslope and downslope ditch bottom as deep as is practical (say 2 m to 3 m) and extending from the higher ground 100 m east of the site as far west as possible before needing to daylight the subdrain.
- Depending on gradients, it may be necessary to trench or drill the upslope subdrain through the highway embankment to discharge on the south side of the highway.
- Backfill with 150 mm-diameter drainage pipe enveloped in washed rock or other free-draining gravel wrapped with a non-woven.
- Cap the drain with 500 mm of compacted clay (to limit surface water infiltration) and cover with salvaged topsoil and seed.

For the toe berm:

- All soft or organic material should be removed from below the toe berm footprint.
- Low- to medium-plastic clay or clay till or pitrun gravel are acceptable for the berm construction. If granular material is used, a non-woven geotextile should be used for separation.
- A drainage layer (granular or synthetic) should be constructed behind the berm to facilitate groundwater flow.
- The berm should be constructed up to about half the height of the embankment and extend into the ditch 6 m with a 4H:1V slope.
- The length of the toe berm should extend at least the width of the presumed scarp which is likely about 60 m.
- The highway sideslope above the berm should be flattened to at least 3H:1V.
- All topsoil should be removed from below the footprint of the toe berm and stockpiled for reuse.
- All soft or organic material should be removed from below the toe berm.
- The bottom edge of the toe berm against the natural ground should be lined with TRM to reduce the potential for erosion.

A geotechnical investigation is recommended to confirm soil properties and groundwater levels particularly at the base of the slope where there is the potential for soft and/or organic soils. Stability analyses will need to be undertaken to determine the appropriate size and slopes of the toe berm.

The estimated cost to construct two subdrains will be in the order of \$100,000 and for the toe berm repair will be in the order of \$300,000. There may be some savings if both methods are implemented at the same time. These costs do not include resurfacing of the highway.



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

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

Attachments:

- Statement of Limitations and Conditions
- DWG No. 32121-HWY 697-06 CALL-OUT-1
- Selected Photos



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

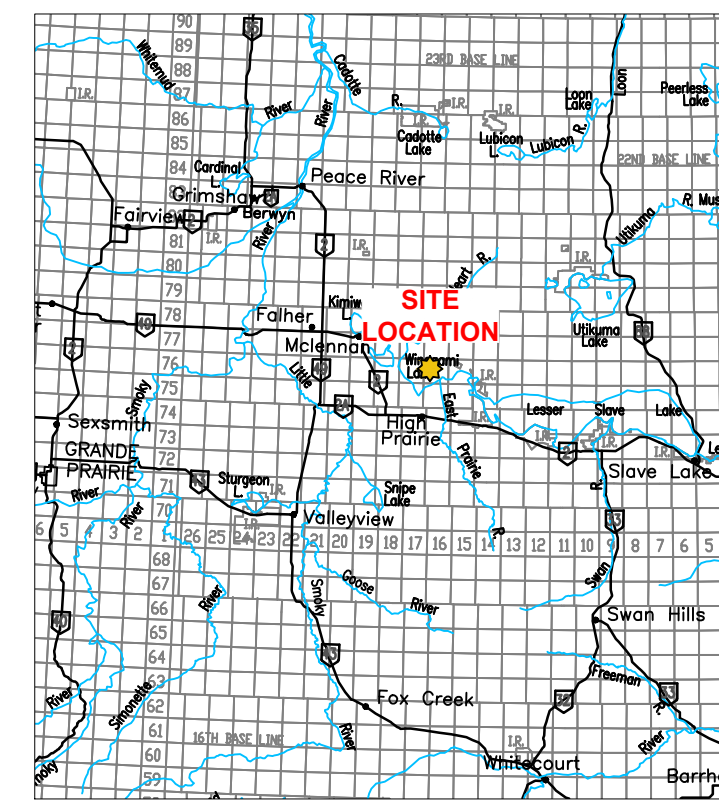
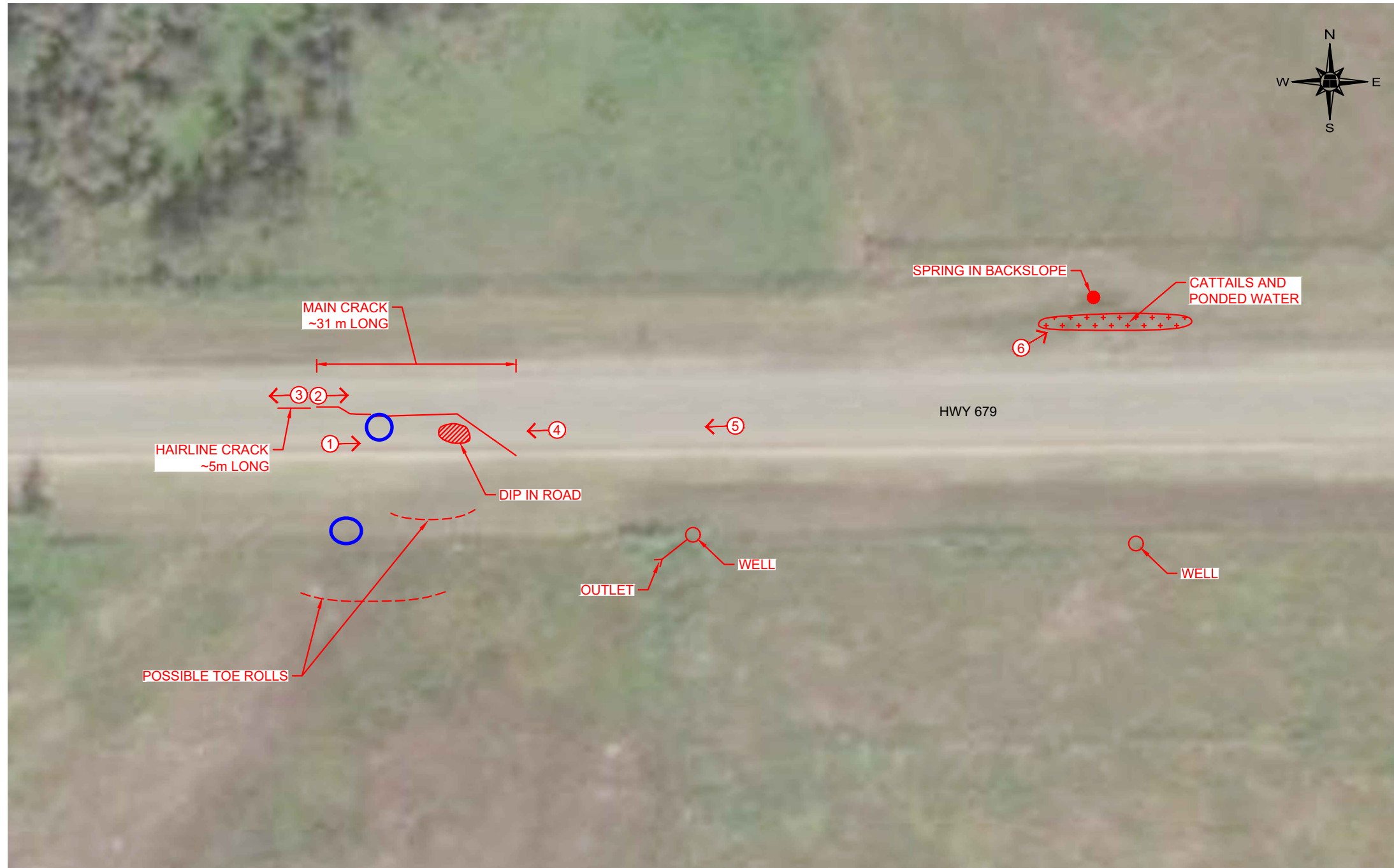
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification 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.



KEY MAP
SCALE 1:3 000 000

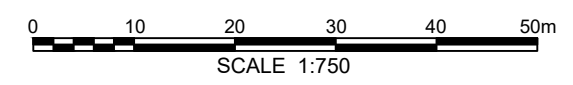


LEGEND

① → DIRECTION AND NUMBER OF PHOTO

NOTES

1. FEATURE LOCATIONS ARE APPROXIMATE.
2. MAY 30, 2022 OBSERVATIONS SHOWN IN RED.
3. AUGUST 2013 SATELLITE IMAGE FROM ESRI WORLD IMAGERY (DOWNLOADED 2022-10-18)



PEACE REGION (PEACE RIVER DISTRICT)
PRAIRIE ECHO: HWY 679:06 km 8.18 TO KM 8.24

CALL-OUT SITE PLAN

DWG No. 32121-HWY 679:06 CALLOUT-1

DRAWN BY	KLP
DESIGNED BY	KEF/MG
APPROVED BY	DWP
SCALE	1:750
DATE	OCTOBER 2022
FILE No.	32121





Photo 1 – Looking east along slight rise in the highway as there is a low backslope cut on the north side behind the trucks. The cattails are roughly where the seep was observed (blue arrow). The second groundwater well was on the higher ground to the south (red arrow)



Photo 2 – Looking east at the west end of the arc-shaped crack. The second well is located in the bush on the south side of the highway (red arrow).



Photo 3 – Looking west at hairline cracks forming west of the main scarp crack.



Photo 4 – Looking west at the main scarp crack where it crosses the EBL.



Photo 5 – Looking west across the site at the general topography sloping down toward the southwest.



Photo 6 – Looking northeast at spring observed in backslope east of the site. Cattails and ponded water present in the ditch.