

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT
PEACE REGION (PEACE RIVER DISTRICT)
2023 INSPECTION**



| Site Number | Location | Name | Hwy | km |
|-------------------|------------------------------|--------------------------|-----------|------|
| PH087-1 | North of Town of Peace River | Whitemud River (km 43.4) | 743:02 | 43.4 |
| Legal Description | | UTM Co-ordinates | | |
| NW1-88-21-W5 | | 11V N 6,273,215 | E 487,109 | |

| | Date | PF | CF | Total RISK LEVEL |
|-----------------------------|--|--------------|---|------------------|
| Previous Inspection: | 7-July-2021 | 11 | 4 | 44 |
| Current Inspection: | 16-May-2023 | 9 | 4 | 36 |
| Road AADT: | 163 | Year: | 2023 | |
| Inspected By: | Max Shannon, TEC Rocky Wang, TEC Pramaya Kannel, TEC | | Don Proudfoot, Thurber Ken Froese, Thurber | |
| Report Attachments: | <input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items | | | |

| | | | |
|---|---|-------------------------------------|-------------------------------------|
| Primary Site Issue: | Two historic landslide blocks have been re-activated and the backscarps are affecting the surface of a two laned gravelled road at two locations separated by about 130 m of unaffected ground. | | |
| Dimensions: | North slide lobe is 90 m wide along the shoulder, 310 m wide at the creek and 135 m long from the highway to the creek. South slide lobe is 75 m wide along the shoulder, 130 m wide at the creek and 150 m long from the highway to the creek. | | |
| Date of any remediation: | Fall 2020: An interim highway re-alignment was constructed around the north landslide lobe. | | |
| Maintenance: | July 13, 2020: Highway closed due to landslide movements at other sites and reopened late in the year after detours had been constructed. | Worsened? | |
| Observations: | Description | Yes | No |
| <input checked="" type="checkbox"/> Pavement Distress | Cracks in gravel road at both slide scarp lobes. At the north side, the road surface within the scarps has dropped about 1 m forming a sunken "graben" feature. At the south side the cracks are showing in the shoulder, but the road has not dropped yet. The detour has shifted off of these features. | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Slope Movement | Cracks and drops in roadway surface indicate active landslide movements. Numerous historical and active scarps on slopes below previous roadway. | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Erosion | Some erosion occurring in the new ditch from spring and surface runoff. | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> Seepage | Seepage occurring at the top of the new backslope cut and in the middle of the interim re-alignment. | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> Culvert Distress | | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> Other | | <input type="checkbox"/> | <input type="checkbox"/> |

Instrumentation:

None.

Assessment:

The site was discovered on June 24, 2020, during the PH039B call-out inspection on the north valley slope. It is not known when the cracking first started or if there have been historical issues at this location.

The site is located on Highway 743:02 near the middle of the south slope of the Whitemud Creek valley about 630 m south of the bridge and 220 m north of the existing PH011 Geohazard site. The valley slopes down to the west at this site.

The road is being affected by the backscarps of two landslide lobes. The north lobe is affecting a 90 m long length of road necessitating a 200 m long interim re-alignment (detour road) constructed in Fall 2020. The backscarp of the landslide has crossed over the original road at each end of the lobe and parallels the east edge of the road. The road had dropped about 1 m in the slide area in a depressed graben-like feature. The detour road appears unaffected at this time by slide movements which have subsided with the slope unloading from detour construction. However, there is some seepage in the backslope which should be contained and erosion gullies forming in the new ditch at the toe of the slope. At the north of the detour, it splits around a soft feature which could be drained by a subdrain. The south lobe had created tension cracks extending about 1 m into the edge of the road. There was a minor extension of the crack in 2021; however, the road has not dropped noticeably in this area yet despite some deformation of the guardrail. There was no further deformation observed in 2023.

LiDAR provided by Alberta Transportation shows an unstable valley slope leading down to a tributary stream of the Whitemud Creek. Drawing 13351-PH087-1 shows the LiDAR image (grey-shaded by slope angle from white at 0° to black at 35° and steeper). The terrain shows indications of a developing retrogression pattern bounded to the northeast by a significant scarp face whose south face is 35 m high and standing at 34°. There is also instability moving in a perpendicular direction on the north side of this feature.

The conclusion is that this movement at the highway is part of an ongoing larger, retrogressive slide complex likely driven by the downcutting of the tributary channel which is about 135 m away horizontally and 20 m lower in elevation. The heavier-than-normal rainfall over the last few years leading into 2020 have likely also contributed both through raising of the groundwater table (creating springs) and increased river flows. The LiDAR also shows that the slope above the highway has also been subject to historical movement. The inspection of site PH011-2 observed fresh tension cracks opening up above the backslope and further movement is anticipated which could result in temporary blockage of the highway by debris from the slide.

Recommendations:**Short-Term (<3 months):**

- The detour roadway should be inspected routinely to assess if movement is occurring (in the roadway or significant slumps in the backslope).
- More seeding and erosion control blankets (temporary type on the backslope and TRM in the bottom of the ditch) should be used to limit erosion of the ditch and backslope.
- A swale should be constructed at the top of the backslope where the majority of the seepage is occurring. The east ditch should be properly shaped and lined with TRM.
- A subdrain should be installed to manage the water along the backslope ditch. Additional subdrains could be installed if other seepage areas are observed.
- The channel at the north end of the site should be armoured (TRM or riprap) to protect against erosion from the seepage.
- Clay excavated from the PH011-2 site should be hauled to the stockpile site south of the valley rather than spread out at this site and the upslope ditch re-established.

Medium-Term (3 to 5 years):

- A further shift into the backslope may be required if additional retrogression occurs. Thurber designed a permanent detour, as shown in purple on Dwg. No. 32121-PH087-1, which could be constructed

as the medium-term solution. The detour constructed in 2020 is the alignment shown in brown on the drawing which was limited due to weather and available funding.

Long-Term (>5 years):

- The highway could be realigned south of the Whitemud Creek bridge to rise out of the valley perpendicular to the valley slope and then curve back to cross the tributary creek east of PH011-1, as shown approximately on Figure 1 below. The curved alignment is required due to the proximity of the Peace River valley to the east of the Whitemud Creek valley. This re-alignment would be expensive, and as there would be limited fills, the excavated material would need to be hauled out of the valley and stockpiled well back (at least 300 m) from the valley crest. This would also require a significant new road segment on the uplands to bring the new alignment back to the existing highway, as well as a new bridge file culvert and embankment fill at the tributary crossing.

Ongoing Investigation:

- It is recommended that the Geohazard inspection should continue as scheduled (every second year).
- Should a major re-alignment be considered, a preliminary engineering design is required to assess the potential alignment and develop ballpark costs. This would include route selection and geometric planning. Once a route has been selected, it is recommended that a geotechnical investigation be undertaken shortly afterward such that detailed design and tender can be undertaken should a realignment be suddenly required due to further movements. Slope stability analyses should be carried out to further develop the option and to determine safe cut slopes for the realignment.

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.

Tarek Abdelaziz, Ph.D., P.Eng.
Partner | Senior Geotechnical Engineer

Ken Froese, P.Eng.
Associate | Senior 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.

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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.

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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.
- 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.

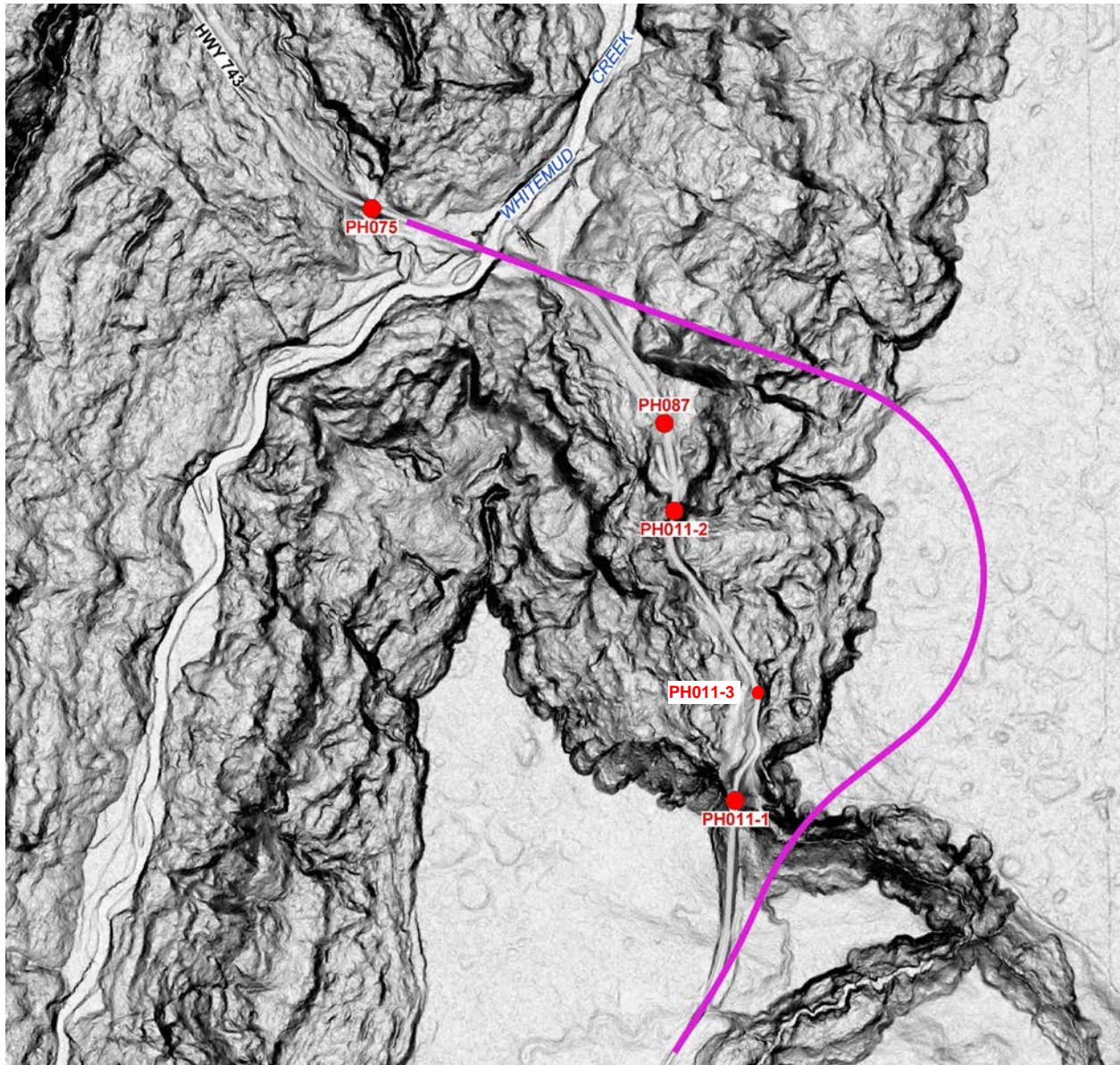
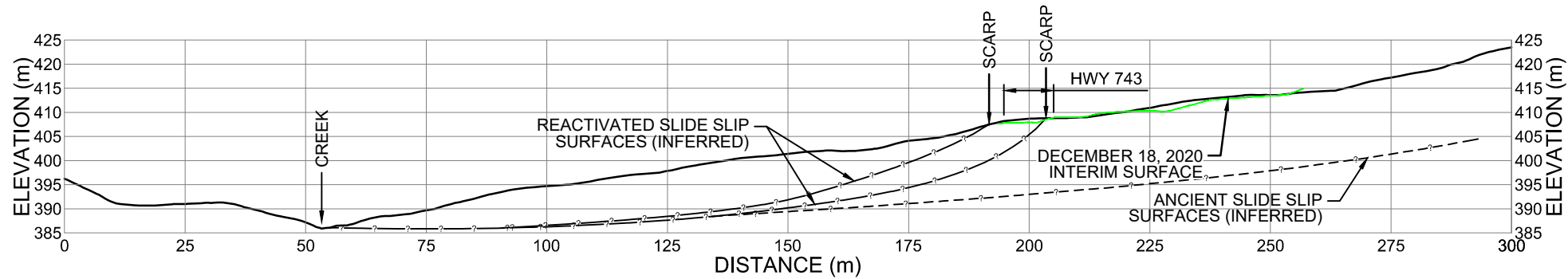
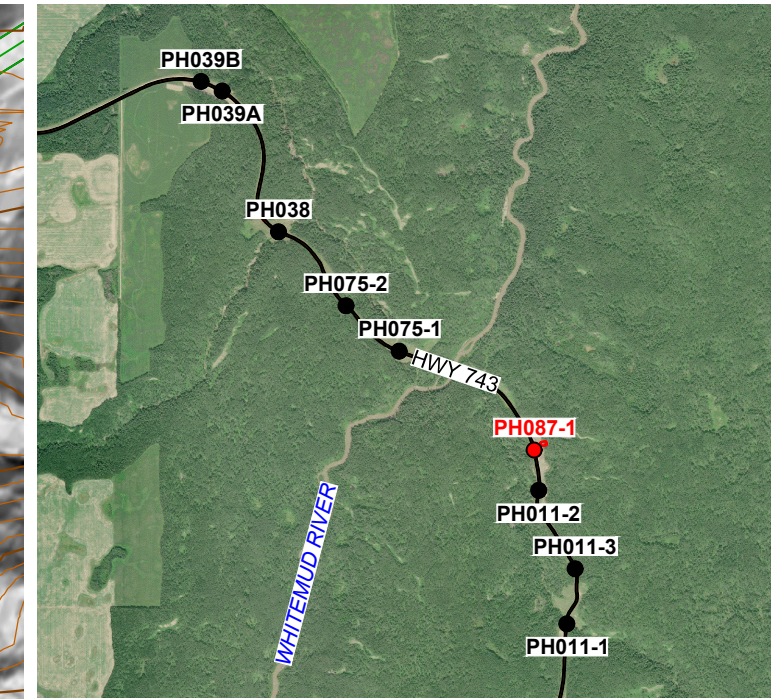
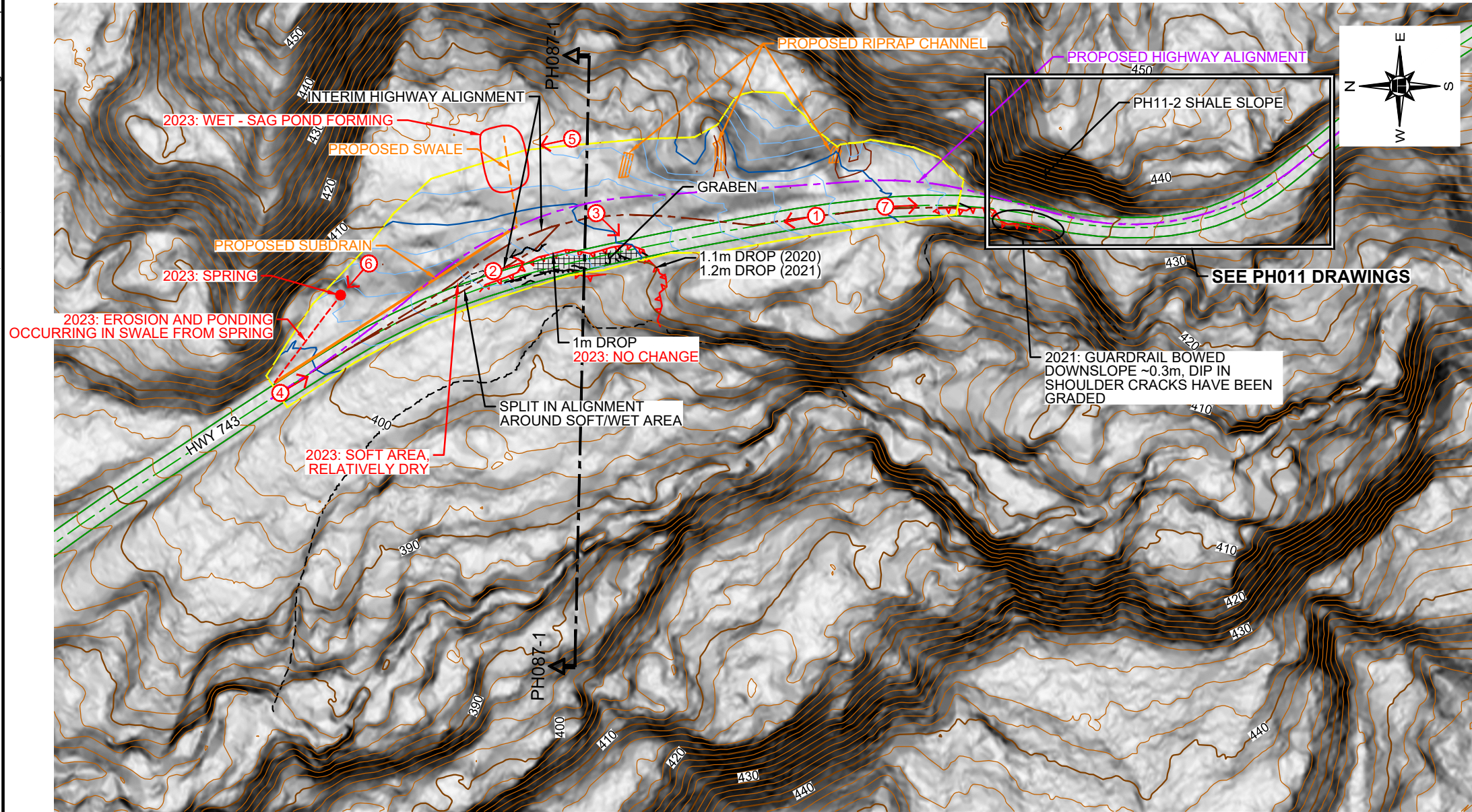


Figure 1: Proposed long term realignment for Hwy 743:02 south of the Whitemud Creek



LIDAR PROVIDED BY ALBERTA TRANSPORTATION

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

PH087-1: HWY 743:02
2023 SITE INSPECTION PLAN

DWG No. 32121-PH087-1

| | |
|-------------|----------------|
| DRAWN BY | KLW |
| DESIGNED BY | KEF |
| APPROVED BY | TSA |
| SCALE | 1:2500 |
| DATE | SEPTEMBER 2023 |
| FILE No. | 32121 |

THURBER ENGINEERING LTD.



Photo 1 – Looking north at the landslide area. Note absence of vegetation in the foreground when clay material from PH011-2 has been spread.



Photo 2 – Looking south along the alignment. Scarp through the old road denoted by arrow. Note that there is only a shallow v-ditch that has been cut by the grader.



Photo 3 – Looking southwest at the south side of the landslide scarp. It did not appear to have moved since the 2021 inspection.



Photo 4 – Looking south at the north end of the detour where it splits around a previously-soft area. Upslope ditch has less erosion than at the previous inspection.



Photo 5 – Looking north at poor vegetation coverage at top of new backslope.



Photo 6 – Looking north along the drainage channel at the north end of the site.



Photo 7 – Looking south towards the south landslide lobe and high shale backslope (PH011-2) on left. The cracks are at the guardrail but had been graded out at the time of the photo.



UAV Photo 2023 – Looking north toward the site: trucks are parked on the approach that was previously used for slumped soil from the PH011-2 backslope site. The bare area on the right side of the highway is where PH011-2 material has been spread recently. The detour around the slide is visible further north.