

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2021 INSPECTION**



Site Number	Location	Name	Hwy	km
PH012	Judah Hill	Heart River Slides	744:04	57.114
Legal Description		UTM Co-ordinates		
SE¼ 20-083-21 W5M		11V E 483284	N 6229209	

	Date	PF	CF	Total
Previous Inspection:	29-July-2020	15	7	105
Current Inspection(s):	6-July-2021	15	7	105
Road WAADT:	600		Year:	2020
Inspected By:	Tyler Clay, TEL Ed Szmata, TRANS Max Shannon, TRANS		Don Proudfoot, TEL Kristen Tappenden, TRANS Erwin Kurz, TRANS	
Report Attachments:	<input checked="" type="checkbox"/> Photographs		<input checked="" type="checkbox"/> Maintenance Items	
	<input checked="" type="checkbox"/> Plans			

Primary Site Issues:	<p>Prior to 2014, there were four slide features on the east side of Hwy 744, adjacent to a layby (brake check lane).</p> <p>Slide 1 was previously repaired in March 1998.</p> <p>Slides 2, 3 and 4 were active and had retrogressed into the northbound layby lane. During the summer of 2011, the northbound layby lane was closed, and the guardrail was moved to the edge of the northbound lane (NBL). In 2013 and the Spring of 2014, Slides 2, 3 and 4 continued to retrogress, coalescing into a larger single landslide feature with the resulting backscarp encroaching into the southbound lane (SBL) of Hwy 744:04.</p> <p>Slides 2, 3 and 4 were repaired by excavation and reconstruction with a uniaxial geogrid reinforced crushed gravel backfill under Contract 15153 during the summer of 2014 (Photos 7,5,9).</p> <p>New landslide scarps have appeared between the location of Slide 1 and the former Slide 2, referred to herein as Slide 1A, and to the south of the sheet pile repair at former Slide 2. The “Y” connector to the solid pipe below the sheet pile wall became disconnected between 2017/2018. The sheet pile wall has deflected from slide movement / earth flows and is no longer effectively retaining the slope at its north end. Mud flow scour channels have appeared and continue to grow at the bases of former slides 2, 3 and 4.</p>		
Dimensions:	Refer to attached Figures.		
Maintenance:	Concrete jersey barriers have been erected around the backscarp and a gravel detour has been constructed to the west of Slide 1A in 2020.		
Observations:	Description	Worsened?	
<input type="checkbox"/> Pavement Distress		<input type="checkbox"/>	
<input checked="" type="checkbox"/> Slope Movement	Slide 1A (km 57+300) has grown and has active retrogression of the main scarp and	<input checked="" type="checkbox"/>	

	<p>flanks. The largest increment of movement occurred around September 2020 and has encompassed the NBL now is just past the median. There is 0.5 m offset of the scarp from the concrete barriers. Since the last major increment of main scarp retrogression there has been ongoing flank erosion, retrogression and some minor retrogression at the main scarp. (Photos 1-4, Drone Photo 1).</p> <p>Continued slide and shallow earth flow movements have occurred at the north end of the sheet pile wall and the structure has become deflected further downslope and outflanked. Increased retrogression of two main scarps south of the sheetpile wall was also observed (former Slides 2 and 3). Shallow earth flows and seepage was observed below the former repairs (Photos 5-7, Drone Photo 2).</p>	
<input checked="" type="checkbox"/> Erosion	Scouring has been previously observed below the disconnected "Y" connector pipe below the sheet pile wall and is likely ongoing concurrently within disturbed slide materials and earth flow processes. An active scour channel is getting progressively deeper and retrogressing towards the road at the south end of the site (Photo 8).	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	Evidence of seepage was observed in the main scarps of Slides 1A and former Slides 2 and 3. Pondered water within the upper disturbed slide mass at Slide 1A was no longer present.	<input type="checkbox"/>
<input type="checkbox"/> Bridge/Culvert Distress		<input type="checkbox"/>
<input checked="" type="checkbox"/> Other	The solid "Y" connector pipe is disconnected below the sheet pile wall. Jersey Barriers were installed, and a gravel detour constructed in July 2020 around the Slide 1A scarp into the road. (Photo 11)	<input type="checkbox"/>
<p>Instrumentation:</p> <p>No instruments are currently installed at the site.</p> <p>As part of the preliminary engineering assessment for Contract 15153, Thurber had previously installed five (5) standpipe piezometers in June 2013 at locations shown on Figure 1. Some of these piezometers were destroyed by landslide movement and the remainder were removed as part of the excavation work for the landslide repair.</p> <p>Seepage was encountered in all the test holes at about 5 m to 6 m below the existing ground surface during drilling in 2013.</p> <p>The last water level readings taken in the standpipe piezometers (Fall 2013) varied between 1.1 m to 4.9 m below ground surface in standpipes installed to 10 m depths (SP13-1A, SP13-2A and SP13-3) and from 23.3 m to 25.2 m in standpipes (SP13-1 and SP13-2), installed to depths of 26 m.</p>		

Assessment:

A combination of weathering, heavy precipitation, and active seepage beneath the old highway embankment fill, which was built through a slough, and surface water drainage in the ditch appears to have caused the retrogression of Slides 2, 3 and 4 before they were repaired. The previous repair at Slide 1 continues to perform well. No new cracking noted on the slope or pavement damage above these slide areas has been observed to date.

The main scarp of Slide 1A (formed between Slide 1 and the former Slide 2) has retrogressed to just past the highway centreline and will continue to retrogress towards the SBL. The rate of retrogression has reduced since September 2020; however, it is expected be highly dependent on groundwater and precipitation conditions. There is still risk the nearly vertical scarp at the highway could retrogress in sudden large increments by breaking off with relatively little warning. Signs of active seepage have been noted at the exposed scarp face and appear to be a driving factor in the loss of soil strength and rapid retrogression. Currently there is approximately 0.5 m of offset between the scarp and current concrete barriers

The sheet pile wall has been compromised from slope movements and is deflected and ineffective at its north end. Ongoing slide movement and loss of material upslope from the wall due to earth flows are expected in the following years. Loss of material here and further south of the sheetpile wall could begin to undermine the upslope repairs above former slides 2 and 3.

Scour in seepage zones in the till underlying the 2014-2015 repair from Contract CON0015153 continue to develop resulting in shallow earth flows on the colluvium slope below the locations of the former slides 2, 3 and 4.

Recommendations:

Cost

Maintenance:

The concrete barriers may need to be rapidly shifted to the west if a significant increment of movement occurs at the Slide 1A main scarp. This would result in the narrowing of the current detour to one-lane traffic and temporary automated lights may be required for safe traffic control, or the detour will need to be widened.

\$50k

Short Term:

Consideration should be given to temporary stabilization measures at the main scarp face to reduce rate of retrogression and provide increased time allowance for long-term mitigation design and construction measures. This could involve installation of launched perforated soil nails. These would reinforce the main scarp face and reduce the magnitude of the incremental retrogression (i.e. significant "break-off" or calving at the scarp face) and would also reduce seepage induced pore pressures at the face.

\$200k to
\$300k

Alternatively, AT could look at implementing a short realignment of the highway further to the west now that the natural gas pipeline that flanks the highway on that side is no longer in service. This will also involve the acquisition of land which is currently privately owned and still will only be a mid-term solution as the Heart River slides on the east side of the highway still have the potential to retrogress into the highway.

\$500k

Longer term mitigation measures could involve removing the landslide debris from Slide 1A and former Slide 2, realigning the road further west (as described above), combining cutting and filling with gravel to flatten the sideslope through the backscarp zones, protecting /reinforcing the toes of the relocated sideslope with shotcrete and soil nails; and adding a series of driven H-Pile or sheet pile walls at the top of erosion gullies to limit retrogression at these locations.

\$3M

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

Tyler Clay, P.Eng.
Geological Engineer



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.

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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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- 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.

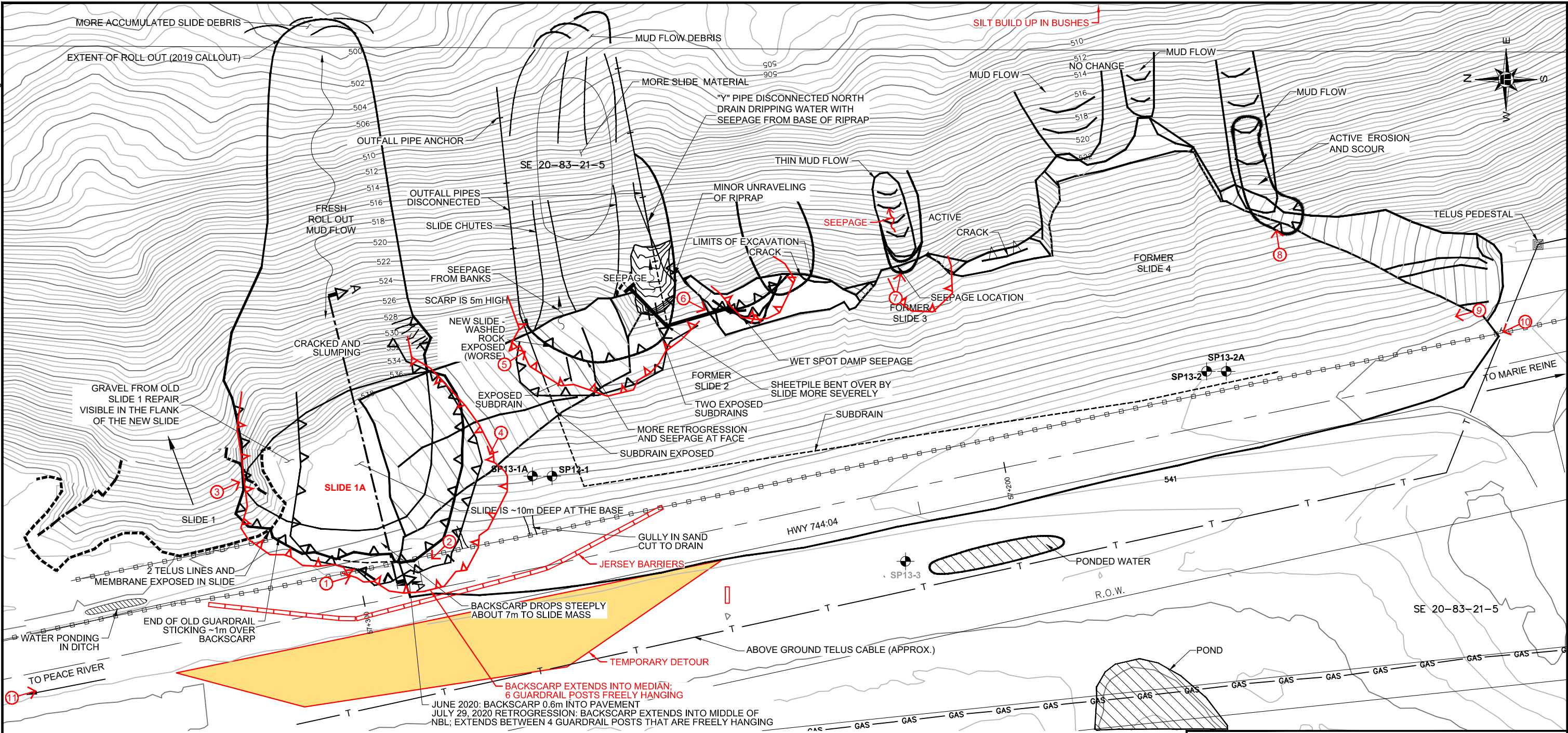
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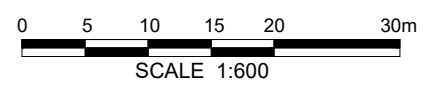


LEGEND

- 150mm Ø PERFORATED SUBDRAIN
- 150mm Ø OUTFALL PIPE
- EXISTING GUARD RAIL
- T—T— APPROXIMATE LOCATION OF RELOCATED ABOVE GROUND TELUS CABLE
- TELUS PEDESTAL
- ⊕ 2013 TEST HOLE (INSTRUMENTS NO LONGER ACTIVE)
- ①➔ DIRECTION AND NUMBER OF PHOTO

NOTES:

- 1 LOCATION DATA RECORDED USING HAND HELD GPS RECEIVER. ALL LOCATIONS ARE APPROXIMATE AND ARE FOR ILLUSTRATIVE PURPOSES ONLY.
- 2 JULY 2021 OBSERVATIONS SHOWN IN RED



PEACE REGION (PEACE RIVER DISTRICT)

**PH012-1 JUDAH HILL HEART RIVER SLIDES
2021 SITE INSPECTION PLAN**

DWG No. 32121-PH012-1-1

DRAWN BY	KLW
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:600
DATE	OCTOBER 2021
FILE No.	32121





Photo 1.
Looking south from south end of Slide 1 from the NBL shoulder of Hwy 744:04 towards the top of the Slide 1A bowl (57+300). The main scarp of the slide has retrogressed entirely into the NBL: and has reached just past the median strip. Gravel detour has been constructed to expand the SBL.



Photo 2.
Looking north towards the Slide 1A bowl flank and main scarp south of Slide 1. The main scarp now has reached past the highway median. Six guardrail posts are freely hanging.



Photo 3.
Looking at the south flank of the Slide 1A area. South flank area expanded since the previous inspection. North flank has had minor expansion within the upper slope relative to the previous inspection.



Photo 4.
Looking towards the northwest at the main backscarp of Slide 1A. Note the wet soil horizon and dried water deposits from seepage.



Photo 5.
 Looking southeast from north end of Heart River Landslide repair excavation (Former Slide 2). More slide / earth flow movement and main scarp retrogression has occurred since the previous inspection. The north end of the driven sheetpile has deflected further downslope.



Photo 6.
 Looking southwest from north end of Heart River Landslide repair excavation (Former Slides 2, 3 and 4). Area has vegetated well through the Type B ECSC. Increased retrogression at the scarp and movement within the slide in the foreground.



Photo 7.
Looking east at mud flow at the location of former Slide 3, which has been more active since 2020. Decreased vegetation since previous inspection indicative of active soil movement.



Photo 8.
Looking south at the scour that has formed south of the former Slide 4. The scour is deeper and has ongoing erosion at the flanks since the 2020 inspection with evidence of recent earth flows.



Photo 9.
Looking northwest from south of the location of former Slide 4. Overall repairs from 2014 are performing well in this area. Overall slope is well vegetated and there are no apparent slumps in the granular backfill slope. No change from 2020.



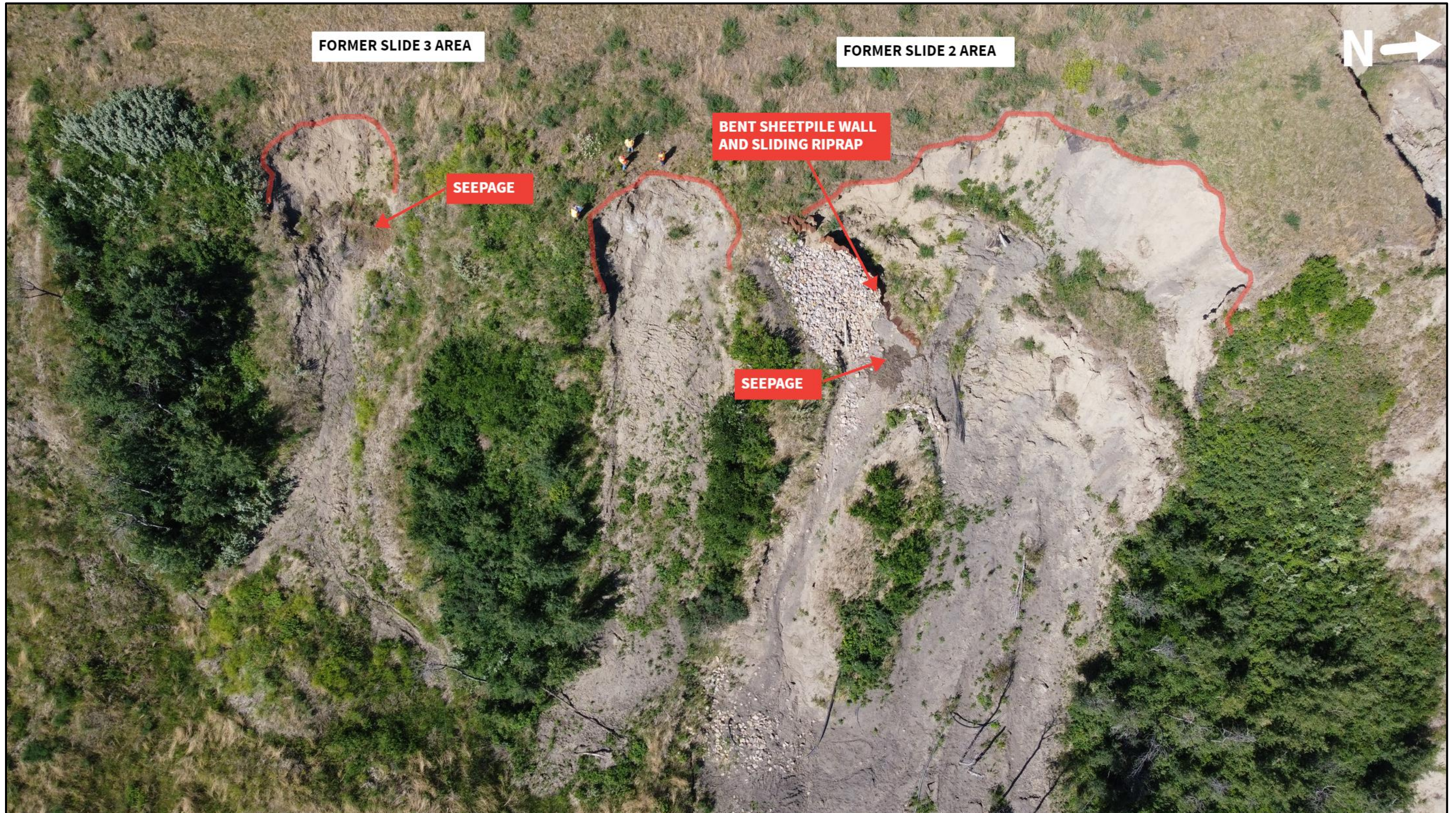
Photo 10.
Looking north along the highway from the south end of the site (57+120). No apparent pavement changes south of Slide 1A. Note detour signage at Slide 1A.



Photo 11.
Looking south along the highway from the north end of the site (57+375) at the gravel detour constructed next to the SBL by Slide 1A.



PH012 - Drone Photo 1
Aerial view looking north from the south side of Slide 1A.



PH012 - Drone Photo 2

Aerial view looking west towards former area of Slides 2 and 3. Active retrogression was noted along the three scarps highlighted in red. Seepage is expected to be major contribution to the loss of soil strength and earth flow behavior at this site.