

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



Site Number	Location	Name	Hwy	km
PH032	Judah Hill	Makeout Landslide	744:04	57.924
Legal Description		UTM Co-ordinates		
NE¼ 20-083-21 W5M		11U E 483171	N 6229947	

	Date	PF	CF	Total
Previous Inspection:	10-June-2020	5	6	30 (Highway)
		14	2	28 (Downslope)
Current Inspection:	6-July-2021	5	6	30 (Highway)
		14	2	28 (Downslope)
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"/> Plans <input checked="" type="checkbox"/> Maintenance Items			

Primary Site Issue:	<p>In 1997, this section of the highway was partially realigned into the backslope, which was flattened, the embankment was rebuilt with shredded tire lightweight fill and was stabilized with a buried anchor pile retaining wall.</p> <p>In 2001, a 40 m wide landslide occurred affecting both highway lanes. Repair work was conducted in the form of a toe berm and drainage improvements in the upslope ditch. In 2005, the road was re-aligned to the east into the backslope and re-grading/off-loading of the sideslope was conducted below the highway.</p> <p>Between 2006 and 2013, slides developed to the south of the re-graded area and erosion occurred along the lined channel for the subdrains at the toe of the sideslope. Subsequently, cracking and slope movement occurred below the drains and below the previously installed pile wall.</p> <p>In October 2013, several crack features were observed in the ACP observed above the 1997 pile wall and the 2005 repair with a landslide bowl feature developed about 20 m downslope of the highway at km 58.12 below the outlet of a subdrain pipe. As part of Contract CON0015153, two cast-in-place concrete pile walls (Makeout and km 58) supported with tieback soil anchors were installed in 2014/2015 below the cracks in the ACP and the landslide bowl feature was excavated and rebuilt with uniaxial geogrid reinforced clay fill.</p>
Dimensions:	<p>Prior to construction, the cracks in the ACP above the km 58 pile wall extended over an area of about 120 m in length and of about 35 m in length at the Makeout pile wall. The slide bowl that occurred in the sideslope above km 58.12 measured approximately 40 m in diameter.</p>
Maintenance:	<p>The concrete drain trough/gutters for the KM 58 and Makeout pile walls were cleaned in 2018. No other maintenance reported.</p>

Observations:	Description	Worsened?
<input checked="" type="checkbox"/> Pavement Distress	Several cracks were observed in the ACP in 2013 (See Photos 1, 7 and 9) prior to the construction of the km 58 and Makeout pile walls and have not significantly changed since the previous inspection. A crack and minor dip in the SBL (km 58.04) behind the km 58 pile wall was slightly worse (Photo 7).	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	<p>The old landslide scarps below the km 58 pile wall that were regraded in 2015 have ongoing movement at intermittent rates. A scarp at the south end of the wall was well vegetated with no major expansion or significant downslope movement since 2020 (Photo 3). The tieback and waler of the old downslope wall are now exposed near the middle of the wall with a 1.2 m drop (Photo 4). Most of the piles from the old wall are now exposed with the highest drop at 2.0 m from the top of the exposed piles (unchanged from 2020).</p> <p>The bench and graded area below the 2015 Makeout pile wall was in good condition with no observable changes from 2020 (Photo 9).</p> <p>Lower slope area between the walls appears the most active; exacerbated by seepage and erosion processes from disconnected drains (Photo 6)</p>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	<p>Both ends of the km 58 pile wall have become eroded by runoff water and water overtopping the outlet of the pile wall due to blockage of the drain trough with sediment buildup. Scour at the north end of the wall has not changed since 2020.</p> <p>The solid HDPE outlet drainpipe for the clay backfilled area became disconnected from the perforated CSP drainpipe at the base in 2018 and erosion damage is ongoing (Photo 5).</p>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	Seepage was noted in the lower slope area between the pile walls near the active erosion gully (Photo 6).	<input type="checkbox"/>
<input type="checkbox"/> Bridge/Culvert Distress		<input type="checkbox"/>
<input checked="" type="checkbox"/> Other	No change observed in the ACP shoulder protective cover at either pile walls (Photos 2 and 10).	<input type="checkbox"/>
Instrumentation:		
Makeout Pile Wall		
SI-PM12 and SI-PM24	<p>Two slope inclinometers were installed in retaining wall piles during construction. PM12 has shown a rate of movement of 0.6 mm/yr over the length of the pile and no discernible movement over the combined length of the pile and waler since the fall of 2020 readings. Since completion of construction, PM12 has shown total cumulative deflections of 1.8 mm in the downslope direction over the length of the pile.</p> <p>SI-PM24 showed a rate of movement of 0.1 mm/yr over the length of the pile and no discernible movement over the combined length of the pile and waler since the fall</p>	

	of 2020 readings. Since completion of construction, PM24 has shown total cumulative movements of 0.1 mm in the upslope direction over the length of the pile.
VC1848, VC1849, VC1851, VC1852 and VC 1854	The load cells showed increases in measured load ranging from 4.32 kN in VC1852 (anchor M24M) to 8.14 kN in VC1848 (anchor M12L). Load cell VC1854 showed its highest ever recorded load since the fall of 2020 readings, on March 6, 2021. The load cells at the Makeout wall have generally shown an overall trend of relatively stable loads since the end of construction, with seasonably higher loads during the winter months
Km 58 Pile Wall	
SI-PK15, SI-PK36, SI-PK54 and SI-PK80	Four slope inclinometers were installed in retaining wall piles during construction. Since construction completion the total cumulative movements measured as of Spring 2021 are summarized below. SI-PK15: 1.4 mm downslope over length of pile, 1.6 mm downslope over combined length of pile and waler. SI-PK36: 3.7 mm downslope over length of pile, 4.3 mm downslope over combined length of pile and waler. SI-PK54: 7.5 mm downslope over length of pile, 6.4 mm downslope over combined length of pile and waler. SI-PK80: 7.9 mm downslope over length of pile, 6.9 mm downslope over combined length of pile and waler. Overall rates of movement over the length of pile at all instruments has been small and has ranged between 0 mm/yr to 3.0 mm/yr.
VC1853 and VC1855 to VC1862	Load cell VC1859 showed a decrease in measured load of 0.19 kN. The rest of the load cells showed increases in measured load ranging from 0.19 kN in VC1858 (anchor K15L) to 7.40 kN in VC1850 (anchor K55U). Load Cells VC1862, VC1858, VC1860 and VC1861 registered all-time high measured loads during a period between March 6, 2021 and April 1, 2021. Overall, the measured loads have shown a trend of overall stable, to gradually increasing loads since the end of construction, with seasonally higher loads during the winter months. The peak loads measured in the load cells seem to correspond the later part of the winter (March to early April) when the depth of frost penetration is highest.
PN13-32-1S and PN13-32-1D	Pneumatic piezometer PN13-32-1S showed no change in groundwater since the fall of 2020 readings. PN13-32-1D showed a decrease in groundwater level of 0.01 m since the fall of 2020 readings. Overall, the piezometers at this site have shown little change between readings cycles over the past several years.
Assessment:	
<p>The newly reconstructed slide bowl repair and pile walls appear to be performing well. Recent movement observed in the passive soil bench below the km 58 wall was anticipated and accounted for in the design.</p> <p>The progressing of the scour below the disconnected drainpipe at the base of the clay backfilled slide bowl will need to be monitored. This slide could grow rapidly in size and retrogress toward the highway if the water leakage is not remediated.</p> <p>The drain troughs for both the km 58 and Makeout pile walls will require annual cleaning and the protective soil cover that was lost at the north end of the km 58 pile wall because of the drain trough overtopping should be re-instated in order to prevent further scour enlargement and soil loss.</p>	

Recommendations:**Cost**

The slope inclinometers will continue to be read manually twice per year and the datalogger installed at the site will continue to take readings of the load cells twice daily as part of the Geohazard Assessment Program.

Monitoring

The pile wall surface drainage gutters will require to be regularly cleaned in order to continue to provide erosion protection for the partially buried pile wall and avoid clogging of its solid down drain pipes.

Maintenance

Some further drainage efforts might be required at the wet area as a future maintenance item as history has shown that persistent seepage can lead to significant slide movements. The disconnected drainpipe below the north end of the km 58 pile wall should be reconnected to help prevent further retrogression of the landslide scarp that has formed below it.

Maintenance

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

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.

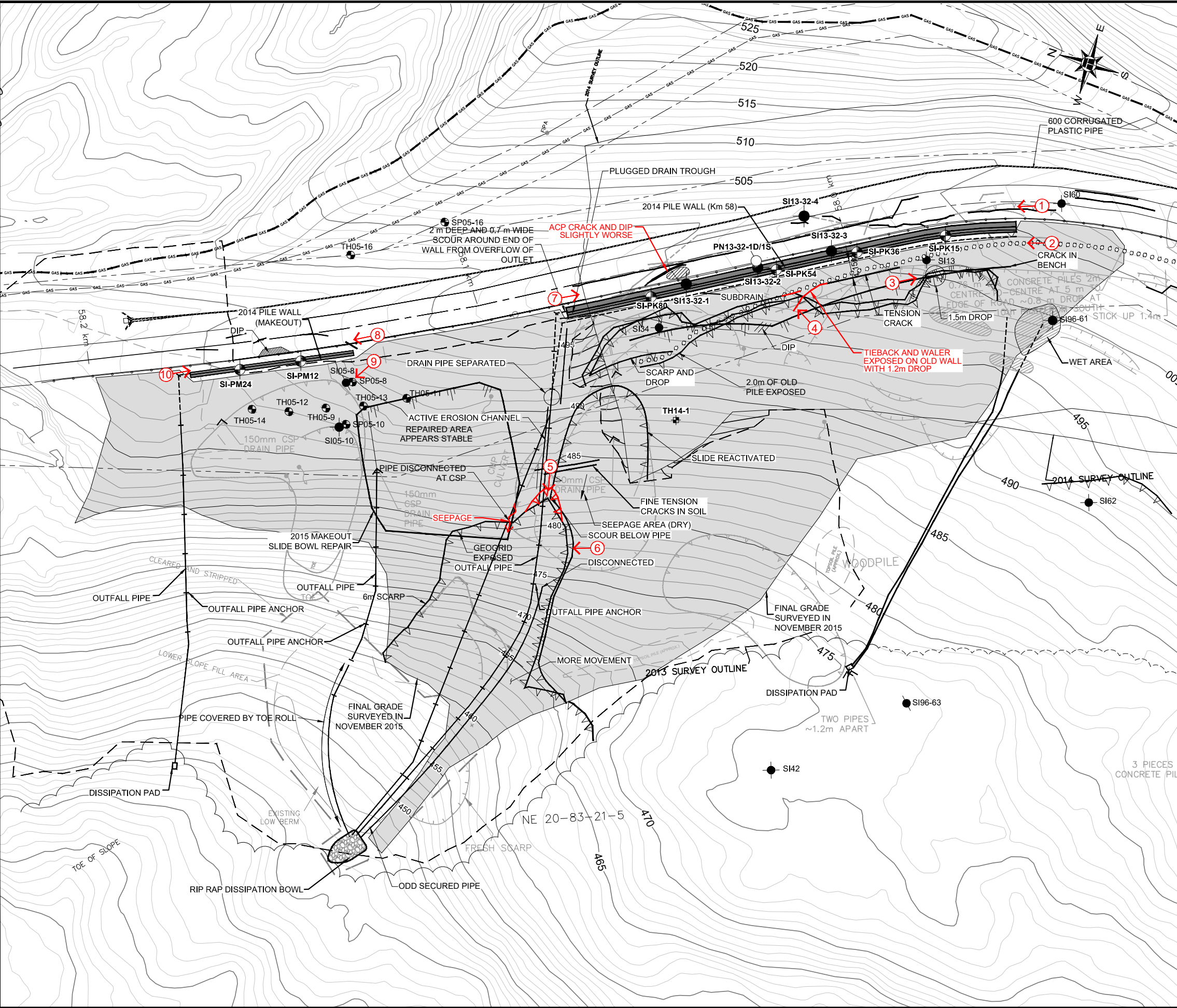
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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

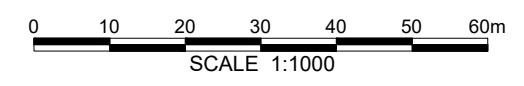
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or 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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- LEGEND**
- 2014 SLOPE INCLINOMETER LOCATION
 - 2014 TEST PIT LOCATION
 - PREVIOUS SLOPE INCLINOMETER (PRESENT)
 - PREVIOUS SLOPE INCLINOMETER APPROXIMATE LOCATION (MISSING)
 - 2014 PNEUMATIC PIEZOMETER (PRESENT)
 - PREVIOUS TEST HOLE LOCATION
 - 2014 PILE WALLS
 - 1997 H-PILE REINFORCED CONCRETE PILE WALL
 - GASLINE ABANDONED IN 2018
 - GASLINE ABANDONED IN 2005
 - GUARD RAIL
 - DRAINAGE PIPE OUTLET
 - TREE LINE (SURVEYED)
 - TREE LINE (ESTIMATED)
 - SOLID DRAIN PIPE
 - BURIED DRAIN PIPE
 - CONTROL POINT
 - DIRECTION AND PHOTO NUMBER

NOTES:
 1 LOCATION DATA RECORDED USING HAND HELD GPS RECEIVER. ALL LOCATIONS ARE APPROXIMATE AND ARE FOR ILLUSTRATIVE PURPOSES ONLY.
 2 JULY 6, 2021 OBSERVATIONS SHOWN IN RED.





PEACE REGION (PEACE RIVER DISTRICT)

**PH032-1 JUDAH HILL - MAKEOUT SLIDE
2021 SITE INSPECTION PLAN**

DWG No. 32121-PH032-1

DRAWN BY	KLW
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:1000
DATE	OCTOBER 221
FILE No.	32121



THURBER ENGINEERING LTD.



Photo 1.
Looking northwest from the SBL shoulder of Hwy 744:04 at km 57.96 along the guardrail above the km 58 pile wall. There has been no major changes in the cracks in the ACP since 2020.



Photo 2.
Looking northwest from the south end of the km 58 pile wall. The ACP shoulder protective cover was in good condition. No significant changes were noted downslope of the wall at this site relative to the 2020 condition.



Photo 3.
Looking south at a scarp in the bench below the south end of the wall with approximately 1.5 m maximum drop. Area is well vegetated with no significant expansion or downslope movement since 2020.



Photo 4.
Looking northeast from below the north end of the km 58 pile wall. The old landslide scarps below the pile wall that were regraded in 2015 have ongoing movement. Additional old tieback and waler was exposed from the movement at the south end. Highest drop was 2.0 m from the top of the exposed piles.



Photo 5.
View downslope towards the head of an active erosion gully approximately 40 m downslope from the north end of the pile wall and disconnected drainpipe further upslope.



Photo 6.
Looking at the north flank of the lower slide area between the pile walls. Seepage from a disconnected drainage pipe is causing erosion and exacerbating slide movement.



Photo 7.
Looking south from the north end of the km 58 pile wall. Slightly worse crack and dip within the ACP directly behind the wall but overall road condition has not significantly changed since the 2020 condition.



Photo 8.
Looking northwest at the highway above the "Makeout" pile wall. No major change to the dip around the SBL shoulder near the middle of the wall or ACP cracking relative to the 2020 condition.



Photo 9.
Looking north at the bench and graded area below the “Makeout” pile wall. Area appeared in good condition and had no observable changes from 2020.



Photo 10.
Looking south along the top of the “Makeout” pile wall. ACP shoulder protective cover was in good condition. Drainage trough was relatively clear and functioning.