

**ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – SWAN HILLS
2024 INSPECTION**



Site Number	Location	Name	Hwy	km
SH013-13	Little Smoky River	Little Smoky River Valley, North Hill – Site #13	744:02	21.36-21.49
Legal Description		UTM Co-ordinates		
SE28/SW27-76-22-W5M		11U E 478,608	N	6,162,922

	Date	PF	CF	Total
Previous Inspection:	6-Jun-2023	11	4	44
Current Inspection:	4-Jun-2024	11	4	44
Road AADT:	270		Year:	2023
Inspected By:	Rishi Adhikari, TEC Robert Senior, TEC		Ken Froese, Thurber Roger Skirrow, Thurber	
Report Attachments:	<input checked="" type="checkbox"/> Photographs		<input checked="" type="checkbox"/> Plans	<input type="checkbox"/> Maintenance Items

Primary Site Issue:	Highway traverses deep-seated, retrogressive landslides with ongoing creep movements due partly to erosion at toe by the Little Smoky River and Peavine Creek resulting in cracking and sagging of the pavement surface at numerous locations. Approx. 4 km of the highway crosses this unstable north valley slope. An active slump developed in Fall 2018 in the east embankment slope and erosion from the culvert outlet has contributed to the width of the slide. This slump extends downslope to merge with a larger slower moving landslide that extends to the base of the valley slope. Site #13 is 55 m above and 310 m away from the Peavine Creek and 35 m above and 115 m away from the tributary gully.		
Dimensions:	20 m wide active slide on east side of embankment.		
Date of Remediation:	<u>1997:</u> Investigation and construction of gabion wall and surface pipe to direct culvert outflow. <u>2002:</u> Downslope slump on the east side of the highway excavated, subdrain installed, and backfilled with imported clay. <u>2014:</u> Repair of upslope side of embankment <u>2017:</u> Installed new 760mm SWSP culvert, placed fill on upslope side, new riprap apron on downslope, and grouted old culvert.		
Maintenance:	Routine ACP crack sealing, milling, and patching, when required. <u>2017 (post-inspection):</u> Overlay through Sites 13, 15, and 14 2020: Line painting 2021: Hwy upgrades on north valley slope including 50 mm overlay, new guardrails, line painting, and ditch improvements		
Observations:	Description	Worsened?	
<input checked="" type="checkbox"/> Pavement Distress	Crack pattern predominantly along the centerline. Cracks continue to extend and reflect through 2021 overlay.	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/> Slope Movement	Ongoing creep movement toward Peavine Creek. North portion of east embankment slid in August 2018 removing part of the gabion wall. The backscarp has retrogressed and was 1.4 m from the guardrail.	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/> Erosion	Loss of vegetation and change in flow patterns due to Aug. 2018 slide is causing erosion at several locations including loss of material into the	<input checked="" type="checkbox"/>	

	valley below. Gully forming in NW quadrant from ditch flow in 2022. Similar conditions were observed in 2023 and 2024	
<input checked="" type="checkbox"/> Seepage	Some seepage noted at location where old culvert was cut off. Soft and damp in the area.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert	Culvert outlet hanging. Riprap apron continuing to deteriorate due to erosion and lower portion lost or covered due to slide.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Other	Gabion basket wall north half lost due to Aug. 2018 slide and south half deformed by erosion and scarps; guardrail installed in 2021 has sustained some damage near the north end possibly from grader contact.	<input type="checkbox"/>
Instrumentation:		
None.		

Assessment:

The overall valley slope is moving as several separate slide blocks in response to the toe erosion and downcutting of 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. At this site, the driving force is downcutting of a tributary gully (starts at SH013-14) to the Peavine Creek.

This site may be affected by deep-seated valley movements; however, localized movements are the primary concern. The formation of an erosion gully below the old culvert outlet led to the requirement for the initial repair in 1997. Subsequent replacement of a slumped portion of the downslope embankment was required in 2002. In 2008, a failure developed on the west side of the embankment (upslope) which continued to retrogress toward the road. A temporary repair was undertaken in 2014, but it did not slow movements and the slide movement obstructed the culvert inlet resulting in ponding of water in the upslope ditch. In spring of 2017, the Maintenance Contractor pushed a 760 mm smooth-wall steel pipe (SWSP) through the embankment. The inlet is approximately 1.2 m higher than the old culvert and some of the softened material was left in place. Approximately 300 m³ of pitrun was placed on the embankment sideslope. The riprap apron at the outlet was extended about 10 m past the gabion wall. The old culvert was grouted (approximately 35 m³ of grout required) and the damaged surface pipe removed. The soils immediately above the new culvert inlet and in the ditch bottom were soft and wet with standing water. The ditch bottom was improved during the summer of 2017.

All of Highway 744 along the north valley slope was overlaid in 2021 including replacement of culverts (although not at this site), installation of new guardrail, and regrading of the ditches. Erosion control blankets with GeoRidges were installed along the bottom of some portions of the upslope ditch (including between this site and SH013-15, further up the valley).

Heavy spring runoff in 2018 led to erosion and undermining of the riprap apron below the new culvert outlet particularly immediately below the outlet where the discharge flow impacted the top of the apron. There was also erosion, displacement of riprap, and damage to the gabion basket wall further down-channel. In Fall 2018, the north portion of the east embankment slope failed at the approximate location of the 2002 slump. By 2019, the scarp was approximately 20 m in width up to the north tree line and extended through the gabion wall removing the north half of it. The landslide head scarp was approximately 12 m from the east edge of the highway at the closest point. In 2020, the scarp had widened to 22 mm and was about 11 m from the east edge of the highway. Three of the five stakes (A to E as shown on the site plan) placed in 2019 to measure regression had to be relocated away from the encroaching scarp in 2023 and two of the stakes had to be relocated again in 2024. The rate of regression of the east landslide appears to have slowed down since 2020. However, tension cracks were observed 1.4 m and 3.8 m from the guardrail. This increased rate of movement may start to impact the guardrail and pavement.

The south half of the gabion wall has displaced further and the retrogressive slumping below it is affecting the riprap apron including the erosion bowl forming below the culvert outlet. The inspection in 2023 and

2024 observed deeper and wider slumps at and downstream of the culvert outlet and the culvert outlet was hanging.

Cracks started to reflect through the pavement overlay in 2023 and 2024 due to the residual movements of the west embankment slide (buttress fill placed in 2017 during culvert installation).

There is significant risk of failure of the east embankment due to the continued erosion of the gully and retrogression of the slide mass.

Recommendations:

Short-Term:

- Road maintenance of milling and patching should continue as necessary to maintain a safe roadway surface. Cracks should be sealed to minimize the infiltration of rain fall and snow melt into the crack network.
- Routine observation of the site, particularly following periods of heavy precipitation, to ensure that the slide mass has not retrogressed closer to the highway.
- Preliminary engineering design should be undertaken so that there are developed options available for implementation should there be rapid deterioration of the site.

Short-to-Medium Term:

- The upper portion of the east sideslope could be repaired by excavating the failed material and rebuilding the slope with compacted common clay or granular fill while reinforcing the failing gabion wall with sheet piling or driven H piles to buy some time (maybe 5 years) before a realignment is completed.

Medium-Term:

- A pile wall could be constructed across the narrower downslope end of the east sideslope near the outlet of the old culvert to buttress the slope. The slump in the east embankment could then be reconstructed with geogrid-reinforced fill after over-excavating the slide material.
- A surface pipe should be installed from the new culvert extending further east to where it meets the tributary coming down from Site #14.
- Although the upslope ditches were regraded and protected from erosion during the 2021 overlay, the gully from the ditch down toward the culvert inlet should also be shaped and protected from erosion to minimize eventual downcutting of the ditch and sediment accumulating at the culvert inlet.

Long-Term:

It is understood that, at this time, the only long-term remediation option under consideration is realignment of the entire north hill section of Highway 744 and this study is currently being undertaken by CIMA+.

Ongoing Investigation:

- It is recommended that the annual Geohazard inspection should continue as scheduled.
- At least one deep slope inclinometer should be installed on the downslope side between the highway and the gabion basket should be installed to confirm the stratigraphy at the site and provide an indication of the depth and rate of movement. Additional test holes should be drilled if a pile wall is to be designed.

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.

Roger Skirrow, P.Eng.
Senior Geotechnical Engineer

Mark Gallego, P.Eng.
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.

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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.

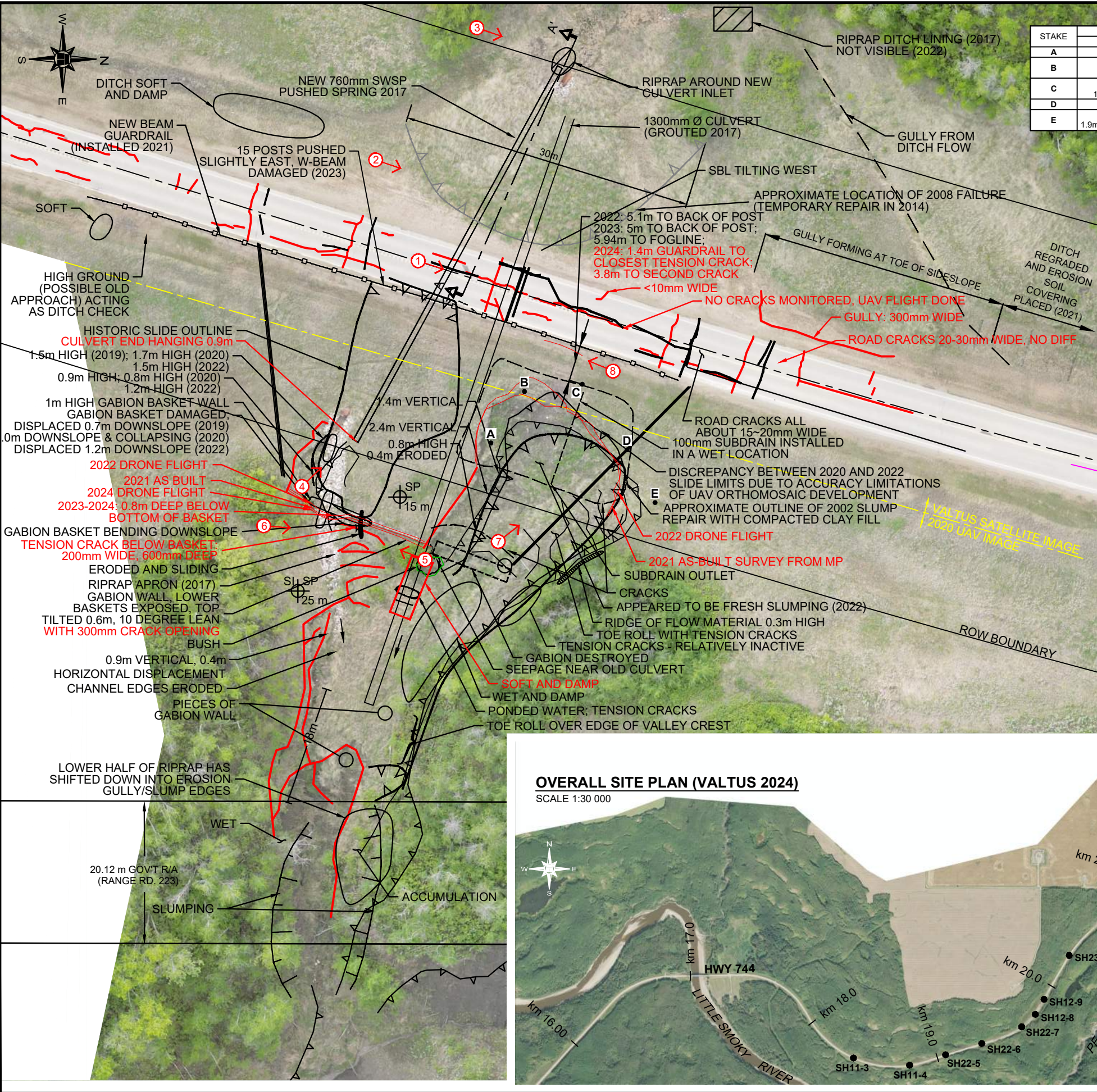
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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.

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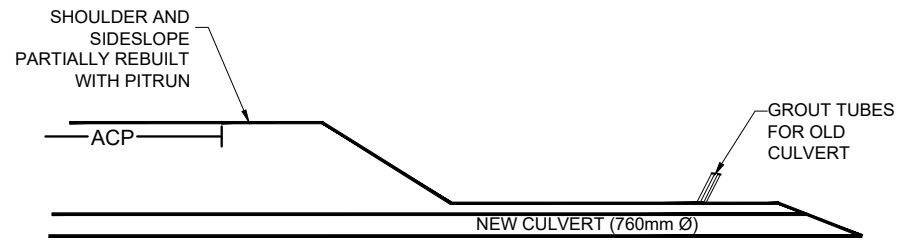
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G:\32000\32121 AT GRMP Peace River District 2021-2025\CAD\2024\KEF\32121 SH013-13.dwg - 13 - Oct. 07, 2024



STAKE	SCARP (HEIGHT)				
	2019	2020	2022	2023	2023
A	3.1m (1.5m HIGH)	? (1.8m HIGH)*	1.8m (0.6m HIGH)	RESET: 2.0m (0.4m HIGH)	RESET: 1.8m (0.8m HIGH)
B	1.5m DOWNSLOPE 1.7m LATERAL	0.3m / 2.0m** (0.5m HIGH)	2.0m (0.2m HIGH)	2.0m (0.2m HIGH)	1.9m (0.25m HIGH)
C	1.3m 11.6m TO GUARDRAIL	0m / 2.0m**	2.0m (0.6m HIGH)	1.5m (0.4m HIGH)	1.4m (0.3m HIGH)
D	0.6m 0.6m TO CRACK	FELL / 2.0m**	1.3m (0.6m HIGH)	1.3m (0.6m HIGH)	1.3m (0.6m HIGH)
E	1.9m TO SCARP (0.5m HIGH)	1.9m TO SCARP (0.5m HIGH)	1.9m TO SCARP (0.5m HIGH)	(OPEN, 150mm WIDE, 200mm DEEP) 1.9 TO SCARP (0.5m HIGH)	RESET: 2.5m TO FIRST TENSION CRACK, 3.7m TO MAIN SCARP, 0.5m HIGH SCARP

* STAKE MISSING; SCARP HEIGHT MEASURED AT APPROXIMATE LOCATION
** OFFSET FROM SCARP BEFORE/AFTER STAKE RELOCATED

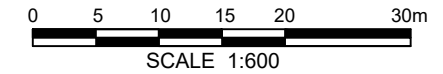


NOTES

- PREVIOUS OBSERVATIONS SHOWN IN BLACK
- THIS DRAWING TAKEN FROM EXH ENGINEERING SERVICES LTD. PROJ. NO. 1202177 WITH 2013-2015 OBSERVATIONS FROM AMEC FIGURE 1, PROJECT EG10030 (PROVIDED BY AT)
- DUE TO SIGNIFICANT CHANGES OBSERVED IN 2019, NUMEROUS HISTORICAL FEATURES AND OBSERVATIONS WERE REMOVED FROM THIS DRAWING
- JUNE 2024 OBSERVATIONS SHOWN IN RED.**
- CRACK AND PATCH PATTERNS RESET USING 2024 UAV IMAGERY
- GUARDRAIL AND CULVERT LOCATIONS TAKEN FROM MCINTOSH PERRY AS-BUILT DRONE SURVEY (JULY 2021) FOLLOWING THE OVERLAY IN SUMMER 2021

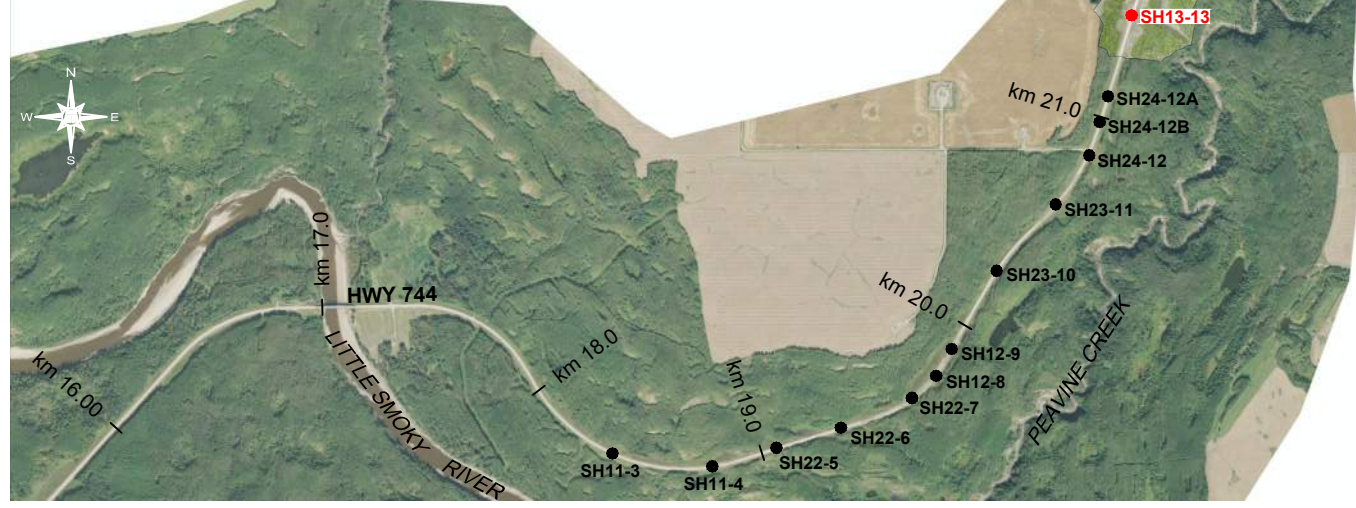
LEGEND

① DIRECTION AND NUMBER OF PHOTO



SATELLITE IMAGE FROM VALTUS IMAGERY (DATED 2014)
UAV IMAGE ACQUIRED BY THURBER (JUNE 2024)

OVERALL SITE PLAN (VALTUS 2024)
SCALE 1:30 000



Alberta

PEACE REGION (SWAN HILLS)

SH013-13: HWY 744:02 LITTLE SMOKY RIVER VALLEY 2024 SITE INSPECTION PLAN

DWG No. 32121-SH013-13

DRAWN BY	ML
DESIGNED BY	KEF
APPROVED BY	RKS
SCALE	1:600
DATE	OCTOBER 2024
FILE No.	32121

THURBER ENGINEERING LTD.



Photo 1 – Looking north where the crack pattern is starting to reflect through the 2021 overlay.



Photo 2 – Looking north at sideslope above culvert inlet.



Photo 3: Looking north at culvert inlet.



Photo 4: Looking northwest at hanging culvert outlet. Erosion on left-hand side (south) is worse and may be part of a retrogressive tension crack from the slide further down the slope.



Photo 5 – Looking south at gabion wall on downslope side of embankment. Note eroded south face of riprap apron from culvert outlet.



Photo 6 – Looking north at the distorted gabion wall and riprap apron as well as slumping below the wall.



Photo 7 – Looking northwest at top of east embankment slide.



Photo 8 – Looking south at tension crack forming east and downslope of the guardrail.