ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2024 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
PH009-3	Town of Peace River	Shaftesbury Trail – Shop Slide	Old 2:02	0.025
			684:02*	30.990
Legal Description		**UTM Co-ordinates**		
SW31-083-21 W5M		11V E 480339	N 6232158	

	Date	PF	CF	Total
Previous Inspection:	3-Jun-2020	15	5	85
Current Inspection:	29-May-2024	4	5	20
Road AADT:	840 (684:02)		**Year:**	2024
	*The site is on the Hwy 2 off-ramp and not on Hwy 684:02			
Inspected By:	Rocky Wang, TEC Robert Senior, TEC Erwin Kurz, TEC		Ken Froese, Thurber Don Proudfoot, Thurber Tyler Clay, Thurber	
Report Attachments:	☒ Photographs	☒ Plans	☒ Maintenance	

Primary Site Issue:	Active landslide movement was most pronounced at NW end of slide, near junction with 99 Avenue.	
Dimensions:	Older, deeper slide affects about 130 m of the off-ramp. An active slump located 35 m downslope of the highway is about 40 m in width. There is a dormant slide located upslope of the highway.	
Date of Remediation:	2022: 240 m concrete pile wall constructed consisting of 3 segments. Type 1 and 2 (NW end) are 19.2 m x 1.2 m dia. reinforced concrete tangent piles tied-back with 30 m long grouted soil anchors and Type 3 (SE end) are 24.8 m x 1.5 m dia. reinforced concrete piles (2.5 m spacing). The upper 3 m of the wall is timber lagging supported by H-piles embedded in the concrete waler. The slope was regraded with up to 6 m of soil removed.	
Maintenance:	1984: TEC built a 5 m-deep granular shear key at the toe of the slope to mitigate material flowing into the CNR railway right-of-way. 2010: Town of Peace River replaced pipe rack supports for the above-ground insulated water and sewer line. 2011: The Town re-graded area south of the pipe racks after a surface slide. 2013: The Town off-loaded more material and placed geomembrane sheets below the off-ramp embankment to channel the seepage from the springs and the ditches. 2015/2016: The Town re-aligned the storm and water lines to the north around the slide site and removed the pipes and pipe racks. 2016: TEC removed the outer NBL of the Highway 2 off-ramp 2020: CNR most-recently cleaned encroaching debris from their right-of-way (this was ongoing maintenance).	
Observations:	**Description**	**Worsened?**
☐ Pavement Distress	The sinkhole near the NW end of the wall (due to subsidence over a tieback anchor) that formed in 2023 was patched again in Spring 2024.	☐
☒ Slope Movement	Pavement cracks and unevenness SE of 99 Ave indicating ongoing creep movement of the deeper	☒

	landslide as the slide block engages the new pile wall. There was new movement at the scarp east of the wall just beyond the highway ROW.	
☒ Erosion	Most of the re-lined SW ditch is stable except for one area where the rock appears to have been disturbed by the power line company contractor. A shallow erosion gully is forming beyond the south-most pile wall riprap drainage basin.	☒
☒ Seepage	The spring along the southeast ditch of 99 Avenue continues to flow. The existing subdrain brought through the pile wall continues to flow. Slow and steady seepage was noted from other subdrains installed during construction.	☐
☒ Bridge/Culvert	The previous sinkhole above the buried 762 mm SWSP drainpipe has been successfully repaired. The Town will be installing a culvert in the ditch to connect the pedestrian path to the subdivision SW of the site.	☒
☐ Other	The datalogger enclosure was broken into and the batteries stolen. Thermal expansion and contraction appear to have disconnected some conduit connections. These will be repaired in Fall 2024.	☐

Instrumentation (as of Spring 2024):	
Destroyed	*Inclinometers: SI05-2 sheared in 2009 at 10.7 m. SI05-3 sheared in 2009 at 17.5 m. SI05-4 sheared in 2012 at 6.7 m. SI09-1/VW09-1 sheared in 2011 at 1.8 m. SI09-2/VW09-2 destroyed in 2010.* *Piezometers: SP09-6, BH13/SP09-11, SP09-5, SP19-2, SP09-7, VW09-3 (dry since installation*
Upslope Inclinometers	SI05-1 is located outside of the major areas of movement and the measured displacement is shallower (less than 3.0 m in depth).
Pile Wall SAA	SAA-P34 (Type 1, 1.2 m dia., tie-back) has measured pile head deflection of 20 mm. SAA-P77 (Type 2, 1.2 m dia., tie-back) has measured pile head deflection of 21 mm. SAA-P113 (Type 3, 1.5 m dia.) has measured pile head deflection of 17 mm.
Pile Wall Load Cells	The anchor loads have risen since they were locked off and anchors A19, A34, and A77 have exceeded the SLS design loads but not yet exceeded the criteria that would require remedial measures to be implemented. Anchors A51 had exceeded the SLS criteria but dropped back in Spring 2023 and A67 has increased only slowly.
Pile Wall Strain Gauges	See the Instrumentation report for details.
Pile Wall Inclinometers	SI09-4 is located immediately downslope of the pile wall, near the SE end, and developed two movement zones (9.6 m and 12.6 m depth) during construction but both have stabilized since. SI11-01 at the NW end of the wall developed a zone at about 15.1 m depth during construction, likely related to a temporary excavation immediately below the location, and though the rate of movement has subsided (3 mm/yr down from a peak of 34 mm/yr), it has not stopped.
Downslope Inclinometers	SI09-3 is located on the far side of the tracks and has not shown movement.
Standpipe Piezometers	SP09-8, SP09-9, and SP11-06: dry since installation. SP05-1, SP05-4, SP05-5, and SP09-10: no obvious pattern. SP19-3: steadily decreasing over the last four years.
Vibrating Wire Piezometers	VW09-4: steadily decreasing since 2012.
Pneumatic Piezometers	PN19-5A: may no longer be functional. PN19-5B: steady since completion of construction.

Assessment:

This site is characterized by several landslides affecting the hillside above and below the road. The slide bowl above the road appears to be currently inactive, while the lower slide was active prior to completing the slope stabilization measures. The highest rates of movement had been at the NW flank of the lower slide bowl where ongoing movement had forced numerous temporary repairs and relocation of the Town of Peace River sewer and water lines outside the limits of the landslide in 2015/16. The movement had destroyed the pedestrian path and was beginning to undermine the roadway shoulder. The toe of this slide was in the CN right-of-way which necessitated routine excavation to keep their ditch flowing but led to further destabilization. The SE flank was semi-active but much deeper-seated and was observed to cause cracking through the highway and could sometimes be observed in the upslope ditch.

Both movement zones were addressed by the pile wall constructed in 2021 and 2022. The 240 m pile wall was constructed about 3 m downslope of the highway shoulder with tie-back anchors installed in the more-active NW portion. The backfill behind the wall was a combination of washed rock, drainage gravel, and pitrun and included provisions for drainage to manage the numerous seepage points that have been observed in the past. The slope below this portion was regraded to remove up to 6 m of soil. Downslope of the wall, the ground was covered with riprap channels and erosion control soil coverings to manage overland drainage. The pile wall and slope regrading appear to be performing as intended. Creep movement is being measured in the wall and this may continue until equilibrium is reached and until that time, there will be some deformation observed on the roadway such as the historical crack pattern and dips. Once movement has slowed or stopped, an overlay would remove those features. A sinkhole was observed in 2023 and is likely related to a cavity that formed during anchor installation. The anchor drilling records indicate the presence of sand and gravel in that area and the grouting records suggest that there is the potential for a void as the amount of grout injected was much higher than the theoretical volume of the hole (assuming it was a perfect cylinder of the specified dimensions).

The slump located east of the wall just beyond the highway right-of-way was present before the construction of the pile wall and has gotten worse. However, it is outside of the highway ROW, is more than 30 m from the highway shoulder, and does not appear to be interfering with CN's operations.

Recommendations:

Short-Term:

- Road maintenance such as crack sealing of the ACP to limit infiltration.
- Routine inspection to confirm that the sinkhole has stabilized.

Medium and Long-Term:

- Nothing is required at this time.

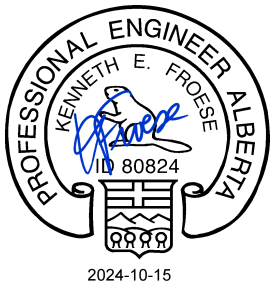
Ongoing Investigation:

- This site is currently scheduled for annual inspection. It is recommended that this be reduced to every two years; however, the instrument readings should continue to be completed twice a year to monitor the performance of the remedial measures

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, M.Eng., P.Eng.
Partner | Senior Geotechnical Engineer



2024-10-15

Ken Froese, P.Eng.
Associate | Senior Geotechnical Engineer

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: October 15, 2024
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

THURBER

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.

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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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STEADY FLOW FROM SPRING
POLE LEANS 10° SE &12° NE (2019)
-WIRES SAGGING 25° SE & 5° NE (2020)
THERMAL EXPANSION/CONTRACTION
DISCONNECTED CONDUITS FROM ENCLOSURE
RIPRAP DISTURBED BY POWER LINE
COMPANY CONTRACTOR, ALLOWING
WATER TO FLOW IN GRASSED AREA
CRACK 10-200 mm
WIDE, 10 mm DIFF
SLIGHT DIPS IN HIGHWAY
SINKHOLE
1.2m x 1.3m x 0.6m DEEP
(REPAIRED IN 2021)
TRICKLE OF WATER
FROM SUBDRAIN OUTLET
BH13/SP09-11
(NON-OPERATIONAL)
SCARP 0.9 m HIGH
SCARP 1.9 m HIGH
762 mm Ø SWSP
WATER PONDING AT SILT FENCE;
SLIGHT CHANNEL FORMING BEYOND
DATA ENCLOSURE AND SOLAR PANEL
2023: ENCLOSURE BROKEN INTO AND BATTERIES STOLEN;
JUNE 2024: NEW LOCK INSTALLED
WEEP DRAINS DRY
SOME WEEP DRAINS FLOWING
EXISTING SUBDRAIN FLOWING STEADILY;
SEDIMENT ACCUMULATING IN DOWNPIPE
TOWN CONSTRUCTING
SIDEWALK AND WILL INSTALL
CULVERT THROUGH DITCH
2023 SINKHOLE 0.9 m Ø;
PATCHED AGAIN SPRING 2024
HIGHWAY 2 OFFRAMP
300 mm DIA 1/2 CULVERT
NEW
800 mm
Ø CSP
CONCRETE SWALE
150 mm Ø PERFORATED SUBDRAIN
STEADY, SLOW SEEPAGE
SLIGHTLY SPARSER VEGETATION
PONDED WATER AND CATTAILS
800 mm Ø CSP
600 mm Ø CSP
S.W.1/4 SEC.31-85-21
99 AVENUE
OLD HWY 2
OLD HWY 2 R/W
HIGHWAY 684:02
CNR R/W
ATCO HIGH PRESSURE BOUNDARY
POWERLINE R/W
SEWER MAIN
WATERMAIN
KM 0+200
KM 0+000

SP09-8
SP19-3
TH19-4
SP19-2 (DAMAGED)
SP19-1
SI11-01
SI05-1
TH05-1
SP09-10
SI09-4/VW09-4
SI05-3 (SHEARED)
SP05-3
SP05-2/SI05-2 (SHEARED)
SAA-P113
VC2343
VC2344
SAA-P77
VC2342
VC2341
SAA-P84
VC2340
SP09-7 (DAMAGED)
SI09-2/VW09-2 (DESTROYED)
SP09-6 (DAMAGED)
SI19-5 /PN19-5A/B
SI09-1/VW09-1 (SHEARED)
SP05-4/SI05-4
SP09-5
SP05-5
SI09-3/VW09-3
SP09-9

LEGEND

- PHOTO LOCATION AND DIRECTION
- ASPHALT CEMENT PAVEMENT
- ASPHALT CEMENT SLOPE PROTECTION (40 mm THICK)
- EROSION CONTROL SOIL COVERING (ECSC) (TYPE B)
- PERMANENT RECP (TRM TYPE B, COMPLETE WITH SYNTHETIC PERMEABLE DITCH BARRIERS AT 15 m INTERVALS ALONG SWALE)
- CLASS 1M RIPRAP (0.4 m THICK)
- CLASS 1 RIPRAP (0.8 m THICK)
- FIBRE ROLL
- INSTRUMENT INSTALLED DURING CONSTRUCTION
- HISTORICAL THURBER INSTRUMENT
- NON-OPERATIONAL
- SI SLOPE INCLINOMETER
- VW VIBRATING WIRE PIEZOMETER
- SP STANDPIPE PIEZOMETER
- PN PNEUMATIC PIEZOMETER
- T TELUS LINE (BURIED)
- G GAS LINE
- P POWER LINE AND POWER POLE
- GUY WIRE
- RAIL LINE
- ROW BOUNDARY
- SIGN POST
- TELUS UNDERGROUND VAULT
- GUARDRAIL
- SILT FENCE (APPROX)

NOTES

1. PREVIOUS OBSERVATIONS SHOWN IN BLACK
2. THIS DRAWING CREATED FROM 2022-09-14 RECORD DRAWINGS 18262-202006-RD-C004, 18262-202006-RD-C005, AND 18262-202006-RD-C027
3. MAY 2024 OBSERVATIONS SHOWN IN RED.
4. SATELLITE IMAGE FROM ESRI WORLD IMAGERY, CAPTURED 2022-09-05 (DOWNLOADED 2024-08-15)

0 10 20 30 40 50 60 70 m
SCALE 1:1250

Alberta

PEACE REGION (PEACE RIVER/HIGH LEVEL)

PH009-3 SHAFTESBURY TRAIL SHOP SLIDE

DWG No. 32121-PH009-3-1

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:1250
DATE	AUGUST 2024
FILE No.	32121

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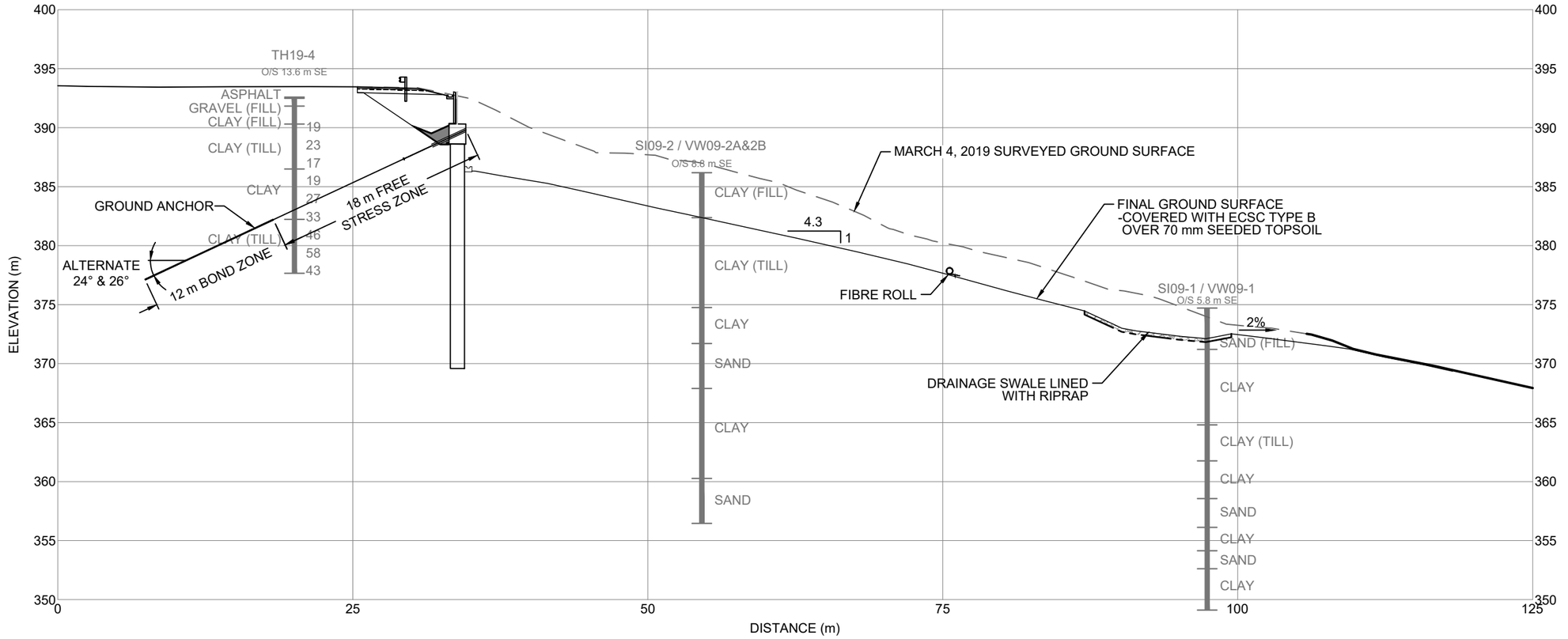

LEGEND

15 SPT N VALUE

STANDPIPE PIEZOMETER SCREENED INTERVAL

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PEACE REGION (PEACE RIVER/HIGH LEVEL)

CROSS-SECTION B-B'
(WALL TYPE 1)

DWG No. 32121-PH009-3-2

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:400
DATE	AUGUST 2024
FILE No.	32121

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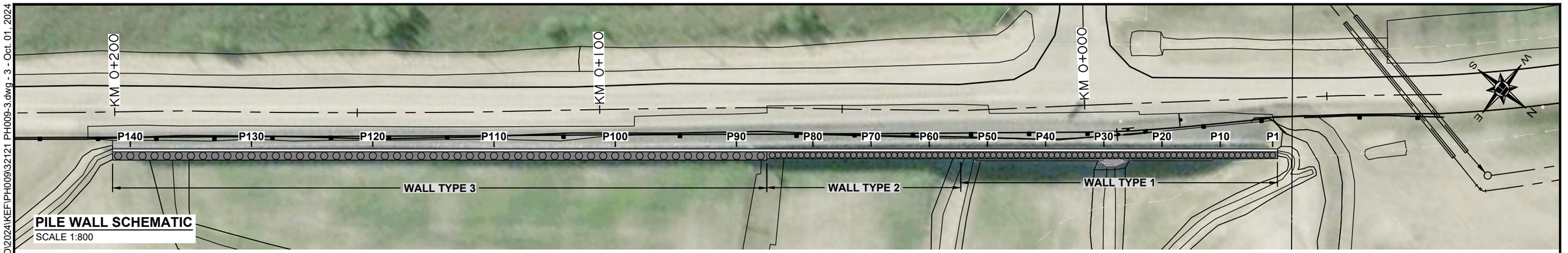
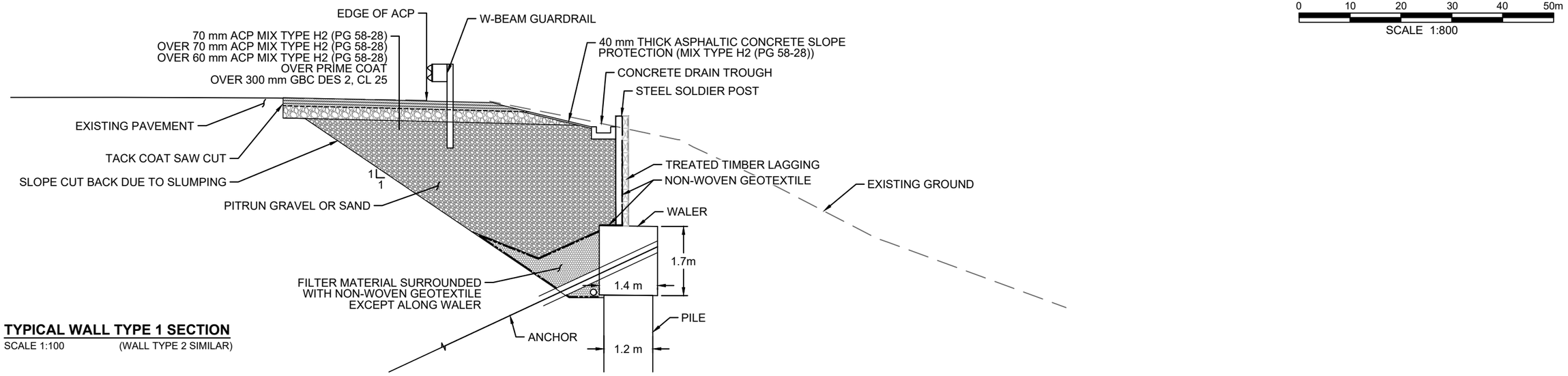
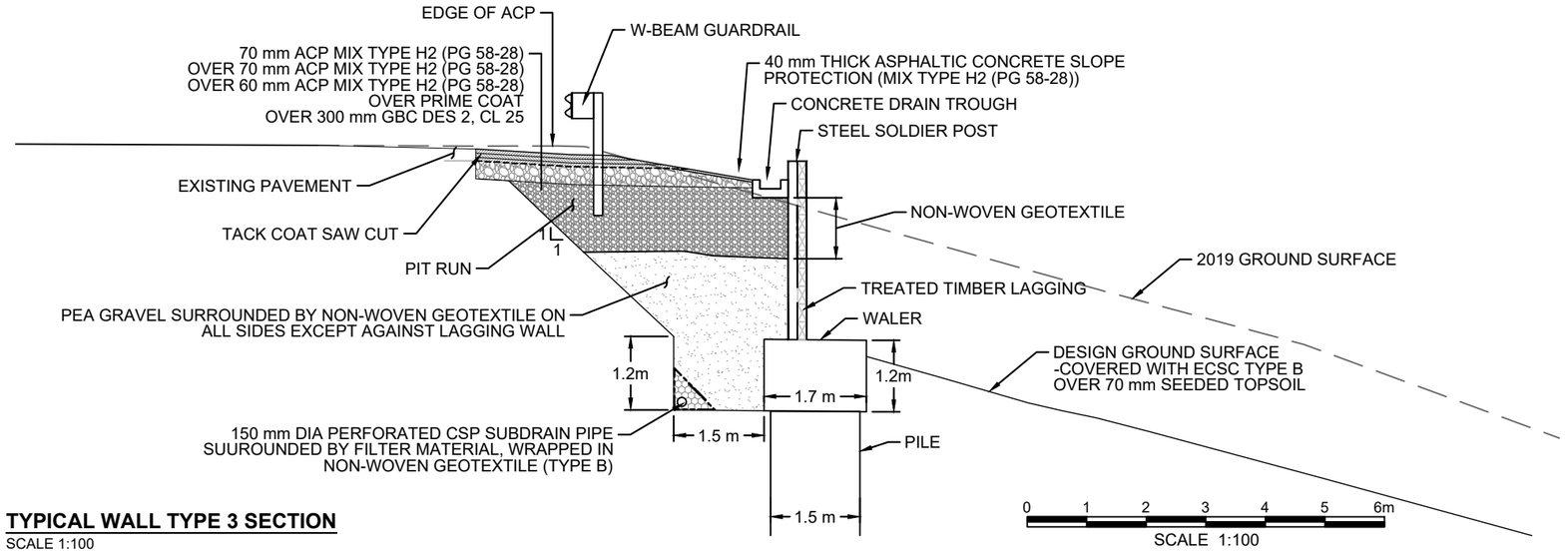


PILE WALL SCHEMATIC
SCALE 1:800



TYPICAL WALL TYPE 1 SECTION
SCALE 1:100 (WALL TYPE 2 SIMILAR)



TYPICAL WALL TYPE 3 SECTION
SCALE 1:100

0 10 20 30 40 50m
SCALE 1:800

0 1 2 3 4 5 6m
SCALE 1:100

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PEACE REGION (PEACE RIVER/HIGH LEVEL)

PILE WALL DETAILS

DWG No. 32121-PH009-3-3

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	AUGUST 2024
FILE No.	32121

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Photo 1: Looking north at spring along 99 Avenue and Town building new pedestrian pathway.

Photo 2: Looking southeast along grouted riprap in Hwy 2 off-ramp ditch at 99 Avenue culvert inlet

Photo 3 – Looking northwest at repaired ditched along Hwy 2 off-ramp.

Photo 4 – Looking northwest at patched sinkhole in Hwy 2 off-ramp surface northwest of 99 Avenue intersection.

Photo 5: Looking south at NW end of wall just below SI11-01 which continues to move even after construction is completed.

Photo 6: Accumulating rusty sediment from the existing subdrain flow. The pipe was flipped to flow the other way and some sediment blockage manually removed during the inspection.

Photo 7: Looking north at bottom of the main riprap channel at the edge of the CN ROW.

Photo 8: Looking southwest back up at the wall along the regraded slope and riprap drainage channels.

Photo 9: Thermal expansion/contraction may have detached this conduit from the side of the data enclosure.

Photo 10: Small void or settlement at the junction between Wall Types 2 and 3.

Photo 11: Looking southeast at the shallow gully forming beyond the silt fence at the end of the riprap dissipation bowl.

Photo 12: Looking southeast at the active scarp just beyond the edge of the highway ROW.

Photo 13: Looking north at the recent movement on the northwest flank of the active scarp. The CN rail line is located downslope of this landslide.

Photo 14: Looking northwest along the re-lined upslope ditch where recent construction activity disturbed the riprap diverting flow out of the channel.

Photo 15: Looking west at the historical deep-seated crack location at the SE end of the pile wall.

Photo 16: Looking northwest the dips in the roadway surface.

Photo 17: Looking south at the cracks coincident with the northwest flank of the deep-seated landslide.