

**ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS GRMP
NORTH CENTRAL (ATHABASCA AND FORT
McMURRAY DISTRICTS)
2025 SITE INSPECTION**



Site Number	Location	Name	Hwy	km
NC104	Approximately 7.7 km north of Hwy 29 (North of Elk Point)	Kehiwin Lake	41.23	7.7
Legal Description		UTM Co-ordinates (NAD 83)		
NE-25-58-7-W4M		12U N 5988325	E 506652	

	Date	PF	CF	Total
Previous Inspection:	May 18, 2023	11	4	44
Current Inspection:	May 15, 2025	11	4	44
Road WAADT:	1,400		Year:	2024
Inspected By:	José Pineda, Bruce Nestor (Thurber) Rishi Adhikari (TEC)			
Report Attachments:	☒ Photographs ☒ Plans ☐ Maintenance Items			

Primary Site Issue:	Landslide (NC104, previously known as NC24C) developed abruptly to the south of the km 7.8 pile wall (NC103 site previously known as NC24A) after occurrence of heavy rainfall events in 2011, causing pavement distress in the highway surface.
Dimensions:	Cracked section of highway to the south of the southern limit of the NC103 site: About 180 m long (parallel to the highway alignment) and 80 m wide (parallel to the slope direction). Area susceptible to future local landslides to the south of the cracked section of the highway: About 160 m long.
Site History:	Remedial measures were implemented between the fall of 2016 and the fall of 2017 and consisted of the following: (a) the construction of a 230 m long cast-in-place tied-back pile wall to the south of NC24A to retain the cracked section of the highway (NC24C tied-back wall), (b) the construction of a 125 m cast-in-place cantilever pile wall (NC24 pile wall extension) to the south of the NC24C tied-back wall as a precautionary measure against future landslides. The NC24C pile wall extension (NC24C interim pile wall) was designed to accommodate the installation of additional piles, anchors and waler (if needed) in the future subject to instrumentation monitoring results, (c) installation of twin culverts and lining of C2 culvert by others, (d) grouting of culvert C1, ditch regarding and lining with TRM. Slope inclinometers and load cells were installed in the NC24C tied-back pile wall to monitor the wall movement and anchor loads. Slope inclinometers, a Shape Accelerometer Array (SAA) and strain gauges were installed in selected piles of the NC24C pile wall extension to assess wall movements and the bending moment in one of the piles.
Maintenance:	After the first site visit was completed on May 12, 2011, the most pronounced distressed area of the highway surface was patched in the fall of 2011; patched again in fall 2012; cracks opened again and sealed in the early spring of 2013; cracks were sealed in June 2014. ACP patch was completed after construction in the fall of 2017. ACP patch scheduled for the summer of 2025.

Observations:	Description	Worse?
☒ Pavement Distress	Reflective cracks 10 to 60 mm wide, no drop; 20-50 mm wide crack has developed in west pavement shoulder near south end of NC24C interim pile wall with 10-20 mm drop. Potholes up to 800 mm long by 400 mm wide developed on the northbound lane near pile P66 and on the south bound lane near Piles P146 and P186.	☒
☐ Slope Movement		☐
☐ Erosion		☐
☒ Seepage	Water ponding on the south east ditch between SP12-4 and SP12-7; no flow in the twin culverts.	☐
☐ Bridge/Culvert Distress		☐
☒ Other	Sharp drop off on the west side of highway due to previous ACP patches; areas of standing water in the south ditch (cattails observed in ditch since previous inspection have been mowed).	☐

Instrumentation: (1 SAA, 16 SIs, 6 PNs, 4 SPs, 16 VCs, 9 SGs)

The following provides the slope inclinometers' rate of movements in the Spring of 2025:

- SI15-15 (located in the east ditch within the southern limit of the landslide) = 0.3 mm/yr.
- SI15-16 and SI15-21 (located near the west edge of the highway downslope of the pile walls) ranged between 0.5 and 0.6 mm/yr.
- SI12-11, SI15-17, SI15-20 (located at the bottom of the highway west side slope) ranged between 0.4 and 1.2 mm/yr.

Total pile head movement:

- N24C tied-back pile wall: SI16-1 = -8.3 mm, SI16-2 = -3.7 mm, SI16-3 = -2.7 mm, SI16-5 = -0.2 mm, SI16-6 = 4.5 mm
- N24C interim pile wall: SI17-1 = 6.2 mm, SI17-2 = 8.9 mm, SI17-3 = 16.0 mm, SI17-4 = 11.7 mm, SAA17-1 = 1.7 mm.

Vibrating wire load cell readings ranged from 180 kN to 258 kN; The readings of the strain gauge, installed in Pile 146 of the NC24C Interim pile wall, showed relatively small change in micro-strain.

Groundwater levels fluctuated in the piezometers and ranged from an increase of 0.5 m in SP15-18 to a decrease of 0.2 m in PN15-21.

Assessment (Refer to attached Figure):

The site condition has not changed significantly since the 2023 site inspection visit.

The site observations and instrumentation readings indicate that implemented remedial measures have been effective in stabilizing the landslide mass. Reflective highway surface cracks may however get wider over time until the pile wall mobilizes the full magnitude of the stabilizing force.

The interim pile wall has been performing satisfactorily. There is no immediate need to install the full retaining system at this location. The pile head deflections are still below the revised threshold (i.e., 57 mm), recommended by the structural consultant, GeoMetrix.

There were areas of standing water visible in the south east highway ditch, which indicate poor surface drainage. These areas previously contained cattails which were mowed after the previous inspection. Poor drainage, and possibly water ponding, in the ditch can result in elevated groundwater levels and an accelerated landside movement at the interim pile wall location.

The existing sharp drop off near the edge of pavement still constitutes a safety hazard to runaway vehicles.

Recommendations:

The frequency of the site visits can be reduced to one site visit per contract. However, it is important to continue reading the instruments installed at this site at least once a year.

The local MCI should watch closely for the development of new cracks or widening or existing cracks in the highway surface. Open cracks should generally be sealed to reduce surface water infiltration into the landslide mass.

The local MCI should also check whether the south ditch is draining towards the C2 pipe and the twin culverts. Consideration should be given to re-grading the ditch, within the areas of standing water, to promote positive drainage.

Consideration should also be given for placing the least amount of fill off the highway surface to smoothen the existing sharp drop off and eliminate the existing hazard. Otherwise, sharp shoulders warning signs should be erected to warn the motorists of the existing hazard.

Closure

It is a condition of this letter report that Thurber's performance of its professional services will be subject to the attached Statement For Use and Interpretation of Report.

José Pineda, M.Eng., P.Eng.
Associate | Senior Geotechnical Engineer

Bruce Nestor, M.Eng., P.Eng.
Geotechnical Engineer

STATEMENT FOR USE AND INTERPRETATION OF REPORT

1. STANDARD OF CARE

This Report has been prepared in a manner consistent with that degree of care and skill ordinarily exercised by members of the same profession currently practicing under similar circumstances at the same time and in the same or similar locality and in compliance with all applicable laws.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment, including this Statement For Use and Interpretation of Report, 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, AS DESCRIBED ABOVE. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE OF THE 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 for the development, design objectives, and/or purposes described to Thurber by the Client. **NO OTHER PARTY MAY USE OR RELY ON THE REPORT OR ANY PORTION THEREOF FOR OTHER THAN THE CLIENT'S BENEFIT IN CONNECTION WITH THE PURPOSES DESCRIBED IN THE REPORT.** Any use which a third party makes of the Report is the sole responsibility of such third party and is always subject to this Statement for Use and Interpretation of Report. Thurber accepts no liability or responsibility for damages suffered by any third party resulting from use of the Report for purposes outside the reasonable contemplation of Thurber at the time it was prepared or in any manner unintended by Thurber.

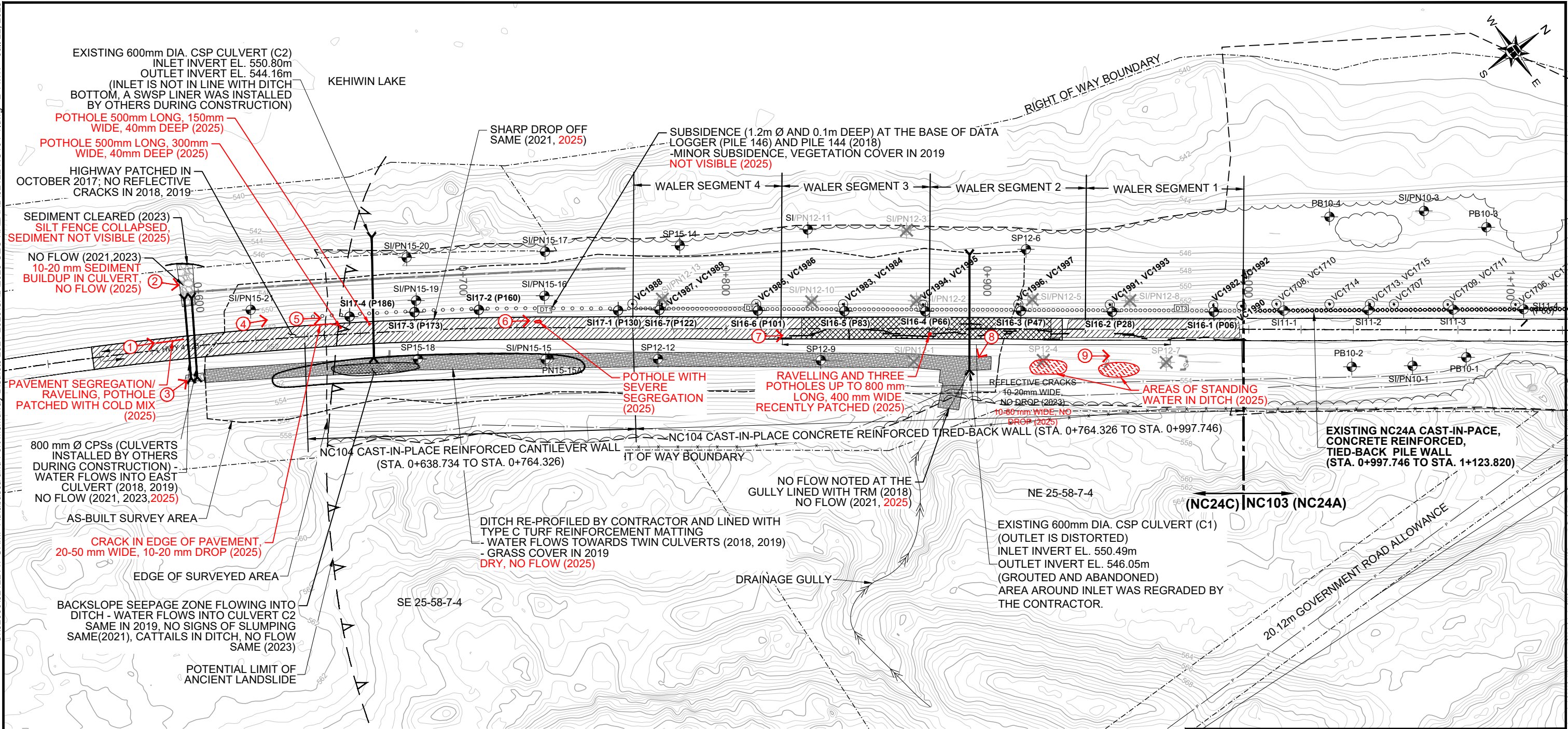
5. INTERPRETATION OF THE REPORT

- 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 is inherently judgement-based. 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 parties making use of such documents or records with or without our express written consent need to 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 parties. Some conditions are subject to change over time and those making use of the Report need to be aware of this possibility and understand that the Report only presents the interpreted conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client must 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 based on conditions in evidence at the time of site inspections and based on 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 resulting from misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other parties 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 is recommended to 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 need to 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 to confirm and document that the site conditions do not materially differ from those 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. 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 other parties 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, unless such decisions expressly form part of the stated purpose of the Report as described in Paragraph 3.

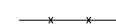
G:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\CAD\2025 GEO HAZARD\32122 NC104-1.dwg - 2 11x17 - Jul. 22, 2025



LEGEND



PILE WALL



FENCE LINE



BUSH LINE



ACTIVE SLIDE CRACKS ON HIGHWAY



TEST HOLE LOCATION



DAMAGED INSTRUMENT



SLOPE INCLINOMETER



PNEUMATIC PIEZOMETER



STANDPIPE PIEZOMETER



POORBOY



VIBRATING WIRE LOAD CELL



SHAPE ACCELEROMETER ARRAY



DATALOGGER



GROUND SURFACE CONTOUR



OVERHEAD POWER LINE (APPROXIMATE)



TELUS LINE (APPROXIMATE)



SILTY FENCE



VIBRATING WIRE LOAD CELL LOCATION



PAVEMENT DISTRESS AREA



ACP PATCH (OLD)



RIP RAP



PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION

Load Cell Serial #	Anchor
VC1990	G0001S
VC1982	G007U
VC1992	G007L
VC1993	G029U
VC1991	G029L
VC1997	G049U
VC1996	G049L
VC1995	G070U
VC1994	G070L
VC1984	G087U
VC1983	G087L
VC1985	G106U
VC1986	G106L
VC1987	G126U
VC1989	G126L
VC1988	G132S

NOTES:

1. FEATURE LOCATIONS ARE APPROXIMATE.
2. PREVIOUS OBSERVATIONS ARE SHOWN IN BLACK.
3. MAY 15, 2025 OBSERVATIONS ARE SHOWN IN RED.
4. CONTOUR INTERVAL IS 0.5m.
5. CONTOURS INSIDE SURVEYED AREA WERE SURVEYED BY WSP. ELEVATION CONTOURS OUTSIDE SURVEYED AREA WERE DERIVED FROM LIDAR DATA.
6. INSTRUMENTS AND DATALOGGERS INSTALLED DURING CONSTRUCTION ARE SHOWN IN BOLD.
7. SHAPE ACCELEROMETER ARRAY AND STRAIN GAUGES ARE CONNECTED TO DT1 (CAMPBELL SCIENTIFIC CR6 DATALOGGER, SERIAL No. 5839); LOAD CELLS VC1983 - VC1989, VC1994, VC1995 ARE CONNECTED TO DT2 (RST DT2040 DATALOGGER, SERIAL No. 2202); AND LOAD CELLS VC1982, VC1990 - VC1993, VC1996, VC1997 ARE CONNECTED TO DT3 (RST DT2040 DATALOGGER, SERIAL No. 2203).
8. SHAPE ACCELEROMETER ARRAY AND STRAIN GAUGES ARE INSTALLED IN PILE P146.

0 20 40 60 80 m

SCALE 1:1500



NORTH CENTRAL REGION
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
2025 GEOHAZARD ASSESSMENT

NC104: HWY 41:23 LANDSLIDE (km 7.7)
SITE PLAN SHOWING SITE FEATURES AND
INSTRUMENT LOCATIONS

DWG NO. 32122-NC104-1

DRAWN BY	ML
DESIGNED BY	JGP / BWN
APPROVED BY	TSA
SCALE	1:1500
DATE	JULY 2025
FILE No.	32122





Photo 1. Looking north at highway surface from the south end of site. Segregation and raveling of pavement have worsened since the 2023 inspection. Some cold mix asphalt was placed in 2025.



Photo 2. Looking northeast at the twin culvert outlets. 10-20 mm of sediment has accumulated at the outlets of the culverts since the 2023 inspection.



Photo 3. Looking north at the inlets of the twin culverts. No flow noted during current inspection.



Photo 4. Looking north at sharp drop at shoulder of pavement on the southbound lane.



Photo 5. Pavement stress cracks noted on southbound lane shoulder near south end of NC104 pile wall extension. Cracks were 20-50 mm wide with a 10-20 mm drop.



Photo 6. Looking at datalogger DT1 installed at the pile P146 location in the NC104 pile wall extension. New pothole with segregation developed in 2025.



Photo 7. Looking north at reflective cracks, 10 to 60 mm wide with no drop, in the northbound lane.



Photo 8. Looking southeast at TRM lined gully and ditch area. No flow was noted in the gully.



Photo 9. Looking north at ponding water in the east highway ditch. |