

GEOHAZARD ASSESSMENT PROGRAM
NORTH CENTRAL REGION – ATHABASCA
2020 SPRING INSPECTION



| Site Number | Location | Name | Hwy | km |
|-------------------|---|-----------------------------|----------|------|
| NC 073-1 | 36 km Northwest of the Junction of Hwy 2:46 and Hwy 44:04 | Hwy 2:46 Mitsue Frost Heave | 2:46 | 39.5 |
| Legal Description | | UTM Co-ordinates (NAD 83) | | |
| N.W.14-72-4-W5M | | 12 N 6124047 | E 658906 | |

| | Date | PF | CF | Total |
|-----------------------------|--|--------------|------|-------|
| Previous Inspection: | March 05, 2020 | 9 | 2 | 18 |
| Current Inspection: | June 05, 2020 | 9 | 2 | 18 |
| Road AADT: | 2360 | Year: | 2019 | |
| Inspected By: | José Pineda, Tarek Abdelaziz (Thurber) Gordon Wolters, Arthur Kavulok, Roger Skirrow (AT) | | | |
| Report Attachments: | <input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items | | | |

| | |
|---------------------------------|---|
| Primary Site Issue: | Differential heave between insulated and un-insulated roadway sections, resulting in transverse bump cracks at the transition zones (Cracks A and D). The sharp drop across Crack A surface has been adversely affecting roadway rideability and safety of motorists. |
| Dimensions: | The heaved section of the highway to the west of the bump crack (Crack A) location is approximately 66 m long. Crack E defines the western limit of the heaved section of the highway. |
| Date of any remediation: | N/A |
| Maintenance/History: | <p>Frost heave repairs were completed in October 2008 and consisted of insulating an approximately 90 m long section of the highway to the east of existing bump crack. The repair consisted of excavating the pavement structure and placing 150 mm (3 layers, each 50 mm thick) of extruded polystyrene insulation (STYROFOAM Brand High Load 100) on the top of the prepared sub-grade. The new pavement structure consisted of 220 mm of ACP and 500 mm of granular base course.</p> <p>A temporary remedial measure was implemented after the call-out site visit in March 29, 2011 and consisted of milling the highway surface at the crack location to create an even pavement surface and provide a smooth ride to travellers.</p> <p>A sink hole developed on the highway WBL and was filled a few times with ACP between March 2011 and June 2012.</p> <p>Potholes were filled in 2014 and 2015; the highway was patched at Crack A location and ACP was used to fill around Crack D location.</p> <p>ACP overlay in September 2016; cracks reappeared on the highway surface in the winter of 2017; speed reduction and bump warning signs were placed in 2017; a sharp drop at Crack A location was noted in the early winter of 2018 and an asphalt taper was placed to smooth out the drop later in 2018. In the spring of 2020, a pothole developed adjacent to Crack A was filled with cold mix asphalt.</p> |

| Observations: | Description | Worse? |
|---|--|-------------------------------------|
| <input checked="" type="checkbox"/> Pavement Distress | Crack A in the western limit of the insulated section: up to 50 mm drop across the crack surface; pothole noted in the winter was filled with ACP; Crack D in the eastern limit of the insulated section: showed cracks up to 40 mm wide and no drop was noted; Crack E in the western limit of the heaved section: 20 to 40 mm wide and no drop was noted; Crack B: up to 20 mm wide with no drop; Crack C: 15 to 30 mm wide with less than 10 mm no drop. Highway eastbound lane to the west of Crack A location (approximately 66 m long section): 10 to 20 mm wide longitudinal frost heave tension cracks along the highway edge of pavement and near the crest of the south embankment. Tension cracks terminate at Crack E location. | <input type="checkbox"/> |
| <input type="checkbox"/> Slope Movement | N/A | <input type="checkbox"/> |
| <input type="checkbox"/> Erosion | N/A | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> Seepage | Water ponding along the ditch | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> Bridge/Culvert Distress | | <input type="checkbox"/> |
| <input type="checkbox"/> Other | | <input type="checkbox"/> |

Instrumentation: None

Assessment (Refer to attached Drawings):

The untreated sections of the highway beyond the ends of Crack A and D locations continued to experience frost heave movements. The differential movement between the treated and untreated sections of the highway resulted in the development of pronounced cracks at the insulation transition locations (Crack A and D locations).

The ACP patch and pothole filling completed up to date has temporarily improved driving conditions across Crack A. However, the seasonal differential movement between the treated and untreated sections of the highway at Crack A location continued to be severe, resulting in the development of a sharp differential height across the crack surface and rough driving conditions. The sharp drop continued to constitute a safety hazard to motorists, particularly in the wintertime. It is anticipated that the existing drop across the crack surface will continue to get worse with time and impact the roadway condition until a suitable remedial measure is successfully implemented.

The differential frost heave issue between the treated and untreated sections of the highway is presumably due to insufficient transition length of insulation at the ends of the treated section (i.e. at Crack A and D locations). The presence of the frost-susceptible soils and high ground water levels below the pavement structure in the untreated sections are likely the main triggers for the ongoing seasonal frost heave issue.

The heaved section of the highway to the west of Crack A location is about 66 m long and appears to terminate at Crack E location.

The longitudinal tension cracks in the highway EBL shoulder and side slope reflect the differential heave between the highway surface and the highway shoulder/slope surface. The differential movement is likely due to snow insulation on the side of the road.

The existing catch water ditch is connected to a natural gully in the bush and hence it constitutes a continuous source of water to the south ditch through the conductive sand layers. This is in addition to the poor drainage condition in the south ditch, which continued to aggravate the situation.

Recommendations:

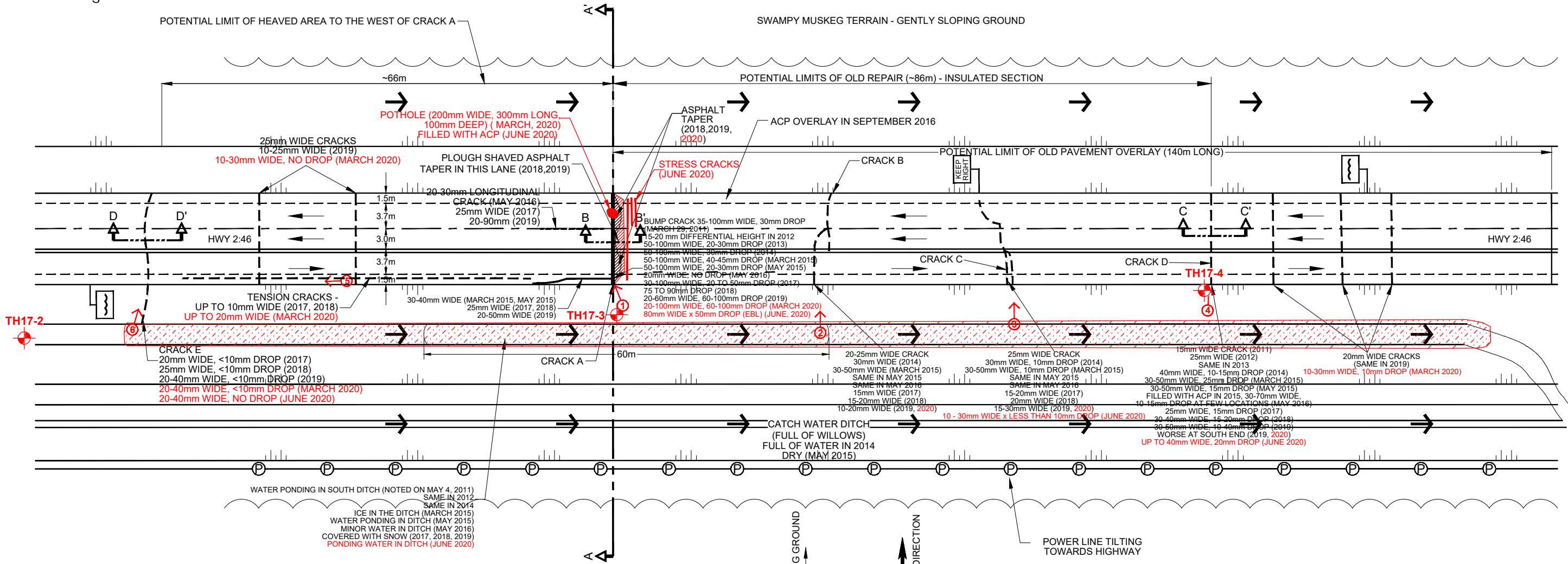
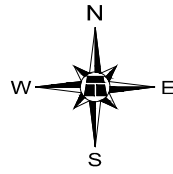
In the short term, the following should be considered:

- Place additional asphalt on the east side of Crack A location, as needed, to further smooth existing drop. The asphalt taper should be extended long enough towards east to provide a smooth ride over the bump crack.
- Seal all open cracks inside and outside the treated section of the highway (approximately 70 m beyond each end of Cracks A and D) to prevent surface water infiltration into the sub-grade material.
- Maintain the bump warning signs and reduce the speed in both directions, particularly during the winter season, to warn motorists of existing hazard.

The intermediate remedial measure has been designed by Thurber. However, the tender date is unknown. This intermediate measure will include the installation of an approximately 300 m long sub-drain in the south ditch to reduce ground water levels in. The sub-drain will extend approximately 90 m within the untreated sections of the highway beyond Crack A and D locations. The ballpark cost of this intermediate option would be in the order of \$380,000.

The long-term remedial measure is to extend the insulation outside the treated section of the highway for approximately 70 m to the west of Crack A location. This option will require excavating the highway surface, reconstruction of the pavement structure, and alternating lane closures to complete the repair work. The ballpark cost of this option would be in the range of \$850,000 to \$900,000. The long-term remedial measure should only be considered if the intermediate term measure is not sufficient to remediate the problem.

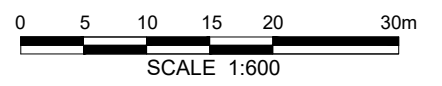
H:1300013357 Geohazard Assessment - Athabasca (CON0017605)\Drafting\2020\UGP13357-NC073-1-1 - AUGUST 28, 2020.dwg - 1 - Aug. 28, 2020



LEGEND

- APPROXIMATE TEST HOLE LOCATION
- CRACKS
- BUMP CRACK
- SLOPING GROUND
- POWER POLE
- BUMP WARNING SIGN
- WATER FLOW DIRECTION IN DITCH
- TREE LINE
- PHOTOGRAPH NUMBER AND APPROXIMATE LOCATION AND DIRECTION

NOTE:
MARCH 5, 2020 AND JUNE 5, 2020 SITE OBSERVATIONS ARE SHOWN IN RED.



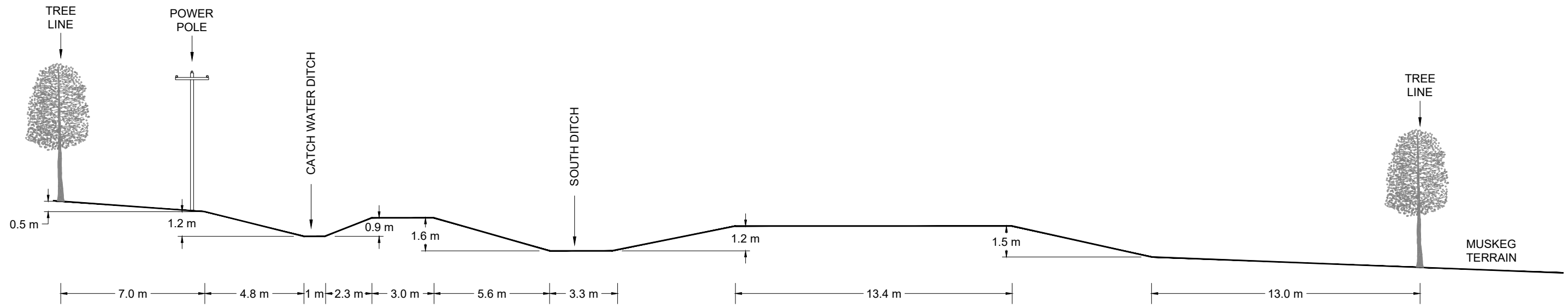
**NORTH CENTRAL REGION (ATHABASCA AREA)
2020 GEOHAZARD ASSESSMENT
(JUNE 5, 2020 SITE INSPECTION)
NC073-1: HWY 2:46 MITSUE FROST HEAVE
SITE PLAN**

DWG NO. NC073-1-1

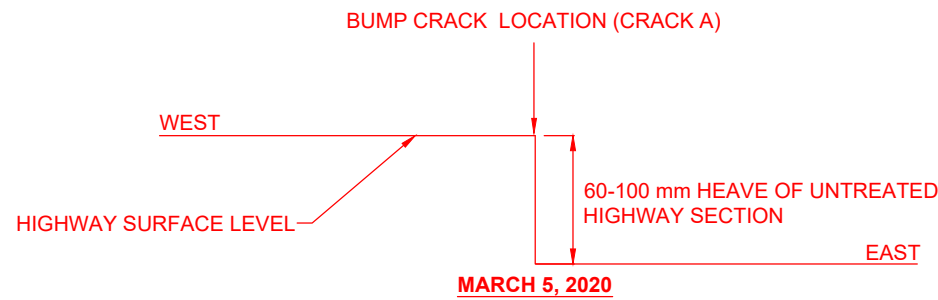
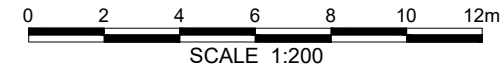
| | |
|-------------|-------------|
| DRAWN BY | ML |
| DESIGNED BY | JGP |
| APPROVED BY | TSA |
| SCALE | 1:600 |
| DATE | AUGUST 2020 |
| FILE No. | 13357 |

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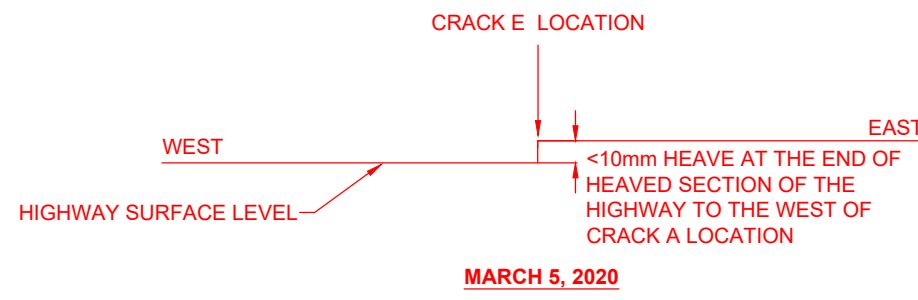
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CROSS SECTION A-A'
SCALE 1:200



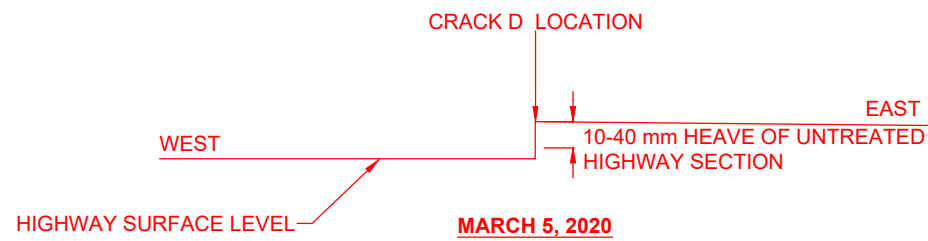
CROSS SECTION B-B' - PROFILE ALONG HIGHWAY SURFACE AT BUMP CRACK A LOCATION
SCALE 1:5



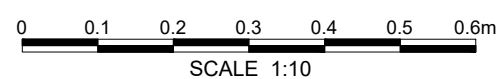
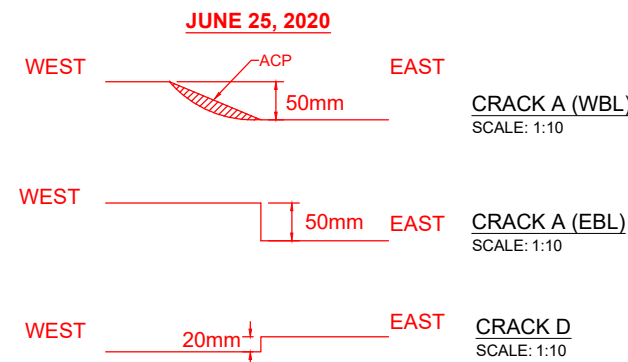
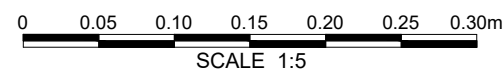
CROSS SECTION D-D' - PROFILE ALONG HIGHWAY SURFACE AT CRACK E LOCATION
SCALE 1:5

NOTES:

CROSS SECTION A-A' IS BASED ON APPROXIMATE SIMPLE FIELD MEASUREMENTS AND MAY NOT REPRESENT THE ACTUAL PROFILE AT THE AREA OF CONCERN.



CROSS SECTION C-C' - PROFILE ALONG HIGHWAY SURFACE AT CRACK D LOCATION
SCALE 1:5



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|--|--------------|
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| NORTH CENTRAL REGION (ATHABASCA AREA) 2020 GEOHAZARD ASSESSMENT (JUNE 25, 2020 SITE INSPECTION) | |
| NC073-1: HWY 2:46 MITSUE FROST HEAVE CROSS SECTIONS A-A', B-B', C-C' AND D-D' | |
| DWG NO. NC073-1-2 | |
| DRAWN BY | ML |
| DESIGNED BY | JGP |
| APPROVED BY | TSA |
| SCALE | AS SHOWN |
| DATE | OCTOBER 2020 |
| FILE No. | 13357 |

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Photo # 1 Looking north at the bump crack (Crack A); there is about 50 mm drop at the crack location; drop is more noticeable within the EBL



Photo # 2 Looking north at Crack B



Photo # 3 Looking north at Crack C



Photo # 4 Looking north at Crack D (East end of treated section)



Photo # 5 Looking west at a longitudinal crack along the highway shoulder



Photo # 6 Looking north at Crack E