

SITE NUMBER AND NAME: <b>C058-I, -II, &amp; -III Sinkholes</b>		HIGHWAY & KM: 570:02, 8.3, 9.2, 9.8	PREVIOUS INSPECTION DATE: July 10, 2019	INSPECTION DATE: <b>June 24, 2021</b>
LEGAL DESCRIPTION: 10-08-027-17 W4M	NAD 83 COORDINATES: UTM Northing Easting <b>C058-I</b> 12 5683470 405475 <b>C058-II</b> 12 5683845 404934 <b>C058-III</b> 12 5684148 404224		RISK ASSESSMENT: PF: 8 CF: 5 TOTAL: 40 PF: 8 CF: 5 TOTAL: 40 PF: 8 CF: 5 TOTAL: 40	
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 510 (west) & 360 (east) (Ref No. 116220 & 997198)			CONTRACT MAINTENANCE AREA (CMA): 521	

SUMMARY OF SITE INSTRUMENTATION:  There is no instrumentation at the C058 site.  LAST READING DATE: N/A	INSPECTED BY: Chris Gräpel (KCB) James Lyons (KCB) Roger Skirrow (AT) Tony Penney (AT)
PRIMARY SITE ISSUE: Settlement of Hwy 570 due to the presence of dispersive-soil voids beneath the highway surface.	
APPROXIMATE DIMENSIONS: Numerous soil voids along a 1.5 km stretch of Hwy 570.	
DATE OF ANY REMEDIAL ACTION: May 3, 2010 – remediated using foam injection; May 29, 2015 – excavated (deep) and reconstructed with gravel fill and a culvert; unknown – sinkholes in ditch backfilled; speed reduction signs to 50 km/h and hazard markers installed. Sinkhole at C058-I on near south edge of pavement recently patched. October 2018 – at C058-I sinkhole at culvert inlet was filled with 4 m <sup>3</sup> of grout. 2019 – All sites appeared to have been recently patched (MCI later confirmed that all sites were patched in June 2019). 2021 – All sites appeared to have been recently patched.	

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		C058-I: Both lanes recently patched; small sinkhole forming on north edge of pavement. C058-III: Pavement has subsided due to sinkhole on north edge of pavement.	X	
Slope Movement		X	None observed		X
Erosion	X		C058-I: Dispersive soil voids potentially forming beneath highway; erosion channel downstream of culvert at south end of site C058-I and -II: Soil voids of various sizes forming above and below highway along drainage pathways.	X	
Seepage		X	None observed		X
Culvert Distress		X	C058-I: 600 mm diameter CSP culvert open and flowing		X

<b>COMMENTS</b>
C058-I: <ul style="list-style-type: none"> <li>Pavement has been recently patched in both lanes. A small sinkhole (0.3 to 0.5 m in diameter) has formed on the north edge of the pavement (Waypoint 21). The sinkhole is located across the highway diagonally from a dip in the pavement surface on the south side of the highway indicating the presence of a void.</li> </ul>

- A sinkhole at the culvert inlet (north of the highway) was filled with 4 m<sup>3</sup> of grout in October 2018. The grout is intact and has not subsided since 2018.

C058-II:

- Pavement has been recently patched in both lanes. The patch has settled since completion, with ponded water from recent rain showing in the dip location.
- A large sinkhole was discovered north of the highway at the fence line during the 2018 inspection. The sinkhole has expanded since the 2018 and 2019 inspections (in line with asphalt settlement).
- A sinkhole was discovered along the valley draw above the highway in 2018 that lines up with the sinkhole downslope of the road.
- Additional sinkholes were discovered during the 2018 inspection below the fence line on the south side of highway at the culvert outlet and near the toe of the slope, respectively.
- During the 2019 inspection, a series of small sinkholes were found near the fence line on the south side of the highway.

C058-III:

- North (westbound lane) of highway recently patched where sinkhole was observed during 2018 inspection.
- A sinkhole in the north ditch was filled with grout in 2018. The grout appeared to be heaving from groundwater pressure during the 2018 inspection. The grout cap and sinkhole are now buried with soil deposits and gravel fill.
- During the 2018 inspection, the MCI identified two sinkholes marked with 2x4 posts were full of water following filling of the sinkhole with grout (Waypoint 687), indicating that the void had been plugged. When dispersive voids re-opened beneath the road, the MCI could see the water in the holes dropped, indicating that void filling/plugging efforts had failed. The ground around the posts has since been covered in sediment, obscuring observations of groundwater
- Two large sinkholes were found near the toe of the embankment on the south side of the highway during the 2018 inspection (Waypoint 691 and 692). Sinkhole at Waypoint 691 does not appear to have expanded since 2018 inspection.
- A continuous void (or series of voids) could be present under the entire highway at this location.

The portion of Hwy 570:02 along the Red Deer River valley appears to be susceptible to dispersive-soil-void geohazards.

No repairs are required at the C058 sites. However, if voids are present at depth below the highway, anywhere the highway embankment is founded on dispersive soils or constructed with dispersive soils, enlargement of a void could result in subsidence of the pavement, followed by brittle collapse of the pavement. AT's strategy to date is to backfill sinkholes and voids and patch the pavement when subsidence of the pavement occurs. The hazard markers at the C058 sites should be maintained. A speed reduction should be implemented, and repairs conducted immediately if further subsidence is noted.

A draft of geohazard-risk-level factors (e.g., probability and consequence factors) for subsurface-void geohazards was submitted to AT for review and discussion in early 2019.

Discussed remedial actions:

- C058-I and C058-II: Reinforced subgrade or asphalt to prevent collapse of roadway surface and installing a new culvert to allow ditch water more chance of draining through the embankment in a culvert, rather than through dispersive soils that could form voids
- C058-III: Install a cut-off wall in the ephemeral creek valley upslope of the highway to force groundwater to the surface and prevent further subsurface erosion.

- C058-I, -II, & -III: AT believes that heavily loaded trucks are exacerbating and hastening the collapse of subsurface voids. A weight restriction should be placed on this section of highway until a solution to void formation below the highway is developed. AT should patrol this section of highway frequently to identify areas of pavement settlement to reduce the possibility of brittle collapse of the pavement under highway traffic.

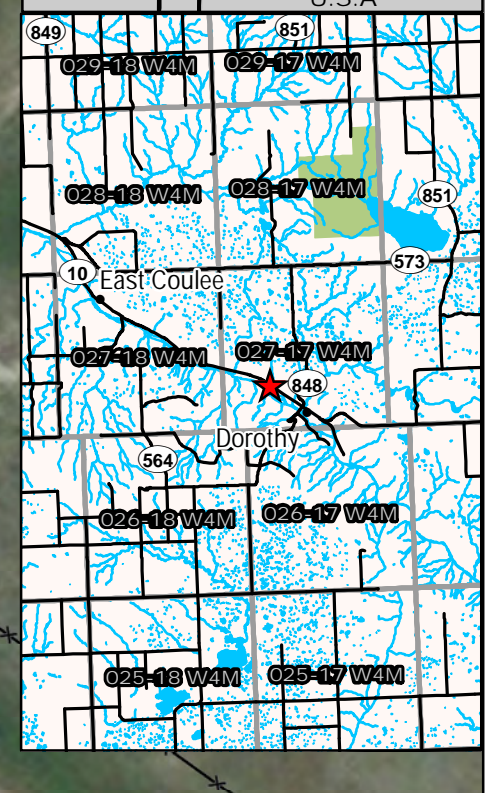
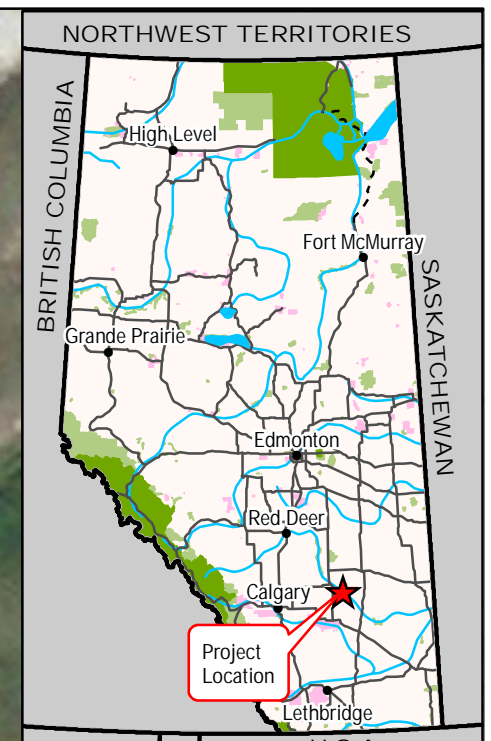
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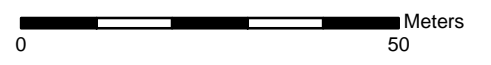
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- (ii) The observations, findings, and conclusions in this report are based on observed factual data and conditions that existed at the time of the work, and should not be relied upon to precisely represent conditions at any other time.
- (iii) KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.

Chris Gräpel, M.Eng., P.Eng.  
Civil Engineer, Associate



- Legend**
- ▲ GPS Waypoint (June 29, 2021)
  - Flow Direction
  - GPS Track (June 29, 2021)
  - ⊗ Sinkhole
  - ✕✕ Fence
  - Guardrail
  - ⌒ Culvert
  - ~~~~ Crack



<b>NOTES:</b> 1. HORIZONTAL DATUM: NAD83 2. GRID ZONE: UTM Zone 12N 3. IMAGE SOURCE: Bing Maps, Microsoft Corporation 2019	<b>CLIENT</b> 	<b>PROJECT</b> CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM
		<b>TITLE</b> Site Plan C058-I Hwy 570:02, km 9.8
<b>SCALE</b> 1:1,000	<b>PROJECT No.</b> A05116A02	<b>FIG No.</b> 1

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- Legend**
- GPS Waypoint (June 24, 2021)
  - GPS Track (June 24, 2021)
  - Sinkhole
  - Culvert
  - Fence

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0 50 Meters

NOTES: 1. HORIZONTAL DATUM: NAD83 2. GRID ZONE: UTM Zone 12N 3. IMAGE SOURCE: Bing Maps, Microsoft Corporation 2019	CLIENT 	PROJECT CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM
		TITLE Site Plan C058-II Hwy 570:02, km 9.3
	SCALE 1:1,000	PROJECT No. A05116A02
		FIG No. 1



- Legend**
- GPS Waypoint (June 29, 2021)
  - GPS Track (June 29, 2021)
  - Fence
  - Sinkhole
  - Grouted Sinkhole

**NOTES:**  
 1. HORIZONTAL DATUM: NAD83  
 2. GRID ZONE: UTM Zone 12N  
 3. IMAGE SOURCE: Bing Maps, Microsoft Corporation 2019

CLIENT

PROJECT CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM		
TITLE Site Plan C058-III Hwy 570:02, km 8.3		
SCALE 1:1,000	PROJECT No. A05116A02	FIG No. 1

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## Inspection Photographs

- Photo 1** Both lanes at C058-I have been recently patched. A small sinkhole (first observed in 2018) is on the north edge of the pavement indicated by red arrow). Photo taken June 24, 2021 looking west.



- Photo 2** Small sinkhole (0.3 m to 0.5 m diameter) along the north edge of pavement at C058-I. Sinkhole is located diagonally from dip in pavement on south side of highway (red circle). Photo taken June 24, 2021 looking northwest.



**Photo 3** Large sinkhole (indicated by black circle) on the north side of the highway at C058-II has expanded since the 2019 inspection. Photo taken June 24, 2021 looking north.



**Photo 4** New asphalt patch at C058-II. Settlement in the westbound lane that was holding water from recent precipitation is above the existing culvert. Photo taken June 24, 2021 looking west.





**Photo 5** C058-III was recently patched, covering the previously observed sinkhole. Photo taken June 24, 2021 facing west.



**Photo 6** Large sinkhole (indicated by a red circle) at the toe of the south slope below highway at C058-III has not expanded since 2019 inspection. Photo taken June 24, 2021 looking southeast.

