

SITE NUMBER AND NAME: C011-1 and -2 Erosion and Sinkholes		HIGHWAY & KM: 837:02, 5.637	PREVIOUS INSPECTION DATE: May 30, 2022	INSPECTION DATE: June 18, 2024
LEGAL DESCRIPTION: 10-04-30-21-W4M	NAD 83 COORDINATES: UTM Northing Easting 12 5711672 368445 12 5711584 368473		RISK ASSESSMENT: C011-1: PF: 7 CF: 2 TOTAL: 14 C011-2: PF: 11 CF: 6 TOTAL: 66	
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 280 (north) & 310 (south) (Ref No. 106230 & 107250)			CONTRACT MAINTENANCE AREA (CMA): 517	

SUMMARY OF SITE INSTRUMENTATION: There is no instrumentation at the C011 site. LAST READING DATE: N/A	INSPECTED BY: Chris Gräpel (KCB) James Lyons (KCB) Tony Penney (TEC) Rocky Wang (TEC)
PRIMARY SITE ISSUE: Erosion in the ditch on the east side (northbound lane) of Hwy 837 near the geocell armoring; and of the unarmored fill that was placed in either 2015 or the spring of 2016.	
APPROXIMATE DIMENSIONS: The site is approximately 200 m long, and the highway embankment above the ditch is approximately 1.2 m high sloped at approximately 4H:1V.	
DATE OF ANY REMEDIAL ACTION: October 2002 – geocell and gabion basket drop structures installed; Spring 2016 – unarmored fill placed downstream of the gabion basket drop structures to divert water away from the edge of the highway. 2018 and 2019 – the HMC has regraded the unarmored fill from the C018 site downslope of geocell on the backslope above the existing erosion gully. 2020 – The HMC replaced approximately 60 m of the geocell armoring (upstream of the gabion basket drop structure).	

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		Pavement cracking on north (westbound) shoulder and settlement downhill (southeast) of the site		X
Slope Movement	X		Steep gully slopes in unarmoured fill are failing		X
Erosion	X		Erosion of ditch and unarmored fill stockpile. Continued erosion of gully.	X	
Seepage		X	N/A – none observed during the 2024 inspection.		X
Culvert Distress		X	N/A – none observed during the 2024 inspection.		X

COMMENTS
During the 2021 inspection, KCB and TEC discussed potentially separating the C011 site into two subsites (i.e., C011-1 and -2). C011-1 would be the north portion of the site (ditch erosion that was partially repaired in 2020) and C011-2, which would capture the gully erosion downslope of the geocell armoring/gabion drop structures and the sinkholes on the east and west side of Hwy 837. The site was separated into two subsites in late-2021.
<u>C011-1 Erosion:</u>
<ul style="list-style-type: none"> The geocell armoring upstream of the gabion drop structure was repaired in fall 2020 (Photos 1 through 3) Overall, the repaired geocell armoring appears to be in good condition and vegetation is growing on the ditch side slopes. Along the repair, some material in the geocells has been washed away (likely during significant precipitation events) and some of the cells show minor damage (Photo 3).

- The CSP culvert upslope of the geocell armouring is corroding. No significant changes between the 2022 and 2024 inspections were observed.

C011-2 Sinkholes:

- The unarmoured fill stockpile continues to be affected by gully erosion and the erosion gully downslope of the unarmoured fill stockpile continues to expand off highway right-of-way (Photo 4).
 - The erosion is causing slope failures that are enlarging slowly and extending upslope (south) towards the highway (Photo 5). Continued erosion of failed material will eventually cause sliding that is large enough to impact the highway.
- The large sinkhole on the east highway embankment slope (Photo 5 and 6) does not appear to have increased in size between the 2022 and 2024 inspections.
- The sinkhole historically observed on the south side of the highway (Photo 7) is filled with water and does not appear to have increased in size between the 2022 and 2024 inspections.
- The depression in the highway surface, southeast of the large sinkhole south of the highway (Photo 7), appears similar as during the 2022 inspection. The depression is between sinkholes north and south of the highway, which could indicate that void formation and collapse is occurring below the highway surface, likely due to the dispersive soils located at the site.
- Depressions in the highway surface downhill (southeast) of the site were observed during the inspection (Photo 8). The depressions can likely be attributed to void formation and collapse below the highway surface due to the dispersive nature of the soils at the site.
- The sinkholes observed during the 2022 inspection, north and south of the highway, range from approximately 1 m to 5 m in diameter. The sinkholes observed near the downstream limit of the erosion gully appear to be in an area of exposed bedrock fill with little to no vegetative cover.
- The linear erosion features (up to 1.5 m deep and 10 m long) near the toe of the highway embankment that run approximately parallel to the highway surface appear to be in similar condition as during the 2022 inspection.
- The linear erosion feature (approximately 3 m long, 3 m deep, and 20 m long) on the highway embankment slope near the southern extent of the site is downslope of the CSP culvert outlet (found during the 2024 inspection) appears to be in similar condition as during the 2022 inspection.
- The surface of the embankment slope has several sinkholes as shown in Figure 1, including a line of sinkholes extending southeast along the south edge of the erosion gully. The line between sinkholes on the east and west side of the highway indicates a preferential flow path along the sinkholes on both sides of the embankment at a shallow depth below the highway. The presence of the sinkholes indicates that dispersive soil fill is present in the embankment and foundation.
- Review of the drainage path from the bottom of the hill indicated that the drainage from the erosion gully to the Red Deer River was not clearly defined.

Maintenance/Repair/Monitoring Recommendations:

General:

- The site should be regularly inspected by TEC's MCI, particularly after significant precipitation events (spring freshet or heavy and/or prolonged rainfall). TEC operations crews should also monitor this site for possible settlement or collapse of the pavement like they do at the C058 geohazard site on Hwy 570.
- The site should continue to be inspected every two years as part of the GRMP Section B Inspections.

C011-2:

- A seamless HDPE slope drain could be used to convey flows over the eroded areas and into the sediment pond, or to a natural creek channel for discharge into the Red Deer River. An energy dissipation structure would be required at the base of the slope to reduce the flow velocity from the slope drain outlet.

- A tracer dye test could be completed to assess the connectivity of the sinkholes observed on the north and south sides of the highway.

This report is an instrument of service of Klohn Crippen Berger Ltd. (KCB). The report has been prepared for the exclusive use of Alberta Transportation and Economic Corridors (Client) for the specific application to the Central Region Geohazard Risk Management Program (Contract No. CON0022160) and it may not be relied upon by any other party without KCB's written consent.

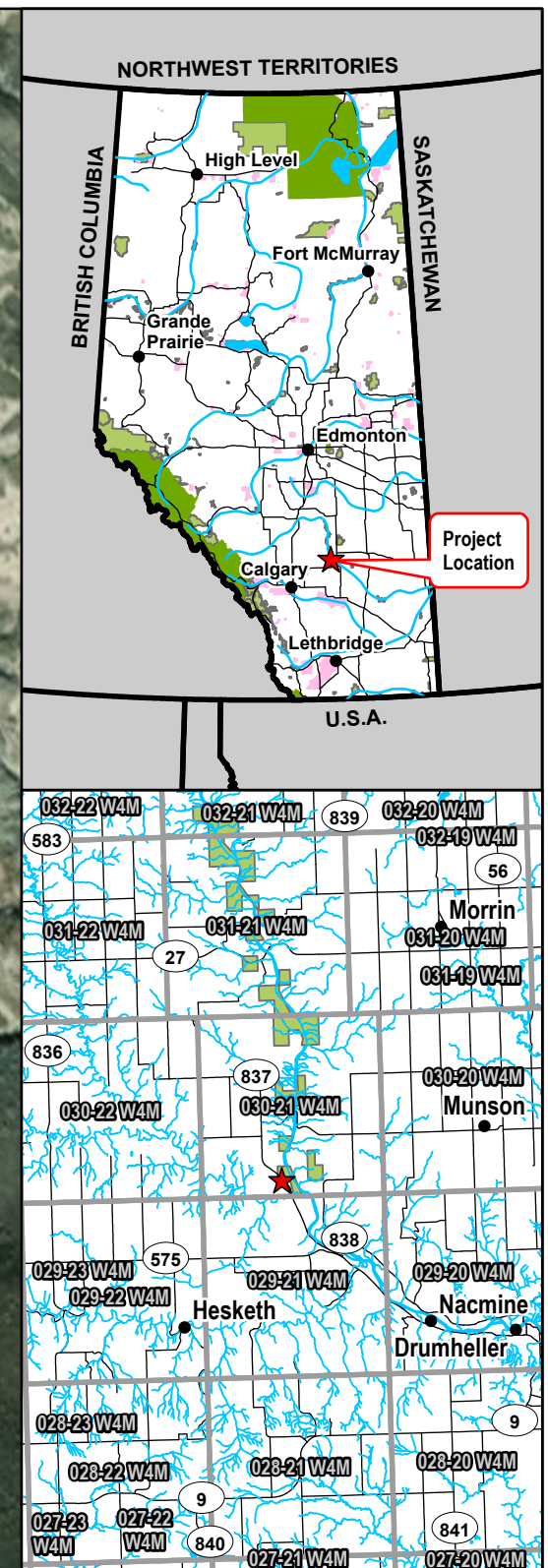
KCB has prepared this report in a manner consistent with the level of care, skill, and diligence ordinarily provided by members of the same profession for projects of a similar nature at the time and place the services were rendered. KCB makes no warranty, express or implied.

Use of or reliance upon this instrument of service by the Client is subject to the following conditions:

- (i) The report is to be read in full, with sections or parts of the report relied upon in the context of the whole report.
- (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) The report is based on information provided to KCB by the Client or by other parties on behalf of the client (Client-supplied information). KCB has not verified the correctness or accuracy of such information and makes no representations regarding its correctness or accuracy. KCB shall not be responsible to the Client for the consequences of any error or omission contained in Client-supplied information.
- (iv) KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.
- (v) This report is electronically signed and sealed and its electronic form is considered the original. A printed version of the original can be relied upon as a true copy when supplied by the author or when printed from its original electronic file.

James Lyons, P.Eng.
Civil Engineer

File: Z:\A\EDM\A05\116\A02\ABT_Central Region GRIP\400 Drawings\GIS\02_ProFiles\2024\Section B\AT_CentralRegion_SectionB_240627\AT_CentralRegion_SectionB_240627.aprx Date: Time: Creator: EQuine



Legend		



NOTES:
 1. HORIZONTAL DATUM: NAD83
 2. GRID ZONE: UTM ZONE 12N
 3. IMAGE SOURCE: 2024 MICROSOFT CORPORATION, MAXAR, CNES DISTRIBUTION AIRBUS DS.
 4. LOCATION OF 2020 SINKHOLE IS APPROXIMATE AND WAS DETERMINED BASED ON PHOTOS.

CLIENT

PROJECT CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM		
TITLE Site Plan C011 - Ditch Erosion Hwy 837:02, km 5.637		
SCALE 1:1,500	PROJECT No. A05116A02	FIG No. 1

Photo 1 Geocell armouring installed in fall of 2020 is performing well and vegetation cover has improved since the 2022 inspection. Photo taken June 18, 2024, facing northwest.



Photo 2 Fine-grained material (silt and clay) has been deposited in the geocell armouring. Photo taken June 18, 2024, facing northwest.



Photo 3 Some of the coarse-grained material has been washed out between the individual cells between the 2022 and 2024 inspections. Photo taken June 18, 2024, facing north.



Photo 4 The erosion downstream of the geocell repair and gabions is significantly wider and deeper than during the 2022 inspection (indicated by red arrow). Photo taken June 18, 2024, facing east.



Photo 5 Erosion gully downstream of the geocell repair, along the toe of the natural slope and highway embankment slope. The slide and sinkhole on the highway embankment slope (indicated by red arrows) appears not to have changed significantly since 2022. Photo taken June 18, 2024, facing east.



Photo 6 Sinkhole on the highway embankment slope (location shown in Photo 5) appears similar as during the 2022 inspection (approximately 2 m to 3 m in diameter). Photo taken June 19, 2024, facing north.



Photo 7 Sinkhole previously observed on the south side of the highway is full of water. No significant changes were observed since the 2022 inspection. Photo taken June 18, 2024, facing northwest.



Photo 8 Depressions were observed in the highway surface downhill (southeast, location indicated by red arrow) of the C011 site. Photo taken June 18, 2024, facing southeast.

