



**Klohn Crippen Berger**

# **Alberta Transportation**

**CON0017608 Central Region GRMP**



***Hwy 609:02, km 16.42***

***Call - Out Report***



A05115A02

**ISO 9001**  
**ISO 14001**  
**OHSAS 18001**

January 2021

January 27, 2021

Alberta Transportation  
4<sup>th</sup> Floor, Provincial Building  
4920 – 51 Street  
Red Deer, Alberta  
T4N 6K8

**Tony Penney, P.Eng.**  
**Construction Engineer**

Dear Mr. Penney:

**CON0017608 Central Region GRMP**  
**Hwy 609:02, km 16.42 Call-Out Report**

## **1 INTRODUCTION**

As part of the Geohazard Risk Management Program (GRMP) contract for the central region, Klohn Crippen Berger Ltd. (KCB) was requested by Alberta Transportation (AT) to conduct a call-out inspection for ditch erosion at km 16.42 on Hwy 609:02 (the site). The site is located approximately 4 km east of Edberg, Alberta. The legal land description of the site is NW 8-44-19-W4M and SW 17-44-19-W4M. A site plan is presented in Figure 1. The 2019 annual average daily traffic for this section of Hwy 609:02 is 920 vehicles per day (AT 2019).

The site was inspected on June 24, 2020 by Messrs. Chris Gräpel, P.Eng. and James Lyons, E.I.T. of KCB with Messrs. Dwight Rewega (Maintenance Contract Inspector) and Rishi Adhikari, P.Eng. of AT. This is the first time KCB has inspected the site. The site was first identified to the GRMP by the Maintenance Contract Inspector (MCI) in the spring of 2020. Photographs from the site inspection are included in Appendix I.

This call-out report was prepared for AT under Contract No. CON0017608. KCB's site observations, assessments, and recommendations for short-term and long-term remedial actions are presented in this report.

## **2 SITE DESCRIPTION**

The site is located at km 16.42 of Hwy 609:02, approximately 970 m west of the intersection of Hwy 609:02 and Hwy 56:16. This section of Hwy 609:02 is a paved two-lane roadway that runs east-west between the intersection Hwy 609:02 and Hwy 56:16 (south of Driedmeat Lake) and the intersection of Hwy 609:02 and Hwy 21:22 (north of Ferintosh).

# **Alberta Transportation**

## **CON0017608 Central Region GRMP**

*Hwy 609:02, km 16.42*

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Erosion is occurring in the ditch on the north side of Hwy 609:02. The ditch erosion begins at the west extent of the site near an outcrop of bedrock and extends east pass a culvert into a gully at the east extent of the site. The gully extends north outside of AT's Right of Way (ROW). The approximate extents of the erosion are shown on Figure 1. The highway embankment slopes are well vegetated and slope at approximately 4H:1V.

According to the Alberta Geological Survey (AGS 2013a), the site is in an area containing pre-glacial fluvial deposits transported by stream and rivers prior to glaciation. The fluvial deposits are typically comprised of well-graded quartzite and chert gravel and cobbles (i.e., particles ranging from silt and clay sized particles to cobbles and boulders). Bedrock in the area consists of feldspathic sandstone interbedded with siltstone, bentonitic mudstone, carbonaceous mudstone, concretionary sideritic layers, and laterally continuous coal seams of the Horseshoe Canyon Formation (AGS 2013b). The bedrock is believed to be marine in origin and has the potential to be dispersive in nature.

### 3 SITE OBSERVATIONS

Our site observations were as follows:

- The weather was 20°C to 25°C and mostly sunny.
- There is an exposed utility line in the ditch on the south side of Hwy 609:02 (Photo 12, Waypoint 24).
- There is ongoing erosion in the ditch on the south side of Hwy 609:02, but it is outside AT's Clearance Zone (approximately 8 m to 10 m) and is not as significant as the erosion in the ditch on the north side of Hwy 609:02.

#### Erosion along North Ditch of Highway 609:02

- A 1.0-m-diameter CSP culvert below Hwy 609:02 is orientated approximately north to south. Corrosion was observed at the bottom of the culvert inlet and outlet (Photo 1 and 2, respectively).
- On the north side of the highway there is an area of exposed bedrock (i.e., the highway backslope) that was created during highway construction. The bedrock appears to be marine in origin that is prone to dispersive soil erosion (e.g., similar characteristics as soils in Alberta's badland region).
- The north ditch that discharges into the gully at the culvert outlet is less than 1 m to 1.5 m deep west/upslope of the culvert outlet (Photo 8 to 10). The erosion along this stretch of the ditch is typically 3 m to 4 m away from the highway but comes within 1.5 m near the north extent of the site.
- The erosion in the base of the ditch (i.e., the ditch bottom), is steep-sided, and has eroded below the vegetation.
- The ditch west/upslope of the bedrock backslope is well vegetated and is performing well (Photo 10).

### Gully Erosion Downslope of the Culvert

- Ditch erosion on the north side of Hwy 609:02 is impacting the fence between AT's ROW and private land (Photo 4).
- Water flowing from the culvert outlet has eroded an approximate 2-m-deep channel into the underlying bedrock (Photo 3, Waypoint 22). The gully erosion extends outside of AT's right of way (ROW). The gully erosion has extended into bedrock from the outlet of the culvert to where the erosion gully terminates on private land.
- The depth of erosion is upwards of 2 m to 3 m near the culvert outlet (Photos 5 and 6), 4 m to 5 m east/downslope of the culvert outlet (Photo 7).
- The deepest section of erosion begins approximately 10 m east/downslope of the culvert outlet and extends approximately 50 m north. Some trees have fallen into deepest section of the erosion gully east/downslope of the culvert outlet (Photo 7).

### Private Land

- There are cobbles at the erosion gully outlet, east/downslope of the culvert outlet (Photo 11). These cobbles are believed to have been from the soils that the gully eroded through.
- Eroded material from the erosion gully is being deposited at the outlet of the erosion gully outside AT's ROW.

### South of C054

During the site visit KCB and AT also inspected the ditch on the west side of Hwy 56:16 near the C054 site (approximately 400 m south of the intersection of Hwy 609:02 and Hwy 56:16) and an erosion gully east of Hwy 56:16. Our site observations were as follows:

- The erosion in the ditch on the west side of Hwy 56:16 is minor (Photo 13 and 14) and could be regraded during repairs to the more significant ditch erosion on the north side of Hwy 609:02 and off highway ROW described earlier.
- The erosion gully east of Hwy 56:16 and just south of C054 (Photo 15). The erosion gully is approximately 2 m wide by 2 m deep at the inlet and increased in size further to the north (the length of the erosion gully was not inspected). However, since there is a guardrail installed east of the northbound lane and the erosion gully is located outside of AT's Clearance Zone of 8 m to 10 m (Photo 16), AT and KCB agree that repair recommendations are not required at the time this report was written.

## **4 ASSESSMENT**

KCB's assessment of the site is as follows:

- Higher surface water flows over the backslope excavated into bedrock on the north side of the highway (Figure 1) could have attributed to the erosion upslope of the culvert outlet.

- Erosion is likely exacerbated by periods of heavy rainfall.
- The presence of dispersive soils appears to be a contributing factor to the degree of erosion at the site.
- Leakage through the culvert could cause material loss beneath and around the culvert – with the potential for subsurface voids to develop and cause damage to the culvert and the highway embankment/road surface.
- Ongoing erosion will cause further damage to the fence between AT's ROW and private land.
- Erosion in the ditch upslope/west of the culvert outlet is within approximately 1.5 m of the highway and 1 m deep. If erosion continues, it has the potential to encroach upon the westbound lane of Hwy 609:02.
- Erosion downstream of the culvert outlet outside of the highway ROW should be repaired.

## 5 RISK LEVEL

Risk levels for AT GRMP sites are determined according to the following:

$$\text{Risk Level} = \text{Probability Factor} \times \text{Consequence Factor}$$

Where the AT risk level is defined as follows:

- Probability Factor varies from 1 (inactive, very low probability of erosion, non-erodible soils or bedrock, physical or structural limitation to erosion expansion. Flat slopes, well vegetated) to 20 (mass of wasting great volumes of soil is occurring, gullies 10 m wide and 4 m deep).
- Consequence Factor varies from 1 (relatively small area of erosion involved confined to ditch or backslope. Less than 25 m of ditch of 100 m<sup>2</sup> of slope affected) to 10 (sites where the eroded material could directly flow into fish bearing rivers or affect water quality and aquatic resources).

The risk level was determined using AT's risk level system and is presented as follows:

- Probability Factor – A rating of 11 was selected for the site because there is active erosion that is increasing the depth and width of the ditch on the north side of the highway which has the potential to destabilize the shoulder of the westbound lane. The gully erosion occurring on private property (downslope/east of the culvert outlet) also poses a risk to the farmer's livestock.
- Consequence Factor – A rating of 2 was selected for the site because partial closure of the road would be required if the ditch erosion begins to impact the westbound lane of Hwy 609:02.

A total Risk Level of 22 was assigned for the site.

## 6 RECOMMENDATIONS

### 6.1 Short-Term

KCB's short-term recommendations include:

- The MCI should continue to monitor the site to see if the ditch erosion retrogresses/expands towards the westbound lane of Hwy 609:02 and if there is leakage from the culvert (may result in subsurface voids that could impact the integrity of the highway).
- If the ditch erosion begins to impact the highway embankment/road surface, signage should be installed to warn the public of the hazard (e.g., hazard and speed reduction signs).
- Notify utility owner than line is exposed in the ditch on the south side of Hwy 609:02.

### 6.2 Long-Term

Based on site observations and the repair options discussed on site with AT personnel, KCB recommends the following (long-term) remedial measures:

- Repair the existing culvert, the culvert should be lined with a smaller diameter smooth walled steel culvert and the annulus between them should be backfilled with grout.
- Armour the culvert inlet and outlet with riprap that meets the specifications in AT's standard culvert drawings.
- Grade the ditch west/upslope of the culvert and reinforce the centerline of the ditch with geotextile and geocell and gravel armouring:
  - ◆ The geocell should be backfilled with granular material or fine-grained material that will promote more rapid revegetation. Design of the repair could consider various ways of promoting vegetation growth to supplement the armouring effect of geocell and gravel.
  - ◆ The geocells should be installed to maintain a channel shape (i.e., with the lowest point of the ditch in the center) to help prevent erosion occurring at the edges of the geocell reinforcement.
  - ◆ The geotextile should be regularly keyed into the bottom of the ditch (longitudinally spaced along the length of the ditch) top create gravel or sand check dams to assist in addressing dispersive soil erosion beneath the geocell that could cause undermining erosion. The key-in trenches should be at least 0.5 m by 0.5 m and the width of the geocell reinforcement.
- Remove vegetation and other debris in the erosion gully downslope/east of the culvert outlet.
- Repair the erosion gully downslope/east of the culvert outlet. Some repair options include:
  - ◆ Option 1: Backfill the erosion gully with common fill (e.g., till), grade a channel, and reinforce the channel with geotextile and geocells. This is KCB recommended option as it is more economical than Options 2 and 3 and would require less maintenance.

- ◆ Option 2: Backfill the erosion gully with common fill, grade a channel, and protect the channel with geotextile and riprap.
- ◆ Option 3: Install a slope drain beginning near the outlet of the existing culvert and ending northeast of where the erosion ends. This option would require the construction of an intake structure at the inlet of the slope drains and an energy dissipation structure at the outlet of the slope drain.
- Treat disturbed soil and bedrock areas with a flexible growth medium (e.g., a spray-on erosion control blanket) then hydroseed with a seed mix that is suitable for the exposed soil type and soil chemistry/available soil nutrients. An assessment of soil nutrients, soil chemistry, and review of what species would grow well on badland marine bedrock or soils derived from badland marine bedrock would assist in preparing a seed mix and hydro-mulch amendments that promote revegetation.
- KCB estimates that the cost for this repair work will be between \$250,000 and \$500,000 based on the scope of repairs outlined in this report.

A hydrotechnical assessment should be completed to assess the peak runoff for the site and would assist in designing the selected repair option. Weather station data from the Environment Canada weather station (No. 46733) approximately 10 km southwest of the site should be used to select a rainfall event that is appropriate for the site (e.g., 1:10 or 1:20 rain fall event).



## 7 CLOSING

This report is an instrument of service of Klohn Crippen Berger (KCB). The report has been prepared for the exclusive use of Alberta Transportation (Client) for the specific application to the central region GRMP, 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:

1. The report is to be read in full, with sections or parts of the report relied upon in the context of the whole report.
2. 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.
3. KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.

Please contact the undersigned if you have questions or comments about this report.

Yours truly,

**KLOHN CRIPPEN BERGER LTD.**

Chris Gräpel, P.Eng.  
Senior Geotechnical Engineer, Associate

JL:kc



James Lyons, E.I.T.  
Civil Engineer

### ATTACHMENTS

Figures

Appendix I      Site Photographs

## REFERENCES

Alberta Geological Survey (AGS). 2013a. Map 601. Surficial Geology of Alberta. Published March 25, 2013.

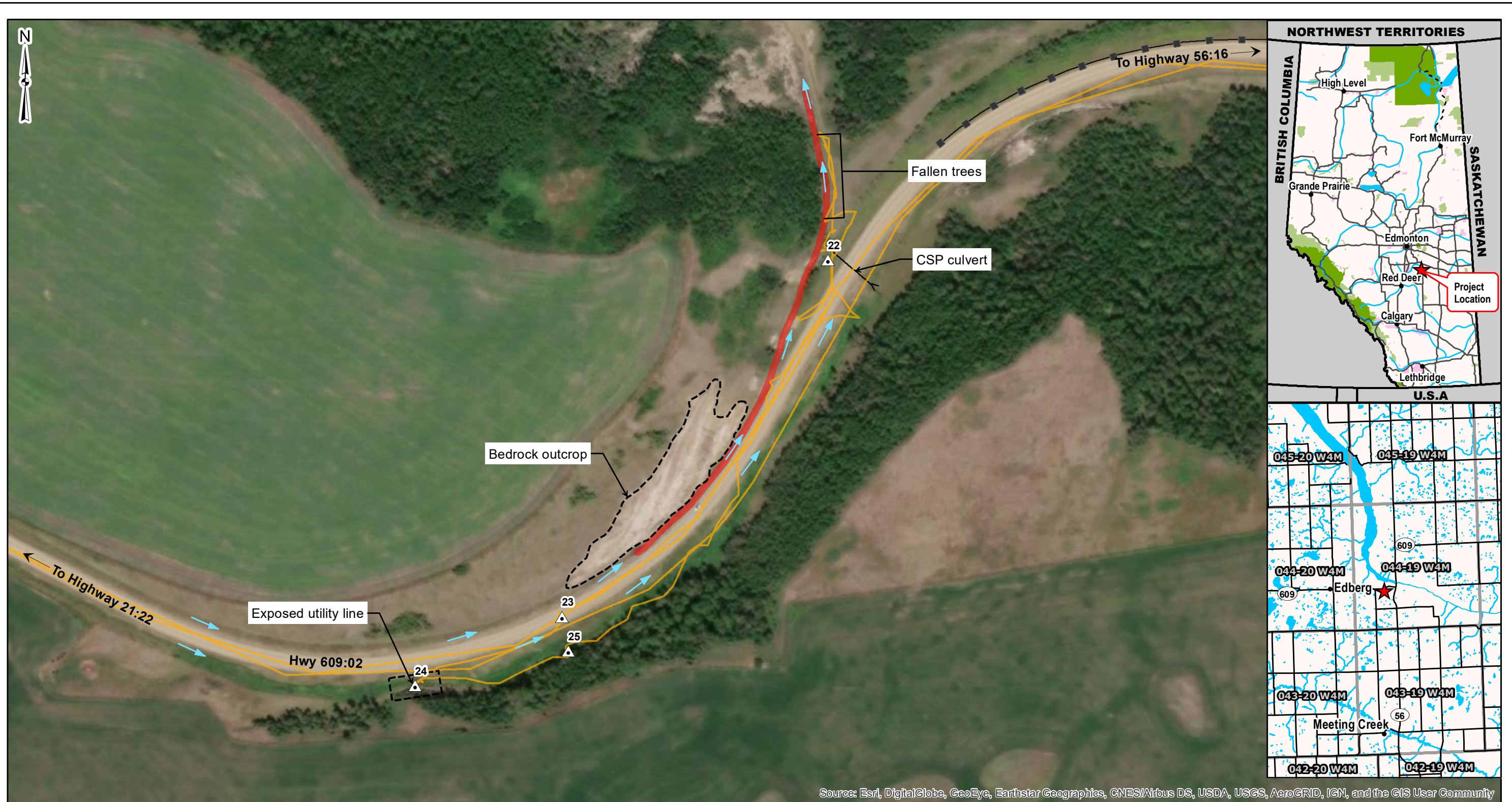
Alberta Geological Survey (AGS). 2013b. Map 600. Bedrock Geology of Alberta. Published June 17, 2013.

Alberta Transportation (AT). 2019. Traffic Counts Reference No. 107370 and No. 110370. Retrieved on June 27, 2020 from: <http://www.transportation.alberta.ca/mapping/>

## FIGURES

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Time: 11:40:53 AM  
 Date: July 02, 2020  
 File: Z:\A\EDM\A05115\A02 ABT Central Region GRM\PI\00 Drawings\2020\4. Section DIMXD\H609\_Inspection\_200629.mxd



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

**Legend**

- GPS Waypoint (June 24, 2020)
- GPS Track (June 24, 2020)
- Guardrail
- Culvert
- Erosion
- Flow Direction



NOTES:  
 1. HORIZONTAL DATUM: NAD83  
 2. GRID ZONE: UTM Zone 12N  
 3. IMAGE SOURCE: World Imagery, ESRI ArcGIS Online  
 4. The locations of features were estimated from site observations and were not surveyed.

CLIENT

PROJECT	CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM	
TITLE	Site Plan Unnumbered Site - South of Driedmeat Lake Erosion Hwy 609:02, km 16.42	
SCALE	PROJECT No.	FIG No.
1:2,500	A05115A02	1

# APPENDIX I

## Site Photographs

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## Appendix I Site Photographs

**Photo 1** Culvert outlet. The bottom of the culvert is corroded and water is leaking into the underlying material. Photo taken June 24, 2020 facing southwest.



**Photo 2** Culvert inlet. The bottom of the culvert is corroded and water is leaking into the underlying material. Photo taken June 24, 2020 facing north.



**Photo 3** Erosion at the culvert outlet. Water flowing from the culvert outlet is eroding a channel into the underlying bedrock (indicated by black ellipse). Photo taken June 24, 2020 facing south.



**Photo 4** Erosion upslope of the culvert outlet that is impacting the existing fence. Photo taken June 24, 2020 facing northeast.



**Photo 5** Erosion in the ditch upslope of the culvert outlet. Photo taken June 24, 2020 facing southwest.



**Photo 6** Erosion increasing in depth upslope of the culvert outlet. Photo taken June 24, 2020 facing southwest.





**Photo 7** Trees are falling into the erosion gully east/downslope of the culvert outlet. Photo taken June 24, 2020 facing north.



**Photo 8** Erosion upslope of the culvert outlet. The approximate location of the culvert outlet is indicated by the black arrow. Photo taken June 24, 2020 facing northeast.



**Photo 9** Mild erosion and sedimentation upslope of the erosion presented in Photo 8 and near the east extent of the bedrock outcrop. Photo taken June 24, 2020 facing northwest.



**Photo 10** The ditch is well vegetated upslope (northwest) of the bedrock outcrop (indicated by black ellipse). Photo taken June 24, 2020 facing southeast.



**Photo 11** Erosion gully downslope of where the trees are falling into the erosion gully. Where the erosion gully terminates is indicated by the black arrow. Photo taken June 24, 2020 facing northeast.



**Photo 12** Erosion on the south side of Hwy 609:02 has exposed an underground utility line (indicated by black ellipse). Photo taken June 24, 2020 facing west.



### Hwy 56:16 Photographs

**Photo 13** Mild erosion in the ditch on the west side of Hwy 56:16 (south of C054). Photo taken June 24, 2020 facing south.



**Photo 14** Mild in the ditch on the west side of Hwy 56:16 (south of C054). Photo taken June 24, 2020 facing north.



**Photo 15** Erosion gully inlet view from the ditch east of Hwy 56:16. Photo taken June 24, 2020 facing northeast.



**Photo 16** Outlet of the erosion gully on the east side of Hwy 56:16 (southeast of C054). Photo taken June 24, 2020 facing south.

