PEACE REGION
(GRANDE PRAIRIE DISTRICT – SOUTH) GRMP
SITE INSPECTION FORM

SITE NUMBER AND NAME: **GP036 Rockfall 2.0 km South of McIntyre Mine**	HIGHWAY & KM: 40:36, 12.061	PREVIOUS INSPECTION DATE: June 14, 2022	INSPECTION DATE: **June 12, 2023**
LEGAL DESCRIPTION: NW 04-58-08-W6M	NAD 83 COORDINATES: UTM 11 Northing 5984469 Easting 359856	RISK ASSESSMENT: PF: 16 CF: 5 TOTAL: 80	
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 780 (north) & 980 (south) (Reference No. 25592, 2022)		CONTRACT MAINTENANCE AREA (CMA): 504	

SUMMARY OF SITE INSTRUMENTATION:	INSPECTED BY:
There is no instrumentation at the GP036 site. LAST READING DATE: N/A	Chris Gräpel (KCB) Courtney Mulhall (KCB) Roger Skirrow (TEC) Max Shannon (TEC) Renato Macciotta (UofA)

PRIMARY SITE ISSUE: Rockfall hazards from rock slope along/above west side of Hwy 40:36. Talus deposits and rockfall particles from rock slope constrict west highway ditch and falling rocks are a traffic hazard. The site is located along the west valley slope of the Smoky River. In 2022, debris flow component of this site was separated into its own GRMP site (GP054) for the debris flow.

APPROXIMATE DIMENSIONS: Rock slope is approximately 250 m long and 20 m to 50 m high above pavement surface with an approximate cut angle ranging from 50° to 70°. Ditch ranges from 3 m to 10 m wide and 0.6 m to 1.0 m deep.

DATE OF ANY REMEDIAL ACTION: Around 2010 – Lock blocks placed adjacent to guardrail on west side of Hwy 40:36. Ongoing highway ditch cleaning and removal of rockfall particles from pavement surface.

ITEM	**CONDITION EXISTS**		**DESCRIPTION AND LOCATION**	**NOTICABLE CHANGE FROM LAST INSPECTION**	
	YES	NO		YES	NO
Pavement Distress		X	None observed at time of 2023 inspection.		X
Slope Movement	X		Previously fallen rockfall particles (up to 1.5 m x 1.0 m x 0.8 m) and talus materials between toe of slope and lock blocks. Relaxations of joints on rock slope appeared to be increasing.	X	
Erosion	X		Differential weathering, freeze thaw, ice jacking, and seepage eroding rock mass. Some erosion along crest of slope.	X	
Seepage	X		Seepage observed flowing from rock slope.		X
Culvert Distress	X		Culvert inlet on west side of highway partially blocked with rock fall particles. Some rockfall particles removed by KCB during 2023 inspection by hand.	X	

COMMENTS
Site is partially downslope/east of a mine area.
In 1998, gradeline improvements were made along this section of highway which resulted in some of the original rock slopes being excavated further with drill-and-blast methods while other sections were not.
Brow of rock slope is treed with a relatively thin layer of soil.
Bedrock structure consists of non-planar bedrock planes with some evidence of limited folding and faulting dipping generally to the south or southwest (dip estimated between 60° to 70°). The bedrock bedding planes have been distorted during mountain building and are not planar. The degree of non-planar distortion in bedding planes varies across the rock slope, dipping from 32° to 64° to near vertical at the top of the slope. The bedding layers in the bedrock vary in thickness from quite thin (tens of centimeters) to several meters thick. Some of the bedding layers in the bedrock mass are coal seams which appear to have been disrupted by faulting.
Rock mass consists of beaded and sheared sedimentary rocks, with coal seams which are weathering faster. Faster weathering of the coal results in the undermining of more competent rocks, which results in overhanging blocks and particles with little support that eventually fall, and the deposition of talus cones/slopes at the toe of the coal seams with occasional adjacent lateral rock block piles/cones. Cubical shaped rockfall particles appear to be rolling and bouncing down the talus cones bringing them closer to the highway (i.e., the talus cones act like chutes for rockfall particles). Whereas flat platy shaped rockfall particles appear to get hung up in the talus.
Several hanging rock blocks with some close to falling, including one potentially large rock block. A bedrock discontinuity “plane” (distorted and non-planar) appears to underlie the large rock block. Along the north side of the large rock block is a layer of fractured rock and a coal seam which is weathering faster than the rest of the slope. The discontinuity between the undulating discontinuity and the large rock block appears to be dilated. Continued weathering of the coal seam could result in loss of confinement, resulting in overstressing the remainder of the attachments for the large rock block to the slope, causing a large rockfall event that would likely cover the section of highway below.
Mid-slope ledges and talus cones/slope could potentially bounce/launch/roll rockfall particles out onto highway.
TEC says that some rock particles make it to the highway, and some are large enough to require a front-end loader to remove.
Possible fault structure located between rock slopes that is infilled with soil.
Decommissioned coal mine shaft entrance approximately midway up rock slope.
Ponded water is sometimes observed in the highway ditch at the toe of the rock slope, which could be due to seepage and/or poor ditch drainage. During the 2023 inspection, the ditch channel was wet and some seepage was observed from the rock slope.
A TransCanada Pipelines Ltd. high-pressure natural-gas pipeline is located below the west highway ditch.
Segment of guardrail deflected and pushed towards south/westbound traffic from rockfall strike.
“Watch for fallen rock” signs on either side of site, located on the east shoulder before the site for northbound traffic and on the west shoulder before the site for southbound traffic. Also, no parking sign on the east side of the highway at the northern site limit (end of guardrail) for northbound traffic.
Swallows have been observed at the site. Construction would need to be outside nesting period.

Maintenance/Repair/Monitoring Recommendations:

- Short-term
  - Clean highway ditch regularly to maintain rockfall storage volume (i.e., keep ditch as wide and deep as possible to retain material within the ditch) and reduce the potential for material reaching the highway. A buried gas line and fiber optics cable along the ditch limits the depth the ditch can be excavated or cleaned out. Estimated cost: approximately $25,000 to $40,000.
  - Some of the concrete lock blocks are deteriorating and have been damaged by rock strikes. They will eventually need to be replaced.
  - Inlet of culvert which is blocked with rockfall particles should also be cleaned to maintain ditch flow.
- Long-term:
  - The rockfall hazards should be further studied to assess the effectiveness of rock slope stabilization mitigations such as bolting, trim blasting, shotcrete, and attenuation mesh, which should be completed with scaling. This work is underway, and a site investigation was completed by KCB in May 2023 to support design work. Estimated cost: approximately $700,000 to $850,000 for 70% mesh and approximately $100,000 to $200,000 for scaling.
  - The environmental aspects of the proposed rock slope scaling and stabilization mitigation will need to be assessed.

This report is an instrument of service of Klohn Crippen Berger (KCB). The report has been prepared for the exclusive use of Alberta Transportation and Economic Corridors (Client) for the specific application to the Peace Region (Grande Prairie District – South) Geohazard Risk Management Program (Contract No. CON0022166) and it may not be relied upon by any other party without KCB's written consent.

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PROFESSIONAL ENGINEER ALBERTA
COURTNEY E. MULHALL
2023 Oct. 14
APEGA ID#: 153449

Courtney Mulhall, M.Sc., P.Eng.
Geotechnical Engineer

PERMIT TO PRACTICE
KLOHN CRIPPEN BERGER LTD.
RM SIGNATURE: Pamela Jones
RM APEGA ID #: 187607
DATE: 14 Oct. 2023
PERMIT NUMBER: P009196
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Inspection Photographs

Photo 1 **Rock slope along west side of Hwy 40:36 near southern site limit. Note soil infilling of possible fault feature and GP054 km 12.1 debris flow site on right/east. Photo taken June 12, 2023, facing northwest.**

Photo 2 **Rock slope along west side of Hwy 40:36. Note GP054 km 12.1 debris flow site on left/west. Photo taken June 12, 2023, facing northwest.**

Photo 3 **Rock slope along west side of Hwy 40:36. Note talus material mainly from coal seams and rockfall particles in highway ditch and potential rock block on upper slope (circled in white, see photo below). Photo taken June 12, 2023, facing northwest.**

Photo 4 **Potential rock block on upper slope shown in previous photo. Note dilated or open joints below rock block (indicated with white arrow), joints or shear planes to left and below rock block (circled in white), and rock and coal to right of rock block which is eroding. Photo taken June 12, 2023, facing northwest.**

Photo 5 **Rockfall particles in west ditch of Hwy 40:36. Note yellow sign indicating location of high-pressure natural-gas pipeline. Photo taken June 12, 2023, facing northwest.**

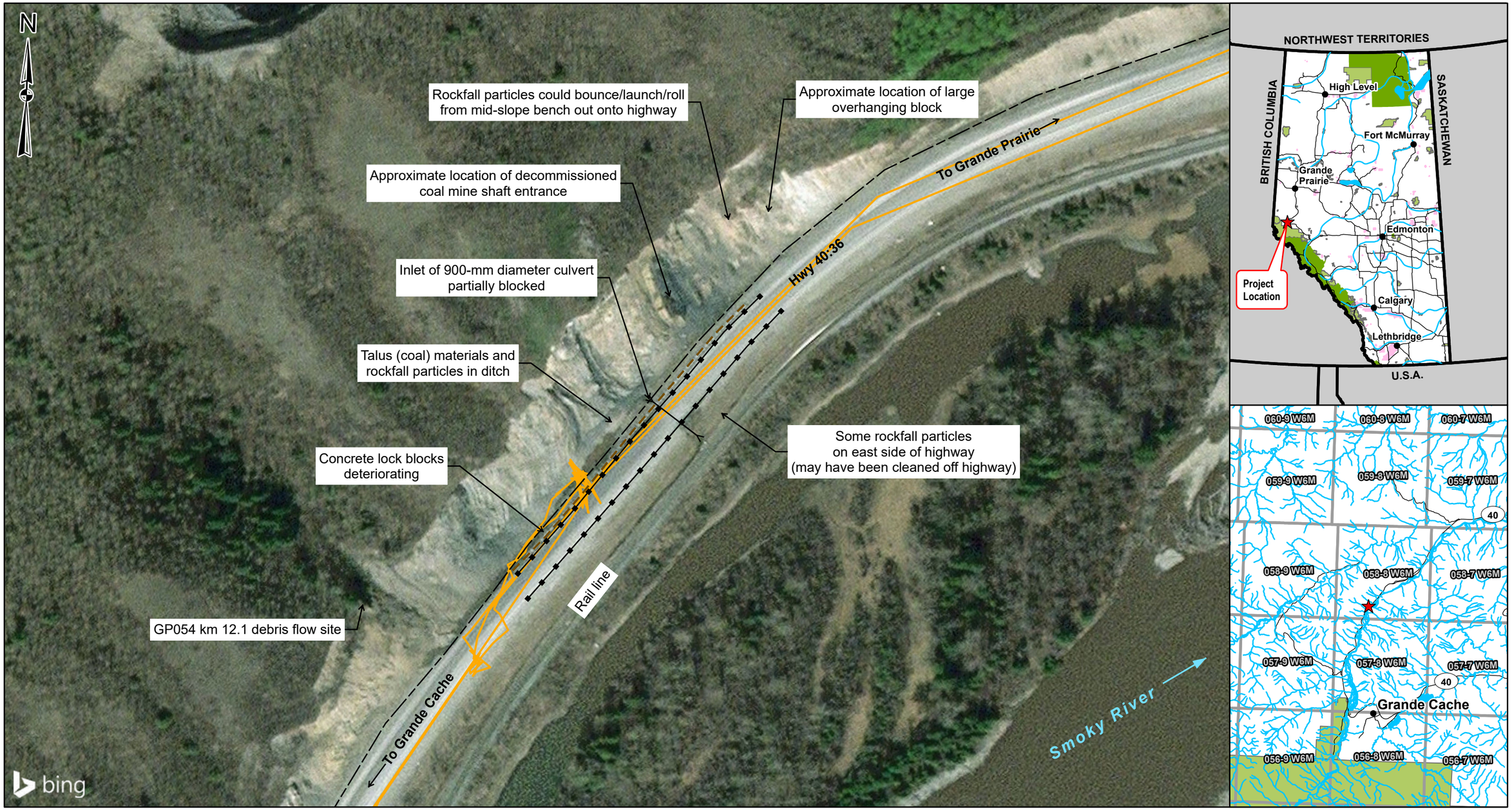
Photo 6 **Rock slope along west side of Hwy 40:36. Note near-vertical bedding orientation of bedrock. Photo taken June 12, 2023, facing northwest.**

Photo 7 **Rock slope along west side of Hwy 40:36. Note talus material mainly from coal seams and rockfall particles in highway ditch. Photo taken June 12, 2023, facing southwest.**

Photo 8 **Rock slope along west side of Hwy 40:36 near northern site limit. Note hanging rock block (circled in white). Photo taken June 12, 2023, facing northwest.**

Photo 9 **Culvert inlet in west ditch of Hwy 40:36 partially blocked with rockfall particles. Some rockfall particles removed from culvert inlet by KCB by hand during 2023 inspection. Photo taken June 12, 2023, facing southeast.**

Photo 10 **Segment of guardrail deflected and pushed towards southbound traffic from rockfall strike. Note lock blocks are deteriorating. Photo taken June 12, 2023, facing southwest.**



Legend

- GPS Track (June 12, 2023)
- Flow Direction
- Concrete Lock Block
- Guardrail
- Culvert
- Pipeline

0 50 Metres

NOTES:
1. HORIZONTAL DATUM: NAD83
2. GRID ZONE: UTM ZONE 11N
3. IMAGE SOURCE: 2022 MICROSOFT CORPORATION, 2022 MAXAR CNES, DISTRIBUTION AIRBUS DS

CLIENT: Alberta

Klohn Crippen Berger

PROJECT: PEACE REGION (GRANDE PRAIRIE DISTRICT-SOUTH) GEOHAZARD RISK MANAGEMENT PROGRAM

TITLE: Site Plan
GP036 - Rockfall 2.0 km South of McIntyre Mine
Hwy 40:36, km 12.061

SCALE	PROJECT No.	FIG No.
1:1,500	A05116A01	1

File: \\int.klohn.com\Proj\Data\AEDM\A05116A01 ABT Grande Prairie South GRMP#400 Drawings\GIS\MXD\2023\Section B\ABT_GPSouth_SectionB_230619ABT_GPSouth_SectionB_230619.aprx Date: Time: Creator: : aharrison