

SITE NUMBER AND NAME: GP056 Debris Flow near McIntyre Mine	HIGHWAY & KM: 40:36, 13.700	PREVIOUS INSPECTION DATE: June 10, 2024	INSPECTION DATE: June 02, 2025
LEGAL DESCRIPTION: NE 09-58-08-W6M	NAD 83 COORDINATES: UTM Northing Easting 11 5985608 361022	RISK ASSESSMENT: PF: 8 CF: 5 TOTAL: 40	
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 760 (north) & 960 (south) (Reference No. 25592, 2024)		CONTRACT MAINTENANCE AREA (CMA): 504	

SUMMARY OF SITE INSTRUMENTATION: There is no instrumentation at this site. LAST READING DATE: N/A	INSPECTED BY: Chris Gräpel (KCB) Courtney Mulhall (KCB) Babatunde Awokunle (TEC) Rocky Wang (TEC)
PRIMARY SITE ISSUE: Debris flows originating from former McIntyre Mine (now CST Canada Coal Ltd.), located upslope/west of highway, reach west highway ditch and sometimes cross highway. Large debris flow event that occurred in June 2023 crossed highway eroding several gullies on east side of highway. Site located on west valley slope of the Smoky River valley, approximately 50 m upslope of a rail line and 70 m upslope of the Smoky River, and adjacent to the GP057 rockfall site.	
APPROXIMATE DIMENSIONS: Debris flow on west side of highway approximately 110 m long. Erosion gullies on east side of highway approximately 35 m long.	
DATE OF ANY REMEDIAL ACTION: Clean-up of debris flow material as needed.	

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		Subgrade exposed and pavement partially undermined on west south side of highway due to erosion.		X
Slope Movement		X	None observed at time of 2025 inspection.		X
Erosion	X		Debris flow material/fan along west side of highway (approximately 110 m long). Erosion gullies on east side of highway (approximately 35 m long, 2 m to 3 m wide, and up to 0.5 m deep), which appeared more rounded compared to 2024 inspection.	X	
Seepage	X		Seepage from toe of mine-waste dump flows into west highway ditch.		X
Culvert Distress		X	Crown of culvert inlet at north end of site dented.		X

COMMENTS Area upslope of the site includes mine-waste dumps and mine (haul and access) roads developed on the mountain side. Mine-waste dumps and mine roads appear to be composed of varying mixtures of fine grained and coarse-grained materials, including some boulders. We understand from previous discussions with TEC that a rockfall fence was previously installed at the adjacent unnumbered rockfall site in 2011 or 2012 to protect the public using the highway from fly rock during blasting and rockfall from waste-dump construction. A high-pressure natural-gas pipeline is located below the west highway ditch. TEC has indicated that pipeline is shallow and that any excavation of debris flow material from ditch must be undertaken with a pipeline representative present. Debris flow material source appears to consist of erodible soils (mainly mine-road and mine-waste-dump materials) with little to no vegetation soil cover, and erosion is likely to occur during most precipitation events.
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SITE INSPECTION FORM

Debris fan mainly consisted of coarse-grained material, including some cobbles and a few boulders, in a matrix of fine-grained material.

Volume of eroded material and surface water overflow is influenced by operations within the mine and increased erosion and more frequent debris flows of a higher severity may be occurring than in a natural state (i.e., before mine). Unless revisions to mine surface water drainage are undertaken, erosion and subsequent debris flow/deposition of materials in and across the highway right of way is likely to occur again under similar heavy precipitation events.

KCB reviewed available precipitation data recorded at Kakwa weather station (located approximately 30 km northeast of site) from 1967 to 2025. Record discontinuous before 1990, but average daily precipitation data from 1990 to 2025 is shown on Figure 2. Based on data from Kakwa weather station higher-than-average rainfall events were recorded on June 9, 2017 (approximately 80 mm), June 28, 2019 (approximately 70 mm), July 1, 2020 (approximately 70 mm), June 29, 2022 (approximately 70 mm), June 19, 2023 (approximately 110 mm), and June 27, 2024 (approximately 60 mm). Based on available data intensity and frequency of heavy precipitation events appears to be increasing in recent years.

During the large precipitation event in June 2023, material (mainly mine-road and mine-waste-dump material) was eroded and transported downslope through an existing erosion gully onto the highway and railway tracks and into the Smoky River. Based on the available aerial imagery and UAV photos:

- two smaller erosion gullies, one on the side of a mine road bench and another between the north flank of the mine-waste dump and natural ground, appeared to have connected and eroded further downslope below the rockfall fence and through the mine road at the toe of the mine-waste dump prior to our May 2023 fieldwork at the adjacent GP057 rock slope site and our June 2023 inspection of this site; and
- erosion gullies observed on the east side of the highway during our June 2023 inspection of this site were not visible during our May 2023 fieldwork at the GP057 site.

These observations indicate erosion at the site is active, and increased erosion and more frequent debris flows of a higher severity may be occurring. No debris flows since this event in June 2023 have been reported to KCB.

Between the June 2023 Section D call-out inspection and the June 2024 Section B inspection,

- Debris flow material in the west highway ditch has been removed and graded back to the tree line (backslope up to approximately 4 m high, Photos 2 and 3) improving storage capacity in the highway ditch and removing load/weight from the high-pressure natural-gas line. It appears the majority of the flow material overtop of the high-pressure natural-gas line has been removed. It does not appear any debris flow material has been removed upslope of the ditch within the treed area (approximate distance of 60 m).
- Erosion channel under the rockfall fence and part of the erosion channel between the mine-waste dump and the natural slope has been backfilled with waste rock.
- Area of ponded water at the northeast corner of the mine-waste dump has also been backfilled with waste rock.
- KCB spoke with mine personnel in September 2023 and September 2024. Based on these conversations, it is our understanding that the mine:
 - has taken efforts to divert drainage and reduce erosion on their site, which should reduce the reoccurrence of debris flow reaching the highway; and
 - is frequently monitoring mine-waste dump for instability and they have no concerns about mine-waste dump stability.

Seepage from the toe of the mine-waste dump flows through the treed area down the backslope into the west highway ditch. Some of the water ponds in the ditch and the remainder flows to the culvert at the north end of the site across the highway (Photos 1 through 4). The seepage may be from a possible drain below the mine-waste dump.

Maintenance/Repair/Monitoring Recommendations:

- Short-term:
 - Debris flows crossing the highway have eroded channels on the east side of the highway, partially exposing the highway subgrade, partially undermining the pavement, and leaving some w-beam guardrail posts unsupported along the east highway shoulder (Photos 5 and 6). The erosion gullies on the east side of the highway should be backfilled to provide support to the highway pavement, subgrade, and guardrail posts where exposed. The estimated cost for the HMC to complete this work is between \$20,000 and \$40,000.
 - Debris flow reporting could be improved by maintaining a record of debris flows that reach the highway, including the date of event, approximate location, volume of particles, and maximum particle size. It appears that TEC may already be doing this, but a formal record could be prepared by the HMC or MCI based on e-mails to TEC and the regional geotechnical consultant.
 - Install signage to warn motorists of debris flow risk.
- Long-term:
 - As discussed above, the intensity and frequency of heavy precipitation events appears to be increasing in recent years. A study should be completed to assess the potential impacts of increased precipitation on debris flow, not only originating at the mine site but along the subject section of Hwy 40:36, including the GP054 and GP056 sites.
 - If efforts taken by the mine to divert drainage and reduce erosion on their site does not mitigate the occurrence of debris flows that impact the highway, and therefore the safety of motorists, TEC should conduct a debris flow risk assessment to verify the cause of the debris flows, assess the risk of future debris flows, and assess how the public could be protected (e.g., debris flow barrier, increased debris flow storage capacity, and/or improved drainage measures, including how much maintenance and removal of material is needed).

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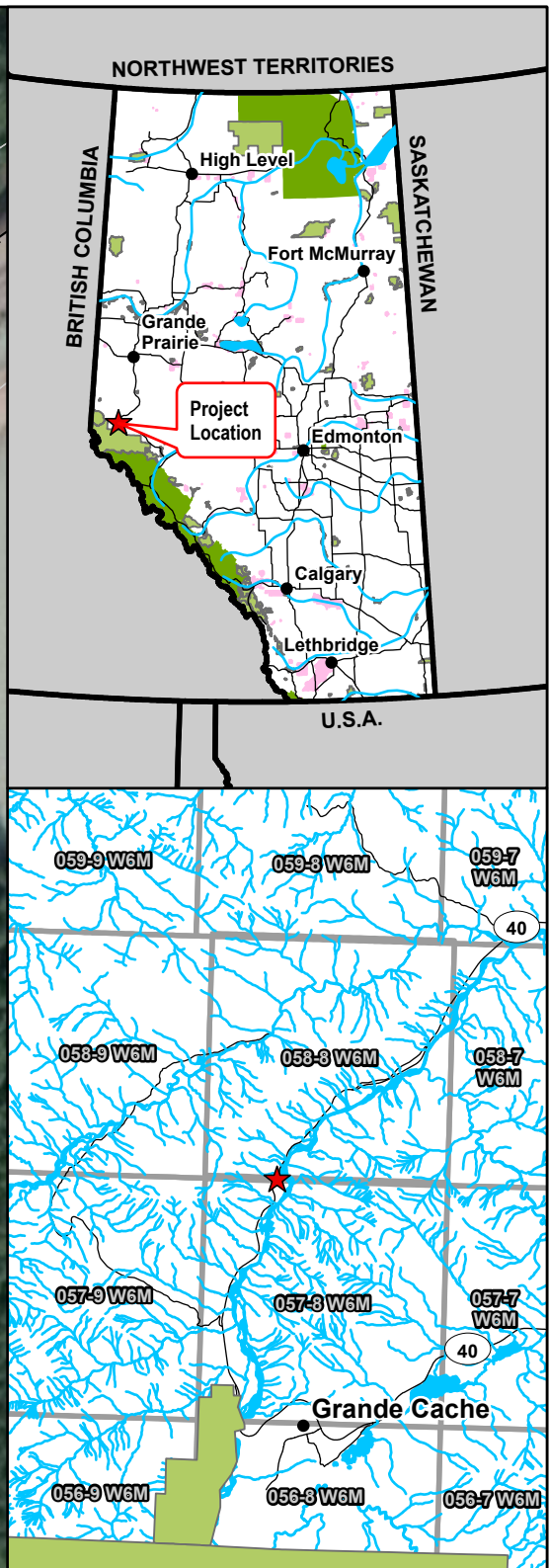
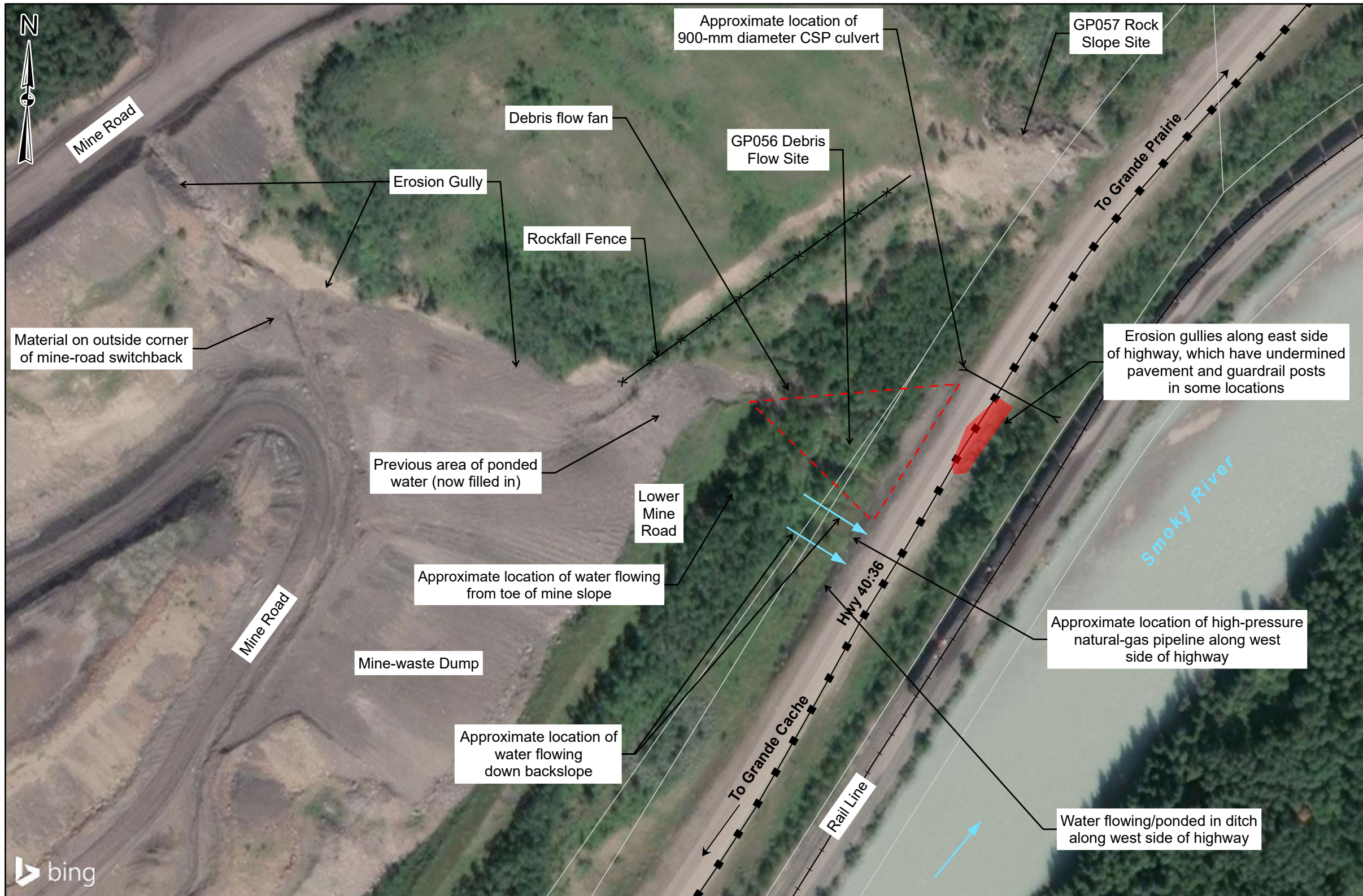
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2. The observations, findings and conclusions in this report are based on observed factual data and conditions that existed at the time of the work and should not be relied upon to precisely represent conditions at any other time.
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Courtney Mulhall, M.Sc., P.Eng.
Geotechnical Engineer

File: Z:\A\EDMA05116A01\ABT Grande Prairie South GRMP\400 Drawings\GIS\MXD\2025\Section BIG\SS\AT_GPSouth_SectionB_GP056_250703.aprx Date: Time: Creator: HManandyan



Legend

- | | |
|----------------|-----------------|
| Flow Direction | Guardrail |
| Rail Line | Right-of-way |
| Rockfall Fence | Debris Flow Fan |
| Culvert | Erosion |

NOTES:
1. HORIZONTAL DATUM: NAD83
2. GRID ZONE: UTM ZONE 11N
3. IMAGE SOURCE: 2025 MICROSOFT CORPORATION,
2025 MAXAR CNES, DISTRIBUTION AIRBUS DS

CLIENT

Alberta

Klohn Crippen Berger

PROJECT

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

TITLE

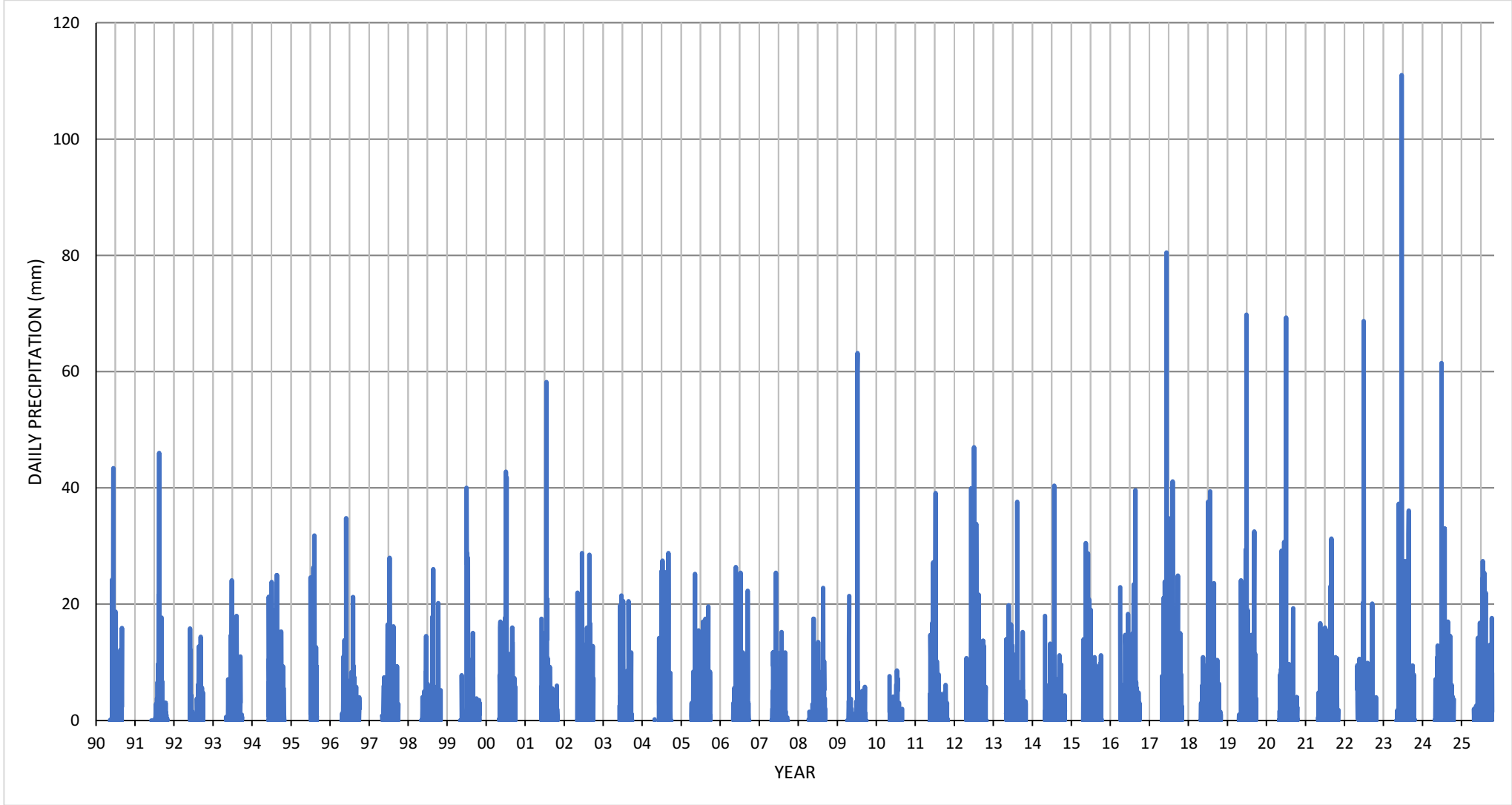
Site Plan
GP056 - Debris Flow Near McIntyre Mine
Hwy 40:36, km 13.7

SCALE
1:1,700




PROJECT No.
A05116A01

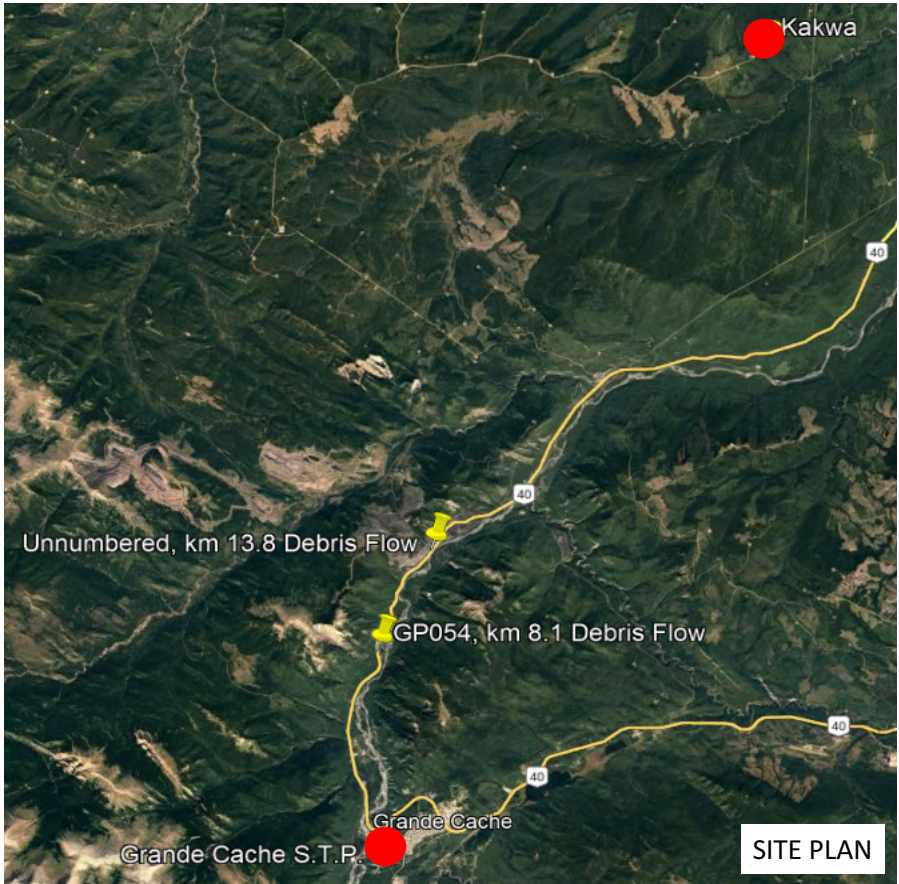
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LEGEND:

-  WEATHER STATION
-  DEBRIS FLOW SITE
-  WEATHER STATION DATA - KAKWA



- NOTES:
- 1) DATA DOWNLOADED FROM GOVERNMENT OF CANADA (GoC) OR ALBERTA CLIMATE INFORMATION SERVICE (ACIS) WEBSITES.
 - 2) KAKWA STATION LOCATED APPROXIMATELY 30 KM FROM SITE.
 - 3) DATA DISCONTINUOUS BEFORE 1990 SO NOT INCLUDED. NO DATA RECORDED DURING WINTER MONTHS
 - 5) SITE PLAN VIEW SOURCE FROM GOOGLE EARTH PRO.

CLIENT		PROJECT	
 		PEACE REGION (GRANDE PRAIRIE DISTRICT - SOUTH)	
		GEOHAZARD RISK MANAGEMENT PROGRAM	
		TITLE	
		DAILY PRECIPITATION DATA	
		GP056 DEBRIS FLOW SITE	
		HWY 40:36	
SCALE	-	PROJECT No.	FIG No
		A05116A01	2

Inspection Photographs

Photo 1 Water flowing down backslope and in ditch on west side of Hwy 40:36. Note some ponding in highway ditch. Photo taken June 2, 2025, facing southwest.



Photo 2 Debris flow material on west side of Hwy 40:36 (circled in white). Photo taken June 2, 2025, facing north.

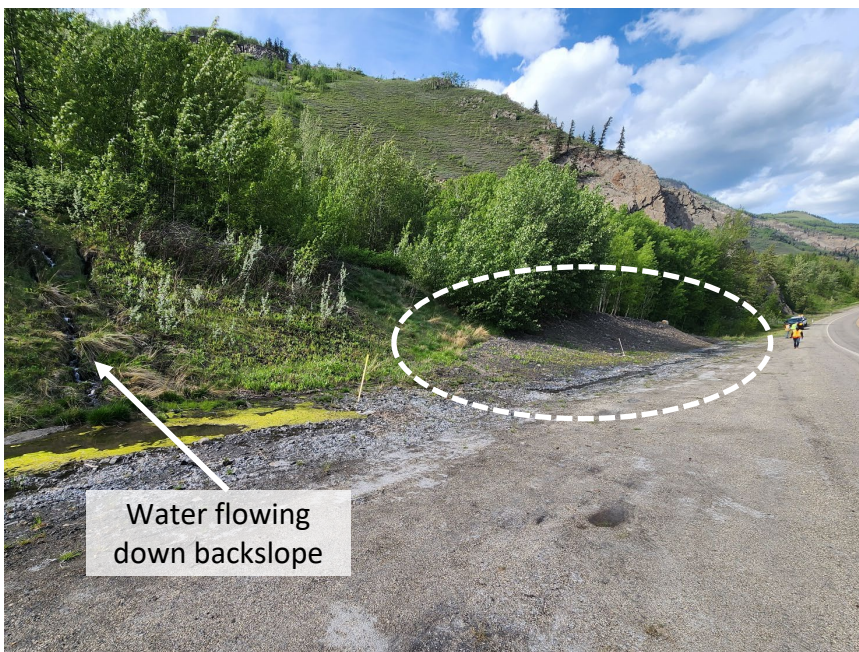


Photo 3 Debris flow material on west side of Hwy 40:36. Note flowing water in highway ditch. Photo taken June 2, 2025, facing southwest.



Photo 4 Inlet of culvert that conveys flow from west side to east side of Hwy 40:36. Photo taken June 2, 2025, facing south.



Photo 5 **Erosion gullies along east side of Hwy 40:36. Photo taken June 2, 2025, facing southwest.**



Photo 6 **Subgrade exposed and edge of pavement partially undermined on east side of Hwy 40:36. Some guardrail posts also unsupported. Photo taken June 2, 2025, facing southwest.**

