BRIEF FILE REVIEW
(LANDSLIDE RISK ASSESSMENT)

1)	**Site (GP6b)**	Hwy 40:36 Sheep Creek (Railway Track) Embankment Slide
2)	**Reference Location along Highway:**	Hwy 40:36 N. of McIntyre Mine and 3 km S. of Sheep Creek
3)	**Legal Description:**	NE Section 31, Twp 58, Rge 7, W6M
4)	**UTM Coordinate:**	Northing 5995177.079 Easting -263259.520
5)	**AI File:**	Hwy 40:36

6) **Alberta Infrastructure Plan and Profile (attached)**
- Site location plan (aerial photo)
- Site sketch of affected area (EBA September 1998 Slide Tour Report)
- AI highway mosaic (approximate Station 26+000)

7) **General Description of Instability**

Settlement (100mm approximately) and cracking of pavement was noted in July 1997. The affected stretch of pavement was approximately 105 m in length and totaled approximately 170 m when the longitudinal cracks along the guardrail are included. Cracking transgressed to cross the centreline to the backslope ditch. Part of the backslope cut was in shale and part of cut in granular, bouldery, overburden material. The embankment slide was assessed to be of shallow nature and was mainly caused by high groundwater table and blockage of seepage exit paths by the highway (2H:1V) fill at the toe of this mountain slope. CN railway line runs along the toe of the highway fill embankment and an overhead power line runs between the highway and railway line.

Patching of the settled pavement has been undertaken as a maintenance measure since 1997. Prior to the 1995 pavement construction of this highway, the highway was operated as a gravel road and it was possible that any movement that was occurring might have been re-leveled by the grader as a maintenance operation.

High piezometer pressure was monitored as equivalent to groundwater level at 1 m below road surface and close to backslope ditch elevation. Obvious shear movement zones were not apparent from most slope indicator readings. Shear movement was assessed at 10 m depth based on one SI (SI-1) sheared off after 2 years of monitoring; the possibility of sudden movement in response to abnormal groundwater fluctuation can exist in this mountainous and high rainfall environment. Raffling, striation and slight bulging of slope including small piles of piping fines can be observed along the sideslope. It is obvious that high seepage exit gradient caused piping loss of material and shallow runoff failures occurred along the sideslope. Several "tear drop" strip failures, indicative of seepage, high groundwater pressure and piping out of material, occurred down the dip of the slope at 3 to 4 locations. It is believed that the composition of this sidehill fill can be granular bouldery nature but with high fines and clay content. Normally the granular material can be more resistant to movement strains caused by loss of material due to seepage forces as other types of fill material would have incurred more drastic slope deformations. The main cause of slope movement was assessed to be high groundwater due to seepage exit which is blocked by the steep highway fill embankment of soil type possibly of high clay/fine content.

Horizontal drain installations was proposed in 1998 as the remediation measures to alleviate the adverse groundwater effect on the fill.

8) **Date of Initial Observation**
- May 1997 (1997 Slide Tour)

9) **Date of Last Inspection**
- June 1999 (1999 Slide Tour)

10) **Instrument Installed**
Slope Indicators (4 pieces)
- SI #1, 2, 3 and 4

Piezometers (4 pieces)

11) **Instrument Operational**
Slope Indicators (4 pieces)
- SI #1, 2, 3 and 4

Piezometers (4 pieces)

12) **Risk Assessment**
PF (8) * CF (4) = 32

PF = 8
- High groundwater and seepage flow as the main contributing cause of movement of a sidehill fill embankment which blocks drainage at the toe of a high mountain slope.
- Slow rate of movement and indeterminate movement pattern; shallow to medium seated movement depth can be postulated at the fill/native interface as deep shear movement was not observed from slope indicators up to October 1999. However, recent indicator data (SI-1) revealed in October 2000 that shear movement at 10 m depth along the shoulder line can be occurring (probably at fill/native gravel interface).
- Increase in rate of movement can be occurring as noted by the recent (October 2000) shearing off SI-1 along shoulder. The recommended horizontal drains should be constructed ASAP to improve the site performance.
- Granular backfill of existing embankment (from native overburden through possibly clayey with fines) can be more resistant to movements if horizontal drain measures are implemented to lessen the porewater and seepage conditions prevalent.

CF = 4
- Sliding failure will result road closure and will require reconstruction of embankment.
- Can affect railway adjacent to roadway.
- A detour route is not apparently available for this stretch of Hwy 40:36.

Note:
This Risk Assessment rating is based on the Scheme proposed by AI in the Request for Proposal (2000).

Probability Factor (PF) :	1 to 20 scale
Consequence Factor (CF) :	1 to 10 scale

13) **Geotechnical Conditions**
- This site is a sidehill fill embankment located along the lower slope the floodplain of the Smoky River. The Smoky River valley is located on steeply sloping and mountainous topography at the foothills and eastern flank of the Rocky Mountains. The surficial (overburden) deposits in the general area include glacial till, gravel, and in places weathered sandstone. The glacial till can comprise of sandy clay and the stoney. At close to river area, glacial outwash material of silt/sand and gravel can be located. Part of the surficial deposits can be of colluvial origin.
- The bedrock generally consists of Cretaceous bedrock of Brazeau Formation of sandstone; shale; conglomerate; minor coal and ash beds.
- The bedrock stratigraphy could be affected by faulting and folding due to past tectonic activities in the Rocky Mountain area.
- Groundwater flow can be along material interface between soil overburden and/or along permeable bedrock zones towards the Smoky River along the river valley.

14) **Chronology**

Historical setting: past site problem (including construction problem)

- Grading and gravel road fill construction completed in mid 1980's along the sidehill at the toe of a mountain slope
- Pavement construction completed around 1995
- Cracking and settlement of pavement noted in 1997 (movements might have been occurring at the gravel road stage prior to 1995)
- Slope indicators and piezometers installed in 1997

Mitigative measures recommended (1998) and remains to be implemented

Horizontal drain design proposed in July 1998.

15) **Action**

- Install horizontal drains ASAP (as recommended by EBA July 30, 1998)
- The site can be deteriorating as can be noted after 2.5 years of monitoring with the shear movement (SI-10) at 10 m depth along shoulder. It is advised that the horizontal drain should not be postponed any further.
- Continue visual and instrumentation monitoring
- Maintain highway serviceability by patching as required.
- Additional instrumentation should be considered to further define the movement zones.

END