LANDSLIDE RISK ASSESSMENT
SOUTHERN REGION

SITE S7: EMBANKMENT FAILURE WEST OF MILLARVILLE

LEGAL LOCATION:	LSD 4-3-21-4 W5M and 1-4-21-4 W5M
REFERENCE LOCATION ALONG HIGHWAY	The slide area is located between Sta. 3+750 and 3+820 on SH 549, approximately 1.5 km west of the junction with SH 762
UTM COORDINATES:	5624700 N 677400 E (NAD27) NTS Map Sheet 82 J/9 (Turner Valley)
AI FILE:	SH549:02
AI PLAN & PROFILE:	Sta. 3+800 (Metric)/Sta. 75+50 (Imperial)
Date of Initial Observation:	Spring 1987
Date of Last Inspection:	July 2003 Instruments read May 2003
Instruments Installed:	March 2001 – 2 slope inclinometers, 2 pneumatic piezometers, 4 standpipes
Instruments Operational:	2 pneumatic piezometers 2 standpipes
Risk Assessment:	PF(13) * CF(5) = **65** (increased from 11*5 = 55 in June 2002)
Last updated by:	AMEC Earth & Environmental Limited, August 2003

Comments:

Location

The slide area is located between Sta. 3+750 and 3+820 on SH 549, approximately 1.5 km west of the junction with SH 762. This site is approximately 12 km west of Millarville, AB.

General Description Of Instability

The road in the failure area is aligned east-west and located on a sidehill with the south side upslope. The embankment in the failure area is 5 to 6 m in height and is constructed at the cut-to-fill transition between a cut section immediately west of the failure area and lower areas to the east.

In the spring of 1987 a landslide occurred in the road embankment in this area. The slide consisted of a rotational earth slide encompassing the entire north slope of the embankment between approximately Sta. 3+780 and 3+820. The slide was characterized by downdropping of the upper half of the slope face and bulging outwards of fill in the lower half of the slope face. In addition, sinkholes and depressions in the fill material were noted above a culvert located at Sta. 3+816 and upslope of the outlets of a pair of horizontal drain pipes between approximately Sta. 3+755 and 3+780.

No cracking or other signs of distress were noted in the pavement adjacent to the slide.

After a geotechnical investigation by AI personnel, the failure was attributed to a combination of the following factors:

- Saturation of the embankment/elevated groundwater table within the embankment due to slope runoff from the south and discharge from the horizontal drains onto the embankment slope in the vicinity of Sta. 3+780.
- The presence of a weak organic layer on the natural slope face beneath the embankment fill.
- Poor weathering characteristics of the “sandy shale rock” fill used to construct the embankment.

Geological Setting/Geotechnical Conditions

A series of boreholes drilled by AMEC during the geotechnical investigation in March 2001 encountered clay fill in the road embankment, which was underlain by high plastic clay (likely glaciolacustrine), which was in turn underlain by high plastic clay till that extended beyond the completion depth of the boreholes. A 0.5 m thick layer of organic material was encountered at the base of the road fill in one of the boreholes.

Chronology

Table A1 provides the Chronological Background of the slide.

Past Investigations

AI personnel performed a site reconnaissance and excavated a series of test pits in the slide area in June, 1987. Test pit logs were not available in the AI files. No records of any other geotechnical investigations were found.

AMEC performed a geotechnical investigation in March 2001. The results of this investigation, including recommendations for further remedial measures, were submitted to AT during the summer of 2001.

Remedial Measures

A number of remedial measures were recommended by AI personnel in order to reconstruct the embankment with improved foundation and drainage conditions. These measures were as follows:

- Excavate the slide mass and any underlying weak organic material to expose a competent base.
- Bench the exposed base and place a 0.3 m thick gravel drainage blanket.
- Reconstruct the embankment using suitable material.
- Improve the surface drainage in the area adjacent to the north toe of the embankment so that water discharging from the drainage blanket and surface runoff is not able to accumulate adjacent to the toe of the embankment.
- Extend the outlets of the horizontal drain pipes between approximately Sta. 3+755 and 3+780 so that they would not discharge onto the north embankment slope.
- Install a subsurface drain beneath the upslope (south) ditch to intercept groundwater flow and prevent it from saturating the embankment.
- Repair culverts as necessary.

The remedial measures were implemented by AI personnel from August to November, 1988. It was reported that the job went well and there were no significant problems.

The road surface was repaved on several occasions between the fall of 2000 and the fall of 2001 in order to repair significant cracking and settlement of the road surface.

Monitoring Results

No records of any follow-up site inspections or other monitoring prior to the fall of 2000 were found.

The results of the ongoing monitoring by AMEC since the fall of 2000 are as follows:

- Active shear zones have been noted in both of the slope inclinometers installed during the March 2001 geotechnical investigation. The slope inclinometer in BH-

1, on the slope face below the road, measured approximately 100 mm of displacement between March and October 2001 along a shear zone approximately 5.7 m below ground surface. Additional movement at this depth sheared off the slope inclinometer in BH-1 between October 2001 and May 2002. The slope inclinometer in BH-2, in the westbound lane of the road, measured approximately 12 mm of movement between March and July 2001 along a shear plane approximately 3 m below ground surface before being paved over in late summer 2001.

- Tension cracking has been noted on the slope face below the road and to the east of BH-1.

- Significant cracking and settlement of the road surface has continued, with horizontal and vertical displacements of up to approximately 100 mm noted to have occurred between the September 2001 repaving and the last instrumentation readings on October 16, 2001.

Table A1
S7: Embankment Failure West Of Millarville - Chronological Background

YEAR	MONTH	DESCRIPTION
1986	Fall	Overlay construction in area.
1987	Spring	Slide first observed.
	June	Initial inspection by AI personnel on June 9th. Backhoe test pit investigation on June 23rd.
	August	Report on slide issued with recommended remedial measures.
1988	August to November	Remedial measures implemented.
2000	September	Site inspection by AMEC and AT personnel.
	October	Road repaved after continued settlement and cracking.
2001	March	Geotechnical site investigation by AMEC, including the installation of 2 slope inclinometers and 2 pneumatic piezometers.
	May	Site inspection by AMEC and AT personnel.
	Summer	Instrument readings taken by AMEC.
	August	Repaving after continued settlement and cracking of road surface. One slope inclinometer paved over.
	September	Repaving after continued settlement and cracking of road surface.
	October	Cracking/settlement area repaved on October 12th. Instruments read by AMEC.
2002	May	Instruments read by AMEC. Slope inclinometer in BH-1 sheared off at 5.7 m depth below ground surface. Piezometer 25152 appears to be blocked by debris/ice. Annual inspection by AMEC and AT personnel. New cracking noted near cattle pass culvert. Increased Probability Factor from 11 to 13.
	October	Piezometers in BH-1 read by AMEC. Road appears to have been repaved at least once since the site inspection in May.
	November	AT reports that this site has been repaved twice during 2002.
2003	May	Instruments read by AMEC.
	July	Annual inspection by AMEC and AT personnel. Site was seen to be recently repaved.