LANDSLIDE RISK ASSESSMENT
SOUTHERN REGION

SITE S1: JUMPINGPOUND CREEK LANDSLIDE

LEGAL LOCATION:	**LSD 10-31-24-04 W5M**
REFERENCE LOCATION ALONG HIGHWAY	**TBD**
UTM COORDINATES:	**N 5662650 E 672100** (NAD27) NTS Map Sheet 82 O/2 (Jumpingpound Creek)
AI FILE:	**H01:04**
AI PLAN & PROFILE:	
Date of Initial Observation:	December, 1986
Date of Last Inspection:	Instruments read September, 1999
Instruments Installed:	1987 - 3 Slope Inclinometers 1992 – 2 of the original 3 SIs replaced
Instruments Operational:	2 Slope Inclinometers
Risk Assessment:	PF(3) * CF(10) = **30**
Last updated by:	AGRA Earth & Environmental Limited, May 2000
Comments:	

Location

The site is located below the bridge of the westbound lanes of the TransCanada Highway over Jumpingpound Creek, approximately 20 km west of the Calgary City Limits.

General Description of Instability

The instability occurred in the east abutment slope of the westbound lanes directly below the bridge (see photos in Appendix F). The instability was relatively shallow and appeared to be due to a combination of weathering of the exposed shale bedrock and toe erosion. This resulted in oversteepening of the abutment slope. There was concern regarding the potential loss of support to the bridge deck.

The problem was reportedly repaired by placement of granular fill over the slope, combined with flattening. Details of the repair measures were not available.

Geologic Setting

Based on the borehole logs, the soil profile appears to consist of less than 2 m of fluvial sands and gravels underlain by primarily shale bedrock. The shale has been found to be generally low to medium plastic.

Chronological Background

Table A1 provides the Chronological Background of the slide.

Past Investigations

AI conducted a detailed investigation in 1987 and installed 3 slope inclinometers. Subsequent, less detailed, investigations were undertaken in 1992 prior to mitigative works, which included replacement of two of the SI's.

Golder Associates performed semi-annual instrument readings from at least 1997 to 1999.

AMEC has performed semi-annual instrument readings since the spring of 2000.

Mitigative Measures Taken

Slope flattened and covered with granular fill in about 1992. Details of the works were not available.

Monitoring Overview

Slope Indicators (SIs) 1A and 3A (both installed in 1992) have been monitored regularly since installation. SI 1A shows no significant movement. SI 3A shows significant movement in the B direction, however much of the indicated movement may be due to instrument drift during the initial readings and may not reflect actual conditions. The Spring 2001 readings in SI 3A showed an apparent movement zone in the upper 2 m, with an approximate downslope displacement of 10 mm. No additional movement was noted for this zone in the October 2001 readings. Approximately 8 mm of additional incremental movement was noted in this zone in the April 2002 readings, suggesting a pattern of annual movement in the spring.

The initial data sets for the slope inclinometer plots were switched to the May/June 2000 readings for the following reasons:

- Between 1992 and 1999, no significant movement was noted in either slope inclinometer.
- The spring 2000 readings showed apparent downslope movement in SI 1A when compared to the fall 1999 readings (obtained by the previous consultant using a different probe). This apparent movement was not consistent with the failure mechanism previously observed at this site.
- The fall 2000 and spring 2001 readings showed no further movement.
- It was therefore concluded that the apparent movement noted in spring 2000 was actually a result of comparing data obtained from different probes.

By switching the initial data sets, the slope inclinometer plots no longer show the apparent movement between the fall of 1999 and Spring 2000.

Table A1 –S1 – Jumpingpound Creek - Chronological Background

YEAR	MONTH	DESCRIPTION
1957		Original Bridge Constructed
1966		Second bridge build to carry east bound traffic – Highway twinned.
1984		Ditch erosion noted on east site of creek
1986	December	Geotechnical input requested due to landslide occurring below the bridge on the east abutment of the westbound (older) bridge.
1987	January	Initial Geotechnical Inspection of the site. Some potential solutions discussed.
	February	Three boreholes drilled and 3 slope indictors installed.
	May	Geotechnical report indicated problem is not deep seated instability, but is related to erosion. No movements in SI's. Remedial options proposed.
1991	September	Further Geotechnical inspections reveal continued oversteepening of east abutment slopes below both bridges. Crack noted in highway above steep abutment slope, but may be old. Need for restoration highlighted.
	Nov.	Another Geotechnical inspection – steep abutment slopes and crack in highway noted, but no changes since previous visits.
	Dec.	SI's read, but one missing and 1 damaged (blocked). Some movements noted in one remaining SI (#2). High water levels observed.
1992	January	Two SI's replaced.
	Summer??	East abutment slope below westbound lane repaired by covering/flattening slope with granular material. Rip-rap placed adjacent to creek.
1998	May	Instruments read by Golder Associates. 5 mm movement reported in SI 1A and 25 mm movement reported in SI 3A, with shear plane at 2.5 m depth.
	September	Instruments read by Golder Associates. No movement reported in SI 1A and 6 mm additional movement reported in SI 3A, with shear plane at 2.5 m depth.
1999	May	Instruments read by Golder Associates. No movement reported in SI 1A and 20 mm additional movement reported in SI 3A, with shear plane at 3 m depth.
	September	Instruments read by Golder Associates. No movement reported in SI 1A and 5 mm additional movement reported in SI 3A, with shear plane at 2.5 m depth.
2000	May/June	Instrumentation read by AMEC. Apparent movements were double checked and confirmed by a second set of readings in June. **Recommended adding this site to the Annual Inspection list.**
	September	Instrumentation read by AMEC. No movement since previous readings.
2001	May	Instrumentation read by AMEC. Movement at 2 m depth in SI 3A noted. Apparent movement noted in spring 2000 was attributed to comparing data obtained by different probes. Annual inspection by AMEC and AT personnel.
	October	Instrumentation read by AMEC. No significant movement since the May 2001 readings noted.
2002	April	Instrumentation read by AMEC. Approximately 8 mm of additional movement noted in the movement zone at approximately 2 m depth in SI 3A (vs. approximately 5 mm over the same time period last year).
	May	Annual inspection by AMEC and AT personnel. Probability Factor increased to 5 from 3.

	November	Instrumentation read by AMEC. The new instrument data does not confirm the approximately 8 mm of additional downslope movement noted in SI 3A in April, 2002.
2003	May	Instrumentation read by AMEC. The new instrument data continues to show the downslope movement at approximately 2 m depth in SI 3A, however the magnitude of the movement is unclear given the apparent reversal, then resumption of the movement as shown on the April 2002, November 2002 and May 2003 data.
	July	Annual inspection by AMEC and AT personnel. No changes to the Risk Level noted.

APPENDIX A
Risk Level Factors

Table A2 – Rock Fall Risk Level Factors

Probability Factor – Rock Falls
(For Each Rock Cut or Rock Slope)

Weight	Description
1	Inactive, very low probability of fall occurrence.
3	Inactive, low probability of fall occurrence.
5	Inactive, moderate probability of fall occurrence.
7	Inactive, high probability of fall occurrence (e.g. seasonal, following freeze/thaw cycles) and/or a fall has occurred in the historic past.
9	Active, falls occur after exceptional weather (e.g. the melting of greater than average snow accumulations or exceptionally intense precipitation), fall frequency is in the order of once a decade.
11	Active, one or two falls occur each year triggered by annually recurring weather conditions.
13	Active, several falls occur each year and/or the frequency of falls is increasing in comparison to equivalent time periods in previous years.
15	Active, many falls occur each year and/or the area producing rock falls is expanding. Ongoing or persistent rock falls during specific times of the year.
20	Active, a large volume of rock is surrounded by open cracks. Toppling or sliding of the displacing mass is accelerating. Sites where rapid movement of a large fall is possible.

Consequence Factor – Rock Falls
(For Each Rock Cut or Rock Slope)

Weight	Description
1	Rock fall contained by ditch if cleaned as required to maintain capacity.
2	Rock fall onto roadway removable by maintenance crews by hand or with shovels. Road closure not required. Minor damage to the road surface that can be repaired during annual patching and sealing of the road. Minor to no damage to vehicles being struck by falling rocks or striking rocks deposited onto road.
3	Rock fall onto road that could damage a vehicle (e.g. flat tire, dent body of vehicle). Rocks bounce or roll onto the road surface but likely not with a trajectory that would pass through the windows or windshield of a passing vehicle.
4	Individual rocks or the total volume of rocks deposited on the road large enough to: Damage vehicles or cause accidents if struck by traffic or damage vehicles and injure occupants if they strike a moving vehicle. o Cause partial closure of the road or require a detour lane prior to cleanup. Damage to the road surface may require temporary repair in order to re-open road.
6	Individual rocks or the total volume of rocks deposited on the road large enough to: o Damage/destroy vehicles and severely injure occupants if struck by traffic or damage/destroy vehicles and severely injure/kill occupants if they strike a moving vehicle. o Cause complete closure of the road, with a rough detour/diversion possible within hours to days. o Require days to weeks required to restore the road to normal service. Possibly significant damage to the road surface that requires immediate repair.
8	Same as weighting of 6, but with several days required to develop a rough detour/diversion around the rockfall site.
10	Individual rocks or the total volume of rocks deposited on the road large enough to: o Damage/destroy vehicles and severely injure occupants if struck by traffic. o Bury vehicles if they strike a moving vehicle. o Cause complete closure of the road, with a temporary, rough detour or diversion possible in days to weeks. o Require complete reconstruction or rerouting of the road after the rockfall.