LANDSLIDE RISK ASSESSMENT
SOUTHERN REGION

SITE S5: CHIN COULEE LANDSLIDE

LEGAL LOCATION:	**LSD 10-36-07-17 W4M**
REFERENCE LOCATION ALONG HIGHWAY	
UTM COORDINATES:	**N 5495250 E 414900** (NAD27) NTS Map Sheet 82 H/9 (Chin Coulee)
AI FILE:	**H36:02**
AI PLAN & PROFILE:	
Date of Initial Observation:	Fall 1978
Date of Last Inspection:	Instrumentation read October, 2001 Inspected May, 2001
Instruments Installed:	1981 - 4 Slope Inclinometers 1998 – 2 Slope Inclinometers, 2 Piezometers
Instruments Operational:	1 Slope Inclinometers (1998), 2 Piezometers (1988)
Risk Assessment:	Overall Slide PF(6) * CF(5) = **30** Ongoing shallower slides PF(10) * CF(2) = **20**
Last updated by:	AMEC, October 2001
Comments:	

Table A1 –S5 - Chin Coulee - Chronological Background

YEAR	MONTH	DESCRIPTION
1950's		The Chin Coulee Reservoir was constructed. Current alignment of Highway 36 constructed.
1960's		Highway paved. Re-surfaced at least once since that time.
1978	Fall	Movement of the slide was first noticed after a period of heavy rainfall and runoff. A scarp of up to 1 m in height was formed at that time and the head of the slide was reported to have affected the shoulder of the highway for a distance of about 45 m. The slide was reported to be 500 m across at the water line, with the toe of the slide not visible.
1979	May	Inspected by geotechnical personnel. No further movements noted.
1979	Sept.	Inspected by geotechnical personnel. No further movements noted.
1981	Nov.	Slope inclinometers installed by ATU (?).
1981	Dec.	4 boreholes drilled and slope inclinometers installed. Very limited information available on drilling and followup monitoring.
1997	Spring	Re-activation of slide following a period of wet weather. The amount of movement that took place appears to be similar to the 1978 movements and the headscarp of the slide again developed adjacent to the shoulder of the road for a distance of about 40 m. Relatively minor deflection of the paved surface (mostly in the shoulder) also occurred at that time.
1998	June	A detailed investigation of the slide was conducted by Golder Associates. This included drilling 5 boreholes, installing one standpipe piezometer, two pneumatic piezometers and two slope inclinometer casings
1999	May	Instrumentation read. One slope indicator sheared off at 15.5 m depth. Significant movements noted in sheared SI. Little definitive movement in deeper SI
	June	Annual Inspection – No signs of significant additional movement.
	Sept.	Instrumentation read. Further significant movements noted in sheared SI. Slight distress to pavement. Little definitive movement in deeper SI
2000	May	Instrumentation read by AMEC.
	Sept.	Instrumentation read by AMEC.
2001	May	Instrumentation read by AMEC. Annual site inspection by AMEC and AT personnel.
	Sept.	File and airphoto review completed by AMEC. Report submitted to AT recommending installation of additional instrumentation upslope of the existing road and preparation of a design for upslope relocation of the existing road.
	October	Instrumentation read by AMEC.

Location

The slide is located on the north bank of the Chin Coulee Reservoir, adjacent to Highway 36. The site is about 20 km south of the town of Taber in Southern Alberta. Specifically, the site is ___ km from the nearest major intersection (to be filled in after first site visit.).

General Description of Instability

The Chin Coulee Reservoir is estimated to be 60 to 70 m in height from the original valley bottom to the prairie level. The slide itself has an elevation difference of approximately 50 m from the reservoir level to the headscarp adjacent to the highway. The toe of the slide is not visible and is believed to be below the water level in the reservoir. The width of the slide is approximately 350 m at the shoreline. The length of the slide is approximately 200 m. The overall angle of the slide is about 13 degrees.

The slide has shown large scale movements on two known occasions since the 1950's, with some possible ongoing smaller/shallower movements contained within the overall slide mass. The ongoing movements appear to be having a slight impact on the road. There remains a risk of reactivation of the larger slide mass, which could have a more significant effect on the road.

The overall slide is inferred to be deep seated with a failure surface at a depth of about 30 to 40 m near the highway (scarp) and 17 m near the reservoir (toe). The failure surface is though to be along weak zones in the bedrock and overlying till. One slope indicator was sheared off at a depth of about 15 m, possibly indicating a shallower, more active portion of the slide.

Geologic Setting

The site geology generally consists of a silty clay till overlying shale/siltstone bedrock. The thickness of the overburden was in the order of 10 m near the reservoir (toe of the slide) and 37 m below the highway. The surface of the bedrock appears to dip in the direction of the slide, although the bedrock bedding is reported to dip to the north. Fill thicknesses in excess of 5 m appear to have been placed during highway construction.

Groundwater levels measured in standpipes indicate that water levels range from the ground surface to depths of about 15 m. It has been speculated that water levels lower in the slope are associated with the reservoir, and those higher in the slope are in a perched water table, primarily associated with flow along sand layers in the till.

Chronological Background

Table A1 provides the Chronological Background of the slide.

Past Investigations

The site was investigated by Al in 1979, however little information is available from that study. Golder Associates conducted an investigation in 1998. Golder's report concluded that the slide was the site of an historic landslide, which was reactivated by a number of factors, including the presence of the reservoir, natural fluctuations in overall

groundwater levels and, to a smaller degree, the presence of Highway 36. The report provided recommendations for various courses of action, including minor improvements and observation, highway relocation and major stabilization.

Mitigative Measures Taken

No major mitigative measures undertaken.

Monitoring Overview

Monitoring conducted to date appears to indicate decreasing movement of a deep slip surface about 40 m below the road surface. One slope indicator was sheared off at a depth of 15.5 m and continues to show significant surface movements.

1.0 Site Visit

The Annual Inspection site visit was conducted on May 30, 2001. At the time of the visit, the weather was clear and blustery.

2.0 Significant Observations

The following observations, considered to be relevant to the stability of the slope were made:

- The scarp area of the slide was directly adjacent to the north shoulder of the road. Photo 1 shows this feature.
- It was reported by maintenance personnel that the guardrail had been previously repaired, and fill had been placed on the downslope side of the guardrail. It was evident that at least portions of this fill had been lost downslope. There was some distortion to the guardrail, but it was not possible to determine if this was due to slope movement or was how the rail had been installed during realignment. See Photos 1 and 2, comparing the 2000 and 2001 assessments.
- One major longitudinal crack had been sealed in the eastbound lane adjacent to the slide. Horizontal displacements and distortion of the road surface were minimal. Refer to Photos 3 and 4.
- Separate slide blocks within the overall landslide area showed evidence of recent movements.
- Inspection of the area on the upslope side of the road indicated no evidence of deeper-seated movements.
- A terraced area upslope of the highway was concluded to be an old road fill.
- Maintenance personnel reported a possible tension crack located above the old road fill, however this are had since been cultivated and no cracks were visible during the assessment. A tension crack at that location would indicate that the slide is potentially active on a much larger scale and significant portions of the road could be lost.

3.0 Changes from Previous Visits

The following significant changes for the previous assessment were evident:

- Guardrail replaced. Note dip in guardrail – possibly as installed.
- Drainage improvements in the upslope ditch, with fill cast downslope.
- Recent crack sealing on road.

Movements of the previously noted landslide blocks well downslope from the highway continue but do not appear to be affecting the road at this time. This includes the slide block containing Slope Indicator GA98-3, which had previously sheared off at a depth of 15 m.

4.0 Discussion

This site is a major landslide complex, with the highway located directly adjacent to the active scarp area. No significant movement in the remaining slope inclinometer (in Borehole GA98-2) adjacent to the downslope edge of the road has been measured since the spring of 2000, although additional movement is essentially certain over time, likely in response to high precipitation events. Retrogression into the present road surface will be likely at some time.

The reports of some tension cracks upslope of the road are of concern as this could threaten the entire road surface. An additional slope indicator in the upslope ditch would be able to confirm any sheared zones in this area.

As part of a further scope of work AMEC is conducting further investigations of this slide and assessing realignment options. This will be reported under separate cover.

5.0 Assessment

The area downslope of the highway is a large active slide area. This includes a significant potion of the highway embankment. It is not considered feasible to mitigate this entire slide area.

Ongoing, relatively shallow movements are likely to cause damage to the road, however such types of movement will not likely result in closure of the entire road. However, the guardrail, shoulder and portions of the eastbound lane could be lost in single events.

A deeper seated type of failure, containing the entire road surface is considered to be possible, but less likely. The reports of tension cracks upslope of the road are of concern in this regard, and additional instrumentation should be installed to further monitor this mode.

On the basis that two separate modes of failure could affect this highway, two risk levels are provided.

For the shallow modes of failure, the Probability Factor is taken as 10 since the rate of movement is moderate and ongoing. A Consequence Factor of 2 is assigned to this slide type on the basis that only a portion of the road would be lost. Based on the above, the Risk Level for the relatively shallow movements at this site is calculated as 20.

For a deep-seated mode of failure, the Probability Factor is taken as 6 since the movement is inactive, but somewhat uncertain. A Consequence Factor of 5 is assigned to this slide type on the basis that a large portion of the road would be lost. Based on the above, the Risk Level for the deep-seated movements at this site is calculated as 30.

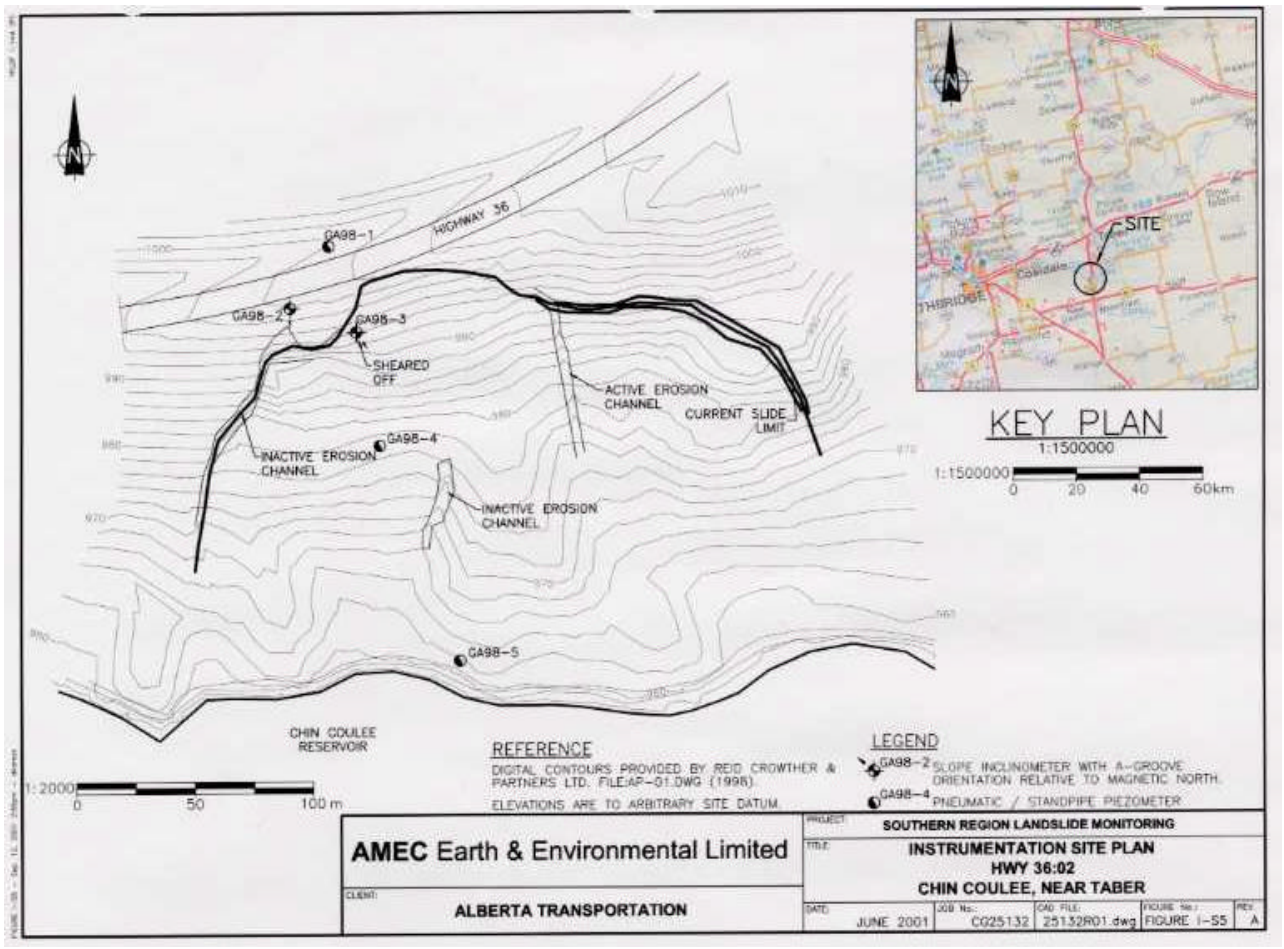
6.0 Recommendations

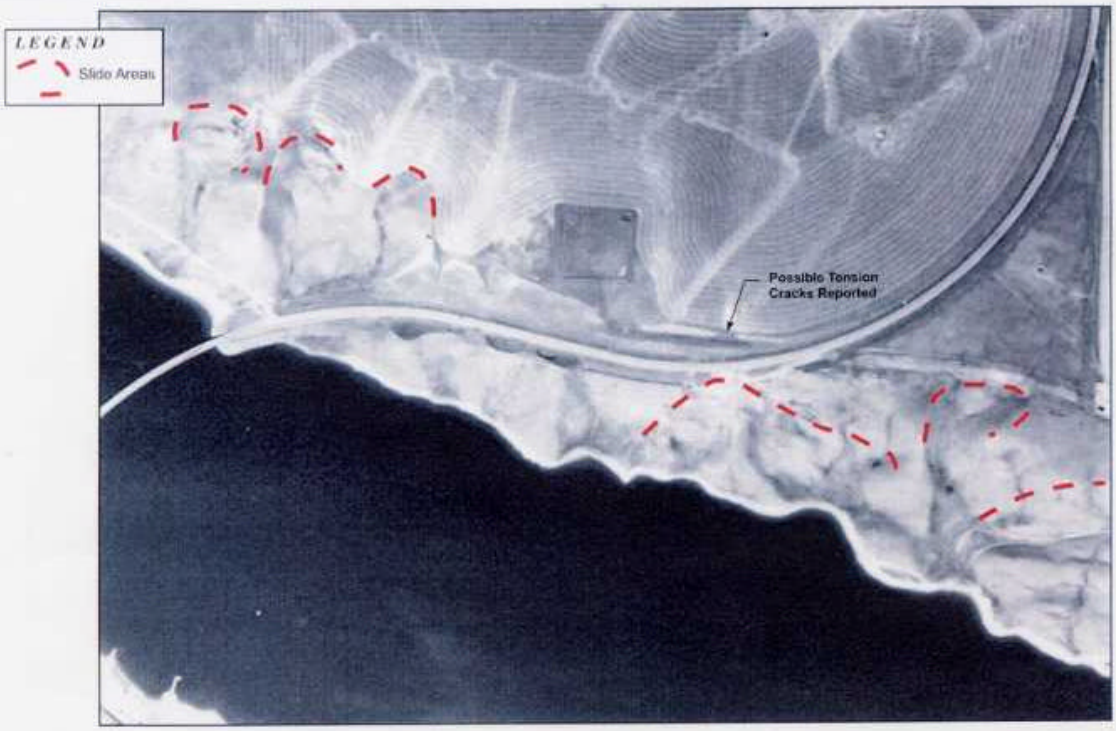
On the basis of the above, it is recommended that relocation of the highway be considered at this site. There does not appear to be an immediate risk to large portions of the

highway, so such repairs could be delayed somewhat. However, in the interim, continued maintenance will be required, particularly in wet years and the likelihood of more significant failures will increase as time passes.

The monitoring programs currently in place should be continued. It is recommended that one additional slope indicator be installed on the upslope side of the highway to assess deep seated movements.

The surface conditions of the road at this location should be carefully monitored by maintenance personnel. This would be in conjunction with slope indicator and piezometer monitoring to provide as early detection of potential problems below the road as possible.


N
HIGHWAY 36
GA98-1
GA98-2
GA98-3
SHEARED OFF
ACTIVE EROSION CHANNEL
CURRENT SLIDE LIMIT
INACTIVE EROSION CHANNEL
GA98-4
INACTIVE EROSION CHANNEL
GA98-5
CHIN COULEE RESERVOIR
1:2000
0 50 100 m
SITE
COALDALE
LETHBRIDGE
KEY PLAN
1:1500000
1:1500000
0 20 40 60km
REFERENCE
DIGITAL CONTOURS PROVIDED BY REID CROWTHER & PARTNERS LTD. FILE:AP-01.DWG (1998).
ELEVATIONS ARE TO ARBITRARY SITE DATUM.
LEGEND
GA98-2 SLOPE INCLINOMETER WITH A-GROOVE ORIENTATION RELATIVE TO MAGNETIC NORTH.
GA98-4 PNEUMATIC / STANDPIPE PIEZOMETER
AMEC Earth & Environmental Limited
CLIENT: ALBERTA TRANSPORTATION
PROJECT: SOUTHERN REGION LANDSLIDE MONITORING
TITLE: INSTRUMENTATION SITE PLAN
HWY 36:02
CHIN COULEE, NEAR TABER
DATE: JUNE 2001
JOB No.: CG25132
CAD FILE: 25132R01.dwg
FIGURE No.: FIGURE 1-S5
REV: A



Enlarged View from Airphoto
AP 82H LN-15
As4955-257
May 6/99

Approx Scale: 1:6600

Alberta Transportation/S. Region Landslide Monitoring Program

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Figure S5-1

Date: Aug 2000 | Revision: A

Job No: CG25132

File No: JZ16CW03.ai

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Photo 1 – View of downslope edge of the road above slide area (2001). Note newly-installed guardrail and slide scarp visible downslope of road.

Photo 2 – Downslope edge of road as seen during the June 2000 assessment.

Photo 3 – Facing northeast along road through slide area. Note newly-installed guardrail.

Photo 4 – Facing southwest along road through slide area. Note newly-installed guardrail.

Photo 5 – View of Highway 36 on the north side of the Chin Coulee reservoir. The monitoring/assessment site is near the crest of the hill. Note landslide throughout the north valley wall.

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Alberta Transportation
Southern Region Landslide Monitoring Program
Spring 2001 Assessment Report

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