LANDSLIDE RISK ASSESSMENT
CENTRAL REGION

SITE C1: GHOSTPINE CREEK

LEGAL LOCATION:	**SW 16-31-22-4**		
REFERENCE LOCATION ALONG HIGHWAY:	**Sta. 11+800**		
UTM COORDINATES:	**N 5,724,044**	**E 356,737**	(NAD83)
AI FILE:	**H27:10**		
AI PLAN:	Jct. Hwy 21 – West of Red Deer River, Sheet 4 of 6		
Date of Initial Observation:	September, 1989		
Date of Previous Inspection:	June 9, 1999		
Inspected By:	Golder Associates Ltd.		
Date of Current Inspection:	**May 12, 2000**		
Inspected By:	Klohn-Crippen Consultants Ltd.		
Instruments Installed:	4 Slope Inclinometers (1994)		
Instruments Operational:	3 Slope Inclinometers (2000)		
Date of Last Reading:	May 12, 2000		
Read By:	Klohn-Crippen Consultants Ltd.		
Risk Assessment:	PF(9) * CF(1) = **9**		
Last Updated by:	Klohn-Crippen Consultants Ltd.		
Date:	May 15, 2000		

Location and General Description of Instability:

This site is located on Highway 27 between the junction of SH836 and the Ghostpine Creek crossing (Sta. 11+800). Significant slides have occurred in the past at this cut to fill transition zone location and these have been remediated with subsurface drains and berms. The significant features at the site consist of cracking of the pavement and side slopes, which are a remnant from the previous slide activity.

The cracking of highway pavement and slopes is summarized on Figure 1 and is described below:

Feature A: 10-20mm wide transversal crack across the entire width of the pavement
Feature B: 2-5mm wide diagonal crack with 1-2mm vertical displacement
Feature C: 5-10mm wide longitudinal crack along paved surface
Feature D: 2-5mm wide longitudinal crack halfway along west bound lane
Feature E: Cobble lined ditch
Feature F: 0.2 m wide by 0.25-0.6m deep eroded tension crack
Feature G: 10-20mm open crack parallel to valley wall
Feature H: 2-5 mm wide transversal cracks
Feature I: thin cracks at centerline

The maximum cumulative movements at the surface, as measured by the slope inclinometers, are less than 30 mm since 1994.

The highway ditch on the south side of the highway was being eroded and was subsequently upgraded with cobble size drain rock erosion protection in 1998. On the north side of the highway, ditch flows have eroded the tension cracks to form channels terminating in a large eroded gully down to the creek.

There is no sign of imminent slope instability and it was recommended that eroded gullies be upgraded to ditches that are protected against erosion to form drainage conduits to the base of the valley.

Geotechnical Conditions

Soil conditions generally consisted of 8 m to 9 m of silty clay overlying siltstone bedrock. One hole indicated a silty sand layer from surface to 6 m deep. SPT blow counts in the clay ranged from 5 to 19, with an average of about 10.

Test hole logs and additional information are provided in Section G.

Chronology (Refer to Section G for Further Information)

September 1971
The highway completion report indicated that springs were encountered in the area during construction and that the steady flow was cut off by the fill.

September 1989
Embankment failures were observed on the north and south sides of the deep fill section. Crack patterns were evident in the pavement.

October 1989
The slide was repaired by refilling the slipped area with pit run gravel and common cut material and reshaping the side slope. Shortly after, cracking appeared in the pavement at about Station 11+800. A site investigation was undertaken including auger holes and test pits. In general, the material encountered in the valley consisted of silty clay, with sand and silt lenses. Based on the groundwater conditions encountered, it was suspected that an isolated spring exists in the valley face that has been blocked by the fill material. It was recommended that pit run gravel filled french drains be installed on the north side of the slope. The depth of trenching varied from about 2 m at the toe to about 4.5 m at the shoulder.

July 1990
2 french drains were installed. A slide about 35 m long was observed in the same location on the north side of the fill.

April 1991
The lateral drains appear to have been blocked by the reshaping of the fill. It was recommended that the longitudinal drainage trench (7 m deep) be extended by about 50 m into the natural valley cut section, another lateral drain be installed, and the ends of all the drains be improved to allow free flow.

May 1991
Trenching for the new drains proved to be very difficult due to saturated sand layers caused the trench to cave in. At the bottom of the slope, a saturated sand layer 2 m thick was encountered. The 2 existing lateral drains were opened up to daylight at the toe of the slope. There was evidence of a spring that came out to the surface in the south ditch about halfway through the cut section (Sta. 11+650 – 11+750).

September 1992
The north side slope failed over a length of about 45 m during the summer, probably due to heavy rainfall. The fill material was noted to become very soft when wet. It was recommended that more drainage measures be constructed to capture flow from the spring on the south side and that berms be constructed on the side slopes to get effective slope angles of about 5H:1V (from the existing slope angle of about 3H:1V).

November 1994
To investigate the possibility of a slide phenomenon in the roadway fill, 4 inclinometers were installed. Two inclinometers were installed on each shoulder on either side of the crack in the pavement. The inclinometers were installed to depths of about 10 m to 15 m. Prior to 1998, SI #1 became unreadable. No record is available as to the cause of the damage to this instrument.

June 1998
No significant changes in pavement cracking. Movements of less than 25 mm recorded in the inclinometers since 1994. Continued erosion in eastbound ditch with gully depths extending to 1.3 m. It was recommended that the ditch be upgraded and this was completed using a geosynthetic fabric and cobble size drain rock.

June 1999
No significant changes in pavement cracking. Maximum cumulative movements of 35 mm or less since November 1994. Most movement has occurred in SI #4. A shear plane at about 3 m depth has formed with a movement measured at the surface of about 15 mm. From the repaired area, the water flows over relatively flat ground to the crest of the fill slope. A 6 m deep gully has been cut before exiting into the creek.

September 1999
Slight depressions were noted on the road in both lanes. No significant changes in pavement cracking. Cracks were noted on the slope of the rock drain ditch. The movement in SI #4 had reduced to a cumulative movement of about 25 mm at the surface.