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THURBER

ALBERTA INFRASTRUCTURE
LANDSLIDE RISK ASSESSMENT

PART A: GEOTECHNICAL FILE REVIEW

NORTH CENTRAL REGION

SITE NC9: CANYON CREEK

LEGAL LOCATION:	**7-73-8-W5M**
NEAREST LANDMARK:	**Approx. 26 km W. of Jct Hwy 88 (or 3.2km W. of Canyon Creek)**
Highway Control Section:	**Hwy 2:48**
Date of Initial Observation:	**1992**
Date of Last Inspection:	**1999**
Last Observed By:	**Thurber Engineering Ltd.**
Instruments Installed:	**6 Slope Inclinometers, 4 Pneumatic Piezometers (1992)**
Instruments Operational:	**3 Slope Inclinometers, 4 Pneumatic Piezometers (2000)**
Risk Assessment:	PF(5) * CF(4) = 20

1. LOCATION

The area of instability at the Canyon Creek site affects a 60 m stretch of Hwy 2 located approximately 3.2 km west of the access road to the Village of Canyon Creek (about 26 km west of the junction of Highway 2 and Highway 88). A site plan (Figure NC9-1) is provided in Section F showing the approximate location of the slope movement and monitoring instrumentation installed previously at the site.

2. GENERAL DESCRIPTION OF SLOPE INSTABILITY

The area of instability is associated with a 14 m high embankment fill crossing a ravine. The original embankment slope is estimated to have been 20° (2.7H:1V) for the upper slope and 30° for the lower slope prior to slope movement. A graben has formed within the embankment side slope at a vertical distance of approximately 3 m below the pavement surface. This graben feature appears to have been flattened to allow installation of instrumentation at this location. In addition, a lower bench has been created at a vertical distance of approximately 11 m below the pavement surface, also presumably to allow for instrumentation installation.

At present the highway road surface is experiencing minor distress in the form of cracking on the pavement surface. Small movements measured in the slope inclinometers over the past three years are attributed to ongoing creep of the slump area adjacent to the cracking noted in the pavement.

The slope instability at this site is likely caused by a relatively high water level in the embankment fill material, especially during extended wet periods. Observations in 1992 of ponded water within the ditch below the back slope (south of the highway, adjacent to the area of instability) indicate that infiltration may be one source of water to the embankment. The embankment fill may also impede natural groundwater discharge from the area.

It is understood that the last significant movement to occur at this slope coincided with a period of above average annual precipitation for this area. Based on the results of the slope inclinometer monitoring, the shear plane is located within the embankment fill in the head slope area at an approximate depth of 6 m. In the vicinity of the middle of the slide the shear plane is at a depth of approximately 14 m, and near the toe of the slope the shear plane is at an approximate depth of 6 m (i.e. near the clay/clay shale interface).

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

Physiographic Region: Northern edge of the Swan Hills upland.

Surficial Geology: Relatively thin surficial sediments (<30 m).

Bedrock Geology: Wapiti Formation of Cretaceous age, composed of grey feldspathic clayey sandstone, bentonitic mudstone and bentonite, scattered coal beds, non marine.

Hydrogeology: Possible discharge area. Groundwater flow direction is north toward Lesser Slave Lake. Potential yields of the surficial sediment are expected to be low; 0.4 L/s. Potential yields of the bedrock expected up to 2 L/s.

The above noted geological descriptions are based on published information.

Stratigraphy: The general soil stratigraphy within the highway embankment during drilling at the site consists of the following

Material	Depth (below ground surface)
Clay (Fill) - stiff, medium plastic, silty	Below topsoil to a depth of 3.5 - 5.8 m (encountered in test holes drilled near head and midpoint of slope).
Sand – brown, fine grained, silty	Interbedded with clay layer to depths between 5.8 – 10.5 m (encountered in test holes drilled near head and mid point of slope).
Clay - firm to stiff, high plastic, sandy	Below clay (fill) and sand to a depth of 15.1 m
Sandstone (Rafted?)	At a depth of approximately 10 – 12 m at mid point of slope.
Clay (Till)	Below sandstone; encountered only at mid point of slope at approximately 12 m below ground surface.
Clay Shale	Below clay.

4. CHRONOLOGY

1992

First indication of failure of embankment side slope identified in October 1992.

A major scarp was evident within the embankment side slope, adjacent to cracking within the roadway surface over a length of approximately 60 m which extended from the shoulder edge to just beyond the centreline. In addition, ponded water was observed in the back slope ditch.

Slope inclinometers and piezometers were recommended for this site.

1993

6 SI's and 4 pneumatic piezometers were installed. The test holes were logged during installation.

1994

Cracking and settlement of the pavement surface occurred in 1994. An asphalt patch was placed on the west bound lane to repair the failed pavement section.

1997 through 1999

In 1997, two crack features were noted in the asphalt pavement over distances of 17 m and 9 m, parallel to the 50 m long slump feature in the embankment side slope. An intermediate scarp had formed over a 10 m length in the side slope within the main slump area. No distress to the side slope was noted between the north shoulder of the highway and the scarp of the slump area.

No obvious deformation was noted in the guard rail through this section of highway and no height differential was measured across the cracks in the pavement surface.

The location of the west cracks within the pavement surface appear to be coincident with those occurring prior to the overlay in 1994.

No seepage was noted from the embankment side slope and no ponding was evident in the south ditch.

No change was noted in the instability features discussed above over the time period from 1997 to 1999.

Down slope movements occurred as measured in slope inclinometers in September 1997 compared with previous readings from May 1997. A rate of movement of up to 8 mm per year was measured over this time frame. Small creep movements (less than 1 mm/year) have been measured since in the slope inclinometers since September 1997.