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THURBER

ALBERTA INFRASTRUCTURE LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

NORTH CENTRAL REGION

SITE NC2: WILLEY WEST PARK

LEGAL LOCATION:	**SW 11-49-7-W5M**
NEAREST LANDMARK:	**3.5 km West of Junction with Hwy 39 (West of the Town of Drayton Valley)**
Highway Control Section:	**HWY22:33**
Date of Initial Observation:	**Late 1960's**
Date of Last Inspection:	**1999**
Last Inspected By:	**Thurber Engineering Ltd.**
Instruments Installed:	**10 Slope Inclinometers (1990), 2 Slope Inclinometers (1992)**
Instruments Operational:	**6 Slope Inclinometers (1999)**
Risk Assessment:	PF(10) * CF(4) = **40**

1. LOCATION

The area of slope instability at the Willey West Park site affects a 165 m long stretch of Hwy 22, located approximately 3.5 km west of the junction of Highway 22 and Highway 39 (west of the Town of Drayton Valley). The area is located approximately 100 m east of the Willey West Campsite Access road.

The attached site plan (Figure NC2-1, Section F) shows the approximate location of the slope movement and monitoring instrumentation installed at the site. In addition, the locations of drainage measures implemented in the past at this site are shown on the site plan

2. GENERAL DESCRIPTION OF SLOPE INSTABILITY

The area of instability is located within an embankment fill through a ravine with a total height of approximately 7 m. The highway embankment has a side slope angle of about 15° (4H:1V), sloping down from the north shoulder of the pavement surface. A transverse steel pipe culvert is located east of the area, providing drainage from south to north across the highway. Minor cracking is evident within the south half of the pavement surface.

The most probable reasons for slope instability at this site are embankment loading combined with high water levels occurring during extended periods of heavy precipitation. Evidence of accelerated movements along a defined shear plane have been observed in slope inclinometers during wet periods. The shear plane appears to be located within a layer of native high plastic clay, at typical depths of approximately 6 m to 10 m below the embankment slope surface. The general direction of slope movement is to the northeast, toward the pre-existing ravine location.

Ongoing movements measured in the slope inclinometers since 1997 indicate that small movements are continuing to occur. However, over time they may accumulate to amounts that impact the highway. Accelerated movements may also occur during or after periods of heavy and/or prolonged precipitation.

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

Physiographic Region: Eastern Alberta Plains.

Bedrock Geology: Paskapoo Formation of Tertiary age.

Surficial Geology: North Saskatchewan River valley with fine fluvial deposits and stream and slopewash along valley walls. On the uplands fine lacustrine deposits are found.

Hydrogeology: Potential groundwater yields from the river valley fluvial deposits of up to 11.5 L/s. The Paskapoo Formation capable of providing yields up to approximately 2.3 L/s. Groundwater flow direction is generally north toward the river.

Stratigraphy: The general soil stratigraphy in the vicinity of the highway embankment as encountered during drilling and test pit excavation at the site consisted of the following:

Material	Depth (below ground surface)
Clay (Fill) - firm, medium plastic silty	Below topsoil to 1.5-4.9 m
Clay - firm to stiff, high plastic	Below clay (fill) to 4.3-10.0 m
Clay (Till), stiff to very stiff	Below high plastic clay to full depth of drilling, maximum 21.8 m. Bedrock not encountered.

Organic soil and trees were encountered within the fill material in one test pit. Groundwater was encountered at a depth of approximately 1.5 m below ground surface in the test pits. Bedrock was not encountered during drilling at the site.

4. CHRONOLOGY

Late 1960's

The effects of slope instability have been observed at this location by Highway Maintenance personnel since the late 1960's when the bridge over the North Saskatchewan River was constructed. Movements have generally occurred once or twice each year during the wet season.

It is understood that the slide originated near the transverse culvert located at the east end of the embankment fill and over time has progressed to the west.

1987

A trench drain was installed in the south ditch, located approximately as shown on the site plan in Section G to intercept groundwater from upslope (i.e.: south of highway). In addition the concrete transverse culvert pipe was replaced with a steel pipe, reportedly during wet/rainy conditions.

1989

Significant slumping and cracking of the road surface was observed. The length of the area of instability was approximately 150 m along the highway, extending west from a point 25 m west of the existing transverse culvert.

A site investigation was conducted to assess the stability of the slope, including a visual inspection and a test pit excavation program (Test Pits A through G and 6 on South Side, and Test Pits 1 through 5 on North Side). During the field program the existing french drain in the south ditch was found to be blocked and saturated.

A new trench drain with subdrain pipe was constructed within the south ditch, extending to the west of the original french drain and draining into the transverse culvert located at the east end of the area of road distress. It is understood that the new drains were ineffective at substantially reducing the magnitude of movements observed.

1990

10 slope inclinometers (SI's 1 through 10) were installed in January of 1990.

A 25 mm to 100 mm high scarp had formed through the highway pavement surface in early July. Large scale movement of the side slope were again observed in August and September.

1991

Six horizontal drains were drilled from the toe of the slope in May, connecting to one discharge point. In addition, three groundwater observation wells were installed. Measured water levels dropped by 5 m after installation of the horizontal drains, and slope movements were reduced to negligible levels. Flow rates from the discharge point stabilized at about 0.6 l/min after four months of operation.

1997

Annual site inspections and a semi-annual instrumentation monitoring program were initiated at the site.

Three crack features were noted within a 165 m long asphalt patch section in the area of previous instability. A slight vertical differential in the pavement elevation (approximately 6 mm) was noted across the easternmost crack. The cracks were not visible beyond the pavement surface. No distress was noted in the highway side slopes at the time of the site reconnaissance.

Discharge from the horizontal subdrains was estimated to be between 0.5 l/min and 1.0 l/min, which is similar to that measured shortly after installation.

1998 and 1999

Based on the results of the annual site inspections, no additional movement of the slide area was evident compared to the observations made in 1997. The cracking pattern on the asphalt pavement has remained relatively constant, indicating no significant further slide development over this time period. Estimated flow rates from the horizontal drain discharge point are similar to those of 1997.

Ongoing movements measured in the slope inclinometers since 1997 indicate that small movements are continuing to occur. The majority of the observed movement occurs once or twice each year during the wet season. The rate of slope movement has remained relatively constant at up to 14 mm/year since 1997. This is an increase from the measured rate of about 6 mm/year prior to 1996.