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THURBER

ALBERTA INFRASTRUCTURE LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

NORTH CENTRAL REGION

SITE NC1: WHITECOURT EAST HILL

LEGAL LOCATION:	**NE 26-59-12-W5M**
NEAREST LANDMARK:	**Within the Town of Whitecourt**
Highway Control Section:	**HWY 43:16**
Date of Initial Observation:	**1964**
Date of Last Inspection:	**1999**
Last Inspected By:	**Thurber Engineering Ltd.**
Instruments Installed:	**Not Available**
Instruments Operational:	**9 Slope Inclinometers (2000)**
Risk Assessment:	PF(6) * CF(2) = **12**

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

Physiographic Region: Eastern Alberta Plains

Bedrock Geology: Scollard member of Paskapoo (Tertiary age) with sandstone, mudstone and coal beds; Underlain by Whitemud and Battle Formations, bentonitic sandstone and mudstone (Whitemud), purplish-black bentonitic beds with siliceous tuff (Battle). Upper Cretaceous.

Surficial Geology: Coarse river alluvium in the valley underlay the Town of Whitecourt, on valley slopes stream and slopewash eroded deposits with exposed till and bedrock, local slump material.

Hydrogeology: Some evidence of discharge in the river valley bottom, one spring (possibly a contact spring) indicated in the southeast corner of Section 26. River valley alluvium could produce up to 8 L/s for single wells.

The above descriptions are based on published information.

Stratigraphy: The general soil stratigraphy in the vicinity of the highway embankment consists of silty sand with some silt layers, overlying high plastic clay. Gravel was encountered at depth (12 to 16 m) in many of the test holes. Clay shale bedrock was encountered below the gravel or clay in some of the test holes drilled near the bottom of the valley.

Seepage was encountered from the gravel layer. Water also was encountered perched in the base of the sand layer above the clay.

4. CHRONOLOGY

1964

Slope instability has been experienced at this location since about 1964 when the highway was constructed.

1972

A slide impacting the highway occurred at a location east of a sewer line in June of 1972. The location of the sewer line was not provided. There was no indication of the method of repair.

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1979

In June of 1979, cracking in the pavement was noted "about halfway up the hill." It is expected that this cracking was located in the vicinity of Station 1+700 to 1+900 based on the available roadway profile (Figure NC-1, Section F).

1980

In March of 1980, two sets of horizontal drain pipes were installed below the highway from the side slope. One set was installed near the bottom of the hill (i.e.: toe of the slope) and another set was installed near the top of the hill.

In June of 1980, cracking in the pavement was noted halfway up the hill (in the same location of the cracks noted in 1979). A trench drain with perforated subdrain pipe was installed in the upslope (south) ditch, exiting into Beaver Creek located beyond the toe of the valley slope.

1986

Subsidence was noted in the west bound lane of the roadway surface at a location midway down the hill. More horizontal drains were planned but there was no confirmation that they were installed. There was no reference to how the roadway was repaired in the AI files.

1989

Pavement cracking and subsidence were noted in the roadway surface, again approximately half way up the hill. The movement appeared to be activated by heavy rainfall. It is understood that all of the failures occurring to 1989 in the mid slope area occurred in the westbound (north) lane of the highway.

Stone/cement columns were installed to provide vertical drainage by bottom draining the upper sand to a gravel layer at a depth of approximately 13 m. The stone columns were cemented above the target drainage level to provide additional shear resistance. A total of 154 columns were proposed over a 100 m stretch of the roadway. It is not clear in the AI files how many were actually installed. The locations of the stone columns were not well documented, however based on a photograph taken during installation it appears that they were located in the middle to upper portion of the hill within the westbound lane.

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1990

A total of seven slope inclinometers (SI# 1 through #7) were installed below the roadway in 1990. The readings indicated that the slope movements were likely located at the interface of the embankment fill and native materials.

1993

In April of 1993, fourteen test holes were drilled to aid in geotechnical characterization of the slope for the twinning design. This was supplemented by an additional program of eleven test holes and seven test pits undertaken in June of 1993. The station, offset and elevation are provided on each individual log.

Numerous springs were noted on the back slopes and side slopes, highlighting the need for subsurface drainage at the site.

Diagonal cracking was noted in the pavement at a location east of the sewer line in 1993.

1995

Six slope inclinometers (SI #25, and #30 through #34) were installed near the bottom of the valley (Station 1+200 to 1+300) adjacent to the McConnell property, south of the roadway. In addition, SI #16 and #17 were installed further up the hill on the south side of the highway. It is not clear if the SI numbering indicates that a total of 34 slope inclinometers have been installed at the site as of this date.

A bin wall was constructed in 1995 below the McConnell property at the bottom of the hill, on the upslope (south) side of the roadway in the vicinity of Stations 1+200. After construction it was noted that the bin wall had settled, however it did not appear to have moved laterally down slope although it was constructed without passive toe resistance. A pile wall was installed adjacent to the bin wall between Stations 1+210 and 1+260 at 2 m spacing to a depth of 24 m. It is not clear if these piles are tied into the bin wall.

Shallow slumps were observed in the three areas of the back slope cut during roadway construction in 1995. These occurred at Station 1+323 to 1+356, Station 1+536 to 1+560, and Station1+584 to 1+606. These areas were repaired by slope flattening during construction. In addition, significant erosion of the sand in the back slope occurred at Station 1+960 to 1+980 which was apparently repaired.

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Approximately 3000 m of subdrain pipe was installed within the back slope and below the highway alignment over a 700 m stretch of the hill during construction in 1995. Documentation of the location of the subdrains is not available in the geotechnical files.

A toe berm was placed between approximate Stations 1+700 and 1+800 below the roadway to buttress the existing embankment in the middle to upper portion of the hill

1996

A shallow slump occurred in the lower back slope near Station 1+350, below the walking trail. The slope was repaired by excavation of the slide mass and replacement with free draining granular backfill. Subdrain trenches were also provided in the slide area, outletting into the ditch at the base of the slope.

1997 through 1999

Annual site inspections and a semi-annual instrumentation monitoring program were initiated at the site in 1997. A summary of the results of the inspection and monitoring follows:

a. Signs of Roadway Distress

No signs of distress to the roadway were noted in 1997. In 1998, some minor diagonal cracking was noted in the north (driving) lane of the west bound roadway surface. These were noted again in 1999 and did not appear to have extended substantially since noted in 1998. There was no indication of distortion in the adjacent guard rail in 1998 or 1999.

b. Slope Inclinometer Readings

Some minor movement has been recorded in some of the slope inclinometers since 1997; specifically below the McConnell property near Station 1+250 (SI#32 and #34), and below the roadway at approximately Station 1+650. Movement rates are low at this time (in the order of 2 mm/year to 6 mm/year) and do not appear to be increasing. Based on visual observations there was no evidence of surficial movement at these locations.

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c. Back Slope Slumps and Erosion

Minor slumps were noted in the back slope above the walking trail at Station 1+400, apparently caused by saturation of the weak clay soils near the surface that were somewhat oversteepened during the back slope cut. In addition, the lower back slope at this location (Station 1+400) was exhibiting signs of distress (tension cracking near the walking trail) similar to that observed in the adjacent 1996 back slope failure. The lower slope was repaired in 1998 using a similar methodology to that employed during the 1996 repair. The upper backslope was repaired in 1999 by slope flattening and subdrain installation, tied in to the existing subdrain system.

In 1998 a number of small slumps and erosion rills were repaired along the length of the Whitecourt East Hill, both below and above the roadway. In addition, erosion around culvert inlets and half-round surface drainage pipe conduits was repaired.

In 1999, erosion and slumping was noted around the outlet end of a portion of the subdrain system at approximate Station 1+720, downslope of the roadway. This was repaired by Alberta Infrastructure forces during the summer of 1999.