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THURBER

ALBERTA INFRASTRUCTURE LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

NORTH CENTRAL REGION

SITE NC8: NORTH OF LABICHE RIVER

LEGAL LOCATION:	**34-68-17-W4M**
NEAREST LANDMARK:	**0.8 to 0.9 km North of the Bridge over the Labiche River between the Villages of Atmore and Wandering River**
Highway Control Section:	**HWY 63:02**
Date of Initial Observation:	**1987**
Date of Last Inspection:	**1999**
Last Inspected By:	**Thurber Engineering Ltd.**
Instruments Installed:	**8 Slope Inclinometers (1996) and 2 Slope Inclinometers (1997), 2 Pneumatic Piezometers (1996)**
Instruments Operational:	**5 Slope Inclinometers (2000)**
Risk Assessment:	PF(2) * CF(3) = **6**

1. LOCATION

The area of slope instability at the Labiche River site affected a 100 m long stretch of Hwy 63, located approximately 0.8 to 0.9 km north of the Labiche River bridge between Atmore and Wandering River. The area is located immediately south of the junction of Hwy 63 and a forestry road operated by ALPAC.

The attached site plan (Figure NC8-1 in Section F) shows the approximate location of the previous slope movement and monitoring instrumentation installed at the site. In addition, the extent of subsurface drainage measures and surface drainage re-routing implemented in the past at this site are shown on the site plan.

2. GENERAL DESCRIPTION OF SLOPE INSTABILITY

The instability was located within an area of embankment fill that flanks the east side of an abandoned meander channel (oxbow) of the Labiche River. The maximum height of the embankment is approximately 5 m, with a side slope angle of about 3H:1V over the upper 3 m of the embankment and flattening to 5H:1V or flatter on the lower portion of the slope.

The roadway embankment was originally constructed through an area of extensive muskeg. The embankment likely acted as a long dam between the muskeg area to the east and the Labiche River to the west which allowed groundwater to back up on the east side of the embankment. Prior to remedial construction in 1997, surface water from the east was directed across the roadway to the west in two centreline culverts in the immediate vicinity of the embankment failure with outlets into the oxbow feature.

As a result of the 1997 construction, surface water collected in the east ditch is now directed north (i.e. away from the area of instability). In addition, groundwater adjacent to the embankment now can flow through a granular blanket installed below the roadway surface.

The reasons for the slope instability at this site were likely a combination of weak foundation soils below the embankment, and high pore water pressures within the embankment. These conditions were likely made worse when water levels rose in the oxbow and adjacent muskeg lands during periods of prolonged and/or heavy precipitation.

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

Physiographic Region: Eastern Alberta Plains.

Bedrock Geology: Lea Park Formation (Klp) of Cretaceous age (mainly clay shale).

Surficial Geology: The surficial sediments can be deep (up to 100 m thick) in the area due to a wide buried channel in the bedrock. The surficial sediments can be very sandy near surface, however fine sediments predominate at depth.

Hydrogeology: The area is poorly drained, likely with a shallow water table. Potential groundwater yields from the surficial sediments are low (up to 0.4 L/s). The regional groundwater flow direction is generally northeast, however local flow may be toward the Labiche River.

The above noted geologic descriptions are based on published information.

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 interbedded firm clay and sand to a minimum depth of 24 m below the roadway surface. Bedrock was not encountered during drilling at the site. The embankment clay fill material appeared wet and soft to a depth of about 3 to 4 m below the pavement surface.

Seepage was encountered from the east side of test pits excavated in the area.

4. CHRONOLOGY

1987

Slope instability has been experienced at this location since 1987 which has been associated with periods of heavy precipitation and high water levels within the oxbow adjacent to the roadway embankment. Highway maintenance crews had been periodically patching the pavement cracks that occurred as a result of the slope instability.

A centreline culvert under the roadway had been installed prior to 1987 at the north end of the area of instability, providing drainage of surface water from the east into the oxbow on the west side of the highway.

1990

A test pit investigation was undertaken and a cut-off trench with subdrain pipe was installed in the ditch on the east side of the road to intercept seepage from the muskeg to the east. It is understood that the cut-off trench became non-functional soon after installation due to silting of the outlet end of the pipe.

1994

A drilling program consisting of shallow test holes was undertaken as a result of "problems" reported at this location. The nature of the problem was not reported. The results of the drilling program indicated soft ground conditions at a depth of approximately 3 to 4 m below the roadway surface. No remedial measures were undertaken at this time.

1996

Significant slope instability occurred at the site in July of 1996. The area was patched with cold mix asphaltic concrete. Additional test pit excavations were undertaken which indicated seepage from east to west at a shallow depth.

An additional centreline culvert was installed at the south end of the slide area in August of 1996 to assist in moving water from the east ditch to the oxbow on the west side of the roadway.

Slope monitoring instrumentation (inclinometers and pneumatic piezometers) was installed in November, 1996. Drilling during instrumentation installation indicated firm clay with interbedded sand layers to a depth of at least 24 m below the pavement surface. Measurements from the slope inclinometers indicated movements at a depth of 4 m to 8 m below the road surface.

1997

Significant slumping and cracking of the road surface occurred in June of 1997 which formed a main scarp extending a distance of 45 m along the southbound lane of the highway. Cracking in the pavement surface was noted over an additional 40 m to 50 m of the highway surface. The failure movement was to the west toward the oxbow feature and included a significant downward component in the central portion of the slide area. Granular fill was placed in the zone of subsidence by the Highway Maintenance contractor for the area to maintain trafficability. The speed limit was reduced through the area for safety reasons. The

rate of movement of the slide increased during the summer such that maintenance was required on a weekly and sometimes daily basis to maintain safe driving conditions.

An engineering assessment and stability analyses based on existing information were undertaken which formed the basis for the remedial design. Construction took place during the fall of 1997, which consisted of the following:

- excavation of the failed mass and embankment fill to a depth of approximately 3.5 m below the entire roadway surface over a 100 m length,
- installation of a 100 m long, 600 mm thick granular drainage blanket above a geotextile separation layer across the full width of the roadway, draining to the oxbow,
- construction of a 15 m wide toe berm along the west side of the roadway (230 m length), including above the 100 m long drainage blanket, and
- regrading the east ditch to flow north through a new culvert constructed under the ALPAC forestry road. The two centreline culverts were abandoned by construction of a compacted clay plug at the inlet end of each culvert.

Two new slope inclinometers were installed in November of 1997 to replace the instruments near the west shoulder of the roadway that were lost during the failure and subsequent remedial construction.

1997 through 1999

Annual site inspections and a semi-annual instrumentation monitoring program were initiated at the site in 1997.

No distress has been noted in the highway surface or side slopes since the 1997 construction.

Some small movements have been measured in the slope inclinometers located adjacent to the area remediated in 1997. The rate of slope movement is about 2 mm/year and is decreasing. Essentially no movement has been noted in the inclinometers installed in the area south of the 1997 repair.