THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

ALBERTA TRANSPORTATION
LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

NORTH CENTRAL REGION

SITE NC36: LAZY "S" SLIDE

LEGAL LOCATION:	SE29/SW28-56-8-W5M
NEAREST LANDMARK:	10 km South of Mayerthorpe
HIGHWAY CONTROL SECTION	HWY 22:32 km 30.34
DATE OF INITIAL OBSERVATION:	2004
DATE OF LAST INSPECTION:	June 10, 2008
LAST INSPECTED BY:	Thurber Engineering Ltd.
INSTRUMENTS INSTALLED:	2 Slope Inclinometers (2006) 3 Standpipe Piezometers (2006)
INSTRUMENTS OPERATIONAL:	2 Slope Inclinometers (2008) 3 Standpipe Piezometers (2008)
RISK ASSESSMENT:	PF(9) CF(4) = **36** (2008)
LAST UPDATED:	April 2009, Thurber Engineering Ltd.

1. LOCATION

The site is located on Highway 22:32 about 240 m north of Township Road (TR) 564 and about 10 km south of Mayerthorpe, Alberta.

2. GENERAL DESCRIPTION OF DISTRESS

The site is located mostly in the northbound lane of the highway. Approximately 43 m of highway is affected by arc-shaped cracking which extends just past the centerline slightly affecting the southbound lane. In 2008, the differential across the crack was up to about 40 mm with a noticeable depression over the slide feature. Based on recent instrumentation results, the zones of movement appear to be between about 3.5 m and 4.5 m below ground surface extending below the twin centerline culverts. The water table is located about 3 m below ground surface.

Along the east toe of the highway embankment, there is a pair of buried 1200 mm diameter culverts ("parallel pipes") carrying ditch flow north from TR564 to a natural swale at the site. The ditch water then flows through the skewed centerline culverts (also 1200 mm diameter) into a treed gully west of the site. The distress at this site began in 1999 when Alberta Transportation excavated part of the highway to connect the parallel pipes to the centerline culverts. The temporary excavation failed affecting the highway and the disturbed material was removed and replaced with pit-run gravel. It was observed during excavation that the fill was wet and underlain by corduroy wood presumably placed during original construction to bridge soft subgrade soils.

In 2004, the slide began to move again affecting the highway. At the time of the call-out visit in June 2004, the height differential across the 43 m long crack was up to 60 mm. This area was patched that same year to improve ride quality. The annual site inspection the following year, 2005, identified a toe roll along the centerline culverts but affecting the parallel pipes. Additional cracking was observed in 2006 in both lanes south of the main crack beyond the limits of the 2004 patch. The main crack had fully reflected through the patch by 2007. As of 2008, the differential height across the crack was up to about 40 mm and the general area is about 50 mm below the surrounding pavement height.

During the 2006 annual inspection visit, a new arc-shaped crack, about 13 m long, was observed north of the main slide location affecting the southbound lanes. A slight toe bulge was observed at the west toe of the embankment. The crack was located in an area that had been recently patched. As of 2008, the crack at this second location had widened to about 5 mm and there was a noticeable depression about 50 mm deep in the cracked area.

In 2008, another crack was observed in the southbound lanes. This one was located above the centerline culverts and about 5 mm wide.

The annual inspections have also observed that there does not appear to be any flow through the culverts. In addition, the inlet grate located in the east ditch (for flow not contained in the parallel pipes) is often covered with significant amounts of silt and debris. There has also been about 300 mm of standing water in the culvert below the grate since inspections began at this site.

The highway distress, at both locations, is likely related to weak foundation soil, high groundwater levels, and poor surface drainage. However, the newer area of distress north of the twin centerline culverts is likely a shallow slump. Based on the 2006 geotechnical investigation, the clay fill is relatively wet with moisture contents up to about 40%. The underlying native clay is high plastic, relatively weak and generally wetter than the clay fill. Clay till was encountered below the soft clay and had moisture contents generally less than 20%. There was no mention of organic material on the test hole logs from the investigation.

It has been recommended that the main slide could be stabilized using a toe berm and improved site drainage. This would involve abandoning the existing centerline culverts and installing new culverts.

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

Physiographic Region: Eastern Alberta Plains of the Interior Plains (1969, Atlas of Alberta, University and Government of Alberta).

Bedrock Geology: The bedrock at the site is non-marine sandstone and bentonitic mudstone with thick coal beds of the Scollard Formation (Map 236). The bedrock elevation is about 670 m (Map 57) which is about 45 m below ground surface. The bedrock dips north toward a bedrock channel approximately coincident with the present-day Paddle River.

Surficial Geology: A large-scale (1:500,000) surficial geology map indicates that the site is located in an area of fine-grained sediments (silt and clay) deposited in ice-contact lacustrine environment with undulating to hummocky topography. Just to the north of the site are the fine sand, silt, and clay fluvial deposits of the Paddle River valley.

Hydrogeology: The Scollard Formation bedrock would have an expected yield of 0.3 L/s to 1.6 L/s groundwater flow with lesser flows expected from the overlying sediments. The elevation of the regional groundwater table is located above the bedrock at elevation 700 m. Regional groundwater flow is toward the Paddle River

and then northeast along the river. Artesian flow conditions were not noted in the vicinity.

Stratigraphy: No plan/profile information or original construction records were available for this site. A geotechnical investigation was undertaken by Jacques Whitford in 2006 which involved the drilling of five test holes on both the east and west sides of the embankment.

Based on the test holes drilled in the main slide location, the soil consists of clay fill overlying soft, native clay, overlying clay till. The clay fill was about 1.8 m thick and had moisture contents up to 40%. The underlying soft, native clay extended to depths between 6.5 m and 8.5 m below ground surface. Natural moisture contents of the native clay were between about 30% and 50% and SPT N values (blows per 300 mm of penetration) were between 6 and 10. The slide movement appears to be occurring within this layer. The underlying clay till had moisture contents less than about 20% and SPT N values between 8 to 21. Similar soil conditions were encountered in the test hole drilled on the west shoulder.

Two of the test holes were drilled on the shoulders of the highway near the twin centerline culverts. The test hole on the east side encountered similar stratigraphy to those drilled at the main slide location. The test hole on the west side encountered about 5 m of clay fill overlying about 1.5 m of soft, native clay. However, at this test hole, the native clay was low plastic and the measured moisture content was about 28%. As at the other locations, clay till was encountered below the native clay.

4. CHRONOLOGY

1999

AT connected parallel pipes running along toe of embankment to the centerline culverts. During the excavation to make the connection, the temporary excavation slope failed. The fill encountered in the excavation was wet and underlain by corduroy wood. The slide area was excavated and rebuilt with pit-run gravel and the east pipe cut to facilitate ditch drainage.

2004

A call-out was undertaken by Thurber in June, as reported to AT in a letter to Mr. Rob Lonson, P.Eng., dated August 30, 2004. At this time, there was a 43 m length of affected roadway with a differential drop of about 60 mm. This distress was in the same location as the failure during the 1999 construction.

It was recommended that a toe berm with improved surface drainage would potentially mitigate the movements. The original culverts should be abandoned and replaced to match improved ditch drainage.

A patch was placed over this area following the call-out visit to temporarily improve ride quality.

2005

The site had its first yearly inspection under the North Central Annual GeoHazard Assessment program.

2006

A geotechnical investigation was carried out by Jacques Whitford. Two slope inclinometers and two standpipe piezometers were installed at the top and bottom of the highway embankment on the east side and a third standpipe piezometer was installed on the west shoulder. Two additional test holes were drilled in the east and west shoulders near the twin centerline culverts.

The yearly site inspection identified a new crack north of the main slide location and twin centerline culverts.

2008

A new crack was identified in the southbound lanes over the twin centerline culverts during the annual site inspection.

5. REFERENCES

1. University and Government of Alberta, 1969. "Atlas of Alberta."

2. Ozoray, G.F. 1970. "Hydrogeological Map, Wabamun Lake, Alberta, NTS 83G". Alberta Research Council, Map 103, Report 72-8.

3.Alberta Research Council, 1971. Map No. 57. "Bedrock Topography of the Wabamun Lake Map-Area, NTS 83 G, Alberta".

3. Hamilton, M.N., Price, M.C., and Landenberg, C.W. (compilers), 1999. Geological Map of Alberta, Alberta Geological Survey, Alberta Energy and Utilities Board, Map No. 236 , scale 1:1,000,000.

4. Shetsen, I. 1990. Quaternary Geology, Central Alberta. Alberta Geological Survey, Map 213.

5. Canadian Centre for Mapping, Department of Energy, Mines and Resources, 1989. NTS 1:50,000 Topographic Map, 83 G/14: Mayerthorpe, Alberta.

6. Alberta Transportation, Geotechnical Files.