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THURBER

ALBERTA TRANSPORTATION
LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

PEACE REGION
(SWAN HILLS)

SITE SH7: ISLAND CREEK SLIDE

LEGAL LOCATION:	**SE33-71-9-W5M**
NEAREST LANDMARK:	**22 KM SOUTH OF JCT HWY 2 AND 33 52 KM NORTH OF SWAN HILLS**
Highway Control Section:	**HWY 33:14 km 22.620 to km 23.180**
Date of Initial Observation:	**1996**
Date of Last Inspection:	**2004**
Last Inspected By:	**Thurber Engineering Ltd. (Thurber)**
Instruments Installed:	**6 Slope Inclinometers (1998), 2 Standpipe Piezometers (2000)**
Instruments Operational:	**3 Slope Inclinometers (2004), 1 Standpipe Piezometers (2004)**
Risk Assessment:	PF(8) · CF(1) = **8**
Last Updated:	July 2004 – Thurber Engineering Ltd.

1. LOCATION

The site is located on the southwest side of Highway 33:14 approximately 52 km north of the Town of Swan Hills and about 1.1 km south of the Island Creek Bridge (Figure 1.1, Section G).

2. GENERAL DESCRIPTION OF SLOPE INSTABILITY

Hwy 33 is aligned parallel to the crest of the Swan River valley slope near the slide location and then descends the valley slope onto the broad flood plain where it crosses Island Creek about 500 m north of the slide site. Prior to the highway realignment in 2000, the slide limits used to extend from the centreline of the existing highway where the back scarp was located, all the way down the valley slope to the flood plain level. A series of subdued scarps were noted at various levels on the valley slope through the slide mass.

A second larger slide was present to the south of the study slide but was not affecting the highway (Drawing 15-76-10-1, Section G).

This site was first affected by the retrogressive slumping in 1996 and Thurber conducted a geotechnical investigation in that year. Between 1998 and 2000, GAEA Engineering Ltd. (GAEA) conducted further investigations at the site, installed 6 slope inclinometers, and developed several remediation alternatives.

It is believed that the slide was originally caused by erosion at the toe of the valley slope from a tributary of the Swan River and over the years the slide propagated up the slope eventually reaching the road location in about 1996. The extent of the slide and the location of the slip zone were well established through site surveying of tension cracks and slope indicator readings, as shown on Cross-section A-A', Section G. These indicated that the slip zone extended steeply down through the road fill and then horizontally outward through the upper part of a varved clay deposit. From there the slip zone appeared to parallel the slope surface down to the valley floor.

The groundwater table was relatively high at the site and it is likely that slide movements were greater during wetter periods such as spring breakup when there was a rise in the groundwater table.

In 2000, Thurber installed 2 standpipe piezometers and provided the detailed design for a highway realignment away from the slide area with construction completed in the same year. As part of the work, the former road embankment was removed to partially unload the slide area. Since the remedial work, no distress has been observed on the highway surface.

Since the realignment and slope unloading in 2000, the movement observed in the

slope inclinometers (SI), when there is discernable movement, has been limited to creep of less than 2 mm between monitoring events.

Only one cross-section of three SIs and one standpipe piezometer have been monitored. Copies of the routine monitoring inspections including slope indicator and piezometer plots for the monitored instrumentation are included in Sections C and D while the instrumentation plots for discontinued instruments are in Section G.

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

Physiographic Region: Swan Hills Upland (1969, Atlas of Alberta, University and Government of Alberta).

Bedrock Geology: The bedrock at the site is nonmarine grey feldspathic clayey sandstone, bentonitic mudstone, and bentonite, with scattered coal beds of the Wapiti Formation. Depth to bedrock is likely greater than 15 m.

Surficial Geology: No information available.

Hydrogeology: The bedrock at this site may be capable of providing groundwater flow up to 2 L/s though immediately to the west, the sands and gravels of the Swan River valley may be capable of up to 8 L/s. Near-surface groundwater flow is interpreted to be downward at this location with horizontal flow toward the Swan River to the west and ultimately to Lesser Slave Lake to the north. A flowing well was reported to the north of the site within the same Section. Some groundwater seepage was observed in the slide mass at the site.

Stratigraphy: Based on Thurber's 2000 geotechnical investigation, the soils at the site consisted of clay fill over a till-like clay over varved clay and silt over clay till. Bedrock was not encountered. The clay fill contained traces of gravel, coal chips, clay shale, and peat. The till-like clay was medium to high plastic, sandy, and contained traces of pebbles, shale, and coal. The varved clay was a horizontally-laminated high plastic clay and silt. The clay till was medium to high plastic, sandy and silty, and containing traces of gravel and coal. A pre-construction site plan and stratigraphic cross-section are included in Section F. Test holes logs from GAEA's investigations (SI installations, test pile drilling, and test pitting) and Thurber's investigation are included in Section G.

4. CHRONOLOGY

1977

Highway was constructed.

1996

The slide began to reach the highway and Thurber performed a geotechnical site investigation. The report was submitted in 1997.

1998

A detailed geotechnical investigation was done by GAEA. During GAEA's investigation of the site ending in 2000, they installed six SIs, drilled five 600 mm test pile holes, and dug several test pits in the right ditch.

1999 - 2000

GAEA presented a geotechnical report, based on the 1997 investigation, that recommended several remedial options: construct a toe berm, install a pile retaining wall, place drains in highway ditch and finger drains on sideslope, realign the highway, replace existing highway structure with light-weight fill.

The light-weight fill option was dependent on the availability of recycled tire chips, which were unavailable for this project. The pile wall option was considered to be too expensive, hence the highway re-alignment option was selected. The area to the east (backslope) had been recently cleared and used for borrow which would facilitate the realignment.

2000

The detailed design and construction administration for the highway re-alignment was carried out by Thurber. EXH Engineering Services Ltd. were retained as subconsultants responsible for geometric design and surveying. Four additional test holes were drilled at the site: two to determine the existing highway structure and two deep holes to confirm subsurface soil conditions. Two standpipe piezometers were installed in the deep holes.

The key features of the realignment design were:

- minimum horizontal shift of 7.5 m at midpoint of affected section of highway with total re-alignment length of 480 m
- minimum grade lowering of 0.5 m at midpoint of affected section of highway
- unload existing road fill from slide area to provide finished side slope of 4H:1V for shifted roadway
- lower right ditch to 1 m below top of new subgrade
- install subdrain 2 m below base of right ditch

The highway realignment was carried out as additional work for an overlay project between April and June 2000. Seeding was completed in August. The prime contractor for the slide repair work was Wapiti Gravel Supplies, Division of N.P.A.

Ltd., Thurber provided supervision, engineering, and quality control testing for the slide repair, and GAEA was responsible for the main overlay and side sloping contract. The final as-constructed cost was $422,742.

In November and December 2000, the subdrain in the right ditch was extended down the hill to the north and straw bale ditch checks were installed to abate a ditch erosion problem that was starting to develop. Gravel drainage slots were also installed in the right side slope at intervals along the highway to improve the drainage of the highway gravel base course.

REFERENCES

1. Thurber Engineering Ltd., December 21, 2001. "Project Summary Report, Slide Repair 50 km North of Swan Hills, Hwy 33:14, km 22.620 to km 23.180, Amendment to Contract 5992/99, Peace Region." File 15-76-10.

2. Thurber Engineering Ltd., April 11, 2000. "Highway 33:14 Island Creek Slide Area Slope Stability Assessment." File 15-76-10.

3. GAEA Engineering Ltd., February 2000. "Supplementary Engineering Reports: Hwy 33:14 – Klumph Creek & Hwy 33:14 Island Creek Slide Areas."

4. Alberta Research Council, 1978. "Hydrogeological Map, Lesser Slave Lake, Alberta (83-O)."

5. Alberta Research Council, 1976. "Bedrock Topography of the Lesser Slave Lake Map Area, NTS 83 O, Alberta."

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