June 21, 2007 File: 15-85-73

Alberta Infrastructure and Transportation
Room 301, Provincial Building
9621 – 96 Avenue
Peace River, Alberta
T8S 1T4

Attention: Mr. Ed Szmata, Senior Support Technologist

PEACE REGION – SWAN HILLS AREA - GEOHAZARD ASSESSMENT (CE047/2004)
CALL-OUT FOR EMBANKMENT FAILURE (SH 25)
ON HWY 744:04 ~KM 45, 3 KM NORTH OF MARIE REINE, ALBERTA

Dear Sir:

This report presents the results of a call-out for a site located as described above and as shown on the attached Figure 1. Mr. Barry Meays, P. Eng. of Thurber Engineering Ltd. conducted the inspection on June 14, 2007, during the 2007 Geohazards Assessment inspection tour. Mr. Ed Szmata of Alberta Infrastructure and Transportation (AIT) made the request for the call-out.

1. BACKGROUND

The site is new, and as such has not been documented during the annual landslide tours. The site is located on the west side of the highway. The following information was obtained from Mr. Ed Szmata of AIT during the call-out visit:

- The slide was first noticed last fall by area residents, but AIT was only notified this spring;
- The site is located on the opposite side of the highway and a 100 m south of where a previous highway slide repair took place about 10 years ago;
- At this site, Township Road 822 (which has a gravel surface) runs in a direction somewhat parallel to but skewed westwards from the highway as it progresses south, separated by the township road embankment which also forms the highway backslope. The slide consists of slumping on this

common ground, a portion of which has transgressed into the edge of the township road shoulder; and

- There are no apparent problems with the highway itself at this site. No other site history is known.

2. OBSERVATIONS

A sketch plan showing the limits and extent of the slides labelled as Slides 1 and 2 on June 14, 2007, is provided on Figure 2. Selected photographs taken during the site reconnaissance are also attached.

The slides were located on common ground forming the west highway backslope and the east township road embankment. Slide 1 is located further south (centered about 25 m north of the beginning of the curve). Slide 2 is further north (separated from Slide 1 by about 15 m), and is presently contained entirely within the common ground area.

Slide 1 is about 20 m wide and extends about 12 m long down the slope. The scarp extends about 1 m into the east shoulder edge of the Township Road, and appears to toe out inside the caragana thicket (although the toe push was not readily apparent). The scarp is identified by a crack about 18 m in total length, although the portion that intersects the road is 7 m long by 150 mm wide by 0.5 m deep. The township road embankment was approximately 7.5 m high, and inclined at approximately 30º to 32º above the caraganas. The west edge of the highway was separated from the east edge of the road by about 22 m horizontally.

Slide 2 had overall dimensions in plan view of about 50 m by 12 m. The scarp was about 1.0 to 1.5 m high, and was located in the embankment between 1 m to 3.5 m from the east edge of the township road. The soil exposed in the scarp appeared to be silty, medium to high plastic clay fill. The toe pushed into the center of the west highway ditch at a couple of locations, and was as high as 0.4 m. The total height of the embankment varied from 5 m at the north end to about 6 m at the south end of the slide on an approximate 26º to 28º slope.

No seepage or surface water was observed within the slide outlines, in the highway ditches or on the west side of the township road. The slope and highway ditch was grassed, except for the caraganas that are approximately shown on Figure 2. Bush existed south of the caraganas and adjacent to the south side of the township road. The west highway ditch sloped downwards to the south at an approximate 4% slope.

Two barricades existed at the time of the inspection, straddling overtop the Slide 1 scarp crack and east township road shoulder. Lathe with red ribbon had been placed in the scarp crack.

3. ASSESSMENT

The failures appear to have been predominantly the result of too steep a slope for the medium to highly plastic clay (fill over native) embankment material. Since the slide happened last fall, details on the rainfall events at that time could not be qualified (which may have softened the clay and helped trigger the slides). Based on current observations there does not appear to be a high water table through the slide mass. In addition, gradual weakening of the clay fill by weathering processes consisting of freeze thaw and wetting and drying cycles could also have contributed to slide formation.

The pattern of cracks, toe observed in Slide 2, and the general slide outlines suggest the predominant direction of slide movement was perpendicular to the embankment contour lines. The Slide 1 outline implies that the caragana thicket may have influenced its shape, and possibly curtailed the slide from extending further downslope.

Examination of the 1:50,000 topographic map indicates that this site is located on the western cusp of a tributary to the Heart River. This may have accounted for the old landslide repair performed about 10 years ago on the other side of the highway, but does not appear to have any immediate connection to the slumping observed at this site.

4. RISK LEVEL

In the short term there is some risk that Slide 1 could retrogress further into the east driving lane or the center of the graveled Township Road, which could impact traffic safety and cause partial closure. Similarly Slide 2 could retrogress into the road with time. However, the risk of total closure of the entire road is relatively small. There does not appear to be any danger to Highway 744:04, although toe debris could impede or block ditch drainage.

Based on the AIT's Risk level rating system, the risk level for this site has been assessed as follows:

Risk (30) = PF (10) x CF (3) [Eq. 1]

This risk level was based on a Probability Factor (PF) of 10 (active with a moderate steady rate of movement) and a Consequence Factor (CF) of 3

(site having a moderate fill, where partial closure of the township road or a detour is a direct result of the slide movement).

5. RECOMMENDATIONS

Slide #1 is currently affecting the township roadway and both slides could continue to retrogress further into the road. The barricades that are currently erected should be maintained around the slide area to warn motorists of the hazard and the slide should be inspected on a regular basis so that barricades can be moved and traffic signs or signals set up, or a detour constructed if the slides worsen.

For the short term, it is recommended that the gravel surface and the top edge of the slide areas should be regularly inspected and filled/graded to bridge the open cracks and scarp to reduce water infiltration into the slide cracks, and to taper runoff off of the graveled surface onto the sideslope.

Since there is no available space to flatten the slope within the existing right of ways, the recommended long-term solution is to subexcavate the area between and entailing the failed slide masses down to intact clay and rebuild the slope with imported crushed gravel. The new crushed gravel fill material should be placed and compacted in thin horizontal lifts, benched into the intact slope surface. A gravel shear key or possibly driven treated timber piles may also be needed to stabilize the slide area. The excavated clay would have to be hauled offsite. A subdrain should be installed along the base of the slide excavation backslope, to drain any surface/subsurface water that may enter the rehabilitated slide mass. Another requirement will be to strip the topsoil and caraganas from the slide area and replace and seed the topsoil upon completion of the repairs. The ballpark cost of this work, excluding land and engineering costs is about $400,000 to $500,000.

Alternatively, the slope could be flattened from its existing inclination to the order of about 3H:1V or 4H:1V, and relocating the north-south portion of the township road further west into private land. It is estimated that a 20 m wide strip of property parallel to the township road would be required. The above repairs will require land negotiation and acquisition and a right-of-way extension. However there is a residence located in this immediate proximity, therefore, there is the possibility of objections from the landowner. It is anticipated that this scenario would generate excess cut material, which would require a disposal site. The new roadway and subgrade could be constructed with some of the excess material placed and compacted in thin horizontal lifts. Any portion of the existing slide not excavated as part of the new cut slope should be further sub-excavated and recompacted by benching into the intact slope surface, and installing a subdrain, along with stripping and replacing/reseeding the new topsoil. Assuming that a 100 m length of roadway is shifted, the ballpark cost of this work, excluding land and engineering costs is estimated to be $150,000 to $200,000.

As a third alternative, a pile wall could be considered, however the cost for this alternative would likely be much higher (~ in the order of $1,100,000), assuming 75 m in length.

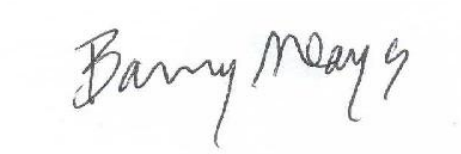
6. ADDITIONAL INVESTIGATION AND DESIGN

Geotechnical drilling, a topographic site survey and slope stability analyses is recommended prior to carrying out the remedial measures to determine the required details of the above options and to provide the most cost effective design. It is recommended to drill two test holes near the edge of the township road near the center of each of the slide backscarps, and two test holes in the ditch at the toe of the slope. Piezometers should be installed in each test hole to assess groundwater levels. It is recommended that this investigative work be carried out prior to preparation of a tender package to properly expedite repairs and to provide a cost beneficial solution.

7. CLOSURE

We trust that the above information is sufficient for your present requirements. However, if you have any questions or require any additional input please do not hesitate to call us.

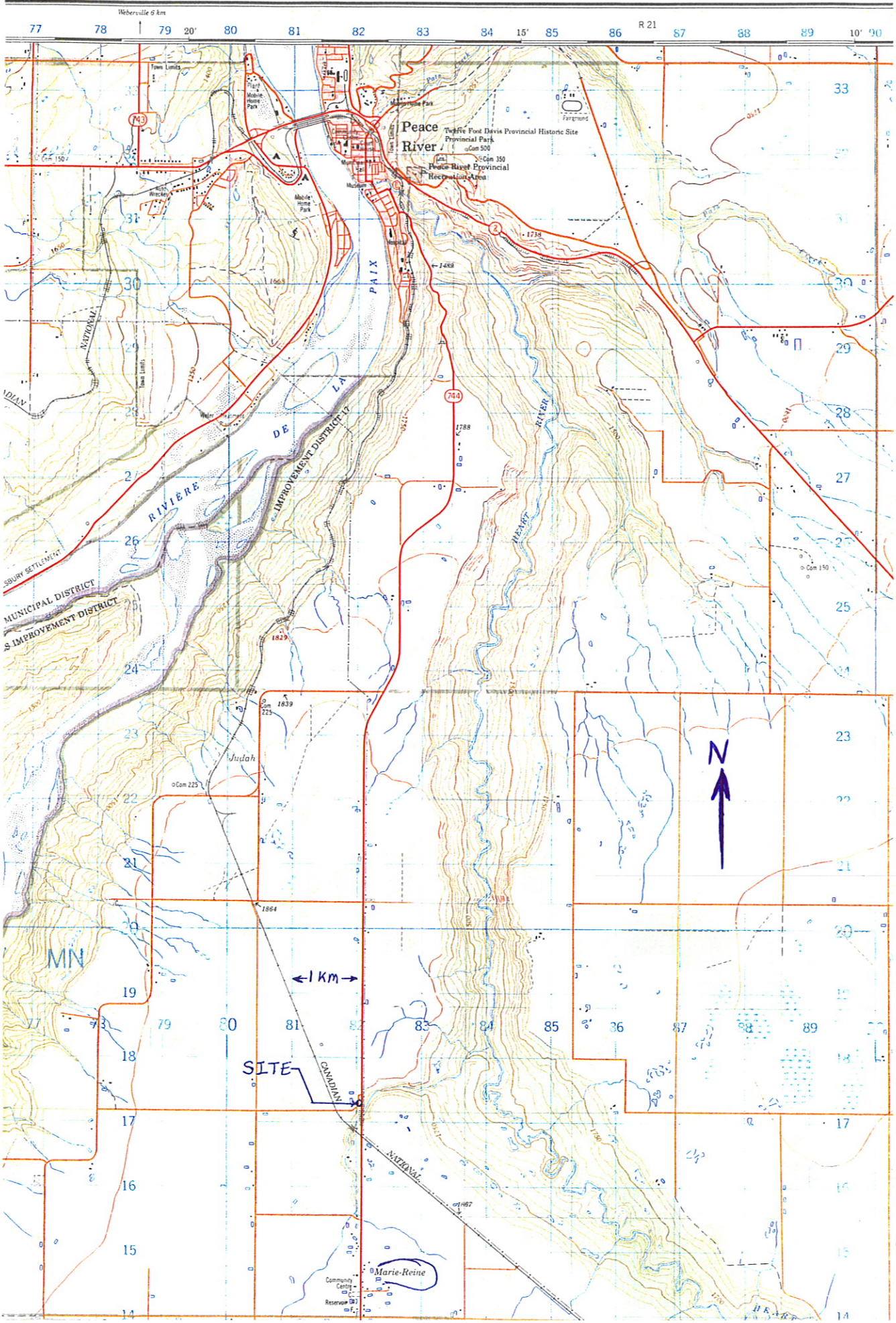
Yours truly,
Thurber Engineering Ltd.
Don Proudfoot, P. Eng.
Review Principal



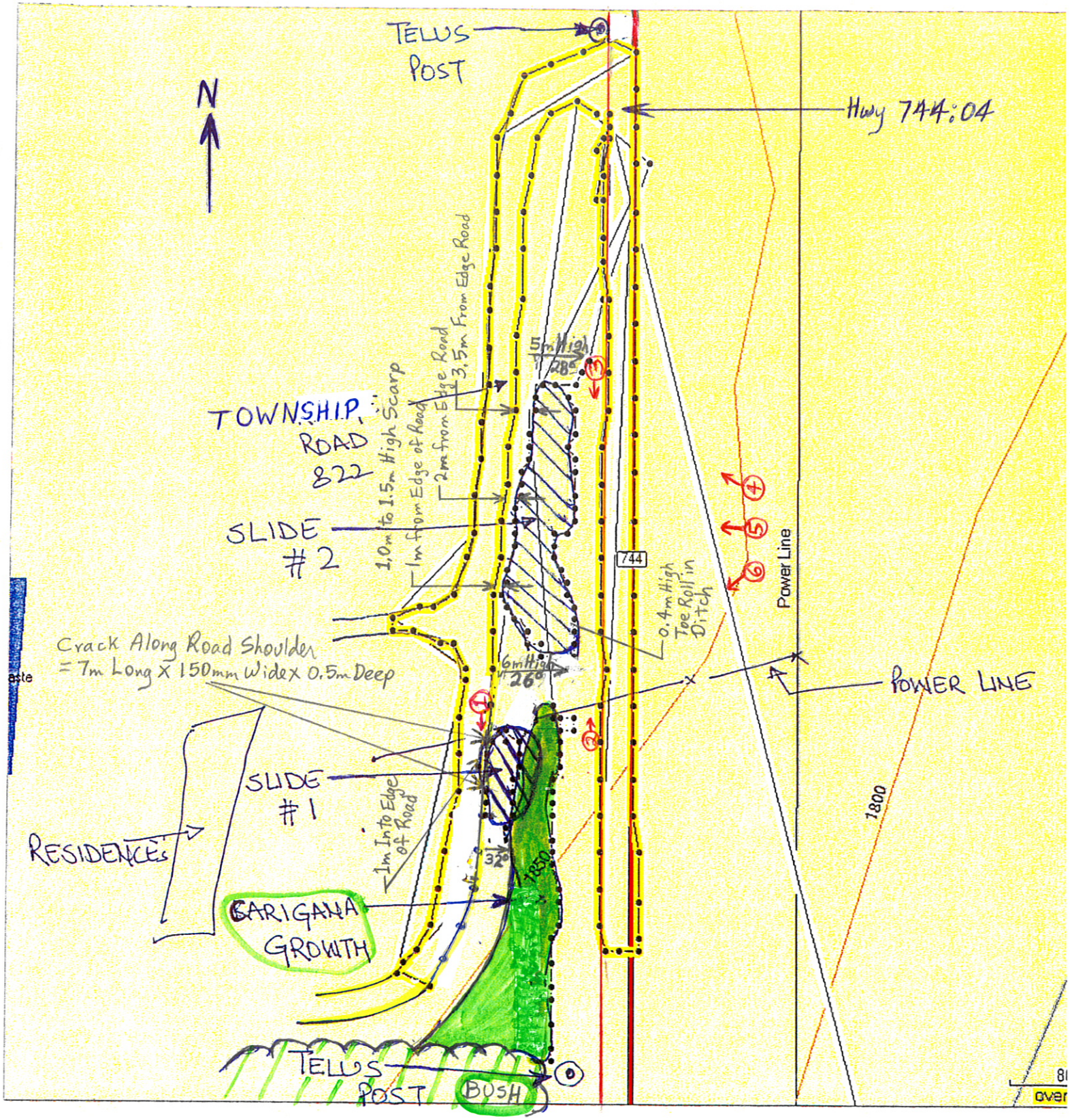
Barry Meays, P.Eng.
Project Engineer
/dw

Attachments

cc: Mr. Roger Skirrow, P. Eng.
Geotechnical Director, Alberta Infrastructure and Transportation



SITE LOCATION PLAN
FIGURE 1



① → PHOTO NUMBER AND DIRECTION

Approx. Scale 1:1,000

ALBERTA INFRASTRUCTURE AND TRANSPORTATION	
SITE PLAN SHOWING MARIE-REINE SLIDE	THURBER ENGINEERING LTD.
CALL OUT JUNE 14, 2007 — HWY 744:04 3 KM NORTH-MARIE REINE — JUNE, 2007 — 15-85-73 FIGURE 2	

Photo 1 – Looking south at Slide 1 along edge of Twp. Road 822.

Photo 2 – Looking north along highway ditch and toe of Slide 2.

Photo 3 – Looking south along highway ditch at slide area.

Photo 4 – Looking west at north end of Slide 2.

Photo 5 – Looking west at south end of Slide 2.

Photo 6 – Looking west at Slide 1.