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THURBER

October 25, 2004

15-16-190

Alberta Transportation
Room 301, Provincial Building
Bag 900, Box 29
9621 – 96 Avenue
Peace River, AB T8S 1T4

Attention: Mr. Ed Szmata

PEACE REGION – PEACE HIGH LEVEL GEOHAZARD ASSESSMENT (CE049/2004) CALL-OUT FOR EMBANKMENT AND DITCH EROSION DISTRESSES ON HWY 986:01, DAISHOWA EAST ACCESS PH 7

Dear Sir:

This report presents the results of a call-out for a section of advanced ditch erosion along the south side of the highway between approximately Station 12+120 and 12+920 and a location of slope instability located downslope of the recently completed pile wall along Hwy 986:01 east of the Peace River. Mr. Don Proudfoot, P. Eng. of Thurber Engineering Ltd. conducted the inspection on September 22, 2004. Mr. Ed Szmata of Alberta Transportation (AT) who was present during the site reconnaissance, made the request for the call-out.

1. BACKGROUND

Background information for the callout sites was previously provided in the site binder.

Ditch erosion was noted along the south side of the highway during our June 2004 annual hazard inspection trip. A few previous attempts were made to correct the erosion problem. Due to a significant amount of rainfall since our June 2004 trip, the erosion became significantly worse, prompting the callout request.

During our June 2004 site visit, the construction work at the pile wall site was still in progress and there was no visual evidence of slope instability. It is understood that the remedial measures associated with the pile wall construction were completed by July 2004 under the direction of AMEC Earth and Environmental Ltd. (Amec). During the early part of the work (winter/spring 2004), soil excavated from

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the pile wall area was stockpiled downslope in the area of the current failure as shown on the attached Figure 2. The stockpile was later removed and the soil used to reconstruct the upper part of the slope after completion of the pile wall in June to July 2004.

The shallow slides in the lower slope have developed since completion of the pile wall.

2. DITCH EROSION

2.1 Observations

Figure 1 shows the approximate extent of the ditch erosion which spans about 800 m along the south highway ditch from approximately Station 12+920 to the centerline culvert at Sta. 12+120 and then north from the outlet of the culvert cutting down through the slope below the highway to a natural marshy pond area about 115 m north of the highway. Photos 1 through 8 show the extent of the erosion.

The ground surface north of the culvert outlet slopes at about 5 degrees for about 45 m and then dips at about 15 degrees for another 50 m before flattening out over an additional 20 m length into the pond. At the outlet of the culvert there is a scour hole of about 0.8 m in depth by 1.2 m in width. The erosion channel, extending north of the culvert, has a maximum depth of about 3 m, top width varying from 3 to 5 m and base width of less than 1m, roughly below the inflection point between the 5 and 15 degree slopes.

Based on the above measurements there is a total drop of about 16.5 m over a length of about 95 m resulting in a gradient of about 17 percent along the base of the erosion gully.

As shown on Photo 3, a non-woven geotextile, perhaps in conjunction with gravel or riprap, had been placed along the gully bottom in the past. However, since the depth of the gully extended below the geotextile it appears that this technique was not sufficient to prevent further down cutting of the erosion gully.

A significant amount of silt has been deposited in the pond as shown in Photo 1.

The centerline culvert is about 35 m in length with a drop of about 0.2 m between the inlet and outlet. The culvert is about 750 mm in diameter.

Measurements of the approximate width and depth of the erosion channel upstream of the culvert were as follows:

Station	Top Width (m)	Maximum Depth (m)
12+220	1.2	0.2
12+320	1.5	0.4
12+420	1.5	0.4
12+520	3.0	2.5
12+620	2.0	0.2
12+720	5.0	2.5
12+820	1.1	1.1
12+920	1.1	0.5

Asphalt pieces were present in the ditch bottom between about Sta. 12+320 and Sta. 12+470 that had presumably been placed in the past to help abate erosion.

The highway and south ditch section are sloped at a grade of about 7% over the length of the erosion section.

2.2 Assessment

The ditch gradient is too steep to handle the runoff flows that have occurred at the site. The gradient of the erosion channel north of the culvert outlet is even steeper resulting in more aggressive erosion down slope of the culvert. The erosion in the ditch and erosion channel are expected to worsen until proper erosion protection measures are implemented.

2.3 Risk Level

The Risk Level for this site has been assessed as 24. This is based on a Probability Factor of 12 (Active erosion with moderate but increasing rate of erosion) and Consequence Factor of 2 (erosion problem that is not affecting highway but could impact safety of motorists).

2.4 Recommendations

It is understood that AT are concerned that the more deeply eroded ditch sections are now causing a potential traffic safety hazard and hence would like to carry out some site improvements in the near future.

It is recommended that short term measures be carried out this year to mitigate the immediate safety concern consisting of ditch shaping and minor filling with coarse pitrun gravel the areas of most concern along the south highway ditch to form a smoothed out ditch channel. In particular this would include sections such as near Sta. 12+520 and Sta. 12+720 to 12+820. The ballpark cost of this work might be about $10,000 to $20,000. This will only provide a short term fix and with time we expect that runoff will erode some of the gravel and the clay beside and below the gravel.

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Additional design is recommended to determine the most appropriate long-term repair since some unsuccessful attempts have already been made to fix the erosion problem. As a minimum, air photos and rainfall records should be reviewed to assess the drainage area feeding the ditch and expected runoff flows for various design rainfall events. The results of this assessment can be used to assess flow volumes and velocities in the ditch and erosion gully and design the proper ditch cross-section (depth and area) and required armouring and culvert diameter. The erosion gully extending north from the culvert could probably be transformed into a ditch by filling and compacting the bottom with clay and flattening and shaping the sideslopes. This will result in a grade of about 17% and based on experience from previous jobs, the transformed ditch will need to be lined with gabion mattress or heavy riprap placed over a gravel bed over non-woven geotextile.

Alternatively a better solution might be to use a smooth wall welded steel drop pipe buried within the existing gully to convey water from the culvert to the pond. The gully could then be backfilled, topsoiled and seeded.

Assuming high flow soil covering and gabion ditch checks along the south ditch, a larger diameter culvert and drop pipe for the steep gully section north of the culvert, the estimated cost for the long term repair could be in the order of $200,000 to $350,000.

3. SLIDE BELOW PILE WALL

3.1 Observations

Figure 2 and 3 show a sketch plan and cross-sections of the slide(s) located downslope of the pile wall. Selected photographs of the slide(s) are also attached.

At the time of the site visit, a well-developed slide was present in the slope below the east portion of the pile wall. The slide had a total length of about 75 m from flank to flank and was located approximately within the footprint of the soil stockpile that was temporarily placed over the lower slope during pile wall construction. The backscarp of the slide was located within about 5 m to 10 m downslope of the centerline of the pile wall. There was a well defined toe roll as shown on the photographs and Figure 2.

Additional backscarp cracking was also noted extending to about the western limit of the former slide area and pile wall. However, this portion of the slope had not moved sufficiently to form a definite toe roll.

Other observations of note were a wet spot and some ground subsidence in the vicinity of Pile 25. Also, as shown on Photo 11, water flowing in the creek in the valley bottom continues to erode the toe of the valley slope causing additional instability in the lower slope area.

3.2 Assessment

The slide appears to be a relatively shallow rotational slide. The limits of the slope failure closely correspond to that of the 2003 slide. The pile wall was designed to stabilize the portion of the slope above the wall where the highway is located but not the section of slope located below the wall where the current instability is located. The soil below the current slide was likely remolded from past slide events and the placement of the temporary soil stockpile during pile wall construction in this area may have further weakened the soil.

Now that the slope has failed and is in a cracked condition, further growth of the slide is expected especially over the west part of the site where slide cracks have already begun to appear. Rainfall entering the cracks could accelerate movements.

3.3 Risk Level

The assessed Risk Level is 26 based on a Probability Factor of 13 (Active with high rate of movement, steady or increasing) and Consequence Factor of 2 (moderate slope where slide does not impact the highway but with time the creek and/or the pile wall could be affected if sliding continues to progress).

3.4 Recommendations

It is recommended that the slide condition be dealt with before it begins to remove support from the downslope side of the pile wall. The recommended immediate remedial measure is to seal and track pack the slide cracks with clay to reduce potential surface water infiltration into the slide mass. A tracked backhoe would likely be the best piece of equipment to complete this work.

A potential short to medium term fix is to subexcavate all of the failed slope area, bench the back and sides of the cut and reconstruct the slope using moisture conditioned clay placed in thin well compacted horizontal lifts. The goal of this option is to reinstate some cohesion in the slope and reduce water infiltration to attempt to get a few more years of service out of the slope before long term measures can be implemented. The work should be done under the supervision of an experienced geotechnical inspector. Slope reconstruction as described above could cost in the order of $40k to $60k. This work should be completed in warm dry weather conditions and hence should probably be delayed until next spring. Amec should be consulted to assess whether the proposed measures will have any negative effect on the stability of their pile wall before the work is undertaken.

A recommended long term remedial option, which would address the current slope stability problem as well as the instability in the lower portion of the slope near the creek, is to backfill the creek valley up to the level of the berm that is present

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further to the east and then place additional fill above the berm level to flatten the section of slope located immediately below the pile wall.

A similar valley infill procedure has been utilized immediately east of the pile wall and at another location further upstream.

With this option, the approximately 30 m long section of valley located between the two existing berm sections could also be infilled and the existing culvert that is present in the base of the valley below the berm could be removed. The creek could then be rerouted over the top of the berm fill and then stepped down the west end of the new berm extension via a rock lined drop structure.

These long term measures will require some site survey, hydraulic and fisheries input and further slope stability assessments in order to prepare a suitable design.

The long term measures could cost in the order of $400,000 to $500,000 to complete.

4. 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

Don Proudfoot

Chris Workman, P.Eng.
Project Engineer, Associate

/slp

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

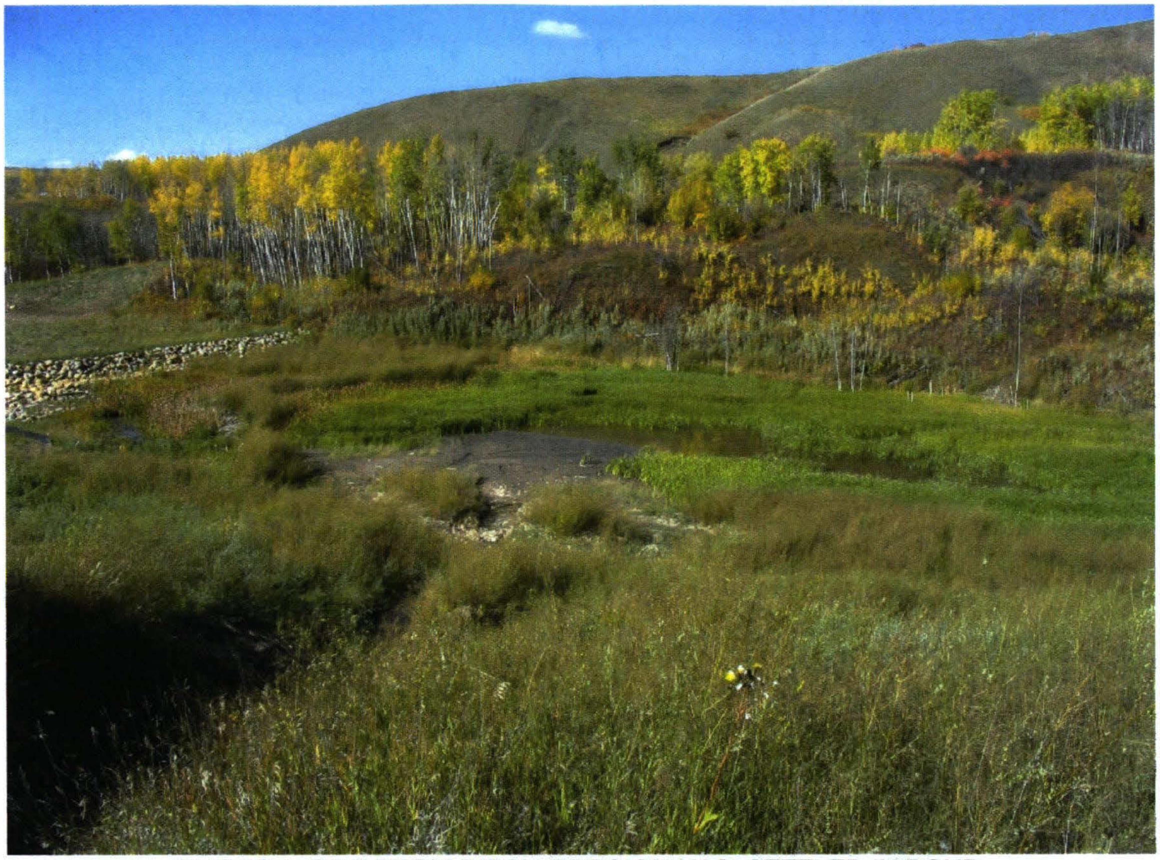

PHOTO 1 SILT FROM DITCH EROSION HAS SETTLED IN POND

PHOTO 2 NORTH END OF EROSION CHANNEL NEAR OUTLET TO POND

PH7 - DAISHOWA EAST ACCESS

HWY 986:01 - SOUTH DITCH EROSION - SITE #6

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PHOTO 3 DEEPEST PART OF EROSION CHANNEL IS ABOUT 3m DEEP

PHOTO 4 SCOUR BELOW OUTLET OF CULVERT

PH7 - DAISHOWA EAST ACCESS
HWY 986:01 - SOUTH DITCH EROSION - SITE #6
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PHOTO 5 LOOKING UPSTREAM (EAST) FROM INLET OF CULVERT AT ABOUT STA. 12+120

PHOTO 6 LOOKING UPSTREAM FROM ABOUT STA. 12+320

PH7 - DAISHOWA EAST ACCESS

HWY 986:01 - SOUTH DITCH EROSION - SITE #6

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PHOTO 7 LOOKING DOWNSTREAM FROM ABOUT STA. 12+520

PHOTO 8 LOOKING DOWNSTREAM FROM EAST END OF ERODED DITCH AT ABOUT STA. 12+920

PH7 - DAISHOWA EAST ACCESS

HWY 986:01 - SOUTH DITCH EROSION - SITE #6

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PHOTO 9 LOOKING WEST AT SLIDE IN SLOPE BELOW PILE WALL

PH7 - DAISHOWA EAST ACCESS
HWY 986:01 - PILE WALL AREA
SEPT. 22, 2004 CALL OUT
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PHOTO 10 LOOKING EAST AT SLIDE TOE ROLL

PH7 - DAISHOWA EAST ACCESS
HWY 986:01 - PILE WALL AREA
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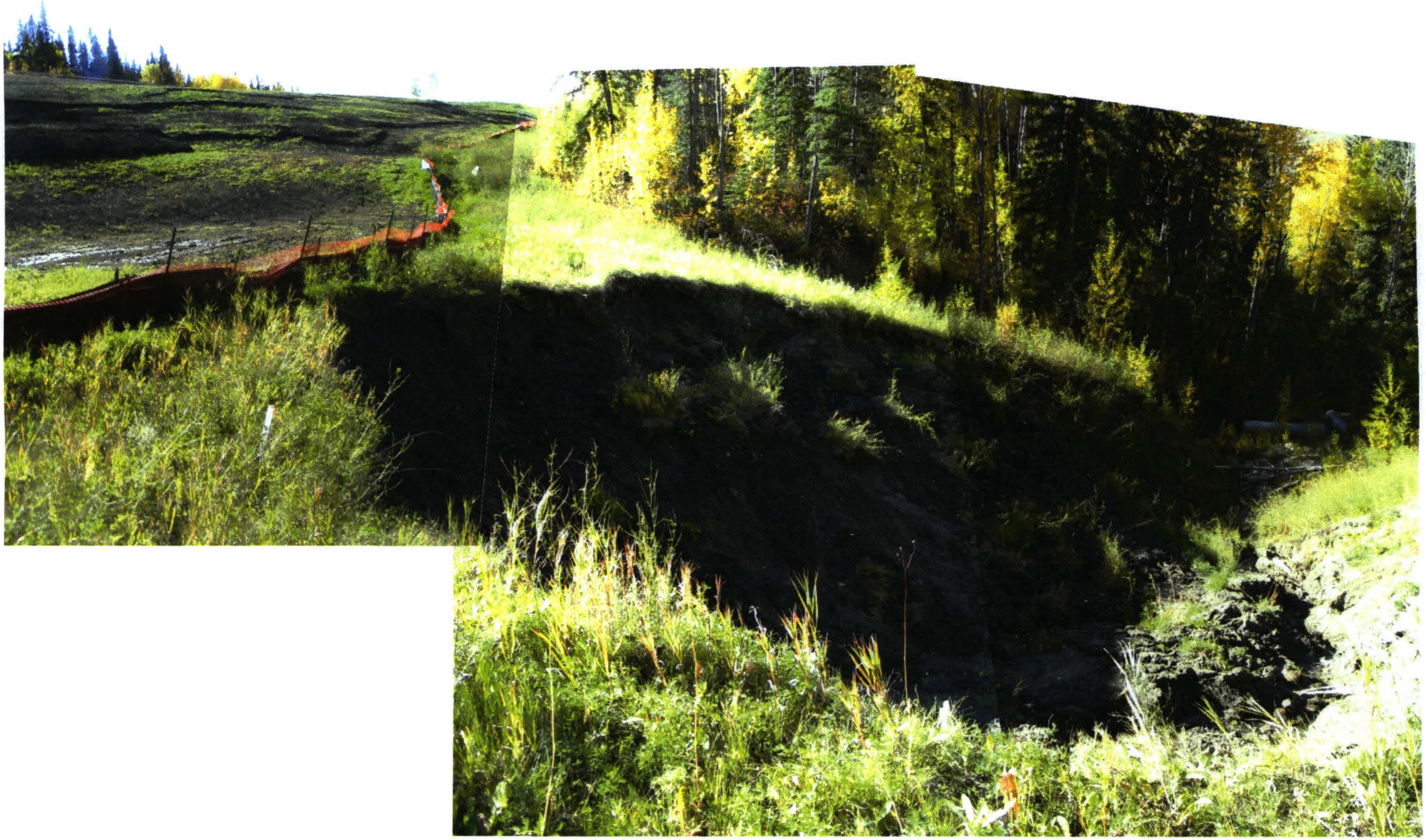

PHOTO 11 CREEK EROSION AND SLUMPING AT TOE OF LOWER SLOPE

PH7 - DAISHOWA EAST ACCESS
HWY 986:01 - PILE WALL AREA
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PHOTO 12 LOOKING WEST AT SLIDE AREA

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PH7 - DAISHOWA EAST ACCESS
HWY 986:01 - PILE WALL AREA
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