



December 4, 2007

15-85-66

Alberta Infrastructure and Transportation
Unit 2, Jewell Building
3603 – 53 Street
Athabasca, Alberta
T9S 1A9

Attention: Mr. Arthur Kavulok

**NORTH CENTRAL REGION GEOHAZARD ASSESSMENT
(CE143/2006)
CALL-OUT FOR ROADWAY DISTRESS DUE TO FROST HEAVE
ON HWY 777:03, NC 61**

Dear Sir:

This report presents the results of a call-out for the above noted site located on Hwy 777:03 approximately 12 km south from the junction of Highway 654 and 777 and 0.8 km north from the junction of Highway 651 and 777. Mr. Don Proudfoot, P. Eng. and Mr. Masud Karim, M.Sc. of Thurber Engineering Ltd. conducted the inspection on May 24, 2007. Mr. Arthur Kavulok of Alberta Infrastructure and Transportation (INFTRA) made the request for the call-out. Mr. Rick Ellwein, the highway Maintenance Contract Inspector (MCI) and Mr. Rocky Wang of INFTRA were present during the visit.

1. BACKGROUND

We understand that a 200 m section of the highway has been undergoing frost heave and related roadway distress for more than ten (10) years. It is understood that the distress shows up as uneven bumps in the winter and soft spongy areas and locations of settlement in the spring after the ground thaws. Each year the frost heave occurs at a different location within the 200 m stretch of the highway. This has become a significant problem for the local farmers who use the highway with their heavy vehicles.

It was discussed that Highway 777 was originally finished with cold mix asphalt (oil bound surface). The soft spots that develop within the distressed area have been replaced by adding 3 inch minus crushed gravel fill over the last 3 years. Apparently there were also previous attempts to fix the problem by installing sub-drains and ditching along the side of the highway (by the County). However,



every time the ditching was done the road surface had started spreading outwards. The MCI typically places 300 – 400 tonnes of gravel each year to keep the highway level.

INFTRA took over maintenance of the Highway from the local County 3 years ago. We understand that in last year the frost heave was not as bad compared to previous years.

2. OBSERVATIONS

The roadway surface, the ditches and side slope areas on both sides of the distress highway alignment were inspected during the reconnaissance. Selected photographs taken during the site reconnaissance are attached. A sketch plan showing the location and extent of the roadway distress and other site features is provided on Figure NC61-1, along with a cross-section through the highway embankment.

The problem area was currently being levelled by gravel by INFTRA which was visible during the site visit. The bulging in the side slopes of the problem area was visible, which was the result of spreading of the gravel layer sideways. There was a wet spongy soft spot almost at the middle of the highway where a previous sub-drain might have been placed. The ditch along the west side of the highway was full of water and had small older trees growing in it but there was no sign of muskeg in the ditch.

3. ASSESSMENT

Based on the observations made during the site reconnaissance the uneven roadway surface is likely the result of high groundwater table, with possible springs, seasonal freezing temperatures, and the presence of frost susceptible silty soil beneath the road. Geotechnical investigation is required in order to confirm the soil conditions. It is expected that, if left untreated, the seasonal roadway distress will continue.

4. RISK LEVEL

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

$$\text{Risk (18)} = \text{PF (9)} \times \text{CF (2)}$$

This risk level was based on a Probability Factor (PF) of 9 (active with moderate seasonal movement) and a Consequence Factor (CF) of 2 (site having a shallow



fill, where the frost heave issues affect the use of the roadway and safety of motorists, but does not require closure of the roadway).

5. RECOMMENDATIONS

The potential for frost heave can be reduced by improving drainage, preventing ground freezing and/or removing frost susceptible soils.

In the short term, the MCI should continue to monitor the roadway surface for any soft spots and maintain the road surface in a smooth condition through ongoing grading and addition of gravel. The site drainage should also be reviewed to see if clearing of vegetation from the ditches and construction of take-off ditches could be implemented to drain the standing water out of the existing ditches without deepening them.

A possible long term solution is shown on Figure 1. It consists of subexcavating the roadbed to 1.5 m depth, installing a continuous geocomposite drainage layer (like Tenax's Roadrain) over the exposed subgrade and reconstructing the roadway with common fill and pitrun gravel placed over biaxial geogrid. The geocomposite drainage layer should be tied into new subdrains installed at about 1.5 m depth below each side ditch.

The subdrains would need to be installed and backfilled in short sections (about 6 m in length) to reduce the risk of the road spreading laterally into the subdrain excavation. Upon backfilling the ditch should be reshaped and lined with clay (minimum 300 mm). For added protection against frost heave a layer of high strength rigid insulation could be installed over the geocomposite drainage layer to further reduce the risk of freezing of the underlying frost susceptible subgrade.

Assuming the above measures are applied to about 200 m of roadway, the ballpark cost would be \$350,000 without insulation and \$400,000 with insulation.

6. 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.

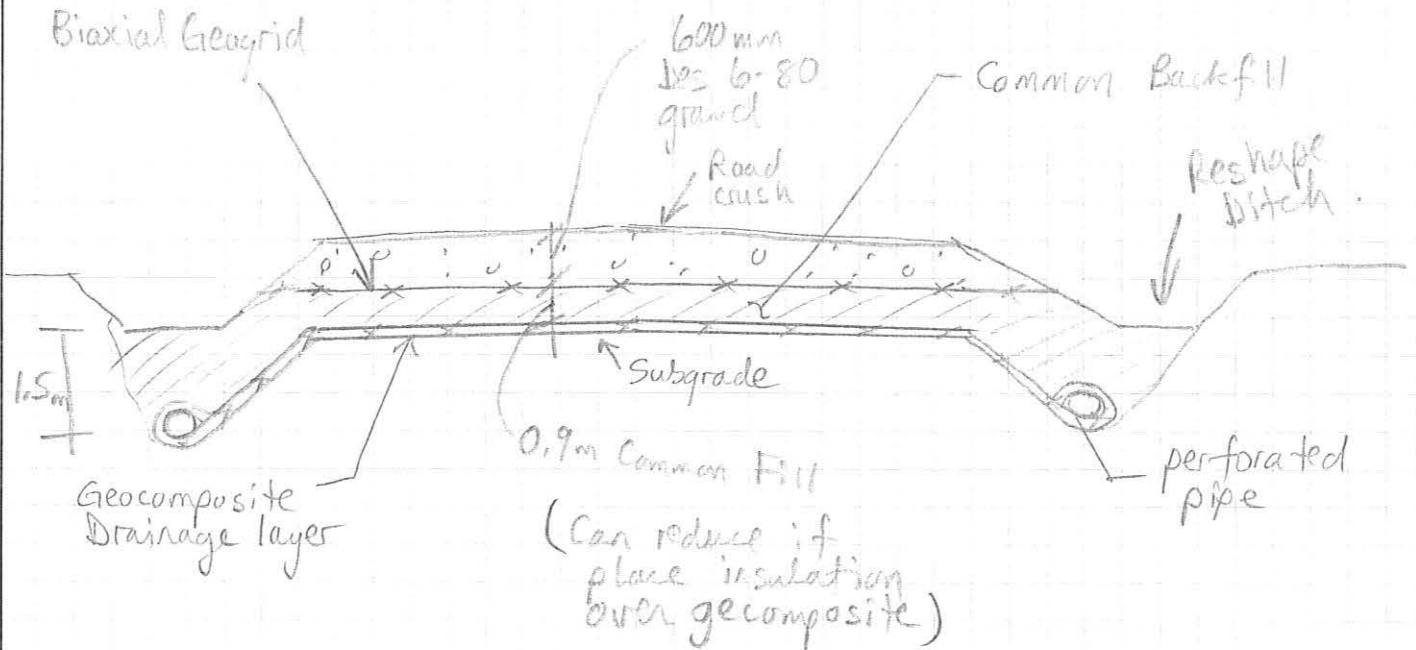
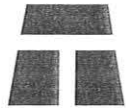
Yours truly,
Thurber Engineering Ltd.
Don Proudfoot, P. Eng.
Review Principal



Masud Karim, M.Sc.
Project Coordinator
/dw

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

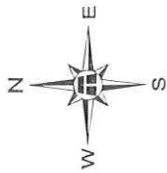
SITE SKETCH PLAN



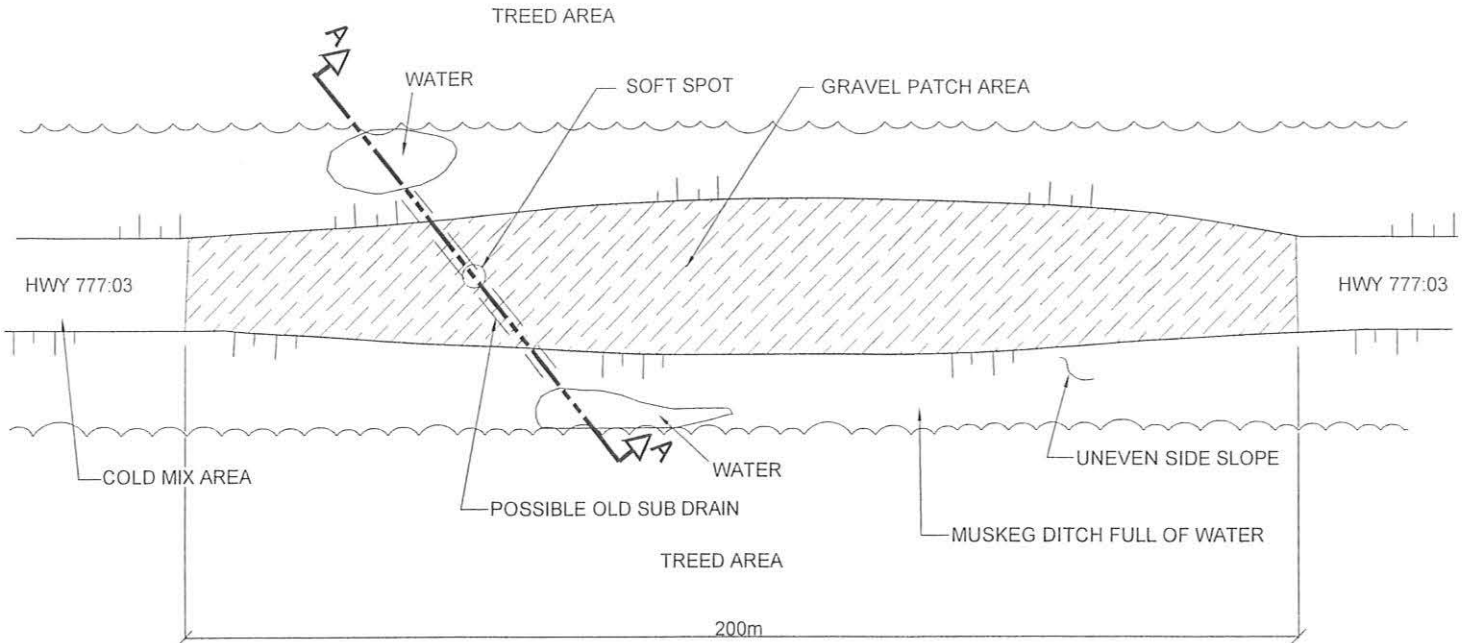
Conceptual Design for Roadbed Reconstruction

Figure 1

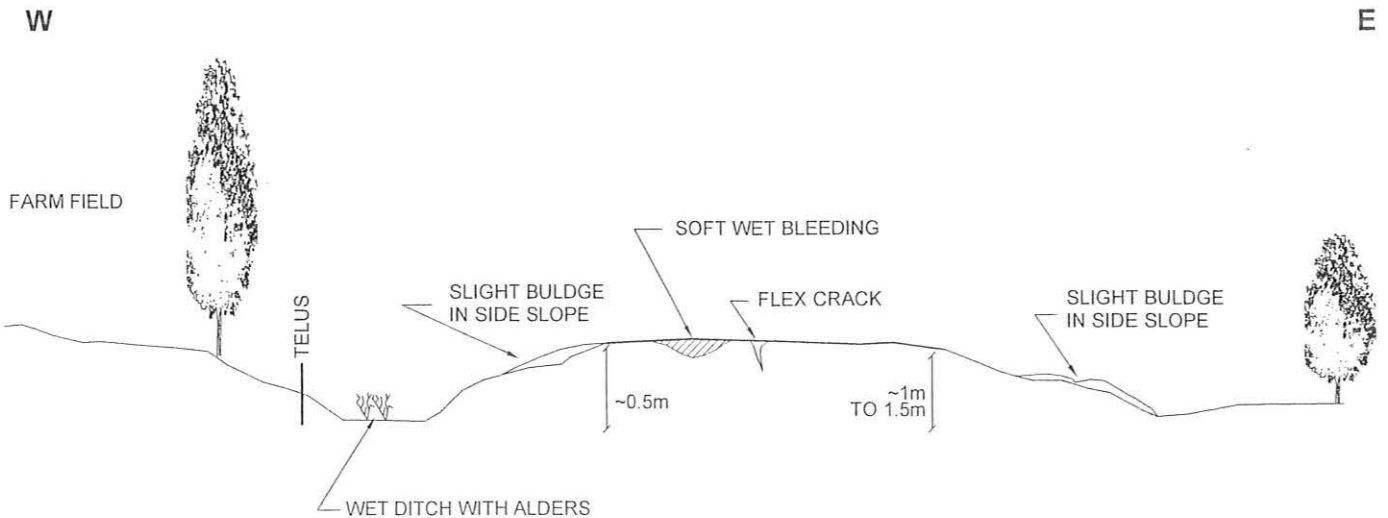
NC 61



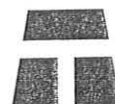
PLAN VIEW



SECTION A-A



**FIGURE NC61-1 SKETCH SITE PLAN
NC61 HWY 777:03**



SELECTED PHOTOGRAPHS



Photo 1 - Looking East at the Soft Spot.



Photo 2 - Looking South at the West Ditch.



Photo 3 - Looking at the Roadway Surface at the Distress Area.



Photo 4 - Looking West at a Depressed Low Lying Area with Ponded Water.