December 9, 2005 File: 15-85-11

Alberta Infrastructure and Transportation
Room 223, Provincial Building
4709–44 Avenue
Stony Plain, Alberta
T7Z 1N4

Attention: Mr. Michael Baik

NORTH CENTRAL REGION GEOHAZARD ASSESSMENT
HWY 32:10 km 33.6 SELECT CONTROLS SUBSIDENCE (NC45)
CALL OUT INSPECTION REPORT

Dear Sir;

This letter documents a call out undertaken by Thurber Engineering Ltd. (Thurber) for the above noted site located southwest of Whitecourt, Alberta. The legal land description is 33-59-12-W5M. The work was undertaken under the terms of our Geotechnical Services for Geohazard Assessment, Instrumentation Monitoring and Related Work contract (CE046/2004, Part D) with Alberta Infrastructure and Transportation (AIT).

The inspection was undertaken on May 31, 2005 by Mr. Don Law, P.Eng. of Thurber. The reconnaissance was carried out in the presence of Mr. Roger Skirrow, P.Eng., Mr. Mike Baik and Mr. Daryl Yagos (MCI) of AIT.

1. BACKGROUND

As part of grade widening work undertaken on Hwy 32:10, a gabion retaining wall structure was constructed within the highway right of way in July and August of 2003 to maintain a lawn area for a house/business owned by Select Controls Ltd. at the above noted location.

It is understood from Mr. Yagos that distress was first noted to the wall in the form of sink holes at the top of the wall and sand piles forming at the base of the wall in the spring of 2005. At the beginning of May 2005, subsidence was noted by the landowner within the lawn area on private property. It is understood that no underground sprinkler system exists in the lawn area in the vicinity of the wall. It is further understood that no geotextile was placed between the wall and the native soil at the time of construction.

Due to the alignment of the depression in the lawn area with the sag in the fence, the largest sinkhole and the largest pile of sand at the toe of the wall, it is expected that these distress features are interrelated and represent the most active zone of piping.

The piping is not expected to have a detrimental effect on the structural integrity of the gabion wall. However, if left untreated, further piping will likely occur which may increase the size of the existing sinkholes and may also cause further depression of the feature in the lawn area. New sinkholes and/or depressions back from the wall may also form in the future.

4. RISK LEVEL

There is no risk to the highway from the distress noted at this site.

5. RECOMMENDATIONS

5.1 Potential Remedial Measures

It is recommended to undertake remedial measures at the site to control the piping, and to rehabilitate existing areas that have been impacted. The “do nothing“ option is not recommended due to the likelihood of further development of sinkholes and ground subsidence within the adjacent private property.

A clay cap combined with placement of a non-woven geotextile on the back face of the wall along its full length is recommended, as shown schematically in the conceptual design detail provided on Figure NC45-2. The non-woven geotextile should extend down the back of the wall to a minimum depth of 2 m. The clay cap should extend a distance of at least 6 m back from the wall and should be a minimum thickness of 1 m to provide an effective seal from infiltrating water. The clay cap should be extended back further in the area of the depression in the lawn to cover an area extending at least 1 m beyond the visible limits of the depression. The clay should be compacted in 200 mm thick lifts to at least 95% of Standard Proctor maximum dry density. A layer of non-woven geotextile should be placed between the clay and the native sand to provide separation. The as-built drawings for the wall should be reviewed prior to finalizing the design of the remedial measures.

A geomembrane should be placed as shown on the conceptual design detail (Figure NC45-2) to provide a lap for surface runoff water to be transmitted to the face of the wall. This is considered important to reduce the risk of water running down the back side of the wall and impacting native sand behind the wall. A review of the as-built drawings for the wall will allow refinement of the design of these details. A minimum clay thickness of 300 mm should be placed above the

2. SITE OBSERVATIONS

The following points summarize the observations made during the reconnaissance. Site features are shown on the site plan (Figure NC45-1), attached for inclusion in Section F. A cross-section through the wall and subsidence feature is provided in Figure NC46-2. Selected photographs taken during the site reconnaissance are attached.

- The gabion wall was approximately 95 m long and 3 m high at its highest point. The wall appeared in good shape from a structural standpoint; no sags or bulges were noted along the top or face of the structure. A chain link fence exists behind the wall approximately 4 m to 5 m from the gabion top.
- Four sink holes were noted in the soil immediately behind the wall, located approximately as shown on the site plan. Sinkhole #1 was the largest, with approximate dimensions of 1 m x 1 m x 0.65 m deep. Sinkhole #3 was about 0.4 m deep and Sinkholes #2 and #4 were smaller and somewhat shallower. A zone of fine sand was noted at the toe of the wall adjacent to Sinkhole #1, and also along a zone of the toe of the west end of the wall as shown approximately on the drawing. Other smaller sand zones were noted along the toe of the wall but are not shown on the drawing. These sand deposits appeared to have come from inside the wall relatively recently (i.e. Spring of 2005).
- A depression was noted in the lawn area covering an area approximately 15 m^2, located approximately as shown on the site plan. The depression was up to about 100 mm lower than the surrounding ground surface.
- Sags in the chain link fence were noted in a few locations along its length. The largest sag was noted in a location between the depression in the lawn area and Sinkhole #1.
- There was no seepage from the toe of the wall, and no evidence that seepage had occurred in the past.

3. EVALUATION

The formation of sinkholes behind the wall and sand deposits in front of the wall as observed during the site reconnaissance are consistent with the migration of fine sand (piping) from behind the wall through the open rock work within the gabion structure. The piping is likely caused by infiltration of water through the soil from precipitation events and snow melt. Due to the lack of evidence of seepage from the toe of the wall, the groundwater does not appear to be a source of water for the piping.

geomembrane to provide cover. A layer of topsoil should be placed above the clay. Grass should be reestablished in this area soon after construction to reduce the potential for future erosion.

The placement of the geotextile, clay cap and geomembrane as described above is expected to significantly reduce the infiltration behind the wall and may be sufficient to stop the piping. There is some risk however that the piping may persist below the clay cap. In addition to the clay cap and associated work, injection grouting may be considered to fill voids at depth behind the wall and below the depression within the lawn, and thereby provide a seal to further reduce the potential for future piping. Injection grouting may be considered during the initial remediation to augment the clay cap, or as a secondary measure should further distress occur after the clay cap is placed. The grout mixture, injection spacing and application pressure should be designed by an experienced contractor.

5.2 Estimated Construction Costs

The cost of the clay cap and associated work is expected to be in the order of $25,000 to $35,000. Injection grouting is expected to be an additional $10,000 to $15,000. The actual costs will be dependent on contractor availability and market costs at the time of tender.

6. CLOSURE

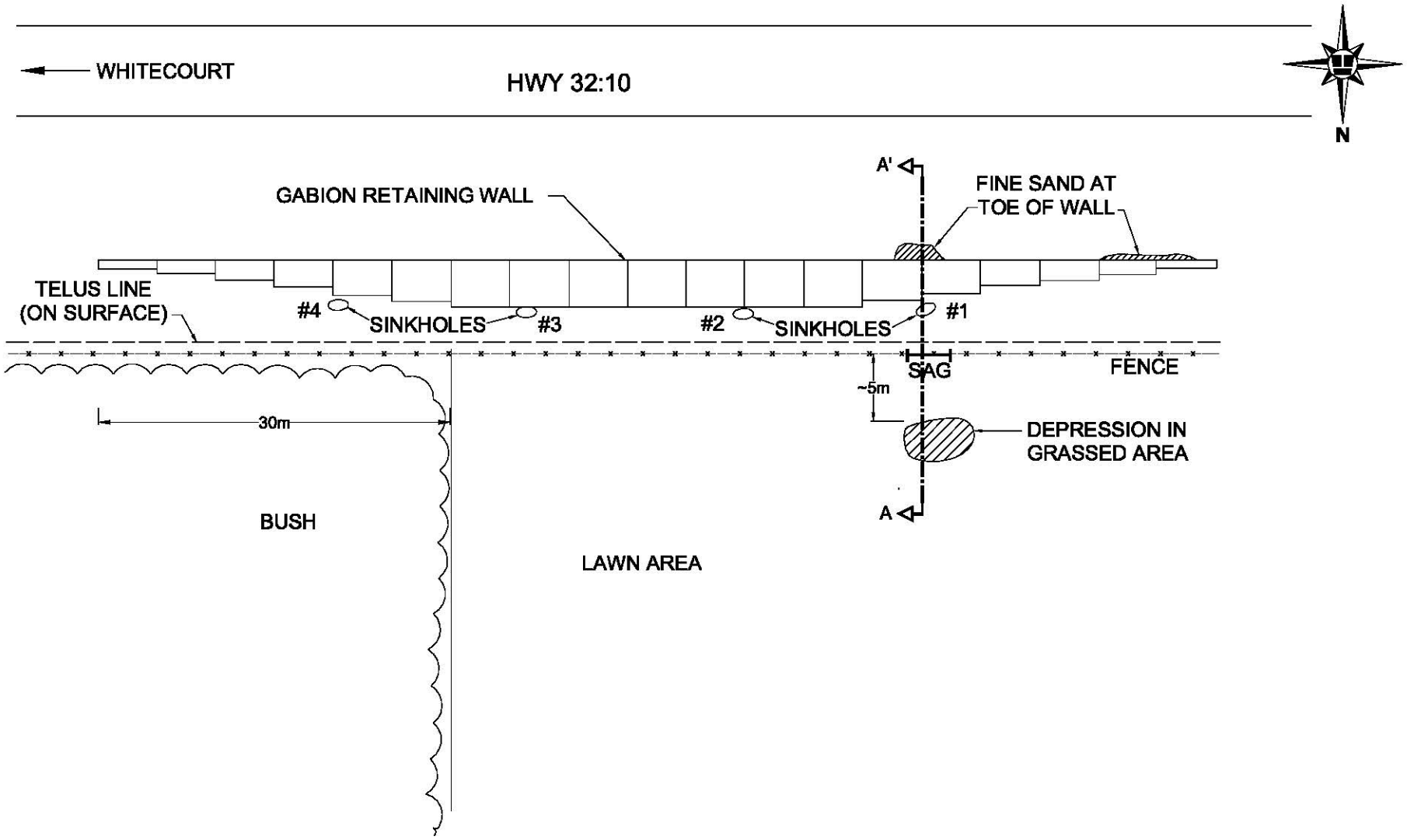
We trust this assessment meets your needs at this time. Please contact the undersigned should questions or concerns arise.

Yours very truly,
Thurber Engineering Ltd.
Dimitri Papanicolas, P.Eng.
Review Principal

Don Law, P.Eng.
Principal, Project Engineer
/slp

Attachments
cc: Mr. Roger Skirrow, P.Eng., Director of Geotechnical Services, AIT

Z:\15\15-85-11-NC\NC45\FIGURE NC45-1.dwg



ALBERTA INFRASTRUCTURE AND TRANSPORTATION

SITE PLAN

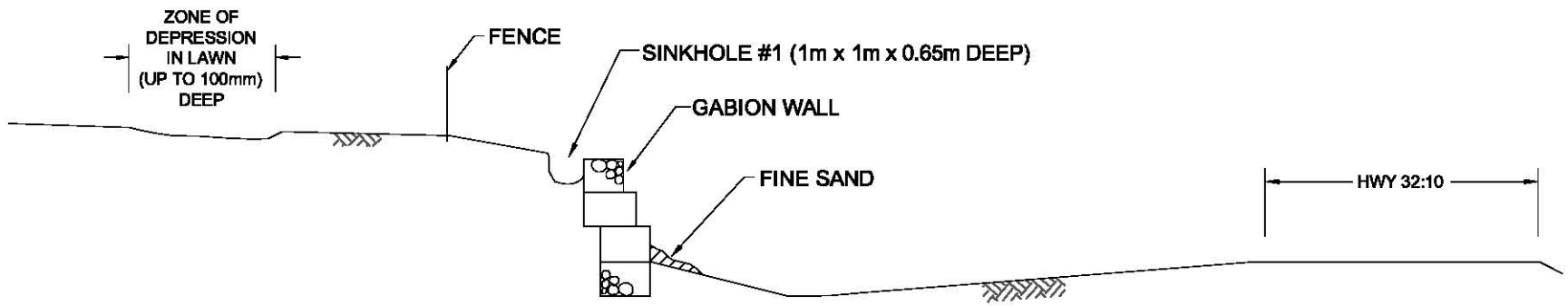
NORTH CENTRAL
GEOHAZARD ASSESSMENT

HWY. 32:10 km 33.6
SELECT CONTROLS SUBSIDENCE

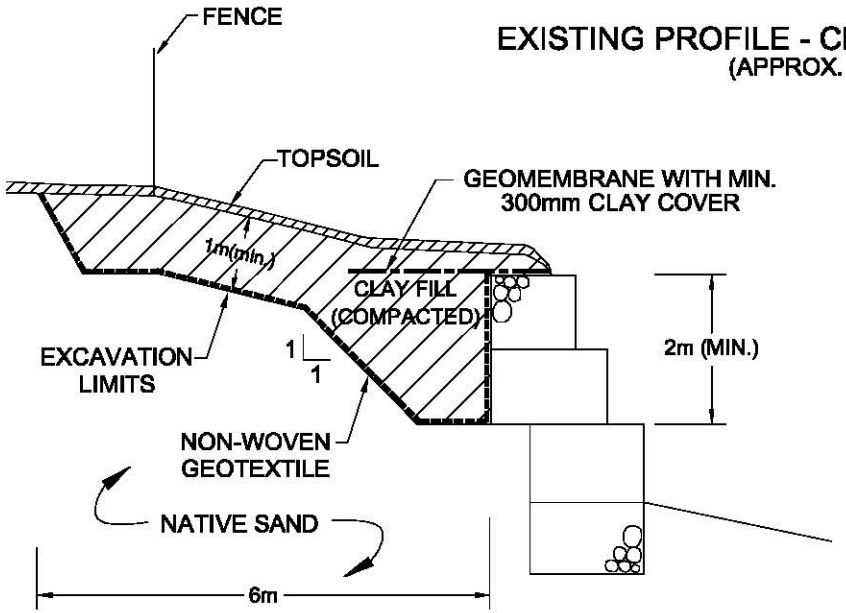
THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

ENGINEER:	DRAWN:	APPROVED:	
DJL	CMH		
DATE:	SCALE:	DRAWING No.	REV.:
DECEMBER, 2005	APPROX. 1:500	FIGURE NC45-1	

Z:\15\15-85-11-NC\NC45\FIGURE NC45-2.dwg



EXISTING PROFILE - CROSS-SECTION A-A'
(APPROX. 1:200)



CONCEPTUAL DESIGN DETAIL
(APPROX. 1:100)

ALBERTA INFRASTRUCTURE AND TRANSPORTATION

CROSS-SECTION A-A'
AND DESIGN DETAIL

NORTH CENTRAL
GEOHAZARD ASSESSMENT

HWY. 32:10 km 33.6
SELECT CONTROLS SUBSIDENCE

THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

ENGINEER:	DRAWN:	APPROVED:	
DJL	CMH		
DATE:	SCALE:	DRAWING No.	REV.:
DECEMBER, 2005	APPROX. AS SHOWN	FIGURE NC45-2	

Photo 1 – Looking east at west end of gabion wall. May 31, 2005

Photo 2 – Looking west at area behind wall (Telus line in foreground).
May 31, 2005

Photo 3 – Sinkhole #1. May 31, 2005

Photo 4 – Sag in Fence between Sinkhole #1 and depression in lawn.
(Looking west). May 31, 2005

Photo 5 – Depression in lawn area and sag in fence. May 31, 2005

Photo 6 – Depression in lawn area. May 31, 2005

Photo 7 – Depression in lawn area. May 31, 2005

Photo 8 – Fine sand deposit at toe of wall adjacent to Sinkhole #1. May 31, 2005

Photo 9 – Sinkhole #2. May 31, 2005

Photo 10 – Sinkhole #3. May 31, 2005