A TETRA TECH COMPANY

May 11, 2011

ISSUED FOR USE
EBA FILE: E12101085.004
Via Email: sabhago.oad@gov.ab.ca

Alberta Transportation
Second Floor, Provincial Building
4709-44 Avenue
Stony Plain, AB T7Z 1N4

Attention: Sabhago Oad, P.Eng.
Operations Engineer

Subject: April 15, 2011 Call Out Inspection
Embankment Overtopping and Slope Erosion
Hwy 825:02

1.0 INTRODUCTION

EBA, A Tetra Tech Company (EBA) is the firm providing project management and engineering services to Alberta Transportation (TRANS) for the Geohazard Risk Management Program for the North Central Stony Plain Region. On April 15, 2011, EBA was requested by TRANS to inspect an embankment on Hwy 825:02 where the highway embankment was overtopped by high flows from snow melt runoff. The inspection was conducted on the afternoon of April 15, 2011. EBA's site representatives for the inspection were Mr. Chris Gräpel, P.Eng., and Mr. Matthew Weatherby, E.I.T. The TRANS representatives were included Sabhago Oad, P.Eng., and one other operations engineer from the TRANS Stony Plain office.

2.0 SITE OBSERVATIONS

Upon arrival on site, EBA noted:

- The highway is a two lane secondary highway which was completely closed to traffic;
- The embankment appears is about 5 m high and has guard rails at the high section;
- The sideslopes of the embankment are sloped approximately 2H:1V;
- The upstream part of the embankment was inundated to within 0.5 m of the crest of the road;
- There was an emergency trench channel approximately 2 m wide excavated to the south of the high section, through the asphalt and into the embankment fill to a depth of about 1.5 m below top of asphalt. The height of embankment at this location was about 2 to 2.5 m;
- Water approximately 0.3 m deep was flowing through the trench;
- There is a culvert (estimated 1 m diameter) beneath the embankment to convey a creek beneath the highway;

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- The downstream slope of the embankment crossing was partially washed out. The extent of overtopping erosion is presented in the attached Figure 1. Three guardrail posts were suspended in mid-air at the time of the inspection. A vertical back scarp is present at the edge of the southbound lane about 3 m high. Eroded/slumped blocks of embankment fill are located at the bottom of the vertical scarp;
- There do not appear to be any signs of slope failure in the remaining lower sections of embankment slope on the downstream side. It is not possible to assess the condition of the upstream slope as it was inundated at the time of inspection;
- The creek runs along the toe of the former downstream toe of the embankment; and
- Efforts to unplug the culvert using water jets were underway during the start of EBA's inspection and were suspended shortly thereafter without success.

During the inspection TRANS advised EBA of the following:

- This section of highway is scheduled for widening in three years;
- The bridge file for the culvert indicates the culvert is likely undersized and may not have been constructed to department standards, as this section of road was formerly owned by the county. The culvert may have a bilinear alignment with a relatively sharp kink below center line;
- The overtopping event started late Monday April 11, 2011 with water depths of 0.3 m or more crossing the embankment;
- Carillion (the regional maintenance contractor) attempted to pump the water from the upstream side of the embankment without success on Tuesday;
- The trench was excavated across the road to divert water through a lower part of the embankment to avoid losing the high section of the embankment;
- There are two utilities located on the upstream side of the embankment – a waterline, diameter and purpose (municipal or industrial) unknown and a Telus fibre optic line;
- Repairs were required immediately to permit re-opening of the road as soon as possible; and
- The repair work would be conducted by Carillion, the regional maintenance contractor.

The overtopping appears to have started when the culvert beneath the road was blocked. The blockage appears to have been either due to woody debris as the area upstream of the culvert inlet has a high incidence of dead trees. Furthermore, downstream of the embankment there appear to be a significant number of dead trees, some cut down by beavers and others with chain saws.

3.0 DESIGN OF SLOPE REPAIR

The directions given to EBA by TRANS during the site inspection are:

- A temporary repair is required. Consequently, this site will be added to the GRMP so it can be regularly inspected, with maintenance work conducted to allow this site to function until the highway is widened; and
- Time is of the essence. TRANS wants to start repairs as soon as possible to prevent loss of a lane of the road.

While on-site, EBA made the following recommendations:

- The slope should be reconstructed using compacted gravel placed in lifts. This will require excavation of the loose materials left in place to an intact base. EBA recommended this work be conducted in sections to limit the length and height of unsupported back scarp slope left standing;
- The presence of the creek at the toe of the embankment means some degree of erosion protection will be required to keep future runoff events from eroding the toe of the reconstructed slope; and
- TRANS operations staff should contact their in-house environmental staff to see what permits, if any, are required to conduct slope reconstruction repairs near the creek.

A sketch of the required repairs is attached to this report as Figure 2. All design and construction recommendations are presented on that sketch.

The proposed repair is subject to a few uncertainties which are discussed as follows:

- Uncertain basal conditions below the reconstructed slope – Due to the urgency of the situation, a subsurface investigation was not conducted before the design was prepared. The existing slopes were standing at about 2H:1V so it seems reasonable to assume they were at least marginally stable. EBA has included a geogrid at the base of the reconstructive fill to provide additional lateral resistance. Additionally, it is recommended Carillion excavate at least one test pit near the toe of the slope to permit assessment of foundation conditions. The findings from excavating this test pit will be used to modify the design during construction, if possible, or to provide TRANS with a better understanding of the risks associated with the proposed design;
- Impact of a repeated overtopping event – Conducting the slope repair quickly is an appropriate course of action. However, in the event of continued rapid melting of snow or a sever rainfall event, it is possible, but not probable, that a repeat overtopping event could occur. This concern is raised as TRANS has not been able to draw down the impounded water upstream of the embankment; and
- Impact of long term impoundment of water – The impoundment of water behind the road has effectively turned the road embankment into a dam about 5 m high. There is a risk of seepage along the outside of the culvert or along more pervious layers of fill could initiate piping erosion that could result in an uncontrolled discharge downstream of the embankment. The placement of granular fill will serve to act as a filter that will retain the existing embankment fill particles under seepage gradient, at least at the higher sections of the embankment. EBA recommend that TRANS monitor the site and assess residences and infrastructure located downstream of the embankment. If residences

are located close to the creek, TRANS should consider warning the occupants of the situation upstream and make arrangements to have them evacuated if the embankment condition starts to deteriorate. Should conditions be observed to deteriorate, EBA recommends that the emergency trench channel be deepened as much as possible and widened. Equipment should be on site to permit this work to be done quickly.

4.0 COST ESTIMATE

4.1 Construction Cost

The rough order of magnitude construction cost estimate developed using judgment and experience is between $20,000 and $40,000. Quantities were not estimated for this work. This cost estimate is based on an estimate of the required volume of gravel - approximately 20 m long for a 2H:1V slope, 5 m high, 10 m wide = 500 m^3. This volume of gravel corresponds to a tonnage of about 1,125 tonnes, which at $14.27/tonne (based on NC-40 construction cost estimate which used TRANS Unit Price Averages) yields a gravel cost of $16,053. This cost was then used to judge the overall range of total construction cost.

4.2 Engineering Cost

The construction of the proposed repair will need to be monitored by engineering staff. EBA's field costs are estimated to be $10,000, assuming three days of construction, not including the cost of the call out.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use Alberta Transportation and their agents. EBA, A Tetra Tech Company, does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Alberta Transportation, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in EBA's Services Agreement. EBA's General Conditions are provided in Appendix A of this report.

6.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

EBA, A Tetra Tech Company

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May 11, 2011

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May 11, 2011

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PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature:
Date: May 11, 2011
PERMIT NUMBER: P245
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

FIGURES

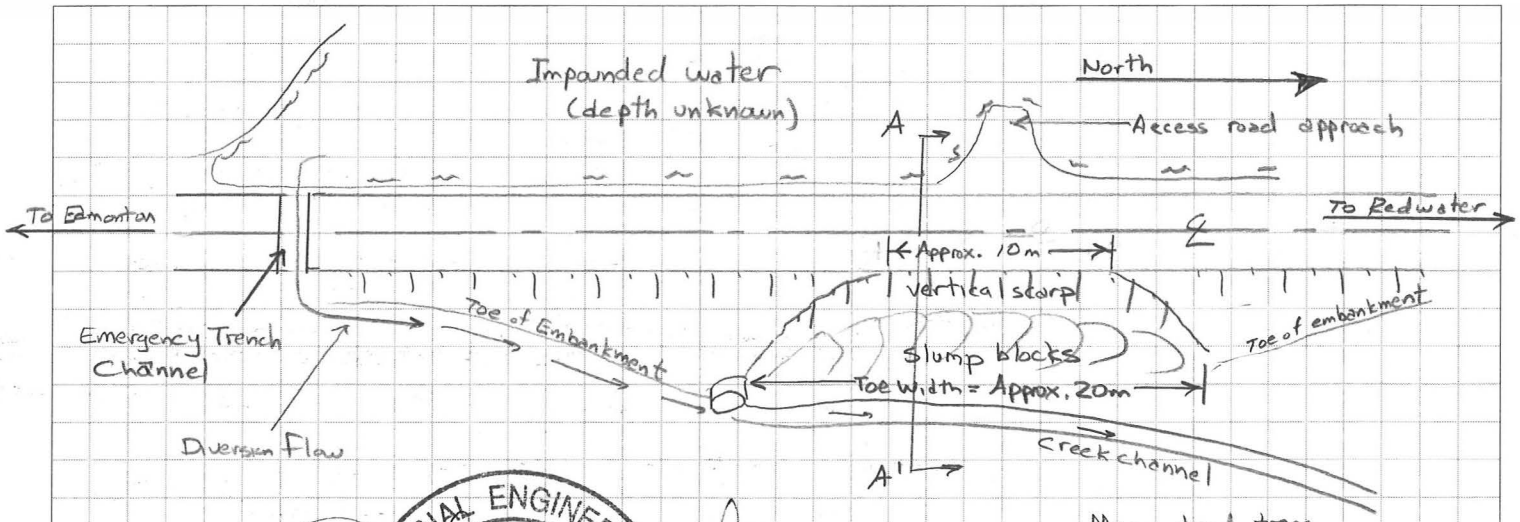
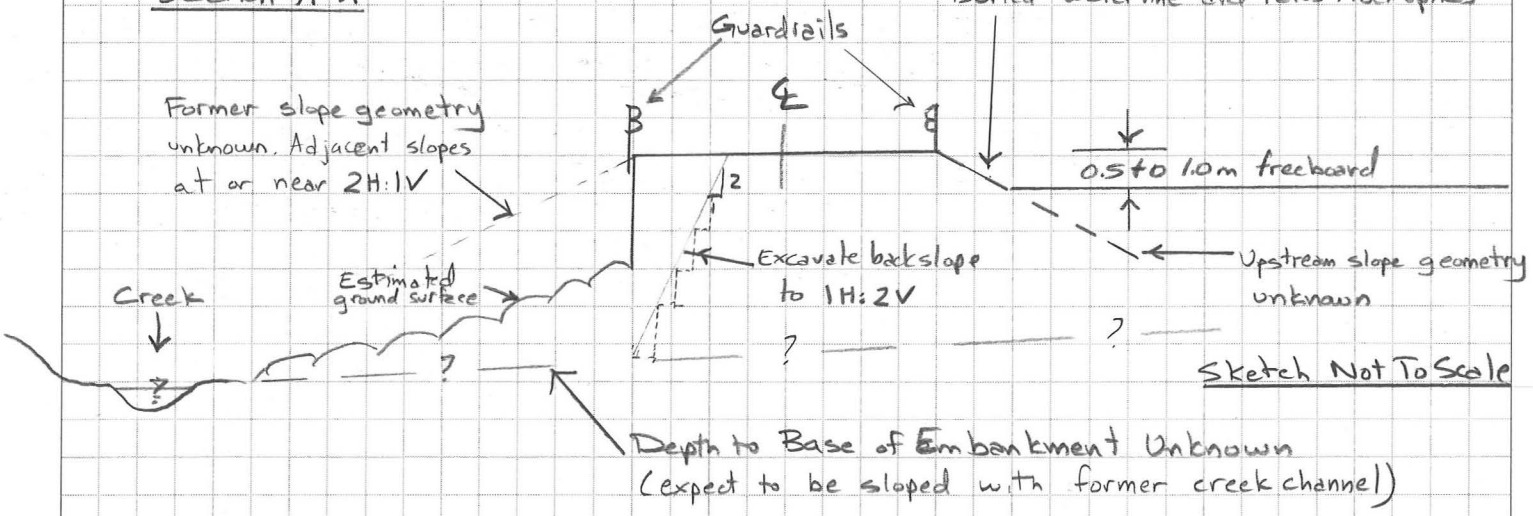


FIGURE 1 - SITE PLAN

PROFESSIONAL ENGINEER
CHRIS GRAPEL
ALBERTA
April 15, 2011

Section A-A'



Sketch Not To Scale

FIGURE 2 - Existing Cross Section

Construction Notes

1. Remove all loosened or eroded material to an intact, undisturbed mineral soil base
2. Excavate backscarp to a 1H:2V slope.
3. Place geogrid over subgrade to TRANS. Use TENSAR Biaxial geogrid BX1500 with minimum 1.5m overlaps.
4. Reconstruct slope with 0.3m thick lifts of compacted pit run (Class and Des. to be provided) compacted to 95% Standard Proctor.
5. The back slope shall be notched in 1.0m increments to key the compacted fill into the existing embankment fill.
6. Re-instate guard rail
7. Place asphalt patch after culvert has been unblocked/repaired and water has drained

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Date: 04/15/2011 By: CKG Checked: Tony Ruban

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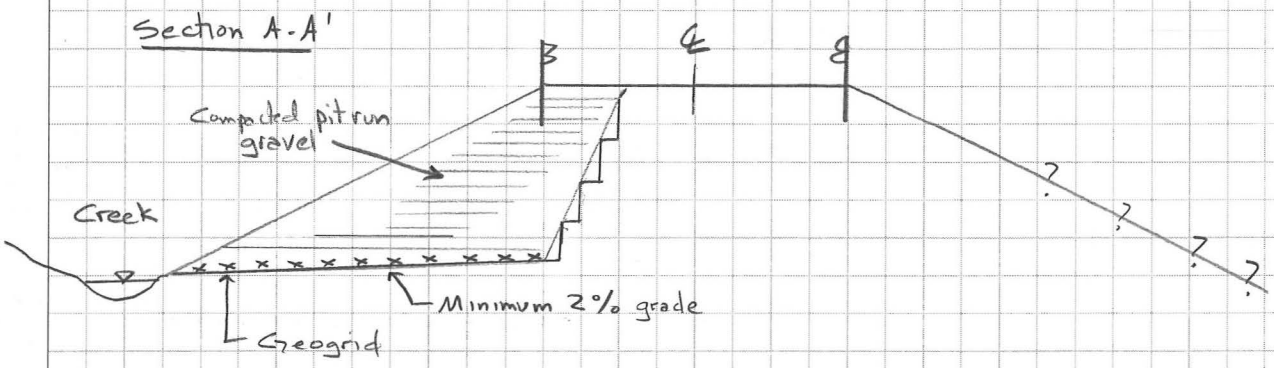
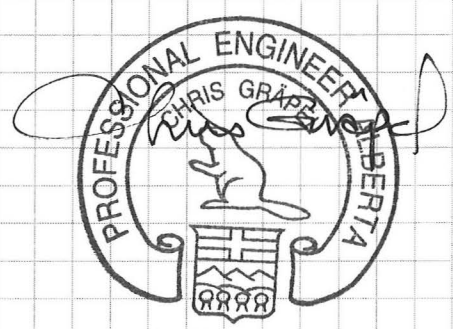


Figure 2 - Proposed Repair Design



April 15, 2011

Photo 1: Hwy 825 washout due to blocked culvert. Facing northeast.

Photo 2: Trench across Hwy 825 promoting drainage due to blocked culvert. Facing northwest.

Photo 3: Flooding on upstream side of blocked culvert of Hwy 825. Facing northeast.

Photo 4a: Extent of slope failure on downstream side of blocked culvert. Facing northwest.

Photo 4b: Extent of slope failure on downstream side of blocked culvert (continued). Facing northwest.

Photo 4c: Extent of slope failure on downstream side of blocked culvert (continued). Facing northwest.

APPENDIX A

APPENDIX A EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA’s Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA’s Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA’s instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.