



CITY OF  
*Lethbridge*

Office of the City Clerk

February 21, 2019

**RE: NOTICE OF HEARING - SUBDIVISION AND DEVELOPMENT APPEAL BOARD**

An appeal has been filed on the granting by the Senior Subdivision Planner for the subdivision of Parcel A, Plan 5171 EW located at 4002 Mayor Magrath Drive South, Subdivision SBD00651.

When an appeal is filed with the Subdivision and Development Appeal Board (SDAB), all persons who own property adjacent to the land being subdivided. In addition, the owner of the property, the applicant, and the person(s) who filed the appeal will also receive a copy of this letter.

The Subdivision and Development Appeal Board (SDAB) will hold a Public Hearing as follows:

**DATE:** Thursday, February 28, 2019  
**TIME:** 6:00 p.m.  
**LOCATION:** Council Chambers, Main Floor, City Hall  
910 – 4 Avenue South

Persons affected by this development have the right to present a written, verbal and/or visual submission to the Board. When making a presentation, keep in mind that in accordance with the legislation that governs the SDAB, the Board can only consider relevant planning matters when rendering its decision. It is recommended that you limit your presentation to five minutes.

If you wish to submit written material to the Board, it should be delivered to the Secretary of the SDAB, no later than 12:00 noon on the Wednesday prior to the hearing. If you are unable to meet this submission deadline, please bring 12 copies of the materials to the Hearing and it will be distributed at the start of the Hearing. Any written and/or visual material received will be made available to the public.

We will be pleased to answer any questions you may have regarding the appeal and can also provide information or advice on Board procedures and how to make presentations to the Board. Please feel free to contact me at 403 329 7329 if you have any questions.

Yours truly,

David Sarsfield  
Board Secretary,  
Subdivision and Development Appeal Board



CITY OF  
*Lethbridge*

## NOTICE OF A SUBDIVISION AND DEVELOPMENT APPEAL BOARD HEARING

**DATE:** Thursday, February 28, 2019

**PLACE:** Council Chambers, 1<sup>st</sup> Floor  
City Hall - 910 - 4<sup>th</sup> Avenue South

**TIME:** 6:00 p.m.

### **AGENDA:**

1. CALL TO ORDER

### **PRESENTATIONS:**

- 2.1 **6:00 p.m.**  
**SDAB No. 2019-04**  
APPEAL OF SUBDIVISION SBD00651

Appellant: Mac Maclean

Address: 4002 Mayor Magrath Drive South  
Parcel A, Plan 5171 EW

To subdivide Parcel A, Plan 5171 EW

**Land Use District: DC, V (Valley)**



City of Lethbridge

### NOTICE OF APPEAL Subdivision & Development Appeal Board

In accordance with sections 678 and 686 of the Municipal Government Act and The City of Lethbridge Bylaw 4749, an appeal to the Subdivision and Development Board must be filed within the legislated time frame.

(Date Received Stamp)

|  |                            |                          |
|--|----------------------------|--------------------------|
| <b>Site Information</b>  |                            |                          |
| Municipal Address of Appeal<br>4002 MAYOR MAGRATH DR   |                            |                          |
| Legal Description of Site (must be completed for subdivision appeals)<br>PARCEL A PLAN 511EW |                            |                          |
| Development Application Number or Subdivision Application Number                             |                            |                          |
| <b>Appellant Information</b>   |                            |                          |
| Name<br>MAC MACLEAN  |                            |                          |
| Mailing Address<br>1424 - 7 <sup>TH</sup> AVE S  |                            |                          |
| City<br>LETHBRIDGE   | Province<br>ALBERTA        | Postal Code<br>T1J 1L3   |
| Residence #<br>403.381.0827  | Business #<br>403.317.5915 | Email<br>MALLIVE@SHAW.CA |

**APPEAL AGAINST** (Check One Box Only) for multiple appeals you must submit another Notice of Appeal

| Development Permit   | Subdivision Permit  | Notice of Order                          |
|--|---|--|
| <input type="checkbox"/> Approval<br><input type="checkbox"/> Conditions of Approval<br><input type="checkbox"/> Refusal | <input type="checkbox"/> Approval<br><input checked="" type="checkbox"/> Conditions of Approval<br><input type="checkbox"/> Refusal | <input type="checkbox"/> Notice of Order |

**REASONS FOR APPEAL** Sections 678 and 686 of the Municipal Government Act require that the written Notice of Appeal must contain specific reasons for the appeal.

The grounds for this appeal are as follows:

(1) WE ARE NOT ASKING FOR ANY DEVELOPMENT ONLY FOR PRE-APPROVED BY-LAW FOR PERMANENT NORTH/SOUTH DIVISION LINE.

(2) THE BARR IS ONLY 50% OVER SET-BACK LINE. IT IS OF 1954 VINTAGE WHEN THE CITY ENDED AT 10<sup>TH</sup> AVE S. IT IS A CITY LANDMARK. WE WOULD ASK IT BE LEFT AS IS FOR NOW AND UNTIL A DEVELOPMENT REQUEST IS SUBMITTED.

(Attach a separate page if required)

The Personal information is collected under the authority of the Freedom of Information and Protection of Privacy Act, Section 33(1) and the Municipal Government Act, Sections 678 and 686. Note: This information will form part of a file available to the public. If you have any questions regarding the collection of this information, contact the POP Coordinator at (403) 329-7329.

|                                    |                      |                            |                                       |
|------------------------------------|----------------------|----------------------------|---------------------------------------|
| Signature of Appellant<br>         | Date<br>2019 12 10 4 |                            |                                       |
| FOR OFFICE USE ONLY                |                      |                            |                                       |
| Final Date of Appeal<br>YYYY MM DD | Appeal Number        | Hearing Date<br>YYYY MM DD | Date Appellant Notified<br>YYYY MM DD |



# CITY OF *Lethbridge*

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## PLANNING AND DEVELOPMENT

910 – 4 Avenue South  
Lethbridge, AB T1J 0P6

Phone No. 403-320-3920  
Fax No. 403-327-6571  
E-Mail: [subdivision@lethbridge.ca](mailto:subdivision@lethbridge.ca)

January 22, 2019

REFERENCE:           Our File No.    SBD00651  
                          Your File No.   18-14112

Brown Okamura & Associates Ltd.  
Box 655  
Lethbridge, AB T1J 3Z4

RE:     **Proposed Subdivision of Parcel A, Plan 5171EW  
          4002 Mayor Magrath Dr S**

Your application for subdivision of the above noted property was approved January 22, 2019 subject to your fulfilling the conditions of final approval as outlined below:

1. That pursuant to Section 655(1)(b) of the Municipal Government Act, prior to final endorsement of the subdivision plan, the developer enter into a service agreement with the City of Lethbridge with respect to the provision of services to this subdivision. Contact Janet Gutsell at 403-320-3091 for more information.
2. That this approval is based on the findings of the "Slope Stability Evaluation Update" dated July 18, 2018, prepared by Tetra Tech Canada Inc. The safe development setback line, established by the geotechnical assessment shall be surveyed in the field and the plan of subdivision adjusted to reflect the actual field location. Lands below the safe development setback line shall be shown as ER (Environmental Reserve) on the plan of subdivision and dedicated to the City of Lethbridge.
3. The existing accessory building that is located on the proposed property line must be removed or relocated prior to final endorsement of the subdivision. Issuance of development approval and a building permit or a demolition permit by the City of Lethbridge is required before relocation. Contact Pam Colling at 403-320-4140 for more information.
4. That easement agreements be registered on each title of the parcel where utilities cross that parcel to service an adjacent parcel. An easement agreement between owners will ensure that each parcel has access to their service connections. This agreement; (a) shall be binding on successive owners of the properties, (b) cannot be discharged from the titles of the Lots without the consent of the City of Lethbridge, (c) shall absolve the City of Lethbridge from all maintenance responsibilities for the utilities constructed on private property (d) and is to be prepared by the applicant and/or his solicitor and registered in Land Titles Office at the same time as the final

### FOIP

Any personal information provided in response to this letter is collected under the Alberta Municipal Government Act and in accordance with Section 33(c) of the Freedom of Information and Protection of Privacy Act. ***Please note that such information may be made public.*** If you have any questions about the collection or use of the personal information provided, please contact the Director of Property Services at 910 – 4 Ave S, Lethbridge, AB T1J 0P6 or phone 403-320-3920.

subdivision documents.

**Informative:**

- a) Justification for this decision is that the intended use conforms to the uses prescribed in the present zoning and should not have a negative impact on the existing neighbourhood.
- b) There were no submissions from adjacent landowners with regard to this application.
- c) Changes made to the approved tentative plan at final endorsement, may require a new application.
- d) Any relocation of existing utilities shall be at the developer's expense.
- e) The South Saskatchewan Regional Plan and applicable municipal statutory plans were considered in rendering this decision.

Pursuant to the Municipal Government Act you may appeal the conditions of the decision to the appropriate appeal board. You may also appeal any reserve requirement (land or money) established by the subdivision authority. The appeal may be commenced within 14 days of receipt of this letter by providing a written statement of the grounds of appeal to:

**Secretary, Subdivision and Development Appeal Board  
City Clerk's Department  
City Hall  
910 - 4th Avenue South  
Lethbridge, AB T1J 0P6**

To finalize the subdivision approval you will be required to:

- (1) Meet the conditions of approval as outline above. Should you require any further clarification on meeting these conditions, please contact the Subdivision Planner.
- (2) Submit a plan of subdivision to the City of Lethbridge. When forwarding these documents please include the finalization fee of \$250.00 (1 lot x \$250.00), payable to the City of Lethbridge.

**Please be advised that it is the applicant's responsibility to ensure that all conditions of approval have been met and the final endorsement documentation is provided to the approving authority.**

Please note that if you are unable to finalize the subdivision within one year of the date of approval, you must enter into an extension agreement with the City of Lethbridge in order to extend the validity of the subdivision authority's decision beyond the one year time limit.

Sincerely,

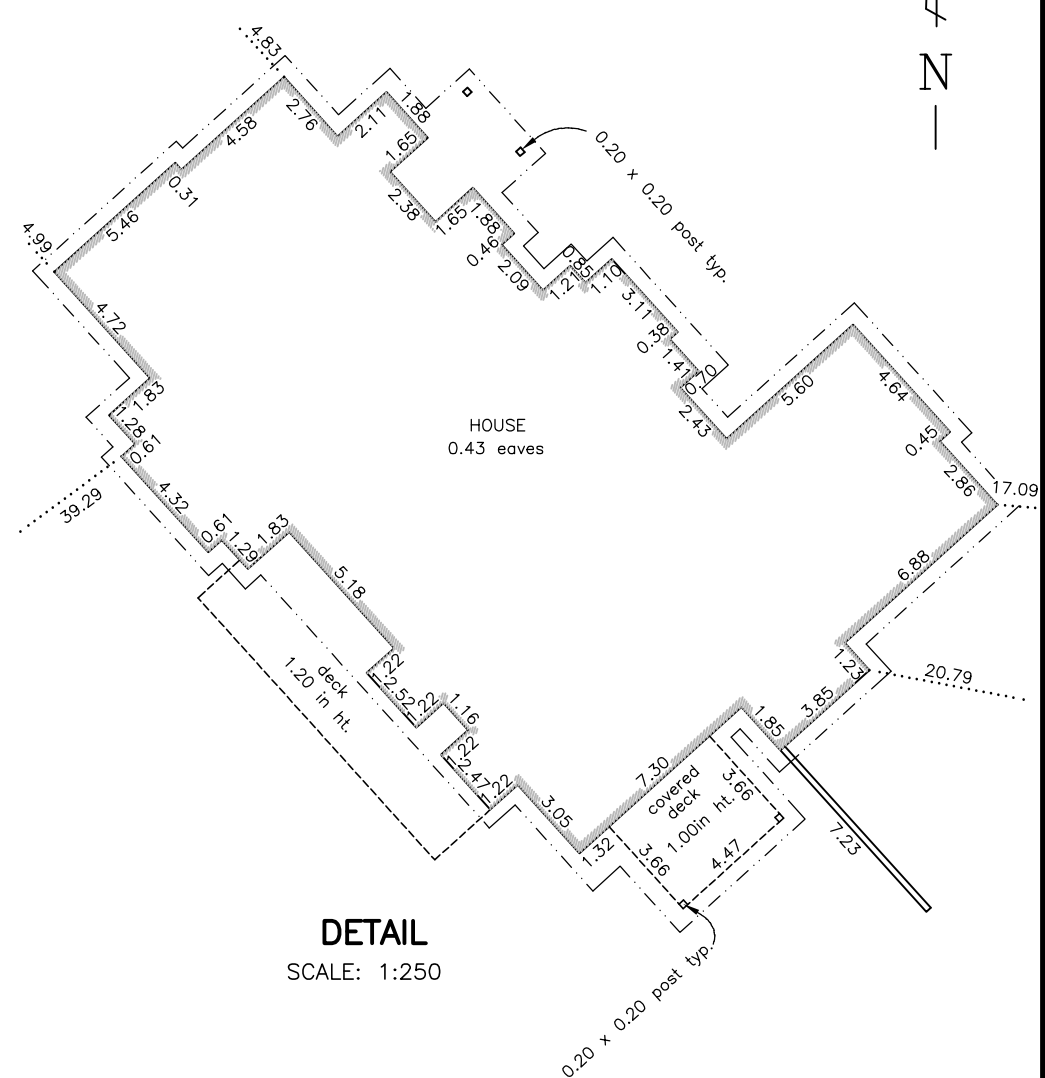
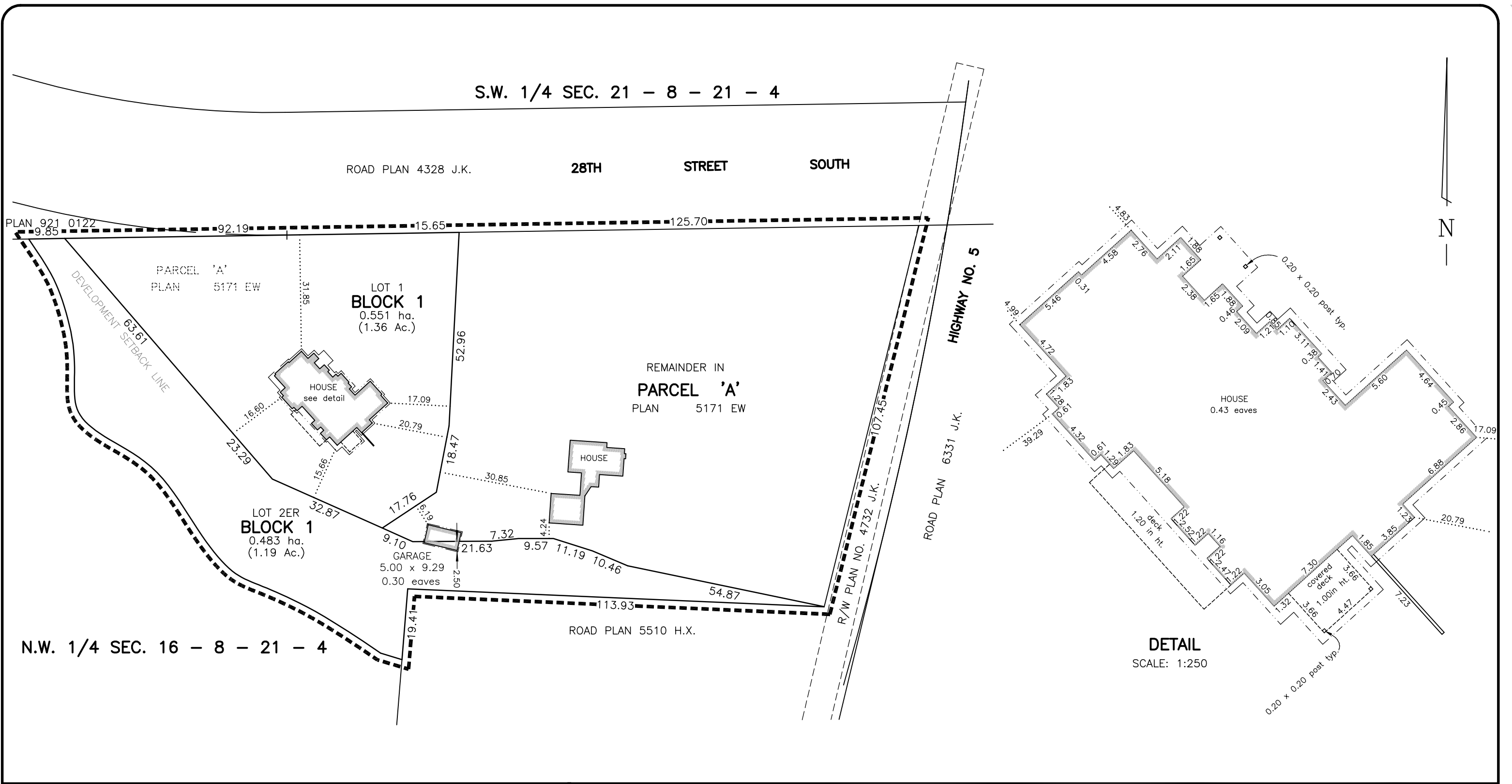


Jason Price  
Senior Subdivision Planner

Cc: Transportation Manager, Electric/Infrastructure, Parks, Water & Waste Water, Assessment & Taxation, Urban Construction Manager, Development Officers, ATCO Gas, Telus, AHS, Mac & Barb Maclean

**FOIP**

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|     |                      |           |    |
|-----|----------------------|-----------|----|
| 1   | ADDED HOUSE & GARAGE | JAN 29/19 | MJ |
| NO. | REVISION             | DATE      | BY |

NOTE : Portion to be approved is outlined thus **-----** and contains approximately 0.908 ha. Distances are in metres and decimal parts thereof.

Distances and areas are approximate and are subject to change upon final survey.

**MAC MacLEAN**

TENTATIVE PLAN SHOWING SUBDIVISION & DEVELOPMENT SETBACK LINE  
of  
PARCEL A, PLAN 5171 E.W.  
within  
N.W.1/4 SEC. 16, TWP. 8, RGE. 21, W.4 M.  
City of Lethbridge



**brown okamura & associates ltd.**  
Professional Surveyors  
514 Stafford Drive, Lethbridge, Alberta

|                     |              |                    |
|---------------------|--------------|--------------------|
| APPROVED            | DRAWN MJ     | DATE JAN 29/19     |
| T.C. Penner, A.L.S. | CHECKED TCP  | JOB 18-14112       |
|                     | SCALE 1:1000 | DRAWING 18-14112TD |

56500651



# brown okamura & associates ltd.

STREET ADDRESS: SUITE 100, 514 STAFFORD DRIVE N., LETHBRIDGE, ALBERTA T1H 2B2  
MAILING ADDRESS: P.O. BOX 655, LETHBRIDGE, ALBERTA T1J 3Z4

TELEPHONE: (403) 329-4688  
FAX: (403) 320-9144

HAND DELIVERED

Date: December 19, 2018

City of Lethbridge, Development Services  
910 - 4 Avenue South  
Lethbridge AB T1J 0P6

Our File: 18-14112

Attention: Jason Price

Letter of Transmittal for Technical Data

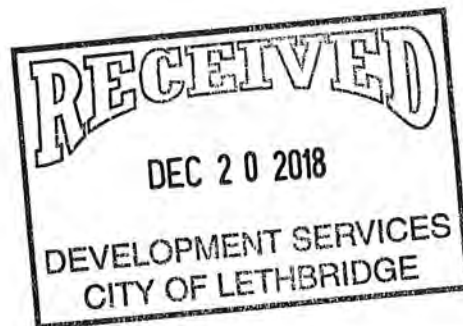
Enclosed herewith are the following:

One print of Tentative Plan showing Subdivision & Development Setback Line of Parcel A, Plan 5171 E.W. within NW ¼ Sec. 16, Twp. 8, Rge. 21, W4M.

Copy of Certificate of Title number 001 181 048 for your reference.

Application Form

Cheque number 035423 in the amount of \$825.00 covering application fees.



Yours very truly,

BROWN, OKAMURA & ASSOCIATES LTD.

A handwritten signature in blue ink, appearing to read 'Tom Penner'.

Thomas C. Penner, ALS

**City of Lethbridge**

**Subdivision Application**

SBD 00651

**Planning and Development Services**

910 - 4<sup>th</sup> Avenue South  
Lethbridge, AB  
T1J 0P6

General #: 403-320-3920  
Inspection #: 403-320-3830  
Fax #: 403-327-6571

Project Address: 4002 Mayor Magrath Dr. S.

Date of Receipt of Completed Form: Dec. 20/18

Fees Submitted: \$325.00

Access Code: \_\_\_\_\_

**THIS FORM IS TO BE COMPLETED IN FULL WHEREVER APPLICABLE BY THE REGISTERED OWNER OF THE LAND THAT IS THE SUBJECT OF THE APPLICATION OR BY A PERSON AUTHORIZED TO ACT ON THE REGISTERED OWNER'S BEHALF.**

**Property Owner**

Applicant

Name: Mac & Barb Maclean Paid   
Address: Box 419  
Picture Butte, AB T0K 1V0  
Phone: 403-317-5915 Fax: \_\_\_\_\_

**Authorized Agent**

Applicant

Name: Thomas C. Penner, ALS Paid   
Address: Brown Okamura & Associates Ltd.  
514 Strafford Dr. N. Lethbridge AB T1H 2B2  
Phone: 403 329-4688 Fax: 403 320-9144

**Legal Description**

|                 |        |       |     |    |     |      |      |       |                      |
|-----------------|--------|-------|-----|----|-----|------|------|-------|----------------------|
| All/part of the | Plan   | Block | Lot | or | 1/4 | Sec. | Twp. | Range | West of 4th Meridian |
|                 | 5171EW |       | A   |    |     |      |      |       |                      |

**Location of Land to be Subdivided**

|  | Yes        | No |
|--|------------|----|
| a. The land is situated in the Municipality of:  | Lethbridge |    |
| b. Is the land situated immediately adjacent to the municipal boundary?<br>If "Yes", the adjoining municipality is:  |            | X  |
| c. Is the land situated within 0.8 kilometers of the right-of-way of a highway?<br>If "Yes", the highway is No.:   | Hwy 5      |    |
| d. Does the proposed parcel contain or is it bounded by a river, stream, lake<br>or other body of water or by a drainage ditch or canal?<br>If "Yes", state it's name: |            | X  |
| e. Is the proposed parcel within 1.5km of a sour gas facility?   |            | X  |

**Existing and Proposed Use of Land to be Subdivided**

|  |
|--|
| a. Existing use of Land: Residential   |
| b. Proposed use of Land: Residential   |
| c. The designated use of the land as classified under a Land Use Bylaw: <u>DC 4387</u> |

**Physical Characteristics of Land to be Subdivided (Where appropriate)**

|   |
|---|
| a. Describe the nature of the topography of the land (flat, rolling, steep, mixed): <u>Mixed</u>  |
| b. Describe the nature of the vegetation and water on the land (brush, shrubs, trees, woodlots, sloughs, creeks, etc.):<br><u>Trees</u> |
| c. Describe the kind of soil on the land (sandy, loam, clay, etc.): <u>Unknown</u>  |

**Existing Buildings on the Land to be Subdivided**

Describe any buildings and structures on the land to be demolished or moved See sketch

**Water and Sewer Services**

If the proposed subdivision is to be served by other than a water distribution system and wastewater collection system, describe the manner of providing water and sewage disposal.

**Registered Owner or Person**

I Thomas C. Penner (full name) hereby certify that:

- I am the registered owner, or
- I am the agent authorized to act on behalf of the registered owner

and that the information given on this form is full and complete and is, to the best of my knowledge, a true statement of the facts relating to this application for subdivision.

Signature: 

Date: December 19, 2018 (18-14112)

Revision Date: October 6, 2011



July 18, 2018

ISSUED FOR USE  
FILE: ENG.LGEO03693-01

Wiseman Feeders  
RR8, Site 32, Comp 23  
Lethbridge, AB T1J 4P4

**Attention:** Mr. Mac Maclean, CEO

**Subject:** Slope Stability Evaluation Update  
Development Setback Line  
Parcel A, Plan 5171 E.W.  
City of Lethbridge, Alberta

## 1.0 INTRODUCTION

This letter provides a geotechnical evaluation update to a slope stability evaluation conducted in March 1998 for Maclean Livestock Co. Ltd. The subject property's legal address is Parcel A, Plan 5171 E.W. within NW ¼ Section 16, Township 8, Range 21, W4M.

The purpose of the slope stability evaluation conducted previously was to determine a safe development setback line, with respect to slope stability issues, in accordance with City of Lethbridge Bylaw 4068. City of Lethbridge Bylaw 4068 incorporated recommendations of development setback lines based from the River Valley Area Redevelopment Plan (RVARP), which was prepared circa the late 1980s. A report documenting the results of the geotechnical evaluation conducted for the slope stability evaluation was issued by Tetra Tech Canada Inc. (Tetra Tech) in March 1998, reference File 0404-98-42101.

City of Lethbridge Bylaw 4068 was replaced with Bylaw 5277, adopted July 26, 2004, based on a revised RVARP which incorporated additional geotechnical studies conducted in the early 2000s. Bylaw 5277, was later revised on March 3, 2008, with Bylaw 5503.

This letter incorporates the recommendations and guidelines established in Bylaw 5503, with respect to assessing a safe Development Setback Line with respect to slope stability issues.

## 2.0 BACKGROUND

Tetra Tech completed the geotechnical evaluation for Maclean Livestock Co. Ltd. for the western limits of the proposed development site noted in Section 1.0. Figure 1 of the previous report (File 0404-98-42101) presented the recommended development setback line, based on analytical techniques and recommendations contained in the RVARP document in force at the time of that evaluation.

For this 2018 evaluation, the subject property extends to the eastern limits of the total property depicted on Figure 1 of this evaluation (attached). The topography used in the 2018 evaluation was taken from a base image provided by a City of Lethbridge aerial photograph, circa 2015.

The 2018 evaluation also included a detailed site reconnaissance of the slopes abutting the south property limits and a detailed survey of the new recommended setback development line established for the property using the recommendations and guidelines set out in City of Lethbridge Bylaw 5503. The detailed survey was conducted by Brown Okamura & Associates Ltd. (BOA), under the direction of Tetra Tech.

The contact elevation of the Lenzie Silts deposit was taken as Elevation 895 m. This elevation was confirmed from the testholes installed for the 1998 evaluation conducted, as well as from other geotechnical evaluations conducted by Tetra Tech for other properties along Six Mile Coulee. The contact elevation derived also satisfies the geotechnical information contained in the report titled "*City of Lethbridge Phase II Development Setback Assessment Oldman River Slopes*", authored by AMEC Earth & Environmental Limited. This report is the base document for the development of the 2008 RVARP document.

### 3.0 DISCUSSION

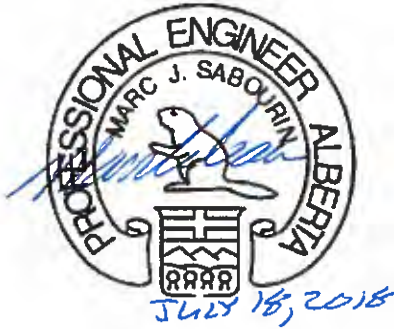
The following geotechnical points are provided by Tetra Tech, based on our review of the documents referenced in Section 1.0 and Section 2.0.

- The development setback line shown on Figure 1 satisfies the requirements of Bylaw 5033 with respect to the minimum distance established from a 4H:1V line from the contact elevation of the Lenzie Silts deposit, where it daylight from the surface of the slopes.
- The development setback line has been surveyed in the field by BOA and the setback line verified by Tetra Tech to meet the site constraints and topographic profile to establish the Top-of-Bank.
- The slopes abutting the south property perimeter have been subject to some historical slope instabilities, as well as erosional instabilities from the action of the 'creek' at the toe of slopes within Six Mile Coulee.
- The east limits of the property are above an engineered embankment, constructed for Mayor Magrath Drive (Highway 5). The natural slopes of Six Mile Coulee in this area have been regraded to an approximate 3H:1V slope profile. There is some surface erosion down the corner of the embankment slope from overland drainage; however, it is assumed in the future, should an erosion rill form, the City of Lethbridge (right-of-way property) would conduct remedial measures as they did on the embankment on the opposite side of Six Mile Coulee.
- A copy of Tetra Tech's geotechnical evaluation conducted in 1998 is attached for reference. The recommended guidelines in Section 7.0 of that report (Page 9) should be adhered to.
- The limitations of the 1998 report also form part of this letter.

## 4.0 CLOSURE

Please feel free to contact this office with any further comments or questions.

Respectfully submitted,  
Tetra Tech Canada Inc.



|   |                      |
|---|----------------------|
| <b>PERMIT TO PRACTICE<br/>TETRA TECH CANADA INC.</b>                      |                      |
| Signature   | <i>Marc Sabourin</i> |
| Date  | <i>JULY 18, 2018</i> |
| <b>PERMIT NUMBER: P13774</b>  |                      |
| The Association of Professional Engineers<br>and Geoscientists of Alberta |                      |

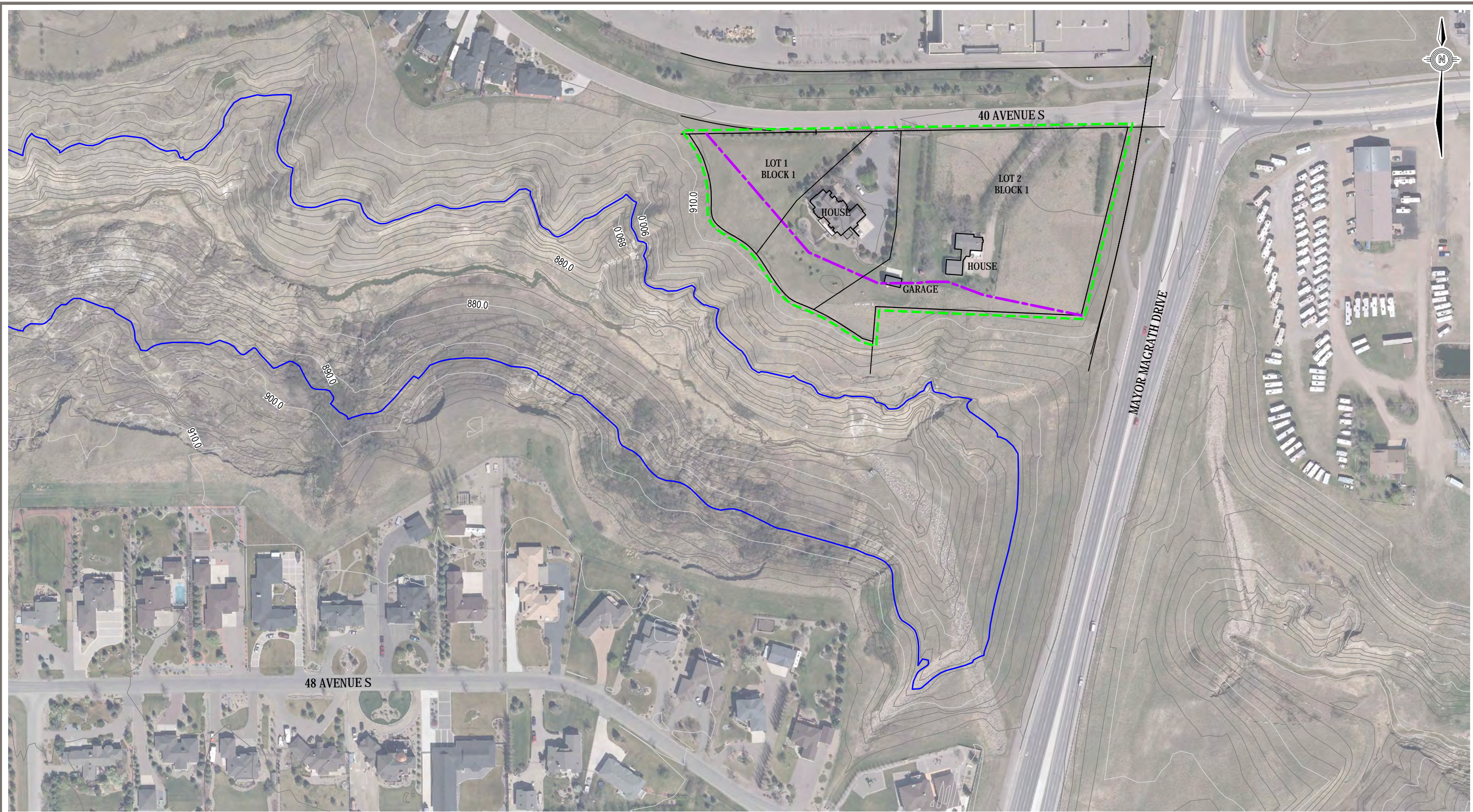
Marc J. Sabourin, P.Eng.  
Vice President – Western Canada  
Engineering Practice  
Direct Line: 403.359.6518  
marc.sabourin@tetrattech.com

/tlp

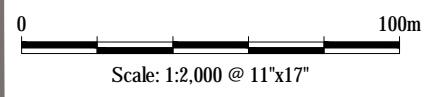
Attachments: Figure 1 – Development Setback Line  
1998 Geotechnical Evaluation



C:\Lethbridge\Drafting\ENG\LGEOLGEO03693\CAD\LGEOLGEO03693-01 Figure 1 R1.dwg [FIGURE 1] July 17, 2018 - 9:32:00 am (BY: HUGHES, LEANNE)



- LEGEND**
- LENZIE CONTOUR EL. 895 m
  - - - SAFE DEVELOPMENT SETBACK LINE (CITY OF LETHBRIDGE BYLAW 5503)
  - - - DEVELOPMENT FOOTPRINT



**NOTES**  
 BASE IMAGE PROVIDED BY THE CITY OF LETHBRIDGE AIR PHOTO CIRCA 2015  
 REFER TO BROWN OKAMURA ASSOCIATES LTD. DRAWING 18-14112TA DATED MAY 9, 2018 FOR DEVELOPMENT SETBACK LINE COORDINATES

**CLIENT**  
 Wiseman Feeders



**SLOPE STABILITY ASSESSMENT  
 RESIDENTIAL LOTS - SIX MILE COULEE AREA**

**DEVELOPMENT SETBACK LINE**

|                             |                   |            |          |
|-----------------------------|-------------------|------------|----------|
| PROJECT NO.<br>LGEO03693-01 | DWN<br>LCH        | CKD<br>MJS | REV<br>1 |
| OFFICE<br>Tt Leth           | DATE<br>July 2018 |            |          |

**Figure 1**



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**GEOTECHNICAL EVALUATION  
PROPOSED RESIDENTIAL DEVELOPMENT  
NW ¼ SECTION 16-8-21-W4M**

**0404-98-42101**

Submitted to:

**MACLEAN LIVESTOCK CO. LTD.**

March, 1998

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APPENDIX A - GEOTECHNICAL REPORT - GENERAL CONDITIONS

APPENDIX B - TESTHOLE LOGS

APPENDIX C - LABORATORY TEST RESULTS



## 1.0 INTRODUCTION

This report presents the results of a geotechnical evaluation conducted by EBA Engineering Consultants Ltd. (EBA) for a proposed residential development to be located in the northwest quarter of Section 16-8-21-W4M.

The principle objective of this evaluation was to provide a site specific, detailed assessment of the stability of the existing slopes bordering the south and west property lines of the proposed development area and to recommend development limits as per City of Lethbridge Bylaw No. 4068<sup>1</sup>.

Authorization to proceed with this evaluation was received verbally from Mr. Mac Maclean on behalf of Maclean Livestock Co. Ltd.

## 2.0 SITE DESCRIPTION

### 2.1 Location

The project site is located near the southeast boundary limits of the City of Lethbridge, Alberta. The legal description of the site is the Northwest  $\frac{1}{4}$  of Section 16, Township 8, Range 21, West of the 4th Meridian. Figure 1 presents a site plan for reference. It is understood that the final configuration of the proposed residential development has not yet been determined.

### 2.2 Surface Conditions

In addition to a detailed site reconnaissance, aerial photographs were reviewed to gain an understanding of past slope activity of this area, as well as the general sequence of area development. Stereopair prints from 1950, 1961, 1969, 1977, 1988 and 1994 were reviewed.

The site of the proposed development is in an area of upland plain, bordered on the south and west by Six Mile Coulee. During construction of Highway 5 to the east, an embankment fill (circa 1950-1961) was constructed across Six Mile Coulee. A creek running west towards the

---

<sup>1</sup> City of Lethbridge Bylaw No. 4068 incorporates recommendations on development setback lines from the River Valley Area Redevelopment Plan (RVARP).

Oldman River is located at the bottom of the coulee. To prevent undercutting of the toe of the north facing slope in the immediate area of the creek, by flow discharging from the embankment culvert, a concrete splash wall has been constructed on the south side of the coulee floor. The concrete splash pad has redirected the flow of the creek northwards such that it makes contact with the toe of the south facing slope (east of the proposed development area) and then continues generally westward along the toe of the south facing slope below the area of the proposed development.

Two areas of instability were noted on the slopes bordering the proposed development area. Both areas of instability are due to undercutting of the toe of the slopes by the creek and subsequent sloughing of the materials above the undercut. The height of the slough mass for both areas, from the coulee floor, is approximately 1/3 the vertical height to the crest of the coulee. The first area of instability is located on the far south slopes (southeast corner of development area) and the second on slopes bordering the west end of the proposed development area. Figure 1 depicts the general areas of instability. The slide mass for the second area appears to have 'pushed' the creek over to the south side of the coulee floor.

Generally, the overall slope angle of the coulee slope in the areas of the proposed development, varies between 1.7 Horizontal:1 Vertical (1.7H:1V) and 2.0H:1V with localized oversteepened sections less than 1.0H:1V. The vertical height varies between 39 m on the east end to 40 m on the west end. Information for the slope geometry was taken from a topographic map compiled by The Orthoshop for the City of Lethbridge (1:2000 scale). The topographic information was compiled by aerial photography flown in October, 1980.

The proposed development site is immediately bordered to the west by a 'draw' in the coulee followed by undeveloped land at the crest of the slopes. To the north, the site is bordered by 28 Street South and to the east by an existing developed acreage. The proposed development site is uncultivated and its vegetation cover comprises short prairie grasses. Two structures are located in the southeastern corner of the proposed development.

The review of aerial photographs also revealed the presence of old slumps along the north and south coulee walls, both to the east and west of the proposed development.

### **3.0 SITE RECONNAISSANCE**

EBA personnel (Sabourin) conducted a detailed site reconnaissance for this site. The reconnaissance included reviewing the existing conditions of the slopes and a visual assessment of the slopes and area at the crest of the slopes. The following pertinent points were noted in addition to the commentary provided in Section 2.0.

- Vegetation at prairie level and on the slopes generally consists of prairie grasses.
- No tension cracks of significance were noted along the crest of the slopes being studied in the evaluation.
- No groundwater seepage was noted along the slopes. Surface water was noted in the base of the gully from a creek (frozen at the time of the site visit).

### **4.0 FIELDWORK**

#### **4.1 Slope Stability Assessment Testholes**

On February 23, 1998, two testholes were completed to depths varying between 12.4 m and 30.5 m below existing ground surface. The testholes were advanced utilizing a truck mounted drill rig contracted from Double D Drilling Ltd. of Picture Butte, Alberta. EBA's field representative was Mr. John Christensen.

Disturbed bulk soil samples were recovered from the auger flights at regular intervals for soil classification. A 25 mm diameter slotted PVC standpipe was installed in each of the testholes to the full depth penetrated to allow future monitoring of groundwater depth. Classification and index tests were subsequently performed in the laboratory on samples collected from the testholes (both disturbed samples and relatively undisturbed Shelby tube samples), to aid in the selection of engineering properties. Laboratory tests included natural moisture content, Atterberg Limits, and a triaxial shear test (consolidated undrained - three stages). The results of the laboratory tests are contained on the testhole logs and/or in Appendix C.

The testhole logs are presented in Appendix B and locations shown on Figure 1.

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## 5.0 SUBSURFACE CONDITIONS

### 5.1 Geology

The following geological summary is based on published information available for the project area and deep drilling conducted by EBA in the Lethbridge area. It is estimated that there are approximately 80 m to 90 m of surficial soils overlying the bedrock. These include glaciofluvial and glaciolacustrine sands, silts and clays, two major glacial till sheets and an interbedded lacustrine deposit (Lenzie Silts) between the till sheets. The Lenzie Silt deposit has been reported to have been 'pinched' out in some areas during deposition of the upper glacial till sheet. A preglacial gravel stratum is found beneath the fine-grained glacial soils. The gravel stratum is typically found between Elevations 848 m and 842 m geodetic. Prairie level is approximately at Elevation 915.0 m geodetic in the project area.

Bedrock comprises transition beds between the Oldman Formation and the Bearpaw Formation, both of upper Cretaceous Age. The bedrock consists of numerous beds of weak shales, mudstones, siltstones and sandstones with occasional bentonitic horizons and coal seams. Bedrock in the Lethbridge area is typically encountered at an elevation of about 842 m geodetic. The bedrock surface dips slightly to the north (1°). The coulee floor in the area of the proposed development is at approximately geodetic Elevation 875 m.

### 5.2 Soil Stratigraphy

Based on the information gathered during this evaluation and from EBA's geotechnical experience in the Lethbridge area, the soil stratigraphy from prairie level to below the base of Six Mile Coulee is considered to consist of the following.

- Upper glaciolacustrine clays and sands: The clay layers are described as silty, sandy, medium plastic to high plastic, olive brown and moist. The sand layer was described as fine grained, silty, trace clay and damp. The thickness of the glaciolacustrine deposits from ground surface varied between 6.0 m and 7.5 m.
- Upper clay till: silty, some sand to sandy, trace of gravel, medium plastic, olive brown, moist to damp with depth, coal specs and oxide staining. One Atterberg Limit test, conducted on a bulk sample from this layer, confirmed a medium plastic soil (LL

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= 35%, PI = 22%). In both testholes the colour of the till included grey mottled zones below 11.0 m from ground surface.

- Lower clay till: silty, some sand, trace of gravel, medium plastic, gray, damp, coal specs and oxide staining. One Atterberg Limit test, conducted on a lower till sample, confirmed a soil of medium plasticity (LL = 34%, PI = 21%). It appears from the results of the drilling program that the Lenzie Silt (refer Section 5.1) deposit has 'pinched out' in this area.

A more detailed description of the subsurface stratigraphy encountered on this specific site is provided on the testhole logs included in Appendix B.

### **5.3 Groundwater**

At the time of drilling, no seepage or sloughing was encountered in either of the testholes. On February 27, 1998 the groundwater level in the testholes were monitored by EBA. At that time, groundwater was measured at 28.9 m below ground surface in Testhole 001. Testhole 002 was dry.

## **6.0 SLOPE STABILITY EVALUATION**

### **6.1 General**

EBA's slope stability evaluation for this project comprised an analysis of the present stability of the slopes abutting the south and west property lines of the proposed development area, an analysis of the impact of development on the stability of the slopes and an analysis of the impact of any potential slope instability on the development ie. setback requirements. These aspects are detailed in the following sections. The Factor of Safety (FS) used to determine the setback requirements was 1.5, which is considered acceptable by today's engineering standards and by the City of Lethbridge Bylaw No. 4068.

## 6.2 Present Slope Stability

The present stability of the slopes bordering the south and west property lines of the project site have been evaluated based on site reconnaissance and analytical techniques using the computer program Slope/W.

Visual observation of the overall coulee slopes in the project area indicate the slopes are currently stable. As discussed in Section 2.0, there has been some past instability visually noted in two areas due to undercutting of the slope toe and subsequent failure of the soil mass above the undercutting. EBA modelled the current conditions to assist in calibrating the stability sections (Figure 2) used in the analyses. In addition, soil strength parameters were based on the results of moisture content, Atterberg limit tests, and the triaxial shear test, conducted by EBA on soil samples recovered from the development site, as well as on other triaxial and direct shear test data obtained by EBA for other sites in the Lethbridge area. Groundwater conditions that can be reasonably expected to develop some years following development were selected by EBA based on local experience for this evaluation.

The soil strength and groundwater parameters selected for the analysis are as follows:

- Material: Glaciolacustrine medium plastic clay  
Unit Weight: 20 kN/m<sup>3</sup>  
Cohesion Intercept C': 5 kPa  
Friction Angle  $\phi'$ : 25°  
Pore Water Pressure Parameter  $r_u$ : existing 0.05  
: post-development 0.2
- Material: Upper Clay Till  
Unit Weight: 20 kN/m<sup>3</sup>  
Cohesion Intercept C': 10 kPa  
Friction Angle  $\phi'$ : 27°  
Pore Water Pressure Parameter  $r_u$ : existing 0.05  
: post-development 0.10

- Material: Lower Clay Till  
Unit Weight: 20 kN/m<sup>3</sup>  
Cohesion Intercept C': 15 kPa  
Friction Angle  $\phi'$ : 27°  
Pore Water Pressure Parameter  $r_u$ : existing 0.05  
: post-development 0.05

Analysis of the slopes indicates that it is presently stable with respect to both deep seated and shallow slope failures (with the exception of the two shallow seated failures noted in Section 2.2) which would affect the proposed development.

The analysis indicates that the bedrock strata does not influence the stability of the slopes due to its depth below the coulee floor.

### 6.3 Impact of Development on Slope Stability

Development of the site may bring about changes in the factors which contribute to the present stability of the slopes. Following development, a portion of the site will be covered with buildings and roadways, although to a lesser extent than would occur with the densities typically associated with urban subdivisions. Evaporation of soil moisture will be reduced by the presence of this cover. Irrigation of lawns, operation of septic fields (if used) and possible leakage of water from underground utilities will increase the amount of water infiltrating the site subsoils. This combination of reduced evaporation of subsoil moisture and increased infiltration of water to the subsoils is considered to be the most significant influence of development on the factors which contribute to the present stability of the slopes.

The relatively steep coulee and river valley slopes in the Lethbridge area rely, in part, upon low degrees of soil saturation for stability. Any increase in the level of soil saturation reduces the stability of the slopes. Therefore it is considered likely that the development will alter the present stability of the slopes.

## 6.4 Impact of Potential Slope Instability on the Development (Setback Lines)

The long-term stability of the slopes adjacent to the project site have been evaluated by means of limit equilibrium analysis conducted on the two typical cross-sections of the slopes referenced above. Figure 2 depicts the two sections.

The approach used in the stability analysis was to first establish the existing Factor of Safety against slope instability using the strength parameters indicated in Section 6.2 and a pore pressure coefficient ( $r_u$ ) of 0.05 to represent the current relatively dry condition of the slopes. Successive points set back from the crest of the slope were then selected and minimum factors of safety were calculated modelling current relatively dry slope conditions. This was followed by additional analysis to determine Factors of Safety when post-development groundwater levels and partially saturated slope conditions, respectively, were assumed.

Based on the analysis, a development setback line was established to provide a factor of safety of 1.5 against slope failure for the assumed post development groundwater condition. The location of the setback line was also checked to confirm that a reasonable Factor of Safety (FS=1.3) exists for anticipated worst case groundwater conditions.

## 7.0 RECOMMENDED DEVELOPMENT GUIDELINES

### 7.1 Top of Slope Setback

Analysis of the present stability of the slopes indicates a factor of safety of slope instability affecting the property at the 'top of bank'<sup>2</sup> of between 1.1 (in the two areas of instability) and 1.4. This models the current condition of the slopes.

For post-development conditions, the recommended development setback line (structures) is as shown on Figure 1. Figure 2 presents the cross-section models. The dimensions provided on Figure 1 are to be measured from the 'top of bank'<sup>2</sup>. It is recommended that the development setback lines be established from the 'top of bank' by field survey.

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<sup>2</sup> Top of Bank: means the line where the general trend of the slope changes from greater than 15 percent to less than 15 percent and remains at less than 15 percent (6.5H:1V), as determined by field survey.



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Precautionary measures which should be included in the design of the proposed development are outlined as follows.

- Any fill excavated from the basements or from regrading of the site should be disposed off site.
- Positive grading should be provided particularly in the front yard to ensure drainage to the street (north). A minimum gradient of one percent is recommended. Drainage off the back of the lot(s) should be directed as sheet flow over the crest of the slopes.
- All utilities and plumbing should be carefully installed and inspected to ensure they are in good working order.
- Normal, prudent design and construction procedures should be followed during development of the residential lot(s).

The upper valley slope should be treated as a restricted development zone. This involves:

- No excavation on the valley slope without review by a qualified geotechnical engineer.
- No clearing of trees or natural vegetation.
- No fill to be placed on the crest or side of the valley slope.
- Maintain vegetation cover along the crest and on the slope.
- No dumping of grass cuttings, branches or other materials of any kind should be permitted on the valley slope.

## 8.0 LIMITATIONS

Recommendations presented herein are based on a geotechnical evaluation of the findings from the fieldwork conducted for this particular evaluation. The conditions encountered during the fieldwork are considered to be reasonably representative of the site. If, however, conditions other than those reported are noted during subsequent phases of the project, EBA should be

notified and given the opportunity to review our current recommendations in light of new findings. Recommendations presented herein may not be valid if an adequate level of monitoring is not provided during construction.

This report has been prepared for the exclusive use of Maclean Livestock Co. Ltd. and their agents for specific application to the development described in this report. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty is made, either express or implied.

For further limitations, reference should be made to the General Conditions in Appendix A of this report.

## 9.0 CLOSURE

EBA trusts that this report satisfies your present requirements. Should any additional information or elaboration be required, please contact this office.

Respectfully submitted,  
EBA Engineering Consultants Ltd.

Prepared by:

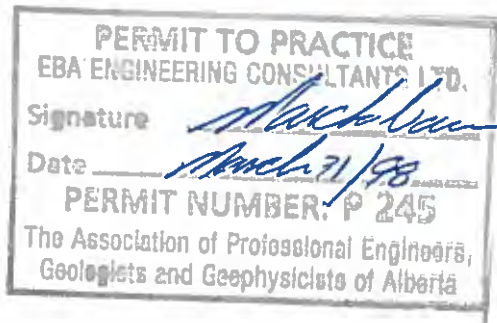


Marc J. Sabourin, P.Eng.  
Branch Manager

:rcm

Reviewed by:

Bob Patrick, P.Eng.  
Senior Geotechnical Consultant



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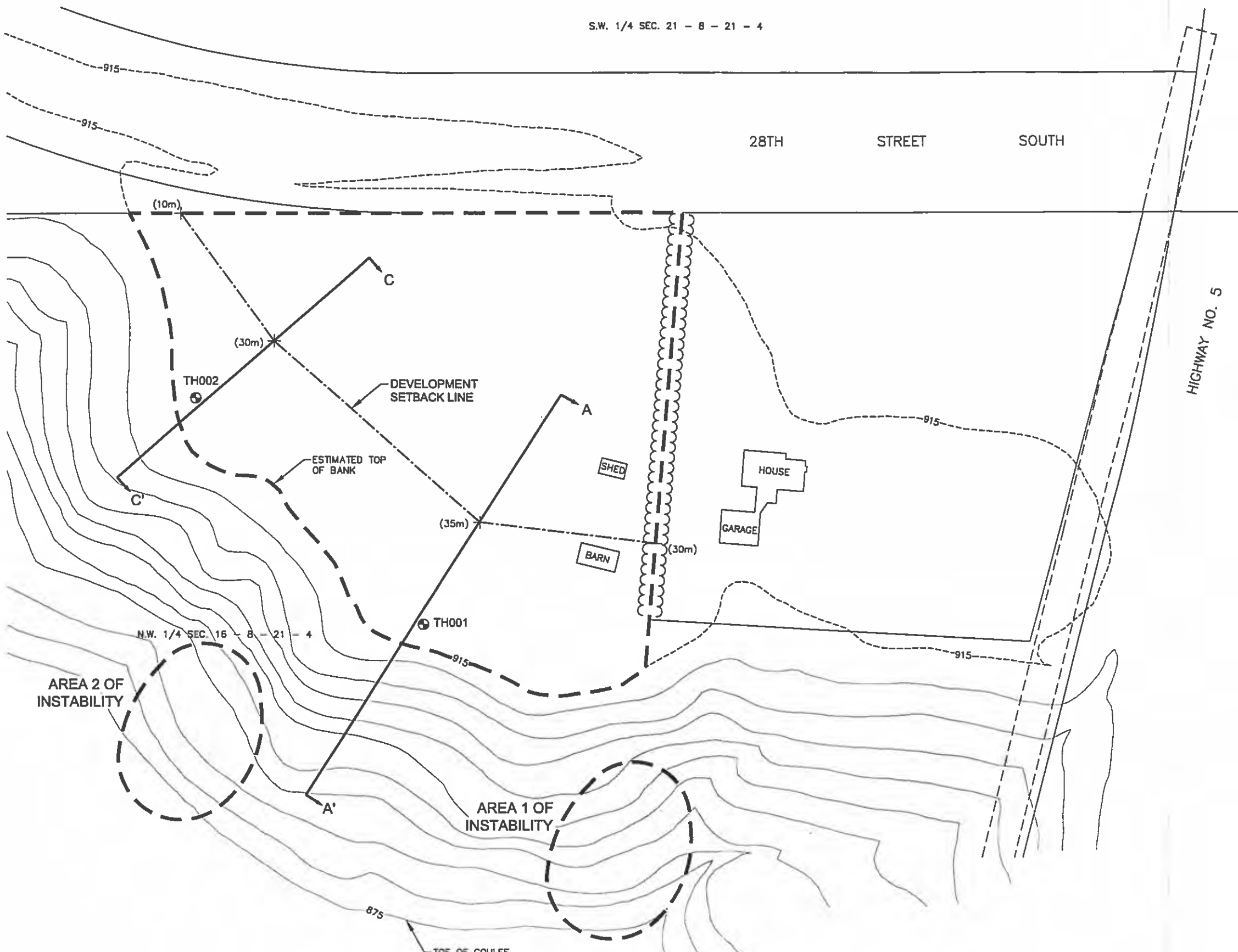
**FIGURES**

S.W. 1/4 SEC. 21 - 8 - 21 - 4



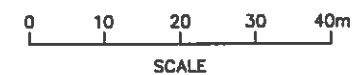
28TH STREET SOUTH

HIGHWAY NO. 5



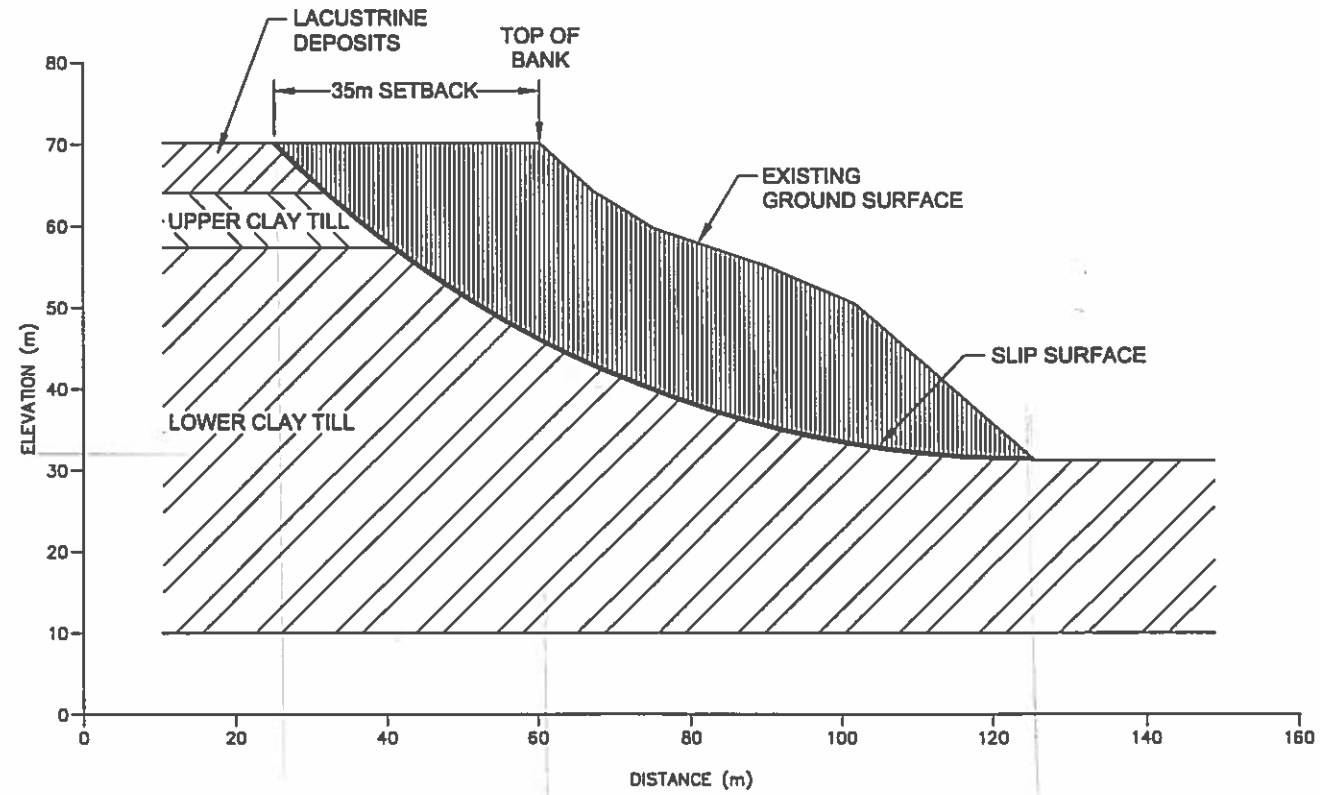
LEGEND

- PROPOSED DEVELOPMENT FOOTPRINT
- DEVELOPMENT SETBACK LINE FROM TOP OF BANK
- ESTIMATED TOP OF BANK
- TESTHOLE LOCATION
- DISTANCE FROM SETBACK LINE TO TOP OF BANK



|          |                            |               |               |
|----------|----------------------------|---------------|---------------|
| CLIENT:  | MACLEAN LIVESTOCK LTD.     |               |               |
| PROJECT: | PROPOSED URBAN DEVELOPMENT | DATE:         | 98/03/30      |
| TITLE:   | DEVELOPMENT SETBACK LINE   | DRAWN BY:     | LCH           |
|          |                            | CHECKED BY:   | MJS           |
|          |                            | PROJECT NO.:  | 0404-98-42101 |
|          |                            | CAD FILE NO.: | 42101S01B     |
|          |                            | DRAWING NO.:  | FIGURE 1      |

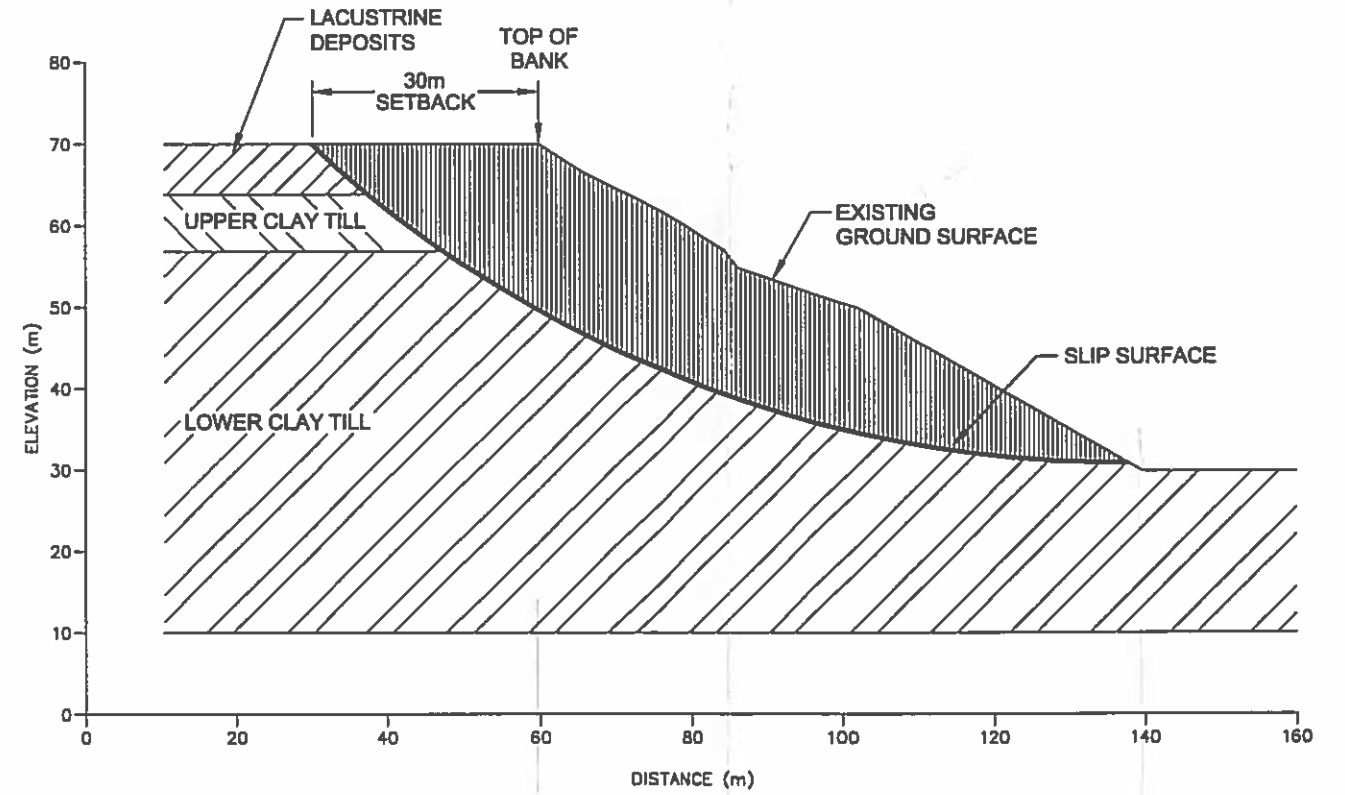
• 1.50  
(NOT TO SCALE)



**SECTION A - A'**


FACTOR OF SAFETY 1.50  
SETBACK DISTANCE 35m

• 1.51  
(NOT TO SCALE)



**SECTION C - C'**

FACTOR OF SAFETY 1.51  
SETBACK DISTANCE 30m

|          |                            |                 |                            |   |                       |
|----------|----------------------------|-----------------|----------------------------|---|-----------------------|
| CLIENT:  | MACLEAN LIVESTOCK LTD.     |                 |                            |  <b>EBA Engineering Consultants Ltd.</b> |                       |
| PROJECT: | PROPOSED URBAN DEVELOPMENT |                 |                            |   |                       |
| TITLE:   | CROSS SECTIONS             | DATE: 98/03/20  | DRAWN BY: LCH              | CHECKED BY: MJS   | DRAWING NO.: FIGURE 2 |
|          |                            | SCALE: AS SHOWN | PROJECT NO.: 0404-98-42101 | CAD FILE NO.: 42101X01A   |                       |

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**APPENDIX A**  
**GEOTECHNICAL REPORT - GENERAL CONDITIONS**

**EBA Engineering Consultants Ltd. (EBA)**  
**GEOTECHNICAL REPORT**  
**GENERAL CONDITIONS**

This report incorporates and is subject to these "General Conditions"

**A.1 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. Any such 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. This report should be read in its entirety.

**A.2 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.

**A.3 LOGS OF TEST HOLES**

The test hole (test pits, boreholes) logs are a compilation of conditions and classification of soils and rocks interpreted 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.

**A.4 STRATIGRAPHIC AND GEOLOGICAL SECTIONS**

The stratigraphic and geological sections indicated on drawings contained in this report are evolved 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 exact locations of geological units is necessary, additional investigation and review may be necessary.

**A.5 GROUNDWATER CONDITIONS**

Groundwater conditions represented in this report refer only to those observed at the times recorded on logs of test holes and/or wells, and/or within the text of this report. These conditions may vary with geological detail between test holes and/or wells; annual, seasonal and special meteorologic conditions; and with construction activity. Where instruments have been established to record groundwater variations on an ongoing basis, the records will be specifically referred to. Interpretation of groundwater conditions from observations and records is judgemental and constitutes an evaluation of circumstances as influenced by geology, meteorology and construction activity. Deviations from these observations may occur.

**A.6 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.

**A.7 SUPPORT OF ADJACENT GROUND AND STRUCTURES**

Preservation of adjacent ground and structures from the adverse impact of construction activity is required. Therefore support of excavation walls, of ground adjacent to anticipated construction and of structures adjacent to the construction must be provided.

#### **A.8 INFLUENCE OF CONSTRUCTION ACTIVITY**

Construction activity may affect 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.

#### **A.9 OBSERVATIONS DURING CONSTRUCTION**

Because of the nature of geological deposits, the judgemental 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 to the benefit of the project.

#### **A.10 DRAINAGE SYSTEMS**

Where temporary and 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.

#### **A.11 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.

#### **A.12 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, or samples will be discarded.

#### **A.13 STANDARD OF CARE**

Services performed by EBA for this report are conducted in a manner consistent with that level and skill ordinarily exercised by members of the profession currently practising under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made, concerning the test results, comments, recommendations, or any other portion of this report.

#### **A.14 ENVIRONMENTAL AND REGULATORY ISSUES**

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, unless otherwise specifically indicated in the report.

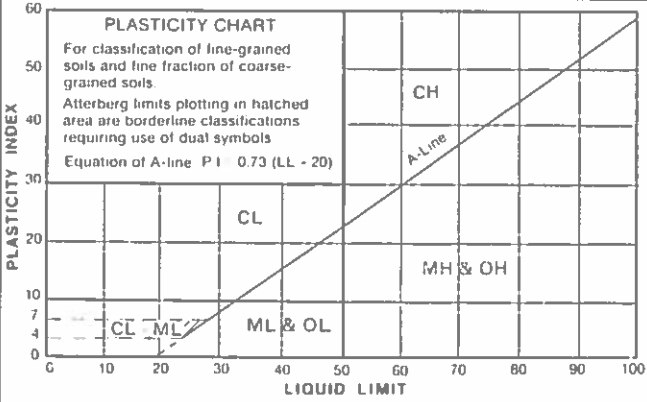


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**APPENDIX B**  
**TESTHOLE LOGS**

# UNIFIED SOIL CLASSIFICATION †

| MAJOR DIVISIONS   |   | GROUP SYMBOLS  | TYPICAL NAMES                                 | CLASSIFICATION CRITERIA   |  |
|---|---|--|---|---|--|
| <b>COARSE-GRAINED SOILS</b><br><small>More than 50% retained on No. 200 sieve *</small> | <b>GRAVELS</b><br><small>50% or more of coarse fraction retained on No. 4 sieve</small> | CLEAN GRAVELS  | GW  | Well-graded gravels and gravel-sand mixtures, little or no fines  |  |
|   |   | CLEAN GRAVELS  | GP  | Poorly graded gravels and gravel-sand mixtures, little or no fines  |  |
|   |   | GRAVELS WITH FINES   | GM  | Silty gravels, gravel-sand-silt mixtures  |  |
|   |   |  | GC  | Clayey gravels, gravel-sand-clay mixtures   |  |
|   | <b>SANDS</b><br><small>More than 50% of coarse fraction passes No. 4 sieve</small>      | CLEAN SANDS  | SW  | Well-graded sands and gravelly sands, little or no fines  |  |
|   |   | CLEAN SANDS  | SP  | Poorly graded sands and gravelly sands, little or no fines  |  |
|   |   | SANDS WITH FINES   | SM  | Silty sands, sand-silt mixtures   |  |
|   |   |  | SC  | Clayey sands, sand-clay mixtures  |  |
|   | <b>FINE-GRAINED SOILS</b><br><small>50% or more passes No. 200 sieve *</small>          | <b>SILTS AND CLAYS</b><br><small>Liquid limit 50% or less</small>      | ML  | Inorganic silts, very fine sands, rock flour, silty or clayey fine sands  |  |
|   |   |  | CL  | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays   |  |
|   |   |  | OL  | Organic silts and organic silty clays of low plasticity   |  |
|   |   | <b>SILTS AND CLAYS</b><br><small>Liquid limit greater than 50%</small> | MH  | Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts   |  |
| CH  |   |  | Inorganic clays of high plasticity, fat clays |   |  |
| OH  |   |  | Organic clays of medium to high plasticity    |   |  |
| Pt  |   |  | Peat, muck and other highly organic soils     |   |  |
|   |   |  |   | <small>Classification on basis of percentage of fines</small><br><small>Less than 5% Pass No. 200 sieve GW, GP, SW, SP</small><br><small>More than 12% Pass No. 200 sieve GM, GC, SM, SC</small><br><small>5% to 12% Pass No. 200 sieve Borderline Classification requiring use of dual symbols</small> |  |
|   |   |  |   | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 4<br>$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3<br>Not meeting both criteria for GW<br>Atterberg limits plot below "A" line or plasticity index less than 4<br>Atterberg limits plot above "A" line and plasticity index greater than 7 |  |
|   |   |  |   | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 6<br>$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3<br>Not meeting both criteria for SW<br>Atterberg limits plot below "A" line or plasticity index less than 4<br>Atterberg limits plot above "A" line and plasticity index greater than 7 |  |
|   |   |  |   | <b>PLASTICITY CHART</b><br>For classification of fine-grained soils and fine fraction of coarse-grained soils<br>Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols<br>Equation of A-line: $P_I = 0.73(LL - 20)$                                    |  |
|   |   |  |   | <small>* Based on the material passing the 3-in. (75-mm) sieve</small><br><small>† ASTM Designation D 2487</small>  |  |



## TERMS USED ON BOREHOLE LOGS

### TERMS DESCRIBING CONSISTENCY OR CONDITION

**COARSE GRAINED SOILS** (major portion retained on 0.075mm sieve): includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

| DESCRIPTIVE TERM | RELATIVE DENSITY | N (blows per 0.3m) |
|------------------|------------------|--------------------|
| Very Loose       | 0 to 20%         | 0 to 4             |
| Loose            | 20 to 40%        | 4 to 10            |
| Compact          | 40 to 75%        | 10 to 30           |
| Dense            | 75 to 90%        | 30 to 50           |
| Very Dense       | 90 to 100%       | greater than 50    |

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

**FINE GRAINED SOILS** (major portion passing 0.075mm sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

| DESCRIPTIVE TERM | UNCONFINED COMPRESSIVE STRENGTH (kPa) |
|------------------|---------------------------------------|
| Very Soft        | Less Than 25                          |
| Soft             | 25 to 50                              |
| Firm             | 50 to 100                             |
| Stiff            | 100 to 200                            |
| Very Stiff       | 200 to 400                            |
| Hard             | Greater Than 400                      |

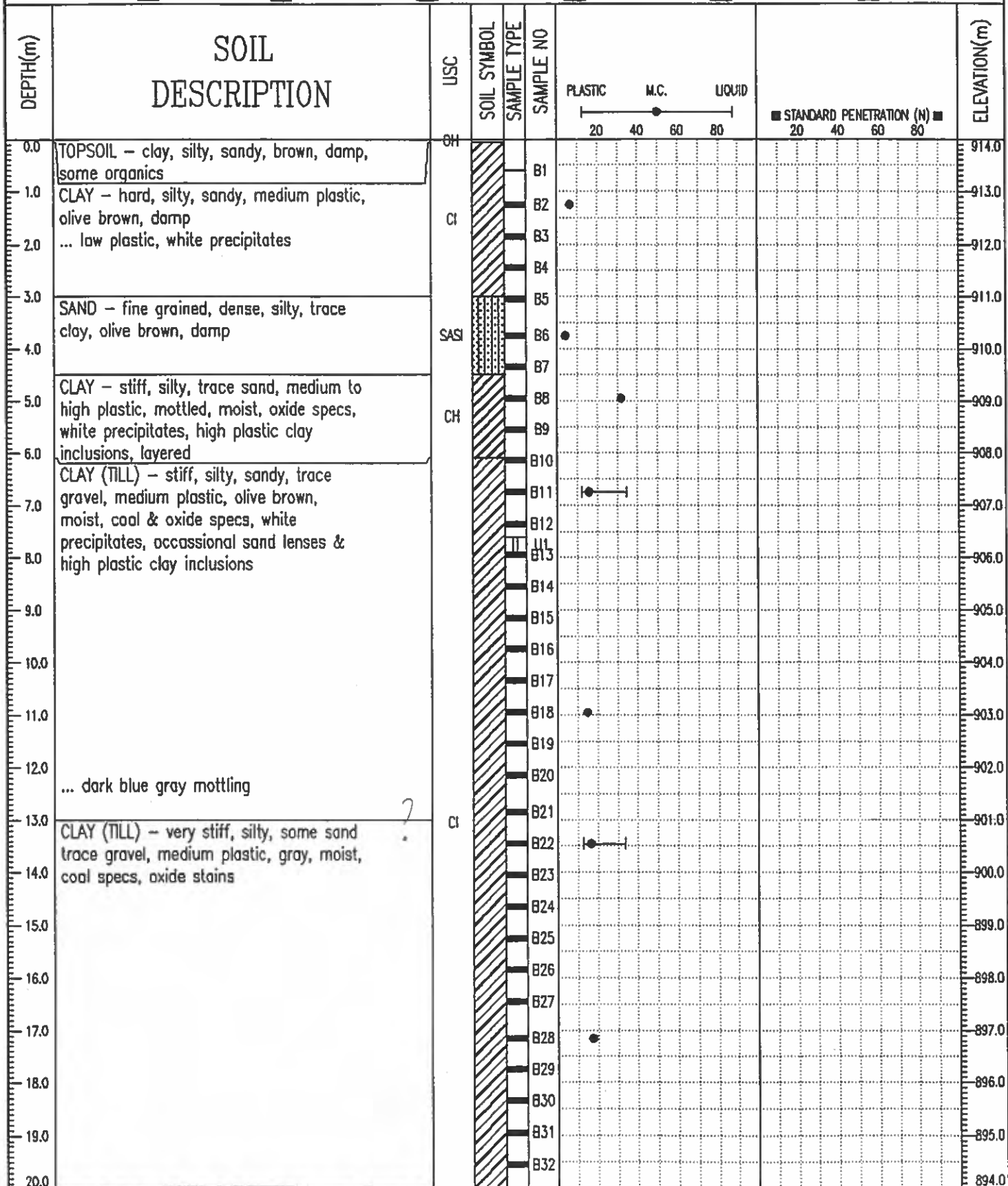
NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

### GENERAL DESCRIPTIVE TERMS

|               |   |
|---------------|---|
| Slickensided  | - having inclined planes of weakness that are slick and glossy in appearance.                           |
| Fissured      | - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical. |
| Laminated     | - composed of thin layers of varying colour and texture.  |
| Interbedded   | - composed of alternate layers of different soil types.   |
| Calcareous    | - containing appreciable quantities of calcium carbonate.   |
| Well Graded   | - having wide range in grain sizes and substantial amounts of intermediate particle sizes.              |
| Poorly graded | - predominantly of one grain size, or having a range of sizes with some intermediate size missing.      |



|  |                                      |                           |
|--|--------------------------------------|---------------------------|
| PROJECT: SLOPE STABILITY ASSESSMENT  | LOCATION: NW 1/4 16-8-21 W4M         | TEST HOLE NO: 001         |
| CLIENT: MACLEAN LIVESTOCK CO. LTD.   | CONTRACTOR: DOUBLE D DRILLING LTD.   | PROJECT NO: 0404-98-42101 |
| PROJECT ENGINEER: MJS  | DRILL METHOD: 150mm SOLID STEM AUGER | ELEVATION: 914.00 (m)     |
| SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE |                                      |                           |

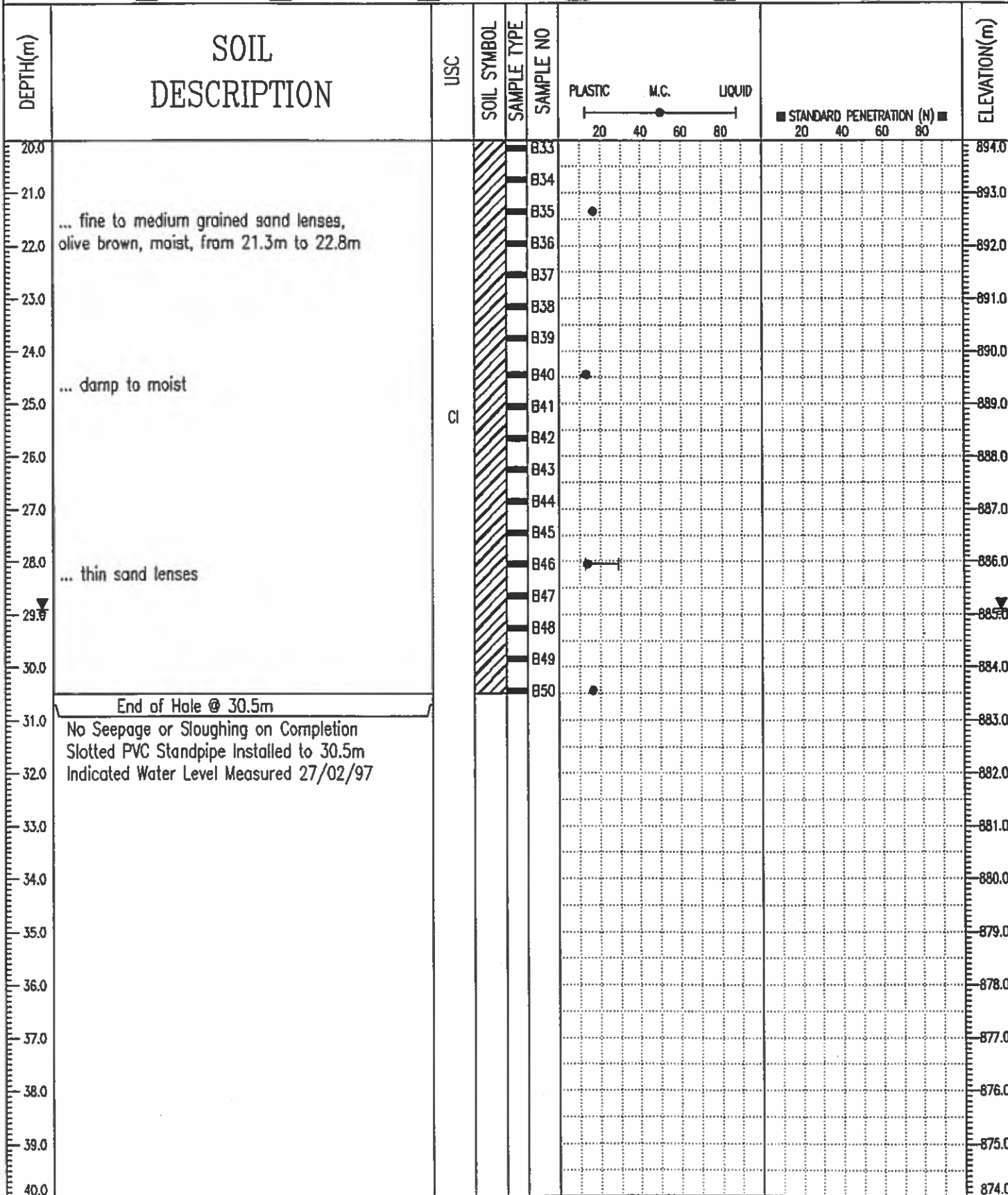


EBA Engineering Consultants Ltd.  
Lethbridge, Alberta

LOGGED BY: JHC  
REVIEWED BY: MJS  
Fig. No: B1

COMPLETION DEPTH: 30.5 m  
COMPLETE: 98/02/23  
Page 1 of 2

|  |                                      |                           |
|--|--------------------------------------|---------------------------|
| PROJECT: SLOPE STABILITY ASSESSMENT  | LOCATION: NW 1/4 16-8-21 W4M         | TEST HOLE NO: 001         |
| CLIENT: MACLEAN LIVESTOCK CO. LTD.   | CONTRACTOR: DOUBLE D DRILLING LTD.   | PROJECT NO: 0404-98-42101 |
| PROJECT ENGINEER: MJS  | DRILL METHOD: 150mm SOLID STEM AUGER | ELEVATION: 914.00 (m)     |
| SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE |                                      |                           |

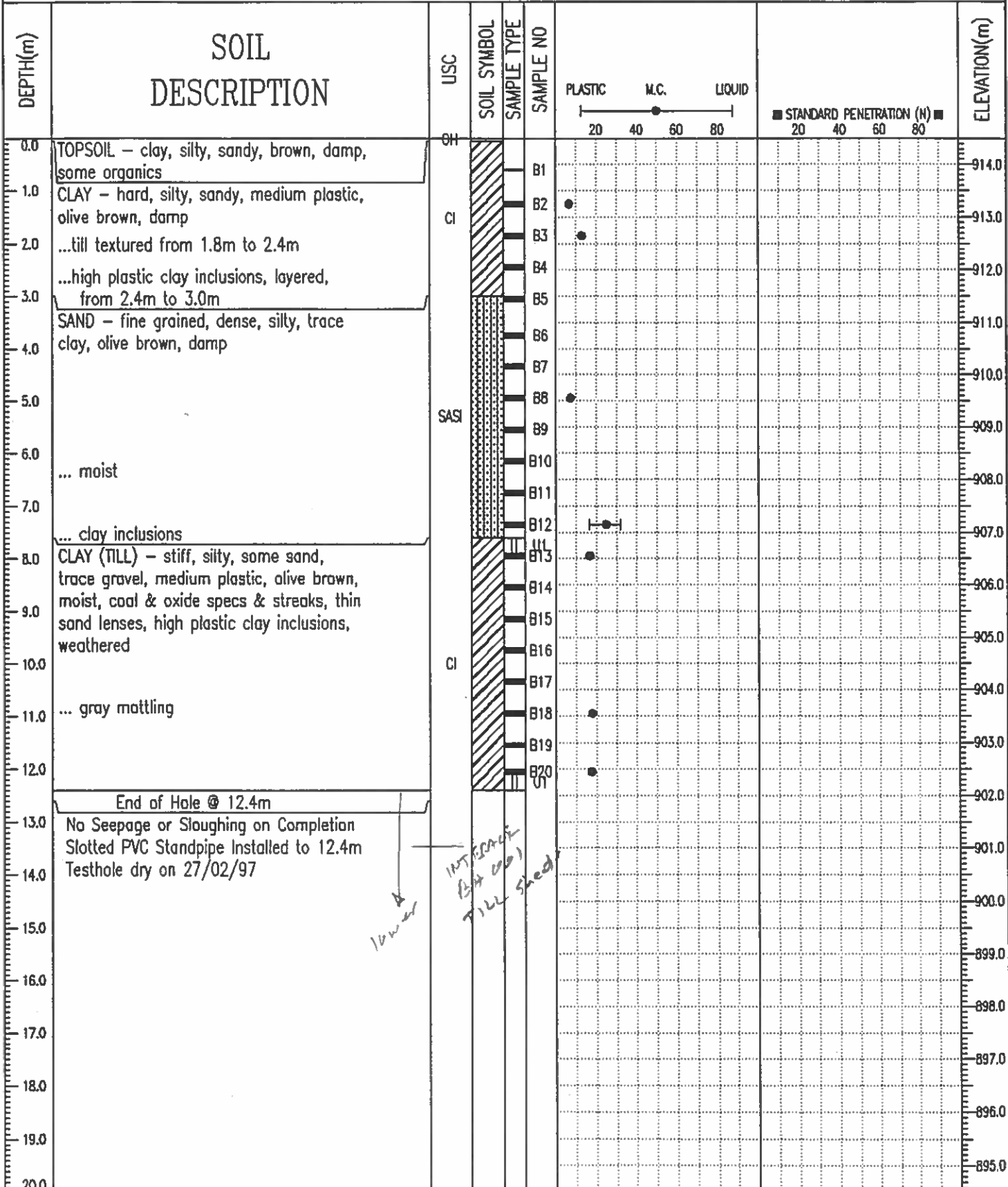


EBA Engineering Consultants Ltd.  
Lethbridge, Alberta

LOGGED BY: JHC  
REVIEWED BY: MJS  
Fig. No: 81

COMPLETION DEPTH: 30.5 m  
COMPLETE: 98/02/23

|  |                                      |                           |
|--|--------------------------------------|---------------------------|
| PROJECT: SLOPE STABILITY ASSESSMENT  | LOCATION: NW 1/4 16-8-21 W4M         | TEST HOLE NO: 002         |
| CLIENT: MACLEAN LIVESTOCK CO. LTD.   | CONTRACTOR: DOUBLE D DRILLING LTD.   | PROJECT NO: 0404-98-42101 |
| PROJECT ENGINEER: MJS  | DRILL METHOD: 150mm SOLID STEM AUGER | ELEVATION: 914.50 (m)     |
| SAMPLE TYPE <input checked="" type="checkbox"/> DISTURBED <input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> SPT <input type="checkbox"/> A-CASING <input type="checkbox"/> SHELBY TUBE <input type="checkbox"/> CORE |                                      |                           |



|   |                  |                          |
|---|------------------|--------------------------|
| EBA Engineering Consultants Ltd.<br>Lethbridge, Alberta | LOGGED BY: JHC   | COMPLETION DEPTH: 12.4 m |
|   | REVIEWED BY: MJS | COMPLETE: 98/02/24       |
|   | Fig. No: B2      | Page 1 of 1              |

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**APPENDIX C**  
**LABORATORY TEST RESULTS**

# EBA Engineering Consultants Ltd.

## Multi-Stage Consolidated Undrained Triaxial Test

STAGE 1

Project No.: 0404-42101  
Date Tested: 98-02-26

Test Hole No.: 2U1  
Depth: 12.1-12.4 ft.  
Test Number: CU-1

|                                   | Initial | Final |
|-----------------------------------|---------|-------|
| Moisture Content (%):             | 16.8    | 15.6  |
| Wet Density (Mg/m <sup>3</sup> ): | 2.167   | 2.274 |
| Dry Density (Mg/m <sup>3</sup> ): | 1.855   | 1.968 |

| Strain (%) | $\sigma_1 - \sigma_3$ (kPa) | Excess PP (kPa) | Parameter a | $\sigma_1 / \sigma_3$ | $(\sigma_1 - \sigma_3) / 2$ (kPa) | $(\sigma_1 + \sigma_3) / 2$ (kPa) |
|------------|-----------------------------|-----------------|-------------|-----------------------|-----------------------------------|-----------------------------------|
| 0.00       | 0.0                         | 0.0             | 0.00        | 1.00                  | 0.0                               | 120.0                             |
| 0.04       | 21.9                        | 10.1            | 0.46        | 1.20                  | 10.9                              | 120.8                             |
| 0.09       | 36.9                        | 17.1            | 0.46        | 1.36                  | 18.5                              | 121.4                             |
| 0.17       | 57.9                        | 26.9            | 0.47        | 1.62                  | 29.0                              | 122.0                             |
| 0.25       | 71.0                        | 31.7            | 0.45        | 1.80                  | 35.5                              | 123.8                             |
| 0.34       | 79.3                        | 34.8            | 0.44        | 1.93                  | 39.7                              | 124.8                             |
| 0.43       | 85.9                        | 37.5            | 0.44        | 2.04                  | 42.9                              | 125.5                             |
| 0.59       | 95.7                        | 41.1            | 0.43        | 2.21                  | 47.8                              | 126.7                             |
| 0.76       | 103.5                       | 44.2            | 0.43        | 2.37                  | 51.8                              | 127.6                             |
| 0.93       | 110.4                       | 46.7            | 0.42        | 2.51                  | 55.2                              | 128.6                             |
| 1.16       | 118.2                       | 47.2            | 0.40        | 2.62                  | 59.1                              | 131.9                             |
| 1.33       | 123.7                       | 48.0            | 0.39        | 2.72                  | 61.9                              | 133.9                             |
| 1.50       | 128.5                       | 48.6            | 0.38        | 2.80                  | 64.3                              | 135.6                             |
| 1.67       | 133.3                       | 49.0            | 0.37        | 2.88                  | 66.6                              | 137.6                             |
| 1.84       | 137.6                       | 49.0            | 0.36        | 2.94                  | 68.8                              | 139.8                             |
| 2.01       | 141.5                       | 48.9            | 0.35        | 2.99                  | 70.8                              | 141.9                             |
| 2.18       | 145.3                       | 49.7            | 0.34        | 3.07                  | 72.7                              | 143.0                             |
| 2.34       | 149.1                       | 48.6            | 0.33        | 3.09                  | 74.5                              | 145.9                             |
| 2.51       | 152.6                       | 48.1            | 0.32        | 3.12                  | 76.3                              | 148.2                             |
| 2.68       | 156.0                       | 47.8            | 0.31        | 3.16                  | 78.0                              | 150.2                             |
| 2.85       | 159.3                       | 47.2            | 0.30        | 3.19                  | 79.6                              | 152.4                             |
| 3.01       | 162.4                       | 46.7            | 0.29        | 3.21                  | 81.2                              | 154.5                             |
| 3.18       | 165.5                       | 46.0            | 0.28        | 3.24                  | 82.7                              | 156.7                             |
| 3.35       | 168.4                       | 45.5            | 0.27        | 3.26                  | 84.2                              | 158.7                             |
| 3.52       | 171.2                       | 44.6            | 0.26        | 3.27                  | 85.6                              | 161.0                             |
| 3.69       | 173.9                       | 43.8            | 0.25        | 3.28                  | 87.0                              | 163.2                             |
| 3.86       | 176.7                       | 43.0            | 0.24        | 3.29                  | 88.3                              | 165.4                             |
| 4.03       | 179.5                       | 42.2            | 0.23        | 3.31                  | 89.8                              | 167.6                             |
| 4.20       | 182.0                       | 41.4            | 0.23        | 3.32                  | 91.0                              | 169.6                             |
| 4.37       | 184.5                       | 40.5            | 0.22        | 3.32                  | 92.3                              | 171.8                             |
| 4.54       | 186.9                       | 39.6            | 0.21        | 3.32                  | 93.5                              | 173.9                             |



Test Hole No.: 2U1  
 Depth: 12.1-12.4 ft.

Test Number: CU-1

STAGE 2

| Strain (%) | $\sigma_1 - \sigma_3$ (kPa) | Excess PP (kPa) | Parameter a | $\sigma_1 / \sigma_3$ | $(\sigma_1 - \sigma_3) / 2$ (kPa) | $(\sigma_1 + \sigma_3) / 2$ (kPa) |
|------------|-----------------------------|-----------------|-------------|-----------------------|-----------------------------------|-----------------------------------|
| 4.54       | 0.0                         | 0.0             | 0.00        | 1.00                  | 0.0                               | 240.0                             |
| 4.59       | 57.5                        | 24.3            | 0.42        | 1.27                  | 28.7                              | 244.4                             |
| 4.68       | 95.4                        | 42.1            | 0.44        | 1.48                  | 47.7                              | 245.6                             |
| 4.76       | 118.2                       | 52.6            | 0.44        | 1.63                  | 59.1                              | 246.5                             |
| 4.86       | 139.5                       | 61.9            | 0.44        | 1.78                  | 69.8                              | 247.9                             |
| 4.94       | 154.3                       | 68.6            | 0.44        | 1.90                  | 77.2                              | 248.6                             |
| 5.03       | 167.6                       | 73.2            | 0.44        | 2.00                  | 83.8                              | 250.6                             |
| 5.11       | 179.6                       | 76.9            | 0.43        | 2.10                  | 89.8                              | 252.9                             |
| 5.19       | 190.6                       | 80.2            | 0.42        | 2.19                  | 95.3                              | 255.1                             |
| 5.36       | 209.9                       | 85.6            | 0.41        | 2.36                  | 105.0                             | 259.4                             |
| 5.44       | 218.6                       | 87.7            | 0.40        | 2.43                  | 109.3                             | 261.6                             |
| 5.53       | 226.0                       | 89.4            | 0.40        | 2.50                  | 113.0                             | 263.6                             |
| 5.61       | 233.1                       | 90.8            | 0.39        | 2.56                  | 116.6                             | 265.8                             |
| 5.78       | 244.8                       | 93.1            | 0.38        | 2.67                  | 122.4                             | 269.4                             |
| 5.87       | 250.0                       | 93.8            | 0.38        | 2.71                  | 125.0                             | 271.1                             |
| 5.95       | 254.7                       | 94.5            | 0.37        | 2.75                  | 127.3                             | 272.8                             |
| 6.04       | 258.8                       | 95.2            | 0.37        | 2.79                  | 129.4                             | 274.2                             |
| 6.21       | 265.9                       | 95.7            | 0.36        | 2.84                  | 132.9                             | 277.3                             |
| 6.29       | 268.9                       | 96.1            | 0.36        | 2.87                  | 134.5                             | 278.4                             |
| 6.38       | 271.6                       | 96.2            | 0.35        | 2.89                  | 135.8                             | 279.6                             |
| 6.46       | 274.1                       | 96.1            | 0.35        | 2.90                  | 137.0                             | 281.0                             |
| 6.63       | 278.6                       | 95.9            | 0.34        | 2.93                  | 139.3                             | 283.3                             |
| 6.71       | 280.7                       | 95.8            | 0.34        | 2.95                  | 140.4                             | 284.5                             |
| 6.80       | 282.5                       | 95.7            | 0.34        | 2.96                  | 141.3                             | 285.6                             |
| 6.97       | 286.0                       | 95.4            | 0.33        | 2.98                  | 143.0                             | 287.6                             |
| 7.06       | 287.5                       | 95.2            | 0.33        | 2.98                  | 143.7                             | 288.6                             |
| 7.14       | 289.1                       | 95.0            | 0.33        | 2.99                  | 144.6                             | 289.5                             |
| 7.22       | 290.6                       | 94.6            | 0.33        | 3.00                  | 145.3                             | 290.7                             |
| 7.40       | 293.3                       | 94.2            | 0.32        | 3.01                  | 146.7                             | 292.4                             |
| 7.48       | 294.8                       | 94.0            | 0.32        | 3.02                  | 147.4                             | 293.4                             |
| 7.56       | 296.0                       | 93.6            | 0.32        | 3.02                  | 148.0                             | 294.4                             |
| 7.65       | 297.2                       | 93.1            | 0.31        | 3.02                  | 148.6                             | 295.5                             |
| 7.74       | 298.4                       | 92.8            | 0.31        | 3.03                  | 149.2                             | 296.4                             |
| 7.91       | 300.8                       | 92.0            | 0.31        | 3.03                  | 150.4                             | 298.4                             |
| 7.99       | 302.0                       | 91.7            | 0.30        | 3.04                  | 151.0                             | 299.2                             |
| 8.08       | 303.0                       | 91.3            | 0.30        | 3.04                  | 151.5                             | 300.1                             |
| 8.16       | 304.2                       | 91.0            | 0.30        | 3.04                  | 152.1                             | 301.1                             |



Test Hole No.: 2U1  
 Depth: 12.1-12.4 ft.

Test Number: CU-1

STAGE 3

| Strain (%) | $\sigma_1 - \sigma_3$ (kPa) | Excess PP (kPa) | Parameter a | $\sigma_1 / \sigma_3$ | $(\sigma_1 - \sigma_3) / 2$ (kPa) | $(\sigma_1 + \sigma_3) / 2$ (kPa) |
|------------|-----------------------------|-----------------|-------------|-----------------------|-----------------------------------|-----------------------------------|
| 8.16       | 0.0                         | 0.0             | 0.00        | 1.00                  | 0.0                               | 400.0                             |
| 8.21       | 67.1                        | 31.8            | 0.47        | 1.18                  | 33.5                              | 401.7                             |
| 8.25       | 108.1                       | 51.3            | 0.47        | 1.31                  | 54.0                              | 402.8                             |
| 8.33       | 158.8                       | 75.8            | 0.48        | 1.49                  | 79.4                              | 403.6                             |
| 8.46       | 209.3                       | 98.6            | 0.47        | 1.69                  | 104.6                             | 406.1                             |
| 8.63       | 258.7                       | 119.7           | 0.46        | 1.92                  | 129.4                             | 409.6                             |
| 8.96       | 330.5                       | 145.6           | 0.44        | 2.30                  | 165.3                             | 419.6                             |
| 9.29       | 378.8                       | 158.0           | 0.42        | 2.57                  | 189.4                             | 431.4                             |
| 9.64       | 408.6                       | 164.8           | 0.40        | 2.74                  | 204.3                             | 439.5                             |
| 9.98       | 425.4                       | 166.4           | 0.39        | 2.82                  | 212.7                             | 446.3                             |
| 10.33      | 435.9                       | 166.3           | 0.38        | 2.86                  | 217.9                             | 451.7                             |
| 10.67      | 443.7                       | 166.0           | 0.37        | 2.90                  | 221.8                             | 455.8                             |
| 11.01      | 449.3                       | 165.7           | 0.37        | 2.92                  | 224.7                             | 458.9                             |
| 11.35      | 454.3                       | 165.3           | 0.36        | 2.94                  | 227.1                             | 461.8                             |
| 11.69      | 458.4                       | 164.7           | 0.36        | 2.95                  | 229.2                             | 464.5                             |
| 12.03      | 462.2                       | 163.9           | 0.35        | 2.96                  | 231.1                             | 467.2                             |
| 12.37      | 465.7                       | 162.8           | 0.35        | 2.96                  | 232.9                             | 470.0                             |
| 12.70      | 468.9                       | 161.7           | 0.34        | 2.97                  | 234.5                             | 472.8                             |
| 13.05      | 471.5                       | 160.4           | 0.34        | 2.97                  | 235.7                             | 475.4                             |
| 13.38      | 474.2                       | 158.9           | 0.34        | 2.97                  | 237.1                             | 478.2                             |
| 13.72      | 476.7                       | 157.3           | 0.33        | 2.96                  | 238.4                             | 481.0                             |
| 14.06      | 478.8                       | 155.6           | 0.33        | 2.96                  | 239.4                             | 483.8                             |
| 14.39      | 481.0                       | 154.0           | 0.32        | 2.96                  | 240.5                             | 486.5                             |
| 14.73      | 483.0                       | 152.5           | 0.32        | 2.95                  | 241.5                             | 489.1                             |
| 15.06      | 485.2                       | 150.9           | 0.31        | 2.95                  | 242.6                             | 491.7                             |
| 15.40      | 486.6                       | 149.3           | 0.31        | 2.94                  | 243.3                             | 494.0                             |
| 15.74      | 488.0                       | 147.7           | 0.30        | 2.93                  | 244.0                             | 496.3                             |
| 16.07      | 489.0                       | 146.2           | 0.30        | 2.93                  | 244.5                             | 498.3                             |
| 16.41      | 489.7                       | 144.6           | 0.30        | 2.92                  | 244.9                             | 500.3                             |
| 16.74      | 490.2                       | 143.0           | 0.29        | 2.91                  | 245.1                             | 502.1                             |
| 17.08      | 490.0                       | 141.6           | 0.29        | 2.90                  | 245.0                             | 503.4                             |
| 17.41      | 490.6                       | 140.5           | 0.29        | 2.89                  | 245.3                             | 504.8                             |
| 17.75      | 490.2                       | 138.9           | 0.28        | 2.88                  | 245.1                             | 506.2                             |
| 18.09      | 489.6                       | 137.5           | 0.28        | 2.87                  | 244.8                             | 507.3                             |
| 18.42      | 488.7                       | 136.2           | 0.28        | 2.85                  | 244.4                             | 508.2                             |
| 18.71      | 487.8                       | 135.1           | 0.28        | 2.84                  | 243.9                             | 508.8                             |
| 19.05      | 486.7                       | 133.9           | 0.28        | 2.83                  | 243.3                             | 509.4                             |
| 19.39      | 485.5                       | 132.9           | 0.27        | 2.82                  | 242.8                             | 509.9                             |
| 19.72      | 484.4                       | 132.0           | 0.27        | 2.81                  | 242.2                             | 510.2                             |
| 20.06      | 483.4                       | 131.2           | 0.27        | 2.80                  | 241.7                             | 510.5                             |
| 20.39      | 482.3                       | 130.5           | 0.27        | 2.79                  | 241.1                             | 510.6                             |



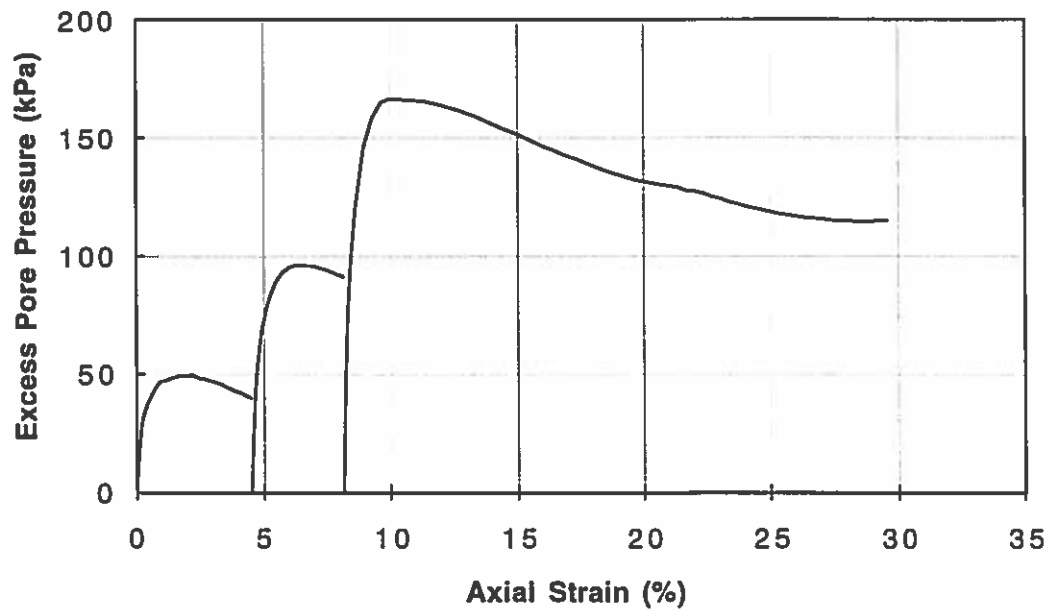
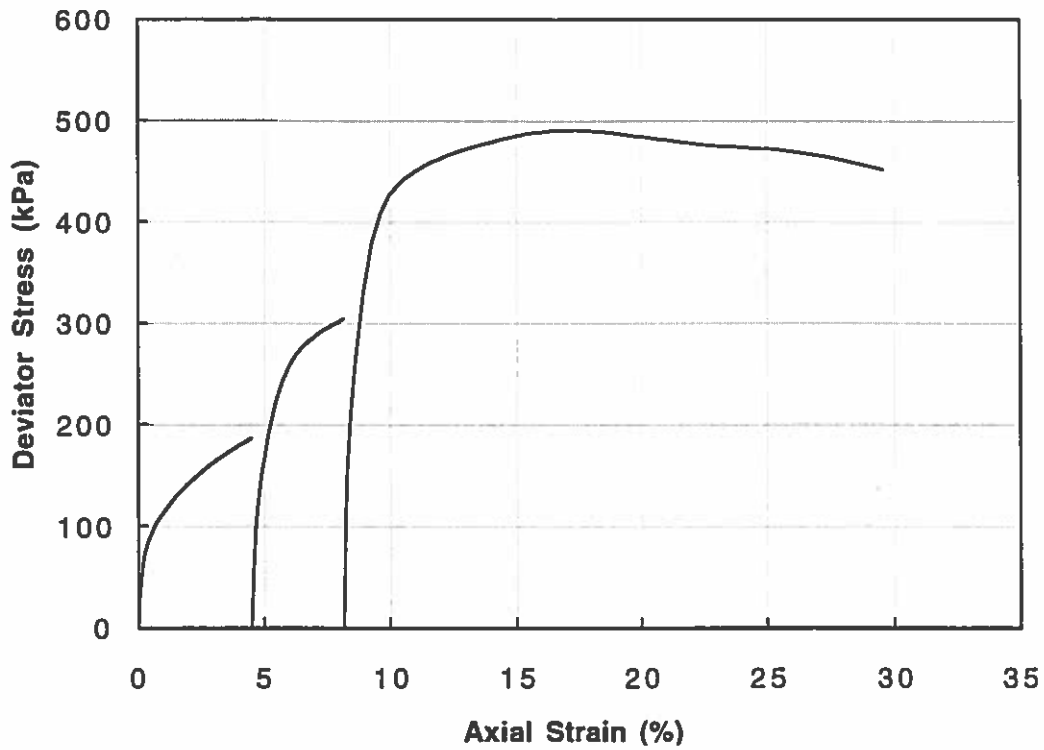
Test Hole No.: 2U1  
Depth: 12.1-12.4 ft.

Test Number: CU-1

STAGE 3

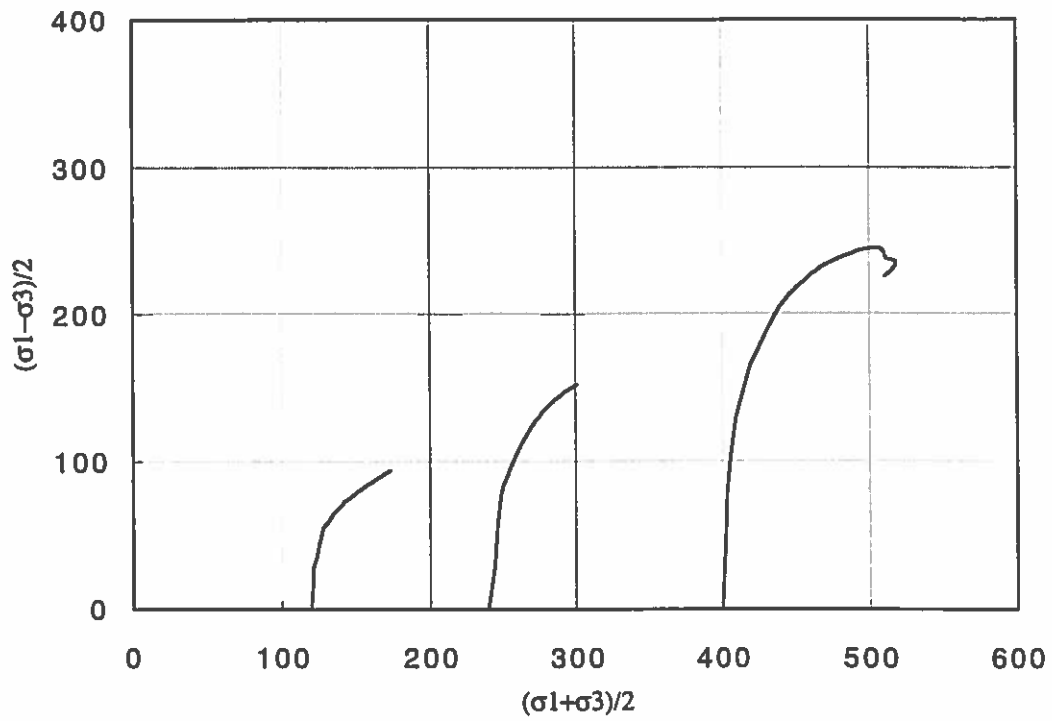
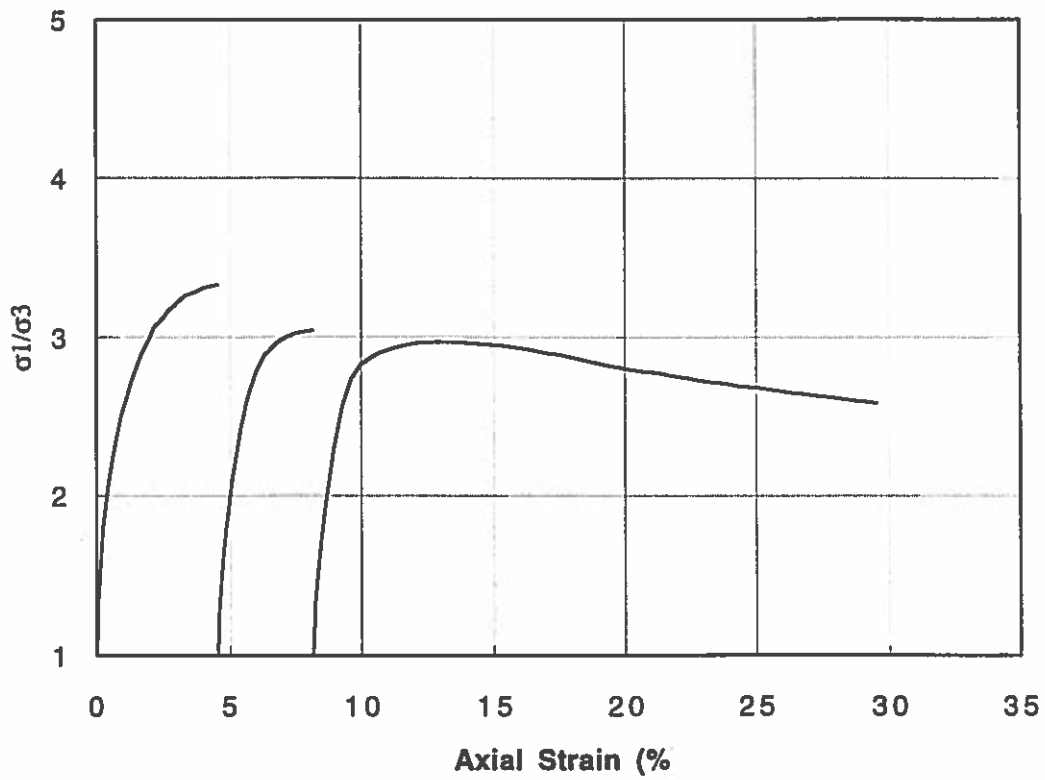
| Strain (%) | $\sigma_1 - \sigma_3$ (kPa) | Excess PP (kPa) | Parameter a | $\sigma_1 / \sigma_3$ | $(\sigma_1 - \sigma_3) / 2$ (kPa) | $(\sigma_1 + \sigma_3) / 2$ (kPa) |
|------------|-----------------------------|-----------------|-------------|-----------------------|-----------------------------------|-----------------------------------|
| 20.72      | 481.1                       | 129.9           | 0.27        | 2.78                  | 240.6                             | 510.7                             |
| 21.05      | 480.1                       | 129.5           | 0.27        | 2.77                  | 240.1                             | 510.6                             |
| 21.38      | 479.1                       | 128.8           | 0.27        | 2.77                  | 239.6                             | 510.8                             |
| 21.72      | 478.0                       | 127.6           | 0.27        | 2.75                  | 239.0                             | 511.4                             |
| 22.05      | 477.0                       | 127.1           | 0.27        | 2.75                  | 238.5                             | 511.4                             |
| 22.38      | 475.9                       | 126.4           | 0.27        | 2.74                  | 237.9                             | 511.5                             |
| 22.71      | 475.4                       | 125.1           | 0.26        | 2.73                  | 237.7                             | 512.6                             |
| 23.05      | 475.0                       | 124.1           | 0.26        | 2.72                  | 237.5                             | 513.4                             |
| 23.38      | 474.6                       | 122.9           | 0.26        | 2.71                  | 237.3                             | 514.4                             |
| 23.71      | 474.1                       | 122.0           | 0.26        | 2.71                  | 237.1                             | 515.1                             |
| 24.05      | 473.6                       | 120.9           | 0.26        | 2.70                  | 236.8                             | 515.9                             |
| 24.38      | 473.0                       | 120.0           | 0.25        | 2.69                  | 236.5                             | 516.5                             |
| 24.72      | 472.2                       | 119.2           | 0.25        | 2.68                  | 236.1                             | 516.9                             |
| 25.05      | 472.0                       | 118.6           | 0.25        | 2.68                  | 236.0                             | 517.4                             |
| 25.39      | 471.3                       | 117.8           | 0.25        | 2.67                  | 235.6                             | 517.9                             |
| 25.73      | 470.2                       | 117.0           | 0.25        | 2.66                  | 235.1                             | 518.1                             |
| 26.07      | 468.8                       | 116.6           | 0.25        | 2.65                  | 234.4                             | 517.8                             |
| 26.41      | 467.6                       | 115.9           | 0.25        | 2.65                  | 233.8                             | 517.9                             |
| 26.75      | 466.5                       | 115.7           | 0.25        | 2.64                  | 233.3                             | 517.6                             |
| 27.09      | 465.2                       | 115.4           | 0.25        | 2.63                  | 232.6                             | 517.2                             |
| 27.42      | 463.6                       | 115.0           | 0.25        | 2.63                  | 231.8                             | 516.8                             |
| 27.76      | 462.1                       | 114.9           | 0.25        | 2.62                  | 231.1                             | 516.2                             |
| 28.09      | 460.2                       | 114.6           | 0.25        | 2.61                  | 230.1                             | 515.5                             |
| 28.42      | 458.2                       | 114.5           | 0.25        | 2.60                  | 229.1                             | 514.6                             |
| 28.75      | 456.3                       | 114.5           | 0.25        | 2.60                  | 228.2                             | 513.7                             |
| 29.08      | 454.3                       | 114.7           | 0.25        | 2.59                  | 227.2                             | 512.4                             |
| 29.41      | 452.5                       | 114.9           | 0.25        | 2.59                  | 226.2                             | 511.4                             |
| 29.57      | 451.3                       | 115.0           | 0.25        | 2.58                  | 225.7                             | 510.6                             |

# EBA Engineering Consultants Ltd.



Test Hole: 2U1  
Effective Stress: 120/240/400 kPa  
Strain Rate: 0.007 %/min.  
Test No.: CU-1

# EBA Engineering Consultants Ltd.



Test Number: CU-1