MUNICIPAL DISTRICT OF TABER
IN THE PROVINCE OF ALBERTA

BYLAW NO. 1798

BEING a bylaw of the Municipal District of Taber in the Province of Alberta for the purpose of adopting Bylaw No. 1798 being the Area Structure Plan for Lot 3, Block 1, Plan 9611496.

WHEREAS the Council of the Municipal District of Taber has redesignated Lot 3, Block 1, Plan 9611496 located in the NW¼ 8-9-16-W4M to the "Grouped Country Residential" land use district;

AND WHEREAS the purpose of proposed Bylaw No. 1798 is to establish standards and requirements regarding the development and subdivision of lands described as Lot 3, Block 1, Plan 9611496 in the NW¼ 8-9-16-W4M;

AND WHEREAS the municipality wishes to provide for orderly growth and development to occur while minimizing land use conflicts;

AND WHEREAS the municipality may adopt an area structure plan pursuant to section 633 of the Municipal Government Act, RSA 2000, Chapter M-26, as amended, and provide for its consideration at a public hearing.

NOW THEREFORE, under the authority and subject to the provisions of the Municipal Government Act, RSA 2000, Chapter M-26, as amended, the Council of the Municipal District of Taber in the Province of Alberta, duly assembled does hereby adopt Bylaw No. 1798 being the Area Structure Plan for Lot 3, Block 1, Plan 9611496.

READ a first time this 14 day of April, 2009.

Reeve - Hank Van Beers *Municipal Administrator – Derrick Krizsan*

READ a second time this 12 day of May, 2009.

Reeve - Hank Van Beers *Municipal Administrator – Derrick Krizsan*

READ a third time and finally PASSED this 12 day of May, 2009.

Reeve - Hank Van Beers *Municipal Administrator – Derrick Krizsan*

Area Structure Plan: Block 1, Lot 3, Plan 9611496

Application for subdividing Block 1, Lot 3, Plan9611496

Detailed Structure Plan

The purpose of this subdivision is to create 3 lots varying in size from 4.96 to 6.4 acres more or less. The land is currently made up of one lot of 17.17 acres, more or less, consisting only of pasture land. The land is currently zoned Group Country Residential and is located approximately 4 miles south of Taber. This proposed development is similar to the existing developments in the immediate area.

Detailed lot sizes:
Lot 4: 4.96 acres
Lot 5: 5.81 acres
Lot 6: 6.4 acres

Road Network

- Lot 4 will be serviced by an approach at the North end of the lot, connecting to township road 9-2.
- Lot 5 will be serviced by an approach at the North end of the lot, connecting to township road 9-2.
- Lot 6 will be serviced by an approach at the North end of the lot, connecting to township road 9-2.
- Approaches will be constructed as per MD guidelines.

Stormwater Management

- The prevailing slope of all three proposed lots is generally southward.
- Property lines will be bermed or swaled to prevent cross lot drainage.
- For further details, refer to portions of Stormwater Management Plan prepared by due South Project Management Ltd. that pertain to this property.
- The attached report encompasses an area beyond the limits of this area structure plan for lot 3,block 1,plan 9611496.This in no way implies or authorizes approval of future subdivision on adjacent lands based on the information in the report.

Geotechnical Report (Percolation tests conducted by EBA Engineering)

Percolation Test	Location	Soil Texture Analysis (0.45m to 0.9m)	Percolation Test Result (min/cm)	Groundwater Levels (m)
P3	4	SAND-trace to some silt, poorly graded, medium grained, damp, compact brown	5	Dry
P2	5	SAND-trace to some silt, poorly graded, medium grained, damp, compact brown	3	Dry
P1	6	SAND-trace to some silt, poorly graded, medium grained, damp, compact brown	4	Dry

- For further details, refer to portions of geo technical report completed by EBA Engineering that pertain to this property.

- The attached report encompasses an area beyond the limits of this area structure plan for lot 3,block 1,plan 9611496.This in no way implies or authorizes approval of future subdivision on adjacent lands based on the information in the report

- **Lot Servicing**

- All lots will be serviced with power, natural gas, and domestic water (raw/non-potable water) to the lot line.
- Power will be provided by overhead line by way of easement.
- Natural gas will be provided by buried line by way of an easement as per Atco's recommendations.
- Each lot will require potable water to be hauled into a cistern, at the expense of the lot owner.
- Domestic water (raw/non-potable) will be provided to each lot through a buried line by way of an easement. Provision of domestic water is subject to the landowner entering into a domestic water use agreement with the irrigation district.

Affected Agencies

- T.I.D. has reviewed the proposal and has responded with no objections, as per attached letter.
- S.M.R.I.D. has reviewed the proposal and has responded with attached letter.
- The CHR Public Health Inspector has reviewed the proposal, including the percolation tests, and has responded with attached letter.
- Horizon School Division has reviewed the proposal and no letter of response was received.
- ATCO Gas was contacted and no letter of response was received.

Design Details

- Any home, pre-built, manufactured or constructed on site must obtain a development permit from the M.D. of Taber.
- All non-residential buildings will be limited to personal use structures (example; garages, garden sheds, greenhouses, gazebos, vehicle storage buildings & pet animal shelters).

Keeping of Animals

- Horses will be allowed to a maximum of two per lot plus foals (up to 12 months old).
- No other animals, other than domestic pets will be allowed.

Garbage Disposal

- Garbage disposal will be by way of dumpster or hauling to the landfill, at the lot owner's expense.
- No burning barrels or burning of garbage in any way will be permitted.

Home Occupations

- Home occupation is a discretionary use and will be determined by the M.D. of Taber Land Use Bylaw.
- No commercial or industrial uses will be permitted.

Right to Farm

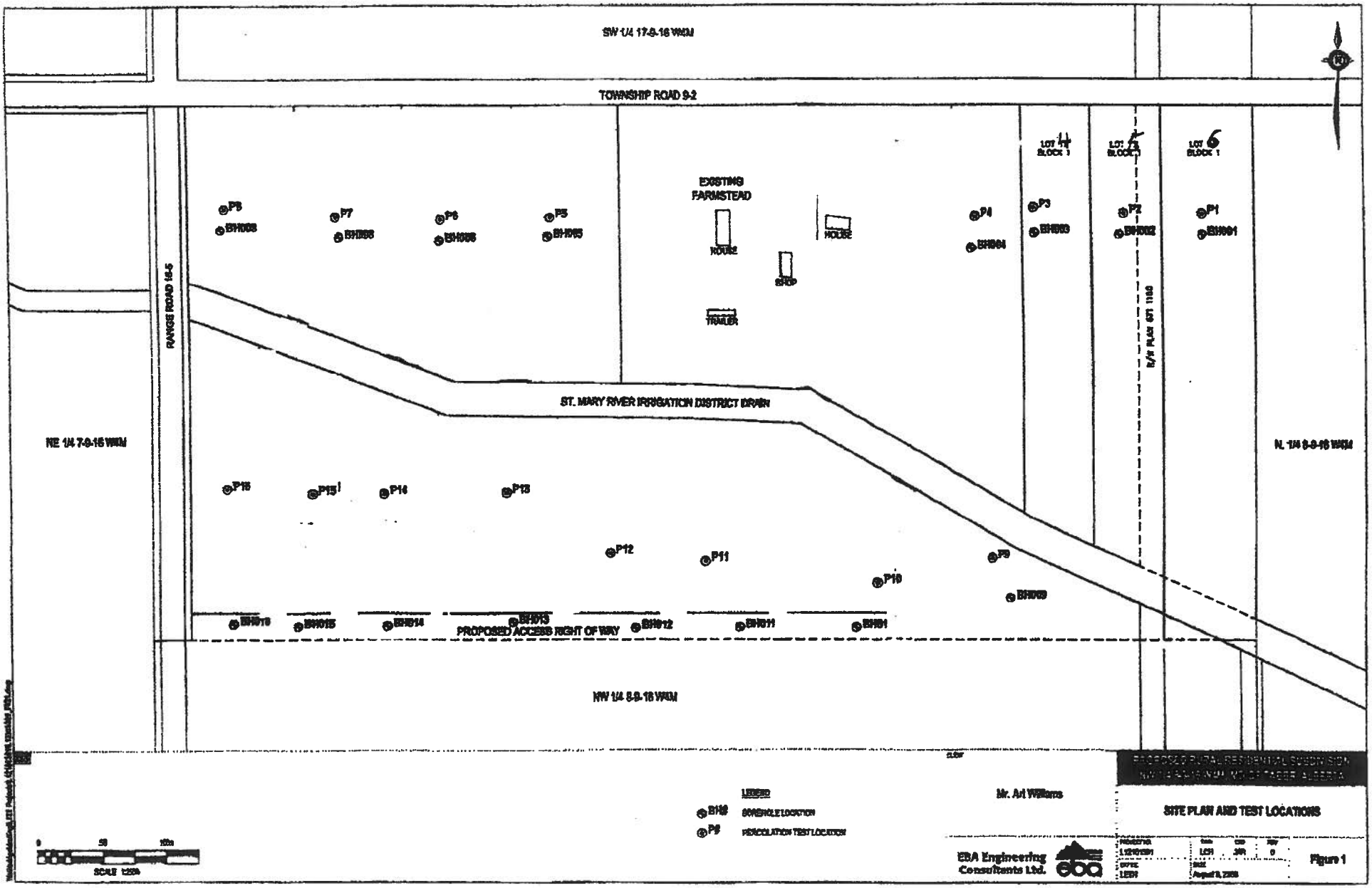
- It is a provision hereof that the owner of the lands may not hold liable any person in an action in nuisance resulting from agricultural operations. The owner of any agricultural operation is not to be prevented by injunction or other order of a court from carrying on the agricultural operation because it causes or creates a nuisance.

Further subdivision of Land

- It is a provision hereof that the owner of the lands may not further subdivide the land unless under the provisions of the Municipal District of Taber Land Use Bylaw.

No Waiver

- Failure by the Municipal District or any third party to enforce or require compliance with any provision hereof shall not render any such provision in any way unenforceable or invalid. No provision hereof shall be waived except in writing duly signed by the Municipal District of Taber.


SW 1/4 17-9-16 W4M
TOWNSHIP ROAD 9-2
RANGE ROAD 16-5
EXISTING FARMSTEAD
HOUSE
SHED
TRAILER
HOUSE
LOT 4 BLOCK 1
LOT 5 BLOCK 1
LOT 6 BLOCK 1
R/W PLAN 671 1180
ST. MARY RIVER IRRIGATION DISTRICT DRAIN
NE 1/4 7-9-16 W4M
N. 1/4 8-9-16 W4M
NW 1/4 8-9-16 W4M
PROPOSED ACCESS RIGHT OF WAY
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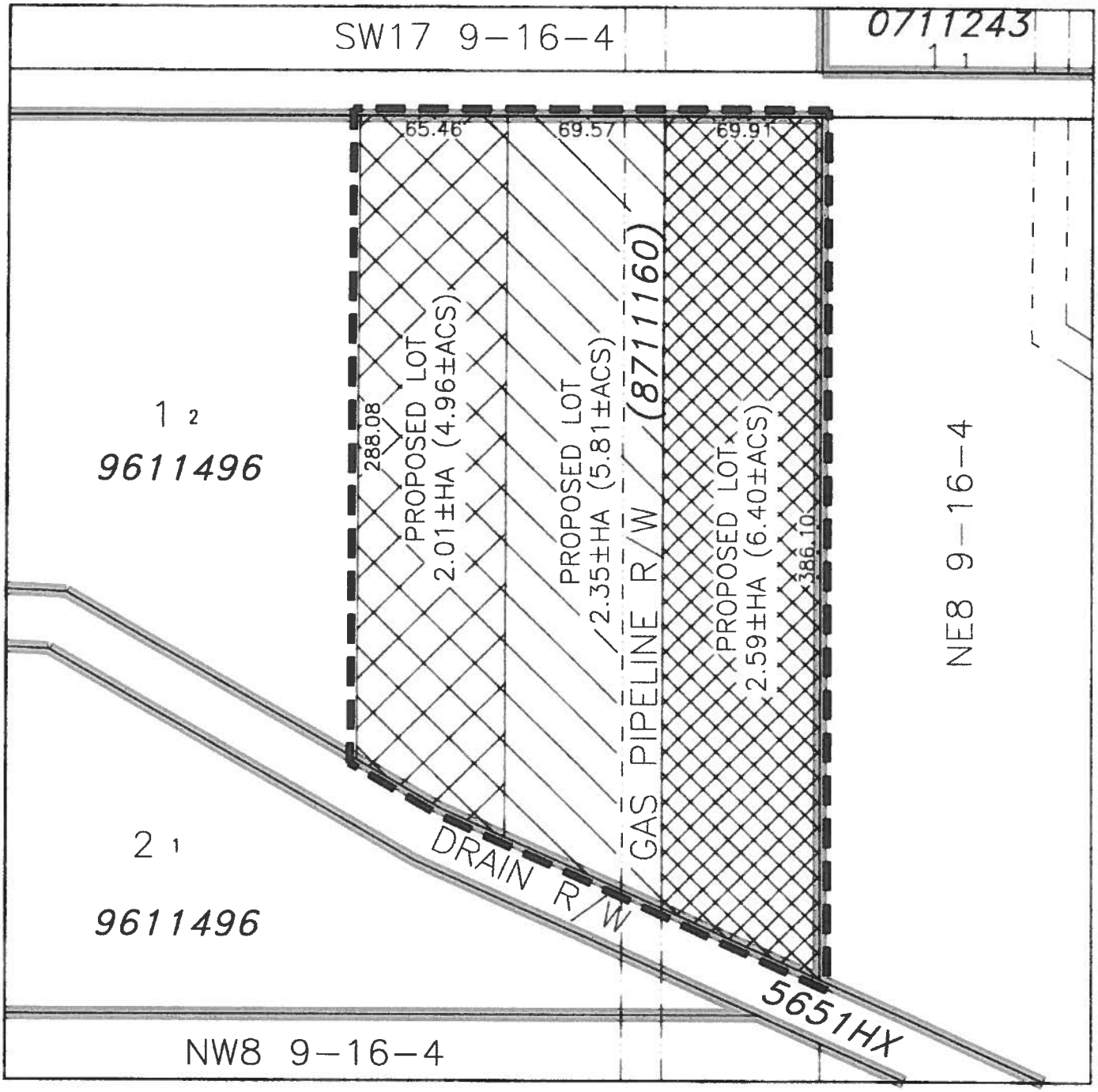
BH015
BH016
LEGEND
BH# BOREHOLE LOCATION
P# PERCOLATION TEST LOCATION
Mr. Art Williams
SITE PLAN AND TEST LOCATIONS
EBA Engineering Consultants Ltd.
Figure 1



SUBDIVISION SKETCH
LOT 3, BLOCK 1, PLAN 9611496 IN
NW 1/4 SEC 8, TWP 9, RGE 16, W 4 M
MUNICIPALITY; M. D. OF TABER
DATE; MAY 20, 2009
FILE; 2009-0-116

OLDMAN RIVER REGIONAL SERVICES COMMISSION

0 Metres 50 100 150 200

May 20, 2009 \\Server\ORRSA-Drawings\Subdivision\2009\2009-0-116.dwg

dueSOUTH
PROJECT MANAGEMENT LTD.

236 – 36 Street North
Lethbridge, AB T1H 3Z7
Tel.: (403) 394-7474
Fax: (403) 394-7404
www.duesouthproject.ca

July 22, 2008

File: 4070-001-00

Wadena Acres
Box 4105
Taber, Alberta T1G 2C6

Dear Mr. Williams

RE: Wadena Acres
Stormwater Management Plan

due South Project Management is pleased to provide the stormwater management plan for the proposed development of 16 country residential lots covering 80 acres on the north half of the NW ¼ of Sec. 8, Twp 9, Rge 16 W4M.

Pre-Development Conditions:

The proposed site is located on agricultural lands that includes dry land and irrigated grasses and forages for the purpose of haying and grazing cattle. There are two established homes located in the existing homestead and a St. Mary River Irrigation District (SMRID) drain splits the site draining towards the south east corner of the site.

The general layout has the highest point of the site located in the northeast corner and the lowest point in the southeast corner of the development. The lands north of the drainage ditch are sandy clay soils used for dry land hay and grazing pasture which slope southerly towards the drain. The lands south of the drainage ditch have heavy clay soils that were used as irrigated hay land. The irrigation turnout is located at the high point in the southwest corner of the site and the land slopes northerly towards the drain.

Typical surface water runoff from this development into the SMRID drain would occur in the spring as a result of snowmelt while the ground is still frozen. Runoff from summer storms into the SMRID drain would be an unusual occurrence because surface water is typically trapped and/or absorbed into the soil. Water is vital to plant growth and the existing drainage of the site was designed to promote retention of soil moisture with positive drainage toward the drain to ensure standing water did not remain in the low areas for extended periods. The only significant runoff that would have reached the drain during the summer would have been when the landowner irrigating his hay on the south side of the drain.

Stormwater Quantity:

The concern with urbanization occurring in a rural area is that there are specific changes to the existing hydraulic regime of the area such as:

- An overall increase in annual volume of runoff
- A much faster rate of runoff from any given storm event
- Summer rainfall events that result in significant runoff from the urbanized areas, while little or no runoff comes from the rural portion of the basin.

These impacts are significant when you consider a typical residential subdivision with a high density of residential houses on small lots with concrete and asphalt surfaces. However the proposed subdivision consists of country residential lots that range in size from 2.9 acres to 6.5 acres. It is anticipated 5% to 10% of the lot will be developed with buildings, parking and driveway and the remaining lot will be unimproved. The increased runoff from the yard site during the summer storm events will be absorbed by the remaining unimproved lands within the lot.

Stormwater Quality

The two main contaminates that would be a concern for the SMRID drain would be sediment loading and nutrient enrichment. The most significant pollutant loading will occur in the spring with snowmelt since runoff from summer storms is a very rare occurrence.

The introduction of additional pollutants from post development of the site will be negligible when compared to the background concentrations from the agricultural land upstream on the SMRID drain or compared to the pollutant loading that would have occurred during irrigation.

Therefore the post development stormwater runoff quantity and quality will be consistent if not better then the pre development conditions and will have no negative impact on the SMRID drain or the downstream watercourse.

To minimize cross lot drainage the developer is recommended to construct either a berm or a swale ditch along the downstream edge of each property.

Should you have any questions or concerns you can contact the undersigned at your convenience.

Yours truly,

due South Project Management Ltd.

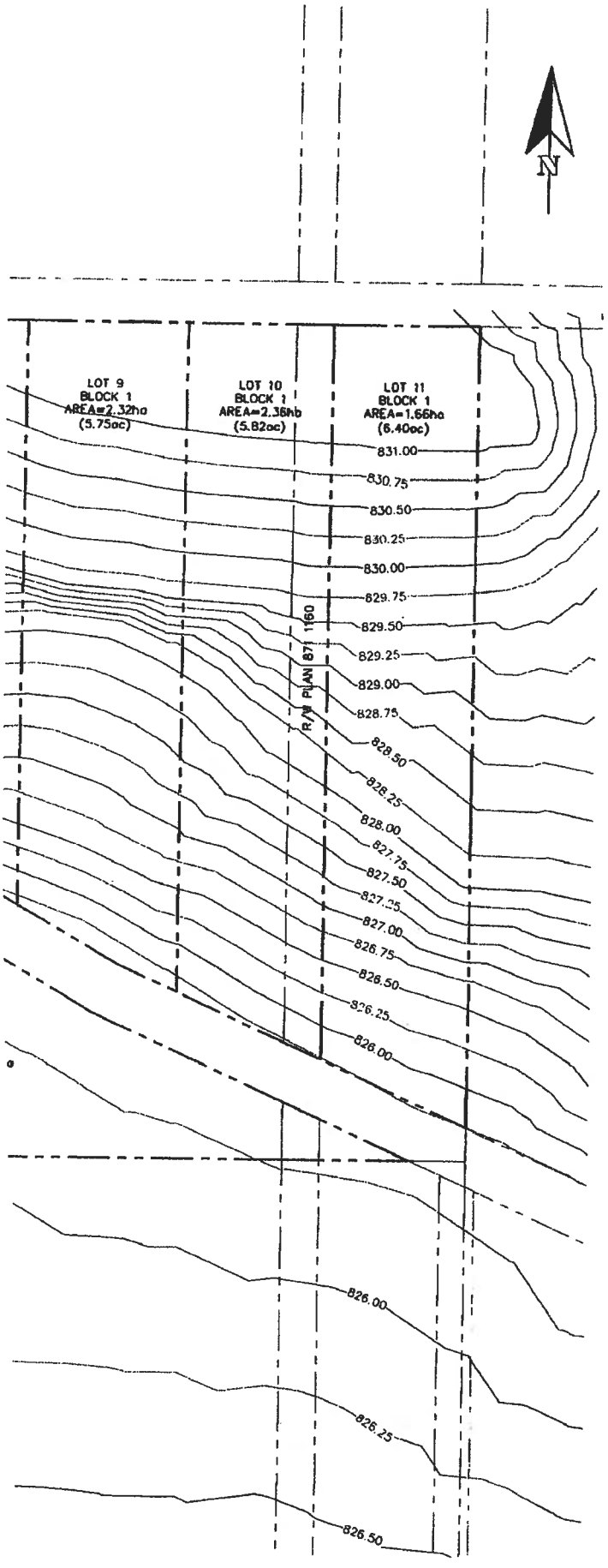
Lloyd Madge, P.Eng.
Project Engineer

LDM:mw

Enclosures (1)

PROFESSIONAL ENGINEER ALBERTA
LLOYD MADGE
July 22, 2008

PERMIT TO PRACTICE
dueSOUTH
DUE SOUTH PROJECT MANAGEMENT LTD.
PERMIT NUMBER: P 9222
The Association of Professional Engineers, Geologists and Geophysicists of Alberta



NOTES:

1. CONTOUR LINES FOR ILLUSTRATIVE PURPOSES ONLY AND ARE INTERPOLATED FROM SMRID CONTOUR PLAN.
2. PROPERTY LINES TO BE BERMED OR SWALED TO PREVENT CROSS LOT DRAINAGE.

ISSUE	DATE	REVISION
1	08-09-04	FOR APPROVAL

PROFESSIONAL STAMPS

dueSOUTH
Project Management Ltd
Consulting Engineers

WADENA ACRES

STORMWATER PLAN
SITE PLAN

DESIGNED	P.G.S.	CHECKED	
DRAWN	K.W.	DATE	SEPTEMBER 2008
SCALE	1:3000	DRAWING	1

ERCB Energy Resources Conservation Board

Calgary Office 640 – 5 Avenue SW Calgary, Alberta, Canada T2P 3G4 Tel 403-297-8311 Fax 403-297-7336 www.ercb.ca

File No. 2008

REFERRAL REPLY FOR PROPOSED SUBDIVISION OR DEVELOPMENT REGARDING SOUR GAS WELLS OR PIPELINES

The *Alberta Regulation 43/2002, Municipal Government Act, Subdivision and Development Regulation* states that the Energy Resources Conservation Board (ERCB) must provide comments relevant to a proposed application that is within 1.5 kilometres of a sour gas facility.

Although the ERCB strives to maintain updated sour gas data related to the sour gas infrastructure, the conditions are not static and changes in level designation often occur and the ERCB may not be aware of these changes. We ***strongly encourage*** municipalities to undertake due diligence by confirming the most current sour gas data with the licencee.

The ERCB has reviewed and completed a search of ERCB regulated wells and pipelines in the vicinity of your referred subdivision or development application and our records indicate the following: ***(condition applicable if box is checked)***

- ☐ A sour gas well (or wells) has (have) been identified within the search area of this application. The recommended setback distance is identified in this letter.
- ☒ Other wells may exist within the area of this application. However, the ERCB has determined that these wells are either licensed as sweet wells or have an ERCB Level 1 sour designation and meet the recommended setback distance requirement of **100m**.
- ☐ For a listing of ERCB wells in a specific area, contact the Information Services Group at the ERCB (403) 297- 8311, Option #2.
- ☐ Sour gas pipeline(s), sour oil effluent pipeline(s) and/or sour salt water pipeline(s) containing greater than 10 moles of H_2S gas per kilomole of natural gas has (have) been identified within the search area of this application. The pipeline licence number, licensee and the recommended setback distance is identified in this letter. Pipeline information must be made available by the licensee upon request. Further, for oil effluent pipelines *Directive 26* requires that the licensee provides the level designation for these pipelines so that a setback determination can be made.
- ☒ Other pipelines may exist within the area of your referred application. However, the ERCB has determined that these pipelines licensed as sweet or have an ERCB Level 1 sour designation. For these types of pipelines, there is no regulated setback distance however, the right-of-way must be observed.
- ☐ The approximate locations of all pipelines in the area of application are shown on an enclosed copy of the ERCB's infrastructure map.
- ☒ The approximate locations of abandoned wells in the area of application are shown on an enclosed copy of the ERCB's infrastructure map.

Attachment

ERCB Setback Distances

A setback distance is the minimum distance that must be maintained between an energy facility and various surface developments for land use and public safety purposes. This distance may increase where sour gas is present. Sour gas is a natural gas that contains hydrogen sulphide (H_2S).

Setback distances are dependant on the development density classification the ERCB assigns to your referral and the level assigned to a well or pipeline. The level of a well is determined by the licensed H_2S release rate measured in cubic metres per second (m^3/s). The level of a pipeline is determined by the licensed H_2S release volume measured in cubic metres (m^3). The development classification is a tool used by the ERCB to provide you with specific setback distance information for your referred application. The development density classifications; Permanent Dwelling, Unrestricted Country Development , Urban Centre and Public Facility are defined within *Interim Directive (ID) 81-3 Minimum Distance Requirements Separating New Sour Gas Facilities From Residential and Other Developments* and *ID 97-6 Sour Well Licensing and Drilling Requirements,* available on the ERCB's website. Setback distances corresponding to these development density classifications are found within these documents. If you feel your referred application has been incorrectly classified, please contact the person named on this letter.

Wells

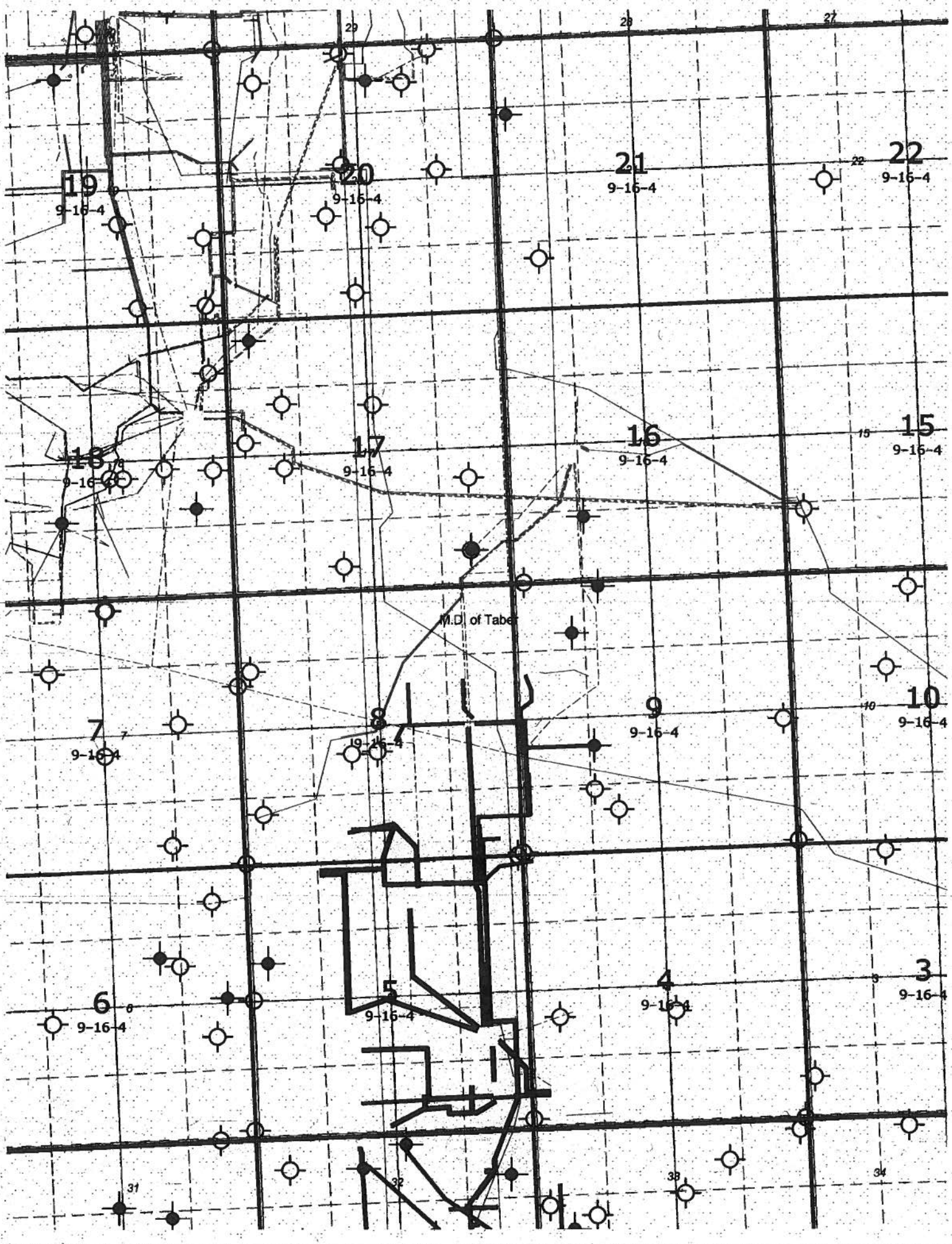
When any well licence is granted, the ERCB requires the licensee to maintain a minimum setback distance of 100 metres (m) from the wellhead to a surface improvement with a possible greater setback distance required if the well contains sour gas. Exceptions to this are surveyed roadways or road allowances that may be as close as 40 m. While the ERCB does not regulate land development, ERCB sour gas setback distances are reflected in the *Municipal Government Act (MGA) Subdivision and Development Regulation.* Both jurisdictions' regulations are intended to complement one another.

Abandoned Wells

The ERCB recommends the applicant locate abandoned wells prior to the land use development planning phase and no structure be placed over top of an abandoned well. Setback recommendations for abandoned wells are explained in a document called *Advisory Land Use Planning Notes - Abandoned Oil and Gas Wells.* These notes have been prepared jointly by the ERCB and Alberta Municipal Affairs and can be viewed on the Municipal Affairs website at, http://www.municipalaffairs.gov.ab.ca/ms/AbandonedWellSites.cfm . For a listing of ERCB abandoned wells in a specific area, contact the Information Services Group at the ERCB (403) 297-8190.

Pipelines

When a pipeline licence is granted for a pipeline transmitting sour natural gas, sour oil effluent or sour salt water containing greater than 10 moles of H_2S gas per kilomole of natural gas, the ERCB requirement for setback distances are stated within *ID 81-3 and Directive 26 Setback Requirements for Oil Effluent Pipelines* respectively. When licences are granted for pipelines transmitting other substances or for abandoned pipelines there is no regulated setback distance. However, land use and construction activity on the pipeline right-of-way is restricted by the right-of-way agreement. The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Municipal District of Taber

Administration Office

EPA Section
APR 09 2009

4900B - 50th Street
TABER, ALBERTA, T1G 1T2
PHONE: (403) 223-3541
FAX: (403) 223-1799

April 7, 2009

NOTICE OF PROPOSED AREA STRUCTURE PLAN

PP

Legal Description: Lot 3, Block 1, Plan 9611496 in NW 8-9-16-W4

Location: 4 miles south of the Town of Taber

Referral Agencies: Horizon School Division, Holy Spirit RC School Division, TELUS (Lethbridge), Chinook Health, FortisAlberta, AltaLink, Alberta Agriculture, Alberta Transportation, ERCB, ATCO Gas, St. Mary River Irrigation District, Taber Irrigation District,

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The Municipal District of Taber is in receipt of an Area Structure Plan for the creation of 3 residential lots within Lot 3, Block 1, Plan 9611496 in NW 8-9-16-W4. The land is currently zoned Grouped Country Residential.

The Municipal District of Taber is requesting your comments on this proposed development to ensure your concerns, if any, are addressed by the developer.

Please submit your comments regarding this proposed development to the M.D. of Taber no later than May 4, 2009.

Sincerely,

Derrick Krizsan
Municipal Administrator

/jjb

ART WILLIAMS

ISSUED FOR USE

SEPTIC DISPOSAL FIELD FEASIBILITY ASSESSMENT
PROPOSED COUNTRY RESIDENTIAL SUBDIVISION
PORTION OF NW 8-9-16-W4M
M.D. OF TABER, ALBERTA

L12101391

August 2008

EBA Engineering Consultants Ltd.
p. 403.329.9009 • f. 403.328.8817
442 - 10 Street N • Lethbridge, Alberta T1H 2C7 • CANADA

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FIGURES

APPENDICES

1.0 INTRODUCTION

This report presents the results of an assessment conducted by EBA Engineering Consultants Ltd. (EBA) of the feasibility of septic disposal fields for a proposed country residential subdivision to be located in the M.D. of Taber. The property proposed for subdivision is located within the north half of NW ¼ Sec 8-9-16 W4M near Taber, Alberta.

The proposed property is shown on Figure 1, inclusive of 16 country residential lots under consideration at this time. The lot sizes appear to range between approximately 2.6 to 4.2 acres, except for Lot 9, with 6.18 acres. It is noted that Lot 8, Block 1, is excluded from this evaluation. The property is bounded to the north by Township Road 9-2 and to the west by Range Road 16-6. The property is bounded to the east and south by farmstead properties. A St. Mary River Irrigation District Drainage channel is noted to run east-west across the middle area of the property, as shown on Figure 1.

It is understood from Mr. Williams that for approval of a rural residential subdivision application, the approving agencies have requested the following requirements be met:

- A percolation test in each lot to determine soil suitability for waste disposal system.
- A borehole in each lot to determine surface ground water conditions.
- Assessment of the potential cumulative effects of the septic systems within the subdivision and surrounding area, including potential impact on the water table.
- Engineering recommendations for residential foundation construction, based on soils and water table information.
- Engineering recommendations for proper compaction of fill materials and grading of building sites.

Authorization to proceed with this assessment was provided by Mr. Art Williams.

2.0 FIELDWORK

In order to access the feasibility of septic disposal fields, EBA selected a total of 16 locations for the purpose of percolation testing (one per lot), as shown on Figure 1.

EBA staff Mr Mitch Van Orman, arranged for the fieldwork to be performed on July 14, 2008, using a drill rig contracted from Chilako Drilling Services Ltd of Coaldale, Alberta. The drill setup was equipped with a 200 mm diameter flight auger. The drilling program included 16 percolation testholes (200 mm diameter) drilled to depths of approximately 900 mm (PH001 through PH016). To determine ground water elevations a total of sixteen boreholes (BH001 through BH016) were also drilled at each lot location to a

depth of 3.0 m (with the borehole numbering matching that of the percolation test number in each case).

The soil conditions were visually classified at the time of drilling and disturbed grab samples were obtained at 600 mm interval from the 3.0 m boreholes. The soil samples were tested at EBA's Lethbridge laboratory for moisture content. The borehole logs including soil descriptions at each location are attached. An explanation of the terms and symbols used on the borehole logs is also included in Appendix B.

The soil conditions encountered included a surface covering of topsoil with a thickness of approximately 0.1 m. Underlying the topsoil, in borehole locations BH001 to BH004, sand was encountered to the borehole termination depths of 3.0 m. The sand was described as medium grained, trace to some silt, poorly graded, damp, compact, and dark brown. Underlying the topsoil in borehole locations BH005, BH006, and BH008, gravel was encountered to depths of approximately 1.7 m to 2.4 m. The gravel was described as containing some sand, well graded, sizes to 20 mm, sub-angular and round, damp, compact and grey brown. Underlying the gravel in the boreholes BH005, BH006 and BH008, clay till was encountered, which was silty, some sand, trace gravel, very moist, stiff, medium plastic and brown with coal and oxide specks.

Excepting the above, at the other borehole locations, layers of clay or clay till were encountered underlying the topsoil throughout the rest of the property, typically extending to depths of 1.1 m to in excess of 3 m below ground surface. The layers were described as silty, with some sand to sandy, moist, stiff to very stiff in consistency, medium plastic and brown. The deeper soils included sand and gravel layers at BH009, BH011 and BH012.

Groundwater levels at the borehole locations. These values are shown on the table below.

The percolation test at each location included half filling the percolation testhole with water and allowing the testhole to saturate for a period of 24 hours. On July 15, 2008, the percolation holes (P1 through P16) were refilled with water to approximately 0.45 m below existing ground surface and maintained for 2 hours. The subsidence of the water was measured versus time (every 30 minutes). The following table provides the water levels and percolation test results.

Percolation Test	Location	Soil Texture Analysis (0.45 m to 0.9 m)	Percolation Test Result (min/cm)	Groundwater Levels (m)
P1	Lot 12 Block 1	SAND – trace to some silt, poorly graded, medium grained, damp, compact, brown	4	Dry
P2	Lot 11 Block 1	SAND – trace to some silt, poorly graded, medium grained, damp, compact, brown	3	Dry
P3	Lot 10 Block 1	SAND – trace to some silt, poorly graded, medium grained, damp, compact, brown	5	Dry
P4	Lot 9 Block 1	SAND – trace to some silt, poorly graded, medium grained, damp, compact, brown	4	Dry
P5	Lot 7 Block1	GRAVEL – some sand, well graded, sizes to 20mm, sub-angular, damp, compact, brown	3	1.8
P6	Lot 6 Block 1	GRAVEL – some sand, well graded, sizes to 20mm, sub-angular, damp, compact, brown	6	1.7
P7	Lot 5 Block 1	SAND –silty, trace gravel, poorly graded, medium grained, moist, compact, brown	8	1.5
P8	Lot 4 Block 1	GRAVEL – some sand, well graded, sizes to 20mm, sub-angular, damp, compact, brown	5	1.4
P9	Lot 9 Block 2	CLAY - silty, some sand, moist, very stiff, medium plastic, light brown,	50	1.6
P10	Lot 8 Block 2	CLAY - silty, some sand, moist, very stiff, medium plastic, light brown,	90	2.2
P11	Lot 7 Block 2	CLAY - silty, some sand, moist, very stiff, medium plastic, light brown,	50	2.0
P12	Lot 6 Block 2	CLAY - silty, some sand, moist, very stiff, medium plastic, light brown,	30	2.2
P13	Lot 5 Block 2	CLAY - silty, some sand, moist, very stiff, medium plastic, light brown,	10	2.3
P14	Lot 4 Block 2	CLAY (TILL) - silty, some sand, moist, very stiff, medium plastic, brown with grey mottling, coal and oxides	16	2.1
P15	Lot 3 Block 2	CLAY (TILL) - silty, some sand, moist, very stiff, medium plastic, brown with grey mottling, coal and oxides	21	2.4
P16	Lot 2 Block 2	CLAY (TILL) - silty, some sand, moist, very stiff, medium plastic, brown with grey mottling, coal and oxides	22	2.3

3.0 SEPTIC DISPOSAL FIELDS

The Safety Codes Council's, Alberta Private Sewage Systems Standard of Practice 1999, states that a subsurface effluent disposal system that uses the absorption of effluent into the soil for treatment and disposal, should absorb the effluent into the soil at a rate of:

- not faster than 5 minutes per 2.5 cm (2 minutes/cm); and
- not slower than 60 minutes per 2.5 cm (24 minutes/cm),

as determined by a percolation test. In addition, the natural separation between the point of effluent infiltration into the soil and the groundwater should be a minimum of 1.5 m.

The percolation test results generally ranged between 3 and 22 minutes/cm for most of the lots, which would comply with these guidelines. It is noted however, that at test locations PH009, PH010, PH011 and PH012, the test results were outside of the Safety Code Council's guidelines, i.e. test in these locations were slower than the minimum rate of 24 minutes/cm, attributed to the medium plastic clay soils.

It is also noted that groundwater exists at some of the locations, but is typically below 1.5 m below ground surface. The exceptions include PH007 and PH008, with groundwater levels of 1.5 m and 1.4 m below ground surface.

These results indicate that the near surface soils for design and construction of septic disposal fields generally satisfy the requirements of the Safety Code Council's guidelines. However, several notes are presented, as follows.

For the case of PH009, PH010, PH011 and PH012, where isolated areas of slower percolation rates than that recommended by the guidelines are encountered, this may require re-location of the proposed septic disposal field to more acceptable areas. Alternatively, other means of establishing a disposal field, such as construction of a septic field mound or other such industry acceptable measures should be considered for these specific lots. Another option would be to raise these specific lots by a minimum of 0.9 m, with fill soils comprising sand or gravel soils obtained from other areas of the property (essentially, mounding the entire property). It is expected that the percolation test results within the granular fill soils would meet the Safety Code Council's guidelines, pending confirmation of percolation rates, following placement of the fill.

The results also show that for PH007 and PH008, because of existing groundwater conditions at 1.4 m to 1.5 m below ground surface, a partial or fully mounded system may be required to satisfy the Safety Codes Council's requirement for a natural separation between the point of effluent infiltration into the soil and the groundwater should be a minimum of 1.5 m. Alternatively, these specific lots should be raised in grade a minimum amount of 0.3 m, so that the installed septic field will be a minimum of 1.5 m above the groundwater table.

Based on the results of this assessment, the use of septic disposal fields for the country residential developments is considered feasible, with the above development modifications

to be considered for specific lots. However, it is noted that the specific site selection of the proposed fields needs careful consideration by the septic field installer to satisfy the requirements of the Regulations Having Jurisdiction (Municipality, AENV, Alberta Labour). This requirement is in accordance with the provincial regulations, which state that two percolation tests are required within the final footprint of the field by the installer. Following the site-specific testing, the septic disposal field should be designed and sized accordingly by the disposal field designer. It is further recommended that the design footprint of the residences be determined once the final disposal field is selected, to ensure the appropriate gravity flow or pumping requirements are satisfied.

During installation of the weeping trenches, the installer should pay close attention to the soil conditions, to define the extent of any sand pockets or any areas of slower percolation rates (higher plastic clay zones). These should be immediately reported to the disposal field designer for review prior to completion of the septic disposal field.

The information provided herein is intended to be a preliminary assessment of the feasibility of septic disposal fields for this residential development as per the provincial regulations. Site specific municipal regulations or siting requirement guidelines with respect to the local health unit, if applicable, have not been addressed.

With regards to the cumulative effects of the septic systems within the subdivision and surrounding area, it is understood that the M.D. of Taber has established the requirement that rural residential lot must not be less than 2 acres. Since all of the lots exceed this minimum required size established by the M.D. of Taber, the potential for cumulative effects of septic disposal fields within the subdivision is minimal. Also if the Safety Codes Council's requirement for a natural separation between the point of effluent infiltration into the soil and the groundwater (i.e., a minimum of 1.5 m) is met, it is considered that the potential for impact on the groundwater table would be negligible.

4.0 SUBDIVISION DEVELOPMENT RECOMMENDATIONS

4.1 LOT GRADING

In general terms, the lot grading should be designed and carried out to the current Engineering Standards of the Municipality. The particulars for this development are discussed in this section.

Following organic stripping, all lots should be initially graded for drainage at a minimum gradient of 2.0%. The existing surficial site soils comprising clay, clay till, sand or gravel are suitable for use as 'landscape fill' materials or for use as 'general engineered fill' materials for lot grading, as defined in Appendix C.

The moisture content of the site soil materials at surface generally appears to be variable with respect to the anticipated optimum moisture content for these soils. It is anticipated therefore, that moisture conditioning will be required at the site for proper compaction.

The earthwork contractor should, however, make his own estimate of the requirements and should consider such factors as weather and construction procedures.

General engineered fill materials for lot grading should be moisture conditioned to within a range of –1% of optimum to +2% of the optimum moisture content prior to compaction and compacted to a minimum of 98% of SPD.

Further recommendations regarding backfill materials and compaction are contained in Appendix C.

4.2 ROAD SUBGRADE PREPARATION

Within all paved areas, the upper 300 mm of native soils or prepared general engineered fill subgrade should be scarified and uniformly moisture conditioned to between minus 1% of optimum and 2% over optimum moisture content. The subgrade should then be uniformly compacted to a minimum of 98% of SPD.

Backfill to raise these areas to subgrade level should be general engineered fill materials, as defined in Appendix C, moisture conditioned and compacted as noted above. The subgrade should be prepared and graded to allow drainage to the road shoulders and ditches. Proof-rolling of the prepared surface is recommended to identify localized soft areas and for an indication of overall subgrade support characteristics.

It is imperative that positive surface drainage be provided to prevent ponding of water within or adjacent to the pavement structure. Surrounding landscaping should be such that runoff water is prevented from ponding beside paved areas in order to avoid softening and premature failure of the pavement surface.

If localized areas of soft subgrade soils are encountered, provisions may be required to subcut each small area and replace with engineered fill, or alternatively, with granular (pit-run) fill with the use of a geogrid or geotextile fabric to strengthen the subgrade support characteristics. Further design information can be provided following initial proof-rolling of the subgrade soils.

4.3 EXCAVATIONS AND TRENCH BACKFILL

Excavations should be carried out in accordance with the Alberta Occupational Health and Safety Regulations.

For this project, the depth of excavations are anticipated to be shallow to moderate for such components as foundations, service trenches, and tie-ins (<3.0 m). Excavations which are to be deeper than 1.5 m should have the sides shored and braced or the slopes should be cut back not steeper than 1.0 horizontal to 1.0 vertical for periods up to one month. Where excavations are open for longer than one month or in granular soils, the slopes may have to be cut back flatter than 1.0 horizontal to 1.0 vertical. This should be reviewed on site by experienced personnel.

It is considered that varying amounts of groundwater seepage will occur in isolated areas, where the excavation exceeds the groundwater level below the existing ground surface. Therefore, although dewatering of most excavations should not be necessary, dewatering should be expected in some areas, particularly in wet, granular soils. In these localized areas, any seepage should be directed towards a sump for removal from the excavation.

Temporary surcharge loads, such as spill piles, should not be allowed within a distance from an unsupported excavation face equal to the depth of excavation. Mobile equipment should be kept back at least 2.0 m. All excavations should be checked regularly for signs of sloughing, especially after rainfall periods. Small earth falls from the sideslopes are a potential danger to workmen and must be guarded against.

The moisture content of the soils encountered across the site is generally variable with respect to the estimated Standard Proctor optimum moisture content for the materials. It is expected that such soils would be satisfactory as trench backfill material, however, may require moisture conditioning prior to compaction.

Trenches must be backfilled in such a way as to minimize the potential differential settlement and/or frost heave movements. A minimum density of 95% of SPD is recommended for all trench backfill, at a moisture content of between –1% and +2% of optimum. The exception is that the top 600 mm of all trenches should be compacted to 98% of SPD. The compacted thickness of each lift of backfill shall not exceed 150 mm. The upper 1.5 m of service trenches should be cut back at a maximum slope of 1.0 horizontal to 1.0 vertical to avoid an abrupt transition between backfill and in situ soil.

It should be noted that the ultimate performance of the trench backfill is directly related to the uniformity of the backfill compaction. In order to achieve this uniformity, the lift thickness and compaction criteria must be strictly enforced.

For frost protection, pipes buried with less than 2.1 m of soil cover (above top of pipe) should be protected with insulation to avoid frost effects that might cause damage to or breakage of the pipes. Rigid insulation placed under areas subject to vehicular wheel loadings should be provided with a minimum thickness of 600 mm of compacted granular base.

General recommendations regarding construction excavation, backfill materials and compaction are contained in Appendix C.

4.4 CONCRETE TYPE

As per CSA and EBA's experience in this area, the potential degree of sulphate attack on concrete may be considered to be severe (Class S-2). Accordingly, the use of Sulphate Resistant Portland cement at a maximum water/cementing materials (W/CM) ratio 0.45 is recommended for foundation concrete and all concrete exposed to soil and/or groundwater. If available, a proven flyash should be used as a supplemental cementing material. Based on EBA's experience with Alberta aggregates, a W/CM ratio of 0.45 normally corresponds to a 28-day compressive strength of 28 MPa or greater

(32 MPa at 56-days). Stricter recommendations may be required due to structural or other considerations, or for exposure to de-icing chemicals.

Air entrainment of 4 to 6% by volume is recommended for all concrete exposed to freezing temperatures, native soils and/or groundwater. This should be increased to 5 to 7% for exterior flatwork.

4.5 PAVEMENTS

The following design for asphalt concrete surfaced pavement is provided for this development. Car and light-truck usage only has been assumed for the access road, with occasional to rare delivery truck, garbage disposal truck, and fire truck traffic. Note that this structure is equivalent to a City of Lethbridge local pavement structure.

DESIGN PAVEMENT SECTION	
MATERIAL TYPE	LIGHT-DUTY (mm)
Surface Course Asphalt Concrete (Type III)*	75
Granular Base Course*	200

* Current City of Lethbridge Transportation Engineering Standards (or equivalent)

The above recommended pavement layer thicknesses generally refer to average values and recognize typical construction variability. As constructed layer thicknesses should satisfy the thickness tolerances identified in the City of Lethbridge Engineering Standards for granular materials and asphalt concrete (or equivalent for the Municipality).

Subgrade support for pavements generally consists of stiff, moist, silty clay soils or compact sand or gravel soils. It should be recognized that the consistency of these materials, groundwater, site drainage, weather conditions, or other factors could impact the constructed subgrade support characteristics.

The upper 300 mm of soils should be scarified, uniformly moisture conditioned to between minus 1% of optimum and 1% over optimum moisture content and uniformly recompacted to a minimum of 98% of SPD. Backfill to bring these areas to subgrade level should be general engineered fill materials, as defined in this report. The subgrade should be prepared and graded to allow drainage to the shoulders and ditches. Proof-rolling of the prepared surface is recommended to identify localised soft areas and for an indication of overall subgrade support characteristics.

It is imperative that positive surface drainage be provided to prevent ponding of water. Recommended minimum grades of 1.0% should be used in hard surfaced areas. Surrounding landscaping should be such that runoff water is prevented from ponding beside paved areas in order to avoid softening and premature failure of the pavement surface.

All asphalt paving lifts should be compacted to a minimum of Marshall design density, as per current City of Lethbridge Transportation Detailed Engineering Standards. Note that the Municipality may have somewhat different requirements, however, the Lethbridge Standards are used most frequently by most contractors in southern Alberta. Additional recommended guidelines for design and construction of pavement structure are presented in Appendix C of this report.

If a granular pavement section is to be considered, it may be comprised of pit-run gravel with a minimum thickness of 300 mm. However, since the local pit-run gravel may be relatively coarse (large, rounded particles) and sandy, it will be difficult to blade smooth during regular maintenance. It is recommended that a surfacing layer of crushed gravel (granular base course) be placed within a nominal thickness of 50 mm, as this layer will be easier to maintain. All granular layers should be compacted to 100% of SPD. Recommendations for maintenance of gravel pavement are provided in Appendix C, "Gravel Yards and Pavements".

4.6 RECOMMENDATIONS FOR FOUNDATIONS

Based on our understanding of the proposed residential buildings configuration, shallow foundations should be constructed a minimum of 1.4 m below the final design exterior ground surface (frost protection requirement) or deeper, if a basement is to be considered. At this depth the foundation subgrade soil should consist of stiff to very stiff, damp to moist, medium plastic clay, sand or gravel. At this depth, the foundation subgrade soil should rest on native soils only.

The net allowable static bearing pressure for the design of strip and spread footings at this depth may be taken as 75 kPa, on native, undisturbed soils. The factor of safety used from ultimate bearing capacity was 3.0. Footing dimensions should be in accordance with the minimum requirements of the Alberta Building Code 1997 (Section 9.15.3 Footings).

It is recommended that a smooth edge-trimming bucket or Grade-All be used for final excavation to the foundation subgrade elevation to minimize disturbance of the founding soils. The foundation concrete should be placed immediately following excavation to ensure the bearing soil (medium plastic clay) does not dry out below the plastic limit. A mud slab is recommended immediately after excavation to footing level within granular soils, in order to prevent disturbance of the granular foundation subgrade.

The foundation soils are prone to volume changes (both heave and settlement) with varying moisture content. Therefore, a permanent weeping tile system is also recommended around the outside perimeter of the structure at the foundation elevation to maintain a consistent moisture profile of the founding soils. This will reduce the potential of differential movement (heave or settlement) of the foundations.

Settlement of footings designed and constructed in accordance with the above recommendations should be well within the normally tolerated values of 25 mm total and 15 mm differential.

4.7 BELOW GRADE WALLS

All below grade walls should be designed to resist lateral earth pressures in an "at-rest" condition. This condition assumes a triangular pressure distribution and may be calculated using the following expression.

$$P_o = K_o (\gamma H + q)$$

Where:

P_o	=	lateral earth pressure "at-rest" condition (no wall movement occurs at a given depth)
K_o	=	co-efficient of earth pressure "at-rest" condition (use 0.5 for cohesive backfill and 0.45 for sand and gravel backfill)
γ	=	bulk unit weight of backfill soil (use 19 or 21 kN/m^3 for cohesive or granular backfill, respectively)
H	=	depth below final grade (m)
q	=	surcharge pressure at ground level (kPa)

Considering the groundwater levels, hydrostatic pressures may not need to be considered in the wall design, provided a below grade weeping tile system is installed at the lowest wall elevation and appropriately tied into the on-site drainage system.

Backfill around concrete walls should not commence before the concrete has reached a minimum two-thirds of its 28-day strength and the walls should be laterally braced. Only hand operated compaction equipment should be employed within 600 mm of the concrete walls. Caution should be used when compacting backfill to avoid high lateral loads caused by excessive compactive effort. A compaction standard of 95% of Standard Proctor maximum dry density (SPD) is recommended. To avoid differential wall pressures, the backfill should be brought up evenly around the walls.

4.8 FROST PROTECTION

For protection against frost action, perimeter footings in heated structures should be extended to such depths as to provide a minimum soil cover of 1.4 m. Isolated or exterior footings in unheated structures should have a minimum soil cover of 2.1 m unless provided with equivalent insulation.

Pipes buried with less than 2 m of soil cover should be protected with insulation to avoid frost effects that might cause damage to or breakage of the pipes. Rigid insulation placed under areas subject to vehicular wheel loadings should be provided with a minimum thickness of 600 mm of compacted granular base.

5.0 DESIGN AND CONSTRUCTION GUIDELINES

Recommended general design and construction guidelines are provided in Appendix C, under the following headings.

- Shallow Foundations
- Construction Excavations
- Backfill Materials and Compaction
- Proof-Rolling
- Pavements
- Gravel Pavement

These guidelines are intended to present standards of good practice. Although supplemental to the main text of this report, they should be interpreted as part of the report. Design recommendations presented herein are based on the premise that these guidelines will be followed. The design and construction guidelines are not intended to represent detailed specifications for the works although they may prove useful in the preparation of such specifications. In the event of any discrepancy between the main text of this report and Appendix C, the main text should govern.

6.0 LIMITATIONS

Recommendations presented herein are based on a geotechnical evaluation of the findings in 16 geotechnical boreholes and 16 percolation test locations. 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 Mr. Art Williams, for specific application to the development described in Section 1.0. It has been prepared in accordance with generally accepted soil engineering practices. No warranty is either expressed or implied.

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

7.0 CLOSURE

We trust this report satisfies your present requirements. Should you require additional information, please contact our office.

Respectfully submitted,
EBA Engineering Consultants Ltd.

Prepared by:

John Christensen
Senior Technologist

/sdt

Reviewed by:

PROFESSIONAL ENGINEER ALBERTA
JAMES A. RYAN

J.A. (Jim) Ryan, P.Eng.
Project Director

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature
Date August 11, 2008
PERMIT NUMBER: P245
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

FIGURES

APPENDIX

APPENDIX A GEOTECHNICAL REPORT – GENERAL CONDITIONS*

GEOTECHNICAL REPORT – GENERAL CONDITIONS

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 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.

3.0 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.

4.0 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.

5.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

6.0 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.

7.0 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.

8.0 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.

9.0 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.

10.0 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.

11.0 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.

12.0 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.

13.0 STANDARD OF CARE

Services performed by EBA for this report have been conducted in a manner consistent with the level of 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.

14.0 ENVIRONMENTAL AND REGULATORY ISSUES

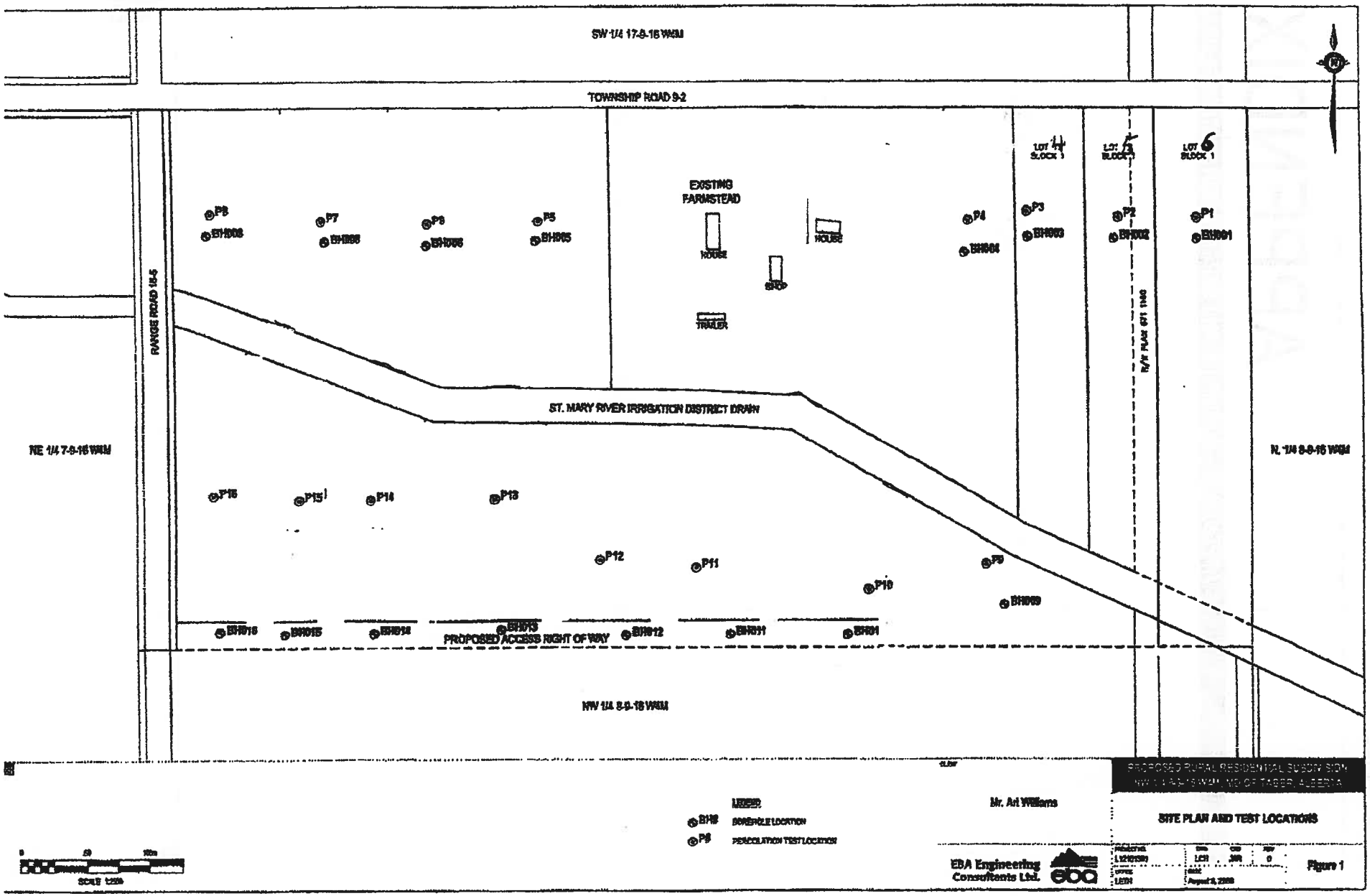
Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

15.0 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), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

The Client agrees that 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. The Client warrants that EBA's instruments of professional service will be used only and exactly as submitted by EBA.

The Client recognizes and agrees that 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.


SW 1/4 17-9-16 W4M
TOWNSHIP ROAD 9-2
RANGE ROAD 16-5
EXISTING FARMSTEAD
HOUSE
HOUSE
SHED
TRAILER
LOT 4 BLOCK 1
LOT 5 BLOCK 1
LOT 6 BLOCK 1
R/W PLAN 671 1940
ST. MARY RIVER IRRIGATION DISTRICT DRAIN
NE 1/4 7-9-16 W4M
N. 1/4 8-9-16 W4M
P8
BH008
P7
BH007
P6
BH006
P5
BH005
P4
BH004
P3
BH003
P2
BH002
P1
BH001
P16
P15
P14
P13
P12
P11
P10
P9
BH009
BH016
BH015
BH014
BH013
PROPOSED ACCESS RIGHT OF WAY
BH012
BH011
BH01
NW 1/4 8-9-16 W4M
PROPOSED RURAL RESIDENTIAL SUBDIVISION
NW 1/4 8-9-16 W4M NO OF TABER, ALBERTA
LEGEND
BH# BOREHOLE LOCATION
P# PERCOLATION TEST LOCATION
Mr. Art Williams
SITE PLAN AND TEST LOCATIONS
EBA Engineering Consultants Ltd.
eba
Figure 1

APPENDIX

APPENDIX B BOREHOLE AND PERCOLATION TESTHOLE LOGS*

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.

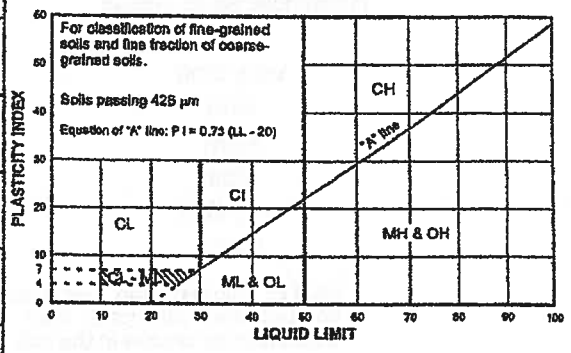
GENERAL DESCRIPTIVE TERMS

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.

MODIFIED UNIFIED SOIL CLASSIFICATION †

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines: Less than 5% Pass No. 200 sieve; More than 12% Pass No. 200 sieve; 5% to 12% Pass No. 200 sieve. GW, GP, SW, SP GM, GC, SM, SC Bordering Classification requiring use of dual symbols. $C_U = D_{60}/D_{10}$ Greater than 4; $C_U = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures	Atterburg limits plot below "A" line or plasticity index less than 4
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterburg limits plot above "A" line or plasticity index greater than 7
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines	$C_U = D_{60}/D_{10}$ Greater than 6; $C_U = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures	Atterburg limits plot below "A" line or plasticity index less than 4
			SC	Clayey sands, sand-clay mixtures	Atterburg limits plot above "A" line or plasticity index greater than 7
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	Atterburg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			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	
	SILTS AND CLAYS Liquid limit greater than 50%		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	
HIGHLY ORGANIC SOILS			PT	Peat, muck and other highly organic soils	

PLASTICITY CHART



*Based on the material passing the 3 in. (75 mm) sieve
†ASTM Designation D 2487, for identification procedure see D2488

SOIL COMPONENTS

FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR
GRAVEL				
coarse	75 mm	19 mm	>35 %	"and"
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"
SAND				
coarse	4.75 mm	2.00 mm	10 to 20 %	"some"
medium	2.00 mm	425 µm		
fine	425 µm	75 µm	>0 to 10 %	"trace"
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior	

OVERSIZE MATERIAL

Rounded or subrounded

COBBLES 75 mm to 200 mm
BOULDERS > 200 mm

Not rounded

ROCK FRAGMENTS >75 mm
ROCKS > 0.76 cubic metre in volume

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH001
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	SAND - trace to some silt, poorly graded, medium grained, damp, compact, dark brown						
			B1	3.1			
1							
			B2	2.7			5
2			B3	3.7			
			B4				
3	SILT - sandy, trace clay, damp, compact to dense, low plastic, light brown		B5	6.9			10
	End of Borehole @ 3.0m						
	No Seepage or Sloughing on Completion Slotted PVC Standpipe Installed to 3.0m Borehole Measured Dry July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B1	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH002
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	SAND - trace to some silt, poorly graded, medium grained, damp, compact, dark brown						
			B1	3.2			
1							
			B2	3.6			
							5
			B3	3			
2							
			B4				
3	... trace gravel, coal and oxides		B5	4.5			10
	End of Borehole @ 3.0m						
	No Seepage or Sloughing on Completion Slotted PVC Standpipe Installed to 3.0m Borehole Measured Dry July 16, 2008						
4							
							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B2	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH003
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	SAND - trace to some silt, poorly graded, medium grained, damp, compact, dark brown						
			B1	4.4			
1							
			B2	1.7			5
			B3	2.8			
2							
			B4				
3	... trace gravel, coal and oxides		B5	5			10
	End of Borehole @ 3.0m						
	No Seepage or Sloughing on Completion Slotted PVC Standpipe Installed to 3.0m Borehole Measured Dry July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B3	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH004
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	SAND - trace to some silt, trace gravel, poorly graded, medium grained, damp, compact, dark brown						
			B1	3.6			
1							
			B2	2.6			5
			B3	2			
2							
			B4				
3	... coal and oxides		B5	9			10
	End of Borehole @ 3.0m						
	No Seepage or Sloughing on Completion Slotted PVC Standpipe installed to 3.0m Borehole Measured Dry July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B4	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH005
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	GRAVEL - some sand, well graded, sizes to 20mm, subangular and round damp, compact, grey brown						
			B1	3.3	●		
1							
			B2	2.9	●		
							5
2 07/16/08	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown, coal and oxide specks		B3	21.5	●		07/16/08
			B4				
3	... free water		B5	19.9	●		10
	End of Borehole @ 3.0m						
	No Seepage or Sloughing on Conmpletion Slotted PVC Standpipe installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							
							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B5	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH006
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics			
	GRAVEL - some sand, well graded, sizes to 20mm, subangular and round damp, compact, grey brown			
			B1	3.4
1			B2	4.4
	... free water		B3	20.4
2				
	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown, coal and oxide specks		B4	
			B5	23
3	End of Borehole @ 3.0m			
	Some Seepage or Sloughing on Completion Slotted PVC Standpipe Installed to 3.0m Indicated Water Level Measured July 16, 2008			
4				
5				

PLASTIC M.C. LIQUID (20 40 60 80)

STANDARD PENETRATION (N) (20 40 60 80)

UNCONFINED (kPa) (50 100 150 200)

POCKET PEN. (kPa) (100 200 300 400)

07/16/08

Depth (ft): 0, 5, 10, 15, 16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B6	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH007
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	CLAY - silty, sandy, very moist, stiff, medium plastic, light brown, trace organics, white precipitates		B1	21.3			
1							
	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown, coal and oxide specks		B2	20			
	07/16/08						5 07/16/08
			B3	23.3			
2							
			B4	21			
3	End of Borehole @ 3.0m		B5				10
	Some Seepage or Sloughing on Completion Slotted PVC Standpipe Installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B7	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH008
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	GRAVEL - some sand, well graded, sizes to 20mm, subangular and round, damp, compact, grey brown						
			B1	7.2			
1							
			B2	4.5			
	... free water						
							5
	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown, coal and oxide specks		B3	20.6			
2							
			B4				
							10
3			B5	18.7			
	End of Borehole @ 3.0m						
	Some Seepage or Sloughing on Completion Slotted PVC Standpipe installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							
							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B8	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH009
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	CLAY - silty, sandy, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates		B1	23.3			
1			B2	16.4			
	SAND - silty, trace clay, trace gravel, poorly graded, fine to medium grained, wet, compact, brown (07/16/08)						5 (07/16/08)
2			B3	19			
	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown, coal and oxide specks		B4				
3			B5	23.3			10
	End of Borehole @ 3.0m						
	Some Seepage or Sloughing on Conmpletion Slotted PVC Standpipe installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B9	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH010
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	CLAY - silty, sandy, moist, very stiff, medium plastic, dark brown with grey mottling						
			B1	21.6			
1			B2	19.1			
	... 200mm gravel seam with free water @ 1.5m						5
	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown with light brown and grey mottling, coal and oxide specks						
2			B3	18.9			
	7/16/08						7/16/08
			B4				
3			B5	19.4			10
	End of Borehole @ 3.0m						
	Some Seepage or Sloughing on Conmpletion Slotted PVC Standpipe Installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B10	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH011
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics			
	CLAY - silty, sandy, moist, very stiff, medium plastic, dark brown with grey mottling		B1	19.5
1	GRAVEL - some sand, well graded, sizes to 20mm, subangular and round damp, compact, grey brown		B2	6.7
	SAND - trace to some silt, trace gravel, poorly graded, fine to medium grained, free water, compact, brown		B3	20.6
2	7/16/08		B4	
3	End of Borehole @ 3.0m		B5	18.8
	No Seepage or Sloughing on Conmpletion Slotted PVC Standpipe Installed to 3.0m Indicated Water Level Measured July 16, 2008			
4				
5				

PLASTIC M.C. LIQUID
20 40 60 80

STANDARD PENETRATION (N)
20 40 60 80
◆ UNCONFINED (kPa) ◆
50 100 150 200
▲ POCKET PEN. (kPa) ▲
100 200 300 400

Depth (ft): 0, 5, 10, 15, 16

7/16/08

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B11	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH012
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	CLAY (TILL) - silty, sandy, moist, stiff, low to medium plastic, brown, coal and oxide specks						
			B1	8.3			
1							
			B2	12.6			
	SAND - silty, poorly graded, fine grained, moist, compact, brown						5
			B3	19			
2							
	CLAY (TILL) - silty, sandy, moist, stiff, low medium plastic, brown, coal and oxide specks						
7/16/08			B4				7/16/08
			B5	16.2			
3	End of Borehole @ 3.0m						10
	Some Seepage or Sloughing on Conmpletion Slotted PVC Standpipe Installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B12	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH013
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	CLAY - silty, some sand, moist, stiff, medium plastic, light brown, trace organics						
			B1	17.9			
1	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown, coal and oxide specks						
			B2	15.1			
	... 200mm medium grained sand seam @ 1.5m						5
			B3	18.7			
2	7/16/08						7/16/08
			B4				
3			B5	19.5			10
	End of Borehole @ 3.0m						
	Some Seepage or Sloughing on Conmpletion Slotted PVC Standpipe installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B13	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH014
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown, coal and oxide specks						
			B1	17.1			
1							
			B2	17.7			5
	... sand lenses with free water						
			B3	17.3			
2	7/16/08						7/16/08
			B4				
			B5	17.8			10
3	End of Borehole @ 3.0m						
	Some Seepage or Sloughing on Completion Slotted PVC Standpipe Installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B14	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH015
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown, coal and oxide specks						
			B1	19.8			
1							
			B2	17.7			
							5
			B3	16.7			
2							
7/16/08			B4				7/16/08
	... sand lenses with						
	SAND - trace to some silt, poorly graded, fine to medium grained, free water, compact, brown						
3			B5	22.4			10
	End of Borehole @ 3.0m						
	Some Seepage or Sloughing on Completion Slotted PVC Standpipe Installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B15	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08BH016
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics						0
	CLAY (TILL) - silty, some sand, very moist, stiff, medium plastic, brown, coal and oxide specks						
			B1	17.9			
1			B2	17.6			5
			B3	18.8			
2							
	7/16/08		B4				7/16/08
3			B5	17.7			10
	End of Borehole @ 3.0m						
	Some Seepage or Sloughing on Completion Slotted PVC Standpipe Installed to 3.0m Indicated Water Level Measured July 16, 2008						
4							15
5							16

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LOGGED BY: MV	COMPLETION DEPTH: 3m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH001
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	SAND - trace to some silt, poorly graded, medium grained, damp, compact, dark brown				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH002
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC — M.C. — LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; ◆ UNCONFINED (kPa) ◆ 50 100 150 200; ▲ POCKET PEN. (kPa) ▲ 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	SAND - trace to some silt, poorly graded, medium grained, damp, compact, dark brown				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH003
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC — M.C. — LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	CLAY - silty, sandy, damp, stiff, low plastic, brown, trace organics				
	SAND - trace to some silt, poorly graded, medium grained, damp, compact, dark brown				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH004
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT	PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics					0
	SAND - trace to some silt, poorly graded, medium grained, damp, compact, dark brown					
1	End of Borehole @ 0.9m					5
2						
3						10
4						
5						16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH004A
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	SAND - silty, trace gravel, poorly graded, fine grained, damp, compact, light brown				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/29/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH005
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	GRAVEL - some sand, well graded, sizes to 20mm, damp, compact, grey brown				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH006
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC 20 40 60 80 M.C. LIQUID	STANDARD PENETRATION (N) 20 40 60 80 / UNCONFINED (kPa) 50 100 150 200 / POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	GRAVEL - some sand, well graded, sizes to 20mm, subangular and round, damp, compact, grey brown				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH007
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT (PLASTIC / M.C. / LIQUID; 20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	CLAY - silty, sandy, very moist, stiff, medium plastic, light brown, trace organics, white precipitates				
	SAND - silty, trace gravel, poorly graded, fine to medium grained, moist, compact, light brown				
	GRAVEL - sandy, trace silt, well graded, sizes to 25mm, subangular and round, moist, compact, brown				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH008
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC — M.C. — LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80 / ◆ UNCONFINED (kPa) ◆ 50 100 150 200 / ▲ POCKET PEN. (kPa) ▲ 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	GRAVEL - sandy, trace silt, well graded, sizes to 25mm, subangular and round, moist, compact, brown				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH009
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics					0
	CLAY - silty, some sand, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates					
1	End of Borehole @ 0.9m					5
2						
3						10
4						
5						15
						16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH010
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC — M.C. — LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	CLAY - silty, some sand, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH010A
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; ◆ UNCONFINED (kPa) ◆ 50 100 150 200; ▲ POCKET PEN. (kPa) ▲ 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	CLAY - silty, some sand, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/29/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH011
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT	PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics					0
	CLAY - silty, some sand, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates					
1	End of Borehole @ 0.9m					5
2						
3						10
4						
5						15
						16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH012
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	CLAY - silty, some sand, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates				
1	End of Borehole @ 0.9m				5
2					
3					10
4					15
5					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH013
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics					0
	CLAY - silty, some sand, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates					
1	End of Borehole @ 0.9m					5
2						
3						10
4						
5						15
						16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH014
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	CLAY (TILL) - silty, some sand, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

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LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
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PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH015
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT: PLASTIC / M.C. / LIQUID (20 40 60 80)	STANDARD PENETRATION (N) 20 40 60 80; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	CLAY (TILL) - silty, some sand, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

EBA Engineering Consultants Ltd.

LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B31	Page 1 of 1

PROJECT: RURAL RESIDENTIAL SUBDIVISION	CLIENT: MR. ART WILLIAMS	PROJECT NO. - BOREHOLE NO.
LOCATION: NW1/4 SEC. 8-9-16 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101391 - 08PH016
CITY: SOUTH OF TABER, AB	PROJECT ENGINEER: JIM RYAN	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	MOISTURE CONTENT (PLASTIC / M.C. / LIQUID)	STANDARD PENETRATION (N) / UNCONFINED (kPa) / POCKET PEN. (kPa)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics				0
	CLAY (TILL) - silty, some sand, moist, very stiff, medium plastic, dark brown with grey mottling, trace organics, white precipitates				
1	End of Borehole @ 0.9m				5
2					
3					10
4					
5					15
					16

STANDARD PENETRATION (N): 20 40 60 80

UNCONFINED (kPa): 50 100 150 200

POCKET PEN. (kPa): 100 200 300 400

PLASTIC M.C. LIQUID: 20 40 60 80

EBA Engineering Consultants Ltd.

LOGGED BY: MV	COMPLETION DEPTH: 0.9m
REVIEWED BY: JAR	COMPLETE: 7/14/2008
DRAWING NO: B32	Page 1 of 1

APPENDIX

APPENDIX C DESIGN AND CONSTRUCTION GUIDELINES*

SHALLOW FOUNDATIONS

Design and construction of shallow foundations should comply with relevant Building Code requirements.

The term 'shallow foundations' includes strip and spread footings, mat slab and raft foundations.

Minimum footing dimensions in plan should be 0.45 m and 0.9 m for strip and square footings respectively.

No loose, disturbed or sloughed material should be allowed to remain in open foundation excavations. Hand cleaning should be undertaken to prepare an acceptable bearing surface. Recompaction of disturbed or loosened bearing surface may be required.

Foundation excavations and bearing surfaces should be protected from rain, snow, freezing temperatures, excessive drying and the ingress of free water before, during and after footing construction.

Footing excavations should be carried down into the designated bearing stratum.

After the bearing surface is approved, a mud slab should be poured to protect the soil and provide a working surface for construction, should immediate foundation construction not be intended.

All constructed foundations should be placed on unfrozen soils, which should be at all times protected from frost penetration.

All foundation excavations and bearing surfaces should be inspected by a qualified geotechnical engineer to check that the recommendations contained in this report have been followed.

Where over-excavation has been carried out through a weak or unsuitable stratum to reach into a suitable bearing stratum or where a foundation pad is to be placed above stripped natural ground surface such over-excavation may be backfilled to subgrade elevation utilizing either structural fill or lean-mix concrete. These materials are defined under the separate heading 'Backfill Materials and Compaction'.

CONSTRUCTION EXCAVATIONS

Construction should be in accordance with good practice and comply with the requirements of the responsible regulatory agencies.

All excavations greater than 1.5 m deep should be sloped or shored for worker protection.

Shallow excavations up to about 3 m depth may use temporary sideslopes of 1H:1V. A flatter slope of 2H:1V should be used if groundwater is encountered. Localized sloughing can be expected from these slopes.

Deep excavations or trenches may require temporary support if space limitations or economic considerations preclude the use of sloped excavations.

For excavations greater than 3 m depth, temporary support should be designed by a qualified geotechnical engineer. The design and proposed installation and construction procedures should be submitted to EBA for review.

The construction of a temporary support system should be monitored. Detailed records should be taken of installation methods, materials, in situ conditions and the movement of the system. If anchors are used, they should be load tested. EBA can provide further information on monitoring and testing procedures if required.

Attention should be paid to structures or buried service lines close to the excavation. For structures, a general guideline is that if a line projected down, at 45 degrees from the horizontal from the base of foundations of adjacent structures intersects the extent of the proposed excavation, these structures may require underpinning or special shoring techniques to avoid damaging earth movements. The need for any underpinning or special shoring techniques and the scope of monitoring required can be determined when details of the service ducts and vaults, foundation configuration of existing buildings and final design excavation levels are known.

No surface surcharges should be placed closer to the edge of the excavation than a distance equal to the depth of the excavation, unless the excavation support system has been designed to accommodate such surcharge.

BACKFILL MATERIALS AND COMPACTION

Maximum density as used in this section means Standard Proctor Maximum Dry Density (ASTM Test Method D698) unless specifically noted otherwise. Optimum moisture content is as defined in this test.

"Landscape fill" material may comprise soils without regard to engineering quality. Such soils should be placed in compacted lifts not exceeding 300 mm and compacted to a density of not less than 90 percent of maximum density.

"General engineered fill" materials should comprise clean, inorganic granular or clay soils. "Select engineered fill" materials should comprise clean, well-graded granular soils or inorganic low plastic clay soils. Engineered fill materials should be placed in layers of 150 mm compacted thickness and should be compacted to 98 percent of maximum density.

Granular soils used for select engineered fills should consist of relatively clean, well graded, sand or mixture of sand and gravel (maximum size 75 mm).

Low plastic clay with the following range of Atterberg limits is generally considered suitable for use as select engineered fill.

Liquid Limit	= 20 to 40%
Plastic Limit	= 10 to 20%
Plasticity Index	= 10 to 30%

Clay fill materials should be compacted at or slightly above the optimum moisture content.

"Structural fill" materials should comprise clean, well-graded inorganic granular soils. Such fill should be placed in compacted lifts not exceeding 150 mm and compacted to not less than 100 percent of maximum density.

Backfill adjacent to and above footings, abutment walls, basement walls, grade beams and pile caps or below highway, street or parking lot pavement sections and base courses should comprise "general engineered fill" materials as defined above.

Backfill below slabs-on-grade or where increased volumetric stability is desired should comprise "select engineered fill" materials as defined above.

Backfill supporting structural loads should comprise "structural fill" materials as defined above.

Exterior backfill adjacent to footings, foundation walls, grade beams and pile caps and within 300 mm of final grade should comprise inorganic clay "general engineered" fill as defined above. Such backfill should provide a relatively impervious surface layer to reduce seepage into the subsoil.

Backfill should not be placed against a foundation structure until the structure has sufficient strength to withstand the earth pressures resulting from placement and compaction. During compaction,

careful observation of the foundation wall for deflection should be carried out continuously. Where deflections are apparent, the compactive effort should be reduced accordingly.

In order to reduce potential compaction induced stresses, only hand held compaction equipment should be used in the compaction of fill within 500 mm of retaining walls or basement walls.

Backfill materials should not be placed in a frozen state, or placed on a frozen subgrade. All lumps of materials should be broken down during placement.

Where the maximum-sized particles in any backfill material exceed 50 percent of the minimum dimension of the cross-section to be backfilled, such particles should be removed and placed at other more suitable locations on-site or screened off prior to delivery to site.

Bonding should be provided between backfill lifts, if the previous lift has become desiccated. For fine-grained materials the previous lift should be scarified to the base of the desiccated layer, properly moisture-conditioned and recompacted and bonded thoroughly to the succeeding lift. For granular materials, the surface of the previous lift should be scarified to about a 75 mm depth followed by proper moisture-conditioning and recompaction.

Suggested specifications for various backfill types are presented below.

"Pit-Run gravel" and fill sand shall be reasonably well graded and should conform to the following gradings:

PERCENT PASSING BY WEIGHT		
SIEVE SIZE	**PIT RUN GRAVEL (A.T. D6-C80)**	**FILL SAND**
80.0 mm	100	--
50 mm	55-100	--
25 mm	38 – 100	100
16 mm	32 – 85	--
5.0 mm	20 – 65	75 – 100
630 µm	--	45 – 80
315 µm	6 – 30	--
80 µm	2 – 10	2 - 10

The Pit-Run gravel should be free of any form of coating and any gravel or sand containing clay, loam or other deleterious materials should be rejected. No oversize material should be tolerated. The percent of material passing the 80 µm sieve should not exceed 2/3 of the material passing the 315 µm sieve.

20 mm and 40 mm crushed gravel should be hard, clean, well graded, crushed aggregate, free of organics, coal, clay lumps, coatings of clay, silt and other deleterious materials. The aggregates should conform to the following Alberta Transportation gradation requirements when tested in accordance with ASTM C136:

PERCENT PASSING BY WEIGHT		
SIEVE SIZE	20 mm CRUSH (A.T. D2-C20)	40 mm CRUSH (A.T. D2-C40)
40 mm	--	100
25 mm	--	70 – 94
20 mm	100	--
16 mm	84 – 94	55 – 85
10 mm	63 – 86	44 – 74
5.0 mm	40 – 67	32 – 62
1.25 mm	20 – 43	17 – 43
630 µm	14 – 34	12 – 34
315 µm	9 – 26	8 – 26
160 µm	5 – 18	5 – 18
80 µm	2 – 10	2 – 10

A minimum of 60 percent of the material retained on the 5 mm sieve for the 20 mm crushed gravel should have at least two freshly crushed faces. Not less than 50 percent of the material retained on the 5 mm sieve for the 40 mm crushed gravel should have at least two freshly crushed faces.

The 20 mm granular course should be compacted in lifts not exceeding 150 mm to 100 percent of Standard Proctor maximum dry density.

"Coarse gravel" for bedding and drainage should conform to the following grading:

PERCENT PASSING BY WEIGHT		
SIEVE SIZE	28 mm GRAVEL	20 mm GRAVEL
40 mm	100	--
28 mm	95 - 100	100
20 mm	--	85 – 100
14 mm	25 - 60	60 – 90
10 mm	--	25 – 60
5 mm	0 - 10	0 – 10
2.5 mm	0 - 5	0 - 5

"Coarse sand" for bedding and drainage should conform to the following grading:

SIEVE SIZE (Square Openings)	PERCENT PASSING (By Weight)
10 mm	100
5 mm	95 - 100
2.5 mm	80 - 100
1.25 mm	50 - 90
630 µm	25 - 65
315 µm	10 - 35
160 µm	2 - 10
80 µm	0 - 4

"Lean-mix concrete" should be low strength concrete having a minimum 28-day compressive strength of 3.5 MPa.

PROOF-ROLLING

Proof-rolling is a method of detecting soft areas in an 'as-excavated' subgrade for fill, pavement, floor or foundations or detecting non-uniformity of compacted embankment. The intent is to detect soft areas or areas of low shear strength not otherwise revealed by means of testholes, density testing, or visual examination of the site surface and to check that any fill placed or subgrade meets the necessary design strength requirements.

Proof-rolling should be observed by qualified geotechnical personnel.

Proof-rolling is generally accomplished by the use of a heavy (15 to 60 tonne) rubber-tired roller having 4 wheels abreast on independent axles with high contact wheel pressures (inflation pressures ranging from 550 kPa (80 psi) up to 1030 kPa (150 psi).

A heavily loaded tandem axle gravel truck may be used in lieu of the equipment described in the paragraph above. The truck should be loaded to approximately 10 tonnes per axle and a minimum tire pressure of 550 kPa (80 psi).

Ground speed - maximum 8 km/hr recommended 4 km/hr.

The recommended procedure is two complete coverages with the proof-rolling equipment in one direction and a second series of two coverages made at right angles to the first series; one 'coverage' means that every point of the proof-rolled surface has been subjected to the tire pressure of a loaded wheel. Less rigorous procedures may be acceptable under certain conditions subject to the approval of an engineer.

Any areas of soft, rutted, or displaced materials detected should be either recompacted with additional fill or the existing material removed and replaced with general engineered fill, or properly moisture conditioned as necessary.

The surface of the grade under the action of the proof-roller should be observed, noting; visible deflection and rebound of the surface, formation of a crack pattern in the compacted surface or shear failure in the surface of granular soils as ridging between wheel tracks.

If any part of an area indicates significantly more distress than other parts, the cause should be investigated, by, for example, shallow auger holes.

In the case of granular subgrades, distress will generally consist of either compression due to insufficient compaction or shearing under the tires. In the first case, rolling should be continued until no further compression occurs. In the second case, the tire pressure should be reduced to a point where the subgrade can carry the load without significant deflection and subsequently gradually increased to its specified pressure as the subgrade increases in shear strength under this compaction.

PAVEMENTS

The following recommended procedures for pavements have been based on the use of the area generally by cars with some light truck traffic, as is normal for parking lot areas and access roadways. Recommendations for occasional heavy truck access areas are also presented. These recommendations are intended as minimums only for subgrades having a California Bearing Ratio (CBR) value of 2 or higher, under saturated conditions.

Maximum density as used in this section means Standard Proctor Maximum Dry Density (ASTM Test Method D698) unless specifically noted otherwise.

The subgrade should be graded to drain towards catch basin locations. All loose, soft or organic material should be removed from beneath pavement areas. The subgrade should be scarified to a depth of not less than 150 mm below the surface and recompacted. In areas where general engineered fill is placed to achieve design grades, the subgrade should be compacted to 98 percent of maximum density and proof-rolled prior to placing fill. The upper 150 mm of subgrade (and/or general engineered fill) under pavement sections should be compacted to not less than 100 percent of maximum density.

Proof-rolling of the entire surface area under pavement sections should be carried out to detect any local soft spots. Soft spots detected as a result of proof-rolling should be excavated and backfilled with 'general engineered fill'. Recommended procedures for proof-rolling are presented under a separate section in Appendix C. General engineered fill is defined under the section entitled "Backfill Materials and Compaction" in Appendix C.

The parking area and roadways base course should comprise a layer of compacted cement stabilized aggregate or crushed gravel of nominal size equal to 20 mm placed on top of the compacted subgrade. The base course should have a compacted thickness of not less than 100 mm. The base course should be compacted to not less than 100 percent of maximum density.

The surface of the final lift of base course must have an asphalt prime coat of SS-1, or its equivalent, applied prior to the placement of asphaltic concrete.

The asphalt thickness is dependent on asphalt mix specifications and should be reviewed when details of the mix are available. Minimum surface lift thickness in multiple-lift construction should be not less than 50 mm.

Preparation of the subgrade should be carried out within restricted areas. This is to avoid loosening of the prepared areas by site traffic before compaction of the subgrade and placement of the granular material have been completed. Protection of the prepared subgrade against precipitation and frost should be undertaken.

Observation of compaction and asphalt laying operations should be carried out by staff of EBA Engineering Consultants Ltd.

Where there is risk of gasoline or diesel oil spillage, such as in the vicinity of pump islands, concrete pavements are preferred to asphalt.

MAINTENANCE OF GRAVELLED YARDS

Gravel surfaced yards are susceptible to rapid deterioration if not properly maintained. For most gravel surfaced roads and yards this will involve grading at least three times yearly, twice in the spring and once in late summer or fall, with occasional touch up in problem areas. No noticeable rutting should be allowed to persist in spring time when frost is coming out of the ground. High wheel loads from forklifts, poor surface drainage and/or a high water table and clay subgrade soils can all result in a need for increased maintenance.

Ruts should not be allowed to exceed 25 mm in 1.2 m (1" in 4'). Areas that rut should be repaired as soon as possible. If not repaired promptly, the rutted areas will hold water, which reduces the ability of the gravel to bridge over soft areas and can lead to softening of the subgrade. Rutting will get progressively worse and more costly and difficult to repair.

In rutted areas, 20 mm crushed gravel should be placed to fill low spots. The high areas should not be graded off to fill in low areas. This creates areas of reduced gravel thickness in the high spots, which will eventually lead to future punchouts and/or soft spots.

The overloading of forklifts can lead to excessively high stresses under the front axle. This should be avoided. High wheel loads from an overloaded forklift could exceed the allowable stresses for the gravel thickness, especially in rutted areas where ponded water can lead to softening.

Excessive regrading will also negatively impact performance. Gravel surfacing tends to form a crust with traffic. This crust provides improved stability and helps shed water. Excessive regrading can breakup this crust and reduce the ability of the gravel surfacing to shed water. There is also a tendency to pull gravel from high spots to fill minor ruts. As noted above, this can cause problems with the reduced gravel thicknesses in areas that initially perform well.