Fortune Minerals Limited
London, Ontario

NICO MINE ACCESS - PROPOSED BRIDGE
MARIAN RIVER CROSSING

1700127.005

February 2007

EBA Engineering Consultants Ltd.
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1.0 INTRODUCTION

1.1 GENERAL

The report provides the results of a geotechnical evaluation and site survey carried out at the location of a proposed bridge crossing of the Marian River northwest of Rae Edzo, NT. The bridge is part of an all season access road to the NICO Mine from the winter road to Wha Ti. This report follows other reports and investigations carried out by EBA Engineering Consultants Ltd. (EBA) as part of the geotechnical input to the design, construction and operation of the mine site and access road.

This project was carried out in general accordance with EBA's proposal, dated October 6, 2006, which was submitted to Mr. Garrett Macdonald, P.Eng., Engineering Manager for Fortune Minerals Ltd. Authorization to proceed was given by e-mail from Mr. Macdonald on October 18th, 2006.

1.2 PROJECT DETAILS

The proposed crossing site is located at a narrowing of the Marian River as it passes along outcropping bedrock (63° 31' 08" N, 116° 46' 04.1" W). The location is indicated on Figure 1 of this report. The proposed bridge is to consist of a prefabricated steel girder design assembled on site.

1.3 SCOPE OF WORK

The required scope of work for this project consists of the following tasks:

- Arrange for site access via helicopter for a geotechnical engineer and field survey party;
- Travel to the site and conduct an appraisal of the geotechnical conditions for support of the proposed structure;
- Direct the survey crew to carry out a detailed topographic survey of both abutments sufficient to establish the existing grade/elevation, span length and shape of the founding surface to support the design of the abutments for the proposed bridge;
- Develop geotechnical recommendations to support the design and construction of the bridge foundations; and,
- Submit a report that presents the findings from the site investigation and provide the recommendations for design and construction of the foundation system.

2.0 METHOD OF INVESTIGATION

2.1 SITE INVESTIGATION

EBA used Great Slave Helicopters to access the site and a survey crew from Sub-Arctic Surveys of Yellowknife to carry out the field survey and develop the topographic plan. The field survey was carried out on October 23rd and 25th, 2006. During this period the weather was cool but not freezing. There was no snow cover or ice during the site survey.

The presence of competent bedrock at the ground surface made identification of the geotechnical conditions straight forward. The field survey was carried out using differential GPS methods with a local base station set up at each abutment area servicing two GPS mobile units. The survey was hampered by the disappearance of satellite coverage at this high latitude as the day progressed. The loss of signal primarily affected the survey of low lying areas. Surveying of the higher areas of outcropping abutment rock proceeded normally. The loss of topographic information in the low lying areas is considered to be of little consequence.

3.0 SITE DESCRIPTION

3.1 SURFACE CONDITIONS

The Marian River crossing is situated at km 47.4 along the proposed year round access road to the mine site. The Marian River is the major water crossing along the route. The river valley at the proposed location is approximately 15 m wide. It is understood that the river is used by canoeists as there is an existing portage route around two sets of rapids behind the south abutment area.

Pink to red metamorphosed granitic bedrock is exposed at the ground surface in the abutment areas on both sides of the proposed river crossing. The rock is identified specifically as “feldspar porphyry, feldspar-quartz porphyry” of Proterozoic age in Lord (1942). At many locations the bedrock possessed a medium to coarse grain size of quartz and feldspar crystals. Less frequent were local areas where the rock displayed a schistose to gneissic texture due to metamorphism.

The bedrock surface is rounded with a very limited surficial weathering. The rock is competent and has moderate fracture spacing.

The soil conditions at the site consist of very localized brown silty sand with some gravel and occasional cobbles. Pockets of mineral soil are limited to local depressions over the bedrock surface. Several trees had blown down revealing soil depths of less than 300 mm tapering to zero within distances of 1 to 2 m. Lichens, mosses and low organic vegetation were present over less than half of the bedrock area at both abutments. Jack pine and small birch trees were common but well spaced as indicated in the attached photographs.

In the land behind the abutment area and in the adjacent low lying areas, evidence of near surface groundwater included muskeg vegetation and local pockets of black peat without vegetation where pools of water would routinely accumulate, perched on the low permeability bedrock.

3.2 PERMAFROST CONDITIONS

This area of the Northwest Territories is in the zone of widespread discontinuous permafrost. The frozen ground is often close to the freezing point, with temperatures within about a degree of thawing. Ground temperature instrumentation was not installed at this site to measure ground temperatures.

No evidence of permafrost was observed at the site during this investigation. Permafrost is not expected to impact the bridge structure, which will be supported on bedrock, but permafrost may impact the design and performance of approach fills.

4.0 RECOMMENDATIONS AND CONSIDERATIONS

4.1 GENERAL

It is understood that the proposed route will consist of a gravel road to provide access to NICO mine site only. The proposed route will not function as a territorial highway, therefore, low traffic volumes are anticipated. Moreover, due to constantly changing conditions of gravel roads, it is assumed that the traffic speeds will be low. A typical road-top width of 6 m is assumed. This is comparable to the all-weather road at the Wha Ti end of the proposed route, the existing winter trail, and other low traffic volume gravel roads in the vicinity of Yellowknife.

A single span steel girder bridge with concrete abutments, or possibly a bridge plate arch was previously considered for the Marion River crossing with a 6000 mm clear width.

The site hydrology assessment was conducted by Golder Associates. A copy of the resulting Technical Memo is presented in Appendix B, for information. We have determined that it is appropriate to configure the bridge opening width and height to handle the flood flow conditions of the river based on a one hundred year return period condition. This corresponds to an estimated flood magnitude of 148 m^3/s and a corresponding water surface elevation of 172.4 m for the current stream channel geometry. At the time of the site survey and as shown in Figure 2 and 3 of this report, the river level was approximately at elevation 17.1 m, with a flow of about 12 m^3/s and a depth of approximately 0.6 m. These conditions are roughly equivalent to the one year return period event.

Based on the site topography, the north abutment rises rapidly to elevation 176 m. The south abutment rises more gradually as shown in Figure 3. With a 25 m span bridge, the north abutment can be relatively small, approximately 1 m high to provide a bearing surface with a larger wing wall to support the approach fill. The south abutment will have to be constructed to a height of 4 m for the bearing surface and about 176 m for the wing walls.

The height of this configuration will provide ample clearance for the passage of "river traffic". In this case, man made traffic is considered to consist only of summer canoeists.

Based on observations during the site visit, no significant amounts of ice scour seem to take place at this site. This is based on the absence of damage to trees growing immediately at the edge of the river and the presence of moss and minor amounts of soil which would have been removed by moving ice. Only along the north shore is there a possible indication of abrasion where there is a lighter colored band along the rock face where no mosses appear to grow. This feature extended about 1 m above the water level at the time of the site inspection and could be caused by higher water flows as much as ice scour.

4.2 DESIGN CONSIDERATIONS

The geotechnical parameters for this site include an allowable bearing capacity of the local bedrock of 5 MPa and virtually no settlement. There are, presently, no indications of frost heave or frost shattering of the local bedrock.

The construction of reinforced concrete foundations may be complicated by the necessity to establish a temporary batch plant to provide the quantities of Portland cement concrete required for such construction. Alternatives do exist. Quantities of concrete can be greatly limited by using it only to level the bedrock surface in advance of construction of other abutment structures such as timber cribs, bin walls, or other prefabricated steel structures. Any cast in place concrete for footings or complete abutments will need to be fully reinforced & dowelled into sloping bedrock surfaces to prevent lateral dislocation and to counteract backfill loads and possible uplift forces.

The alternative of trim blasting to prepare a more level rock surface is not recommended as it would likely lead to increased and unwanted fracturing of the bedrock. Introduction of water into such fractures and its subsequent freezing could lead to dislocation of rock support from beneath or in front of the abutments.

Abutment areas could be levelled with tapered timbers field fitted to prepare a level surface. Timber cribs of treated lumber are very versatile and compatible with a design life of 20 years or more. Such crib work, filled with fine rockfill and dowelled into the bedrock should meet all performance expectations of the manufacturer of the prefabricated bridge components.

The absence of indications of ice scour and the presence of surficial bedrock indicates there is no requirement for rip rap erosion protection against all faces of the abutments. Some protection may be required along the upstream face of the abutments to prevent damage to the south abutment from floating debris during flood conditions.

Based on the elevation of the bedrock surface, the approach fills will be placed at an elevation above the anticipated level of the flood waters and heavy rip rap will not be

required for erosion protection. The placement of coarse rockfill or fine rip rap over the face of any deep fill areas will minimize flattening and gullying of the side slopes.

5.0 REVIEW OF DESIGN AND CONSTRUCTION

EBA should be given opportunity to review details of the design and specifications related to geotechnical aspects of the project prior to construction.

All recommendations presented in this report are based on the assumption that an adequate level of monitoring will be provided during construction, and that all construction will be carried out by suitably qualified contractors, experienced in earthworks and foundation construction in the north. Adequate levels of monitoring are considered to be:

- for shallow foundations, inspection of bearing surfaces and excavations; and
- for earthworks, full time monitoring and compaction testing.

All such quality assurance monitoring should be carried out by suitably qualified persons, on behalf of the owner, independent of the contractor. One of the purposes of providing an adequate level of monitoring is to check that the provided recommendations, which are based on the findings at discrete borehole locations, are relevant to other areas of the site. EBA will provide these services upon request.

6.0 LIMITATIONS

This report presents the findings made during a site visit. The conditions encountered during the fieldwork are considered to be representative of the site. If conditions other than those reported are encountered, EBA should be notified and given the opportunity to review the present recommendations. Recommendations and comments 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 Fortune Minerals Limited, together with their agents for application specific to the development described in this report. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty is made, either expressed or implied.

Reference should be made to the General Conditions in Appendix A of this report for further limitations.

7.0 CLOSURE

We trust this report satisfies your present requirements. If you require any additional information please call our Yellowknife office.

Respectfully submitted,
EBA Engineering Consultants Ltd.

Reviewed by:

K.W. Peck, P.Eng. (NB, NF, NS)
Senior Geotechnical Engineer

T. E. Hoeve, P.Eng.
Principal Consultant, NT/NU
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REFERENCES

Lord, C.S., 1942. Snare River, District of Mackenzie, Northwest Territories. Canada, Department of Mines and Resources, Mines and Geology Branch, Bureau of Geology and Topography Map 690A; Scale 1:253,440 (1 inch to 4 miles).

FIGURES

CLIENT

Fortune Minerals Limited

Nico Mine Access Road

Site Location Plan

EBA Engineering Consultants Ltd.

PROJECT NO./FILE NO.	DWN	CKD	REV
1700127.005 1700127005R01a.cdr	BR	EH	0
OFFICE: EBA-YK	DATE: January 8, 2007		

Figure 1

LEGEND

CREST OF SLOPE ..... — — — — —

TOE OF SLOPE ..... ——·——·——

NOTES:

DISTANCES ARE EXPRESSED IN METRES OR DECIMALS THEREOF.

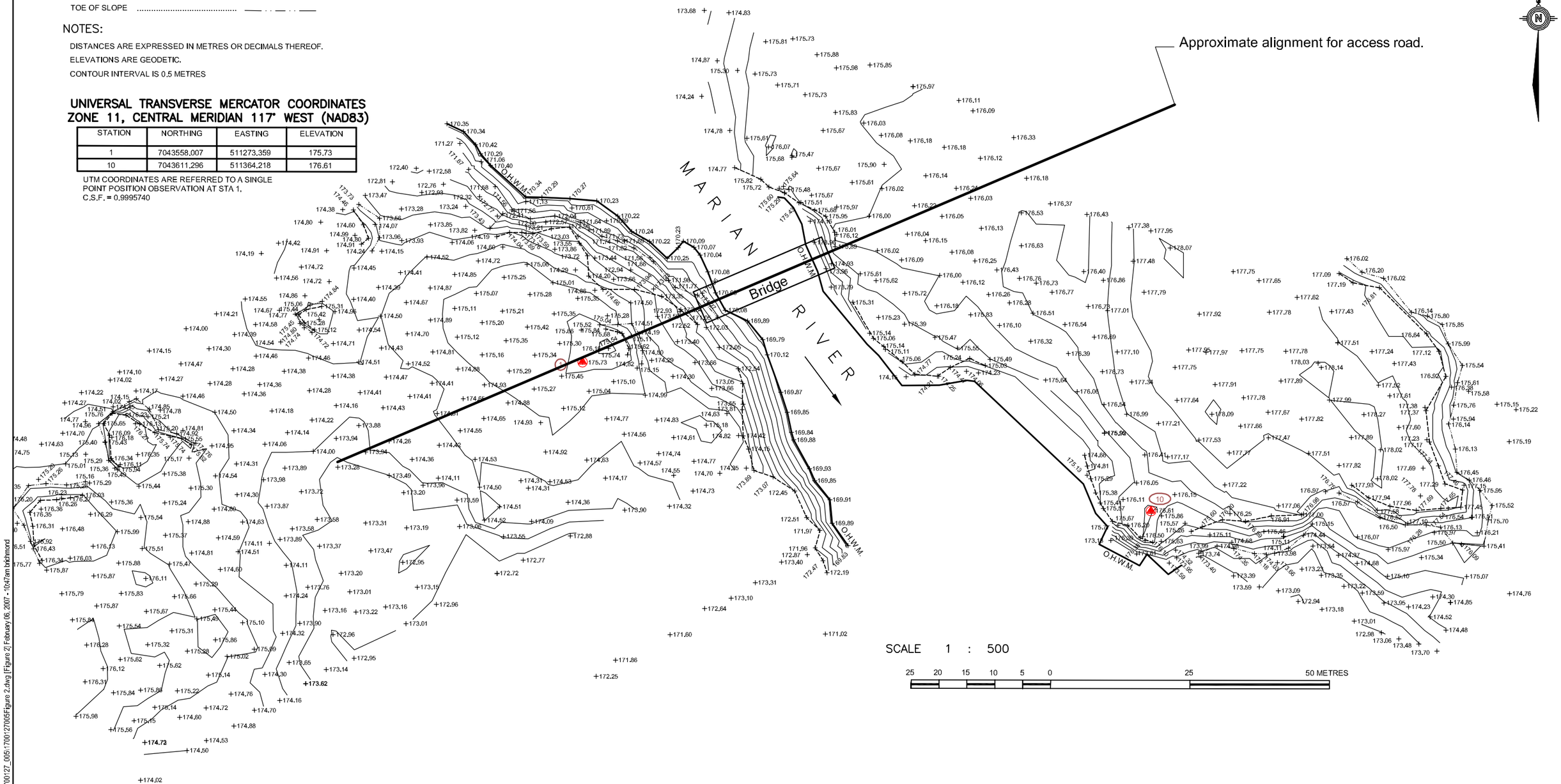
ELEVATIONS ARE GEODETIC.

CONTOUR INTERVAL IS 0.5 METRES

UNIVERSAL TRANSVERSE MERCATOR COORDINATES ZONE 11, CENTRAL MERIDIAN 117° WEST (NAD83)

STATION	NORTHING	EASTING	ELEVATION
1	7043558.007	511273.359	175.73
10	7043611.296	511364.218	176.61

UTM COORDINATES ARE REFERRED TO A SINGLE POINT POSITION OBSERVATION AT STA 1.
C.S.F. = 0.9995740



SCALE 1 : 500

25 20 15 10 5 0 25 50 METRES

DATE OF SURVEY OCT. 24 AND 27, 2006

SUB-ARCTIC SURVEYS LTD.
BOX 2441 YELLOWKNIFE
NORTHWEST TERRITORIES X1A 2P8
PHONE: 873-2047 FAX: 873-9079
E-MAIL sas@sub-arctic.ca

CHECKED BY: B.A.H.	FILE NO. 06-161-ED
SCALE = 1:500	

CLIENT

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NICO Access Road to Marian River Bridge

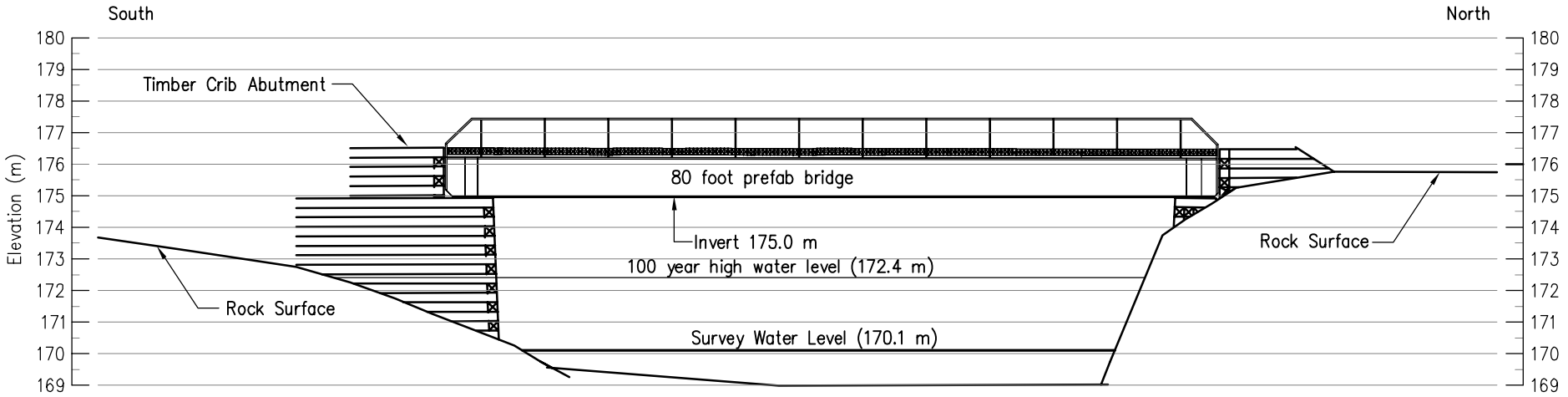
Site Topographic Survey
Marian River Crossing

EBA Engineering Consultants Ltd.

PROJECT NO./FILE NO.	DWN	CKD	REV
1700127.005 1700127005Figure 2	kwp/SAS	EH	0
OFFICE: EBA-YK	DATE: November 2006		

FIGURE 2

Q:\Edmonton\Drafting\DIVISIONS\0701\Projects\1700\127.1700127_005\1700127005Figure 2.dwg [Figure 2] February 06, 2007 - 10:47am brichmond



0 10

Scale: 1: 200 (metres)

CLIENT

Fortune Minerals Limited

NICO Access Road to Marian River Bridge

Bridge Elevation View

EBA Engineering Consultants Ltd.

PROJECT NO./FILE NO.	DWN	CKD	REV
1700127.005 1700127005Figure 3.dwg	BR	EH	0
OFFICE: EBA-YK	DATE: February 6, 2007		

Figure 3

PHOTOGRAPHS

Photo 1
Aerial view of crossing (at upper rapids) from downstream.

Photo 2
Aerial view of crossing (at rapids) from upstream.

Photo 3
River and abutment areas from south bank near proposed centerline.

Photo 4
River and abutment areas from north bank near proposed centerline.

APPENDIX

APPENDIX A 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.

APPENDIX

APPENDIX B HYDROLOGY TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM

Golder Associates Ltd.
145 First Avenue North
Saskatoon, SK, Canada S7K 1W6
Telephone: 306-665-7989
Fax Access: 306-665-3342

TO:	Dr. Kathryn Neale, Fortune Minerals	**DATE:**	December 20, 2006
FROM:	Brent Topp, Golder Associates Ltd.	**JOB NO:**	06-1117-022
EMAIL:	BRENT_TOPP@GOLDER.COM		
RE:	**MARIAN RIVER FLOOD WATER LEVELS**		

This memo provides an estimate of the water elevation of the Marian River at the proposed bridge crossing during peak flows. The memo includes the methodology employed to generate the water levels and the estimated results. No direct measurements of water elevations under peak flow conditions are available for the Marian River and all results are based on regional peak flow characteristics, combined with topographic data collected in the vicinity of the stream crossing. No channel cross-section data are available and channel geometry is based on measured surface widths and cross-section data collected approximately 50 m upstream of the proposed bridge alignment. The results of this memo should be considered as an approximation only.

Flood Magnitude and Frequency

Given the short period of record for Marian River discharges (2 years), flow data from another stream in the region were used to estimate flood magnitude and frequency values for the Marian River at the proposed bridge location. The regionalization of streamflow is based on the idea that areas with similar geology, vegetation, topography, and proportion of lakes that occur within the drainage will respond similarly to weather patterns.

A flood magnitude and frequency assessment was conducted using annual peak discharges recorded at the Indin River which has a continuous flow record covering 28 years (1977 to 2005). The Indin River hydrometric station (07SA004) is located approximately 120 km northeast of the Marian River. Drainage basin delineation resulted in a drainage area of 1,798 km² to the Marian River crossing and 1,520 km² for the Indin River (Environment Canada 2005). Annual peak discharges from the Indin River were pro-rated upwards based on the drainage area difference between the two streams. Peak discharges for the Marian River were estimated and flows were fitted to a probability distribution (Log-Pearson III) to calculate flood magnitude and frequency for the Marian river. The results of the probability analysis are provided in Table 1.

Table 1
Estimate of Flood Magnitude and Frequency for the Marian River

Return Period (Years)	Flood Magnitude (m^3/s)
1.01	10.9
2	49.5
5	76.9
10	94.9
20	111.7
50	132.8
100	148.1
200	163.0

Marian River Water Levels

Golder performed a stream discharge measurement at the Marian River on September 24, 2006 and surveyed surface topography, including the water line in the vicinity of the proposed bridge crossing location on October 27, 2006. While the water level in the stream cross-section that relates to the discharge measured on September 24, 2006 is not know, and while the discharge on the day the topography survey was conducted is not known, it is believed that water levels remained consistent over this period. This assumption is based on the review of water levels from the Indin River over the same time period that indicated static flows. Marian River discharges on the day of the water level and topographic survey are assumed to be 12.022 m^3/s which corresponds to a water level of 170.08 masl.

Peak Flow Water Levels

Manning's equation was used to estimate the depth in the channel for each of the specific return periods. The assumptions used for the equation are as follows:

- channel substrate is cobble and bedrock with a conservative Manning's 'n' value of 0.045;
- average side slopes to the water surface are 3.7:1 (H:V) on the right bank (facing downstream) and 0.83:1 on the left bank;
- side slopes below the water surface are assumed to be 2:1 on each side;
- the base width of the channel is approximately 16 m; and,
- the bed slope is assumed to be parallel to the water surface slope at a grade of 0.5%.

Using these assumptions the return period flood elevations are provided in Table 2.

Table 2
Results of High Water Level Analysis for Marian River

Return Period (Years)	Flood Event (m^3/s)	Depth (m)	Water Surface Elevation (m)
1.01	10.9	0.58	170.05
2	49.5	1.54	171.01
5	76.9	2.00	171.47
10	94.9	2.26	171.72
20	111.7	2.48	171.94
50	132.8	2.73	172.19
100	148.1	2.90	172.36
200	163.0	3.06	172.52

It should be noted that Golder measured a discharge of approximately 43.0 m^3/s at the Marian River on June 6, 2006. This would indicate that peak flows in the Marian River in the spring of 2006 had an approximate 1:2 year return period.

N:\ACTIVE\2006\1117\06-1117-022 FORTUNE MINERALS NICO NWT\MARIAN BRIDGE HIGH WATER MARK\REPORTING\06 12 18 - TECH MEMO - MARIAN RIVER HIGH WATER MARK.DOC