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THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

TECHNICAL MEMORANDUM

To:	Floyd Butts	**Date:**	July 1, 2011
	Hatch Engineering Group	**Rev:**	0
Cc:	Ramli Halim, Shawn Tucker		
From:	Bruce Smith, Steve Sather	**File:**	19-1605-126

MARY RIVER PROJECT
5 MILLION LITRE STORAGE TANK AT MILNE INLET
FOUNDATION RECOMMENDATIONS
ISSUED FOR DESIGN

1. PURPOSE

This memorandum presents foundation recommendations for a 5 million litre diesel fuel tank to be constructed near Milne Inlet on Baffin Island. The storage tank will support construction and operation of the Mary River Iron Mine, which is being developed by Baffinland Iron Mines Corporation.

This Memorandum is subject to the Statement of General Conditions, which is attached.

2. PROJECT DESCRIPTION

A tank storage compound will be constructed near existing facilities on the shores of Milne Inlet, at a site located about 90 km northwest from the proposed Mary River Iron Mine.

We understand that five diesel fuel storage tanks will eventually be constructed in the fuel storage compound. The first tank to be constructed will be a 5 million litre tank and then four additional tanks, each with a capacity of 10 million litres, will be constructed. The 5 million litre tank will be constructed in the summer and fall of 2011 while the 4 larger tanks will be constructed in 2012.

The 5 million litre tank will be shipped to the site in July and erected in August and September of 2011. The structural design of this storage tank has been completed

and the tank is currently being fabricated. This tank is a fixed roof structure with a diameter of 25.6 metres and a height of about 9.8 meters.

The 5 million litre storage tank will be placed inside a lined earthworks secondary containment structure that will be constructed by placing 1.7 metres of imported compacted sand and gravel over the existing subgrade. The tank will be placed on a compacted gravel pad that will raise the base of the tank to an elevation that is about 0.5 meters above the inside surface of the secondary containment. Therefore the total depth of compacted sand and gravel below the tank will be about 2.2 metres.

It is understood that the base of the tank will be placed directly on the surface of the compacted gravel foundation pad. A concrete ring footing will not be provided below the walls of the tank.

Construction of the secondary containment for the 5 million litre tank will begin in mid-August of 2011, and the steel tank will be erected on the prepared foundation pad in September of 2011.

The tank will remain empty until May of 2012, at which time fuel from some existing fuel bladders in the area will be transferred into the tank. The temperature of the fuel from the bladders is expected to range from minus 10 to minus 15^0C.The fuel stored in the tank will then be drawn down during the period from May to September, 2012.

In September 2012 the 5 million litre fuel tank will be filled to capacity from a fuel supply ship. The temperature of the diesel fuel when it is first placed in the tank will be about plus 15^0C. It is expected that, since the tank is neither insulated nor heated, the temperature of the fuel in the tank will fall gradually to near ambient air temperature after about 2 weeks. After that time, the temperature of the fuel in the tank will track ambient air temperatures with a lag of 1 or 2 weeks.

3. GEOTECHNICAL INVESTIGATIONS

Fifteen boreholes were drilled on the site for the proposed fuel storage compound during the period from June 12 to 16, 2011, using a sonic drill rig. Near continuous

core samples were recovered by the drill and selected samples were taken from each core run for laboratory testing.

All of the test holes were drilled to a depth of about 10 metres except for one borehole that was drilled to a depth of 40 metres. Single bead thermistors were installed in two of the test holes, however temperature readings were not available at the time this technical memorandum was prepared. In addition some laboratory testing was being completed and the detailed borehole logs were being prepared while this memorandum was being written.

4. SUBSURFACE CONDITIONS

The subsurface soils below the site consist of sand which contains some gravel sized particles. At the time of drilling, the near surface sand was relatively dry, free-flowing and possibly thawed to depths ranging from 1 to 2.5 metres below ground surface. It is expected that the depth of thaw will increase as the thaw season advances. Below the near surface thawed layer, the sand was frozen to the bottom of all boreholes.

No visible ice was observed in any of the frozen core samples at the time of drilling. The near surface sands were found to have water contents ranging from 5 to 10 percent, indicating that the sands are generally unsaturated. A few samples of the frozen sand were found to have very high water contents, indicating that some excess ice is present at random locations within the sand deposit. These layers or pockets of sand can be expected to settle significantly if thawed.

A limited number of tests indicated that the sands in this deposit contain zones of highly saline pore-water. Additional testing was in progress to establish the distribution of the saline soils within the deposit at the time this memorandum was prepared.

5. FOUNDATION RECOMMENDATIONS

The proposed site for the tank farm is considered suitable from a geotechnical point of view and the design of the secondary containment structure and tank

foundation will be satisfactory provided the site is prepared consistent with the recommendations presented in the following sections.

1.1 Site Preparation

It is recommended that all organic material be removed from the tank containment area and the area proof-rolled by running a heavy wheeled vehicle over the site to identify any loose or soft zones. Any soft areas that are identified during proof-rolling should be sub-excavated if necessary and backfilled with compacted sand. The subgrade should be compacted with a vibratory roller prior to placing imported fill on the site.

It is recommended that free-draining sand and gravel be used to construct the secondary containment structure and tank pads. Ideally, the imported fill should contain no particles greater than 75mm in diameter and have less than 10 percent of the material passing the Number 200 sieve (0.076 mm size).

Soils containing significant salt concentrations are known to be present in this area. It is recommended that the imported sand and gravel be tested to ensure that it is non-saline. It is especially important that saline material not be used in the tank foundations or in areas where steel piping will come in contact with the soil, since the high salinity will cause rapid corrosion of steel components. Consideration should be given to placing a thin layer of sand mixed with bitumen directly below the tanks, to further reduce the risk of corrosion.

The fill should be placed in lifts no greater than 150 mm in compacted thickness and compacted to a uniform density of not less than 100 percent of Standard Proctor Maximum density, to minimize post construction settlements. The sand and gravel fill can be compacted most efficiently with a vibratory compactor. A minimum 5 tonne vibratory drum compactor is recommended. Placement and compaction of the fill material should only be carried out during the thaw season as planned, when air temperatures remain above freezing.

Geothermal analyses indicate that there is a risk that thaw settlements could occur if insulation is not placed below the tank, particularly in an unusually warm thaw season. Therefore it is recommended that rigid, extruded polystyrene insulation

panels (Styrofoam HI-60 or equal) be placed below the entire area of the tank. The insulation should extend at least 2 metres beyond the outside perimeter of the storage tank. The insulation should be placed at a depth of at least 1.5 metres below the base of the tank to maximize its thermal effectiveness.

The insulation should be placed in two layers and have a minimum thickness of 50mm. Two layers are recommended so that the panels placed for the top layer can be laid so that they overlap the joints in the bottom layer. This arrangement would require that each insulation panel be 25mm thick, which is relatively thin. Such thin panels will be fragile and easily damaged during construction. Consideration should therefore be given to using panels which are 38mm thick, which would be less susceptible to damage during installation. The total thickness of the insulation layer below the tank will therefore be 76mm, which exceeds the minimum thickness required based on the thermal analyses.

A minimum of 100 mm of compacted sand, containing no particles greater than 5 mm in diameter, should be placed above and below the extruded polystyrene panels to protect them from damage. Alternatively, a thick, non-woven geotextile can be placed above and below the insulation to minimized damage from larger pieces of gravel.

Extruded polystyrene will quickly degrade when exposed to diesel fuel. Therefore, the board insulation should be placed below the impervious membrane liner used for the secondary containment structure. In addition, consideration can be given to covering the insulation panels with a separate hydrocarbon resistant liner, in the event that the secondary liner were to leak.

Polystyrene panels can be crushed or broken from wheel or point loads imposed by construction equipment, unless they are protected by a minimum thickness of 0.5 metres of sand or gravel to spread the point loads over a larger area. Suitable low pressure equipment will therefore be required to place and compact the first few lifts of material over the insulation.

Consideration should be given to installing several single bead thermistors below and in the vicinity of the tank when the secondary containment structure is being

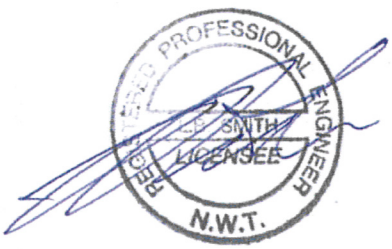
constructed. The data from these thermistors would provide valuable information for the design of the foundations for the 4 larger tanks that will be constructed later.

It is suggested that 1 thermistor bead be placed below the insulation, at location that is at least 3 metres inside the perimeter of the storage tank. The bead should be placed a few inches below the polystyrene insulation. A second bead should be placed about 2 metres outside the insulated area at a depth of about 2 metres below the membrane liner. The wire leads from the two thermistors should be protected, brought to the surface and placed inside a short steel pipe installed near the outside wall of the tank, so that the leads are protected from damage. Ideally, two such pairs of single bead thermistors should be installed, since it is possible that one or more of the wire leads will be accidentally broken either during or shortly after construction.

6. CLOSURE

We trust that the foregoing recommendations meet your current requirements. Please contact us at any time if you have questions or require additional information.

Thurber Engineering Ltd.
Steven Sather, P.Eng.
Review Principal



PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
Signature _____
Date August 9, 2011
PERMIT NUMBER: P0176
The Association of Professional Engineers, Geologists and Geophysicists of the NWT / NU

Bruce Smith, P.Eng.
Project Engineer

Attachments:
1) Statement of General Conditions

THURBER ENGINEERING LTD.

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering or environmental consulting practices in this area. No other warranty, expressed or implied, is made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this Report expressly addresses proposed development, design objectives and purposes, and then only to the extent there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation or to consider such representations, information and instructions.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS WE MAY EXPRESSLY APPROVE. The contents of the Report remain our copyright property. The Client may not give, lend or, sell the Report, or otherwise make the Report, or any portion thereof, available to any person without our prior written permission. Any use which a third party makes of the Report, are the sole responsibility of such third parties. Unless expressly permitted by us, no person other than the Client is entitled to rely on this Report. We accept no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without our express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and this report is delivered on the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

(see over . . . .)

INTERPRETATION OF THE REPORT *(continued . . . .)*

c) Design Services: The Report may form part of the design and construction documents for information purposes even though it may have been issued prior to the final design being completed. We should be retained to review the final design, project plans and documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the report recommendations and the final design detailed in the contract documents should be reported to us immediately so that we can address potential conflicts.

d) Construction Services: During construction we must be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RISK LIMITATION

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause an accidental release of those substances. In consideration of the provision of the services by us, which are for the Client's benefit, the Client agrees to hold harmless and to indemnify and defend us and our directors, officers, servants, agents, employees, workmen and contractors (hereinafter referred to as the "Company") from and against any and all claims, losses, damages, demands, disputes, liability and legal investigative costs of defence, whether for personal injury including death, or any other loss whatsoever, regardless of any action or omission on the part of the Company, that result from an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project. This indemnification shall extend to all Claims brought or threatened against the Company under any federal or provincial statute as a result of conducting work on this Project. In addition to the above indemnification, the Client further agrees not to bring any claims against the Company in connection with any of the aforementioned causes.

7. SERVICES OF SUBCONSULTANTS AND CONTRACTORS

The conduct of engineering and environmental studies frequently requires hiring the services of individuals and companies with special expertise and/or services which we do not provide. We may arrange the hiring of these services as a convenience to our Clients. As these services are for the Client's benefit, the Client agrees to hold the Company harmless and to indemnify and defend us from and against all claims arising through such hirings to the extent that the Client would incur had he hired those services directly. This includes responsibility for payment for services rendered and pursuit of damages for errors, omissions or negligence by those parties in carrying out their work. In particular, these conditions apply to the use of drilling, excavation and laboratory testing services.

8. CONTROL OF WORK AND JOBSITE SAFETY

We are responsible only for the activities of our employees on the jobsite. The presence of our personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control of the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously unknown hazardous conditions or materials and that such a discovery may result in the necessity to undertake emergency procedures to protect our employees as well as the public at large and the environment in general. These procedures may well involve additional costs outside of any budgets previously agreed to. The Client agrees to pay us for any expenses incurred as the result of such discoveries and to compensate us through payment of additional fees and expenses for time spent by us to deal with the consequences of such discoveries. The Client also acknowledges that in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

9. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited investigation conducted within a defined scope of services. We cannot accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.