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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI

October 19th, 2006

File: 3BM-QIK
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Michael O'Hara, P.Eng
Nuna Burnside Engineering and Environmental Ltd.
Box 175, 25 Third Avenue
Rankin Inlet, NU X0C O6O

Subject: Qikiqtarjuaq Water Licence Application

Dear Mr. O'Hara,

The **Nunavut Water Board (NWB)** requests further information pertaining to the Hamlet of Qikiqtarjuaq's water licence renewal application as per ***Section 48 Item 2*** of the *Nunavut Waters and Nunavut Surface Tribunal Act (NWNSRTA)*.

The NWB would like to remind the Proponent that as per **Section 57** of the *NWNSRTA, the Board may not issue a licence unless the applicant satisfies the Board that any waste produced by the appurtenant undertaking will be treated and disposed of in a manner that is appropriate for the maintenance of the water quality standards and effluent standards that the Board considers acceptable.* The Proponent's past performance will also be considered to ensure the completion of the appurtenant undertaking is adequate and such measures as may be required in mitigation of any adverse impact are properly accounted for.

The NWB has completed the review of the Hamlet of Qikiqtarjuaq's renewal application for their municipal water licence submitted May 1, 2006 by the Licensee. The document was distributed upon receipt, for review and comment to interested persons with a submission deadline of September 22, 2006.

In accordance with **Section 48 Item 2** sufficient detail and an avoidance of ambiguity should be followed in submitting response materials to the following comments:

Water Use and Understanding of Waste

i. The Proponent has indicated that the water supply for the Hamlet will remain the Tuluqak River and 37,500 m^3 of water will be pumped from the river over a 3 month period. This is a slight increase in the volume of water currently licensed (35, 000 m^3). Has the Proponent undertaken an assessment of the water supply and its capacity to meet the demands of the Hamlet? For the next five years and the next 20 years?

ii. In the Operation and Maintenance (O&M) Plan for the sewage storage and treatment facility the Proponent has proposed to de-sludge the lagoon every 5-10 years as required. The Proponent shall provide further details in the O&M plan on how the chemical and biological composition of the sludge will be determined and where the sludge will be stored, treated and eventually disposed of.

iii. The Proponent shall provide the references for the assumptions in **Tables 4 and 5** of the Detailed Design Report for the Improvements to the Water Reservoir, Sewage Lagoon and Solid Waste Disposal Facility The Hamlet of Qikiqtarjuaq, Nunavut (Detailed Design Report).

iv. The Proponent used a modified version of the Alberta Department of Environment's wetland model to predict estimated effluent quality and determine the size of the wetland. The Proponent shall provide the NWB with further information on the wetland treatment area as it is an integral

part of the facilities and required to meet the proposed effluent discharge criteria and the provisions of **Section 36 (3)** of the *Fisheries Act*. The NWB requests further site specific description of the wetland, the processes involved within the wetland to achieve treatment, the limitations of the model used to predict the size of the wetland and how the Proponent will ensure that adjacent waterbodies are not impacted by this treatment system.

v. The Proponent stated in the Detailed Design Report in **Section 4.3**, "*...the wetland treatment area will evolve over time into a functioning microbial and terrestrial plan environment capable of providing additional treatment with some effluent evaporation and disinfection.*" The NWB requests further clarification on when the wetland will be capable of treating the effluent to meet the proposed effluent criteria in **Table 8**? Also what will be the estimated effluent qualities from years 0-5? 5-10? 10-15? 15-20?

vi. Prior to developing the former landfill site for bulky waste disposal, the Proponent shall submit to the Board a plan to close the site that estimates the volume and depth of the wastes currently at the site and provides a plan to manage those wastes to reduce their impact on receiving waters.

vii. In **Section 5.6.1** of the Detailed Design Report the Proponent is proposing to use granular material from within the landfill area cell for construction of the perimeter berms. The Proponent shall confirm that the granular material used for construction of the perimeter berms shall be free of contamination.

viii. In **Section 5.6.1** of the Detailed Design Report the Proponent has selected a 100 mm storm event or snow runoff to size the water retention area. The Proponent shall provide further information on the probability of a 100 mm storm event or snow runoff and the probability that the water retention area may overtop during the design life.

ix. Environment Canada has recommended that monitoring wells be installed downstream of the solid waste site and the existing metal dump area as well as a background well upstream of the waste disposal facilities and that all wells should be monitored annually. The Proponent shall provide the NWB a discussion on monitoring the waste disposal facilities that shall include proposed monitoring.

x. In the drawings submitted for the application, the following drawings requested in the supplementary questionnaire were not included:

   a. Fuel and chemical storage for the community;
   b. Traditional use and recreational areas; and
   c. The outline of the drainage basin for the water use and waste disposal facilities.

xi. The NWB points out to the Proponent that the Detailed Design Report did not state that it include compliance with various GN-DOE regulations and guidelines, the NWB recommends the Proponent should review the comments provided by GN-DOE for further information.

Geotechnical Issues

xii. The Proponent is requested to provide additional detail and description to address each of points provided below.

   a. The optimum density and water content of construction materials were not tested on the construction soils.

      i. Why was this not completed during the site geotechnical assessment in addition to completing a sieve analysis?
      ii. Does the Proponent agree that optimum water content and density are important design parameters to engineer and construct a stable structure?

b. **Drawing #10** within Engineering Drawings document depicts a typical cross-section of the lagoon berm with a caption that states that the berm material will be "*placed in lifts and compacted to 95% standard proctor density*".

   i. What is the desired as-placed density; how will this be determined?
   ii. What are the specifications for lift thickness?
   iii. Will these construction specifications be used for the other structures? If not, what are the details of construction specifications for the other structures?

xiii. The lagoon, landfill, hazardous waste storage area, and water reservoir each contain a perimeter berm in the design. Despite each structure containing a similar berm configuration the applied loadings for each structure may be unique. There is not a clear understanding of the stability of the perimeter berm from slope failure under the applied loads. Additional detail and discussion on the stability of the berms from slope failure are requested that provide a full description of:

   a. Method of analysis
   b. Any limitations in the method of analysis
   c. Values of assumed or known soil strength and density used in the analysis with justification for their use.

xiv. The Proponent is requested to provide additional detail and discussion to address each of the following points.

   a. There are no details or discussion on the bearing capacity of the foundation soils under potentially thawing conditions or the expected amount of settlement for the berms. The geotechnical investigation did not establish the ground ice content in the foundation soils which could lead to differential settlements and foundation instability.

      i. Does the Proponent agree that bearing capacity and settlement are important geotechnical considerations in the design, stability, and containment of these structures? If not, why not?
      ii. Have any thermistors been installed to provide site specific temperature date for design purposes?
      iii. Has settlement be considered in the calculations for volume capacity of the reservoir and lagoon, and what are the details of the analysis? If settlement has not been considered, why not?

xv. There is limited to no details into the construction methods and specifications for the lagoon, landfill, hazardous waste storage area, or water reservoir. For example, in **Section 7.1 Appendix B Geotechnical Evaluation**, it is stated that "*soil around the potential new reservoir identified sufficient suitable overburden material to create the berms, and provide the raw material that could be crushed and sorted to provide the needed sand and gravel*"; however, there is no quantifiable measure to describe what material specification is required, or what grain size and distribution is required. Details and discussion of this nature are also not provided for the lagoon or landfill construction.

   a. Additional detail and description into the quality control and quality assurance (i.e., quality assurance program) of, but not limited to, soil type, material characteristics, moisture content, and density, used in constructing each structure is requested.
   b. A detailed monitoring plan, which includes, but not limited to, soil property testing methods (e.g., sieve, density, moisture content, etc) and frequency of testing during construction is requested.
   c. Detail and description into soil and material specifications acceptable for construction, as well as, specifications for as-placed conditions like moisture content, density, and standard proctor are also requested.
   d. Will construction, quality assurance, and quality control monitoring be overseen by a qualified geotechnical engineer? If not, why not? How does the Proponent propose to report this information to the NWB?

xvi. The Proponent is requested to provide additional detail and description to address each of points provided below:

a. There are no details provided regarding the construction of perimeter or interior berms. Additional detail and discussion is requested to address what equipment will be used to construct the berms.
b. The depth to permafrost during the geotechnical assessment as about 2 m below ground surface.

    i. Are the foundation conditions competent for the expected soil loadings and potential foundation thawing conditions?
    ii. Does the Proponent agree that the landfill and lagoon perimeter berms, which do not contain a liner, could have seepage through and under the berm? If seepage could migrate beneath the berm through the proposed design what impacts will this seepage have on waters contained in the soil proximal to the facility?
    iii. Has the potential for seepage through the landfill and lagoon berms and piping failure been considered in the design? If so, additional detail and discussion is required. If not, is the Proponent relying on permafrost aggregation into the berms?
    iv. If permafrost aggregation is relied upon in the design, does the Proponent have an understanding of the thermal regime with time and what are these details?
    v. What, if any, site/foundation prep work is required before berm development occurs, or will they be constructed on top of ground surface without removing the active zone?
    vi. If the berms are not lined or have permafrost aggregation, how will seepage be prevented through the active zone?

xvii. No slope protection on the inside slope of the berms was specified. Is there a concern to protect the inside slope of berms from wave, ice, or wind erosion? If not, why not?

xviii. The refuse is to be contoured to obtain a slope of 3:1. Within **Figure 12** of the Detailed Design Report there is a caption that states "*site operators may elect to install an additional vertical berm if construction wastes with 3:1 slope is problematic.*" This statement suggests that a 3:1 slope may not be stable.

a. What is the level of confidence does the Proponent have that a 3:1 slope will be stable?
b. What evidence or justification is there to suggest that a slope of this angle will be stable?
c. What quantifiable markers are in place to define "*problematic*" in the Proponent's statement?

xix. An interior berm is to be constructed within the landfill to support the refuse and separate stages of construction. The interior berm will have a waste load applied to one side and no load applied to the other during landfilling.

a. What is the stability of the interior berms from slope failure and sliding along the foundation soil for the applied loads?
b. What method of analysis, as well as, what soil and waste strength and density values with justification on their selection, were used to assess stability of the interior berms?

xx. Will a final cover be placed over the landfill? If so, what are the geotechnical engineering design and details, function, and characteristics of the final cover proposed?

xxi. Within **Section 6.0 of Appendix B Geotechnical Evaluation**, the following statements are provided: "*From a geotechnical point, the site can be rehabilitated fairly easily as there are no significant land availability and cover availability constraints.*", and "*From the geotechnical view point the site can be effectively redeveloped and managed to serve the long-term needs of the Hamlet.*" Additionally, within **Section 9.0 of Appendix B Geotechnical Evaluation**, the following statement was provided "*The geotechnical evaluation found the existing wastewater lagoon site, landfill site, and water reservoir site to be suitable for rehabilitation and/or expansion. No compelling geotechnical reasons were found to relocate the landfill or wastewater lagoons.*"

a. The Proponent is requested to further detail and describe what geotechnical considerations were assessed to justify each of these statements?
b. From the phasing used in these statements, the geotechnical considerations include land and cover availability. Does the Proponent agree that there are other geotechnical considerations like slope stability, bearing capacity, construction quality control and assurance, settlement, etc. are important geotechnical considerations in the design of these structures?
c. How were the geotechnical considerations listed in bullet point b) accounted for in the geotechnical statements provided in **Section 6.0 and 9.0 of Appendix B Geotechnical Evaluation** (provided above)?

xxii. There were minimal details regarding the design and construction of the exfiltration berm for the wetland. The Board requests complete details regarding the size, shape, extent, material characteristics, specifications for construction, and engineered drawings (including cross-section details) of the exfiltration berm.

xxiii. **Section 5.5** within the Design Report stated that the existing ditching in the northeast corner of the Bulky Metals Disposal Area will be improved "*so that surface erosion of the area is minimized*". It was further stated that corrective action for this issue was to add additional cover material to the affected area.

a. The Board requests additional detail on the thickness and material type, as well as, specifications of the cover material required for this corrective action.
b. How will the addition of cover material prevent future erosion concerns?
c. Are the ditches around the other structures prone to erosion damage? If not, why not? What has been done to prevent erosion in the other ditches at this site?
d. Will monitoring of the structures and ditching for erosion damage be completed and what will be done for corrective action? If so, what is the frequency of monitoring and reporting to the Board?

xxiv. The Proponent is requested to provide additional detail and description to address each of points provided below with regards to the water reservoir liner.

a. In **Section 3.3.1** of the Design Report, it states that the water reservoir will consist of "*two layers of a non-woven geotextile with a nominal thickness of approximately 165 mil with a 300 mm layer of crushed stone sandwiched between the two layers in order to provide reinforcement of the reservoir walls*".

    i. What is the weight of the non-woven geotextile, as well as, the material specifications?
    ii. What is mean by the phase "to provide reinforcement of the reservoir walls"?
    iii. How do two geotextile and a crushed stone layer provide reinforcement to the reservoir walls?
    iv. Are the reservoir walls not stable?

b. It is further stated in **Section 3.3.1** of the Design Report, that a 45 mil geomembrane will be placed on top of the non-woven fabric. The geomembrane is used to decrease risk of leakage from the reservoir.

    i. Since there are two non-woven geotextile used in the design, which non-woven fabric has the geomembrane placed on top?
    ii. What are the engineering specifications required to ensure a competent geomembrane and adequate anchoring into a key trench (if this is required in the design)?

c. What provisions have been made in the design to protect the liner integrity from construction, operation, and environmental damage?

d. There was no reference within the Design Report to the Engineering Drawings for the water reservoir. Proper referencing within the text to engineering drawings is requested. **Engineering Drawing #10** Section C-C shows a cross-section through the water reservoir

and berm. The details of the liner in the **Engineering Drawing #10** shows a 80 mil HDPE geomembrane, 12 oz. geocomposite, and a gravel bed above the foundation soils. The liner design depicted in this engineering drawing is completely different than that specified in **Section 3.3.1** of the Design Report. Clarification on reservoir liner design and associated engineering drawings is requested to address this unacceptable inconsistency.

xxv. The Proponent is requested to provide additional detail and description to address each of points provided below with regards to the hazardous waste storage area liner.

a. **Section 5.3.3.** of the Design Report states that the Hazardous Waste Storage Area will consist of a liner that "include 10 cm of sand and gravel over the liner for protection" and the liner will consist of a "40 mil HDPE artic liner. **Engineering Drawing #13** states that a liner that consists of a "10 mm HDPE artic liner and covered with 100 mm gravel for protection". Cross-section F-F' is shown on **Engineering Drawing #13** to depict the storage area; however, this section is not provided in the Engineering Drawings and should be provided. In fact, none of the cross-sections depicted in **Engineering Drawing #13** are provided and they should be available.

   i. There are obvious and unacceptable inconsistencies between the Design Report and the Engineering Drawings with regards to the liner materials. Clarification is requested to address if the geomembrane is in fact a 40 mil HDPE and not a 10 mm HDPE, as well as, any other inconsistencies.
   ii. Do manufactures produce geomembranes of 10 mm thickness?
   iii. Clarification is requested to address if the geomembrane will be placed above or below the protection layer.
   iv. Clarification and specifications for the protection layer materials are requested; will sand and gravel be used, or just a gravel, and what are the material size and gradation?
   v. What confidence does the Proponent have that a 10 cm thick protective layer will prevent liner damage?

b. In addition to that described above, the berms around the liner in the Design Report state a height of 1 m. The **Engineering Drawing #13** states that the berm height will be 0.33 m. Clarification is requested to address this inconsistency.

xxvi. The Proponent is requested to provide additional detail and description to address each of points provided below with regards to the lagoon and landfill liner.

a. A synthetic or earthen liner has not been proposed to be placed on the bottom and within the berms of the lagoon and landfill. A liner was proposed for use in the water reservoir to decrease risk of leakage from the reservoir.

   i. Why hasn't the same standard of care been provided for a water reservoir to have a liner and a lagoon and landfill not to have a liner?
   ii. Are there differences in the geology or construction soils within the berms between these facilities that warrant lower risk for seepage of fluid from a water reservoir compared to a lagoon or a landfill?
   iii. Does the Proponent agree that the quality of any waters escaping the lagoon or landfill would likely have higher concentrations of contaminants than water escaping a water reservoir?
   iv. What is the design method and analysis completed to contain wastes and fluid from seeping out of the lagoon and landfill base and berms?
   v. Keeping in mind that the materials in the vicinity of the site that are to be used for construction are classified as an SP-SM soil with about 5% fines, what is the expected hydraulic conductivity of the berm after construction and in the long term?
   vi. Has a seepage analysis been completed? If so, what are the details of the analysis and results? If not, why not?
   vii. If the Proponent is relying on permafrost aggregation into the berms, is there a clear understanding of the thermal regime with time to prevent fluid escaping from the facility?

viii. What confidence does the Proponent have that the lagoon and landfill will contain all fluids?

ix. Additionally, is there a clear understanding on whether the foundation soils will thaw due to the potentially warm sewage below the lagoon?

b. There was no description or detail regarding construction specification, installation, construction and long-term monitoring, quality control, or quality assurance for the installation of the liner. Additional detail and discussion is requested to address each of these issues to ensure that the liner will not be damaged during construction and will perform as designed for the service life of the facility.

xxvii. Within **Section 3.1** of the Design Report, it stated that there was evidence of damage to the existing water reservoir. Specifically, "*numerous areas where the liner had failed*", and "*slumping of the material under the liner was occurring, as well as the sand cover material over the liner had been eroded away*". The reasons for why these damages occurred were not provided. What provisions have been made to ensure that damages of this type will not occur with the construction of the water reservoir, lagoon, hazardous waste storage area, and landfill?

In closing the NWB requests a detailed response to all bulleted items in this letter. The NWB would like to remind the Proponent that **Section 70 Item (c)** of the NWNSRTA allows the Board to install licence conditions that it considers appropriate including conditions relating to the quality, concentration and types of waste that may be deposited and the manner of depositing waste, and studies to be undertaken, works to be constructed, plans, including contingency plans, to be submitted, and monitoring programs to be undertaken. Recommendations may be brought forward for Board judgment once the technical concerns addressed in this letter have been clarified.

Should you have any questions regarding **Water Use and Understanding of Waste** please feel free to contact Ms. Sarah Gagne at 867.873.8948 and should you have any questions pertaining to **Geotechnical Issues** you are invited to contact Dr. Jamie Van Gulck, P.Eng at 519.577.4129

Sincerely,

Original signed by:

Joe Murdock
Director of Technical Services

cc. Mike Richards (Hamlet of Qikiqtarjuaq)
Johnathan Palluq (GN-CGS)
Pat Fuentes (GN-CGS)
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