



August 3, 2017

File: MV2014L3-0008

Ms. Tausia Lal  
Senior Administrative Officer  
Hamlet of Fort Resolution  
General Delivery  
Fort Resolution NT X0E 0M0

Email: [tausia.sao@gmail.com](mailto:tausia.sao@gmail.com)

Dear Ms. Lal:

**Preliminary Engineering Report – New Sewage Disposal Facilities – Interim Approval  
Hamlet of Fort Resolution – Water Licence MV2014L3-0008**

The Mackenzie Valley Land and Water Board (the Board) met on August 3, 2017 to review the Preliminary Engineering Report for the New Sewage Disposal Facilities submitted on May 2, 2017 by the Hamlet of Fort Resolution (Hamlet) in accordance with Part D, item 12 of municipal Water Licence (Licence) MV2014L3-0008.

The Board hereby approves the Preliminary Engineering Report for the new Sewage Disposal Facilities (Report) as an interim report, and requires the Hamlet to submit a revised version (Version 1.1) at the same time that the Hamlet applies for a Water Licence amendment for the new Sewage Disposal Facilities. The revised Report will be considered to be approved upon written confirmation of conformity from Board staff, and shall contain the following additions:

1. Details on how the lagoon design volume was determined;
2. Details on the chosen discharge construction, with rationale;
3. Details on what cost-saving measures will be employed in the design, with rationale;
4. Details on how the lagoon configuration and dimensions were chosen, listing all factors used, with rationale;
5. A reference for the anticipated process performance of the proposed system; and
6. Further details on how the criteria evaluated in Table 7-3 was weighed and compared in order to arrive at the proposed design.

As the Hamlet works to design and construct new Sewage Disposal Facilities, the Board reminds the Hamlet to act in accordance with Part F, items 2 through 6 of Licence MV2013L3-0008 (regarding Construction). As none of these requirements are for “Board approval”, they will not go through a public review process; rather, they will be posted on the Board’s Public Registry and the distribution list will be notified by email.

The Board also notes that the current Water Licence was issued for the current Sewage Disposal Facilities, which are defined in MV2014L3-0008 as “identified in Figures 6, 7, and 8 in Hamlet of Fort Resolution, Background Report for Water Licence Application, 2014 Update, Stantec Consulting Ltd., April 11, 2014.” Therefore, the Hamlet must apply for an amendment to Licence MV2014L3-0008 before constructing and disposing of waste in the new Sewage Disposal Facilities. The subsequent regulatory process will provide opportunities for reviewers to review the design and operation plans for the new Sewage Disposal Facilities, and for the Board to issue new conditions in an amended Licence. Note that this amendment would only pertain to the new Sewage Disposal Facilities and to any other conditions, as applied for in the amendment application.

The Board reminds the Hamlet of the contents of the email regarding a Licence amendment, sent by Board staff on May 18, 2017. Based on the current review, the Board additionally requires the design drawings and specifications for the new Sewage Disposal Facilities to include:

1. Specifications regarding the use of sandy soils for berm construction (i.e. use of liners and slopes made at a 3:1 ratio);
2. Specifications for venting mechanisms; and
3. Specifications of the lagoon discharge system, including the discharge mechanisms/ infrastructure and a defined area (with rationale) of the wetland treatment system.

As per Part I, item 3 and Schedule 2, item 1 of MV2014L3-0008, a Closure and Reclamation Plan shall be submitted to the Board for approval at least 6 months prior to the closure of any of the Sewage or Solid Waste Disposal Facilities.

The Board acknowledges that the Hamlet has made significant progress in recent months to work towards compliance with their Licence, and appreciates the Hamlet’s efforts. The Hamlet shall adhere to the commitments made in their responses to reviewer comments dated June 26, 2017 (attached).

The full cooperation of the Hamlet of Fort Resolution is anticipated and appreciated. If you have any questions or concerns, please contact Erica Janes at (867) 766-7466 or email [ejanes@mvlwb.com](mailto:ejanes@mvlwb.com).

Yours sincerely,



Mavis Cli-Michaud  
MVLWB, Chair

Copied to: Ken Johnson, Stantec Engineering  
Gavin Olvera, MACA South Slave Region  
Distribution List

Attached: Reasons for Decision  
Review Summary Table



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## Reasons for Decision

Issued pursuant to section 72.25 of the *Mackenzie Valley Resource Management Act* (MVRMA) and section 54 of the *Waters Act*

Management Plan	
<b>Preliminary Screener</b>	MVLWB
<b>Reference/File Number</b>	MV2014L3-0008
<b>Applicant</b>	Hamlet of Fort Resolution
<b>Project</b>	Preliminary Engineering Report for the new Sewage Disposal Facilities

### Decision from Mackenzie Valley Land and Water Board Meeting of

August 3, 2017

With respect to this Report, notice was given in accordance with sections 63 and 64 of the *Mackenzie Valley Resource Management Act* (MVRMA) and section 43 of the *Waters Act*. There was no public hearing held in association with this application.

#### 1.0 Background

##### Licence Requirements

Part D, item 12 of Water Licence (Licence) MV2014L3-0008 states:

*Within one (1) year following issuance, the Licensee shall submit for Board approval a Preliminary Engineering Report for a Sewage Disposal Facilities which shall include, but not be limited to the following:*

- a) Design criteria for the proposed new facility;*
- b) Technical information for the proposed site, including drainage patterns;*
- c) An evaluation of the efficacy of the proposed facility to treat sewage and minimize impacts to the surrounding land, groundwater and surface water;*
- d) Discussion of available siting and design options for new Sewage Disposal Facilities, including a decision matrix that compares the viable siting and design options considered and the criteria by which they are rated; and*
- e) An explanation of why the proposed new facility is the best choice.*

Submission Description

The Hamlet submitted a Preliminary Engineering Report for the new Sewage Disposal Facilities on May 2, 2017.

Table 1 below lists the components of the Plan required in Licence MV2014L3-0008, and details on the adequacy of the submission.

**Table 1: Plan Completeness**

	<b>Components of the Plan as required in Part D, item 12 of the Licence</b>	<b>Board staff analysis of the adequacy of the Plan in addressing the component</b>
a)	Design criteria for the proposed new facility;	<p>Based on Comment ID ENR 2, the construction drawings, specifications, and quality control testing conducted for the new lagoon should reflect the suitability of native soils with a synthetic liner, for perimeter berm construction.</p> <p>Based on Comment ID ENR 3, the construction drawings and specifications for the new Sewage Disposal Facilities should include information on how venting mechanisms will be implemented in the new lagoon.</p> <p>Based on Comment ID MVLWB 2, the Hamlet should revise the Report to include detailed information on how the design volume was determined.</p> <p>Based on Comment ID MVLWB 4, the Hamlet should revise the Report to include specifications and rationale for the discharge.</p>
b)	Technical information for the proposed site, including drainage patterns;	Adequate.
c)	An evaluation of the efficacy of the proposed facility to treat sewage and minimize impacts to the surrounding land, groundwater and surface water;	Based on Comment ID MVLWB 3, the Hamlet should ensure that the discharge from the secondary cell is not continuous over the entire year; rather, sewage should be retained over the winter and spring, tested prior to decant for compliance approval, and then discharged to the wetland area. These details should be provided in the water licence amendment application required for the new Sewage Disposal Facilities (process outlined below) as well the Operation and Maintenance Plan for the new Sewage Disposal Facilities.

d)	Discussion of available siting and design options for new Sewage Disposal Facilities, including a decision matrix that compares the viable siting and design options considered and the criteria by which they are rated; and	Based on Comment ID MVLWB 12, the Hamlet should update details on the decision matrix to indicate how the criteria was weighed and evaluated and how the final design was decided upon.
e)	An explanation of why the proposed new facility is the best choice.	Adequate.

## **2.0 Public Review**

By June 5, 2017, comments and recommendations on the Report were received from the Government of the Northwest Territories – Department of Environment and Natural Resources (GNWT-ENR) and Board staff. On June 26, 2017, the Hamlet responded to comments by email, and Board staff posted the Hamlet’s responses to the Online Review System on July 4, 2017.

Both GNWT-ENR and Board staff noted that the Geotechnical Investigation that was included with the Report indicated that the sandy material in the area was unsuitable for the construction of berms/retention of wastes; however, in the review period the Hamlet clarified that it would include certain specifications regarding berm construction (i.e. lining berms, using 3:1 slopes on berms) to allow for the use of this local material in lagoon construction.

GNWT-ENR also raised concerns regarding what venting mechanisms would be in place; the Hamlet indicated that venting mechanisms will be in place at the top of the berm to release possible gases migrating to the surface from the base of the lagoon.

Board staff sought further detail on how the design volume for the new Sewage Disposal Facilities was determined; the Hamlet provided an explanation in their response.

Several comments were made regarding the construction and operation of the discharge of the lagoon system; the Hamlet clarified the construction of the discharge and indicated that a seasonal discharge would be employed.

Board staff requested further information regarding several items in the report including: cost-saving measures that might be included in the design of the system, and further explanation of how the chosen design was decided upon; the Hamlet provided further details in their responses.

Board staff noted during the review that the Hamlet’s plans to construct new Sewage Disposal Facilities will necessitate further submissions under Part F (Construction), and an amendment to the Licence. Board staff notified the Hamlet on May 18, 2017 that a Licence amendment would be required for the new Sewage Disposal Facilities.

### 3.0 Decision

After reviewing the submission of the Hamlet, the written comments received by the Board and the Staff Report prepared for the Board, the Board, having due regard to the facts and circumstances, the merits of the submissions made to it, and to the purpose, scope, and intent of the MVRMA and the *Waters Act* and Regulations made thereunder, has determined that some components of the Preliminary Engineering Report for the new Sewage Disposal Facilities submitted to satisfy the requirements of the Licence, require revision. Therefore, the Board has decided to approve the Report as an interim Report.

The Board requires that the Hamlet submit a revised Report (Version 1.1), at the same time that the Hamlet applies for a Water Licence amendment for the new Sewage Disposal Facilities. The revised Report will be considered to be approved upon written confirmation of conformity from Board staff, and shall include the following revisions:

1. Details on how the lagoon design volume was determined;
2. Details on the chosen discharge construction, with rationale;
3. Details on what cost-saving measures will be employed in the design, with rationale;
4. Details on how the lagoon configuration and dimensions were chosen, listing all factors used, with rationale;
5. A reference for the anticipated process performance of the proposed system; and
6. Further details on how the criteria evaluated in Table 7-3 was weighed and compared in order to arrive at the proposed design.

The Board reminds the Hamlet of the contents of the email regarding a Licence amendment for the construction of new Sewage Disposal Facilities, sent by Board staff on May 18, 2017. The new designs should consider the existing conditions in Licence MV2014L3-0008, specifically Part F: Construction. Based on the current review, the Board additionally requires the design drawings and specifications for the new Sewage Disposal Facilities to include:

1. Specifications regarding the use of sandy soils for berm construction (i.e. use of liners and slopes made at a 3:1 ratio);
2. Specifications for venting mechanisms; and
3. Specifications of the lagoon discharge system, including the discharge mechanisms/ infrastructure and a defined area (with rationale) of the wetland treatment system.

Water Licence MV2014L3-0008 contains provisions that the Board feels necessary to ensure and monitor compliance with the MVRMA and the *Waters Act* and the Regulations made thereunder and to provide appropriate safeguards in respect of the Applicant's use of the waters and/or deposit of waste affected by the Licence. The Board will provide additional referenced material or documents if requested in writing to do so.

SIGNATURE

Mackenzie Valley Land and Water Board



August 3, 2017

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Mavis Cli-Michaud, Chair

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Date

**Review Comment Table**

<b>Board:</b>	MVLWB
<b>Review Item:</b>	Hamlet of Fort Resolution Preliminary Engineering Report for new Sewage Disposal Facilities (MV2014L3-0008)
<b>File(s):</b>	<a href="#">MV2014L3-0008</a>
<b>Proponent:</b>	Hamlet of Fort Resolution
<b>Document(s):</b>	<a href="#">MV2014L3-0008 - Ft Resolution - Preliminary Engineering Report for new Sewage Lagoon - May2-17</a> (69.9MB)
<b>Item For Review Distributed On:</b>	May 8 at 10:28 <a href="#">Distribution List</a>
<b>Reviewer Comments Due By:</b>	June 5, 2017
<b>Proponent Responses Due By:</b>	June 26, 2017
<b>Item Description:</b>	<p>The Hamlet of Fort Resolution as submitted a Preliminary Engineering Report for the new Sewage Disposal Facilities (Lagoon) to address the requirements of Part D, item 12 of their municipal Water Licence MV2014L3-0008. This Plan is for Board approval.</p> <p>Part D, item 12 states:  <i>Within one (1) year following issuance, the Licensee shall submit for Board approval a Preliminary Engineering Report for a Sewage Disposal Facilities which shall include, but not be limited to the following:</i></p> <ul style="list-style-type: none"> <li><i>a) Design criteria for the proposed new facility;</i></li> <li><i>b) Technical information for the proposed site, including drainage patterns;</i></li> <li><i>c) An evaluation of the efficacy of the proposed facility to treat sewage and minimize impacts to the surrounding land, groundwater and surface water;</i></li> <li><i>d) Discussion of available siting and design options for new Sewage Disposal Facilities, including a decision matrix that compares the viable siting and design options considered and the criteria by which they are rated; and</i></li> <li><i>e) An explanation of why the proposed new facility is the best choice.</i></li> </ul> <p>Reviewers are invited to submit questions, comments and recommendations on the Hamlet's Preliminary Engineering Report for the new Sewage Disposal Facilities (Lagoon) by <b>June 5, 2017</b>.</p> <p>If you have questions or comments regarding this review or the Online Review System, please contact Erica Janes at (867) 766-7466 or <a href="mailto:ejanes@mvlwb.com">ejanes@mvlwb.com</a>.</p>
<b>General Reviewer Information:</b>	<p>In addition to the email distribution list, the following organizations received review materials by fax:</p> <ul style="list-style-type: none"> <li>• Fort Resolution Métis Council - Trudy King (867)394-3322;</li> <li>• Hay River Metis Council - Trevor Beck, President (867)874-4472; and</li> <li>• NWT Metis Nation - Tim Heron, NWTMN IMA Coordinator (867)872-3586.</li> </ul>
<b>Contact Information:</b>	<p>Erica Janes 867-766-7466  Heather Scott 867-766-7463  Jen Potten 867-766-7468</p>

## Comment Summary

GNWT - ENR: Central Email GNWT				
ID	Topic	Reviewer Comment/Recommendation	Proponent Response	Board Staff Analysis
4	General File	<b>Comment</b> ( <a href="#">doc</a> ) ENR Letter with Comments and Recommendations <b>Recommendation</b>		Noted.
1	Topic 1: Permafrost	<b>Comment</b> Section 4.0 (Waste Site Relocation Study) specifies that "Fort Resolution has moved its waste site (solid waste and sewage) to three separate locations over a period of thirty (30) years. These relocations were the result of the high groundwater table and associated environmental concerns expressed by the community." A Planning Study that looked at new potential sites recommended that the new Sewage lagoon be constructed at the existing waste management site, to the west side of the road (Figure 9-1). The Memo on Geotechnical Investigation (p. 51 of 120) specifies that "The primary issue of concern with the presence of permafrost is the potential long-term thaw degradation that will occur and the resulting thaw settlement, and that based on the available information, the wastewater lagoon could be located partially on permafrost terrain and partially on unfrozen terrain. Such a situation may lead to differential settlement issues across the lagoon, which could have undesirable consequences to liner and lagoon performance and integrity." Furthermore, this section also states that "If a more precise definition of the	<b>July 4:</b> 1. The presence of permafrost on the lagoon site and the potential pipeline was assessed as part of the geotechnical engineering site investigation. All test pits, except Test Pit 5, to the north of the lagoon were excavated to depths of 4.5 m to 5.0 m. This suggests that no permafrost is present at these deeper test pit locations. At Test Pit 5, being the northernmost test pit location, and outside the lagoon site envelope, excavation refusal on frozen ground was encountered at 1.1 m depth below ground surface. This refusal suggests that Test Pit 5 is located in permafrost, which is considered to be of isolated occurrence in this region. In the unanticipated event that permafrost is encountered in the lagoon site, the area will be excavated and allowed to thaw stabilize.	Noted.

		<p>permafrost boundary is needed, further geotechnical investigations such as drilling/test pitting or geophysical surveys may be considered."</p> <p><b>Recommendation 1)</b> ENR recommends that further details be provided on how permafrost will be assessed in the construction of the lagoon, and if additional permafrost studies will be conducted in the proposed lagoon construction area.</p>		
2	<p>Topic 2: Geotechnical Report Recommendations In situ Sand</p>	<p><b>Comment</b> Recommendations from the Geotechnical Investigation (GI) discuss the use of native/in-situ sands and soils for lagoon construction. Fine-grained sand - the predominant soil texture encountered in all test pits - was said to be unsuitable for use as a natural soil liner or impermeable barrier for the lagoon, and that "A perimeter berm constructed from native sands should not be relied on for any amount of containment of wastewater". The GI suggests that native soils were generally suitable for construction of the lagoon perimeter berm, but could create problematic conditions in terms of compaction and optimum water content (p. 19-20 &amp; p. 52-53). The GI recommended that [native] soils be tested prior to excavation, in order to measure and subsequently achieve optimum water content, as moisture conditioning may be necessary to meet project specifications for soil compaction in the perimeter berms. However, the Preliminary Constructability</p>	<p><b>July 4:</b> 1. The geotechnical investigation identified that the predominate soil texture at the test pit locations comprises sand, being fine-grained. These native soils are considered to be generally suitable for use for perimeter berm construction, and the containment of the wastewater within the lagoon will be achieved with a synthetic liner material. In order to address the long term stability of the berm, the side slopes will be 3:1. It is possible that the native soils may be sensitive in terms of compaction and optimum water content, and this will be addressed by the technical specification and construction quality control testing. The revegetation of the completed slope is anticipated to be an appropriate means to provide long term erosion protection for the berm structure. Revegetation of a berm slope was</p>	<p>Noted. The construction drawings, specifications, and quality control testing conducted for the new lagoon should reflect this information.</p>

		<p>discussion does not necessarily discriminate between sand or soil, referring to in-situ materials around the lagoon site that are generally suitable for construction of lagoon berms (section 8.3 &amp; Closure section). It goes on to say "In situ sand is fine grained, therefore erosion will be an important consideration in the use of the sand for the berm construction. The entire berm should be capped with a coarse gravel, a geosynthetic liner, or a revegetated area. In the construction of the berms, fine silty sand may require special attention to make sure that the appropriate compaction is achieved; it is anticipated that the "Proctor" curve may be very steep with a narrow band of water content over which it can be properly compacted."</p> <p><b>Recommendation 1)</b> ENR request that further rationale be provided for using fine grained in situ material for construction of the berm. ENR request confirmation as to why fine grained sands/silts will be used given the geotechnical concerns and erosion potential of this material. Note, liners and re-vegetation are likely not good combinations in the long-term.</p>	<p>successfully used on the water sedimentation ponds for the Fort Smith water treatment facility, constructed in 1992. The sand material in Fort Smith is similar and characterized as deposits of deltaic sand and glaciolacustrine sand (fine grained sand), silt and minor clay (Thurber Engineering Slope Stability Assessment Raw Water Pipeline Location, Fort Smith NWT, July 2006.</p>	
3	<p>Topic 3: Geotechnical Report Recommendations Consideration for Gas Venting Mechanism</p>	<p><b>Comment</b> The Geotechnical Investigation identified the presence of organic layers in Test Pit 3 at depth of about 3 m. To prevent possible gases migrating to the surface to be trapped under the impermeable liner and potentially lift the unballasted synthetic liner, a recommendation was made to</p>	<p><b>July 4:</b> 1. A venting mechanism to accommodate the release of possible gases migrating to the surface from the base of the lagoon will be accommodated with a venting system located at the top of the berm. The venting system is described as a 50-mm vent hole</p>	<p>Noted. The construction drawings and specifications for the new Sewage Disposal Facilities should reflect this information.</p>

		include a venting mechanism into the liner and lagoon design. <b>Recommendation</b> 1) ENR recommends that further information be provided on how venting mechanisms can be implemented and if and how they are part of the planned design for the lagoon.	located at the crest of the slope and capped with a geomembrane layer that is welded to the liner on three sides and open on the down side. The spacing of the vents will be approximately 15 metres (see detail 1 / C202 on design drawings).	
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**MVLWB: Heather Scott**

<b>ID</b>	<b>Topic</b>	<b>Reviewer Comment/Recommendation</b>	<b>Proponent Response</b>	<b>Board Staff Analysis</b>
1	Part D, item 12a: Design Criteria for the Proposed New Facility	<b>Comment</b> What Design criteria was used? The report does not explicitly state the criteria in a list or table. Nor does the decision matrix illustrate how each design meets or does not meet the specific design criteria. <b>Recommendation</b> What design criteria was used for the proposed system? How were the options rated against the criteria and how did this inform the final design decision?	<b>July 4:</b> 1. The design criteria for the sewage treatment system included effluent quality (anticipated process performance), capital cost, operation and maintenance cost, and simplicity of operation, aesthetic impact, constructability, and service life as presented in the Preliminary Engineering Report (See Table 7.3). A numerical rating system was not applied to the options, and the process selection was based the lagoon configuration with the best anticipated process performance (process performance exceeds the Wastewater System Effluent Regulations) in consideration of the lowest capital and operation and maintenance costs, and the other criteria presented in Table 7.3. Table 7.3 identifies a two-cell configuration as the process with the best anticipated process performance, as identified in the scientific data presented in Figure 7.3	Noted.

			(excerpt from Cold Regions Utility Monograph, 1996). The current edition of GEP (Good Engineering Practices for Northern Water and Sewer Systems) does not include any criteria for sewage lagoons, and the revised edition of GEP has not yet been published.	
2	Part D, item 12a: Design Criteria for the Proposed New Facility	<p><b>Comment</b> What was the design volume for the system? Table 6-3 predicts sewage generation until 2037 as 31,039 cubic metres per year. Is this the volume that the system was designed for? Were other inputs considered for the design volume? Precipitation? Was a flood design applied? Was freeboard considered? Was sludge accumulation factored into the design volume?</p> <p><b>Recommendation</b> Please indicate what the design volume for the system. Please indicate how that number was derived and what inputs were considered to determine the number.</p>	<p><b>July 4:</b> 1. The design volume for the secondary cell is 31,000 cubic metres base upon based upon a 20-year population estimate and a per capita generation rate of 155 litres per capital per day (see Section 6.3 of preliminary report). The per capital generation rate is based upon information in 2008 waste management planning study, Section 3.4. Hydraulic retention time in primary cell is approximately 20 days, which will decrease to approximately 18 days in 2037.</p>	Noted. The Hamlet should update the Report to include this detailed information on how the design volume was determined.
3	Part D, item 12b: Technical information for the proposed site, including drainage patterns.	<p><b>Comment</b> How will the lagoon system work? How will the primary cell be decanted to the secondary? How will the secondary cell be decanted?</p> <p><b>Recommendation</b> Please indicate the mechanisms for decanting/transferring between cells and discharging the lagoon.</p>	<p><b>July 4:</b> 1. The lagoon discharge will be either a pumped decant or piped gravity decant system with a continuous discharge into the supplementary wetland system from the secondary cell in the period from mid-summer to late fall. This discharge period is consistent with the optimum performance period for the supplementary wetland system.</p>	Noted. It is understood that the exact specifications of the lagoon discharge system are not yet finalized. The discharge from the secondary cell should not be continuous over the entire year; rather, sewage should be retained over

				the winter and spring, tested prior to decant for compliance approval, and then discharged to the wetland area.
4	Part D, item 12b: Technical information for the proposed site, including drainage patterns.	<p><b>Comment</b> Section 9.1 indicates that "flow from the lagoon to the wetland may be by gravity or pumping, as circumstances dictate".</p> <p><b>Recommendation</b> Please indicate what circumstances will dictate this design element, and which method of discharge will be used.</p>	<b>July 4:</b> 1. The discharge preference from the lagoon from the GNWT is a piped gravity decant system. The gravity discharge will be at a minimum slope of 0.5 %.	Noted. The Hamlet should include this information in the revised Report.
5	Part D, item 12b: Technical information for the proposed site, including drainage patterns.	<p><b>Comment</b> Figure 9-1 indicates that the discharge will be directed to the "Potential Wetland Area" then flow towards Nagle Bay. It is noted that a former channel of the Slave River Delta lies adjacent to the wetland.</p> <p><b>Recommendation</b> How can it be assumed that the flow will proceed entirely through the wetland to Nagle Bay and not be directed otherwise (i.e. to the former channel of Slave River Delta)? Please provide hydrologic/drainage information that supports these design assumptions. If this work has been done previously, please include a reference to the previous work.</p>	<b>July 4:</b> 1. The discharge pathway from the sewage lagoon discharge to the visibly defined discharge channel from the estimated 10 Hectare supplementary wetland area into Nagle Bay (shown on Figure 1 of the Wetland Report) flows through the wetland area. There is no direct channel from the lagoon discharge point to the discharge pathway from the wetland to Nagle Bay. The sensitivity analyses (See Section 5 of the Wetland Report) forecasts that a smaller wetland area of 5 Hectares, because of a point source discharge from the lagoon, will still produce a significant improvement in the effluent quality from the sewage lagoon. The 10 Hectare supplementary wetland treatment area (See Figure 1 of wetlands report) of is part of a larger 8300 square kilometre	Noted. In application for the water licence amendment required for the new Sewage Disposal Facilities, the Hamlet should clearly define, with rationale, the wetland area used for further treatment after sewage is discharged from the lagoon system.

			(830,000 Hectare) wetland complex in the Slave River delta, and is part of what is likely an evaporation-dominated lake in the older, relic delta (based upon satellite image review using Google Earth). Such lakes, located in the older non-active part of the delta, receive spring snowmelt and evaporation becomes the over-riding process controlling lake water balances during the remainder of the open water season. Evaporation-dominated lakes are physically removed from the influence of the Slave River (reference Sokal, M.A., Hall, R.I., Wolfe, B.B., 2008. Relationships between hydrological and limnological conditions in lakes of the Slave River Delta (NWT, Canada) and quantification of their roles on sedimentary diatom assemblages. J. Paleolimnol, vol. 39, pp. 533-550).	
6	Part D, item 12b: Technical information for the proposed site, including drainage patterns.	<p><b>Comment</b> Appendix C, Drawing C-204 illustrates the proposed berm details. Section 5 indicates that "a perimeter berm constructed of native sands should not be relied on for any amount of containment of wastewater". Section 8.3 indicates that "the in-situ materials around the lagoon site are generally suitable for the construction of lagoon berms".</p> <p><b>Recommendation</b> Please indicate what the fill materials (as per Drawing C-204) will consist of and how the native</p>	<p><b>July 4:</b> 1. The geotechnical investigation identified that the predominate soil texture at the test pit locations comprises sand, being fine-grained. These native soils are considered to be generally suitable for use for perimeter berm construction, and the containment of the wastewater within the lagoon will be achieved with a synthetic liner material. In order to address the long term stability of the berm, the</p>	Noted. The construction drawings, specifications, quality control testing conducted for the new Sewage Disposal Facilities should reflect this information.

		materials will be employed given that their use is referenced as being inappropriate in the construction of wastewater containment. How will the fill materials be specified in the final design?	side slopes will be 3:1. It is possible that the native soils may be sensitive in terms of compaction and optimum water content, and this will be addressed by the technical specification and construction quality control testing.	
7	Part D, item 12b: Technical information for the proposed site, including drainage patterns.	<b>Comment</b> Section 10.2 lists some cost-saving measures that may be applied to the design. <b>Recommendation</b> What will be the criteria for opting for the cost saving measures? Will the cost saving measures still follow best engineering practices for northern sewage treatment and construction of sewage treatment systems? Board Staff note that MACA, GNWT is currently updating the Good Engineering Practice for Northern Water and Sewer Systems.	<b>July 4:</b> 1. The cost saving measures are an optimization of the lagoon design to reduce the capital cost of the project, and will still apply the best engineering practices for northern sewage lagoon treatment and construction. It is noted that GEP is currently being updated, and the document will be reviewed if issued by MACA-GNWT prior to the completion of the detailed design.	Noted.  The Hamlet should include this rationale in the revised Report.
8	Part D, item 12b: Technical information for the proposed site, including drainage patterns.	<b>Comment</b> Board staff note that the preliminary design for access road/turnaround to the new lagoon system consists of a tight s-curve. <b>Recommendation</b> Why was this road design applied? Does this road design take best engineering practices for lagoon access roads and turnarounds into account?	<b>July 4:</b> 1. Access road configuration developed with a perpendicular access to the existing access road, and a 25 metre separation from the access to the solid waste area. The access road has a 7-wide driving surface with a maximum slope of 5 percent slope, and a circular turnaround with a 15 metre radius (30 metres width) to accommodate sewage trucks.	Noted.
9	Part D, item 12c: Efficacy of System	<b>Comment</b> Figure 7-5 illustrates the preferred option for the lagoon design and its anticipated performance. It is not clear what treatment criteria or previous data/research were used to inform the physical design of	<b>July 4:</b> 1. The overall configuration of the lagoon was dictated by geographic constraints of the adjacent solid waste management sites (to the east and west) and the groundwater sampling well (to the east).	Noted.  The Hamlet should include this rationale in the revised Report.

		<p>the lagoon system.</p> <p><b>Recommendation</b> Was the proposed design informed by geographical constraints alone? Were treatment or fluid dynamics considered in the configuration of the cells? Does it assume plug flow conditions? Please indicate the criteria and information that was used to design the physical design elements of the system (shape, size, configuration).</p>	<p>However, wastewater mechanic/fluid mechanics were used as part of the physical design the configuration of the primary lagoon in a rectangular configuration of 2:1 (length to width) was applied to provide a plug flow hydraulics.</p>	
10	None	<p><b>Comment</b> None</p> <p><b>Recommendation</b> Please indicate if wastewater treatment mechanics or fluid dynamics were used to inform the physical design of the system. Were performances of similar northern sewage treatment systems used to inform the design?</p>	<p><b>July 4:</b> 1. Wastewater mechanic/fluid mechanics were used as part of the physical design, in particular, the configuration of the primary lagoon in a rectangular configuration of 2:1 (length to width) was applied to provide a plug flow hydraulics. The physical design of the secondary cell was dictated by the available site geometry. References for the design included the Cold Regions Utility Monograph, and performance information on the City of Whitehorse multicell sewage lagoon ("Livingstone Trail Environmental Control Facility", NTWWA Journal, 2005)</p>	<p>Noted.</p> <p>The Hamlet should include this rationale in the revised Report.</p>
11	Part D, item 12c: Efficacy of System	<p><b>Comment</b> Section 7 references the Cold Regions Utility Monograph (Figure 7-2) regarding the treatment efficacy of lagoons systems.</p> <p><b>Recommendation</b> Please indicate if the "Anticipated Process Performance Parameters" listed on Figure 7-5 were derived from the Cold Regions Monograph alone.</p>	<p><b>July 4:</b> 1. Figure 7.5 is direct excerpt from the Cold Regions Utility Monograph, which is annotated to show the performance differences between 1 cell, 2 cell and multi cell lagoon system. The anticipated Process Performance Parameters were derived exclusively from this figure</p>	<p>Noted.</p> <p>The Hamlet should include this reference for Figure 7.5 in the revised Report.</p>

			Cold Regions Utility Monograph. A reference to CRUM is made in Section 7.2 of the preliminary report.	
12	Part D, item 12d: Decision Matrix	<p><b>Comment</b> Table 7-3 lists all design options and the parameters used to compare the options; however, as per Part D, item 12d, a decision matrix and criteria rating are not clearly indicated. It is simply stated in the paragraph following Table 7-3 that the "two-cell lagoon process configuration proposed on the Planning Study" is confirmed to be the most appropriate option" because of simpler construction and lower cost.</p> <p><b>Recommendation</b> Please indicate the criteria by which each option was evaluated, the weighting of the criteria and how the final design option was chosen based on that evaluation.</p>	<p><b>July 4:</b> 1. The design criteria for the sewage treatment system included effluent quality (anticipated process performance), capital cost, operation and maintenance cost, and simplicity of operation, aesthetic impact, constructability, and service life as presented in See Table 7.3 in the Preliminary Engineering Report). A numerical rating system was not applied to the options, and the process selection was based the lagoon configuration with the best anticipated process performance (process performance exceeds the Wastewater System Effluent Regulations) in consideration of the lowest capital and operation and maintenance costs, and the other criteria presented in Table 7.3. Table 7.3 identifies a two-cell configuration as the process with the best anticipated process performance, as identified in the scientific data presented in Figure 7.3 (excerpt from Cold Regions Utility Monograph, 1996).</p>	<p>Noted.</p> <p>The Hamlet should include this rationale in the revised Report.</p>