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Joe Murdoch
Nunavut Water Board
PO Box 119
Gjoa Haven, NU
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Re: HAMLET OF CAPE DORSET SEWAGE LAGOON AMENDMENT REVIEW

Dear Mr. Murdoch:

On May 15 2006, the Nunavut Water Board commissioned Associated Engineering to provide a technical review of the Cape Dorset Sewage Lagoon design as it pertains to the community's requested Water License Amendment. We reviewed design documents and information posted on the Nunavut file transfer website, including:

- P Lake Area Sewage Lagoon System, Final Design Report (Dillon Consulting Ltd, January 30, 2006)
- Comments on the above noted Dillon report (Environment Canada letter, May 1, 2006)
- Comments on the above noted Dillon report (INAC letter, May 2, 2006)
- License NWB3CAP0207 Hamlet of Cape Dorset (Nunavut Water Board, September 2002)
- Amendment 1 to License NWB3CAP0207 Hamlet of Cape Dorset (Nunavut Water Board, September 22, 2004)
- Construction Tender Documents for the Cape Dorset P-Lake Sewage Lagoon (Government of Nunavut, April 2006)

Our scope includes reviewing the above information to:

- Provide a technical review of the proposed sewage lagoon design
- Provide comments regarding the concerns identified in the Environment Canada and INAC letters

This letter summarizes Associated Engineering's findings, which the Board may find of interest in their deliberations or in the determination that a hearing should or should not be called:

1 SEWAGE LAGOON TEATMENT SYSTEM AND DESIGN

In general we concur that the treatment and disposal system proposed by the community is a significant improvement over the present situation. The proposed system will produce effluent of a quality considerably better than the current license requirements (120 mg/L for TSS and 180 mg/L for BOD). We do, however, have several observations and comments.

We understand the proposed process includes the following unit operations:

- 8.0 m top all-weather, gravel access road
- Sewage truck pad & turn-around
- Discharge flume
- Dyked annual retention/treatment (identified as primary) lagoon
- P Lake lagoon (identified as secondary)
- Wetlands area
- Drainage course to Telik Inlet

The following comments comprise our review of the Dillon Final Design Report:

- p. 2, Section 1.2 Background, last paragraph; while we agree that a lower maintenance lagoon system is fully appropriate for an arctic community such as Cape Dorset, it would have been useful if Dillon had summarized the noted previous studies that provide specific rationale as to why lagoons are preferred over mechanical treatment plants for the benefit of the Board and potential interveners.
- p. 13, Section 4.1.2.1 Water Quality, we are concerned that there is only one set of sampling data and question if the August time frame is representative of the proposed time of discharge ?
- p. 16, Section 4.2.2.1, Habitat, P Lake; is there any information that indicates that P Lake freezes to the bottom, ruling out, or confirming, the presence of fish ? We agree there is likely no fish there, however does DFO have any information in this regard ?
- p. 18, Section 51 Lagoon Configuration; there is no mention in the report of the effects of winter temperatures on the operation of the lagoon system – is the 0.5 m allowance for sludge enough depth to prevent the lagoon from freezing to the bottom once it is discharged to that elevation in the fall ? If not it will freeze to the bottom and result in sheet flow freezing solid as sewageis discharged from the truck down the discharge flume. In the spring then the entire lagoon will be frozen and the possible impact on the system's treatment processes and capability should be further examined.
- p.19, Section 5.2 Berm Construction; what is the size of the proposed rip rap protection on the inside slope ? We are concerned that the specified 95% SPD compaction (per the tendered construction specifications) of the berms will not be achieved using the weight and tracks of the machinery (per AMEC) – we would suggest bringing in proper compaction equipment. A bentonite liner may not be as effective as the synthetic liner (e.g. HDPE) AMEC recommends. Our interpretation of the AMEC report is that the concept of preventing leakage from this lagoon by relying on "freeze back" of the permafrost into the berms is tenuous, not proven and to use AMEC's words, "not technically feasible". Further AMEC indicates that they did not complete a seepage assessment under or through the cut-off curtain below the dyke. Certainly the use of a synthetic

liner from the top of the berms, along its sides and across the base of the lagoon is an option that is not fully examined given the concerns with the recommended vertical liner system on the dykes that seem to emerge from this discussion.

- All of this is a serious consideration for the proposed design of this system as the requirement for a full liner across the entire bottom and sides of the pond may be necessary to contain the treated effluent and achieve the desired level of treatment. At the very least it warrants further discussion by the Board and this subject would likely come up in a hearing.
- p.20, Section 5.3 Truck Pad & Turn-around; Yukon experience dictates that a 20m radius should be considered, for ease of turning and for snow removal/storage.
- p.21, Section 5.6.1 Berm; for future lagoon berm/dyke stability the proper compaction of these granular materials is crucial. There is no mention in the report of any predictable thawing/settlement of the underlying permafrost, which could de-stabilize the berms/dyke, or necessary mitigation thereof. Is the underlying soil taw-stable ?
- p.28, Section 6 Treatment Quality; how was the stated design criteria for BOD, TSS and Fecal Coliforms derived ? To what standards (or who's) are we trying to meet ?
- p.28/29, Section 6.1 Annual Lagoon Kinetics; While the kinetic formula utilized is a common text book formula, it would have been useful to see performance data from other similar systems across the NWT, Nunavut, Yukon or Alaska and provide some real-life back-up data for comparison . For example Old Crow, Yukon, had had a single celled lagoon with wetlands treatment and disposal in operation since the late 1980's. On page 29, the references for the assumed temperatures and treatment times are missing from the report text. These elements are fundamental and critical in the use of this formula, however treatment times of 70 to 90 days appear to be reasonable in this case. Are there any typical temperatures available from other NWT or Nunavut systems to verify the 7 dC temperature limit ?
- p.31, Section 6.3 Fecal Coliform Reduction; the reference for the influent fecal coliform figure is text book and it would be beneficial to confirm this with some typical similar data from other North of 60 communities. Table 6.4 relies on using Table 6.3 and this may be considered to be too generic an application – can this be verified with data from other northern community lagoon systems ? Again it is stated that the "design standard" of 10^{4} coming out of the constructed retention lagoon and then P Lake will be met but what is that standard based on ?
- other than the reference to the general information found in Table 6.3, there is no discussion on the necessary reduction in Suspended Solids in the report.
- p.32, Section 6.4 Wetland Sewage Treatment – Nutrient Removal; what are the regulated levels being referred to for nutrients, and which nutrients. While it is true that wetlands systems are quite efficient at renovating and polishing domestic sewage effluent, this report does not address specifics for this system, e.g. the retention times within the wetland, its size or capability to effectively treat the effluent and reduce levels of nitrogen (ammonia) and phosphorus. As this is the end of the treatment system or the 'end of pipe' compliance point if you will, this effluent must

be non-toxic to fish (as measured by an LC_{50} bioassay test) in order to comply with the federal Fisheries Act and there is no discussion in the report in this regard. While intuitively effluent that reaches the levels of secondary treatment set forth in the stated design criteria may very well be non-toxic, there are no specifics in the report regarding the expected degree of nutrient removal and toxicity to fish with respect to the proposed system.

- p.33, Section 6.6.2 Fort Liard; the performance of a two and three cell lagoon at a lower latitude may be better than the Cape Dorset system so the comparison may not be valid. Are there other systems across the north that can be more aptly used for comparison ?
- p.36, Section 7.1; Sampling Protocol; we agree that the proposed sampling locations are appropriate, however, individual effluent parameters should be identified (e.g. BOD, TSS, pH, Oil & Grease, Fecal Coliforms, Total Coliforms, toxicity to fish, Biosassy Concentration (LC_{50}), Toxic Organic Substances). We recommend that the Board consider establishing compliance points at certain locations within the license for certain parameters at specific locations.
- p.36, Section 7.1 Sampling Protocol; the suggested wetland study could become a license term and we agree it is required
- p.39, Section 9.2 DFO Approvals; refer to the above noted concerns regarding fish toxicity – did DFO ever respond to the Dillon September 2005 submission ? Refer to EC letter of May 1/06 addressing fisheries concerns as well.
- p.40, Section 9.3 Water License Application Requirements; we agree that all of the items listed in this section of the report should be followed up and possibly made license conditions for Board review and approval.
- p.40, Summary and Conclusions; we are concerned that we could not duplicate the volume of the proposed lagoon with the dimensions for useable liquid depth provided as being large enough to store the required 96,100 m^3.
- We note that the Dillon report did not include a Certification Page and therefore does not appear to be sealed by a Professional Engineer registered in the Territory.

2 ENVIRONMENT CANADA REVIEW LETTER – MAY 1, 2006

The following table provides a comment for each of the issues that the EC discusses.

Specific Comments	Associated Engineering's Review Comment
1. Hydrology – inclusion of diversion ditches around the lagoon and P Lake in the report and in the drawings or the tendered contract documents.	AE agrees with this comment.
2. Hydrology – confirmation of talik or fault	AE agrees with this comment. Further is the underlying soil subject to permafrost degradation and is it thaw stable ?
3. Baseline Water Quality – additional baseline data.	AE agrees with this comment.
4. Quarry Operations – buffer zone of 100m.	AE agrees with this comment.
5. Treatment Efficiency – define "short" detention" and "long detention" as it pertains to this system.	AE agrees with this comment.
6. Treatment Efficiency – estimated value for BOD in P Lake compared to the values from Table 6.3.	AE agrees with this comment.
7. Treatment Efficiency – discrepancy in retention times used to estimate BOD reductions	AE agrees with this comment.
8. Treatment Efficiency – proponent should provide further information and justification re: predicted levels of treatment for all of the requisite parameters of concern, for both short and long term.	AE agrees with this comment. Further the consultant or applicant should seek out other performance data on similar lagoon systems 'North of 60' for comparison to this proposed system.
9. Sampling Program – two year sampling program.	AE agrees with this comment, further AE recommends that the sampling program be expanded to include compliance points and as such a full and appropriate ***Monitoring Program*** be established as a license condition effective for the life of the license.

10. Sampling Program - presence of fish in the wetland.	Although the likelihood of fish being present in the wetland is remote, this has not been checked out, therefore AE agrees with this comment. Nonetheless the Consultant/Applicant should confirm that the predicted level of treatment produces an effluent from this system that is not toxic to fish.
11. General – deposit of deleterious substances to any water body (fresh water or ocean), toxicity to fish and the requirement of the Fisheries Act (Section 36 (3)).	AE agrees with this comment. The Consultant/Applicant should confirm that the predicted level of treatment produces an effluent from this system that is not toxic to fish.
12. General - Signage	AE agrees with this comment, further the Board could consider also requiring as a license condition that the site be fenced and gated – this is quite common for Yukon and Alaska lagoon and wetland sites.
13. General – Operations and Maintenance Plan.	AE agrees with this comment.
14. General – 3 Celled Lagoon as Back-up	AE agrees with this comment.
15. General – Closure, Abandonment and Restoration of the 3 Celled Lagoon	AE agrees with this comment - if the old facility is not going to be used the Applicant should be required to submit a closure, abandonment & restoration plan.
16. General – Section 35 of the Migratory Bird Act	AE agrees with this comment.
17. General – Paragraph 6 (a) of the Migratory Bird Act	AE disagrees with this comment, as it is not practical or cost effective to prohibit on-site construction from 15 May to 1 August. Further there is no indication that this site is utilized by any birds of any species as a nesting site.

3 INAC REVIEW LETTER – MAY 2, 2006

The following table provides a comment for each of the issues that INAC discusses.

Specific Comments	Associated Engineering's Review Comments
1. Assessment for alternative selection of sewage treatment design and system.	AE disagrees with this comment. It is our view that the proponent has justified its selection of a lagoon/wetlands system over mechanical systems. Further, we concur that a lagoon system for this type of small remote northern community is preferred over a mechanical sewage treatment plant, as is the case in many Nunavut, NWT, Yukon and Alaska examples.
2. Available geotechnical information/concerns regarding Dillon's interpretation of AMEC geotechnical-related statements and recommendations.	AE agrees with this comment.
3. The Proponent seriously consider/examine the use of an impermeable synthetic liner under the base (and along the lagoon sides and berms).	AE agrees with this comment. The proponent needs to do more to substantiate its proposed design in this regard.
4. Water diversion measures for surface water entering the lagoon area and P Lake.	AE agrees with this comment.
5. Quarry operation erosion protection and sedimentation control measures.	AE agrees with this comment.

4 CONSTRUCTION TENDER DOCUMENTS FOR THE CAPE DORSET P-LAKE SEWAGE LAGOON (GOVERNMENT OF NUNAVUT, APRIL 2006)

The following comments on the tender package are provided for consideration:

- We note that the tender package has been released by the Nunavut Government prior to the issuance of an approved amendment to the Cape Dorset license by the Board.
- Further the design is based on the Dillon Final Design report, which is still under review by the Board, regulatory agencies, potential interveners and the public.
- There is no indication in the 'Schedule of Values' (unit price table) or in the site work specifications that diversion ditches at the lagoon site or P Lake are included in the contract.

We trust that this is the information you need at this time. Please call should you require further assistance.

Yours truly,

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Project Manager
Associated Engineering (Alberta) Ltd.

JMG/ls