OS-4319-2000
Correspond.

DILLON
CONSULTING

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Attention; Joe Murdock
Technical Advisor

RE Cape Dorset Water Licence Application – P Lake Sewage Lagoon
Response to NWB Letter Dated June 21, 2006

Dear Mr. Murdock;

On behalf of the Community of Cape Dorset, this letter is in response to your comments on June 21, 2006. We have provided item by item responses to the concerns raised by the Nunavut water board and your technical advisors. We also provide the following general comments.

- The reports, drawings and specifications forwarded to you have been done so over a period of time. You will have on file more than one version of the reports and the drawings. There are several comments about whether the reviewers received the final version of the reports. We can not comment on what the reviewers were provided, we can only verify that we have forwarded the final versions to the Nunavut Water Board (NWB).
- We do not provide electronic copies of our Professional Seals. NAPEGG recommends against the use of the electronic Seal. As such, your file copies that we provided will have the seal on the drawings and specifications, the electronic copies will not.
- To remove any confusion, we can confirm that the Final report is the November 10, 2005 revision.
- The tender drawings and specifications complete with the Professional Seal, are enclosed. Please verify that these are the version reviewed by your technical advisors.

The responses follow the comments as listed in the NWB letter dated June 21, 2006.

GEOTECHNICAL REVIEW COMMENTS

General Comments
The documents submitted by Dillon to the NWB are deficient in the following major areas that prevent BGC from completing a full geotechnical review of the project:

i. The figures included in the design report were marked "Preliminary Only, Not for Construction".

As a standard tendering procedure, drawings issued during the bidding process are labelled as drawings issued for Tender. Construction drawings are issued after the tender period once the construction contract is awarded.

Dillon Consulting
Limited

Please clarify if the intervener was referring to the drawing issued for tender. If so it is the understanding of GN that it was provided to NWB as part of submission by Dillon Consulting.

ii. There was no discussion of the geotechnical design aspects of the sewage lagoon in the design report prepared by Dillon. Although Appendix G contained the Geotechnical Investigation report prepared by AMEC, the geothermal analysis was carried out for a different liner detail than the one shown in the Dillon drawings.

See comments by AMEC, page 4 section viii.

iii. The Tender documents did not include any of the construction drawings listed in the List of Tender Documents- Appendix A of the Construction Tender. On the basis of these deficiencies alone, BGC would recommend that the NWB reject the submission until a complete set of documentation is provided. The following sections provide specific comments with respect to the information that was available for review by BGC.

See comments related to the versions submitted by Dillon.

Design Report

i. On the title page there is an inconsistency with respect to the type of report. The report is "Final Design Report" in the title, but "Preliminary Design Report" remains in the subsequent sub-title.

The report describes the preliminary design process. This report is not a detailed design report. Another word for preliminary design is Conceptual design.

ii. The enclosed covering letter makes it clear that, this is, in fact the final report, including all comments received from C&GS, as well as the geotechnical assessment (was not included with filed copy). The intent of the report is to develop the Class "C" cost estimate for the construction phase.

No comment required.

iii. In Section 1.1, first paragraph, it is stated that "This document outlines the preliminary design plans for a new sewage lagoon treatment system…".

See comment under i.

iv. There should be some reference in the design report to tie this document to the construction specifications and construction drawings.

The design concept report was completed to set out the parameters for the detailed design. The concept design report pre-dates the detailed design drawings.

v. The climate data in the third paragraph of Section 1.1 needs to be qualified. What is the source (i.e. Canada Climate Normals from Year _ to Year _), are the temperatures mean monthly or daily max./min. ?

The climate data is received from the NBC, 1996 edition. No dates are provided with this data. Environment Canada's data is attached for reference. (Appendix 4)

vi. In the last paragraph of Section 1.1, the required service life of 20 years + is given. Environment Canada has expressed concerns with the existing system. Subsequently in Section 1.2, first paragraph, it was noted that there was a structural failure with the existing three-cell lagoon. It would be useful for Dillon to provide some information on both the nature of the structural failure and the Environment Canada concerns, so that these can be assessed with respect to the proposed sewage treatment system. If structural failure occurred within a similar design to that proposed, previous lessons should be of critical importance.

Environment Canada's Letter is attached for reference. Also included are the responses from the GN to this issue.

vii. In Section 3.3 there are some minor inconsistencies noted in the maximum depth of P Lake. In the first paragraph, the maximum depth is 2.5 m. In the second paragraph, it is 2.75 m. Drawing C shows bathymetric contours down to 2.8 m.

These inconsistencies are related to the information received. It can be assumed that the lake has some fluctuations in water level, and therefore the associated depth. Dillon believes these inconsistencies have no relevance to the design.

viii. Section 3.6.1 Ground Water Movement in Permafrost, does not mention taliks as another mechanism of ground water flow in permafrost. The Geotechnical Investigation report (Appendix G) did not check for the presence of a talik by means of a thermistor in the vicinity of P Lake.

Re taliks – see AMEC response letter part i

ix. In Table 4.4, it should be noted that the pH value of 10.1 is believed to be in error and should be re-measured.

Re the pH – it is the intent to re-measure this value this open water season.

x. There should be a geotechnical design section in the report prior to Section 5- Lagoon Construction to cover off the geotechnical design of the major lagoon components, such as:
a. Selection of berm alignment and location.
b. Selection of embankment materials and type of structure.
c. Foundation conditions- soil and bedrock, surficial geology plan. Longitundinal and cross sections through upstream and downstream berms.
d. Assessment of depth and extent of frost-affected bedrock (FAB) unit.
e. Ground ice conditions.
f. Ground temperatures and taliks.
g. Permeability of active zone soils, especially in the abutment and foundation areas of the upstream and downstream berms.
h. Design of seepage cutoff and justification for selected liner option and configuration and decision for not using a lagoon liner.
i. Foundation preparation requirements.
j. Slope stability assessment and justification of upstream and downstream slopes.
k. Riprap design based on hydraulic design criteria.

l. Geothermal analysis for selected central GCL cutoff option.
It should be noted that the AMEC geotechnical investigations were insufficient to provide this information, as discussed in Section 4.2.1 (**AMEC Geotechnical Report (Appendix G) see below**).

The information is contained in the appendix. The intent of the report is to set out the conceptual design. While bringing this information forward would make the text more complete, it would also make the document more complex. The audience for the report ranges from technical staff to the public and political level. The report is developed to enable the wide range of audience be engaged by the report. Dillon does not believe that the omission of this information in the main report text changes the design, and is therefore not required as part of the permitting exercise.

xi. There should be a section in the report to describe the hydrological and hydraulic design of the major lagoon components, such as:
a. Site hydrology.
b. Determination of design flood.
c. Design flood routing.
d. Design of spillway and discharge facilities.
e. Establishing operating water levels and freeboard requirements (validating the 1 m freeboard value used in setting the height of the berm).

This information is included in appendix F of the report.

xii. In Section 5.2, Berm Construction, the height of the berm does not mention any allowance for flood handling. For this facility, the design event would likely be based on an extreme precipitation event generating rainfall that falls directly into the lagoon as the surrounding berms have effectively diverted surface water runoff from entering the lagoon.

The lagoon is operated with a minimum of a 0.5 meter free board. As the reviewer points out the flood event would be related to the precipitation falling on the lagoon, as run off is handled by the deflection berms. The extreme rain event (data from environment Canada attached) is 41.2 mm.

xiii. Slope stability analysis should be carried out to demonstrate the stability of the slopes under all operating conditions, especially rapid drawdown on the upstream slope due to annual pumping of the lagoon. Due to the lack of site investigations, there is no information on the potential ground ice content of the foundation soils, which could lead to excessive settlement or foundation instability when the lagoon is impounded on the upstream toe of the slope.

See Comments by AMEC, page 4, section vi.

xiv. The spillway is an overflow weir located on the crest of the downstream berm, at the maximum berm section. This arrangement is not recommended due to the potential for uncontrolled erosion of the berm and loss of lagoon containment. An alternative spillway arrangement is recommended, preferably in the abutments, through or on rock. As noted above, spillway design criteria need to be presented and discussed.

The spill way shown is a standard detail for sewage lagoons in both the NWT and Nunavut. The installation of a spillway in the rock would be more costly.

xv. The impermeable liner proposed by Dillon will be placed vertically on the inside of the berm. The geothermal analysis done by AMEC was for a liner on the upstream face of the berm. This option showed that the foundation cutoff trench would remain frozen for the life of the structure. With the vertical liner, this may not be the case. The warm lagoon water would saturate the upstream half of the berm and may result in thawed conditions around the cutoff trench. This may lead to seepage around the liner.

See AMEC's response page 4, section vii.

xvi. From BGC's experience, the installation of a vertical liner, as proposed by Dillon, is impractical and without precedent in northern Canada.

The contractor has indicted that the installation of the liner as shown is practical.

xvii. Since there is no design assessment presented that shows that the base of the lagoon is impervious, the proposed liner arrangement cannot be justified. Dillon incorrectly interprets AMEC's conclusions. The AMEC report (Section 8.4), last bullet "...AMEC has not assessed whether the proposed 2 m deep cut-off system under the dyke is sufficient, although thermal modelling suggests that the subgrade will remain frozen." AMEC is referring to the subgrade under the dam, in the vicinity of the cutoff trench, not the lagoon floor. The geothermal analyses clearly show that the lagoon floor will become thawed to a depth of over 6 m after thirty years of operation. The consequences of this will depend on the existing thermal regime, which has not been determined by actual measurements. Therefore, the validity of the geothermal analyses may also be called into question, since they are based on assumed site parameters, as no thermistors have yet been installed on site.

See AMEC's response, page 1 section i.

xviii. Section 5.5 describes the lagoon discharge structure. The proposed structure is a pipe through the berm at the maximum head section. The design report states that this will be a steel pipe, however the drawings (Drawing 111, Detail 6) shows a 300 mm HDPE pipe. There are several concerns with this arrangement:
a. Constructing a pipe or any conduit through an embankment dam is considered to be poor practice from a dam safety and stability perspective due to the potential for concentrated seepage flow, deformation or cracking of the pipe and inability to inspect its condition.
b. The pipe is composed of HDPE, which would be even less capable of withstanding imposed loads than the steel pipe mentioned in the design report.
c. There is no information on ground ice content in the foundation soils, which may lead to differential settlement if thawing occurs. This has not been taken into account in the design of the pipe.
d. The pipe may freeze up due to the cold ground temperatures at the dam toe.

xix. Dillon should provide some information concerning the performance of the gravity discharge system used at other Nunavut locations, with respect to the above concerns.

Examples of other locations where this system is used include Iqaluit, Pond Inlet, and Deline. The use of a pump for discharge is also common. A pump will be supplied to the community in the event that the discharge system becomes inoperable.

xx. In Section 5.6, the design report indicates that natural materials will be used to construct the lagoon berms. No discussion is presented on how these natural, permafrost affected materials will be excavated and processed for use in the berm.

It is not the intent to provide a methods specification to the contractor.

xxi. No details are provided as to the construction of the lagoon berms in terms of:
a. Foundation preparation measures.
b. Cut-off trench depth and excavation.
c. Liner installation procedures in conjunction with fill placement.

This is detailed in the design drawings. See attached.

xxii. The upstream berm is located on topographic saddle. The lagoon containment limit is at elevation 122.5 m, resulting in a head of about 4.5 m through the berm to the downstream side. There is no liner shown on the drawings for this section of the lagoon, even though this structure has to retain almost as much head as the downstream berm.

The drawings attached shown the liner. See detail 1 drawing 111.

xxiii. The cutoff trench detail assumes there is 2 m of overburden. There is no detail for the liner if bedrock is encountered in the foundation, or the details for the liner configuration at the abutment ends of the structure.

If rock is encountered the contractor will excavate the rock trench similar. Blasting is expected on this project.

xxiv. Since the drawings included in the Design Report are not issued for construction, there are no further comments at this time.

AMEC Geotechnical Report (Appendix G)

See attached letter from AMEC.for responses to this part of the letter.

Tender and Construction Specifications

General
The construction tender was issued by the Department of Community and Government Services, Government of Nunavut. Various dates appear on the document, that require some explanation and updating:
- On the cover of the Construction Tender, "Revised: April 2000"
- On the addendum footer, "January 19, 2004".
- Within the addendum, the text refers to changes taking effect "April 1, 2004".
- Table of Contents, "August 2003".
- Instructions to Tenderers footer, "August 2003"
- Tender form footer, "April 2000".
- List of Tender Documents- Appendix A- footer "April 2000".
- NNI Policy Forms footer- Appendix B, "March 2001".

• Appendix B-1 General Contractors and Sub-Contractors Dollar Amount footer- "April 2000".
• Schedule of Values- Appendix C footer, "February 2006".
• List of Unit Prices- Appendix D footer, "April 2000".
• Transportation of Materials- Appendix H footer, "August 2003".
• Contractor's Certificate of Insurance- Appendix I footer, "April 2000"
• NNI Policy- Appendix J, dated "March 17, 2000".
• Contractor's Obligation to Provide Inuit Content- Appendix K footer, "March 2, 2001".
• Construction Contract cover page, "Revised: April 2000".
• Articles of Agreement footer, "August 2003".
• Terms of Payment footer, "March, 2003".
• General Conditions Table of Contents, page 1 is dated "August, 2003" and page 2 is dated "February 2000".
• General Conditions footer, August, 2003".
• Special Provisions footer, "February 2006".
• Specifications are generally dated "November 2005".

Rather than using a footer date to identify a particular revision of the contract document or form, it is preferred that the contract documents all be consistently dated with the same date to identify that they are all part of the same tender package. This would indicate that some effort was made by the tendering authority, to ensure that all the contractual components are internally consistent and up to date.

Footer dates indicate the last revision of the particular Form/Appendix. As policy of GN alters, the corresponding template is reviewed and updated by GN as deemed necessary and these different dates are used to indicate the last update/revision date. These are hence the standard contract documents GN has been using successfully so far without much of an issue or complaint from the bidders. Nevertheless, this template in its entirety is being reviewed by the Department of Justice – Legal Division. Once the legal review is complete, a single footer date can be used to indicate the date of the full document.

General Conditions and Specifications

These need to be read in conjunction with the construction drawings. Since no construction drawings were filed, BGC can only comment on the adequacy of the specifications. In general, the specifications appear to be generic in nature and have not been specifically written for this project. As a result, the specifications contain some irrelevant provisions that don't pertain to this project and leave out some important provisions that are required for execution of this work.

i. GC34 Changes in Soil Conditions and Neglect or Delay by Owner:

Since no sub-surface investigations were carried out, there is a good chance that the soil conditions assumed by Dillon will differ from the actual conditions. The contractor will likely claim additional expense related to type of material encountered, presence or absence of ground ice, depth to rock, volume of rock excavation required and volume of excavation required.

This is a standard GC issued by the GN, see above.

ii. Section 01110 Summary of Work:

a. The items listed do not include all the work that is required, such as mobilization and demobilization, provision of temporary utilities and construction facilities, site surveys and

layout, borrow area permitting and development, disposal of soil and rock waste materials, commissioning, training and preparation of an operation and maintenance manual.

This section is not intended to be an exhaustive list of all activities. The drawings and specification cover the required works.

b. The contract method is a single fixed price contract. There is insufficient information provided in these documents to allow a contractor to prepare a fixed price contract that will cover all the potential unknowns associated with the work.

The tender drawings provide sufficient detail for the contractors to bid the work.

iii. Section 01410 Regulatory Requirements:
The references and codes listed that the contractor should meet or exceed should already be incorporated into the design and contract specifications. It is up to the Engineer (GN) to ensure that the work is carried out according to the design and specifications. It is the Engineer's responsibility to ensure that the design and specifications are in accordance with the National Building Code and other standards listed, not the Contractor's.

This Section, as with all the sections, are from the National Masters Specification system. The wording has been developed by the Federal Government, consultants, manufacturers and designers. These documents are used extensively throughout the design and construction industry.

iv. Section 01450 Quality Control:
a. Under a fixed price lump sum contract, the Engineer has no opportunity to direct the Contractor to achieve the desired end product while the work is in progress.
b. There is insufficient information provided in this section regarding the basis upon which the Engineer will reject defective work. These details are also not adequately covered in the individual specifications.

See comment under iii above.

v. Section 01561 Environmental Protection:
a. There is nothing covering stockpiling and disposal of waste soil and rock.
b. There should be a separate specification to cover drainage and dewatering works associated with construction of the lagoon.

Section 01561.1.2.3 covers disposal of waste
Section 01561.1.3 covers drainage.

vi. Section 01-31 Operations and Maintenance Manual:
a. It appears that this specification is generic in nature and not specifically written for this project. It seems to be written for a mechanical type sewage treatment plant, rather than for the lagoon design being proposed. The areas that need to be covered include pond operating levels, procedures for flood handling and routing, what to do in case of overtopping, pond drainage procedures (i.e. rates to prevent instability of slopes), inspection of berm slopes, dealing with seepage through the berm, etc.
b. In order to drain the lagoon during an emergency, someone has to drive up the road,

cross the berm, access the manhole and manually open the valve. An Emergency Preparedness Manual is also required to address contingency requirements associated with operating this facility at this location.

The O&M Manual specification has been developed over the past 3 decades by the GNWT and GN. It has been found to be acceptable. The specification is common to all GN facilities. The commonality allows operators and owners to manage the portfolio of facilities in a common manner.

vii. Section 02072 Geotextiles:
a. In the Special Provisions section of the contract, the Contractor is informed of the surplus Bentomat ® panels that are available at the C&GS warehouse in Iqaluit. Presumably these panels meet the requirements of this specification. If so, then C&GS should provide the material warranty because they are no longer directly supplied from the manufacturer. For instance, the panels should have been protected from hydration and damage.
b. If the Contractor elects to use these panels, he should only be responsible for the installation guarantee regarding defects and workmanship, which are under his direct control.
c. Part 3 Execution is a generic specification only. It does not provide details for installation of the vertical liner in the cut-off trench or within the body of the dyke. There are no details regarding abutment treatment or difference in installation in (or on) rock versus soil in the cut-off trench.

The use of the GN supplied geotextile was removed from the contract.

viii. Section 02315 Excavating, Trenching and Backfilling:
a. No information has been provided in the contract regarding the volumes of rock, common and waste materials to be excavated. Since the contract is fixed price/lump sum, the need to define the various classes of excavation is not necessary, as the contractor will have to carry out all excavation at the same price.
b. There is nothing in the specifications that prevents the Contractor from mixing all classes of excavation together and hauling to the designated disposal area.
c. The specification does not provide details on the number of samples, the materials to be sampled or the sampling protocol. Section 01330- Submittal Procedures covers shop drawings only.
d. Although no construction drawings were filed, it is important to note that the lines, grades and elevations shown on the drawings were based on assumed conditions, without the benefit of subsurface exploration. Since the Engineer will be required to establish the final lines and grades based on actual conditions exposed in the field, the Contractor can claim additional costs.
e. The specifications do not state what the quality of the dyke foundation has to be. Provisions should include the need to remove organics, compressible materials, ice lenses, boulders etc. Since frozen ground (permafrost) may be encountered, the provisions in 3.5.2, backfilling not on frozen ground, does not seem relevant.

The site will be inspected during construction. Unsuitable material, as described by BGC will be removed prior to the start of the berm construction. The owner understands that should unexpected conditions occur, additional costs maybe incurred. See also Section 02701 for quality control.

ix. Section 02316 Rock Removal:
This specification does not adequately address the need for removal of frost affected bedrock under the footprint of the berms and dykes. Excavating only to the lines and grades shown on the drawings may result in frost affected bedrock being left under the water retaining structures. Since no subsurface investigations were carried out, the depth of the frost affected bedrock has not been determined for this site. In some areas, it may be in excess of 5 m thick. This contingency has not been addressed by these specifications.

The site will be inspected during construction. Unsuitable material, as described by BGC will be removed prior to the start of the berm construction. The owner understands that should unexpected conditions occur, additional costs maybe incurred

x. Section 02317 Roadway Excavation Embankment and Compaction:
a. The classes of excavation are not consistent with those used in the Excavating, trenching and Backfilling specification (02315).
b. Not sure what the difference is between Common and Unclassified excavation according to the definitions given in the specification.

The road construction methods are common to road development in Nunavut.

xi. Section 02371 Rip-rap:
The specification has not included any durability testing to assess the quality of the rip-rap. Laboratory testing of the proposed rip-rap materials should be carried out, including freeze-thaw, absorption and slake durability.

Agreed – sampling will be completed at the contractor's quarry.

xii. Section 02661 Sewage Storage Lagoons:
a. This is the only specification that covers the construction of the dykes. No detail is given regarding the concurrent construction of the vertical liner and fill placement that is required to execute the proposed design.
b. The dam construction materials specifications are not described.
c. Section 3.5 seems to imply that the impervious liner will be placed on the bottom and sides of the lagoon. This is not what was presented in the Dillon design report.

This is not a methods specification. The GN does not complete construction projects using a methods specification.

Comments from the Review of Mr. John Grainger (AE) provided to the NWB SEWAGE LAGOON TEATMENT SYSTEM AND DESIGN

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

Further information is being submitted by the GN on the selection process.

ii. 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?

Further sampling will be completed this open water season.

iii 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?

DFO was consulted a number of times. They can not confirm that the lake freezes to the bottom.

iv. 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 sewage is 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.

The "Guidelines for Planning, Design, Operation and Maintenance of Waste Water Lagoon Systems, Heinke, Smith, Finch, 1988 recommends a sludge accumulation of 0.35 liters per person per day. In the first year of operation this will result is approximately 160 m3 of sludge generation. This would result in a accumulation of approximately 5 mm over the base of the lagoon.

The guideline also recommends that the discharge structure is to be 0.5 above the base of the lagoon.

v. 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.

The design shows a rip rap layer of 300 mm. This will be increased to 500 mm as per the recommendation of AMEC. See also AMEC's responses related to the liner.

vi. 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.

See comments by AMEC, page 4 section v.

vii. 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.

15 meters is standard in both the NWT and Nunavut.

viii. 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?

See AMEC's Comments on the stability of the base, page 4, section v.

ix. 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?

The criteria were selected to represent the expected requirements of the proposal Municipal Waste Water Effluent (MWWE) Criteria being set out by Environment Canada.

x. 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?

Dillon has under taken a fairly extensive review of available Data as part of the development of the MWWE criteria. There is little data available for communities north of the tree line. The use of NWT and Yukon communities provides some insight. The information presented is the best available data.

xi. 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?

The Standard used was the pending MWWE. However it is likely that Fecal Coliform will be regulated on a risk assessment basis, and may not apply in Nunavut. These guidelines are expected to be published this fall.

xii. 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.

TSS discharge is expected to be 80 to 120 ppm. .

xiii. 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 LC50 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.

Nutrients are not expected to be regulated at this site based on the expected MWWE guidelines.. The information presented does not affect the design criteria.

xiv. 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?

See comments above, section x.

xv. 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 (LC50), Toxic Organic Substances). We recommend that the Board consider establishing compliance points at certain locations within the license for certain parameters at specific locations.

No comment required

xvi. p.36, Section 7.1 Sampling Protocol; the suggested wetland study could become a license term and we agree it is required

No comment required.

xvii. 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.

Environment Canada provided a letter of intervention. Nothing was received from DFO.

xviii. 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.

No comment is required.

xix. 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 m3.

The detailed design drawings should be used for this calculation. Dillon completed all volume calculations using 3-D modeling earthworks software.

xx. 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.

See general comment on page 1.

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:
i. 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.

No comment required.

ii. 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.

No comment required.

iii. 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.

This is a fixed price contract the completion of the works, including the installation of all ditching and deflection berms is included in the fixed price..

GN-CGS is to consult the Hamlet to obtain detailed records of the public consultation that was conducted with respect to this project. GN-CGS is to then provide a report to the NWB outlining the particulars of all public consultation carried through under this application.

Public Consultation:

GN-CGS was in touch with the Hamlet of Cape Dorset to obtain information in respect of public consultation carried out and discussion within the Hamlet council that lead to selection of P Lake as the preferred option of sewage treatment in the community. NWB is advised of the followings:

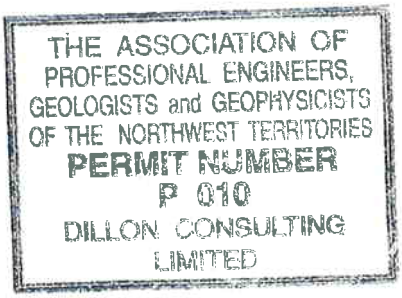
- *A public Meeting was held on November 17, 2003 to discuss the sewage treatment options that are available in the community. Pros and cons of sewage lagoon vis-à-vis mechanical treatment options were discussed and a vote was held. Twenty six people were in favour of P lake sewage Lagoon while there was no vote in favour of mechanical treatment option. Minute of this public meeting documented by the Hamlet is enclosed*
  (Refer Appendix I-A)
- *Motion was passed by the council on November 18, 2003 to proceed with option of Sewage Lagoon at P Lake. Seven votes were in favour and none against. Please refer to motion paper attached –Appendix I-B.*
- *Final design on the P Lake Sewage lagoon project was presented to the council of Hamlet of Cape Dorset on Feb 7, 2006. Details on the project were presented and discussed. The Hamlet council expressed its satisfaction with the project in general. Please refer to a letter from the Hamlet of Cape Dorset as Appendix I -C.*

It is obvious that the Hamlet of Cape Dorset and the community have identified P Lake Sewage as its preferred option for sewage treatment. This is exemplified by unanimous decision during the public consultation and the council meeting.

We trust that this additional information provides the Board with eh confidence to issue a water licence to the community for this project.

Sincerely

Dillon Consulting Limited



Gary Strong, P. Eng.

Project Manager

Encl.
Appendix 1 – Letters from Community
Appendix 2 – Inspector's Direction and GN response
Appendix 3 – AMEC Letter Response
Appendix 4 – Environment Canada Data
Tender Drawings and Specifications

C Anjan Joshi, GN Pond Inlet (excluding tender drawings and specifications)
Bhabesh Roy, GN Pond Inlet (excluding tender drawings and specifications)
Art Stewart, SAO Hamlet of Cape Dorset. (excluding tender drawings and specifications)

Appendix 1

Appendix 1-A

Municipality of Cape Dorset
P.O. Box 30
ᕼᓚᒻᓚᑦ ᑭᙵᓂ
Cape Dorset, N.T. X0A 0C0
Tel: (867) 897-8943
Fax: (867) 897-8030
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MUNICIPALITY OF CAPE DORSET

November 18, 2003

Municipality of Cape Dorset Council

Re: Sewage Treatment Options for Cape Dorset

A Public Meeting was held on November 17,2003 to discuss the sewage treatment options that are available to the Hamlet of Cape Dorset. Representatives from the Department of Community Government & Transportation presented information, which outlined the advantages and disadvantages of each option.

One of the options was to build a mechanical sewage treatment facility This option provided good treatment, however, there is a large yearly maintenance cost of $260,000. In order to afford this facility, the water rates would have to increase by roughly $80 per month per household.

The second option is to build a sewage lagoon on the southwest part of the island near Kingait Mountain called P Lake. This project would require a large capital cost but it would only cost about $37,000 per year to operate. The lagoon would provide very good sewage treatment and would not be visible from the community.

After the presentations and a question period a vote was held to determine which was the preferable option. A show of hands indicated that 26 people favored the P Lake option and no one favored the mechanical facility.

A motion is now required by Council in order to proceed with the P Lake option.

Appendix 1-B

Hamlet Office
Cape Dorset, NU X0A 0C0
(867) 897-8943

MUNICIPALITY OF CAPE DORSET

MOTION PAPER

MOTION NUMBER: 149/03-04

DATE: NOV. 18/03

MOVED BY: [illegible]

SECONDED BY: [signature]

THAT:

MOTION TO APPROVE THE BUILDING OF A SEWAGE LAGOON AT A SITE CALLED P LAKE. THIS WAS THE OPTION THAT WAS SELECTED AT THE PUBLIC MEETING WHICH WAS HELD ON NOVEMBER 17, 2003.

VOTES: FOR 7

AGAINST 0

ABSTENTIONS 0

MAYOR OF THE HAMLET COUNCIL

SENIOR ADMINISTRATIVE OFFICER

Appendix 1-C

Municipality of Cape Dorset
P.O. Box 30.
Cape Dorset, N.W.T. X0A 0C0
Tel: (819) 897-8943
Fax: (819) 897-8030

February 8, 2006

Community Government & Services
P.O. Box 379
Pond Inlet, Nunavut X0A 0S0

Attention: Bhabesh Roy – Municipal Engineer

Re: Presentation of Final Design Report Cape Dorset Sewage Treatment System

At meeting #19/05-06, Gary Strong, Project Manager for Dillon Consulting, made a presentation on the final design report for the Cape Dorset Sewage Treatment System to the Hamlet Council. Bhabesh Roy and Todd Parsons accompanied Gary from the Department of Community Government & Services.

The presentation consisted of reviewing the data that was outlined in the hard copy of the final design report, copies of which were left with the SAO for further review if required. Gary presented a map of the area along with drawings of the road and sewage lagoon site. There were several questions asked regarding the safety of the road, the possible contamination of the streams running from the area into town, the possible contamination of T Lake, the danger of blasting for road construction, the problems associated with snow drifting and clearing on the proposed road and the decanting process.

It was noted to the benefit of the new Councillors that this Sewage Treatment option was previously discussed at a Public Meeting held on November 17,2003 and subsequently approved by Council on November 18,2003

Council indicated that they were satisfied with the answers that were given and are looking forward to construction beginning early in the 2006 construction season.

Sincerely,

Art Stewart,
Senior Administrative Officer

Cc: Hamlet Council

Appendix 2

INSPECTOR'S DIRECTION

Environment Canada
Environmental Protection Branch
Prairie and Northern Region
Iqaluit District Office
P.O. Box 1870
Iqaluit, Nunavut.
X0A 0H0

PROTECTED

13 May 2004

File No. 4408-2004-03-12-005

Acknowledged with receipt.

The purpose of this Inspector's Direction is to inform:

1) The Hamlet of Cape Dorset, Nunavut
   c/o Art Stewart
   Senior Administrative Officer
   Hamlet of Cape Dorset, Nunavut
   P.O. Box 30
   Cape Dorset, Nunavut
   X0A 0C0

2) The Nunavut Territorial Government
   c/o Mr. Tom Rich
   Deputy Minister
   Department of Community Government and Services
   Iqaluit, Nunavut

This letter constitutes an Inspector's Direction to the Hamlet of Cape Dorset, Nunavut and to the Nunavut Territorial Government, under section 38(6) of the Fisheries Act, R.S.C. 1985, c. F-14, as amended and relates to the serious and imminent danger of the deposit of raw sewage into the water frequented by fish, to wit; Tellik Inlet, contrary to subsection 36(3) of the Fisheries Act, R.S.C. 1985, c.F-14, as amended.

REASONABLE GROUNDS FOR BELIEF

I, Sid Bruinsma, an Inspector designated by the Minister of Fisheries and Oceans pursuant to subsection 38(1) of the *Fisheries Act*, R. S. C. 1985, c. F-14, as amended, have reasonable grounds to believe:

1) That on 05 March 2004 at 1330 hours Environment Canada was made aware of a capacity problem at the Cape Dorset sewage lagoons and that the community's Senior Administrative Officer, Art Stewart, reported that the community had to place raw sewage into the old lagoon system to prevent a collapse of the new sewage lagoon system.

2) That on 22 April 2004 at 1330 hours Environment Canada representatives met with representatives of the Territorial Government of Nunavut's Community Government and Services Department. The Department was advised that an inspection would be conducted at Cape Dorset based on the information provided by the Department. The Department of Community Government and Services outlined the problems at the site and provided information of future developments to address capacity and design issued at the Cape Dorset community sewage lagoons.

3) That during an inspection on 05 May 2004, representatives of the Hamlet of Cape Dorset, the Nunavut Territorial Government of Nunavut and I observed the conditions of the two sewage lagoons systems in Cape Dorset. The first system observed was the old lagoon it was in use and it appeared to be exfiltrating under the berm and under the roadway adjacent to the lagoon and heading down a high pitch gradient apparently depositing raw sewage into Tellik Inlet.

4) That during the inspection on 05 May 2004 I observed the use of the second lagoon system had been discontinued. In this three celled lagoon, cells #1 and #2 had reached capacity and in cell #2 the effluent had reached the top of the berm and had overflowed causing erosion and potentially compromising the berms integrity.

5) That during the inspection on 05 May 2004 I observed the location of the new lagoon system and that it had reached capacity and posed an imminent threat due to the condition of the berm and that the impending freshet would add runoff water to the cell and overflow the cell walls resulting in deterioration and possible failure of the berm.

6) That the Hamlet of Cape Dorset and the Nunavut Territorial Government owns the deleterious substance or has the charge, management or control thereof, or has caused or contributed to the causation of a deposit of the deleterious substance or danger thereof.

7) That I am aware the Hamlet of Cape Dorset is responsible for the maintenance and repair of the sewage lagoon in the Hamlet of Cape Dorset, Nunavut and therefore responsible for the structural integrity of the berm surrounding the sewage lagoon.

8) That I am aware that Tellik Inlet is a body of water frequented by fish because of information received by me from communications with Tania Gordanier, Habitat Management Biologist from the Department of Fisheries and Oceans.

9) I am aware from personal knowledge that human sewage is a deleterious substance.

10) That, to the best of my knowledge, reasonable measures consistent with safety and with the conservation of fish and fish habitat to prevent any occurrence or to counteract, mitigate or remedy any adverse effects that result or may reasonably be expected to result therefrom have not been taken by the Territorial Government of Nunavut and the Hamlet of Cape Dorset and that the parties continue to deposit raw sewage and that a serious and imminent danger exists that a deleterious substance may be discharged from the property via surface water runoff from rain or melted snow and that the deleterious substance may enter water frequented by fish or may be deposited in a place where it may enter such water.

MEASURES TO BE TAKEN BY THE TERRITORIAL GOVERNMENT OF NUNAVUT AND THE HAMLET OF CAPE DORSET, NUNAVUT.

Under the authority given to me pursuant to subsection 38(6) of the *Fisheries Act*, I do hereby direct the Territorial Government of Nunavut and the Hamlet of Cape Dorset, Nunavut to take or cause to be taken, immediately, all reasonable measures consistent with the safety and the conservation of fish and fish habitat to prevent the deposit of the aforementioned deleterious substance, that is, raw sewage in water frequented by fish, that is, Tellik Inlet, and to counteract, mitigate or remedy any adverse effects that result or may be expected to result there from, including:

Taking action to prohibit or minimize surface water runoff from entering the sewage lagoon systems containing raw sewage, and

Advising Environment Canada in writing with an interim report by June 1, 2004 and a final report August 1, 2004 of the measures that have been taken to comply with this Direction and with subsection 36(3) of the *Fisheries Act* to prevent the deposit of the aforementioned deleterious substance, that is, raw sewage in water frequented by fish, to wit, Tellik Inlet, and

Monitor the sewage lagoons until such a time that the risk of depositing the deleterious substance in waters frequented by fish, that is, Tellik Inlet, is eliminated.

THE LAW

Subsection 36(3) of the *Fisheries Act* states:

(3) that no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water, except in accordance with prescribed Regulations.

Subsection 38(4) of the *Fisheries Act* states:

(4) Where, out of the normal course of events, there occurs a deposit of a deleterious substance in water frequented by fish or a serious and imminent danger thereof by reason of any condition, and where any damage or danger to fish habitat or fish or the use by man of fish results or may reasonably be expected to result therefrom, any person who at any material time

(a) owns the deleterious substance or has the charge, management or control thereof, or

(b) causes or contributes to the causation of the deposit or danger thereof,

shall, in accordance with any regulations applicable thereto, report such occurrence to an inspector or such other person or authority as is prescribed by the regulations.

Subsection 38(5) of the *Fisheries Act* states:

(5) Every person referred to in paragraph (4)(a) or (b) shall, as soon as possible in the circumstances, take all reasonable measures consistent with safety and with the conservation of fish and fish habitat to prevent any occurrence referred to in subsection (4) or to counteract, mitigate or remedy any adverse effects that result or may reasonably be expected to result therefrom.

Subsection 40(2) of the *Fisheries Act* states that every person who contravenes section 36(3) of the aforementioned Act is guilty of:

"an offence punishable on summary conviction and liable, for a first offence, to a fine not exceeding three hundred thousand dollars and, for any subsequent offence, to a fine not exceeding three hundred thousand dollars or to imprisonment for a term not exceeding six months, or to both; or an indictable offence and liable, for a first offence, to a fine not exceeding one milllion dollars and, for any subsequent offence, to a fine not exceeding one million dollars or to imprisonment for a term not exceeding three years, or to both."

Failure to take reasonable measures as required by subsection 38(5) of the *Fisheries Act* and failure to comply with an inspector's direction issued under subsection 38(6) of the *Fisheries Act* are offences under paragraphs 40(3)(e) and 40(3)(f) of the *Fisheries Act* .

Paragraph 40(3) provides that everyone who...

(e) fails to take any reasonable measures that he is required to take under subsection 38(5) or fails to take such measures in the required manner; and,

(f) fails to comply with the whole or any part of a direction of an inspector under subsection 36(6),

is guilty of an offence punishable on summary conviction and liable, for a first offence, to a fine not exceeding two hundred thousand dollars, and for any subsequent offence, to a fine not exceeding two hundred thousand dollars or to a term of imprisonment for a term not exceeding six months, or to both.

Paragraph 78.1 provides that where any contravention of this Act or the regulations is committed or continued on more than one day, it constitutes a separate offence for each day on which the contravention is committed or continued.

Paragraph 78.2 states that where a corporation commits an offence under this Act, any officer, director or agent of the corporation who directed, authorized, assented to, acquiesced in or participated in the commission of the offence is a party to and guilty of the offence and is liable on conviction to the punishment provided for the offence, whether or not the corporation has been prosecuted.

CONCLUSION

Please be advised that this Inspector's Direction is **WITHOUT PREJUDICE** to any further course of action that Environment Canada or any other enforcement agencies may take with respect to this alleged violation of subsection 36(3) of the *Fisheries Act*, R.S.C. 1985, c. F-14, as amended, or any other Act, including applying for an injunction, issuing a Minister's Request under subsection 37(1) of the *Fisheries Act* or initiating a prosecution.

Also be advised that any future release of a deleterious substance from the property owned or controlled by the Territorial Government of Nunavut or The Hamlet of Cape Dorset into waters frequented by fish may constitute a violation of subsection 36(3) of the *Fisheries Act* which could result in charges being laid against the Territorial Government of Nunavut or The Hamlet of Cape Dorset or their responsible officials.

For more information about the pollution prevention provisions of the *Fisheries Act*, I enclose a copy of the *Compliance and Enforcement Policy for the Habitat Protection and Pollution Provisions of the Fisheries Act.*

For more information, or to respond to the alleged facts contained in this warning, please contact the undersigned by telephone at (867) 975-4644 or by writing to Environment Canada, P.O. Box 1870, Iqaluit, Nunavut, X0A 0H0. Any submissions will be taken into consideration and a response will be provided where appropriate. All submissions received, as well as any response issued by Environment Canada, will be maintained on file with this Inspector's Direction.

I wish to further advise **the Territorial Government of Nunavut** and the **Hamlet of Cape Dorset, Nunavut** that Environment Canada will be conducting further inspections of the site to verify compliance with this Inspector's Direction.

Sincerely,

Sidney F. Bruinsma
Fishery Officer / Inspector

cc:

Mr. Hal Sommerstad
Manager, Regional Enforcement
& Emergencies Division
Prairie and Northern Region
Edmonton, Alberta

Mr. Peter Blackall
Regional Director
Environmental Protection Branch
Prairie and Northern Region
Edmonton, Alberta

Mr. Charles Brumwell
Manager, Northern Division
Environment Protection Branch
Prairie and Northern Region
Yellowknife, Northwest Territories

Mr. Robert Chouinard
Manager, Regional Support Division,
National Programs Directorate
Enforcement Branch
Hull, Quebec

Mr. Craig Broome
Head of Enforcement, Northern Division
Environmental Protection Branch
Prairie and Northern Region
Yellowknife, Northwest Territories

Mr. Doug Sitland, P.Eng.
Community Government and Services
Nunavut Territorial Government
Iqaluit, Nunavut

P.A. Cape Dorset Sewage P3.

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Nunalingni Kavamatkunillu Pivikhaqautikkut
Department of Community and Government Services
Ministère des Services communautaires et gouvernementaux

WITHOUT PREJUDICE

Hand Delivered

June 1, 2004

Environment Canada
Environmental Protection Branch
Prairie and Northern Region
Iqaluit District Office
P.O. Box 1870
Iqaluit, Nunavut
X0A 0H0

Attention: Mr. Sid Bruinsma

Dear Mr. Bruinsma:

The Department of Community and Government Services (formerly Community Government and Transportation – CGT)) and the Hamlet of Cape Dorset were issued an Inspector's Direction on March 25, 2002 in relation to the sewage treatment system in the community. Thus far, CGS (or our Consultant) has provided five responses/updates as follows:

- May 7, 2002 – Initial Response – Outlines immediate action and long term solution
- August 28, 2002 (from Consultant) – Outlines technical issues and levels of treatment
- September 27, 2002 – Progress on repair work in the 2002 construction season
- March 6, 2003 – Intention to proceed with design in Spring 2003
- October 1, 2003 – Update on planning with the Municipality

We are now in receipt of another Inspector's Direction dated May 13, 2004 with respect to the sewage treatment system. In response to that Inspector's Direction, CGS and the Hamlet of Cape Dorset provide this joint response.

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Nunalingni Kavamatkunillu Pivikhaqautikkut
Department of Community and Government Services
Ministère des Services communautaires et gouvernementaux

Actions Taken in the Last Two Years

- Berm at the far end of the "old lagoon" was elevated with extra fill in order to control seepage.
- Three 3-foot high berms were placed on the downslope side of the "old lagoon" to aid in filtration/retention
- The side and end berms of Cell 1 of the "new lagoon" were elevated with extra fill
- Culvert in Cell 1 of the "new lagoon" was moved to prevent runoff to the main road
- The capacity of Cell 2 of the "new lagoon" was increased with additions to the berms on the sides and ends
- A side wall of Cell 3 of the "new lagoon" was repaired and capacity increased
- Ditching was undertaken near the side of the mountain to divert runoff
- Ditching was undertaken on the town side of Cell 3 of the "new lagoon" to divert runoff

Therefore, both the Government of Nunavut and the Hamlet of Cape Dorset take exception to your assertion that "…reasonable measures…have not been taken by the Territorial Government of Nunavut and the Hamlet of Cape Dorset…". That being said, in the interests of fostering positive and productive relations with our federal partners and in the interests of providing adequate sewage treatment systems for all communities, the following additional immediate actions have been taken:

- The ditch above Cell 1 of the "new lagoon" will be cleared of snow to allow runoff to by-pass Cell 1
- The culverts in Cells 1,2 and 3 will be cleared of snow and ice to permit flow as intended
- The single culvert in Cell 2 has been replaced with 2 culverts to encourage positive drainage
- The ditch (and associated culverts) that extends from the dumpsite down past Cell 3 of the "new lagoon" will be cleared of snow and ice so as to encourage positive drainage and prevent flow across the road and into either Cells 2 and 3.

P.O. Box 1000, Station 700 Government of Nunavut, Iqaluit, NU. X0A 0H0
☎ (867) 975-5300 (867) 975-5330

- Public Service Announcements on local radio alerting residents of the issue and asking them to conserve water

As of June 1, 2004, the Hamlet has completed these tasks as best they can, within reason.

Over the summer of 2004, the following "intermediate" term actions will be taken.

- Examine options to increase the capacity of the existing 3-Cell "new lagoon"
- Examine options to increase the capacity of the "old lagoon"
- Continue with Public Service Announcements and ask residents to conserve water in an effort to lessen the demand on the existing sewage treatment systems
- Review operations and maintenance practices to ensure they are updated.

Details on a PRELIMINARY plan to increase the capacity of the existing systems is included for your review. CGS intends to examine in more detail the feasibility of undertaking these works, obtaining permission from the Nunavut Water Board (and relevant stakeholders) and implementing the works in the summer of 2004.

In addition, the following long term actions are proposed for the summer of 2004 and future years.

- As the community preference of "P Lake" is known to have fish, CGS could not move forward as intended over the winter of 2003/04. CGS will initiate fish and bird habitat studies to ensure that the use of "P Lake" and the associated wetland is acceptable to all stakeholders
- CGS will initiate planning and pre-design to estimate the level of treatment that will be obtained with the proposed "P Lake" solution and ensure it is acceptable to all stakeholders
- Pending the successful approval of the "P-Lake" option, CGS will undertake design so that the works can be publicly tendered for the summer of 2005.

It should be noted that the construction of the lagoon system and associated civil works at the "P Lake" site is a minimum 2 construction season job and the earliest that a system could be commissioned is the fall of 2006.

In the event that "P Lake" is not approved, CGS together with the Hamlet will examine other sustainable options for waste water treatment.

As you are no doubt aware, the Federal Department of the Environment recently provided information with respect to wastewater effluent quality guidelines for the City of Iqaluit. While there is no assertion that these guidelines would apply to other communities, it is worth noting that these parameters will be extremely difficult to attain through traditional sewage treatment options and may require the adoption of mechanical treatment systems. As you can imagine, the capital and operations and maintenance costs of these systems is often higher than traditional systems and the skilled work force to operate these systems is not resident in Nunavut. Forcing advanced infrastructure on small, isolated, northern communities with no tax base to generate revenues to offset operations and maintenance costs is a luxury that neither the Government of Nunavut can afford and by extension, nor our Federal partners.

I trust that this response satisfies your needs as outlined in the Inspector's Direction and that no further action will be taken against either the Hamlet of Cape Dorset or the Government of Nunavut. We will continue to involve Environment Canada, and indeed all relevant stakeholders as the planning, design and construction of the Cape Dorset sewage system evolves.

Sincerely,

Tom Rich
Deputy Minister

Art Stewart
Senior Administrative Officer

Cc Doug Sitland, Ddirector Capital Planning
Linda Tingley, Legal Counsel
Timoon Toonoo, Regional Director Baffin Region
Bruce Trotter, Senior Environmental Health Officer

Encl

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Nunalingni Kavamatkunullu Pivikhaqautikkut
Department of Community and Government Services
Ministère des Services communautaires et gouvernementaux

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I trust that this response satisfies your needs as outlined in the Inspector's Direction and that no further action will be taken against either the Hamlet of Cape Dorset or the Government of Nunavut. We will continue to involve Environment Canada, and indeed all relevant stakeholders as the planning, design and construction of the Cape Dorset sewage system evolves.

Sincerely,

Tom Rich
Deputy Minister

Art Stewart CARY MERRITT
Senior Administrative Officer (ACTING).

Cc Doug Sitland, Ddirector Capital Planning
Linda Tingley, Legal Counsel
Timoon Toonoo, Regional Director Baffin Region
Bruce Trotter, Senior Environmental Health Officer

Encl

P.O. Box 1000, Station 700 Government of Nunavut, Iqaluit, NU. X0A 0H0
☎ (867) 975-5300 (867) 975-5330

3-Cell system

The current configuration for the Cell 1 only allows for a friction of the potential capacity of be utilized. CGS in conjunction with the Hamlet, propose that another berm be constructed at the mid-point of Cell 1. Basically creating two cells form Cell 1. Figure 1 (attached) shows the approximate location of the proposed berms and the resulting cells.

Figure 2 shows what the new approximate volumes of the two cells will be as compare to the original cell. It is expected that the two new cells will have an increased capacity of be 45%. There may also be the opportunity to further expand the capacity of Cell through excavation. As preparations for the construction of the new berm commence, test pits will be excavated along the cell bottom to determine if is possible to further excavate the cell to create additional capacity.

It is important to note that neither CGS nor the Hamlet have all physical properties of the existing 3-cell system. For example, the actual slope of the bottom of Cell 1 has been approximated based on current site conditions. After Cell 1 is decanted this summer, final dimensions can obtained to verify the proposed work.

As witnessed this past winter, the wastewater would freeze before it was able to enter Cell 3 and therefore remained empty. There is currently a rough road that allows excess to Cell 2 & 3, but there is not a suitable working area for the sewer trucks to turn around and discharge. CGS and the Hamlet will examine any potential to increase the workability of this access area such that it would be safe for the operators to discharge their sewer trucks into Cell 2/3.

Old Honey Bucket Lagoon.

When the Hamlet was no longer able to discharge into the 3-cell system, they started to use the old sewage lagoon. The Hamlet placed additional fill along the roadside of the lagoon in hopes of increasing the capacity of the lagoon. Unfortunately, the volume seepage under the roadway kept the water level constant in the lagoon.

CGS & the Hamlet will examine the potential to increase the road height as a means to increase lagoon capacity. In order to accomplish this, the surrounding bedrock will have to be examined to determine the degree of fracturing to assess the potential for bypassing. Also, the existing roadway would have to be removed and a material placed in order to stem the seepage. The current road profile would allow CGS & the Hamlet to significantly increase the elevation of road surface. In essences, it would be proposed that we would use the road as a berm.

Another option that will be explored will be expanding the capacity through excavation. This lagoon will have to be decanted before work could be started, once it was decanted, test pits would be dug to determine if there was any potential to expand the lagoon through additional excavation.

Appendix 3

July 17, 2006

Dillon Consulting Limited,
P.O. Box 1409,
4920, 47th Street, Yellowknife, NT,
X1A 2P1

Attn: Gary Strong, P. Eng., Project Manager

Dear Mr. Strong

Re: AMEC Responses to Nunavut Water Board Review
Cape Dorset Sewage Lagoon Geotechnical Investigations

General

AMEC agrees with general comments from the reviewer that a full scale drill program would provide site-specific data on stratigraphy and permafrost conditions at the lagoon site, including soil composition, depth to bedrock, ice content and permafrost temperature. Attempts were made to mobilize a drill rig to the site. The available drill rig (track mounted, down-hole hammer rig) could not get to the lagoon site due to extremely steep slopes around the site. Other options, such as a portable helicopter drill rig, are not available in Cape Dorset or even in the Baffin Island region. This part of the original work scope could not be completed with the available equipment.

AMEC considers that there could be some potential benefit (i.e., confirmation of subsurface conditions and refinement of geothermal modeling and design parameters) from detailed geotechnical investigations. One alternative is to develop rig access to the site in advance of construction to conduct the investigations. However, AMEC maintains that the investigations that were undertaken, which included field reconnaissance, review of available climate data, geological and permafrost information, and the results from geothermal modeling have resulted in an adequate design for the sewage lagoon dykes.

A sensitivity analysis to evaluate the potential effects of global warming on the dyke design was not part of AMEC's original scope of work. However, analyses could be undertaken to assess possible effects of global warming on the dyke temperature and thaw depth within the lagoon impoundment. AMEC would be pleased to provide a scope of work and estimated cost to undertake this work, as is considered appropriate.

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Responses to Specific Points

i. The source of information regarding the permafrost conditions was not provided by AMEC. It would appear that it was estimated from the mean annual air temperature data. No thermistors were installed at the site to provide site specific temperature data for design purposes.

AMEC reviewed available reports on permafrost conditions in the community Cape Dorset (paragraph 4). Previous investigations provided data on moisture content and soil composition within the community (near the shoreline) and for prospective and existing borrow sources. No temperature was measured in the boreholes advanced (5 boreholes) and drilling was not undertaken in mountainous areas near the proposed location of the sewage lagoon. The field reconnaissance of the lagoon site revealed terrain that had thin organics on the surface and was covered with boulders and rock outcrops. Such surface conditions generally indicate coarse composition of the overburden (sand, gravel and boulders) over shallow bedrock.

The mean annual permafrost temperature and thickness of the active layer were calculated based on 1D geothermal modeling. The following parameters were used for the modeling: mean monthly air temperatures (Climate Normals 1970-2000, Environment Canada), mean monthly snow thickness (Climate Normals 1970-2000, Environment Canada), thermal resistance of organic cover (result of field reconnaissance and AMEC experience with other similar projects), bulk density and moisture content of the overburden (field reconnaissance and AMEC experience with other similar projects), thermal properties of dyke materials and soil/bedrock (published data). Based on this modeling, AMEC concluded that the mean annual permafrost temperature at the site would be in a range from -5 °C to -7 °C and the thickness of the active layer would be about 1.5 m.

With respect to the reviewer comments that the site-specific temperature data were not used for the design purposes, AMEC notes that the site-specific temperature data can be used only as initial temperature conditions for calculation (i.e., prediction) of thaw depth within the lagoon impoundment and temperature of the frozen core dyke. The effect of the initial ground temperature is limited mainly by first years of the lagoon operation. After this period of time, the main parameters that influence thaw depth and dyke temperatures are the sewage water temperature and the climate parameters (boundary conditions, see response to comment xi, below).

ii Due to fractured rock covering the site, only one hand auger borehole was able to be drilled to a depth of about 0.15. Therefore, no site-specific subsurface data was obtained for the lagoon foundations. The extent of the frost affected bedrock is critical for design of any water retaining structure.

AMEC agreed with the reviewer that knowledge of the thickness of frost-affected bedrock is important for the water retaining structures. However, the site is located within the continuous permafrost zone and the mean annual permafrost temperature at the site is about -5 °C to -7 °C (the worst case scenario -3 °C). Based on the site visit observations, AMEC considers that the permafrost thickness at the lagoon site is much thicker than 100 m. This permafrost thickness was incorporated in the geothermal model, resulting in the thaw depth under the lagoon impoundment of about 7 m after 30 years of the lagoon operation. Containment is achieved by the frozen zone beneath the base of the lagoon and beneath the dykes around the lagoon perimeter.

Iii *Borrow materials investigations comprised one disturbed sample obtained from each of the proposed borrow areas. No drilling was undertaken at the prospective borrow area locations to estimate soil composition. No information was provided as to the in situ condition of these areas in terms of frozen ground and ice conditions that may affect quantities available, time required for excavation and processing required to render them suitable for dyke construction.*

Two detailed borrow material studies were undertaken previously in the community Cape Dorset (Section 4 of AMEC's report). The report "Granular Material Sources Investigation" was prepared by the engineering division of the Government of NWT. The undertaken studies provide numerous data on composition of borrow materials and their moisture content. AMEC's report provides an analysis of the soil composition for prospective borrow sources. The reports characterized borrow sources 1, 3 and 5 as, "based on the borehole data, borrow material likely comprises of silty sand and sand with various amount of gravel and inclusions of cobbles and boulders". The report also characterizes two prospective clay deposits (near community landfill and the airport). In section 7.2, AMEC provides requirements to the state (frozen/unfrozen) and composition of materials for dyke construction.

General information was provided in the AMEC report regarding to the borrow materials based on our scope of work to "include discussions of borrow source materials". AMEC can provide additional details on the borrow source materials by carrying out site-specific subsurface investigations, if requested. The assessment could include data and information to help assess excavation optimization and processing requirements to render suitable material for dyke construction.

iv *Subsurface conditions were inferred from air photos and the field reconnaissance observations. The value of overburden depth, overburden stratigraphy, mean annual permafrost temperature have not been confirmed by drilling.*

AMEC considered that the air photo reviews and field reconnaissance observations (see photographs attached to the report) provide an adequate conclusion on the geological conditions of the lagoon site (i.e., coarse overburden material over shallow bedrock). AMEC also convinced that our permafrost experience and applied analytical methods allowed adequately assess the mean annual permafrost temperature and thickness of the active layer (see also response to reviewer comment "i").

v *No information was provided regarding the ground ice content and potential behaviour of foundation materials under thawed conditions.*

AMEC agrees that no actual data on ice content of the overburden was obtained during the field reconnaissance. However, the coarse composition of the inferred overburden soils allows AMEC to conclude that no segregative ice would be encountered in the overburden (high ice content usually is due to segregative ice). Ice content due to pore ice is usually low, resulting in the thaw settlement strain of about 2 to 3 percent. Second potential source of high ice content would be wedge ice or massive ice. The field reconnaissance has shown that neither wedge ice nor massive ice present at the lagoon site. Thus, AMEC does not expect considerable thaw settlement to occur under the lagoon impoundment. Even if the overburden thickness would be about 7 m, the thaw settlement amount would be in a range of 14 cm to 20 cm. The overburden thickness is expected to be much less than 7m thick.

vi *There is no discussion provided regarding the design requirements to ensure stability of the lagoon slopes.*

AMEC understands that the lagoon wall will be created by a frozen core berm on all of the sides of the lagoon structure and the impoundment by natural slopes is not part of the design. It is obvious that the stability of the frozen core dyke will be provided (1V:2H, slope steepness about 27 degrees).

vii *AMEC did not carry out any seepage analysis to justify the design of the liner and cutoff trench.*

A seepage analysis was not included in AMEC's scope of work. However, it should be clear that the seepage analysis alone cannot justify design the liner and cutoff trench because frozen soil in the seepage analysis should be incorporated as impermeable material, and will result that no any seepage occurs under the dyke or from the impoundment to the P-Lake. If the seepage analysis is deemed necessary, it should be done using software that includes convective and conductive heat transfer analyses. AMEC can undertake this type of modeling, but it will require a considerable modeling effort and information from deep drilling. Even for large projects, such as Gahcho Kue Diamond Mine Project, this type of geothermal analysis is not required because the geothermal analysis assumes that no seepage occurs through frozen soil.

viii *The liner configuration used in the geothermal analysis is not what Dillon is proposing. With the vertical liner, there will be a greater potential for thaw around the cut trench that has not been evaluated.*

AMEC's response is in two parts:

1. AMEC stated in our report that both liner configurations could be used, but "constructability of the alternative option (over the subgrade and along the upstream slope of dyke) is more favourable, however the liner would be about twice as long".

2. AMEC cannot see a reason why the vertical liner configuration would result in "a greater potential for thaw around the cutoff trench". It is requested that the reviewer clarify this statement. AMEC's opinion is that no thaw occurs under the applied boundary conditions if the cutoff trench is constructed at the recommended location within the dyke cross-section (see Figures 4 through 8 in AMEC's report) or further downstream. Again, constructability of the vertical liner is more complicated and proper compaction near the vertical liner might be more difficult to achieve.

ix *The geothermal analysis assumed that there was a 0.5 m thick layer of coarse rockfill protecting the dyke core. This detail is missing from the Dillon drawing (Drawing 111) and significantly affects the depth of thaw within the berm.*

AMEC agrees, that the 0.5 m thick rockfill layer should be incorporated in the dyke design, as it will provide protection for the dyke core. However, AMEC disagrees that absence of this layer will "significantly affect the depth of thaw within the berm". AMEC requests that the reviewer clarify this statement.

x *The geothermal analysis did not include any component of global warming, which is typically applied to all northern designs.*

AMEC agrees that for the given project, it would be prudent to assess the possible affects of global warming in the geothermal modeling. This aspect of the analysis was not part of AMEC's work scope and would be considered extra to the existing work scope.

xi *The predicted ground temperatures at the base of the dyke are a function of initial temperature conditions, the physical and thermal soil properties and the boundary conditions, all of which were based on assumptions. AMEC did not assess whether the 2 m deep cut-off system under the dyke is sufficient. If actual conditions differ from the assumed parameters, then the actual temperatures in the dyke could vary from predicted temperatures.*

AMEC's response is in three parts:

1. AMEC agrees with the generality of the comment, that, "temperatures at the base of the dyke are a function of initial temperature conditions, the physical and thermal soil properties and the boundary conditions". However it should be clear that the initial temperature conditions are important to dyke the temperatures of the dyke only during first years of the lagoon operation. As the temperatures near steady-state conditions, the impact of the initial temperature is reduced and the steady state heat transfer assessment is conducted without the need to include the influence of initial temperature conditions. Moreover, AMEC experience in geothermal modeling shows that variations of soil thermal properties, within a reasonable range, provides insignificant changes to soil temperature. The boundary conditions have considerably more impact on the resulting dyke temperature throughout the years of the lagoon operation. On this basis, AMEC considers that used soil thermal properties and applied boundary conditions has resulted in an adequate assessment of the dyke temperature regime.

2. With respect to "whether the 2 m deep cut-off system under the dyke is sufficient". Seepage analysis and convective heat transfer could be incorporated into the geothermal modeling to provide a more precise location and depth of the cut-off trench (see response to reviewer comment vii, previously). AMEC did not have the opportunity to review the dyke design drawings and does not know the actual location of the cut-off trench given in the final design. If no additional geothermal analyses are undertaken, AMEC recommends the location of the cut-off trench be located near the –3 °C temperature contour, located beneath the crest of the dyke. AMEC also would like to review the final design location of the cut-off trench.

3. AMEC understands that actual dyke temperatures could differ from predicted temperatures. AMEC recommends the implementation of a temperature monitoring program within the dykes. Several monitoring thermistor strings should be installed in wells, drilled from the completed dyke crest. AMEC can develop a monitoring program upon the request. If actual dyke temperatures differ considerably (i.e., are warmer than predicted) or warming trends are noted, then a contingency plan should be implemented. Currently, it is considered that an appropriate contingency plan would be to install thermosyphons to reduce dyke temperatures to maintain the integrity of the dyke and underlying cutoff trench.

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July 17, 2006

PERMIT TO PRACTICE
AMEC Earth & Environmental, a Division of AMEC Americas Limited
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Date July 17, 2006
PERMIT NUMBER: P 047
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Appendix 4

Environment Canada Environnement Canada

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Canadian Climate Normals 1971-2000

The minimum number of years used to calculate these Normals is indicated by a code for each element. A "+" beside an extreme date indicates that this date is the first occurrence of the extreme value. Values and dates in bold indicate all-time extremes for the location.

NOTE!! Data used in the calculation of these Normals may be subject to further quality assurance checks. This may result in minor changes to some values presented here.

CAPE DORSET A
NUNAVUT

Latitude: 64° 13' N **Longitude:** 76° 31' W **Elevation:** 50.00 m

Climate ID: 2400635 **WMO ID:** 71910 **TC ID:** YTE

Temperature:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily Average (°C)	-25	-26	-21.6	-14.1	-5.5	2.3	7.4	5.7	1.5	-3.9	-11.7	-20.2
Standard Deviation	3.3	2.8	2.8	2	1.8	1.4	1.2	1.3	1.2	1.5	2.7	4
Daily Maximum (°C)	-21.7	-22.7	-17.9	-10.3	-2.7	5.1	11.2	8.8	3.6	-1.8	-8.7	-16.9
Daily Minimum (°C)	-28.3	-29.2	-25.1	-18	-8.3	-0.6	3.5	2.5	-0.7	-5.9	-14.8	-23.4
Extreme Maximum (°C)	-1.4	-1.5	0.8	5.6	10.9	17.9	**25**	21.9	18.1	7.2	3.4	-0.8
Date (yyyy/dd)	1985/18	1986/27	1999/28	1975/29+	1993/31	1985/15	**1984/15**	1991/09	1989/10	1998/02	1985/02	1998/05+
Extreme Minimum (°C)	-38.9	-40.6	-42.2	-32.8	-19.6	-9.3	-3.4	-4.6	-8.3	-23.9	-30.6	**-42.8**
Date (yyyy/dd)	1964/14	1964/26	1964/11	1963/01	1983/15	2000/04	1983/11	1983/23	1963/30+	1986/25	1963/28	**1971/30**
Precipitation:												
Rainfall (mm)	0	0	0	0.1	3.1	14.7	34.4	54.7	32.5	4.3	0	0
Snowfall (cm)	25.5	20.4	25.7	34.6	30.7	9.3	0.4	1.4	14.1	42.8	50.2	41.5
Precipitation (mm)	22.3	17.3	21.8	30.1	31.1	23.7	34.4	56	46.7	44.3	42.4	33.1
Average Snow Depth (cm)	48	46	52	59	56	19	0	0	0	6	22	36
Median Snow Depth (cm)	49	46	52	57	57	18	0	0	0	6	21	36
Snow Depth at Month-end (cm)	48	47	55	58	41	1	0	0	1	13	28	40
Extreme Daily Rainfall (mm)	0	0	0	1.2	11.4	35.2	24.8	**41.2**	32	17.3	0.6	0.2
Date (yyyy/dd)	1964/01+	1963/01+	1963/01+	2001/30	1980/30	2001/17	1995/02	**1986/20**	1998/10	1973/11	1985/02	1998/04
Extreme Daily Snowfall (cm)	**29.7**	20.3	13.6	23	19	15.6	2.6	9.2	19.6	20.2	25.7	15.7
Date (yyyy/dd)	**1971/28**	1964/02	1990/09	1980/21	1990/01	1992/23	1989/05	2000/30	1994/16	1999/31	1970/23	1971/05
Extreme Daily Precipitation (mm)	29.7	20.3	12.4	28.2	18.2	35.2	24.8	**41.2**	32	20.2	25.7	15.7
Date (yyyy/dd)	1971/28	1964/02	1990/09	1995/09	1991/23	2001/17	1995/02	**1986/20**	1998/10	1999/31	1970/23	1971/05
Extreme Snow Depth (cm)	127	84	88	**147**	94	90	3	0	18	36	74	92
Date (yyyy/dd)	1975/13+	2001/26+	2001/26+	**1975/02+**	1983/24	1987/03	1992/01	1971/01+	1992/24	1974/29+	1989/28+	1993/20+
Days with Maximum Temperature:												
<= 0 °C	31	28.3	30.8	29.2	23.8	2.4	0	0	3.8	23	29.1	31
> 0 °C	0	0	0.24	0.77	7.2	27.6	31	31	26.2	8.1	0.94	0
> 10 °C	0	0	0	0	0.06	4.2	18.1	10.4	1	0	0	0
> 20 °C	0	0	0	0	0	0	0.41	0.09	0	0	0	0
> 30 °C	0	0	0	0	0	0	0	0	0	0	0	0
> 35 °C	0	0	0	0	0	0	0	0	0	0	0	0
Days with Minimum Temperature:												
> 0 °C	0	0	0	0	0.23	10.2	27.9	26.4	11.1	0.42	0	0
<= 2 °C	29.8	27.3	30	28.5	29.1	24.7	9.7	13.3	25.1	29.3	28.6	28.7
<= 0 °C	29.8	27.3	30	28.5	28.9	18.5	1.3	3	17.2	28.9	28.6	28.7
< -2 °C	29.8	27.3	29.9	28.3	26.8	7.2	0.1	0.16	7.5	25.7	28.4	28.7
< -10 °C	29.8	27.3	29.3	24.6	9.6	0	0	0	0	3.5	21.2	27.6
< -20 °C	27.1	25.7	24.1	10.6	0	0	0	0	0	0.08	5.4	20.1