# GOVERNMENT REQUEST FOR PROPOSALS

Community & Government Services, Hon.Lavenia Brown, Minister

## Sewage and Solid Waste Facilities Design
## Kugluktuk , Nunavut

The Department of Community & Government Services, Government of Nunavut, is seeking proposals from qualified consultants for Architectural/Engineering services for study of sewage, solid waste (including bulk metals, hazardous materials site and land farm site) facilities. Existing sewage and solid waste facilities require life-extension and containment. Emphasis will be on cost-effective, simple engineering designs that are appropriate to the Arctic environment, with its high energy costs and distances from re-supply markets. Where applicable, alternative energy sources will be considered. Project requires close design collaboration with professional GN Project Personnel.

***For the purposes of this proposal call the provisions of the Nunavummi Nangminiqaqtunik Ikajuuti Policy apply. All or any of the proposals not necessarily accepted.***

This proposal call will close

***3:00 P.M. Local Time , Cambridge Bay NU, September21, 2005***

Proponents may obtain Request for Proposal documents on Thursday, August 26, 2005. Proponents must pay all courier charges and related shipping/handling costs. Electronic copies of the Terms of Reference, with Scope of Work will be sent out on request.

Address enquiries to:

RFP Inquires to:
Navjit Sidhu EIT Project Officer
Department of Community And Government Services
Government of Nunavut
Phone:(867) 983-4142 Fax:(867) 983-4124

Technical Inquires:
Navjit Sidhu, Project Officer
Department of Community and Government Services
Government of Nunavut
Phone:(867) 983-4142 Fax:(867) 983-4123
nsidhu@gov.nu.ca

# Request for Proposals

The Government of Nunavut (GN), Department of **Community and Government Services** is requesting Proposals from qualified proposers for the provisions of Architectural / Engineering consulting services as outlined in this document.

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## 1. Standard Instructions to Proponents

1. Proposals must be received before 3.00 pm local time on September 21, 2005 at:

Regional Director, Anna Kaotalok, Kitikmeot Region
Government of Nunavut
Community And Government Services

Delivered to 2nd floor, Enokhok Building
P.O. Bag 200, Cambridge Bay, NU, X0B 0C0

In care of: Contract Clerk
Project Management Division, Community and Government Services
Telephone: *(867)* 983-4149 Fax: *(867) 983-4124*

**Proposals received after the exact time and date noted above will be rejected.**

The original and **5** copies are to be submitted, quoting **"Sewage and Solid Waste Facilities Design, Kugluktuk: CGS Project No. 04-4406"** on the outside of the envelope or package.

After the closing time, only the identity and addresses of the proponents will be posted.

2. The GN will not be responsible for any proposal that:
   - does not indicate the Request for Proposal reference, closing date and proposer's name;
   - is delivered to any address other than that provided above.

3. Facsimile transmitted proposals will be accepted under the following conditions:

   - the proposal is received before the submission deadline at the facsimile number stated;
   - the GN will not accept liability for any claim, demand or other actions for any reason should a facsimile transmission be interrupted, not received in its entirety, received after stated closing time and date, received by any other facsimile unit other than that stated herein, or for any other reasons;
   - the GN cannot guarantee the complete confidentiality of information contained in the proposal received by facsimile;
   - it is understood that the GN is not allowed to comment on the completeness of the submission, or offer any other opinion other than to state, upon inquiry by the proposer, that a submission has been received
   - the proposer shall submit an original proposal and **5** copies to the address stated herein immediately following the transmission of the facsimile.

4. All questions or enquiries concerning this Request for Proposals must be in writing and be submitted to the address provided above no later than five (**5**) calendar days prior to the proposal deadline. Verbal responses to any enquiry cannot be relied upon and are not binding on either party. The GN contact for this project is:

   Navjit Sidhu, EIT, Project Officer
   Community and Government Services
   Cambridge Bay, NU, X0B 0C0
   Phone no: (867)983-4142
   Fax no: (867)983-4123
   E- mail: nsidhu@gov.nu.ca

5. This is not a Request for Tenders or otherwise an offer. The GN is not bound to accept either the proposal which provides for the lowest cost or price to the GN, or any proposal of those submitted.

6. If a contract is to be awarded as a result of this request for proposals, it will be awarded to the proposer who is responsible and whose proposal provides the best potential value to the GN. Responsible means the capability in all respects to perform fully the contract requirements and the integrity and reliability to assure performance of the contract obligations.

7. Notice in writing to a proposer and the subsequent execution of a written agreement shall constitute the making of a contract. No proposer will acquire any legal or equitable rights or privileges whatever until the contract is signed.

8. The contract will be in the form of the standard "GN Architectural/Engineering Services Agreement" and it will contain the relevant provisions of this Request for Proposals, the accepted proposal as well as such other terms as may be mutually agreed upon, whether arising from the accepted proposal or as a result of any negotiations prior or subsequent thereto. The GN reserves the right to negotiate modifications with any proposer who has submitted a proposal.

9. In the event of any inconsistency between this Request for Proposal, and the ensuing contract, the contract shall govern.

10. The GN has the right to cancel this Request for Proposals at any time and to reissue it for any reason whatsoever, without incurring any liability and no proposer will have any claim against the GN as a consequence.

11. Any amendments made by the GN to the Request for Proposals will be issued in writing and sent to all who have received the documents.

12. The GN is not liable for any costs of preparation or presentation of proposals.

13. An evaluation committee will review each proposal. The GN reserves the exclusive right to determine the qualitative aspects of all proposals relative to the evaluation criteria.

14. Proposers may not amend their proposal after the closing date and time but may withdraw their proposal at any time prior to acceptance.

15. Proposals will be evaluated as soon as practicable after the closing time. No detail of any proposal will be made public except the names of all parties submitting proposals.

16. Provisions of the Government of Nunavut Nunavummi Nangminiqaqtunik Ikajuuti (NNI) Policy will be applied in the evaluation of all proposals.

17. The proposal and accompanying documentation submitted by the proposers are the property of the GN and will not be returned.

# 2. Terms of Reference

The consultant must agree to work in collaboration with the Regional Municipal Planning Engineer and the Project Officer, who will together provide a range of design, engineering, and site management services for the Hamlet of Kugluktuk.[1]

The proposal must demonstrate that the design work will utilize appropriate technology and is shown to provide simple, cost-effective solutions to the various waste-production and handling needs of the hamlet. Renewable energy sources will be utilized wherever they can be shown to provide a viable alternative to fossil fuel.

## 2.1 Background

**2.1.1 Community of Kugluktuk** The community of Kugluktuk, Nunavut (formerly called Coppermine) is geographically is situated on the Coronation Gulf in the mouth of Coppermine river. It is the most westerly community of Nunavut with a population of approximately 1362. It is located on 67° 9' N Latitude and 115 6' W longitude and it is approximately 1000 Km north of Yellowknife. Recent population figures from hamlets point to high exponential growth.
This design may require the relocation, remediation and/or reclamation of the existing facilities.

**Until November 30, 2008, Water Use and Waste Disposal in the community are regulated by Water License NWB3KUG0308, issued on November 20, 2003. Other facilities may need licensing.**

**2.1.2 Sewage Lagoon** The existing sewage lagoon (fig. 1) consists of a truck discharge point into a single cell. Down-slope there is a dyke, recently built up by local crews, which is not adequate to contain the effluent. During spring thaw, the dyke is over-breached, and during summer, the porosity is permitting too much effluent to seep through. In addition, it is no longer large enough to serve population needs in 2005. The effluent collects in a hapharzadly-created secondary cell on the other side of the dyke prior to making its long way to the sea through the tundra wetland. This effluent route crosses the only snowmobile trail available to residents, causing concern for aesthetic and health reasons.

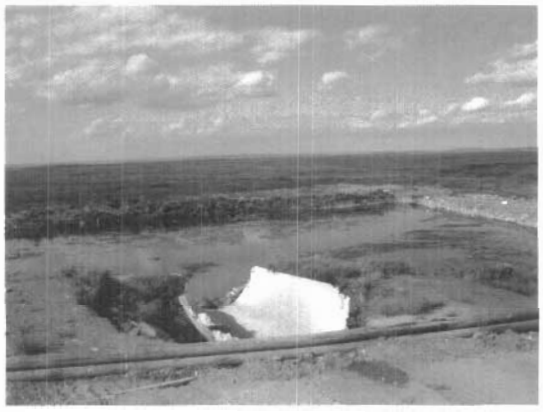


**Fig. 1: Sewage Lagoon**

The lagoon is near an unapproved soil farm and a small waste fuel and discarded battery site (see Fig.2).

1 Note that the Project Officer has had experience working with on-site and lab geotechnical investigations and analyses. The Regional Engineer is experienced in designing on-site sewage facilities, and also with renewable energy resources, including PV and wind generation. While their time is limited, they will be very much a part of the design team, as both resource and input.

Typically, sewage lagoons above the Arctic Circle are assumed to freeze to the bottom in the winter. However, hamlet crews are not convinced that this is the case.

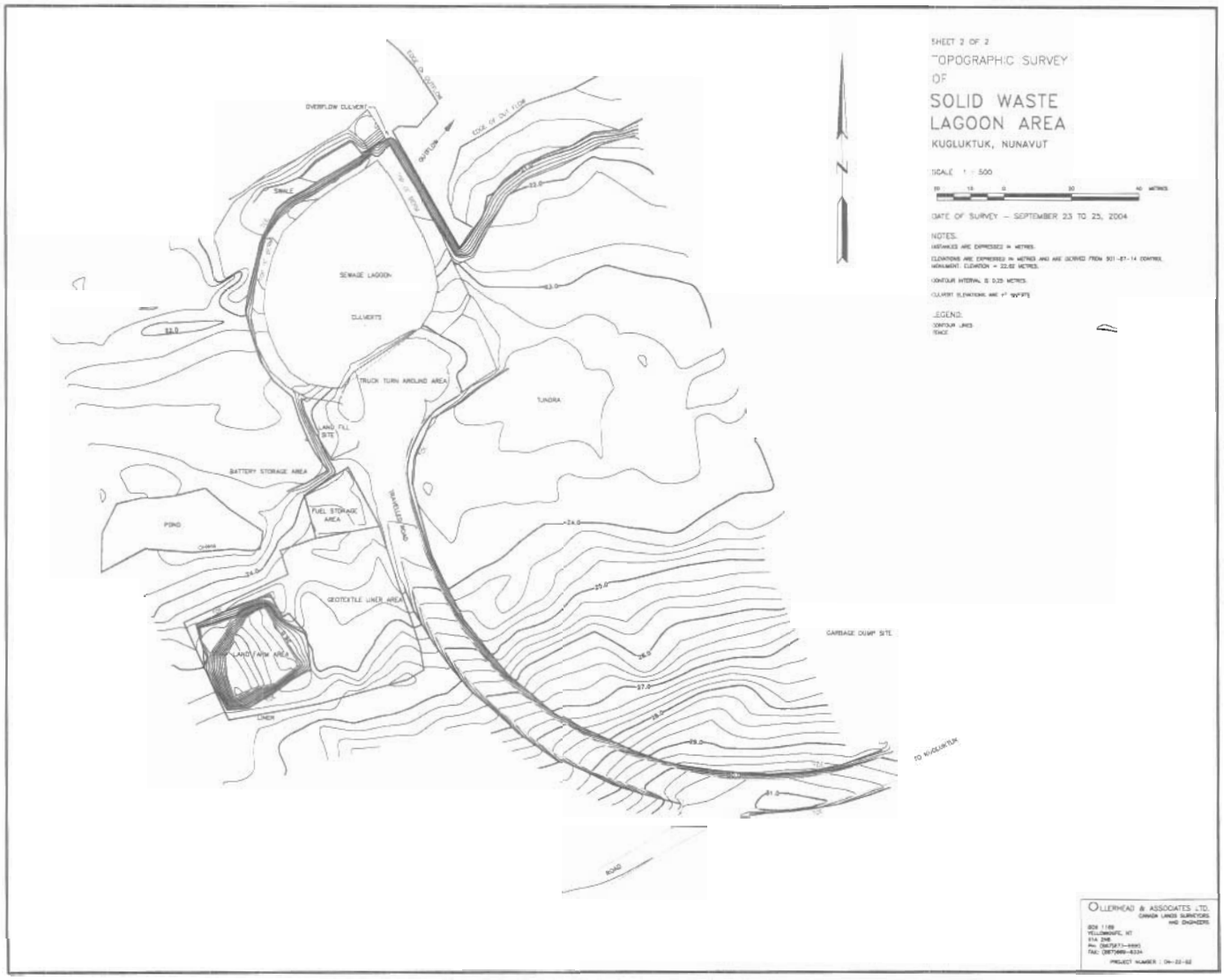



**Fig. 2 Sewage Lagoon, Land Farm, Waste Oil/Batteries Site**

**2.1.3 Solid Waste Disposal Area** The existing area is fenced, has been used for approximately 15 years, and is currently operating under water license NWB3KUG0308. The hamlet has made a ramp of an old truck box, and is typically burning their solid waste (Fig. 3). They have plans to enlarge the area on two sides of the facility to make more room this summer.

**2.1.4 Bulk Metal and Tire Disposal Area** The existing area has been used for approximately 15 years, and currently operating under license NWB3KUG0308. This facility is at capacity (Fig. 4), although the hamlet foreman, Philip Kitik, is creative in separating the waste so recycling is facilitated. He has even allocated a place where discarded bicycles, ATVs and snowmobiles can be accessed by community members for parts (and removes the picked-over hulks at the end of each season).There are many tires in this facility also, which is causing a problem. The area is unfenced, enabling un-controlled dumping.

**Fig. 3 Solid Waste Dump**

**2.1.5 Waste Oil and Batteries Area** This area is near the sewage lagoon (Fig.5). The Hamlet crews have made a good effort at separating the waste oil and batteries, and have put the oil in drums on pallets. At last count, there are approximately 300 drums of waste oil the hamlet foreman has assembled neatly on pallets, as well as more that await placement. Unfortunately, the area is un-fenced, so unauthorized drums of waste liquid of indeterminate nature are being placed there by local contractors.

**Fig. 4 Metals and Tire Dump**

**2.1.6 Land Farm** In 1999 a land farm was designed and built according to the standards of the day. It was designed to accept the contaminated soil from the old tank farm and old pipelines that were in the process of being decommissioned (Fig. 7). New marine barge facilities were being developed, and new pipelines designed and built. However, the project has taken far longer than anticipated, and it is expected that the last of the old fuel pipes are being removed only in the summer of 2005. This not only puts extra strain on the already full metals dump, but the land farm, too, is full – due to uncontrolled augmentation by unauthorized persons. The soil in the land farm has not been remediated or turned as it should over the years. In addition, land farm standards have changed since 1999, and a new facility must be designed.

**Fig. 5 Waste Oil and Batteries**

## 2.2 Project Identification:

**Name:** Kugluktuk Sewage Lagoon and Solid Waste Facilities

**Location:** Kugluktuk, Kitikmeot Region, Nunavut
**Client:** Department of Community and Government Services (CGS)

## 2.3 Project Personnel:

The primary contacts for this project are:

- **Navjit Sidhu,** Bsc (Civil Eng.), EIT
  Project Officer
  Community and Government Services
  Cambridge Bay, Nunavut, X0B 0C0
  Phone: 867-983-4142
  Fax: 867-983-4123
  e-mail: nsidhu@gov.nu.ca
- **Thomas G. Livingston,** P.Eng
  Regional Municipal Planning Engineer
  Community and Government Services
  Cambridge Bay, Nunavut, X0B 0C0
  Phone: 867-983-4156
  Fax: 867-983-4123
  e-mail: tlivingston@gov.nu.ca

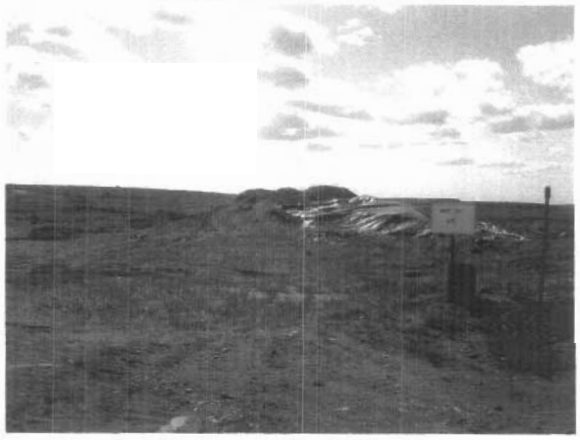


**Fig. 6 Existing Land Farm**

## 2.4 Scope of Work:

The rationale for attacking all of the above waste streams in one RFP is due to two factors: 1). The capacities of all locations for these wastes are at or are fast approaching capacity, and 2). The location of these areas is such that they each have an impact on the other.

The consultant will work with the Project Personnel to study design parameters, prepare designs and construction drawings, and over-see the actual work to the above facilities in the hamlet. Construction work will be broken up into two phases: Phase 1 will consist of geotechnical investigations to locate near-by sources of appropriate granular material, and repair and/or remediation and decommissioning of existing facilities (if required). Phase 2 will be the construction of new facilities (as required).

### 2.4.1 Design

The services of a consultant are required to work in close collaboration with the Project Personnel of CGS to provide Studies and Appropriate Engineering Services for the needs assessment and possible designs of proposed new sewage, solid waste, bulk metal, land farm, and waste oil/batteries facilities. This needs assessment will consider facilities for expected community population growth over the next 20 years. Included in this assessment will be the provision of phased design: if repairs to an existing facility will economically increase its life, then this option may be taken in the short term.

It is to be emphasized that this is a team approach to design and project management: while the successful proponent will of necessity perform the bulk of the work, significant engineering design input and on-going direction will be provided by the Project Personnel. Furthermore, emphasis will be placed on cost-effective, simple, and appropriate engineering designs: designs that will work in this harsh Arctic environment, that will require a minimum operational and maintenance budget (which

implies that they be relatively easy and simple to operate). Where energy to operate systems is needed, the use of renewable energy options will be explored in the design phases, using true-cost-benefit analyses which will include Arctic O&M costs, certain externalities (true cost of fossil fuel, operator training in the north, environmental degradation), decommissioning, and a realistic MARR.

**Possible Concerns**

Note: The GN recognizes the apparent difficulties the proposing consultants will have in providing an estimate for this work, particularly with the added anomaly of collaboration with the CGS Projects Team of PO and RMPE. While this collaborative design approach may be somewhat outside the norm, it should not discourage those consultants who are interested in the integrated design process (sometimes referred to as unified design). One obstacle to entering a proposal can be immediately removed: since it is impossible to determine the relative level of design participation by the GN team, all proposers may enter their estimates as if the GN participation will be nil. In addition, all prospective proposers are encouraged to call or write either the PO or the RMPE with any questions or concerns. Pertinent results of these discussions will be distributed to all proponents.
The Architectural and Engineering Services shall be delivered as described in Section E of the Standard GN Architectural / Engineering Services Agreement and modified as follows.

- AutoCAD drawings: The consultant will present all plans in AutoCAD 2005 format. These drawings will include all details and sections needed for complete construction. The Consultant will prepare reproducible "As Built" drawings from marked up white prints produced by the construction contractor. Note that all final drawings must be stamped by a professional engineer registered to practice in Nunavut.
- The Consultant team shall provide the following engineering services as required:
  -Geotechnical investigation and laboratory analyses
  -Rock Blasting advice and support
  -Solid Waste and Landfill Engineering
  -Soil Farm Engineering
  -Bulk Metals Waste Engineering
  -Sewage Treatment Engineering
  -Site supervisory services and surveys
  -Hazardous materials/chemical contaminants remediation design
- All tender documents shall be noted "Issued for Tender, Not for Construction" at the tender stage
- After tender close, and prior to contract award, the consultant team shall modify all tender documents incorporating all addenda and note the documents, "Issued for Construction"
- All details shown on project documents shall be cross-referenced to note detail number, originating location and location shown
- The consultant shall be responsible for applying for approval from all authorities having jurisdiction on behalf of the GN. These will consist of, but not be limited to, Nunavut Environment Impact Review Board (NIRB), Nunavut Water Board (NWB), Canadian Department of Fisheries and Oceans (DFO).

**2.4.2 Existing studies and investigations:**

- FSC Architects & Engineers prepared a Report on the sewage lagoon (March 8, 2004). This is included with the RFP
- A partial topographic survey has been done and data will be provided to the successful proponent in AutoCAD 2000 format.
- Available effluent analyses from July and October, 2004, and August, 1998 are included as reference
- Also, see Bibliography of relevant studies

**2.4.3 Local employment and training potential**:

The consultant and contractor(s) will be encouraged to use local labour as much as possible. Where training opportunities for Nunavummiut exist, these too will be pursued. NNI minimum standards will be referenced.

**2.4.4 Environmental Assessment**:

Any required environmental audits and assessment will be conducted at the time of this study.

**2.4.5 Funding Sources:**

The potential of funding sources and partnerships will also be explored vigorously. Some funding sources include the Strategic Infrastructure Fund (SIF), the Gas Tax Initiative (GTI), and the Municipal Rural Infrastructure Fund (MRIF). Other funding potential too, will be investigated.

**2.4.6 Facilities**

**2.4.6.1 Sewage Facilities:**

**2.4.6.1.1 Existing Lagoon:**

- Data collection: Obtain historical effluent reports from DIAND. Take effluent samples to determine $BOD_5$ levels, as well as total and fecal coliform, ammonia, and other parameters as needed. Note that concurrently, CGS is undertaking its own Kitikmeot-wide effluent sampling study. Any results and data will be shared. However, the successful consultant is required to undertake a separate sampling program to determine effluent quality in various parts along the sewage path. These samples should be taken at the outfall and also at several points in the lagoon, and various key points in the wetland between.

**Three possible options are available:**

1. Continue using the existing lagoon as it is until a new sewage facility can be designed and built
2. Repair and improve the existing lagoon for the short term until a new sewage facility can be designed and built
   - Explore appropriate options for short-term sewage disposal for the community (if we determine that a new sewage system needs to be constructed in future). Some areas of exploration may be:
     - Use the existing lagoon as a settling pond for solids, and create another cell on the east side of the berm (down-hill). Refer to Fig. 2.
     - De-cant the lagoon and transport the dry sludge to an approved land farm. As part of the Water License application to the Nunavut Water Board, explore the possibility of applying for an *alternative discharge area* in the wetland, and transporting the

aggregate already part of the old system to the new lagoon location. The advantage of this option is that this accomplishes decommissioning of the old lagoon at the same time.
- Increase the height of the existing lagoon's sides and repair breached sections. Ultimate decommissioning would follow.

3. Repair and improve the existing lagoon for the long term (20 years)– in which case, a new facility is not required.

If these options are cost-effective: in collaboration with the CGS team, provide the design and write a Request for Tender (RFT) for the repair, re-construction and/or decommissioning of the old sewage lagoon. Effective strategies must be found to enable people travelling over the land to cross the path the effluent will take to the ocean outfall without experiencing aesthetic or health concerns. These strategies may be a combination of culverts (often not effective due to freeze-up in winter, unless hamlet crews cover them each winter to prevent snow and ice accumulation and subsequent spring blockage), swales, or gravel fords and built-up trail.

**2.4.6.1.2 New Sewage Facilities**

- If consensus is reached that a new sewage facility is required, the consultant team will work with the CGS team to research innovative, appropriate alternative sewage disposal options that are designed to meet community demand and the anticipated (more stringent) effluent standards over a minimum of the next 20 years. Research will be done to determine good design practices for retention time in Arctic applications. Essentially, the consultant-GN team will endeavour to choose that option that simply allows the bacteria (be it aerobic, anaerobic, facultative, or a combination of these) to most easily and cost-effectively perform their function of breaking down sewage influent to an ultimate state where it meets the expected guidelines and criteria at the end of its discharge path.
  - Examples of options may be package treatment plants, engineered wetlands with single cell (or more) lagoon (there is good engineered wetland potential), shallow aerobic lagoon, deeper aerated lagoon to effectively reduce the amount of ammonia (using renewable energy sources to power the high-efficiency pumps), or deep anaerobic lagoons.
  - Communication and information-sharing with the Hamlet mayor and SAO will be necessary. Locations chosen must ultimately meet with Hamlet Council approval – especially if anaerobic or facultative bacterial action is anticipated.
- If the land disposal option is chosen, the consultant team will perform any necessary geotechnical investigations, topographical work (some has been done: see appended plan), and laboratory sieve analyses (and other soil mechanics lab work) if necessary to determine the estimated quantity and quality of aggregate sources within close distance to the proposed lagoon. Part of the scope of the geotechnical investigation will be to determine the sub-surface characteristics of the topography near the proposed sewage site so that breaching and leakage will not occur. Impermeable liners or perhaps rock blasting options will be explored.
- The design will include site preparation work if necessary. The consultant-GN team will explore best options for this, including requiring a sand bed prior to placing the impermeable membrane, the addition of bentonite to augment existing aggregate sources, and locating most cost-effective and acceptable granular sources.

- The design will also include options for monitoring and data collection on the quality and quantity of effluent at various stages along the effluent stream.

**2.4.6.1.3 Depending on which option is chosen:**

- The consultant will work with the RMPE to develop an Abandonment and Restoration (A&R) plan and Operation and Maintenance (O&M) procedures, which will include a Spill-Contingency Plan (SCP) for the new or old facility, prepared in accordance with the requirements of the applicable NWB Guidelines.
- Among others, the following regulatory bodies must be consulted, as required, prior and during design:
  - Department of Fisheries and Oceans
  - DIAND (INAC)
  - Environment Canada
  - Sustainable Development (Environmental Protection Officer)
  - Health and Social Services (Environmental Health Officer)
  - Nunavut Water Board
- In collaboration with the CGS team, write a Request for Tender for the construction of the sewage facilities. Note that this RFT may take one or more forms aimed at one or more contracts, depending on the results of the design options.
- The successful proposer will work with the CGS team to monitor the construction of the new and/or old facilities. This may involve the placement of Shelby tubes and other surveying and monitoring devices.

**2.4.6.2 Solid Waste Facilities:**

- Explore cost-effective methods to extend the life of the existing facility. These will include fencing material alternatives, earthen access ramp and pit, daily tarp cover (to prevent excessive leachate generation and airborne material), movable netting fence to leeward.
- If the existing dump is properly capped and fenced, there is a good possibility that the community could continue to use it for another 20 years. If this alternative is possible, the design team will perform a cost-benefit analysis using an acceptable MARR, etc (see above for other parameters) and compare with the cost of new dump.
- Find alternative locations for a new solid waste facility. (Note: the proposed locations must be acceptable to the community Council).
- Explore innovative options for solid waste disposal, including environmentally-acceptable incineration, reduction of waste production, recycling, separation at source, separation at site, etc. Involvement and consultation with Hamlet staff and foremen will be required.
- Compare the cost-benefit analysis[2] obtained for extending the life of the existing facility with that of constructing the new facility
- In collaboration with the CGS team, write a Request for Tender for the construction of the new solid waste facilities and/or the renewal and of the existing one. Included in this RFT may be alternative approaches to solid waste disposal. This design will include an A&R plan and an O&M procedures document.

2 Cost-Benefit Analysis to include an acceptable MARR, certain externalities (such as true cost of fossil fuel, Arctic O&M costs, environmental clean-up and de-comissioning), and replacement costs

**2.4.6.3 Bulk Metals Facilities:**

- The existing facility needs tidying up and fencing. Cost-effective solutions to the tire accumulation problem must be found. In addition. the hamlet must have control of who has access to dumping and recycling. Determine if it is feasible to extend the life of the existing facility. If so, the design team will perform a cost-benefit analysis and compare with a cost-benefit analysis of constructing a new facility, including a proposed location (Note: the proposed location must be acceptable to the community Council).
- Reduction: Determine if and how any of the metals in the dump can be sent south for scrap with the barge. Exploration of metal cutters, shredders, and drum crushers will be undertaken. Note that as part of the new Marine Facilities just built, there is now a large staging area near the wharf where it may be possible to stock-pile containerized and/or bundled metal prior to shipping south. It would be desirable to determine an immediate solution to the years of metal accumulation, and also to design a system of regular crushing, bundling, and shipping of future accumulations.
- **Recycling:** Work closely with the Project Team and Hamlet Foreman to arrive at a workable solution to community recycling. It is recognized that in the North, dumps are a much-used source of spare parts and items that can re-born, Three requirements must be met in order to make recycling work: 1). Sufficient area must be allocated,2). Hamlet must control of access, in order to prevent indiscriminate dumping, and 3). Provision must be made for eventual disposal of real scrap.
- In collaboration with the CGS team, write a Request for Tender for the construction of the new bulk metals facilities and/or the modification and cleaning up of the existing one. This design will include an A&R plan and an O&M procedures document.

**2.4.6.4 Waste Oil and Batteries Area**

- Determine if the present location is too close to the existing and/or new sewage facility by analysis of overland flow and water sampling. If this is the case, a new holding area must be located (again, in collaboration with hamlet crews, CGS Project Team, and hamlet Council).
- Fencing will be required so that hamlet crews have control of access.
- Determine safe and innovative ways of disposing of existing drums of accumulated oil and other liquids, and batteries.
- Write an RFT for construction of the renovated facility or the new one. If a new facility is required, soil remediation in the existing one will be needed. This design will include an A&R plan and an O&M procedures document.

**2.4.6.5 Land Farm**

- As part of the Water License application to the Nunavut Water Board, the team will determine if we can create a land farm (or alter the existing one) which can accept dry sewage sludge from the existing sewage lagoon. This would give more capacity to the lagoon.
- The successful proposer may be required to design new land farm facilities. This design will include an A&R plan and an O&M procedures document.
- In collaboration with the CGS team, write a Request for Tender for the construction of the new land farm facilities or the alteration of the existing land farm.

**2.4.7 Site Visits, Project Management and/or site monitoring & verification:**

Depending on the nature of the designs, there may be a degree of project management involved. Some aspects will need the site services of a professional engineer. Others will require an engineering technologist or an EIT. As a minimum, the consultant will budget for the following on-site visits (total of 20 trips):

- 3 consecutive days by consultant engineer on site for preliminary assessment of needs and explorations of sites (1 trip)
- 12 days on site (3 consecutive days each visit) for geotechnical investigations and test pits. Local back-hoe will be used, as will the services of a reputable geotechnical laboratory (4 trips)
- 21 days on site during construction (not all consecutive) for various tests, monitoring and verification of contractor work during Phase 1 (4 trips)
- 40 days on site during Phase 2 construction monitoring (5 trips)
- 9 days on site for commissioning (3 trips)
- 20 days on site for training of Hamlet staff operators (3 trips)

**2.4.8 Design Guidelines:**

- Performance criteria, preferred materials or method and logistical considerations for the design and construction of the new facilities are to be in accordance with the GN's "Good Building Practices Guidelines, Design Review Stages, and Document Submissions" (6/05/03), the GNWT's Public Works and Services "Design Standards and Guidelines" (October 1996), and Community Government and Transportation "Capital Standards and Criteria", (GNWT), July 1993 issue. These standards and guidelines are to be referred to in their entirety in the development and construction of this project. Consultants are encouraged to present for consideration alternatives to any design requirement or standards where equal or better performance can be achieved at a lower life-cycle cost.
- As a minimum, all construction of buildings and works in the Nunavut Territory is governed by best engineering practices or by the current editions of:
  - -ASHRAE Standards
  - -Canadian Electric Code
  - -Canadian Measures for Energy Conservation in New Buildings
  - -Illuminating Engineering Socitey's Lighting Handbook
  - -National Building Code of Canada
  - -Canadian Geotechnical Society "Foundation Engineering Manual"
  - -Guidelines for Canadian Drinking Water Quality
  - -Environment Canada's Guidelines for Effluent Quality and Wastewater Treatment
  - -Federal or Territorial solid waste guidelines and best practices

**2.4.9 Monitoring:**

Monitoring sensors may be installed in various facilities if the need is identified during design development. Direct Digital Control (DDC) systems may also be installed.

**2.4.10 Deliverable Documents and Drawings:**

The consultant shall provide the GN with three electronic copies (CD) of all drawings (AutoCAD 2005) and specifications (MS Word format), with complete read/write access.

The consultant shall prepare "AS-Built" electronic drawings (AutoCAD 2005) from marked up prints produced by the contractor and site consultant, and provide the GN with three CD copies. All documents submitted for review shall be in the following formats:

A. Hard copy.
B. Electronic AUTOCAD 2005 drawings, with complete read/write access.
C. Technical Services are reviewing all construction documentation (drawings and specs) electronically. In addition to the specified number of hard copies (required by region, etc...) drawings shall be provided in grey scale PDF format with a resolution of no less than 1200 dpi.PDF paper size shall be the same as the paper size used for the hard copy. PDF drawings shall be coordinated with the hard copy drawings. Each page of the hard copy drawings will be represented with a separate PDF file. The PDF file will be named using the drawing number and the drawing name divided with a dash (example: A1-First Floor Layout).

- Data collected ($BOD_5$, $NH_3$, TSS, FC, and all parameters required in past water licenses)
- Various cost-benefit analyses reports
- Geotechnical reports, including, as needed, various soil mechanics lab analyses
- Topographical surveys, if needed
- Environmental Assessment studies or reports, as required
- Brief report regarding design options explored, along with Class D estimates and C/BAs
- Various designs, specifications, and AutoCAD drawings for the chosen options
- Class A estimates for these options
- Applications to various funding bodies such as the SIF and MRIF, GTI
- Write Operation & Maintenance (O&M) procedures for the various waste facilities, with a Spill Contingency plan for the sewage facility as an appendix
- Write Abandonment and Restoration (A&R) plans for all facilities
- Applications to various regulatory agencies
- Electronic and hard copies of all design drawings (AutoCAD 2005) and Specifications
- One or more RFTs
- Various reports and soil analyses during construction of the facilities, as needed
- As-built electronic and hard copies of all drawings from marked-up prints produced by contractor

**2.4.11 Project Delivery:**

It is expected that this project in Kugluktuk will be delivered through the standard tendering procedure. The Project Officer of Community Government and Services will be responsible for managing this project through the stages of detailed planning, design, tendering processes, construction and warranty. CGS Technical Services in Iqaluit may provide assistance. The Regional Municipal Planning Engineer (RMPE) is responsible for providing over-all program information and direction, and taking part in design and subsequent review of all design submissions. The RMPE must approve any modifications to the program contained within this Request for Proposal prior to implementation of these changes.

**2.4.12 Past Relevant Experience**

Provide a short list of projects in which the Consultant and Sub-Consultant have performed similar work. The outline of experience should indicate how schedules were met and how final costs compared with estimates. References for substantiation are to be provided.

**2.4.13 Target Schedule:**

Note: Periodic review meetings will be held, with the Consultant and GN representatives present. Location of meeting will be dependent on the phase, and will be either in Cambridge bay, on site, or via teleconference.

| | |
|---|---|
| **September 21, 2005** | RFP close |
| **September 28, 2005** | Consultant Contract award. |
| **Sept 28 to Sept 30** | The Consultant will work with the RMPE to provide a review of Terms of reference, providing recommendations and an outline of proposed design parameters. |
| **Oct 03 to Oct 07** | A timetable will be set for a project team site visit during October. Topographic survey, sampling of sewage water and geological study will be undertaking during this visit. |
| **Oct 07 to December 31** | Design Developments. |
| **January 1 to Jan 30** | GN review 100 % complete drawings. |
| **Feb 1 to Feb 15** | Consultant/GN to incorporate required changes in Tender documents and print. |
| **Feb 15 to March 15** | Tender call for construction. |
| **March 15 to April 1** | Tender close. |
| **Construction Season, 2006** | Consultant to provide on-site monitoring and geotechnical services as required. Construction may takes place over one to three construction Seasons depending on design requirements and availability of granular material. |

# 3. Proposal Evaluation

**3.1 Selection Methods**

When an alternative is proposed regarding any specific requirement, it will be evaluated to ensure that the desired results will be achieved.

Proposers should be aware that certain mandatory requirements may have been set out in the Terms of Reference. Proposals that fail to provide these requirements will be deemed not responsive and will not be evaluated.

### 3.2 Rating

- The evaluation team will utilize specific criteria to rate each proposal. Ratings will be confidential and no details will be released to any of the other proposers.
- Each proposal will be evaluated using the standard "Architecture/Engineering Consultant Proposal Rating Schedule included as part of this proposal request." See Appendix "C"

### 3.3 Proposal Content

The following information should be provided in the proposal. This information will be utilised in evaluating each proposal submitted.

#### 3.3.1 Project Team (Proposed Personnel)

- The proposer is to describe the capability of the resources proposed to meet the requirements described in the terms of reference.
- The proposal shall include brief resumes for the proposed sub consultants and project team members with a description indicating how, and in what ways the proposed resource satisfies the needs identified in the Request for Proposal.

#### 3.3.2 Methodology

Describe how the proposer intends to achieve the project's objectives. Demonstrate understanding of the work involved, design collaboration with the RMPE and PO, possible renewable energy content, use of appropriate technology, community input, budget schedule and other significant factors to be considered. It is expected that the methodology and schedule will demonstrate how the proponent will proceed and how much time each stage is expected to take.

#### 3.3.4 Past Relevant Company Experience

Provide a list of projects in which the Consultant and Sub consultants have performed similar work.

#### 3.3.5 Schedule

Indicate how closely the proponent's schedule meets the project requirements in a logical manner delivering a quality service.

#### 3.3.6 Fees and Expenses

Prices bid must be stated in actual dollars and cents expressed in Canadian funds. The proposal must include cost information as follows (broken down according to each facility):

- A lump sum fee for preliminary design, design development, construction documents, bidding
- An estimate of disbursements of non–field expenses such as telephones, facsimile, courier, copy, photographic, postage, computer and tender document printing costs. Assume 25 sets of tender documents for each tender.
- A lump sum for each of the Construction phase requirements (include an estimate for disbursements) as outlined above
- Cost details, daily rate schedule and per diem rates for project team members for in and out of office services.
- An estimated total contract amount
- Do not include GST in your proposed pricing. The Government of Nunavut will pay the Goods and Services Tax (GST).

Note: The number of days and trips listed above are an estimate based on our experience with similar projects and are meant to provide a consistent measure across all proposals. The actual numbers may be different and will be amended based on information as it becomes known.

### 3.3.7 Local and Nunavut Content

Identify the place of residence of each member of the team, his or her home office location and provide an estimate of the percentage of work that will be performed in Nunavut and the communities. Provide an estimate of the percentage of the total work for the project that will be completed by Nunavut businesses and businesses local in the subject community for the project.

### 3.3.8 Inuit Content

In compliance with Article 24 of the Nunavut Land Claim Agreement, the Government of Nunavut will provide consideration for the use of Inuit goods and services and labour. Proponents should describe fully the proposed Inuit content. This Inuit content will be the percentage of work for this project to be completed by Inuit firms listed on the registry of Inuit firms maintained by Nunavut Tunngavik (NTI), and the amount of Inuit employment created related to this project.

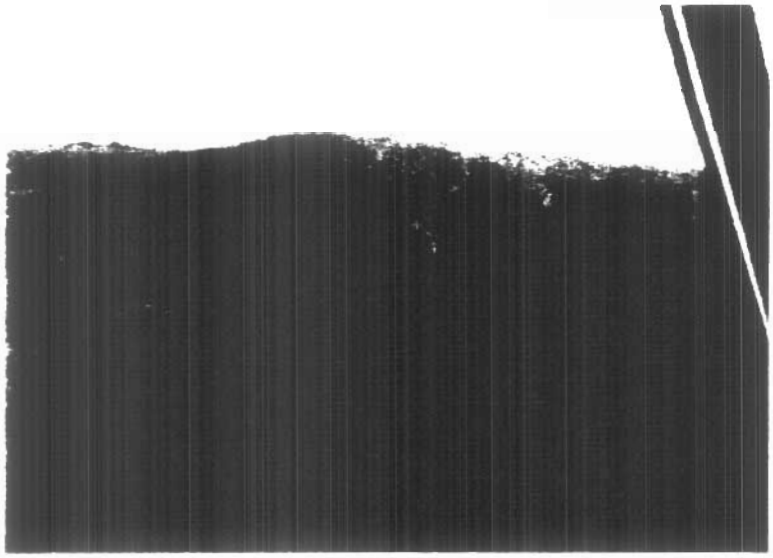
## ACRONYMS

| | |
|---|---|
| A&R | Abandonment and Restoration |
| C/BA | Cost-Benefit Analysis |
| CGS | Community and Government Services |
| DDC | Direct Digital Control |
| DFO | Department of Fisheries and Oceans (Federal) |
| DIAND | Department of Indian and Northern Development (part of INAC) |
| GTI | Gas Tax Initiative |
| INAC | Indian and Northern Affairs Canada |
| MARR | Minimum Acceptable Rate of Return |
| MRIF | Municipal Rural Infrastructure Fund |
| NIRB | Nunavut Impact Review Board |
| NWB | Nunavut Water Board |
| PO | Project Officer |
| RFP | Request for Proposals |
| RFT | Request for Tenders |
| RMPE | Regional Municipal Planning Engineer |
| SCP | Spill Contingency Plan |
| SIF | Strategic Infrastructure Fund |

# Appendix A: Study & schematic Design FSC,2004

# Planning Study & Schematic Design for the Kugluktuk Sewage Treatment Facility

## Final Report



*prepared for:*

*Government of Nunavut*
*Department of Community, Government & Transportation*
*P.O. Box 1000,Station 700*
*Iqaluit, NU X0A 0H0*

*prepared by:*

*FSC Architects & Engineers*
*4910 53rd Street*
*Yellowknife, NT*
*X1A 2P4*

FSC Project No: 2003-0760

Date: March 8, 2004

FSC
ARCHITECTS
& ENGINEERS

# Planning Study & Schematic Design for the Kugluktuk Sewage Treatment Facility

# Final Report

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## 1.0 EXECUTIVE SUMMARY

FSC was contracted to complete a design and a Class "C" estimate for a proposed sewage lagoon in Kugluktuk, NU. The lagoon was required to be of the "exfiltration" type, the effluent of which would receive additional treatment in wetlands that were already in use for sewage treatment.

A proposed lagoon is described. The lagoon would provide 8 months ice storage plus a an additional 4 months of warm weather storage to provide a secondary effluent. The effluent would be further polished in the present wetlands, which have flow attenuation structures proposed to improve treatment capabilities. The system as proposed should meet Nunavut Water Board requirements. A Class C cost analysis estimates the project at $8,870,000.

FSC was also asked to view a granular source located at an esker on the other side of the Coppermine River. This source requires a geotechnical evaluation to determine if it contains sufficient granular resources. Visual inspection suggests that it does not. The granular material in this source, however, is well graded gravel and sand with a trace of silt. It is suitable for use as construction materials.

# 2.0 INTRODUCTION

FSC was contracted to complete an inclusive study of the sewage treatment facilities in Kugluktuk by the Government of Nunavut (GN) Department of Community, Government and Transportation (CG&T).

## 2.1 SCOPE OF WORK

The scope of work for this project includes:

- A detailed topographic survey of the area adjacent to the truck discharge point clearly indicating all relevant features such as;
  - Rock outcrops,
  - Pond areas, and
  - Trail locations etc.
- Prepare a plan of the above area indicating;
  - The proposed location and configuration for a Winter Ice Pack Storage Cell with granular exfiltration berms. The volume of the cell must be adequate to hold all sewage discharged during the winter freeze period. In addition the capacity must take into consideration the population projection for a twenty-year period.
  - The location for a summer lagoon cell:
  - Access road and turn around areas for discharging.
- Using aerial mapping, prepare a plan showing the lateral and longitudinal limits of the wetlands treatment area, between the discharge point and the outfall at the ocean.
- Conduct an inspection along the full length of the wetlands area between the discharge point and the ocean outfall to determine the number and location of granular retention berms required. These berms are intended to slow down the rate of flow of the effluent and to spread the flow laterally over the vegetation of the wetland area.
- Conduct an inspection of a gravel esker, which is located upstream about 2 kilometres from the water intake and across the Coppermine River. The

inspection should determine the estimated quantity and quality of granular materials available that would be suitable for the construction of exfiltration berms. Access to this location must be made by boat.

- Upon completion of the above items, a report is to be submitted with;
  - Recommendations for the proposed facilities;
  - A schematic design; and
  - A detailed Class "C" cost estimate.

# 3.0 BACKGROUND

## 3.1 LAGOON CONFIGURATIONS

A sewage lagoon uses an enhanced version of the natural treatment process. The lagoon's purpose is to compress the natural treatment process in time and space, and to provide some control over the outcome.

In nature, sewage will always act in a particular way. First, the heavy solids will settle. Next the smaller, lighter solids will settle. Dissolved materials usually stay dissolved.

The lagoon is designed according to this understanding. One or more small lagoons are used to remove the heavy solids. These primary lagoons are usually quite deep in order to provide storage for the solids and keep offensive odours in the water.

The next lagoon in the process provides secondary treatment and is called a facultative lagoon.

Many lagoons in the Nunavut and the NWT are single cell ponds, which combine both the primary and secondary function. Some of these lagoons are small and only hold the sewage for a short time. These lagoons are based on older technology. As the communities grow, single-cell sewage treatment in Nunavut and the NWT are being replaced with multi-cell lagoons that have at least 12 months of storage.

## 3.2 GENERAL DESIGN CRITERIA

Following are generalized design criteria for a single cell, annual retention lagoon.

| | |
|---|---|
| Length/Width Ratio | 2:1 |
| Dead Storage | 0.1m to 0.5m deep |
| Working Volume | 1.5m to 2.0m deep |
| Working Volume | Should retain liquid for a design period of 12 months |
| Freeboard | 1.0m |

## 3.3 2-Cell Lagoons

*Sewage Lagoons in Cold Climates* advises that 2-cell lagoons or secondary lagoons are generally used to provide enhanced secondary treatment as a result of an increased storage capacity. To provide maximum benefits, both cells should be able to retain a full years wastewater. This would mean that each year's effluent has a two-season treatment.

Winter effluent can remain in the first cell while treatment is prevented due to snow and ice cover, and reduced sunlight. Treatment is provided over the summer season.

The design for the second cell should meet the criteria generally established for a single-cell lagoon. The inlet arrangement would not usually be a catchment from a truck or intake from a piped sewer system. It could be made up of a valve overflow pipe, siphoning system or a seasonal pumping system.

## 3.4 Cell-to-Cell Transfer

Common practice of Southern Canadian sewage lagoons is to have a multiple cell system with piped transfer between cells. Generally speaking, they also receive raw sewage through a piped system. With heat being continuously added to the lagoon, warm ground and a less harsh climate, the potential for pipes freezing is reduced.

The majority of sewage lagoons in Nunavut are filled using a trucked system or a combination of piped and trucked system. A trucked system is used in Kugluktuk.

For trucked sewage the fill-and-draw method is most often used for cell-to-cell transfer.

In this method, treated sewage is discharged from the first cell until the liquid reaches a predetermined elevation. What generally happens during the winter is that sewage is discharged into the first cell during the day and freezes in a thin layer. By the end of the winter, the entire lagoon may be a block of ice. Thus, it would be impossible to have a continuous stream of liquid required for cell-to-cell transfer.

That being said, we do not have an example in Nunavut of a piped cell-to-cell transfer for a lagoon receiving only trucked sewage.

## 3.5 Wetlands and Overland Flow

Wetland sewage treatment is a web of complex physical and biological processes. Sedimentation, absorption of pollutants in the surface soils, nutrient uptake by plants, and the oxidation of compounds by microorganisms are just some of the processes that affect the treatment.

Wetlands are transition zones between terrestrial (land) and aquatic (water) environments. The word, "wetland", is relatively new terminology which refers to all types of wetland areas. For sewage treatment purposes vegetated areas that are normally dry ground can be converted to a "wetland".

The plants within a wetland act as natural purifiers trapping and binding pollutants in the mud and roots. The plants also provide a media to which bacteria can cling as it grows. These bacteria, many identical to those present in a mechanical sewage treatment plant, remove carbon and nutrients from the water. Figure 2 in Appendix A shows a model of this process.

Finally, the thin layer of now clean water allows sunlight to penetrate deeply, thus, killing pathogenic organisms and disinfecting the water. There are many positive aspects to using wetlands for sewage treatment including:

- By enhancing wetlands with nutrients and liquid, the ecology of the area becomes more productive. This, in turn, attracts birds and mammals with a rich productive food source;
- Wetlands provide inexpensive secondary/tertiary treatment; and
- Wetlands are one of the few technologies that meet the *General Provisions of the Fisheries Act.*

Wetlands nurture biodiversity. In fact, wetlands are said to rival tropical rainforests in productivity. They provide: feeding, spawning, and nursery grounds for fish and other aquatic life; sanctuary and food for millions of insects and birds; and they are the only environment in which certain plants can live. Wetlands are the earth's kidneys - they absorb and filter out pollutants that would otherwise end up in our receiving waters, and they protect shorelines and riverbanks from erosion.

# 4.0 PROPOSED SEWAGE TREATMENT FACILITY

## 4.1 DESIGN CONCEPT

Based on the current wetland system, regulators concerns and the topography of the area, FSC proposes a sewage treatment system (See Drawings, C-1 - C-4 in Appendix B):

1. A sewage lagoon, with two cells joined by a common wall. The first cell would have 8 months storage, including sludge storage, and the second cell would have 4 months storage.

2. From the 4-month cell, the effluent would exfiltrate to the current wetlands system for polishing or finishing before discharge to Coronation Gulf.

This system offers:

- Settling of solids in the 8-month cell. By settling in this containment cell the sludge can be easily removed whenever necessary. Solids accumulation in the wetlands is a regulatory concern.

- More efficient treatment in the 4-month cell after settling in the 8-month cell. With most of the solids settled out in the 8-month cell, sunlight can better penetrate into the working depth and treat the sewage.

- Reduced loading to the wetlands. The effluent from the secondary lagoon will be higher quality than the raw sewage currently being introduced. Therefore, by the time the effluent reaches the wetland discharge point the wetlands should have treated the lagoon effluent to well below the water licence requirements. Estimated effluent quality will be modelled later in the report.

## 4.2 SLUDGE REMOVAL AND DISPOSAL

During the life of the facility, sludge may need to be removed from the sludge storage area. Removal could be accomplished by draining the area in the fall, allowing it to freeze and then scraping the frozen solids from the lagoon using heavy equipment. Sludge could then be disposed in a special cell located near the lagoon, or located at a remote site such as the solid waste site.

Removing sludge from lagoons during their operating life has not been a practice in Nunavut, nor is required by any regulatory agency. Should removal be required, the

Nunavut Water Board must approve the disposal location. There is sufficient space adjacent to the proposed lagoon to construct such a cell.

## 4.3 SEWAGE GENERATION

The volume of the cells will depend on the projected volume of sewage generated by the community in 20 years. FSC assumes that, for a trucked system, the volume of water consumed by all residents is equivalent to the sewage generated.

GN planning guidelines suggest that the increase in the projected per capita water use in a community should be modeled through equation (1) below.

**Per Capita Water Use =**

**RWU x (1.0 + (0.00023 x Population))**

Where: RWU or residential water use is estimated to be 90 litres per capita per day (Lpcd) for populations lower than 2000 using a trucked delivery system.

While completing the water licence application for the Hamlet of Kuglutkuk in June 2003, FSC received water use information from the water treatment plant operators. Their data shows a lower RWU than the model estimates.

At that time, the operator estimated that the daily water use rate for all consumers was 100,000 L per day. FSC estimates the population to be 1,258 this corresponds to a RWU of 65 lpcd. However, for planning purposes, FSC will use the RWU of 90 lpcd.

The projected sewage generation for the 20-year design period is shown below in Table 4.1

**Table 4.1 20-year Sewage Generation, Kugluktuk, NU**

| | |
|---|---|
| Census Population | 1212 |
| Census Year | 2001 |
| % Population Increase | 1.88 |
| Residential Water Use | 90 lpcd |
| BOD | 45 grams |
| TSS | 48 grams |
| T-PO4 | 2.3 grams |
| TKN | 12 grams |
| FC | 9.50E+10# |

| Planning Year | Calendar Year | Total Population | Projected Water Use (lpcd) | Projected Volume (l/day) | Projected Volume (l/day) | BOD (mg/l) | TSS (mg/l) | T-PO4 (mg/l) | TKN (mg/l) | FC (#/dl) |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | 1212 | 115.1 | 139,487 | 50,912,806 | 391 | 417 | 20 | 104 | 8.25E+11 |
| | 2002 | 1235 | 115.6 | 142,692 | 52,082,544 | 389 | 415 | 20 | 104 | 8.22E+11 |
| 0 | 2003 | 1258 | 116.0 | 145,979 | 53,282,340 | 388 | 414 | 20 | 103 | 8.19E+11 |
| | 2004 | 1282 | 116.5 | 149,351 | 54,513,067 | 386 | 412 | 20 | 103 | 8.15E+11 |
| | 2005 | 1306 | 117.0 | 152,810 | 55,775,623 | 385 | 410 | 20 | 103 | 8.12E+11 |
| | 2006 | 1330 | 117.5 | 156,359 | 57,070,938 | 383 | 408 | 20 | 102 | 8.08E+11 |
| | 2007 | 1355 | 118.1 | 160,000 | 58,399,968 | 381 | 407 | 19 | 102 | 8.05E+11 |
| 5 | 2008 | 1381 | 118.6 | 163,736 | 59,763,704 | 379 | 405 | 19 | 101 | 8.01E+11 |
| | 2009 | 1407 | 119.1 | 167,570 | 61,163,168 | 378 | 403 | 19 | 101 | 7.98E+11 |
| | 2010 | 1433 | 119.7 | 171,505 | 62,599,412 | 376 | 401 | 19 | 100 | 7.94E+11 |
| | 2011 | 1460 | 120.2 | 175,544 | 64,073,527 | 374 | 399 | 19 | 100 | 7.90E+11 |
| | 2012 | 1488 | 120.8 | 179,689 | 65,586,637 | 373 | 397 | 19 | 99 | 7.86E+11 |
| 10 | 2013 | 1516 | 121.4 | 183,945 | 67,139,903 | 371 | 395 | 19 | 99 | 7.83E+11 |
| | 2014 | 1544 | 122.0 | 188,314 | 68,734,525 | 369 | 394 | 19 | 98 | 7.79E+11 |
| | 2015 | 1573 | 122.6 | 192,799 | 70,371,740 | 367 | 392 | 19 | 98 | 7.75E+11 |
| | 2016 | 1603 | 123.2 | 197,405 | 72,052,830 | 365 | 390 | 19 | 97 | 7.71E+11 |
| | 2017 | 1633 | 123.8 | 202,135 | 73,779,115 | 363 | 388 | 19 | 97 | 7.67E+11 |
| 15 | 2018 | 1663 | 124.4 | 206,992 | 75,551,962 | 362 | 386 | 18 | 96 | 7.63E+11 |
| | 2019 | 1695 | 125.1 | 211,980 | 77,372,780 | 360 | 384 | 18 | 96 | 7.60E+11 |
| | 2020 | 1727 | 125.7 | 217,104 | 79,243,028 | 358 | 382 | 18 | 95 | 7.56E+11 |
| | 2021 | 1759 | 126.4 | 222,368 | 81,164,212 | 356 | 380 | 18 | 95 | 7.52E+11 |
| | 2022 | 1792 | 127.1 | 227,775 | 83,137,887 | 354 | 378 | 18 | 94 | 7.47E+11 |
| 20 | 2023 | 1826 | 127.8 | 233,331 | 85,165,663 | 352 | 376 | 18 | 94 | 7.43E+11 |

### 4.3.1 Sludge Generation

Sludge accumulation is calculated using the per capita sludge generation model, 50 gms/cd. Table 4.2 projects the average sludge generation and accumulation.

| Planning Year | Projected Sludge ($m^3$/yr) | Accumulated Sludge ($m^3$) |
|---|---|---|
| 0 | 23 | 23 |
| 5 | 25 | 144 |
| 10 | 28 | 278 |
| 15 | 30 | 424 |
| 20 | 33 | 585 |

**Table 4.2 Projected and Accumulated Sludge, Kugluktuk, NU**

## 4.4 DESIGN PARAMETERS

### 4.4.1 SEWAGE VOLUME

As discussed in the previous section the volume of the lagoon will depend on the volume of sewage generated. For planning purposes, the 20-year, 2023 volume of sewage will be used as the total design volume, 85,200 $m^3$.

The volume required for the 8-month cell is 56,800 $m^3$.

The volume required for the 4-month cell is 28,400 $m^3$.

### 4.4.2 SLUDGE STORAGE

A sludge storage area has been incorporated at the head of the 8 month lagoon, immediately downstream of the off-load chutes. The area has a depth of 0.3 m and has a volume of 690 $m^3$.

### 4.4.3 SITE PREPARATION

The lagoon is to be an exfiltration design, therefore, it should be perched as much as possible to allow liquid to travel freely through a short pathway to the collection trench. The invert of the trench leading to the wetlands is to be the same elevation as the base of the lagoon.

Vegetation and organic soil must be removed from the site and stockpiled elsewhere for future use.

Excavation of the site to accommodate the dead storage and accumulated sludge volume of the lagoon may provide additional savings, and if the material is determined to be

suitable, it could be used in the construction of berms. If not suitable, the material should be stockpiled elsewhere for future use.

The site must be graded to proper elevations.

This project is being initiated without benefit of a geotechnical examination of the site. In lieu, based on local knowledge and in consultation with CG&T, it is assumed that the depth of vegetation and organic matter is 300mm. It is also assumed that any granular material recovered from the site will be suitable for construction. It is also assumed that the soil can be excavated a minimum of 1m in depth from the original ground.

### 4.4.4 Liquid Depth

The working depth will be 2m. The freeboard required for the berms will be 0.5m, because the berms will exfiltrate, thus liquid should not exceed 1.0m during the ice-free season.

There is a dead storage area of 0.3m.

The total depth required is therefore 2.8m.

### 4.4.5 Cell-To-Cell Transfer

The cell-to-cell and lagoon to wetlands flow will be by exfiltration through the 2m wide exfiltration berms. We anticipate that sufficient water will exfiltrate the system during the ice-free season. Exfiltration rates are primarily dependant on head and porosity. During the life of the system the head will vary annually and seasonally. The porosity of the berms can also become variable as solids may accumulate, thus, restricting flow.

Recognizing this, an effluent discharge pipe could be installed as a contingency. Windmills or solar pumps are alternate, sustainable technologies that are being seriously considered for the Arviat lagoon. This technology could also be applicable in this situation it be needed in the future.

### 4.4.6 Berms

The berms for the sewage lagoon will be designed using a 3:1 slope. The top of the berms will be 2 m wide for the exfiltration berms and 3 m wide for the containment berms. See drawing C-3 in Appendix B.

### 4.4.7 Stone Check Dams

FSC staff walked the length of the entire wetland area and noted the following:

- It was noted that there is no apparent scouring of the bed of the watershed.
- The stream flows from a small lake south of the proposed location of the sewage lagoon.
- Downstream of the proposed lagoon, the stream enters a small glacially formed valley. This valley has a wetland bottom, with silt and cobble aggregate, and typical high arctic wetland plant communities.
- It appears to be a healthy, and diverse wetland.

As part of the sewage lagoon/wetland system we recommend installing three check dams in locations identified on Drawing C-6. These should be installed in the winter when the ground is frozen to provide access and decrease erosion caused by heavy equipment.

Stone check dams are flow attenuation devices made out of course rock >10cm in diameter (See Drawing C-5). They are designed to slow water flow, increase water retention time, decrease scouring, and spread water flow over a larger wetland area.

The proposed sewage lagoon will not increase total flows in the watershed, as the watershed currently receives the community's sewage. In a typical small arctic watershed, the hydrograph is strongly peaked during the spring snow melt period, than drops rapidly to a low relatively constant summer flow with occasional spikes for heavy rain events. During the spring freshet the potential for scouring of the streambed is the greatest. This is the period when the check dams would be most effective in slowing the flow and spreading it onto the wetland area to slowly recharge the stream later in the season.

Without the sewage lagoon and check dams, and as is the case now, the winter's sewage stored as ice is discharged during the peak in the hydrograph, before the plants in the wetland are active, and adds to the peak flow. The proposed sewage lagoon will now store sewage during the winter and discharge continuously during the summer season, thus, providing a more even flow regime for the lagoon effluent, and a great opportunity for additional treatment in the wetland, while reducing the peak of the hydrograph and the scouring potential.

The three check dams we propose are a preliminary measure, which we further propose as part of a three year monitoring program of the wetland. As the wetland formerly

received untreated sewage, and is now proposed to receive treated sewage, the three-year period is recommended to allow the wetland to cleanse itself of the raw sewage, and stabilze with the new effluent quality, so that discharge quality becomes more predicable.

During this three year period, the wetland should be be monitored during the spring freshet, mid-summer and later in the fall before freeze-up. This should include determining effluent quality from the lagoon, the upper wetland, mid-point, and the lower wetland at the NWB compliance point to determine the effectiveness of the wetland and whether further mitigation, such as more, larger, or different check dams, are necessary.

### 4.4.8 WETLANDS

#### *4.4.8.1 Sewage Characteristics*

The Nunavut Water Board projects raw sewage characteristics based on the per capita rates shown in Table 4.1. The Nunavut Water Board projection demonstrates that parameters testing sewage quality decrease in value as a result of the dilution due to the increase in water use.

Influent into the wetland will have already been treated in the exfiltration cells, therefore it is conservatively estimated that BOD and suspended solids concentrations can be reduced by 40%. All further calculations will be made using the adjusted contaminant calculations in Table 4.3.

**Table 4.3 Sewage Characteristic After Lagoon Treatment**

| Parameter | Concentration |
|---|---|
| | (mg/L) |
| BOD | 233 |
| TSS | 248 |
| T-PO4 | 12 |
| TKN | 62 |
| FC | 4.91E+07 |

#### *4.4.8.2 Treatment Requirements*

##### *4.4.8.2.1 Hydraulic Loading*

With the apparent success of wetlands treatment in the NWT, Yukon and other jurisdictions, the Government of the Northwest Territories commissioned a study of the potential use of wetlands for the treatment of municipal wastewater in the NWT. Doku and Heinke's (1993) study reviewed the use of natural and constructed wetlands in northern and southern wetlands and identified preliminary design considerations. Doku and Heinke recommended that hydraulic and organic loading rates should not exceed 100 to 200 $m^3$/ha.d and 8 kg $BOD_5$/ha.d.

Dillon Consulting was also commissioned in 1998 to study sewage treatment using tundra wetlands. Dillon (1998) concluded that there is a greater range of both hydraulic loading and organic loading, 18-400 $m^3$/ha.d and 0.6-15 kg $BOD_5$/ha.d.

Climate data was downloaded from the Environment Canada website for Kugluktuk. The appended climate normals indicate that ice will be accumulated for 8 months and the duration of the melt period is 60 days.

For the FSC calculations below, the daily sewage generation value was obtained from the 20-year design sewage generation volume within Table 4.1. The wetlands in Kugluktuk are not constructed wetlands but natural wetlands, consequently it cannot be assumed that the entire potential wetland area will be used to treat the effluent from the exfiltration ponds.

However, because it has been in use for approximately 14 years, the treatment area is relatively defined. When walking near the system or from the air, the wetlands are visibly in a depression and the vegetation is more lush and a darker green.

FSC will assume that 80% of the approximate wetland area will be naturally used. Evaporation and sublimation were not included in these calculations. All calculations for hydraulic loading and contaminant loading are appended.

**Table 4.4 Summary of Calculated Hydraulic Loading Rates**

| | **Total Daily Hydraulic Loading Rate ($m^3$/d.ha)** |
|---|---|
| June to July | 123 |
| August to September | 36 |
| October to May | FROZEN |

When compared to Heinke (1993) and Dillon (1998), the FSC calculations did not exceed 100-200 m3/day.ha or 18-400 m3/day.ha either during the melt or after.

#### *4.4.8.2.2 Organic Loading*

The BOD loading rate was calculated by the following equation:

BOD load (kg/d) = [(hydraulic load) – (rainfall)]* BOD concentration

**Table 4.5 Summary of Calculated BOD Loading Rates**

| | Total Daily BOD Loading Rate ($m^3$/d.ha) |
|---|---|
| June to July | 26.67 |
| August to September | 5.33 |
| October to May | FROZEN |

When compared to Heinke (1993) and Dillon (1998), the FSC calculations exceed 8 kg $BOD_5$/day.ha and 0.6-15 $m^3$/day.ha during the melt period of June and July.

#### *4.4.8.2.3 Alberta Environmental Protection Guidelines*

Alberta (1998) has published a set of guidelines, which use spreadsheets and arithmetic algorithms, based on a 20° C rate constant, to define the area of a wetland and its expected effluent quality.

$$A = 0.0365Q/k \bullet \ln (C_i - C^*)/(C_e - C^*)$$

Where
- A = required area
- Q = Design Flow
- k = Rate constant for a given temperature
- $C_i$ = Influent Concentration
- $C_e$ = Target Effluent Concentration
- C* = Wetland Background Concentration
  - for BOD, $C^* = 7.8 + 0.063C_i$
  - for TSS, $C^* = 3.5 + .053C_i$

Based on this model the predicted effluent concentration is determined by the model

$$C_o = C^* + (C_i - C^*) \exp( - kA/0.0365Q)$$

Alberta's guidelines have not been proven in northern climates. In addition, they are designed for an average temperature of 20°C. One must be conservative in applying these guidelines, as Kugluktuk's average summer temperature is approximately 7°C.

Assuming that biological production rate is decreased by half as the temperature decreases from 20° to 10 °C, the again by half as temperature decreases to 5°C, the algorithms have been applied to the Kugluktuk situation and are appended.

**Table 4.6 Summary of Results from Alberta Guidelines Calculations at 5OC**

| Wetland area* | BOD Ci | TSS Ci | Nunavut Water Board Guidline | | BOD Co | TSS Co |
|---|---|---|---|---|---|---|
| | | | BOD | TSS | | |
| (ha) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) |
| 6.37 | 248 | 233 | 100 | 120 | 52 | 22 |

* Wetland area is 80% of potential area, as assumed in section 4.4.8.2.1

According to the Alberta Guidelines calculations the BOD and TSS effluent concentrations are improved over those required by the Nunavut Water Board Guidelines.

# 5.0 GRANULAR RESOURCES & UNIT PRICES

## 5.1 GENERAL

Undertaking a granular resource inventory is beyond the scope of work of this project, however, recognizing the importance of such information, FSC has contacted Harold Mulder of Mulco who has local knowledge. Mulco also is presently undertaking earth work in Kugluktuk, therefore, prices for granular resources have been taken from recent progress payment requests.

Harold Mulder advised that 3/4+ crush is not available in Kugluktuk until such time as his crusher can be returned from Taloyoak where it is waiting on another job.

Harold Mulder advised the following prices for granular materials for budgeting purposes:

**Table 5.1 Mulco Quoted Unit Prices**

| Material | Method | Price |
|---|---|---|
| Pit run, coarse, common fill | Supply, place, pack | $90/m$^3$ |
| 3/4+ crush | Supply, place, pack | $112/m$^3$ |
| Above materials | Place, pack | $52/m$^3$ |
| Sand | Supply, place, pack | $140/m$^3$ |

## 5.2 UNIT PRICES USED FOR THIS PROJECT

While FSC has quoted prices from a local contractor, this project is much larger in scale that those currently being undertaken. Therefore, we believe there will be competition for the work and this will affect the unit prices. We suggest the following unit prices for planning purposes for this project

**Table 5.2 FSC Estimated Unit Prices**

| Material | Method | Price |
|---|---|---|
| Pit run, coarse, common fill | Supply, place, pack | $60/m$^3$ |
| 3/4+ crush | Supply, place, pack | $75/m$^3$ |
| Organic material | Strip and stockpile | $15/m$^3$ |
| In place materials | Cut | $15/m$^3$ |

## 5.3 ABANDONED GRAVEL ESKER

FSC conducted an inspection of a gravel esker, which is located upstream about 2 kilometres from the water intake and across the Coppermine River. The purpose of the inspection was to estimate the quantity and quality of granular materials available that would be suitable for the construction of exfiltration berms. Access to this location was made by helicopter. Estimates were made visually. Pictures are shown in Appendix A. Granular samples were collected and analyzed for grain size. The results are shown in Appendix D.

The perimeter of the site was walked and GPS points were taken at the approximate edge of the esker. The points suggest an area of approximately 5, 400 $m^2$. Assuming a depth ranging between 4 and 6 metres, estimates are between 22,000 and 35,000 $m^3$ of granular material. This estimate was made visually. This is apparently an insufficient quantity to construct the lagoon. A geotechnical program should be undertaken to fully delineate this resource.

Harold Mulder could not provide any additional insight into this source.

# 6.0 PROJECT COST ESTIMATE

## 6.1 GENERAL

The Class C cost estimate for this project is dependant on which gravel source is to be used for construction of the berms. The cost for granular materials from the abandoned gravel esker is not known at this time, however, for planning purposes it is assumed that costs would be those shown in Table 5.2.

EBA Engineering Consultants Ltd performed a sieve test on both the sample from the esker and a sample of Mulco's gravel that they haul from Seven Mile Island. The sieve test showed that both materials were similar, well graded gravel and sand with a trace of silt.

See Appendix D for the aggregate analysis report, sample KUG-01 is the gravel esker sample and sample KUG-02 is the Mulco sample.

Without further research into the cost of hauling from the gravel esker source, and assuming there is sufficient quantity, FSC recommends using the Mulco gravel, as there is no apparent difference in suitability for construction of the berms, and the Mulco gravel source is more accessible, and hence may be generally less expensive.

## 6.2 CLASS "C" COST ESTIMATE

The following table shows the estimated cost of the new sewage treatment facility in Kugluktuk.

**Table 6.1Class "C*" Cost Estimate**

| | | | | |
|---|---|---|---|---|
| Access road | $450 | m | 144 | $64,800 |
| Site, stripping of vegetation (assume 300 mm depth of vegetation) | $15 | m2 | 71,816 | $1,077,240 |
| Site leveling, CUT | $15 | m3 | 11,356 | $170,340 |
| Site leveling, FILL | $60 | m3 | 43,000 | $2,580,000 |
| Containment Berms, CUT | $15 | m3 | 1,700 | $25,500 |
| Containment Berms, FILL | $60 | m3 | 33,400 | $2,004,000 |
| Exfiltration Berms, CUT | $15 | m3 | 630 | $9,450 |
| Exfiltration berms, FILL | $75 | m3 | 12,600 | $945,000 |
| Ditch construction, CUT | $15 | m3 | 550 | $8,250 |
| Truck Turn around, FILL | $60 | m3 | 5,598 | $335,880 |
| Outfall structures | $500 | lump | 3 | $1,500 |
| Signs | $5,000 | lump | 1 | $5,000 |
| | | | | |
| Contingencies | 20% | | | $1,445,392 |
| Engineering design (estimate) | | lump | | $50,000 |
| Engineering field services (estimate) | | lump | | $150,000 |

*Class "C" as defined by the Federal Treasury Board (See Appendix E).

# 7.0 CONCLUSION & RECOMMENDATIONS

## 7.1 CONCLUSIONS

1. The proposed lagoon will fit in the proposed location.

2. The wetland modelling exercise suggests that the proposed sewage treatment facility will surpass the current water licence BOD and TSS requirements.

3. The results of the sieve analysis for the granular samples collected, one from Mulco and one from an abandoned DOT source, indicated that both sources were graded similarly.

4. The gravel esker is located upstream about 2 kilometres from the water intake and across the Coppermine River was visually estimated to contain between 22,000 and 35,000 $m^3$ of granular material. This estimate is less than the estimated requirement for construction.

5. The capital cost of the sewage lagoon is estimated at $8,870,000

## 7.2 RECOMMENDATIONS

1. A geotechnical program should be undertaken to fully delineate gravel esker granular resource.

2. Due to the high capital cost of this project, FSC recommends that CG&T investigate mechanical sewage treatment possibilities in Kugluktuk.

## 8.0 REFERENCES

AESL. 1978. Potential Impact of Wastewater from Communities on the Liard, Peel, and Mackenzie Rivers.

Cold Climate Sewage Lagoons, Environment Canada, Report EPS 3/NR/1 April 1987

Control of Communicable Diseases Manual, Benenson A editor, 16th edition 1995. An official report of the American Public Health Association

Doku, Issac Adjei and Gary W. Heinke. Potential For Use of Wetlands for Wastewater Treatment, Municipal and Community Affairs, GNWT, June 1993.

Ferguson Simek Clark (FSC). 2002b. *Nunavut Water Board Municipal Effluent Guidelines Revision Background Report.* Prepared for the Nunavut Water Board.

Gao, W.; Smith, D.W.; Sego D.C.; Carlson Robert. Spray freezing to treat oil sands tailings pond water, Cold Regions Engineering. The Cold Regions Infrastructure: an International Imperative for the 21st Century. Proceedings of the 8th International Conference, Fairbanks, AK; ASCE, 1996

Grainger, John M. & Ron Yaworsky. Wetlands Sewage Treatment for Yukon Communities: An Overview. Municipal and Community Affairs, GNWT, August 1992.

Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories. 1992. Northwest Territories Water Board.

Hartland-Rowe, R.C.B and P.B. Wright. Swamplands for Sewage Effluents, Final Report. Environmental-Social Committee, Northern Pipelines, Department of Indian and Northern Affairs, Ottawa, Ontario. 1974

Robarts, R. D. and D. F. Bird. Extreme Abundance of Viruses in Prairie Wetlands. Environmental Science and Engineering, May 1998.

Smith, D.W. ed., Cold Regions Utilities Monograph, ASCE and CSCE, 1996.

Sewage Disposal Improvements: Design and Operation Concept - Chesterfield Inlet, Dillon Engineering May 1994.

Sewage Lagoons in Cold Climates, Environment Canada, Report EPS 4/NR/1, 1985

Sewage Treatment Using Tundra Wetlands, Dillon Consulting, 1998

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# APPENDIX A

# SITE PHOTOS

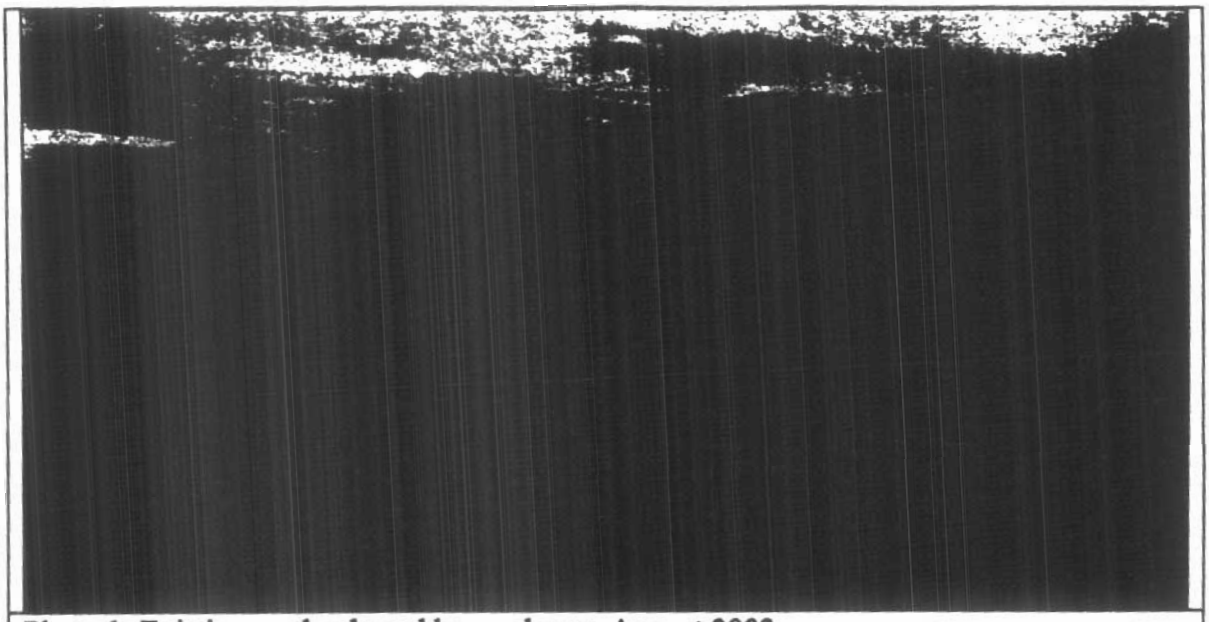


Photo 1: Existing wetlands and bermed area, August 2003

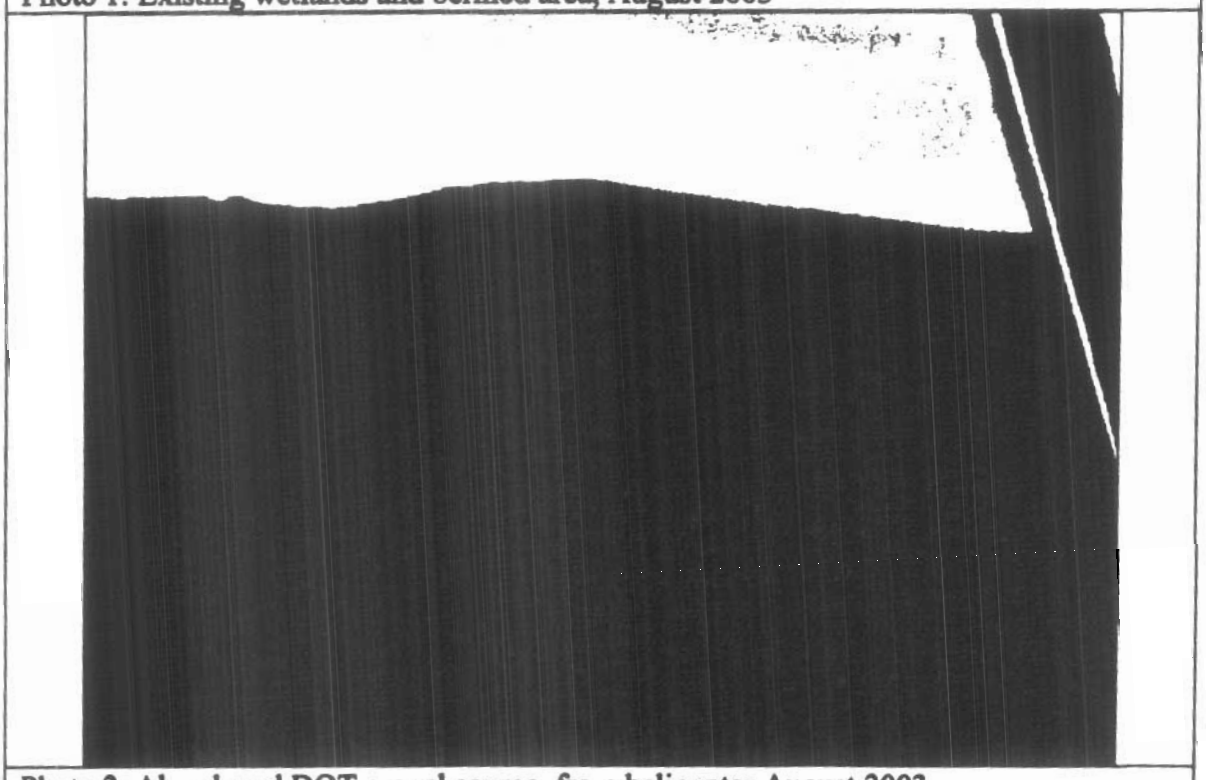


Photo 2: Abandoned DOT gravel source, from helicopter August 2003

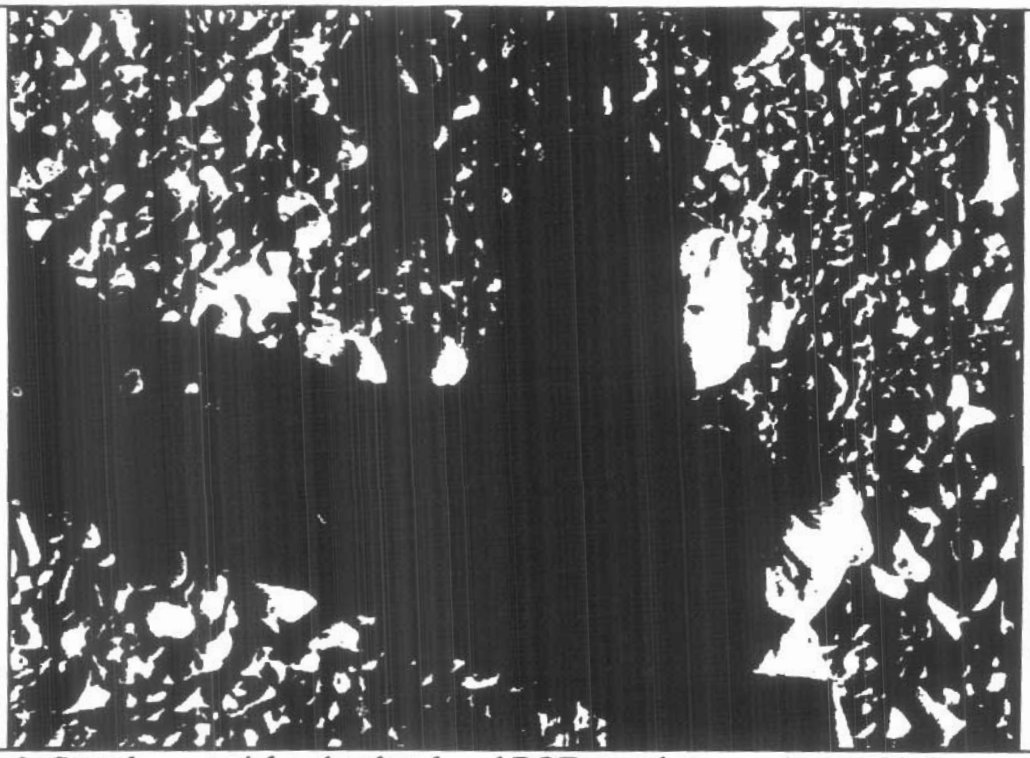


Photo 3: Granular material at the abandoned DOT gravel source, August 2003

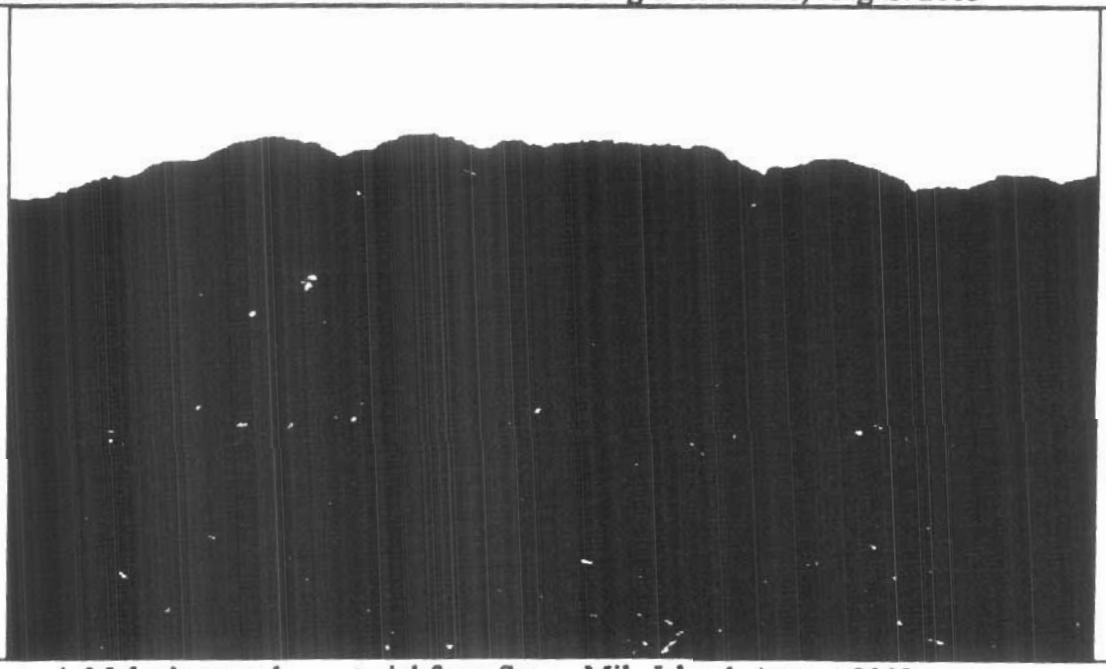
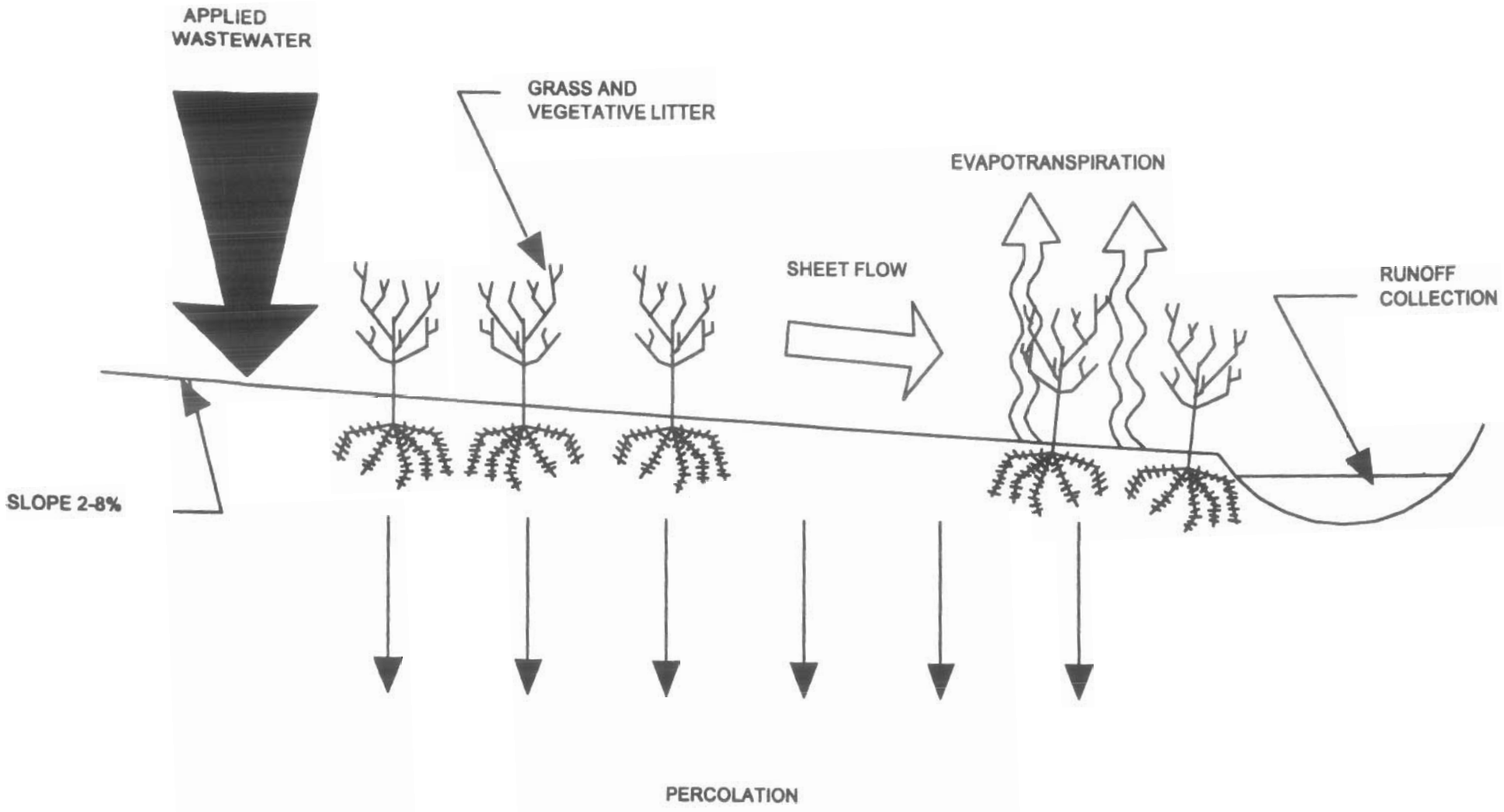


Photo 4: Mulco's granular material from Seven Mile Island, August 2003




DATE DEC 2002

FILE 2002-0420-000

# WETLANDS / OVERLAND FLOW MODEL

FIGURE NO.

2

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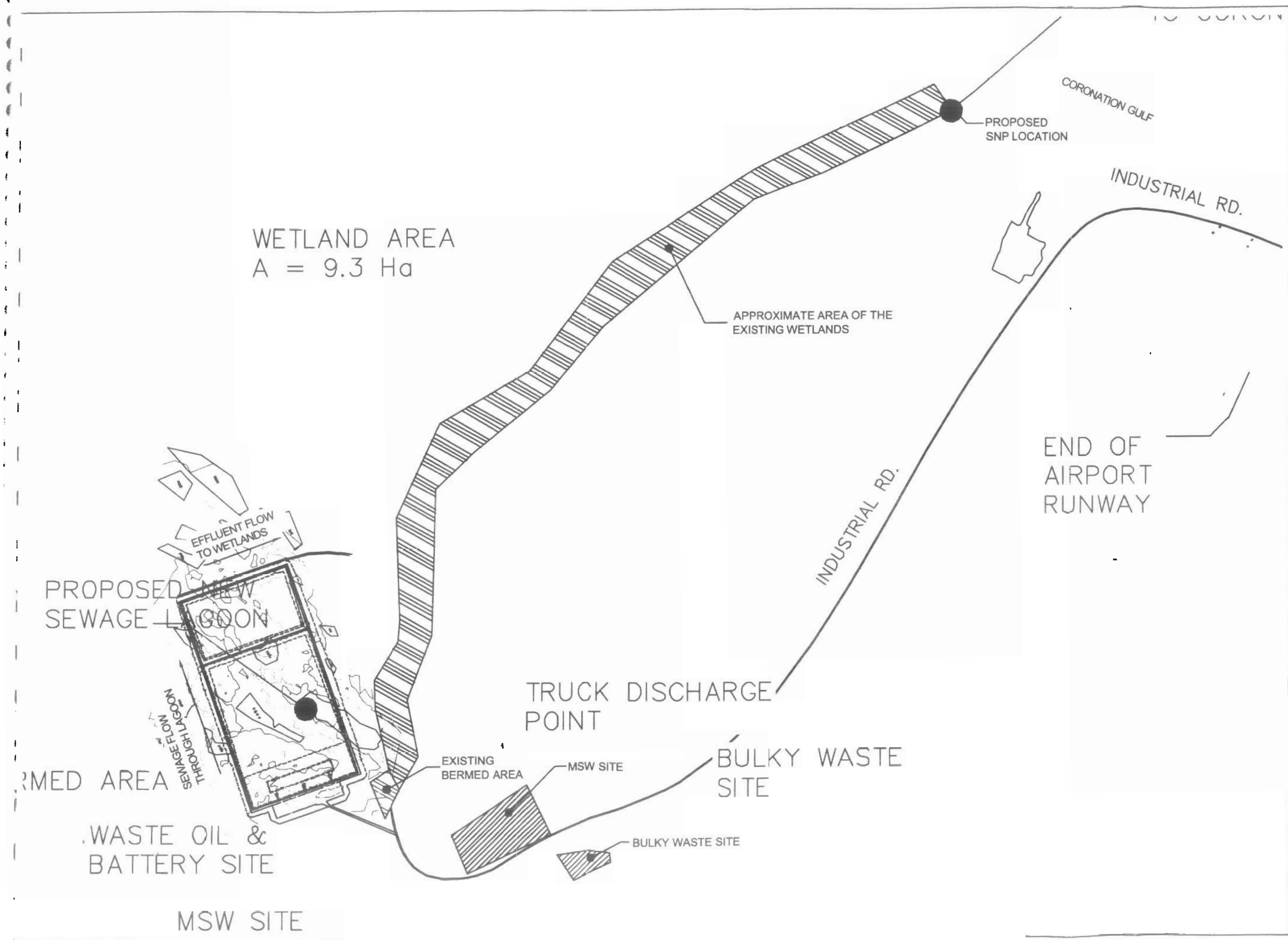
# APPENDIX B

# SKETCHES

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SCHEMATIC DESIGN
KUGLUKTUK SEWAGE
TREATMENT FACILITY

KUGLUKTUK, NU

SITE LOCATION

| | |
|---|---|
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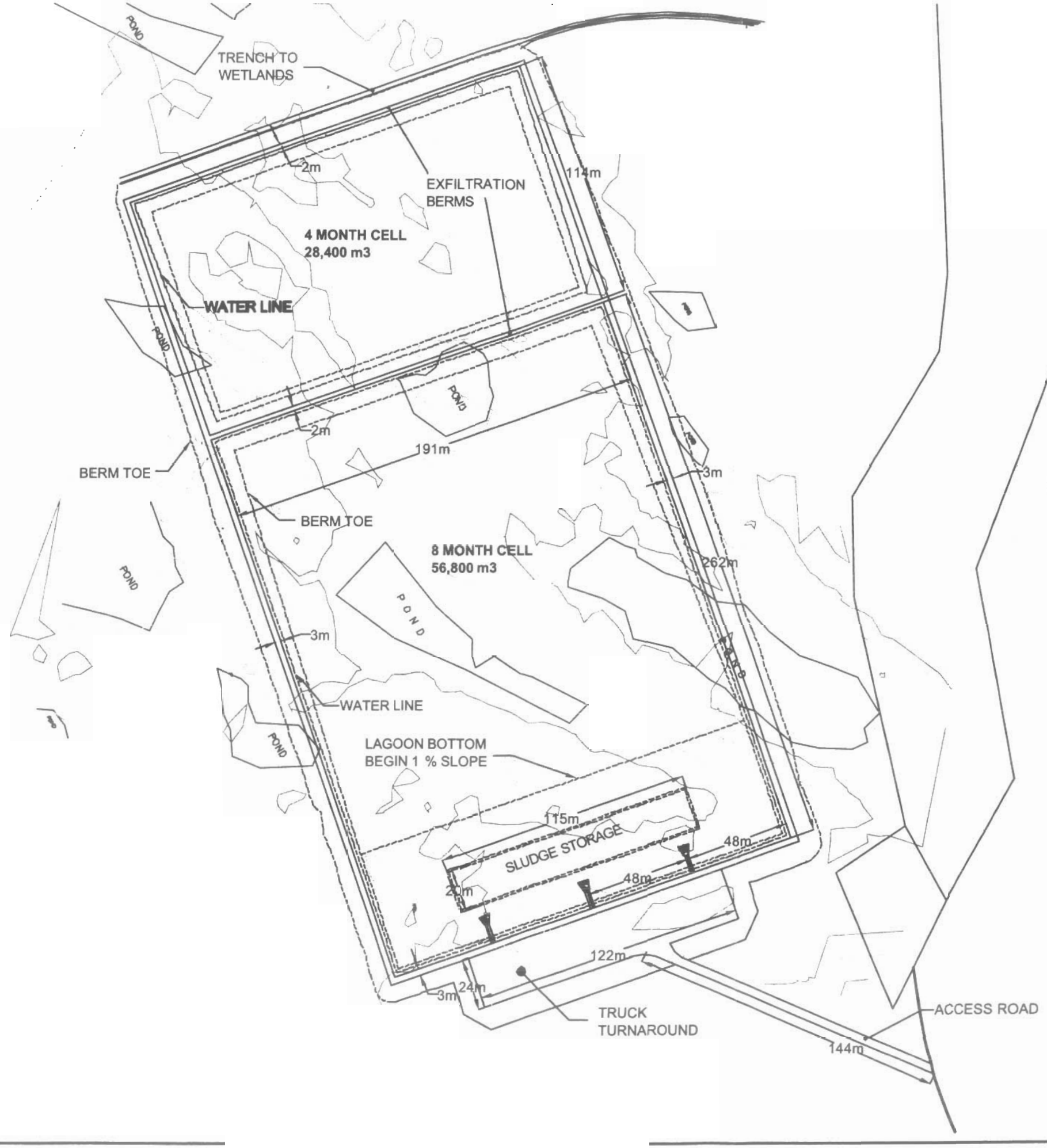
| SD | OCT 7, 2003 |
| RE | |
| 03-0780-01 | 2003-0780 |
| 1 of 5 | C-1 |

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SCHEMATIC DESIGN
KUGLUKTUK SEWAGE
TREATMENT FACILITY

KUGLUKTUK, NU

PROPOSED EXFILTRATION
LAGOON

| | |
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| SB | OCT 8, 2003 |
| BK | |
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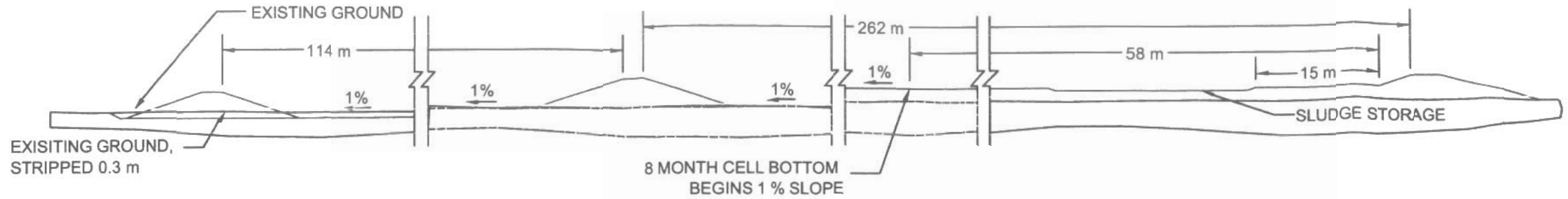


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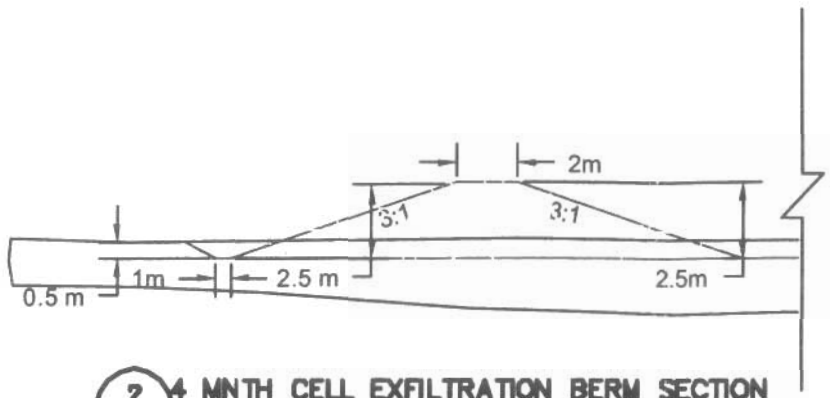
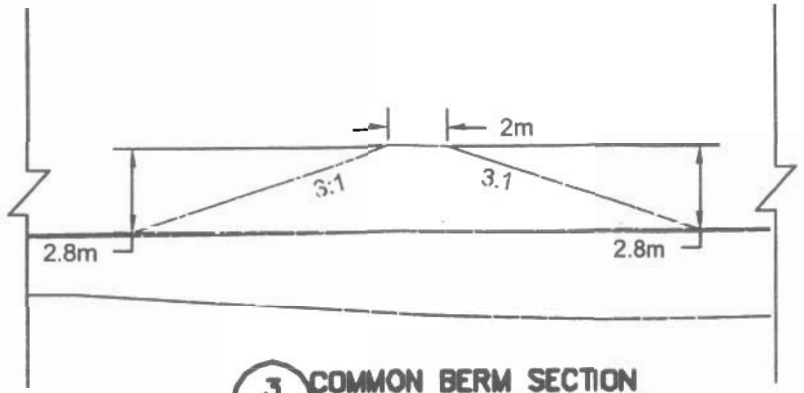
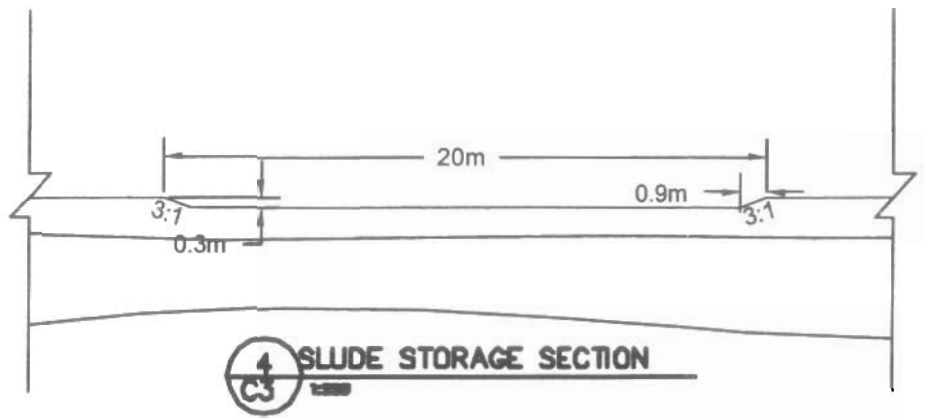


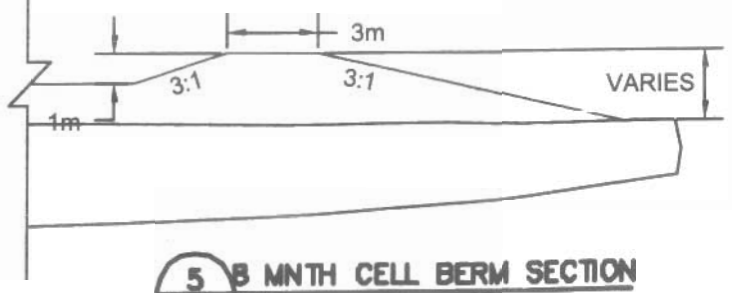

2 C3 4 MNTH CELL EXFILTRATION BERM SECTION




3 C3 COMMON BERM SECTION




4 C3 SLUDE STORAGE SECTION

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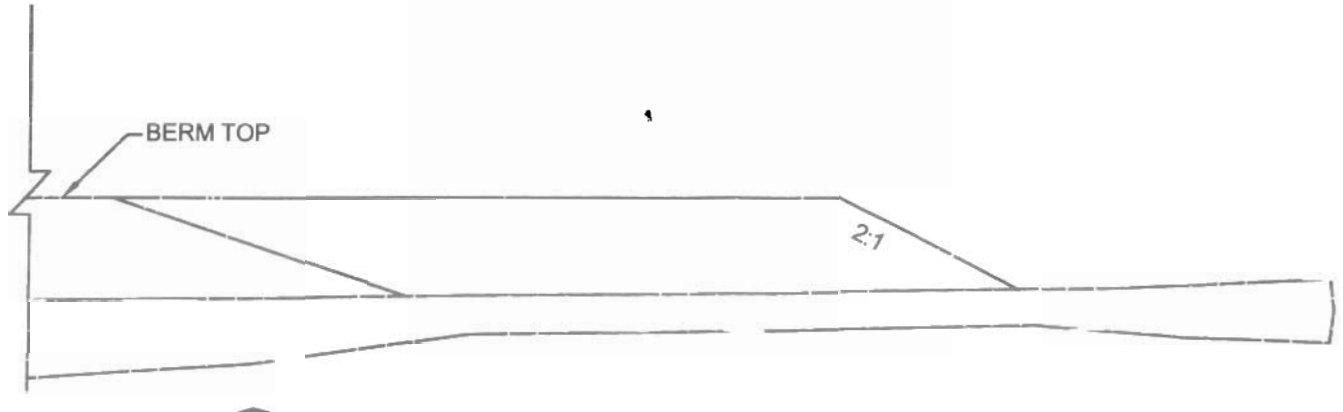


6 C3 TYPICAL TURN AROUND PAD SECTION

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SCHEMATIC DESIGN
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BERM DETAILS

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|---|---|
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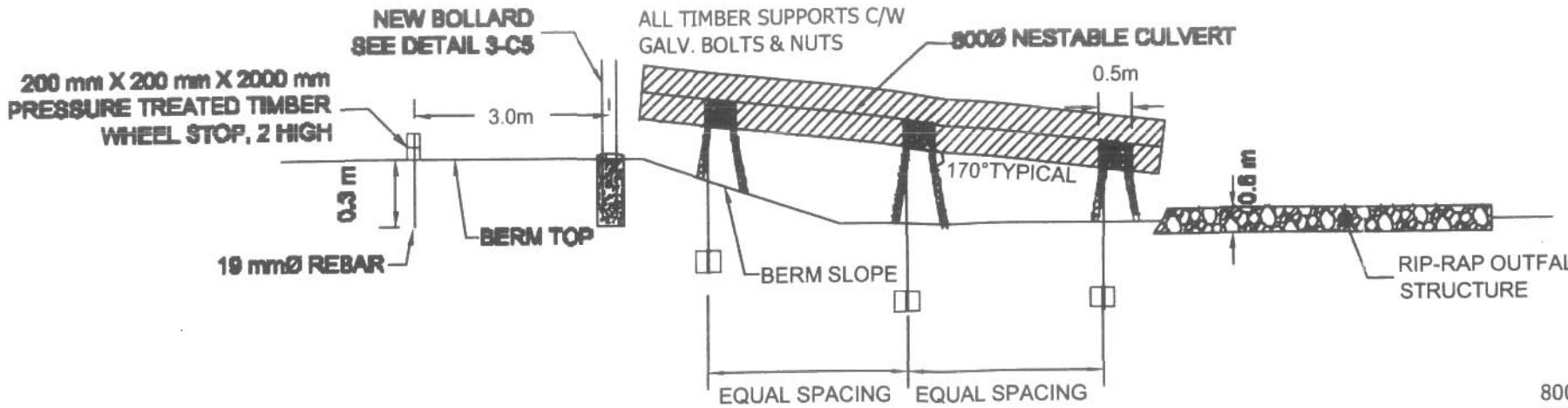
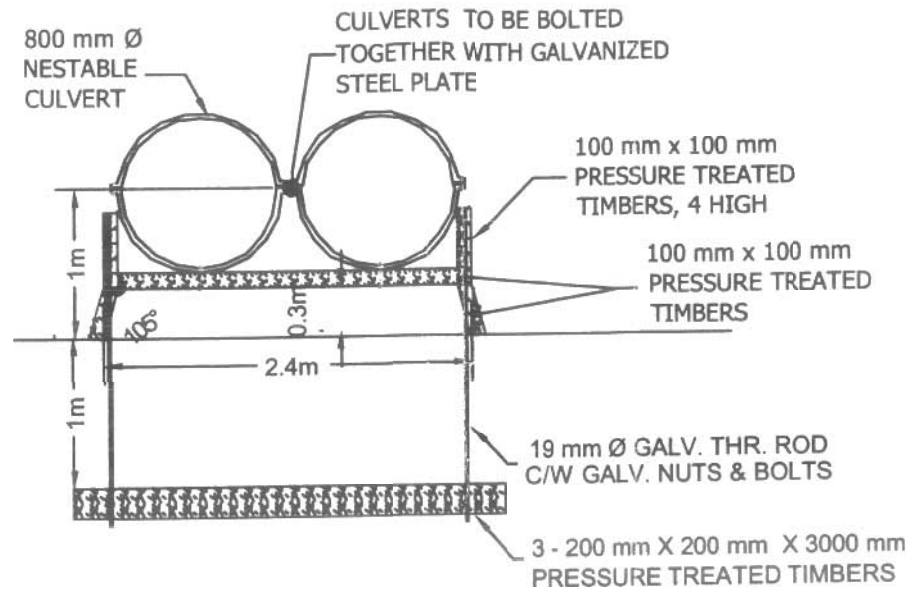
| RK | |
| 03-07BD-01 | 2003-0768 |
| 3 of 6 | C-3 |




2/C4 OFFLOAD CHUTE–SECTION 1:100

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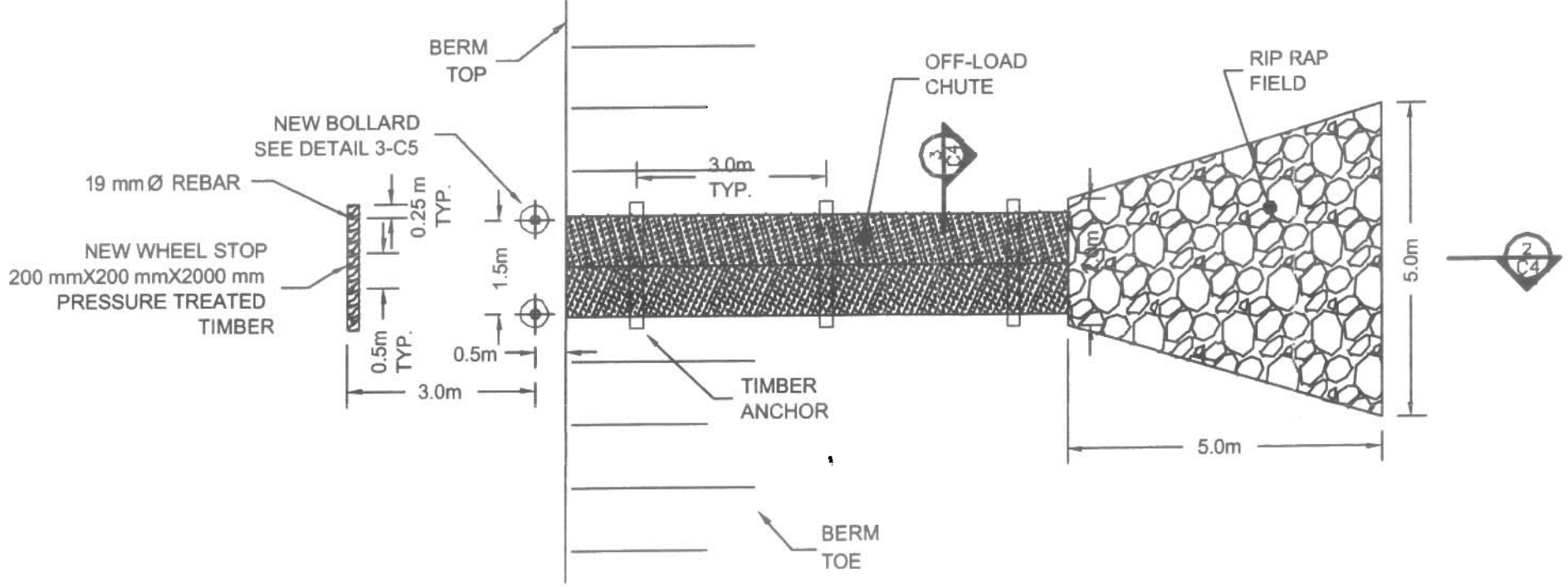


1/C4 OFFLOAD CHUTE–PLAN VIEW 1:100

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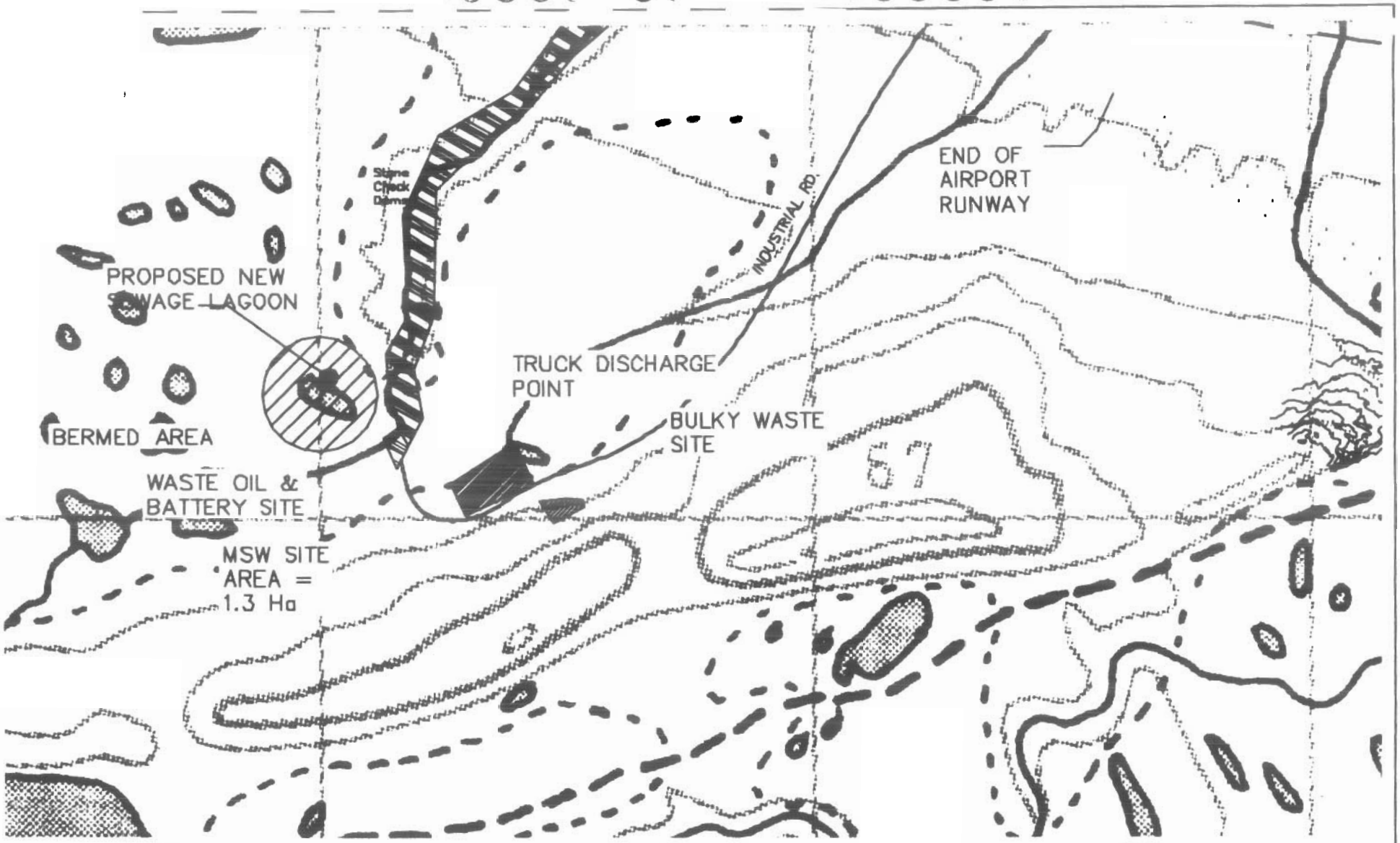
TREATMENT FACILITY

KUGLUKTUK, NU

OFF–LOAD CHUTE
DETAILS

| | |
|---|---|
| DESIGNED BY: SD | SCALE: AS SHOWN |
| DRAWN BY: SD | DATE: OCT 7, 2003 |
| CHECKED BY: RK | PROJECT NO. |
| FSA FILE NO. 03-0780-01 | FSA JOB NO. 2003-0780 |
| SHEET: 4 of 6 | DRAWING NO. C-4 |

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ARCHITECTS & ENGINEERS

F.S.C. JOB NO. 2003-0760

JOB TITLE
KUGLUKTUK SEWAGE LAGOON

KUGLUKTUK, NU

DRAWING TITLE
CHECK DAMS LOCATION ON KUGLUKTUK WETLAND

| | |
|---|---|
| DESIGNED BY: SD | SCALE: NTS |
| DRAWN BY: JA/SD | DATE: NOV 19TH, 2003 |
| CHECKED BY: RK | JOB NUMBER: 2003-0760 |
| SHEET: 6 of 6 | DRAWING NO: C-6 |

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# APPENDIX C

# WETLAND MODELLING

## To calculate daily hydraulic load rate input highlighted values

| | |
|---|---|
| Daily sewage generation (m3/d) | 146 |
| Duration of pond storage (months) | 8 |
| Melt period (months) | 2 |
| After melt period and before freeze (months) | 2 |
| Rainfall during melt period(mm) | 52 |
| Rainfall after melt period (mm) | 81 |
| Size of wetland (ha) | 6.368 |
| Pond Storage (m3) | 35034.96 |
| Ice pack melt (m3/day) | 583.9161 |
| Rainfall rate over wetland during melt (m3/d) | 55 |
| Rainfall rate over wetland after melt (m3/d) | 86 |
| Total daily hydraulic load during melt (m3/d) | 785 |
| Total daily hydraulic load after melt (m3/d) | 232 |

* for this project, wetland is natural and area shown is the actual area reduced by 50%

| | |
|---|---|
| **Heinke requires 100 -200 (m3/d/ha)** | **Dillon 18-400 (m3/d/ha)** |
| **Total hydraulic load during melt per ha** | **123 (m3/d/ha)** |
| **Total hydraulic load after melt per ha** | **36 (m3/d/ha)** |

## No imputs needed, all values taken from other worksheets

| | | |
|---|---|---|
| Total hydraulic load during melt (m3/d) | 785 | |
| Total hydraulic load after melt (m3/d) | 232 | |
| Rainfall rate over wetland during melt (m3/d) | 55.2 | |
| Rainfall rate over wetland after melt (m3/d) | 86.0 | |
| BOD concentration (mg/L) | 233 | |
| TSS concentration (mg/L) | 248 | |
| T-PO4 concentration (mg/L) | 12 | **Contaminant concentrations are taken from "Sewage charac.+ lagoon" worksheet** |
| TKN concentraion (mg/L) | 62 | |
| FC concentration (#/dl) | 4.91E+07 | |
| Size of wetland (hydraulic loading calculation, ha) | 6.368 | |
| **Contaminant load during melt (kg/d)** | | **Contaminant load during melt (kg/d/ha)** |
| BOD contaminant load (kg/d) | 169.8 | **26.67** |
| TSS contaminant load (kg/d) | 181.2 | 28.45 |
| T-PO4 contaminant load (kg/d) | 8.7 | 1.36 |
| TKN contaminant load (kg/d) | 45.3 | 7.11 |
| FC contaminant load (#/d) | 3.6E+07 | 5.63E+06 |
| **Contaminant load after melt** | | **Contaminant load after melt (kg/d/ha)** |
| BOD contaminant load (kg/d) | 34.0 | **5.33** |
| TSS contaminant load (kg/d) | 36.2 | 5.69 |
| T-PO4 contaminant load (kg/d) | 1.7 | 0.27 |
| TKN contaminant load (kg/d) | 9.1 | 1.42 |
| FC contaminant load (#/d) | 7.2E+06 | 1.13E+06 |

**Heinke's recommendation 8 kg/d/ha for BOD**

**Dillon 0.6-15 kg/d/ha for BOD**

**Alberta Environment Wetlands Calculations**

Surface Flow Wetland Treatment

Design Flow m3/d  Q = 785

| | | TSS | BOD | TP | TN | NH4-N | FC |
|---|---|---|---|---|---|---|---|
| Wastewater Characterization | Ci | 233 | 248 | 12 | 62 | 80 | 4.91E+07 |
| Target Effluent Quality | Ce | 120 | 100 | 2 | 4 | 2 | 10000 |
| Wetland Background Input | C* = | 22.45866 | 16.65402 | 0.05 | 2 | 0 | 100 |

for TSS, C* = 7.8 + 0.063Ci
for BOD, C* = 3.5 + 0.053Ci

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Area Rate Constant @20oC | k = | 1000 | 34 | 12 | 22 | 18 | 77 |
| Required Wetland Area | A = | 0.02 | 0.861 | 4.308 | 4.431 | 5.873 | 3.167 |

Models  $A = \frac{0.0365*Q}{k} * \ln \frac{Ci - C*}{Ce - C*}$  Available Area 6.368

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Projected Effluent Quality** | Co | **22.46** | **16.78** | **0.87** | **2.45** | **1.47** | **1.02E+02** |

$Co = C* + [Ci - C*] \exp \frac{-kAmax}{0.0365*Q}$

| | | | | | | |
|---|---|---|---|---|---|---|
| Overall % removal | 90.348 | 93.241 | 92.661 | 96.048 | 98.169 | 100.000 |

**10C**

**Area rate constant, k, has been divided by 2 from 20C value**

Alberta Environment Wetlands Calculations

Surface Flow Wetland Treatment

Design Flow m3/d  Q = 785.0844

| | | TSS | BOD | TP | TN | NH4-N | FC |
|---|---|---|---|---|---|---|---|
| Wastewater Characterization | Ci | 232.6772 | 248.189 | 11.89239 | 62.04725 | 80 | 49120743 |
| Target Effluent Quality mg/l | Ce | 120 | 100 | 2 | 4 | 2 | 10000 |
| Wetland Background Input | C* = | 22.45866 | 16.65402 | 0.05 | 2 | 0 | 100 |
| Area Rate Constant @10oC | k = | 500 | 17 | 6 | 11 | 9 | 38.5 |
| Required Wetland Area, ha | A = | 0.04 | 1.722 | 8.615 | 8.862 | 11.745 | 6.334 |
| Models A = $\frac{0.0365*Q}{k} * \ln\frac{Ci - C^*}{Ce - C^*}$ | | | | Available Area | | | 6.368 |
| **Projected Effluent Quality** | **Co** | **22.46** | **21.95** | **3.17** | **7.21** | **10.83** | **9.55E+03** |

for TSS, C* = 7.8 + 0.063Ci
for BOD, C* = 3.5 + 0.053Ci

$Co = C^* + [Ci - C^*] \exp\frac{-kAmax}{0.0365*Q}$

| | | | | | | |
|---|---|---|---|---|---|---|
| Overall % removal | 90.348 | 91.156 | 73.331 | 88.379 | 86.467 | 99.981 |

5C

**Area rate constant, k, has been divided by 2 from 10C value**

Alberta Environment Wetlands Calculations

Surface Flow Wetland Treatment

Design Flow m3/d  Q = 785.0844

| | | TSS | BOD | TP | TN | NH4-N | FC |
|---|---|---|---|---|---|---|---|
| Wastewater Characterization | Ci | 232.6772 | 248.189 | 11.89239 | 62.04725 | 80 | 49120743 |
| Target Effluent Quality mg/l | Ce | 120 | 100 | 2 | 4 | 2 | 10000 |
| Wetland Background Input | C* = | 22.45866 | 16.65402 | 0.05 | 2 | 0 | 100 |

for TSS, C* = 7.8 + 0.063Ci
for BOD, C* = 3.5 + 0.053Ci

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Area Rate Constant @5oC | k = | 250 | 8.5 | 3 | 5.5 | 4.5 | 19.25 |
| Required Wetland Area, ha | A = | 0.09 | 3.445 | 17.230 | 17.725 | 23.490 | 12.667 |

Models $A = \frac{0.0365*Q}{k} * \ln \frac{Ci - C^*}{Ce - C^*}$  Available Area 6.368

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Projected Effluent Quality** | **Co** | **22.46** | **51.67** | **6.13** | **19.69** | **29.43** | **6.82E+05** |

$Co = C^* + [Ci - C^*] \exp \frac{-kAmax}{0.0365*Q}$

| | | | | | | |
|---|---|---|---|---|---|---|
| Overall % removal | 90.348 | 79.181 | 48.454 | 68.269 | 63.213 | 98.613 |

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# APPENDIX D

# SIEVE ANALYSIS

# EBA Engineering Consultants Ltd.

## AGGREGATE ANALYSIS REPORT

Project: FSC 2003 Testing Services
Address: Kugluktuk, NU

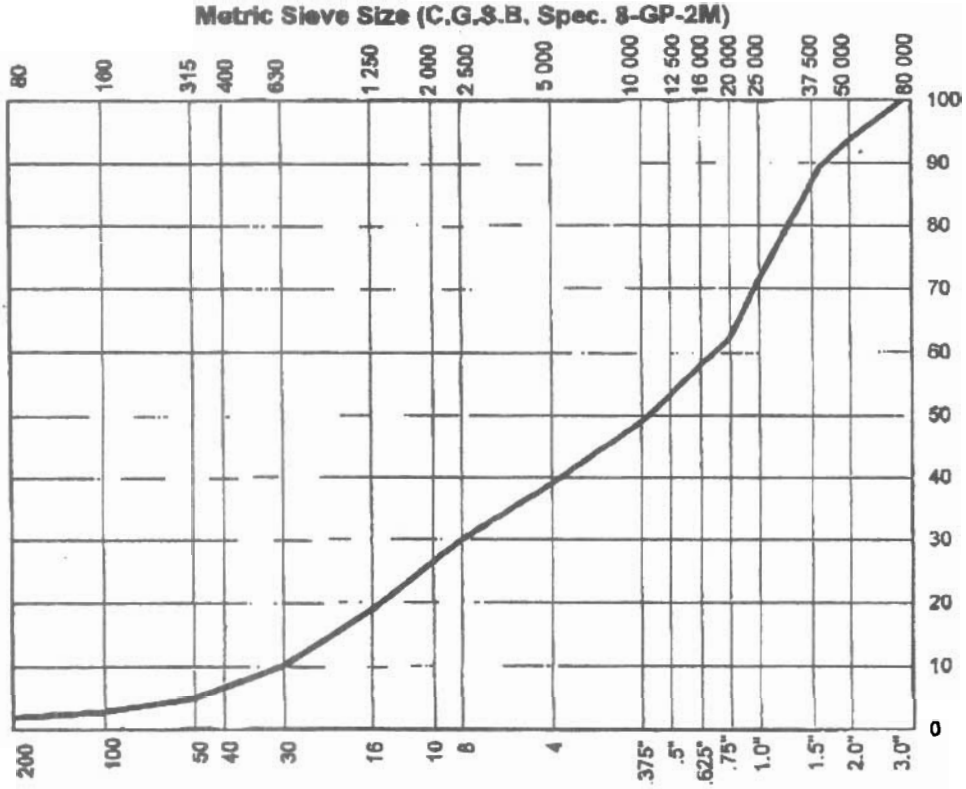
Project Number: 1780084
Date Tested: August 8, 2003
Client: FSC Architects & Engineers
Yellowknife, N.W.T.

Attention: Mrs. Sara Dando

Lab Number: 3326-2(KUG-01)
Sample Description: GRAVEL and SAND, trace silt

Lot Number:
Natural Moisture Content: 2.1%
Colour Plate No.: n/d
Bulk Relative Density: n/d
Apparent Relative Density (SSD): n/d
Aparent Relative Density: n/d
Absorption: n/d

| Sieve Sizes | | % |
|---|---|---|
| U.S. | Metric | Passing |
| 3" | 80 000 | 100 |
| 2" | 50 000 | 94 |
| 1.5" | 37 500 | 90 |
| 1" | 25 000 | 72 |
| .75" | 20 000 | 62 |
| .625" | 16 000 | 58 |
| .5" | 12 500 | 53 |
| .375" | 10 000 | 49 |
| No. 4 | 5 000 | 39 |
| No. 8 | 2 500 | 30 |
| 16 | 1250 | 19 |
| 30 | 630 | 10 |
| 50 | 315 | 5 |
| 100 | 160 | 3 |
| 200 | 80 | 1.9 |




Remarks: Sample collected and delivered by client.

Reviewed By: P.Eng.

# EBA Engineering Consultants Ltd.

## AGGREGATE ANALYSIS REPORT

Project: FSC 2003 Testing Program
Address: Kugluktuk, NU

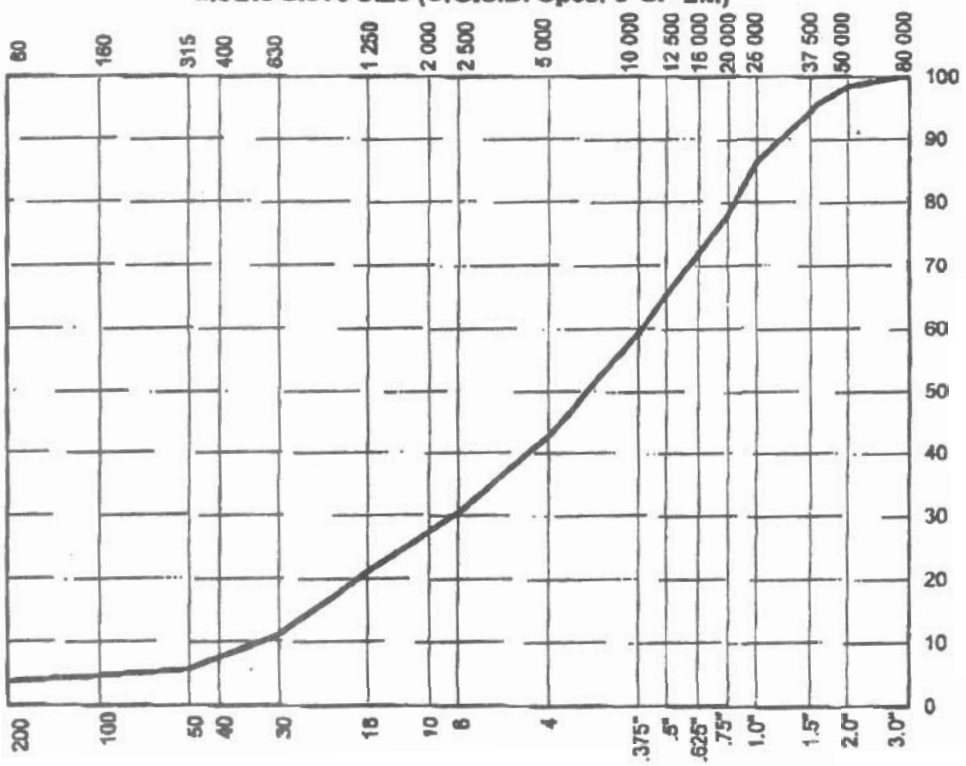
Project Number: 1780084
Date Tested: August 7, 2003
Client: FSC Architects & Engineers
Yellowknife, N.W.T.

Attention: Mrs. Sara Dando

Lab Number: 3326-1(KUG-02)
Sample Description: GRAVEL and SAND, trace silt

Lot Number:
Natural Moisture Content: 8.1%
Colour Plate No.: n/d
Bulk Relative Density: n/d
Apparent Relative Density (SSD): n/d
Aparent Relative Density: n/d
Absorption: n/d

| Sieve Sizes | | % |
|---|---|---|
| U.S. | Metric | Passing |
| 3" | 80 000 | 100 |
| 2" | 50 000 | 98 |
| 1.5" | 37 500 | 96 |
| 1" | 25 000 | 86 |
| .75" | 20 000 | 78 |
| .625" | 16 000 | 72 |
| .5" | 12 500 | 65 |
| .375" | 10 000 | 59 |
| No. 4 | 5 000 | 43 |
| No. 8 | 2 500 | 30 |
| 16 | 1250 | 21 |
| 30 | 630 | 11 |
| 50 | 315 | 6 |
| 100 | 160 | 5 |
| 200 | 80 | 3.8 |




Remarks: Sample collected and delivered by client

Reviewed By: _____ P.Eng.

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# APPENDIX E

# FEDERAL TREASURY BOARD ESTIMATE CLASSES

# Estimate Classes: An Explanation

*by Anthony L. Huxley, MSc, MCIOB, PQS*

**Introduction**

For many years a system of classifying estimates using the terms "Class A, B C or D" has been loosely applied by a number of organizations. Somewhat of a mystery to some, and surrounded in myth for others, it is worth while taking a step back and considering the probable origins and the appropriate use of these terms.

As far as I can tell these classifications are drawn from definitions prepared by the Treasury Board (TB) of the Canadian federal government in the early 1970s. Designed for TB approval processes they were for application to all forms of procurement and not necessarily construction. Consequently they were generic in their description and several attempts, some ill advised, have been made to improve them since they were published. It will be worth noting that TB abandoned these designations several years ago, but they continue in use within Public Works and Government Services and elsewhere.

The following text provides primary definitions of the various estimate classification followed by an amplified explanation of the specific attributes displayed by each of the four estimate classifications. Application notes and references are also included.

**Primary Estimate Definitions**

The following are based on the original TB definitions but have been modified slightly to suit application to construction cost planning and cost control through design.

*Class A Estimate*

Based on complete working drawings and specifications, and prepared prior to calling competitive tenders, this estimate should be sufficient to allow a detailed reconciliation/negotiation with any contractors proffered tender.

*Class B Estimate (Substantive)*

Based on design/preliminary drawings and outline specifications for the project, which include the designs of all major systems and subsystems, as well as the results of all site/installation investigations, this estimate should provide for the establishment of realistic cost objectives and be sufficient to obtain effective project approval.

*Class C Estimate (Indicative)*

Based on a full description of the preferred option, construction/design experience, and market conditions, this estimate should be sufficient for making the correct investment decision, and obtaining preliminary project approval.

*Class D Estimate*

Based upon a statement of requirements, and an outline of potential solutions, this estimate is strictly an indication (rough order of magnitude) of the final project cost, and should be sufficient to provide an indication of cost and allow for ranking all the options being considered.

**Treasury Board Estimate Classifications (Current)**

The following definitions are the current terms and have been transcribed without modification. The two classifications relate specifically to the two main approvals provided by Treasury Board i.e. Preliminary Project Approval and Effective Project Approval. While the latter officially sets a 'budget' in TB's terms don't be fooled! They are quite capable of controlling and restricting expenditures to that sought as a preliminary project approval.

*Indicative Estimate*

This is a low quality, order of magnitude estimate that is not sufficiently accurate to warrant Treasury Board approval as a *Cost Objective*. It replaces the classes of estimates formerly referred to as Class C or D.

*Substantive Estimate*

This estimate is one of sufficiently high quality and reliability so as to warrant Treasury Board approval as a *Cost Objective* for the project phase under consideration. It is based on detailed systems and component design and taking into account all project objectives and deliverables.

While these definitions refer to a cost objective I have been unable to locate a TB definition and append the following as my interpretation.

**Cost Objective**

A planned, and approved, cost limit (or ceiling) within which the project's scope is to be delivered. The authorized expenditure for the current phase.

It might also be worth noting that the new TB definitions state that a 'D' estimate is good enough to be described as 'indicative'. This is unfortunate. I have noted a distinct 'dumbing down' of estimates within PWGSC lately, with insufficient consideration being given to the content of estimates prepared in support of preliminary project approvals. Consequently major problems arise when, as noted above, TB holds completion of the project to that preliminary figure.

**Estimate Attributes**

Each estimate classification displays a quite distinct set of attributes. These attributes, both primary and secondary, are identified in the following text and are also summarised within *Table 1. Cost Estimate Classification Summary – Estimate Attributes* that follows. In my view the primary attribute rules. Many of you may have encountered the lazy client who requests an estimate be classified higher than extant information permits. Content is everything. An estimate can be no better than the information that goes into it.

*continued on page 13*

## Estimate Classes – An Explanation

*continued from page 12*

***(A) Class A Cost Estimate***

**(1) Primary Attribute**

(a) Work Definition

*(i) Complete working drawings and specifications just prior to calling for tenders.*

*(ii) Definition of project typically in the order of 95% to 100% complete.*

**(2) Secondary Attributes**

(a) Intended Purpose

*(i) Confirmation of project compliance with the budget (Effective Project Approval) prior to calling tenders.*

*(ii) Provide the basis/background necessary for detailed negotiation, and cost reconciliation, with any bidder and/or contractor.*

*(iii) A final "run through" of the tender documents checking for errors, inconsistencies and omissions.*

(b) Level of Precision

*(i) High*

(c) Appropriate Preparation Methodology

*(i) Measured and priced, fully detailed quantities, obtained from the completed working drawings and specifications.*

*(ii) This estimate will contain only those cash allowances that are called for in the construction documents.*

*(iii) The extensive detail contained within this estimate will equal the detail within any contractors bid estimate.*

(d) Typical Level of Effort

*(i) High (Extensive and time consuming).*

***(B) Class B Cost Estimate***

**(1) Primary Attribute**

(a) Work Definition

*(i) Completed design documents including drawings and outline specifications at the end of the Design Development stage and just prior to commencement of working drawings.*

*(ii) Definition of project typically in the order of 20% to 35% complete*

**(2) Secondary Attributes**

(a) Intended Purpose

*(i) Confirming validity of Preliminary Project Approval, and*

*(ii) Seeking Effective Project Approval, and*

*(iii) Typically setting the Project Budget*

(b) Level of Precision

*(i) Medium*

(c) Appropriate Preparation Methodology

*(i) Majority of estimate prepared from measured and priced quantities obtained from the completed design drawings and outline specifications*

*(ii) A minor proportion of the estimate may be in the form of allowances*

(d) Typical Level of Effort

*(i) Medium.*

***(C) Class C Cost Estimate***

**(1) Primary Attributes**

(a) Work Definition

*(i) A completed project plan, clearly defining the intent and extent of the planned work*

*(ii) Definition of project typically in the order of 5% to 15% complete*

**(2) Secondary Attributes**

(a) Intended Purpose

*(i) Establish and/or confirm cost of the recommended option, selected from the various options studied, and the associated investment decision, and*

*(ii) Seek approval from Regional and/or Headquarters Investment Management Board, and*

*(iii) Seek Preliminary Project Approval from Treasury Board*

(b) Level of Precision

*(i) Low*

(c) Appropriate Preparation Methodology

*(i) Prepared from measured and priced quantities, where possible, and priced parameter quantities, all obtained from the project information that is available.*

*(ii) A significant proportion of the estimate may be in the form of allowances*

(d) Typical Level of Effort

*(i) Low*

Primarily an extension of the work undertaken in preparing the Class D estimate this estimate is a hard "second look" at the preferred option.

***(D) Class D Cost Estimate***

**(1) Primary Attribute**

**(a)** Work Definition

*(i) A description of the intended solutions with such supporting documentation as is available*

*(ii) Definition of project typically in the order of 1% to 5%*

**(2) Secondary Attributes**

(a) Intended Purpose

*(i) To aid in the screening of various procurement options proposed prior to recommending a preferred procurement solution, and*

*(ii) To provide an "Order of Magnitude" cost only*

**(b)** Level of Precision

*(i) Lowest*

**(c)** Appropriate Preparation Methodology

*(i) Various and simple methods of estimate preparation may be employed in preparing this class of estimate.*

*(ii) A significant proportion of these estimates may be in the form of assumptions and allowances.*

*(iii) Where additional information is available it is appropriate to use it in the estimate*

(d) Typical Level of Effort

*(i) Lowest*

A minimal level of detail, and often significant assumption, combined with an acceptance of the low order of inherent precision assure that these estimates are typically prepared with a minimal amount of effort. Unique projects where existing and comparable cost data is unavailable will require an additional effort, primarily to generate (model) valid and supportable estimates.

*continued on page 14*

Table 1 – Cost Estimate Classification Summary – Estimate Attributes

| | Primary Attribute | Secondary Attributes | | | |
|---|---|---|---|---|---|
| **Estimate Classification** | **Project Definition** | **Intended Purpose** | **Methodology** | **Level of Precision** | **Preparation Effort** |
| Class A | High (completed working documents) | Compliance with effective project approval (budget) | Measured, priced, full detail quantities | High | High |
| Class B (Substantive) | Medium (completed design development) | Seeking effective project approval | Mainly measured, priced, detail quantities | Medium | Medium |
| Class C (Indicative) | Low (project plan) | Seeking preliminary project approval | Measured, priced, parameter quantities, where possible | Low | Low |
| Class D | Lowest (described solutions) | Screening of various alternative solutions | Various | Lowest | Lowest |

## Estimate Classes – An Explanation

*continued from page 13*

### Estimate Attributes – Application Notes

**Primary Attribute**

*Work Definition*

The level of work definition is the primary determinant of an estimate's outcome, and it is the completeness of that information that determines the classification of the estimate. No estimate can be better than the information upon which it is based, nor can it make up for deficiencies in that information. Reasonable efforts should be made to ensure that the estimate does, in fact, make use of the full information set available, else the estimate must be classified at a lower level consistent with the actual level of information used.

While expressed within this text as project documents being a certain percentage such a determination can be subjective and difficult to assess.

**Secondary Attributes**

*Intended Purpose*

Each level (classification) of estimate is intended for a specific purpose within the approvals process. While higher level estimates can be used for lower level purposes the reverse is not the case.

*Level of Precision*

Described here in the relative terms, as Lowest, Low, Medium and High inherent levels of precision, the size of a project has a significant impact on any numerical measure of precision. Contrary to common belief Treasury Board has never attached a numerical level of precision to estimates, and with good reason. Such numerical measures when expressed as a percentage of project cost will vary inversely with project size.

Expressions of precision are also subjective. In addition to project size, consideration should also be given to the availability and/or quality of reference cost estimating data, the uniqueness and/or complexity of the project, and also the competency and skills of potential bidders.

In my view the term 'level of accuracy', while often used, is misleading. Accuracy is a function of both estimate precision and information variability. It also leads to the question "Measured against what?" which can provoke significant debate.

Past research into the results of competitive bids, received by PWGSC, has identified a major distinction between the behaviour of bid competitions for projects of less than $1,000,000 and those above that mark. Two examples were chosen from that research as they are most typical of the size of projects undertaken by PWGSC.

*Projects in the order of $100,000*

In this category the demonstrated range, about the mean bid, for 95% of all bids received, was ± 25%

*Projects in the order of $7,500,000.*

In this category the demonstrated range, about the mean bid, for 95% of all bids received, was ± 4%

*Application*

Within the two major ranges (i.e. above and below $1,000,000) projects of lesser value than the examples provided will exhibit a wider range of precision and vice-versa.

Remember these are the results of competitive bids based on complete drawings and specifications. If you should wish further detail on this research then examining the *Construction Economist* archives will show up a précis of a paper that I wrote and presented at the AACEI Annual General Meeting in Seattle in 1991.

*Appropriate Preparation Methodology*

Numerous estimate preparation methods are available, the choice of which depends primarily on the level of project definition available and to a far lesser extent on intended estimate purpose. Typically, for building construction projects, stochastic type estimates are relatively rare (except perhaps for some "order of magnitude" estimates). Deterministic, i.e. measured, estimate types are the norm. Above all it is important to use an appropriate methodology that uses the all project information available, delivers an appropriate answer, and at a reasonable (affordable) level of effort.

*Typical Level of Effort*

The circumstances surrounding any project or estimate are extremely variable and as a result the necessary level of effort may also vary significantly for reasons other than project size.

NOTE: Regarding Class C Estimates – the description included relates to that estimate needed in support of a preliminary project approval submission i.e. a confirmation and second look at the Class D estimate. That second Class C estimate often prepared later, after project commencement and at completion of the formal project definition phase, will be a new estimate with additional information, and will entail a level of effort, approaching that required of a Class B estimate.

**References**

***Treasury Board Manual***

**Chapter 2-1 Project Approval – 01-06-94**

Appendix A – Requirements for Treasury Board Submissions Seeking Preliminary Project Approval; Appendix B – Requirements for Treasury Board Submissions Seeking Effective Project Approval; Appendix C – Requirements for Treasury Board Submissions Seeking Lease Project Approval; Appendix F – Project Brief; Appendix G – Use of Estimates in Treasury Board Submissions.

**Chapter 2-2 Project Management – 01-06-94**

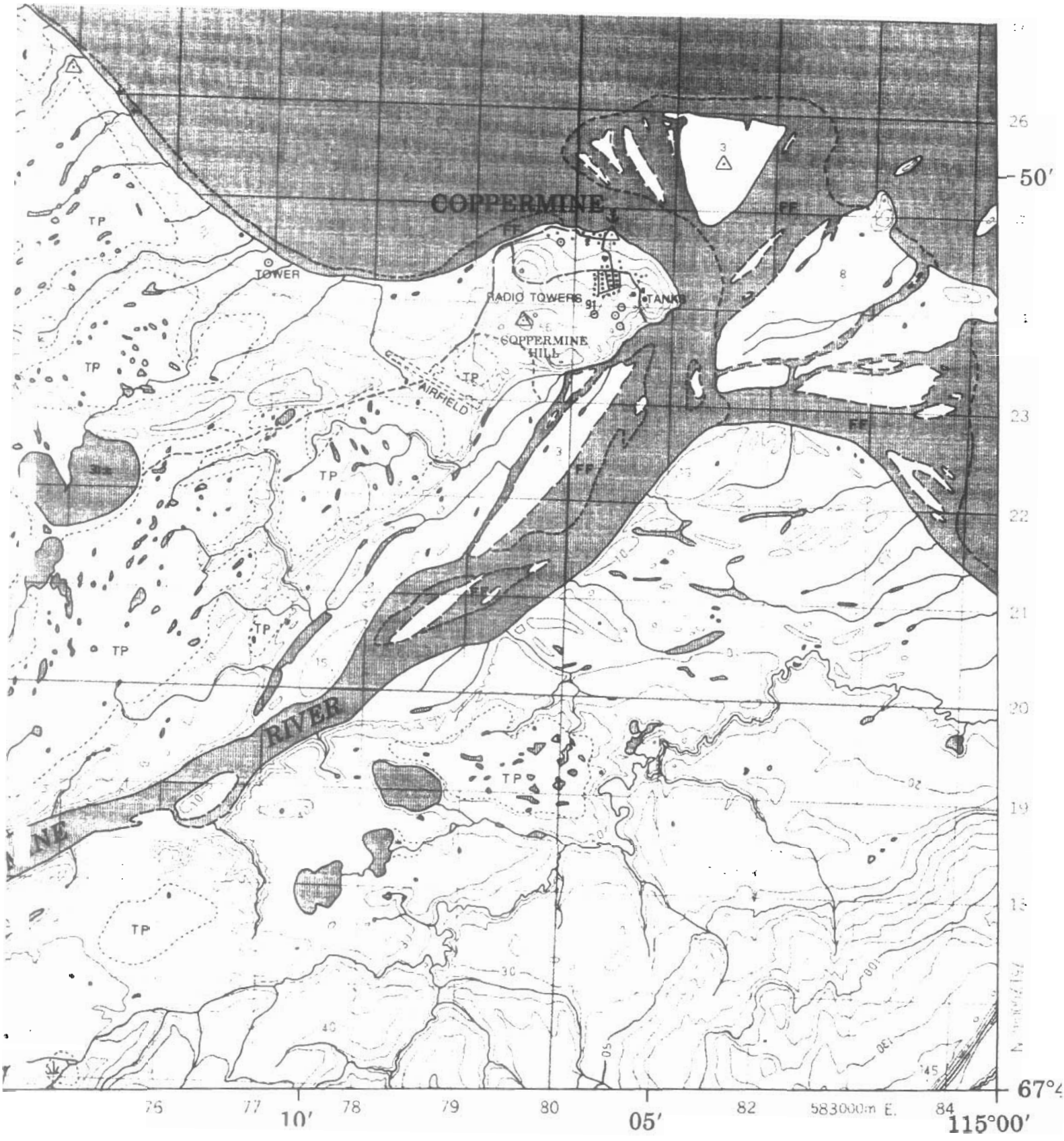
Appendix D – Project Progress Reports and Databases for Project Management Guideline

**Chapter 2-3 Management of Major Crown Projects (MCP) – 01-06-94**

Appendix C – Submission of Requirements for MCP's

**Glossary/Lexique – 01-06-94**

# Appendix B: Various supporting studies and drawings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TOWER
RADIO TOWERS
TANKS
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AIRFIELD
RIVER
TP
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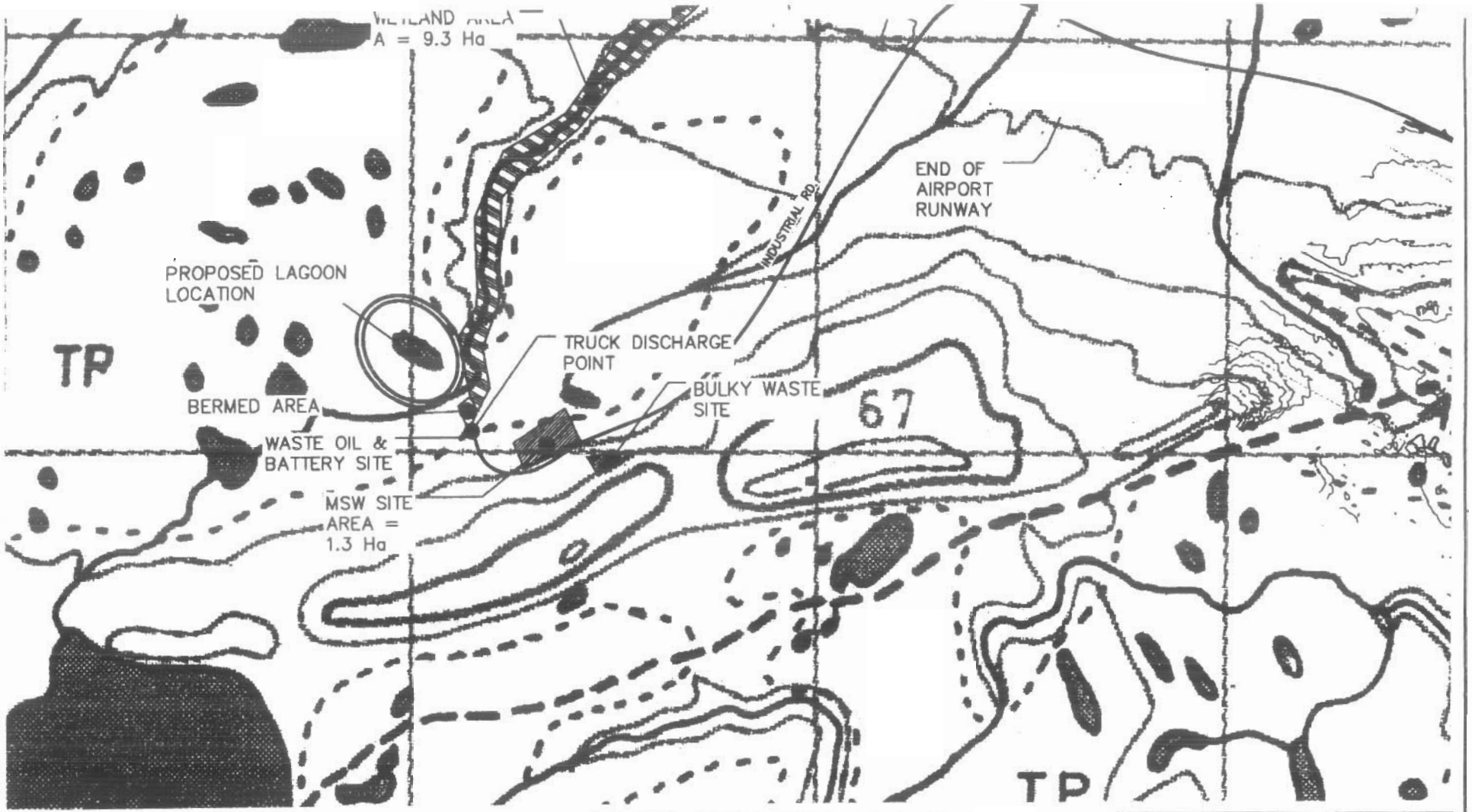
583000m E.

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F.S.C. JOB NO. 2003-0760

JOB TITLE
KUGLUKTUK
SEWAGE LAGOON

KUGLUKTUK, NU

DRAWING TITLE
WETLAND/MSW
AREA MAP

| | |
|---|---|
| DESIGNED BY: SD | SCALE: NTS |
| DRAWN BY: JA/SD | DATE: AUG 8TH, 2003 |
| CHECKED BY: RK | JOB NUMBER: 2003-0760 |
| SHEET: 1 OF 1 | DRAWING NO: EN-1 |

SHEET 1 OF 2

TOPOGRAPHIC SURVEY
OF

# SOLID WASTE LAGOON OUTFLOW AREA

KUGLUKTUK, NUNAVUT

SCALE 1 : 500

20 10 0 20 40 METRES

DATE OF SURVEY – SEPTEMBER 23 TO 25, 2004

NOTES:

DISTANCES ARE EXPRESSED IN METRES.

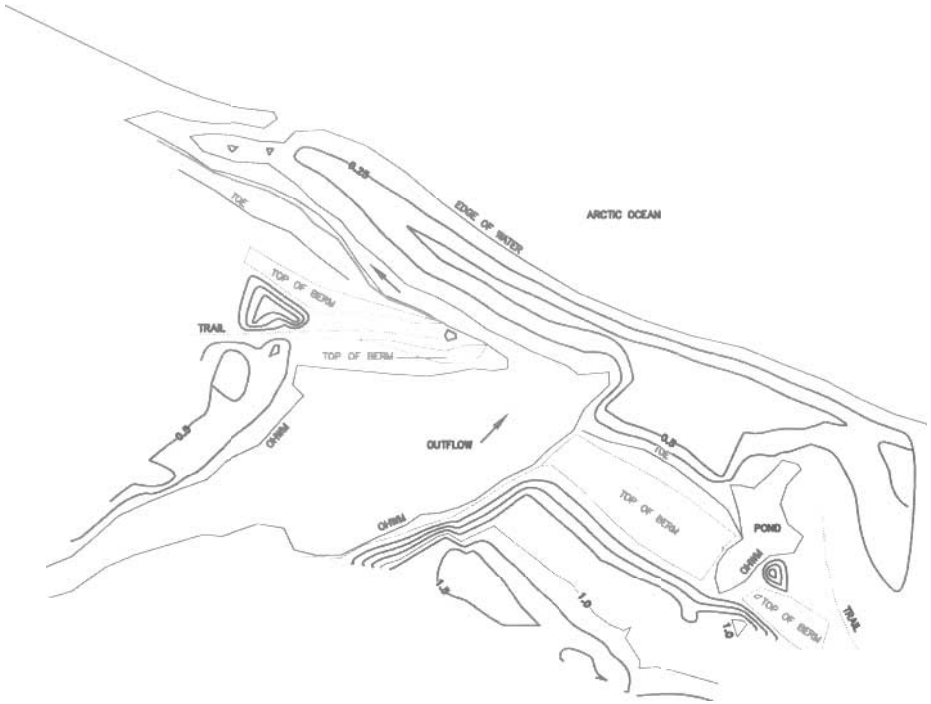
ELEVATIONS ARE EXPRESSED IN METRES AND ARE DERIVED FROM 001-87-14 CONTROL MONUMENT, ELEVATION = 23.62 METRES.

CONTOUR INTERVAL IS 0.25 METRES.

OHWM MEANS ORDINARY HIGH WATER MARK.

LEGEND:

CONTOUR LINES





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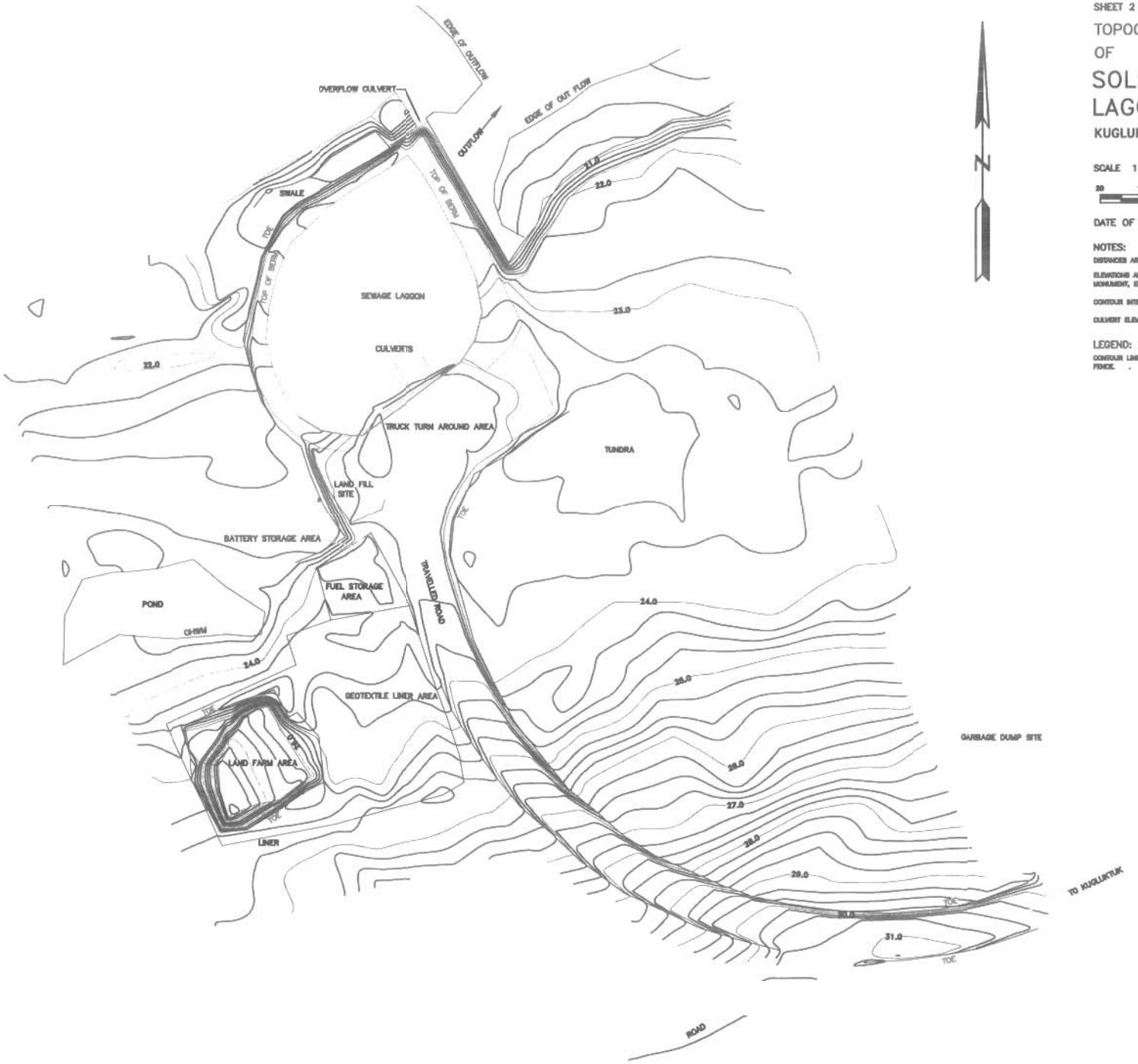
PROJECT NUMBER : 04-23-02

SHEET 2 OF 2

TOPOGRAPHIC SURVEY
OF

# SOLID WASTE LAGOON AREA

KUGLUKTUK, NUNAVUT




SCALE 1 : 500

20 10 0 20 40 METRES

DATE OF SURVEY – SEPTEMBER 23 TO 25, 2004

NOTES:

DISTANCES ARE EXPRESSED IN METRES.

ELEVATIONS ARE EXPRESSED IN METRES AND ARE DERIVED FROM 501-87-14 CONTROL MONUMENT, ELEVATION = 22.62 METRES.

CONTOUR INTERVAL IS 0.25 METRES.

CULVERT ELEVATIONS ARE AT INVERTS.

LEGEND:

CONTOUR LINES . . . . . .

FENCE . . . . . .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PROJECT NUMBER : 04-22-02

# Appendix C: Utilizing Gas Tax Funding In Nunavut

# UTILIZING GAS TAX FUNDING IN NUNAVUT

Over the past year Canada announced two new sources of funding to support municipal infrastructure. They are:

- ***The Municipal Rural Infrastructure Fund*** (MRIF)
  - $16 Million total for Nunavut over 5 years
  - Will be matched 50/50 by the Territorial Government
  - Targeted towards "green" municipal infrastructure
  - Eligible projects include water, waste, tourism, transportation, and other community infrastructure
  - Announced last year and contract is now being negotiated

- ***The New Deal for Cities and Communities (Gas Tax Initiative)***
  - $37.5 Million for Nunavut over the first 5 years
  - Ongoing funding of $15 Million annually after that
  - Not required to be matched by Nunavut
  - Must be used for environmentally sustainable municipal infrastructure
  - Identified priorities by Canada are water and waste water systems, public transit, and community energy systems

The second item, the gas tax funding under the New Deal for Cities and Communities, provides a significant ongoing source of funding from Canada that will address critical infrastructure needs that directly impact on the health and well-being of Nunavummiut. It frees up GN infrastructure funding to address areas of community need that now get put aside because of more critical environmentally related projects.

## NUNAVUT PRIORITIES

There are numerous priorities for infrastructure in communities: housing, water supply, sewage treatment, solid waste, recreation facilities, bulk fuel storage facilities, power generating plants, airports, marine harbours, etc.

The single largest need for community infrastructure at the present moment is housing but that is not fundable under either the MRIF or Gas Tax programs. Nunavut has received $20 million of SIF funding from Canada for housing. This is matched by Nunavut. Negotiations are currently underway with CMHC for additional housing funding.

Current Community and Government Services (CGS) funding for community infrastructure is increasingly being devoted to water, sewage, and solid waste issues because of environmental issues and the substantial need to

## BENEFITS OF THE NEW FUNDING

The combination of the MRIF and Gas Tax funding provides a unique opportunity for Nunavut to develop a long range plan to address critical community infrastructure issues.

- Gas Tax initiative funding will be used for environmentally sustainable water, sewage and solid waste needs across Nunavut and as a sustainable, long term funding source in this critical area of need.
- Non-tax based communities will work with the GN to develop a long range plan to address these needs.
- Iqaluit, as a tax based community, will directly receive a percentage of the funds for use in this area.
- MRIF funding will be combined with GN capital funding for other municipal projects (recreation facilities, hamlet offices and halls, access roads, tourism facilities, mobile equipment, etc.)
- A joint planning mechanism will be established with NAM (and other departments as required) to determine priorities and needs, to develop the long term plan, and to ensure regular consultations and annual updates on emergency issues.

A critical success factor in this plan is cooperation with NAM on the approach. A Community Infrastructure Planning Committee will be established with NAM to develop the long range infrastructure plan and funding criteria for the Gas Tax and MRIF. The Committee will include representatives from Community and Government Services, NAM and other GN departments as required. The Committee will be tasked with developing approval criteria, a consultation mechanism, a communication protocol and reporting criteria.

A second component of the cooperation with both Canada and NAM is the establishment of a Technical Planning Secretariat with responsibilities to research and develop the most feasible and sustainable models for water and sewage treatment. The intent is to work with municipalities on these plans in order to develop community ownership and capability in managing water and sewage systems. The Secretariat will cooperate closely with the Municipal Training Organization to develop training plans for community staff related to the new infrastructure.

# Appendix D: Taiga Environnemental Laboratory

Taiga Environmental Laboratory
4601-52nd Ave., Box 1500, Yellowknife, NT. X1A 2R3
Tel: (867)-669-2788 Fax: (867)-669-2718

# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kugluktuk Sewage Effluent **Taiga Sample ID:** 261702

**Client Project:**
**Sample Type:** sewage
**Received Date:** 22-Jul-04
**Sampling Date:** 20-Jul-04
**Location:** Kugluktuk

***Report Status:*** FINAL

**Approved By** R. Shane Harnish
Quality Assurance Officer

| Test Parameter | Result | Detection Limit | Units | Analysis Date | Analytical Method * | Qualifer |
|---|---|---|---|---|---|---|
| **Physicals** | | | | | | |
| Alkalinity | 61.6 | 0.3 | mg/L | 22-Jul-04 | SM2320:B | |
| Colour | 55 | 5 | | 26-Jul-04 | SM2120:B | |
| Conductivity, Specific | 254 | 0.3 | µS/cm | 22-Jul-04 | SM2510:B | |
| pH | 7.69 | 0.05 | pH units | 22-Jul-04 | SM4500-H:B | |
| Solids, Total Suspended | 6 | 3 | mg/L | 30-Jul-04 | SM2540:D | |
| Turbidity | 7.49 | 0.05 | NTU | 23-Jul-04 | SM2130:B | |
| **Nutrients** | | | | | | |
| Ammonia as N | 1.21 | 0.005 | mg/L | 29-Jul-04 | SM4500-NH3:G | |
| Biological Oxygen Demand | | | mg/L | 22-Jul-04 | SM5210:B | |
| Nitrate as N | 0.51 | 0.01 | mg/L | 26-Jul-04 | SM4110:B | |
| Nitrite as N | 0.05 | 0.01 | mg/L | 26-Jul-04 | SM4110:B | |
| Phosphorous, Total | 0.24 | 0.01 | mg/L | 23-Jul-04 | SM4500-P:D | |
| **Major Ions** | | | | | | |

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## - CERTIFICATE OF ANALYSIS -

**Client Sample ID: Kugluktuk Sewage Effluent** **Taiga Sample ID: 241702**

| | | | | | |
|---|---|---|---|---|---|
| Calcium | 8.5 | 0.1 | mg/L | 26-Jul-04 | SM4110:B |
| Chloride | 36.7 | 0.2 | mg/L | 26-Jul-04 | SM4110:B |
| Magnesium | 7.1 | 0.1 | mg/L | 26-Jul-04 | SM4110:B |
| Potassium | 1.3 | 0.1 | mg/L | 26-Jul-04 | SM4110:B |
| Sodium | 16.7 | 0.1 | mg/L | 26-Jul-04 | SM4110:B |
| Sulphate | 1 | 1 | mg/L | 26-Jul-04 | SM4110:B |
| **Microbiology** | | | | | |
| Coliforms, Fecal | 150 | 10 | CFU/100mL | 22-Jul-04 | SM9222:D |
| **Subcontracted Organics** | | | | | |
| Phenols | < 0.5 | 0.5 | µg/L | 30-Jul-04 | SM5530:C |
| **Metals, Total** | | | | | |
| Aluminum | 75 | 30 | µg/L | 27-Jul-04 | EPA200.8 |
| Antimony | 0.5 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Arsenic | < 1 | 1 | µg/L | 27-Jul-04 | SM3113:B |
| Barium | 10.4 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Beryllium | < 0.1 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Cadmium | < 0.1 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Cesium | < 0.1 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Chromium | < 0.3 | 0.3 | µg/L | 27-Jul-04 | EPA200.8 |
| Cobalt | 0.4 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Copper | 3.3 | 0.3 | µg/L | 27-Jul-04 | EPA200.8 |

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## - CERTIFICATE OF ANALYSIS -

**Client Sample ID: Kugluktuk Sewage Effluent** **Taiga Sample ID: 241702**

| | | | | | |
|---|---|---|---|---|---|
| Iron | 1810 | 50 | µg/L | 04-Aug-04 | SM3111:B |
| Lead | 0.1 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Lithium | 1.5 | 0.3 | µg/L | 27-Jul-04 | EPA200.8 |
| Manganese | 122 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Mercury | < 0.02 | 0.02 | µg/L | 28-Jul-04 | EPA200.8 |
| Molybdenum | < 0.1 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Nickel | 0.6 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Rubidium | 1.5 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Selenium | < 1 | 1 | µg/L | 27-Jul-04 | EPA200.8 |
| Silver | < 0.1 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Strontium | 19.9 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Thallium | 0.4 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Titanium | 2.8 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Uranium | < 0.1 | 0.1 | µg/L | 27-Jul-04 | EPA200.8 |
| Vanadium | 0.5 | 0.1 | µg/L | 27 Jul 04 | EPA200.8 |
| Zinc | < 10 | 10 | µg/L | 27-Jul-04 | EPA200.8 |

## - DATA QUALIFERS -

*Data Qualifier Descriptions:*

11 *Holding time exceeded before sample analysis*

**TAIGA ENVIRONMENTAL LABORATORY**
Dept. Indian Affairs & Northern Development
**4601-52 nd Ave., Box 1500**
**Yellowknife, NT. X1A 2R3**
Tel (867) 669-2788
Fax (867) 669-2718

To: NUNAVUT
Operations Directorate. DIAND
BOX 100
IQALUIT X0A 0H0
**Att'n:** PAUL SMITH

**LAB#** 981437

## SAMPLE INFORMATION

**Our Lab#:** 981437
**Your Sample ID:** Kugluktuk - sewage effluent @ ocean
**Sample Matrix:**

**PROJECT:**

**Collection:**
**Location:** sewage effluent - grab
**Date:** 8/28/1998
**By:** Paul Smith

**Received Date:** Aug-31-1998
**Report Date:** 16-Sep-98
**Approved By:**

## - SAMPLE ANALYSIS REPORT -

| Lab# | Test | Result | Units | Detection Limit | Analysis Date | Analytical Method |
|---|---|---|---|---|---|---|
| 981437 | | | | | | |
| | Tot-Suspended-Solids | 4 | mg/L | 3 | 9/10/1998 | grav |
| | Ammonia-N | 4.68 | mg/L | 0.002 | | 007562 |
| | Tot-Mercury(water) | L0.01 | ug/L | 0.01 | 8/31/1998 | 080314 |
| | Tot-Cadmium(ICP-MS) | L0.1 | ug/L | 0.1 | 9/2/1998 | ICP-MS |
| | Tot-Cobalt(ICP-MS) | 0.5 | ug/L | 0.1 | 9/2/1998 | ICP-MS |
| | Tot-Chromium(ICP-MS) | L2 | ug/L | 2.0 | 9/2/1998 | ICP-MS |
| | Tot-Copper(ICP/MS) | 2.2 | ug/L | 0.1 | 9/2/1998 | ICP-MS |
| | Tot-Iron(AA) | 1.26 | mg/L | 0.020 | 9/14/1998 | ICP-MS |
| | Tot-Manganese(ICP-MS) | 202 | ug/L | 0.1 | 9/2/1998 | ICP-MS |
| | Tot-Nickel(ICP-MS) | 2.4 | ug/L | 0.1 | 9/2/1998 | ICP-MS |
| | Tot-Lead(ICP-MS) | L0.2 | ug/L | 0.2 | 9/2/1998 | ICP-MS |
| | Tot-Zinc(ICP-MS) | L10 | ug/L | 10.0 | 9/2/1998 | ICP-MS |

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Indian Affairs & Northern Development
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Yellowknife, NT. X1A 2R3
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Fax: (867) 669-2718

To: KUGLUKTUK

BOX 278

KUGLUKTUK NT X0E 0B0

Att'n: Pat Laroque

LAB# 980969

## SAMPLE INFORMATION

Our Lab#: 980969
Your Sample ID: SEWAGE DISCHARGE @ CORNATION
Sample Matrix: SEWAGE

PROJECT:

Collection:
Location: Cornation Gulf
Date: 08/07/1998
By: P. Laroque

Received Date: 08-July-98
Report Date: 22-Jul-98
Approved By:

## - SAMPLE ANALYSIS REPORT -

| Lab# | Test | Result | Units | Detection Limit | Analysis Date | Analytical Method |
|---|---|---|---|---|---|---|
| 980969 | | | | | | |
| | Turbidity | 2.9 | NTU | 0.1 | 14/07/1998 | 002081 |
| | Tot-Suspended-Solids | 5 | mg/L | 3 | 13/07/1998 | grav |
| | Ammonia-N | 0.003 | mg/L | 0.002 | 13/07/1998 | 007562 |
| | Tot-Coliforms | 30 | CFU/dL | 1 | 10/07/1998 | 036002 |
| | Faecal_Coliform | L10 | CFU/dL | 1 | 10/07/1998 | 036014 |
| | Bio-Oxy-Demand | 35 | mg/L | 2 | 10/07/1998 | 08208 |

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID: KUG-2** **Taiga Sample ID: 243409**

**Client Project:**
**Sample Type:** Wastewater
**Received Date:** 14-Oct-04
**Sampling Date:** 14-Oct-04
**Location:**

***Report Status:*** **FINAL**

**Approved By** R. Shane Harnish
Quality Assurance Officer

| Test Parameter | Result | Detection Limit | Units | Analysis Date | Analytical Method * | Qualifer |
|---|---|---|---|---|---|---|
| **Physicals** | | | | | | |
| pH | 7.54 | 0.05 | pH units | 21-Oct-04 | SM4500-H:B | |
| Conductivity, Specific | 2900 | 0.3 | µS/cm | 21-Oct-04 | SM2510:B | |
| Solids, Total Suspended | 1540 | 3 | mg/L | 22-Oct-04 | SM2540:D | |
| **Nutrients** | | | | | | |
| Ammonia as N | 7.00 | 0.005 | mg/L | 15-Oct-04 | SM4500-NH3:G | |
| Biological Oxygen Demand | 19 | 2 | mg/L | 14-Oct-04 | SM5210:B | |
| Nitrate+Nitrite as Nitrogen | < 0.01 | 0.01 | mg/L | 19-Oct-04 | SM4110:B | |
| **Major Ions** | | | | | | |
| Calcium | 251 | 0.1 | mg/L | 19-Oct-04 | SM4110:B | |
| Sulphate | 89 | 1 | mg/L | 19-Oct-04 | SM4110:B | |
| Magnesium | 118 | 0.1 | mg/L | 19-Oct-04 | SM4110:B | |
| Sodium | 106 | 0.1 | mg/L | 19-Oct-04 | SM4110:B | |

**ReportDate:** Friday, November 12, 2004
**Print Date:** Friday, November 12, 2004

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID: KUG-2** **Taiga Sample ID: 243409**

| | | | | | | |
|---|---|---|---|---|---|---|
| Potassium | 7.6 | 0.1 | mg/L | 19-Oct-04 | SM4110:B | |
| **Microbiology** | | | | | | |
| Coliforms, Fecal | 900 | 100 | CFU/100mL | 12-Oct-04 | SM9222:D | 20 |
| **Metals, Total** | | | | | | |
| Mercury | < 0.02 | 0.02 | µg/L | 29-Oct-04 | EPA200.8 | |
| Cadmium | 0.1 | 0.1 | µg/L | 08-Nov-04 | EPA200.8 | |
| Arsenic | 4 | 1 | µg/L | 08-Nov-04 | SM3113:B | |
| Iron | 11500 | 50 | µg/L | 27-Oct-04 | SM3111:B | |
| Chromium | 5.7 | 0.3 | µg/L | 08-Nov-04 | EPA200.8 | |
| Copper | 49.2 | 0.3 | µg/L | 08-Nov-04 | EPA200.8 | |
| Nickel | 9.7 | 0.1 | µg/L | 08-Nov-04 | EPA200.8 | |
| Lead | 4.7 | 0.1 | µg/L | 08-Nov-04 | EPA200.8 | |
| Zinc | 63 | 10 | µg/L | 08-Nov-04 | EPA200.8 | |
| **Organic** | | | | | | |
| Oil and Grease (Visible) | non-vis | | | 22-Oct-04 | Visual Exam. | |
| **Subcontracted Organics** | | | | | | |
| Phenols | 1.1 | 0.5 | µg/L | 21-Oct-04 | SM5530:C | |

# - DATA QUALIFERS -

*Data Qualifier Descriptions:*

20 *Possible matrix interference, reported result uncertain*

**ReportDate:** Friday, November 12, 2004
**Print Date:** Friday, November 12, 2004

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID: KUG-4** **Taiga Sample ID: 243410**

**Client Project:**
**Sample Type:** Sewage
**Received Date:** 14-Oct-04
**Sampling Date:** 14-Oct-04
**Location:**

***Report Status:*** **FINAL**

**Approved By** R. Shane Harnish
Quality Assurance Officer

| Test Parameter | Result | Detection Limit | Units | Analysis Date | Analytical Method * | Qualifer |
|---|---|---|---|---|---|---|
| **Physicals** | | | | | | |
| Solids, Total Suspended | 4 | 3 | mg/L | 22-Oct-04 | SM2540:D | |
| pH | 7.25 | 0.05 | pH units | 21-Oct-04 | SM4500-H:B | |
| Conductivity, Specific | 496 | 0.3 | µS/cm | 21-Oct-04 | SM2510:B | |
| **Nutrients** | | | | | | |
| Nitrate+Nitrite as Nitrogen | 0.14 | 0.01 | mg/L | 19-Oct-04 | SM4110:B | |
| Biological Oxygen Demand | 11 | 2 | mg/L | 14-Oct-04 | SM5210:B | |
| Ammonia as N | 14.0 | 0.005 | mg/L | 15-Oct-04 | SM4500-NH3:G | |
| **Major Ions** | | | | | | |
| Calcium | 14.0 | 0.1 | mg/L | 19-Oct-04 | SM4110:B | |
| Sulphate | 6 | 1 | mg/L | 19-Oct-04 | SM4110:B | |
| Magnesium | 10.8 | 0.1 | mg/L | 19-Oct-04 | SM4110:B | |
| Sodium | 30.8 | 0.1 | mg/L | 19-Oct-04 | SM4110:B | |
| Potassium | 3.6 | 0.1 | mg/L | 19-Oct-04 | SM4110:B | |

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID: KUG-4** **Taiga Sample ID: 243410**

| | | | | | |
|---|---|---|---|---|---|
| **Microbiology** | | | | | |
| Coliforms, Fecal | 500 | 100 | CFU/100mL | 12-Oct-04 | SM9222:D |
| **Metals, Total** | | | | | |
| Cadmium | < 0.1 | 0.1 | µg/L | 08-Nov-04 | EPA200.8 |
| Mercury | < 0.02 | 0.02 | µg/L | 08-Nov-04 | EPA200.8 |
| Iron | 3550 | 50 | µg/L | 27-Oct-04 | SM3111:B |
| Arsenic | < 1 | 1 | µg/L | 08-Nov-04 | SM3113:B |
| Chromium | 2.5 | 0.3 | µg/L | 08-Nov-04 | EPA200.8 |
| Copper | 8.9 | 0.3 | µg/L | 08-Nov-04 | EPA200.8 |
| Nickel | 2.2 | 0.1 | µg/L | 08-Nov-04 | EPA200.8 |
| Lead | 0.4 | 0.1 | µg/L | 08-Nov-04 | EPA200.8 |
| Zinc | 20 | 10 | µg/L | 08-Nov-04 | EPA200.8 |
| **Organic** | | | | | |
| Oil and Grease (Visible) | non-vis | | | 22-Oct-04 | Visual Exam. |
| **Subcontracted Organics** | | | | | |
| Phenols | 1.6 | 0.5 | µg/L | 21-Oct-04 | SM5530:C |

*** Taiga analytical methods are based on the following standard analytical methods**
SM - Standard Methods for the Examination of Water and Wastewater
EPA - United States Environmental Protection Agency
CCME - Canadian Council of Ministers of the Environment

**ReportDate:** Friday, November 12, 2004
**Print Date:** Friday, November 12, 2004

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug-2 **Taiga Sample ID:** 242009

**Client Project:**
**Sample Type:** wastewater
**Received Date:** 10-Aug-04
**Sampling Date:**
**Location:**

***Report Status:*** **FINAL**

**Approved By** Teresa Joudrie
A/Laboratory Manager

| Test Parameter | Result | Detection Limit | Units | Analysis Date | Analytical Method * | Qualifer |
|---|---|---|---|---|---|---|
| **Physicals** | | | | | | |
| Conductivity, Specific | 417 | 0.3 | µS/cm | 10-Aug-04 | SM2510:B | |
| pH | 8.22 | 0.05 | pH units | 10-Aug-04 | SM4500-H:B | |
| Solids, Total Suspended | < 3 | 3 | mg/L | 10-Aug-04 | SM2540:D | |
| **Nutrients** | | | | | | |
| Ammonia as N | 0.018 | 0.005 | mg/L | 18-Aug-04 | SM4500-NH3:G | |
| Biological Oxygen Demand | 3 | 2 | mg/L | 10-Aug-04 | SM5210:B | |
| **Subcontracted Nutrients** | | | | | | |
| Nitrate+Nitrite as N | < 0.2 | 0.2 | mg/L | 25-Aug-04 | SM4110:B | |
| **Subcontracted Major Ions** | | | | | | |
| Calcium | 38.1 | 0.2 | mg/L | 25-Aug-04 | SM3120:B | |
| Magnesium | 21.2 | 0.1 | mg/L | 25-Aug-04 | SM3120:B | |
| Potassium | 1.66 | 0.05 | mg/L | 25-Aug-04 | SM3120:B | |
| Sodium | 19.2 | 0.01 | mg/L | 25-Aug-04 | SM3120:B | |

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID: Kug-2** **Taiga Sample ID: 242009**

| | | | | | |
|---|---|---|---|---|---|
| Sulphate | 29.4 | 0.2 | mg/L | 25-Aug-04 | SM4110:B |
| **Microbiology** | | | | | |
| Coliforms, Fecal | 8 | 4 | CFU/100mL | 10-Aug-04 | SM9222:D |
| **Organic** | | | | | |
| Oil and Grease (Visible) | non-vis | | | 20-Aug-04 | Visual Exam. |
| **Subcontracted Organics** | | | | | |
| Phenols | < 0.5 | 0.5 | µg/L | 27-Aug-04 | SM5530:C |
| **Metals, Total** | | | | | |
| Arsenic | < 1 | 1 | µg/L | 18-Aug-04 | SM3113:B |
| Cadmium | < 0.1 | 0.1 | µg/L | 05-Sep-04 | EPA200.8 |
| Chromium | 0.6 | 0.3 | µg/L | 05-Sep-04 | EPA200.8 |
| Copper | 2.6 | 0.3 | µg/L | 05-Sep-04 | EPA200.8 |
| Iron | 262 | 50 | µg/L | 11-Aug-04 | SM3111:B |
| Lead | 0.1 | 0.1 | µg/L | 05-Sep-04 | EPA200.8 |
| Mercury | 0.04 | 0.02 | µg/L | 19-Aug-04 | EPA200.8 |
| Nickel | 1.5 | 0.1 | µg/L | 05-Sep-04 | EPA200.8 |
| Zinc | < 10 | 10 | µg/L | 05-Sep-04 | EPA200.8 |

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug-4 **Taiga Sample ID:** 242010

**Client Project:**
**Sample Type:** wastewater
**Received Date:** 10-Aug-04
**Sampling Date:**
**Location:**

**Approved By** Teresa Joudrie
A/Laboratory Manager

***Report Status:*** **FINAL**

| Test Parameter | Result | Detection Limit | Units | Analysis Date | Analytical Method * | Qualifer |
|---|---|---|---|---|---|---|
| **Physicals** | | | | | | |
| Conductivity, Specific | 351 | 0.3 | µS/cm | 10-Aug-04 | SM2510:B | |
| pH | 7.49 | 0.05 | pH units | 10-Aug-04 | SM4500-H:B | |
| Solids, Total Suspended | 4 | 3 | mg/L | 16-Aug-04 | SM2540:D | |
| **Nutrients** | | | | | | |
| Ammonia as N | 4.34 | 0.005 | mg/L | 18-Aug-04 | SM4500-NH3:G | |
| Biological Oxygen Demand | 4 | 2 | mg/L | 10-Aug-04 | SM5210:B | |
| **Subcontracted Nutrients** | | | | | | |
| Nitrate+Nitrite as N | 0.9 | 0.2 | mg/L | 25-Aug-04 | SM4110:B | |
| **Subcontracted Major Ions** | | | | | | |
| Calcium | 25.6 | 0.2 | mg/L | 25-Aug-04 | SM3120:B | |
| Magnesium | 12.1 | 0.1 | mg/L | 25-Aug-04 | SM3120:B | |
| Potassium | 2.86 | 0.05 | mg/L | 25-Aug-04 | SM3120:B | |
| Sodium | 31.2 | 0.01 | mg/L | 25-Aug-04 | SM3120:B | |

**Report Date:** Wednesday, September 22, 2004

Taiga Environmental Laboratory
4601-52nd Ave., Box 1500, Yellowknife, NT. X1A 2R3
Tel: (867)-669-2788 Fax: (867)-669-2718

# - CERTIFICATE OF ANALYSIS -

**Client Sample ID: Kug-4** **Taiga Sample ID: 242010**

| | | | | | |
|---|---|---|---|---|---|
| Sulphate | 4.2 | 0.2 | mg/L | 25-Aug-04 | SM4110:B |
| **Microbiology** | | | | | |
| Coliforms, Fecal | 56 | 4 | CFU/100mL | 10-Aug-04 | SM9222:D |
| **Organic** | | | | | |
| Oil and Grease (Visible) | non-vis | | | 20-Aug-04 | Visual Exam. |
| **Subcontracted Organics** | | | | | |
| Phenols | 0.5 | 0.5 | µg/L | 27-Aug-04 | SM5530:C |
| **Metals, Total** | | | | | |
| Arsenic | 1 | 1 | µg/L | 18-Aug-04 | SM3113:B |
| Cadmium | < 0.1 | 0.1 | µg/L | 05-Sep-04 | EPA200.8 |
| Chromium | 0.8 | 0.3 | µg/L | 05-Sep-04 | EPA200.8 |
| Copper | 1.7 | 0.3 | µg/L | 05-Sep-04 | EPA200.8 |
| Iron | 2530 | 50 | µg/L | 17-Aug-04 | SM3111:B |
| Lead | 0.2 | 0.1 | µg/L | 05-Sep-04 | EPA200.8 |
| Mercury | < 0.02 | 0.02 | µg/L | 19-Aug-04 | EPA200.8 |
| Nickel | 2.4 | 0.1 | µg/L | 05-Sep-04 | EPA200.8 |
| Zinc | < 10 | 10 | µg/L | 05-Sep-04 | EPA200.8 |

Taiga Environmental Laboratory
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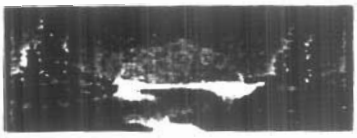
# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug-4 **Taiga Sample ID:** 242010

*** Taiga analytical methods are based on the following standard analytical methods**
SM - Standard Methods for the Examination of Water and Wastewater
EPA - United States Environmental Protection Agency

**Report Date:** Wednesday, September 22, 2004



Taiga Environmental Laboratory
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Tel: (867)-669-2788 Fax: (867)-669-2718

# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug-2 **Taiga Sample ID:** 242776

**Client Project:**
**Sample Type:** Wastewater
**Received Date:** 09-Sep-04
**Sampling Date:** 07-Sep-04
**Location:**

***Report Status:*** **FINAL**

**Approved By** Helene Harper
Client Services Officer

| Test Parameter | Result | Detection Limit | Units | Analysis Date | Analytical Method * | Qualifer |
|---|---|---|---|---|---|---|
| **Physicals** | | | | | | |
| Conductivity, Specific | 352 | 0.3 | µS/cm | 14-Sep-04 | SM2510:B | |
| pH | 7.22 | 0.05 | pH units | 14-Sep-04 | SM4500-H:B | |
| Solids, Total Suspended | 14 | 3 | mg/L | 19-Sep-04 | SM2540:D | |
| **Nutrients** | | | | | | |
| Ammonia as N | 6.10 | 0.005 | mg/L | 14-Sep-04 | SM4500-NH3:G | |
| Biological Oxygen Demand | 4 | 2 | mg/L | 09-Sep-04 | SM5210:B | 2 |
| Nitrate+Nitrite as Nitrogen | 0.65 | 0.01 | mg/L | 14-Sep-04 | SM4110:B | |
| **Major Ions** | | | | | | |
| Calcium | 15.9 | 0.1 | mg/L | 14-Sep-04 | SM4110:B | |
| Hardness | 94.3 | 0.7 | mg/L | 14-Sep-04 | SM2340:B | |
| Magnesium | 11.5 | 0.1 | mg/L | 14-Sep-04 | SM4110:B | |
| Potassium | 2.3 | 0.1 | mg/L | 14-Sep-04 | SM4110:B | |
| Sodium | 28.2 | 0.1 | mg/L | 14-Sep-04 | SM4110:B | |

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID: Kug-2** **Taiga Sample ID: 242776**

| | | | | | |
|---|---|---|---|---|---|
| Sulphate | 11 | 1 | mg/L | 14-Sep-04 | SM4110:B |
| **Microbiology** | | | | | |
| Coliforms, Fecal | 7240 | 10 | CFU/100mL | 09-Sep-04 | SM9222:D |
| **Metals, Total** | | | | | |
| Arsenic | 2 | 1 | µg/L | 24-Sep-04 | SM3113:B |
| Cadmium | < 0.1 | 0.1 | µg/L | 16-Sep-04 | EPA200.8 |
| Chromium | 0.6 | 0.3 | µg/L | 16-Sep-04 | EPA200.8 |
| Copper | 4.6 | 0.3 | µg/L | 16-Sep-04 | EPA200.8 |
| Iron | 1550 | 50 | µg/L | 16-Sep-04 | SM3111:B |
| Lead | 0.2 | 0.1 | µg/L | 16-Sep-04 | EPA200.8 |
| Mercury | < 0.02 | 0.02 | µg/L | 18-Sep-04 | EPA200.8 |
| Nickel | 2.0 | 0.1 | µg/L | 16-Sep-04 | EPA200.8 |
| Zinc | < 10 | 10 | µg/L | 16-Sep-04 | EPA200.8 |

# - DATA QUALIFERS -

*Data Qualifier Descriptions:*

2 *Holding time exceeded upon receipt of sample*

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug-4 **Taiga Sample ID:** 242777

**Client Project:**
**Sample Type:** Wastewater
**Received Date:** 09-Sep-04
**Sampling Date:** 07-Sep-04
**Location:**

***Report Status:*** **FINAL**

**Approved By** Helene Harper
Client Services Officer

| Test Parameter | Result | Detection Limit | Units | Analysis Date | Analytical Method * | Qualifer |
|---|---|---|---|---|---|---|
| **Physicals** | | | | | | |
| Conductivity, Specific | 463 | 0.3 | µS/cm | 14-Sep-04 | SM2510:B | |
| pH | 7.51 | 0.05 | pH units | 14-Sep-04 | SM4500-H:B | |
| Solids, Total Suspended | 5 | 3 | mg/L | 19-Sep-04 | SM2540:D | |
| **Nutrients** | | | | | | |
| Ammonia as N | 0.006 | 0.005 | mg/L | 14-Sep-04 | SM4500-NH3:G | |
| Biological Oxygen Demand | 4 | 2 | mg/L | 09-Sep-04 | SM5210:B | 2 |
| Nitrate+Nitrite as Nitrogen | 0.06 | 0.01 | mg/L | 14-Sep-04 | SM4110:B | |
| **Major Ions** | | | | | | |
| Calcium | 45.6 | 0.1 | mg/L | 14-Sep-04 | SM4110:B | |
| Hardness | 241 | 0.7 | mg/L | 14-Sep-04 | SM2340:B | |
| Magnesium | 21.1 | 0.1 | mg/L | 14-Sep-04 | SM4110:B | |
| Potassium | 2.0 | 0.1 | mg/L | 14-Sep-04 | SM4110:B | |
| Sodium | 18.5 | 0.1 | mg/L | 14-Sep-04 | SM4110:B | |

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## - CERTIFICATE OF ANALYSIS -

**Client Sample ID: Kug-4** **Taiga Sample ID: 242777**

| | | | | | |
|---|---|---|---|---|---|
| Sulphate | 30 | 1 | mg/L | 14-Sep-04 | SM4110:B |
| **Microbiology** | | | | | |
| Coliforms, Fecal | 119 | 1 | CFU/100mL | 09-Sep-04 | SM9222:D 2 |
| **Metals, Total** | | | | | |
| Arsenic | 3 | 1 | µg/L | 24-Sep-04 | SM3113:B |
| Cadmium | < 0.1 | 0.1 | µg/L | 16-Sep-04 | EPA200.8 |
| Chromium | < 0.3 | 0.3 | µg/L | 16-Sep-04 | EPA200.8 |
| Copper | 7.6 | 0.3 | µg/L | 16-Sep-04 | EPA200.8 |
| Iron | 5050 | 50 | µg/L | 16-Sep-04 | SM3111:B |
| Lead | 1.4 | 0.1 | µg/L | 16-Sep-04 | EPA200.8 |
| Mercury | < 0.02 | 0.02 | µg/L | 18-Sep-04 | EPA200.8 |
| Nickel | 2.7 | 0.1 | µg/L | 16-Sep-04 | EPA200.8 |
| Zinc | 22 | 10 | µg/L | 16-Sep-04 | EPA200.8 |

## - DATA QUALIFERS -

*Data Qualifier Descriptions:*

2 *Holding time exceeded upon receipt of sample*

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID: Kug-4** **Taiga Sample ID: 242777**

*** Taiga analytical methods are based on the following standard analytical methods**
SM - Standard Methods for the Examination of Water and Wastewater
EPA - United States Environmental Protection Agency

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug 2 **Taiga Sample ID:** 241209

**Client Project:**
**Sample Type:** wastewater
**Received Date:** 23-Jun-04
**Sampling Date:** 23-Jun-04
**Location:**

***Report Status:*** **FINAL**

**Approved By** R. Shane Harnish
Quality Assurance Officer

| Test Parameter | Result | Detection Limit | Units | Analysis Date | Analytical Method * | Qualifer |
|---|---|---|---|---|---|---|
| **Physicals** | | | | | | |
| Conductivity, Specific | 277 | 0.3 | µS/cm | 30-Jun-04 | SM2510:B | |
| pH | 7.61 | 0.05 | pH units | 30-Jun-04 | SM4500-H:B | |
| Solids, Total Suspended | 6 | 3 | mg/L | 02-Jul-04 | SM2540:D | |
| **Nutrients** | | | | | | |
| Ammonia as N | 0.006 | 0.005 | mg/L | 28-Jun-04 | SM4500-NH3:G | |
| Biological Oxygen Demand | 5 | 2 | mg/L | 23-Jun-04 | SM5210:B | |
| **Subcontracted Nutrients** | | | | | | |
| Nitrate+Nitrite as N | < 0.2 | 0.2 | mg/L | 02-Jul-04 | SM4500-NO3:F | |
| **Major Ions** | | | | | | |
| Calcium | 30.0 | 0.1 | mg/L | 24-Jun-04 | SM4110:B | |
| Magnesium | 12.3 | 0.1 | mg/L | 24-Jun-04 | SM4110:B | |
| Potassium | 1.97 | 0.1 | mg/L | 24-Jun-04 | SM4110:B | |

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug 2 **Taiga Sample ID:** 241209

| | | | | | |
|---|---|---|---|---|---|
| Sodium | 12.6 | 0.1 | mg/L | 24-Jun-04 | SM4110:B |
| Sulphate | 27 | 1 | mg/L | 26-Jul-04 | SM4110:B |
| **Microbiology** | | | | | |
| Coliforms, Fecal | 240 | 4 | CFU/100mL | 24-Jun-04 | SM9222:D |
| **Organic** | | | | | |
| Oil and Grease (Visible) | non-vis | | | 24-Jun-04 | Visual Exam. |
| **Subcontracted Organics** | | | | | |
| Phenols | 4.4 | 0.5 | µg/L | 05-Jul-04 | SM5530:C |
| **Metals, Total** | | | | | |
| Arsenic | < 1 | 1 | µg/L | 02-Jul-04 | SM3113:B |
| Cadmium | < 0.1 | 0.1 | µg/L | 02-Jul-04 | EPA200.8 |
| Chromium | 0.5 | 0.3 | µg/L | 02-Jul-04 | EPA200.8 |
| Copper | 3.3 | 0.3 | µg/L | 02-Jul-04 | EPA200.8 |
| Iron | 809 | 50 | µg/L | 02-Jul-04 | SM3111:B |
| Lead | 0.2 | 0.1 | µg/L | 02-Jul-04 | EPA200.8 |
| Mercury | < 0.02 | 0.02 | µg/L | 04-Jul-04 | EPA200.8 |
| Nickel | 0.8 | 0.1 | µg/L | 02-Jul-04 | EPA200.8 |
| Zinc | 11 | 10 | µg/L | 02-Jul-04 | EPA200.8 |

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug 4 **Taiga Sample ID:** 241210

**Client Project:**
**Sample Type:** sewage
**Received Date:** 23-Jun-04
**Sampling Date:** 23-Jun-04
**Location:**

***Report Status:*** **FINAL**

**Approved By** R. Shane Harnish
Quality Assurance Officer

| Test Parameter | Result | Detection Limit | Units | Analysis Date | Analytical Method * | Qualifer |
|---|---|---|---|---|---|---|
| **Physicals** | | | | | | |
| Conductivity, Specific | 157 | 0.3 | µS/cm | 30-Jun-04 | SM2510:B | |
| pH | 7.20 | 0.05 | pH units | 30-Jun-04 | SM4500-H:B | |
| Solids, Total Suspended | 18 | 3 | mg/L | 02-Jul-04 | SM2540:D | |
| **Nutrients** | | | | | | |
| Ammonia as N | 2.68 | 0.005 | mg/L | 28-Jun-04 | SM4500-NH3:G | |
| Biological Oxygen Demand | **8** | **2** | mg/L | 23-Jun-04 | SM5210:B | |
| **Subcontracted Nutrients** | | | | | | |
| Nitrate+Nitrite as N | < 0.2 | 0.2 | mg/L | 02-Jul-04 | SM4500-NO3:F | |
| **Major Ions** | | | | | | |
| Calcium | 6.6 | 0.1 | mg/L | 24-Jun-04 | SM4110:B | |
| Magnesium | 4.9 | 0.1 | mg/L | 24-Jun-04 | SM4110:B | |
| Potassium | 2.08 | 0.1 | mg/L | 24-Jun-04 | SM4110:B | |
| Sodium | 14.8 | 0.1 | mg/L | 24-Jun-04 | SM4110:B | |

**Report Date:** Wednesday, August 04, 2004

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# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug 4 **Taiga Sample ID:** 241210

| | | | | | |
|---|---|---|---|---|---|
| Sulphate | 3 | 1 | mg/L | 26-Jul-04 | SM4110:B |
| **Microbiology** | | | | | |
| Coliforms, Fecal | 3400 | 100 | CFU/100mL | 23-Jun-04 | SM9222:D |
| **Organic** | | | | | |
| Oil and Grease (Visible) | non-vis | | | 24-Jun-04 | Visual Exam. |
| **Subcontracted Organics** | | | | | |
| Phenols | < 0.5 | 0.5 | µg/L | 05-Jul-04 | SM5530:C |
| **Metals, Total** | | | | | |
| Arsenic | < 1 | 1 | µg/L | 02-Jul-04 | SM3113:B |
| Cadmium | < 0.1 | 0.1 | µg/L | 02-Jul-04 | EPA200.8 |
| Chromium | 1.2 | 0.3 | µg/L | 02-Jul-04 | EPA200.8 |
| Copper | 4.1 | 0.3 | µg/L | 02-Jul-04 | EPA200.8 |
| Iron | 2391 | 50 | µg/L | 02-Jul-04 | SM3111:B |
| Lead | 0.6 | 0.1 | µg/L | 02-Jul-04 | EPA200.8 |
| Mercury | < 0.02 | 0.02 | µg/L | 04-Jul-04 | EPA200.8 |
| Nickel | 1.8 | 0.1 | µg/L | 02-Jul-04 | EPA200.8 |
| Zinc | < 10 | 10 | µg/L | 02-Jul-04 | EPA200.8 |

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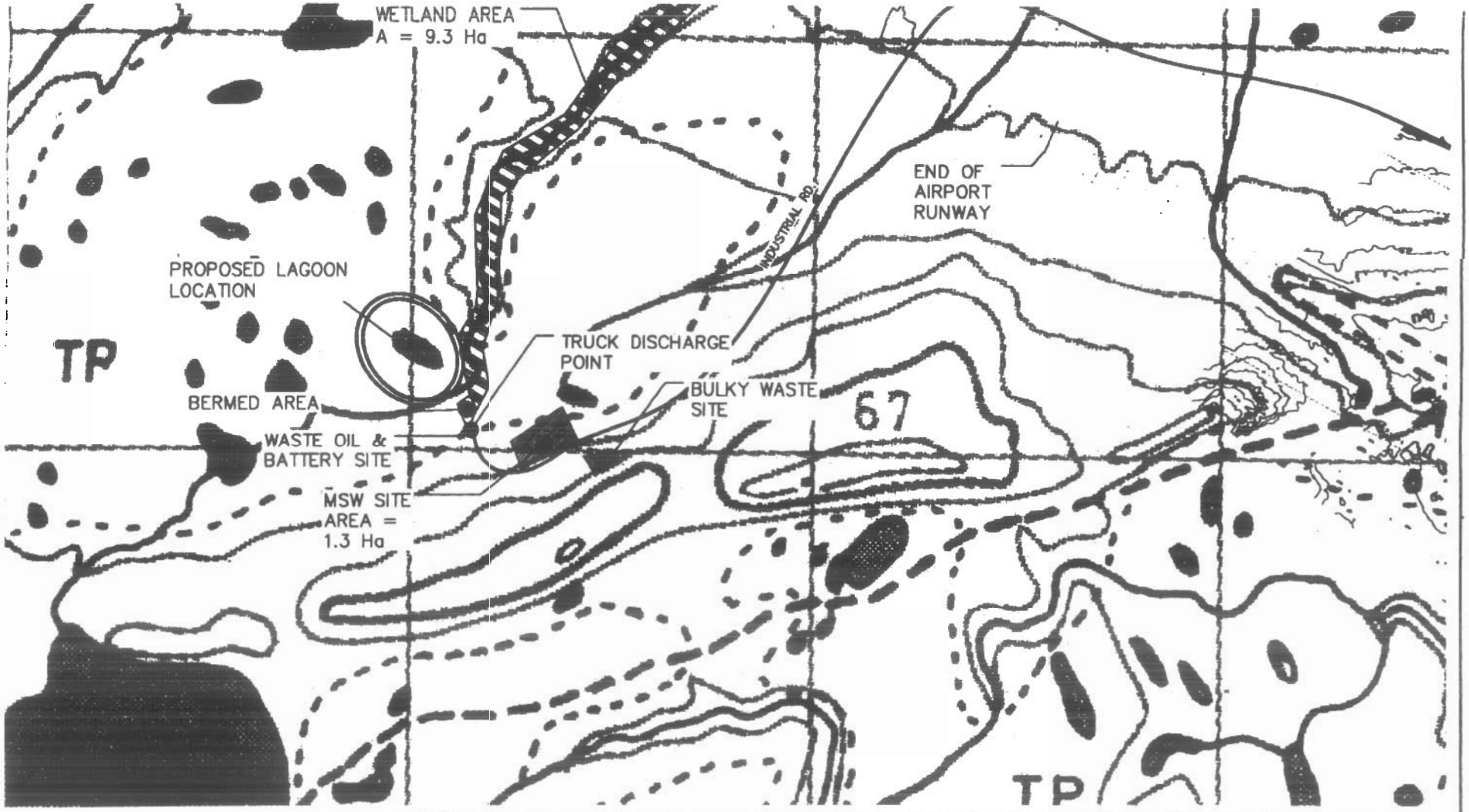
# - CERTIFICATE OF ANALYSIS -

**Client Sample ID:** Kug 4 **Taiga Sample ID:** 241210

*** Taiga analytical methods are based on the following standard analytical methods**

SM - Standard Methods for the Examination of Water and Wastewater

EPA - United States Environmental Protection Agency




FSC
ARCHITECTS
& ENGINEERS

F.S.C. JOB NO. 2003-0760

JOB TITLE
KUGLUKTUK
SEWAGE LAGOON

KUGLUKTUK, NU

DRAWING TITLE
WETLAND/MSW
AREA MAP

| | |
|---|---|
| DESIGNED BY: SD | SCALE: NTS |
| DRAWN BY: JA/SD | DATE: AUG 8TH, 2003 |
| CHECKED BY: RK | JOB NUMBER: 2003-0760 |
| SHEET: 1 of 1 | DRAWING NO: EN-1 |

# Appendix E: Évaluation Criteria / Rating

# ARCHITECTURAL/ENGINEERING
# CONSULTANT PROPOSAL RATING SCHEDULE

| Item | Rating Criteria | | Unit Points Awarded (A) | Assigned Weight (B) | Total Points (A) x (B) = (C) |
|---|---|---|---|---|---|
| 1 | Project Team – personnel Assigned/made available to project | | | 20 | |
| 2 | Methodology or approach proposed by the consultant | | | 20 | |
| 3 | Past Relevant Company Experience | | | 10 | |
| 4 | Project Schedule | | | 10 | |
| 5 | Project Budget Fees and Expenses | | | 10 | |
| 6 | Past Performance References/ Appraisals | | | 10 | |
| 7 | Location of Company and Team Relative to Project Site | | | 5 | |
| 8 | Inuit Content | Inuit Labour | | 10 | |
| | | Inuit Firms | | 5 | |
| | | | | **SUB-TOTAL WEIGHTED SCORE (C):** | |

**LOCAL/NUNAVUT BONUS POINTS**

Nunavut

Businesses (C) _____ x (D) _____ x 7 % = _____

Labour (C) _____ x (E) _____ x 7 % = _____

Add the results of the above calculations for the **TOTAL NUNAVUT BONUS PONTS:**

Local

Businesses (C) _____ x (F)_____ x 1. 5 % = _____

Labour (C) _____ x (G) _____ x 1. 5 % = _____

Add the results of the above calculations for the **TOTAL LOCAL BONUS POINTS:**

PROPOSER _____ **TOTAL:**

**Comments:** _____.

**Committee Member:**_____. **Date:**_____.

**LEGEND:**

A – Evaluation Points Awarded
B – Weighting Factor
C – Sub-Total Weighted Score (A times B)
D - % of Work to be done be Registered Nunavut Businesses including Local
E - % of Work to be done by Nunavut Residents including Local Residents
F - % of Work to be done by Nunavut Businesses or Inuit Firms Local to the subject community
G - % of Work to be done by Local Residents of the Subject Community
Note: for Definitions of terms used in the Legend refer to the NNI Policy Definitions section.

RATING POINTS:

| | |
|---|---|
| Poor | 1 - 3 points |
| Fair | 4 - 6 points |
| Good | 7 - 8 points |
| Excellent | 9 - 10 points |