

FINAL DRAFT

**CLYDE RIVER NWT
WASTE DISPOSAL PROJECT
NO. 7414032
ENGINEERING REPORT**

July 1991

Revised November 1991

**Reinders Northern Limited
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REINDERS

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INTRODUCTION

The Baffin Region Municipal and Community Affairs (MACA) instructed Reinders Northern Limited by means of Service Contract S.C. 290749 dated May 23, 1991 to undertake the following work:

- 1) Inspect the area recommended by the Hamlet for the location of the solid waste site, bulky metal site, lagoon and honeybag burial pit. Assess the suitability of the area in terms of:
 - the site and its ability to meet the requirements imposed by the Department of Indian and Northern Affairs, N.W.T. Water Board, the Baffin Regional Health Board and the Department of Transportation (G.N.W.T.)
 - the site in terms of community growth
 - the site as related to sources of granular for construction and porosity of soil for filtering of effluent.
- 2) Design the remaining roadworks to the solid waste site lagoon, honeybag burial pit and bulky metal site. All design work is to be done in such a method as to be clearly understandable to the Hamlet administrator and works foreman. Sketches and drawings should indicate dimensions and locations. Design with a 10 year horizon in mind.
- 3) Estimate the cost of work remaining on the road project in terms of management costs, granular required, equipment rental and man hours required. When costing the work, cost according to the individual parts of the project (e.g. lagoon, dumpsite, etc.).

- 4) Prepare a work plan based on the remaining work and funding available. The work plan shall give the Hamlet works foreman adequate direction to carry out the project.
- 5) Survey roadways, solid waste, bulky metals, sewage lagoon and honeybag sites. Where necessary stake the boundaries of the various sites with the works foreman.
- 6) Provide site photo's of the area.
- 7) Suggest methods of assessing whether costs have actually been incurred by the Hamlet so that funding for the project is kept on track.
- 8) List of Hamlet project team after consultation.

The preliminary report shall be completed within 20 days of the site inspection which took place on June 19 and 21, 1991 and shall be sent to Municipal and Community Affairs.

PRESENT SITUATION

PRESENT FUNDING

Funding for this project is currently set up by MACA as follows:

1991/92 Construction - Access Road Site	\$41K
1992/93 Construction - Lagoon/Solid Waste Sites	45K
1993/94 Clean-up Old Site	<u>45K</u>
1991/94 Total	\$131K

STATISTICS AND PROJECTIONS

	<u>Existing</u>	<u>Projected</u>	
	1991	2000	2010
Population	530	649	801
No. of Housing Units	126	173	228
Water Usage (million litres)	10.3	24	31

GENERAL INFORMATION

Land Topography	Land is gently sloping down towards the bay from North to South.
Surficial Geology	Bedrock with a layer of glacial till.

Tides	Mean tidal range 0.3m, high tidal range 0.9m
Wind	NW, 14.4 km/hr
Climate	July 7.8°C, 0.4°C Average high, low Jan -22.5°C - 30.3°C
Precipitation	206 mm total, 26 mm rain and 689 mm snow
Water Supply	Lake fed from a series of lakes and streams, and is located approximately 1km inland from community. Water is trucked to houses and buildings in the Hamlet.
Airport	Located approximately 3.2 km east of community
Proposed Dumpsites and Sewage Lagoon Site Granular Sources	Located up hill approximately 2.0km from the airport and approximately 1.2km from water supply.
Typical Soil Formation	Sand, and silty soils with boulders overlying bedrock.
Community Growth	The community is expected to almost double in size to 228 housing units by the year 2010. Growth will be predominantly in the easterly direction.
Baffin Regional Health Board Regulations	See Appendix A
NWT Water Board	Issues licence to operate water supply and waste disposal facilities. Clyde River at present is not licenced.
Department of Indian	

and Northern Affairs Enforcement Agency that monitors Water Board licence conditions.

Department of Sets guidelines for minimum distance between dumpsites and airports
Transportation (GNWT) (see Appendix C).

ACCESS ROAD TO NEW SEWAGE LAGOON AND DUMPSITES

The proposed access road for the Sewage Lagoons and Bulky Metal Dumpsite is an extension of the existing solid waste dumpsite access road in a westerly direction for a distance of 229 metres.

HAMLET PROJECT TEAM

Lizzie Palituq	Senior Administrative Officer
David Arreak	Foreman
Elisha Sanguya	Landsman

DESIGN PARAMETERS

A) ROAD

1. The purpose of the new road is to allow year round access to the sewage lagoon and dumpsites by the Hamlet's service vehicles, including snow clearance of the sewage lagoon access road.
2. The horizontal alignment for the sewage lagoon road was designed to provide access to all parts of the lagoon, with turn round areas where required.
3. The road widths of 5.0m and 3.0m where used to provide an appropriate width of access dependent on anticipated frequency of use and likely size of vehicle requiring access.

The intersection radii are set to the minimum reasonable size allowing easy vehicle manoeuvring.

4. The vertical alignment for the access road was designed to follow the natural topography with a maximum gradient of 5%, by going across the slope.

The access tracks around the lagoon are set on Top of Berm.

5. Road drainage is provided by grading the top of the road construction to a 3% crossfall. A cut off ditch is provided on the up hill side of the road were required to prevent surface water crossing the road or entering the road construction. The depth of the ditch is 0.3m minimum with the maximum depth set by the depth of the existing water courses which are to be intercepted.

5. The road construction proposed is to be confirmed by the Geotechnical Consultant.

B) SEWAGE LAGOON

1. The sewage lagoon design is based on the recommendations in the "Guidelines for the Planning Design, Operation and Maintenance of Wastewater Lagoon Systems", Volumes I and II, by C.W. Heinke, D.W. Smith and G.R. Finch.
2. The capacity of the lagoon is based on the projected community population in the year 2010 as published by the Government of the North West Territories. The year 2010 was chosen to give the lagoon an expected minimum design life of 20 years. The lagoon volume is based on the theoretical wastewater volume adjusted for community size with trucked water delivery and trucked wastewater collection.
3. A storage type lagoon has been used as the climate will only allow the lagoon to treat the sewage for a short period in the summer. The lagoon has therefore been sized to allow for 365 days of storage of the wastewater, allowing the lagoon to be drained once a year in the autumn.
4. The lagoon is to be constructed as two independent cells. The cell to be built now is sized to accommodate the theoretical waste water from the present community population. This will still allow for some growth in the community as the theoretical waste water volume is greater than the actual water consumption as recorded by the Hamlet.

5. To protect the berms, an overflow is provided which drains to the existing water course via a ditch. The overflow is slightly lower than the top of the berm and is protected from water flow damage by rip rap.
6. Each cell has concrete truck discharge aprons and a sluice gate controlled outlet.
7. The lagoon is to be constructed without a flexible liner as the cost is considered to be prohibitively high. In addition, proper installation and maintenance of a flexible liner may not be adequately achieved with the local equipment and personnel. The geotechnical consultant has therefore proposed that the lagoon berm be constructed with a minimum width of 10 m, so that the permafrost table will aggrade (rise) into the berms, creating a permafrost bowl to retain the sewage.
8. The lagoon is to be constructed by utilizing a cut and fill procedure. To assist with the balance of the cut and fill quantities and to encourage the permafrost bowl to form, majority of the lagoon depth will be below the existing grade.
9. Vehicle access is provided to all parts of the sewage lagoon by the access road and a 3.0m wide access track around the top of the berm.

C) **SOLID WASTE DUMP** including "Honey Bags"

1. Part of the solid waste dump has been designated for the dumping of the Honey Bags.

The Honey Bag dumping will be discontinued when all the houses are converted to the wastewater system. The Honey Bag dumpsite has been sized assuming that its use will be phased out over the next 2 years.

2. The whole dumpsite is enclosed by a 2.4m high chain link fence with truck access through 5.0m wide double gates. The fences are to limit loose garbage being blown away and to stop wild animals getting into the garbage.
3. The solid waste dumpsite slopes down away from the access road. The garbage will be dumped over a small bank, once a pile forms, it should be compacted with a bulldozer and a layer of natural soil placed over the top to cap the garbage. This cap is then used as the vehicles access for future tipping.
4. If it is the current practice to allow community scavenging of the dumped garbage, this can be continued by arranging for the gates to be open for general access at a designated time. There should be no scavenging of the compacted or covered garbage.
5. If it is the current practice to burn the garbage before dumping, this can be continued. The burning should be carried out in one location in the solid waste dump site, the burnt garbage should be allowed to cool before final dumping and capping.

D) BULKY METAL DUMPSITE

1. This is an open area of ground to the north of the access road, designated for the dumping of large metal items.
2. A vehicle access track is provided to enable easy access.
3. The dumpsite is approximately 100m from the nearest watercourse.

**Photographs of the Proposed Sewage Lagoon
and Solid Waste Dump Site**



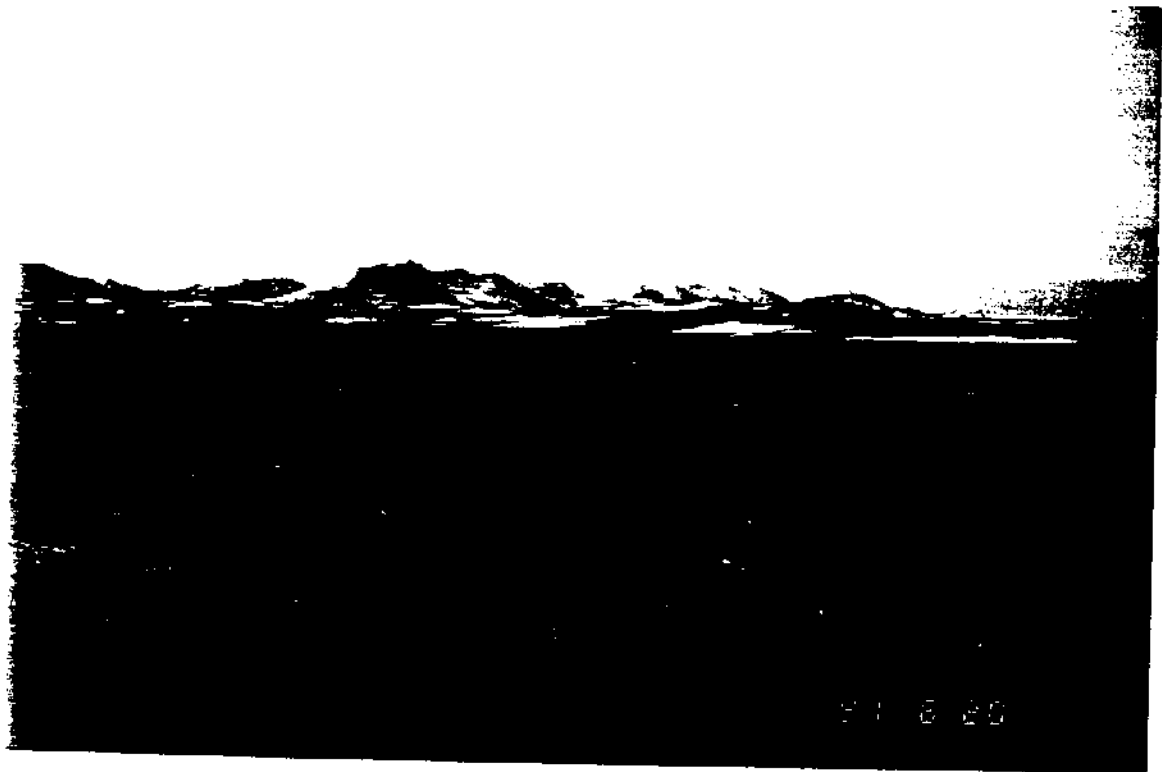
Solid Waste Dump Site Looking South



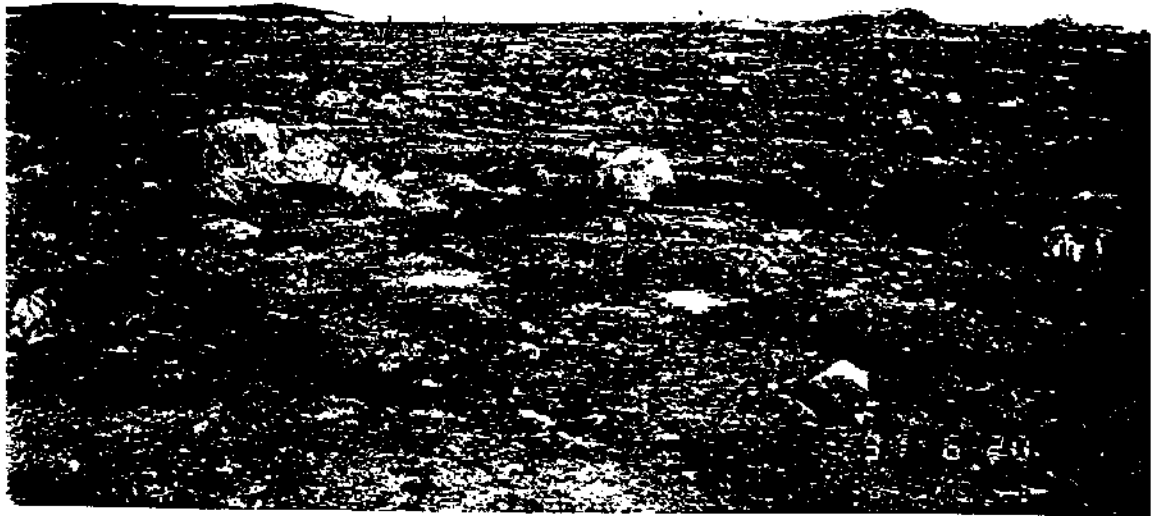
Heavy Metal Dump Site Looking N.W.



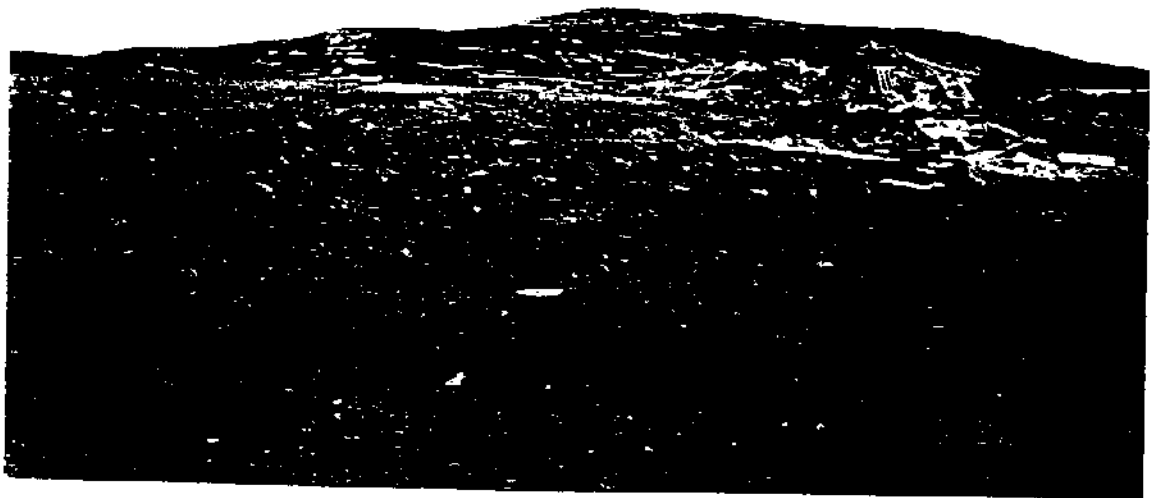
Proposed Access Road Looking West



Sewage Lagoon and Proposed Access Road Looking S.W.



Sewage Lagoon and Solid Waste Site Looking North



Solid Waste Dump Site Looking S.E.

SEWAGE LAGOON DESIGN

Design based on "Guidelines for the Planning, Design Operation and Maintenance of Wastewater Lagoon Systems", Volume 1

Site chosen is on a south facing slope, 0.8 km north of the coast line, 4.4 km west of the airport, 1.2 km west of the Hamlet.

Prevailing wind: NW

The planned site is downwind of Hamlet.

Clyde River Hamlet has a truck system for water distribution and wastewater collection.

POPULATION

Present	1991	530 people
Projected	2000	649 people
	2010	801 people

WASTEWATER VOLUME

From Guidelines: Trucked water delivery situation has a sewage pump out wastewater volume of 90 litres (L) per day (p.d.) per person

Adjust water use for community size.

0 to 2000 people

Residential rate $\times [1 + (0.00023 \text{ Pop})]$

Present theoretical water use

101 L/p.d. per person

COMPARE ACTUAL WATER USAGE TO THEORETICAL WATER USAGE

From water storage reservoir records

Actual water use 10,331,848 L/yr. in 1990/91 from Hamlets records (10,332m³)

Number of houses using "Honey Bag" collection 15

Total number of houses - 126

Therefore, 12% of the population use the "honey bag" waste collection system, therefore use less water.

Compare actual water use to theoretical water use:

Theoretical water use $530 \times 101 \times 365 = 19,538,450 \text{ L or } 19,538\text{m}^3$

There is a large discrepancy between actual use and theoretical water use. To be conservative, use theoretical figure only for sizing of lagoon.

SIZE OF LAGOON

Provide 365 day storage - lagoon to be drained once a year in the Autumn.

Year	Pop	L	Volume m ³
1991	530	19,538,450	19,539m ³
2000	644	24,399,155	24,399m ³
2010	801	31,283,055	31,283m ³

The sewage lagoon has to store a minimum water volume of 31,280,000 L for a one year period. The lagoon is designed in two cells with a working depth of 3 metres. See Plan 01 for layout and design details.

SIZE LAGOON - One Cell

$$\text{Volume} = d [(a + sd) (b + 5d) + 0.0472S^2d^2]$$

Depth from HWL to invert of outlet pipe 3.0

4:1 side slopes

$$V = 3.0 [(106 + 12) (43 + 12) + 0.0472 \times 4^2 \times 3^2]$$

$$V = 19,490\text{m}^3$$

TIME TO DRAIN

Assume controlling factor is outlet pipe.

300mm dia at 1% gradient

CSP $n = 0.03$

Mannings formula for flow in pipes $Q = 1/n AR^{2/3} S^{1/2}$

Assume hydraulic gradient is from lagoon half full to free draining outlet.

Water Elev. $\frac{96.75 - 93.75}{2} = 95.25\text{m}$ (for datum refer to Drawing 01)

Length 40.0 m

Invert at outlet 93.00 m

Drop 1.25 m

Gradient 3.13%

$Q = 0.074$ cms at 1.5m/sec.

Time to drain $\frac{19500}{0.074 \times 60 \times 60} = 73.20$ hours approx. 3 days

SEWAGE LAGOON - Work Plan

1. Strip tundra cover from area of lagoon and cut off ditch.
2. Excavate cut off ditch, excavated material to be used as fill for berm. Place rip rap erosion protection as shown on plan and at any other points of high erosion.
3. Excavate lagoon, using excavated material to construct berms. All fill material to be unfrozen, inorganic soil. Boulders of greater than 0.3m dia to be removed, and used for rip rap. Berms to be built up in layers less than 0.3m thick and well compacted (a minimum of 8 passes with a large dozer or equivalent). Provide sumps and pump in lagoon during construction, to drain bottom of excavation. If the top of the permafrost is encountered during excavation. Leave surface exposed for some time. Then continue excavation at a latter time when exposed permafrost has thawed.
4. Before berm is constructed on the west side, lay outlet pipe, and construct outlet control manhole.
5. Complete construction of berms including erosion protection, gabion wing walls for outlet control manhole and overflow.
6. Construct access roads, access tracks on top of berms, and concrete truck discharge aprons.
7. Wait for permafrost to aggrade into the lagoon berms before starting to use lagoon. Leave outlet control valve open until lagoon is ready for operation.

SOLID WASTE DUMP DESIGN

Design based on "Guidelines for the planning design, operation and maintenance of solid waste modified landfill sites in the Northwest Territories", Vol. 1.

Waste generation rates: 0.014m³/person/day for Baffin region.

Total community refuse volume (m³) for the life of the dump:

$$\frac{365 V P_1 [(1+G)^{PH} - (1+G)]}{LN (1+G)} + \frac{0.084 V P_1^2 [(1+G)^{2PH} - (1+G)^2]}{2 LN (1+G)}$$

Where V = Average residential refuse volume, m³/person day
 P_n = Population in 17th year
 G = Average community population growth rate/1000
 PH = Planning horizon (years) 20 years.

Average community population growth rate:

Pop 1991	530	
Pop 2010	<u>801</u>	
	271	20 years

Total Volume

$$\frac{365 \times 0.014 \times 530 [(1 + 0.014)^{20} - (1 + 0.014)]}{LN (1 + 0.014)} + \frac{0.084 \times 0.014 \times 530^2 [(1 + 0.014)^{2 \times 20} - (1 + 0.014)^2]}{2 LN (1 + 0.014)}$$

194801 [0.307] + 11880 [0.716]

Total Uncompacted Volume 68,304m³

By compaction and burning, the volume is reduced by between 2/3 to 3/4.

Volume of storage required 22,770m³.

Area of proposed dump typical 100 x 120 x 1.9m average depth excluding capping.

VOLUME OF HONEY BAG SITE

0.5m³ per person per year.

Approx. 12% of population use Honey Bags

$$\frac{530}{100} \times 12 = 63 \text{ people}$$

Say all continue to use system for 2 years.

Total Volume of Honey Bag storage

$$2 \times 63 \times 0.5 = 63\text{m}^3$$

Area required assuming Honey Bag dump is below original ground - 12.5 x 11.75 x 1.0 m average depth.

SOLID WASTE DUMP SITE - Work Plan

1. Strip tundra cover from area of Honey bag dump.
2. Excavate Honey bag dump, retain material for covering of Honey bags and compacted garbage. Provide a sump in the corner of Honey bag dump. This sump is to be pumped out as required to keep the Honey bags dump dry.
3. Erect chainlink fence and gates around solid waste dumpsite.

PRELIMINARY COST ESTIMATES AND PROJECT BUDGET

PRELIMINARY COST ESTIMATE - Sewage Lagoon

	<u>Unit</u>	<u>Est. Qty.</u>	<u>Unit Price</u>	<u>Total</u>
1. Strip tundra cover	m ²	26 208	0.3	\$ 7 862.
2. Excavation	m ³	22 411	3	67 233.
3. Fill	m ³	21 621	---	
4. Concrete apron	m ³	144	\$20	2 880.
5. Erosion protection:	m ³	4 294	\$15	64 410.
a) rip rap 20-100 dia. OR				
b) well graded pit run				
6. Rip rap ditch protection 50 - 300 dia.	m ³	465	\$22	6 975.
7. Outlet control including:		1	L.S.	35 000.
precast concrete manhole sections 1200 x 1200	No.	5		
300 dia. CSP	m	40		
sluice gate including cast iron wall thimble	No.	1		
manhole cover	No.	1		
Gabion baskets	m ³	36		
concrete base	m ³	1		
8. top gravel	m ³	915	\$20.80/cm	19 032.
9. subbase gravel	m ³	600	\$18.39/cm	<u>11 028.</u>
				\$214 420.
10. Contingencies (10%)				<u>\$21 440.</u>
TOTAL SEWAGE LAGOON				<u>\$235 860.</u>

ALTERNATE BUDGET

December 3, 1991

Clyde River Sewage Lagoon

1. <u>Total Excavation</u>	25,000m ³	<i>INCLUDES STRIPPING</i>	
3 machines - 1800m ³ /day (+foreman) - \$830/day	$\frac{25000}{1800} \times \830		\$11,500.
2. <u>Erosion Protection</u>	<i>CHECK SIZE IN THURBER REPORT</i>		
Pit Run	1700m ³ x \$15/m ³		\$25,500.
3. <u>Ditch Construction and Protection</u>	340m ³ x \$22/m ³		\$7,500.
4. <u>Outlet Control Structure</u>	LS		\$22,000.
5. <u>Contingencies (10%)</u>	<i>CIRCUMSTANCE</i>		<u>\$6,600.</u>
Total			\$73,100.

Solid Waste Dump Site

1. Fence 130m x \$70.		\$9,100.
2. Gravel Access Road 50m ³ x \$18.		\$900.
3. Contingencies (10%)		<u>\$1,000.</u>
Total		<u>\$11,000.</u>
GRAND TOTAL		<u>\$84,100.</u>

PRELIMINARY COST ESTIMATE - Solid Waste Dump Site

<u>Unit</u>	<u>Est. Qty.</u>	<u>Unit Price</u>	<u>Total</u>
1. strip tundra cover	m ²	330	0.3 99.
2. excavate for honey bag dump	m ³	83	3 249.
3. 1.8m high chain link fence and gates	m	574	\$70/m <u>40 180.</u>
			\$40 528.
4. Contingencies (10%)			<u>4 050.</u>
TOTAL SOLID WASTE DUMP			<u>\$44 578.</u>
<u>CONSULTING SERVICES</u>			<u>\$23 500.</u>

(this figure is assuming that the sewage lagoon and solid waste dump projects are undertaken simultaneously).*

ACCESS ROAD - 1991 Work Programme

Prepare 229m (750ft) of road subbase and construct ditch along North side (Right side) of road and to construct driveway to sewage lagoon site.

Place 1688m ³ subbase gravel @ \$10.92	\$18,430.
Place 525m ³ top gravel @ \$12.50	6,570.
Engineering	4,000.
Soil Testing	7,500.
Contingencies	<u>4,500.</u>
Total Estimated Cost	<u>\$41,000.</u>
PROJECT TOTAL	<u>\$344 938.</u>

* The total consulting service cost estimate for this project is made assuming that site visits to Broughton Island and Clyde River can be combined.

APPENDICES

APPENDIX A

Baffin Region Health Board Regulations

PURSUANT TO THE
PUBLIC HEALTH ORDINANCE

REG. 214

REVISED REGULATIONS OF THE
NORTHWEST TERRITORIES, 1980

REGULATION No. 214

GENERAL SANITATION REGULATIONS

Short title

1. These regulations may be cited as the *General Sanitation Regulations*.

Interpretation

2. In these regulations "waste disposal ground" means any place used for the disposal of garbage, refuse, excreta or other waste material.

Application

3. (1) These regulations apply
 - (a) to every person;
 - (b) to every installation, building, place or thing constructed, made, set up or established after 1st September, 1957;
 - (c) to every installation, building, place or thing that was constructed, made, set up or established on or before 1st September, 1957, and that is used for business, commercial or industrial purposes or where the public has access as of right or by invitation, expressed or implied, except however that when compliance with any of the requirements of sections 15, 16, 21, and paragraphs 23(a) and 23(b) is not practicable with respect to any such installation, building, place or thing, a Medical Health Officer may, where having regard to local circumstances he is of the opinion that this can be done without endangering public health, suspend the application of such requirement with respect to such installation, building, place or thing for a reasonable period of time and may, in his discretion, extend such period from time to time as appears to him to be justified; and
 - (d) to every installation, building, place or thing that was constructed, made, set up or established on or before 1st September, 1957, and that is not included amongst those mentioned in paragraph (c), except however that the requirements of sections 15, 16, 21, and paragraphs 23(a) and 23(b) shall not apply thereto unless a Medical Health Officer, having regard to local circumstances, is of the opinion that in the interest of public health, any such installation, building, place or thing should be subject thereto and

so directs by way of a written directive addressed to the person who owns, operates or maintains it as the case may be.

(2) Where a Medical Health Officer exercises his discretion under paragraphs (1)(c) and (d), he shall report all the facts of the case to the Chief Medical Health Officer.

General sanitation

4. No person shall create, establish or maintain any insanitary condition.

5. (1) Without limiting the generality of section 4, no person shall create, establish or maintain a condition likely to become injurious to public health in or on any

- (a) premises or part thereof;
- (b) highway, lane, path, pool, ditch, gutter, water course, well, sink, water or earth closet, toilet, privy, urinal, septic tank, cesspool, drain, dung pit or soakage pit;
- (c) stable or other building where birds or animals are kept;
- (d) building or land used for any work, manufactory, trade or business; or
- (e) schoolhouse, theatre, factory, church, shop or other public building.

(2) No person shall create, establish or maintain any chimney or smoke stack emitting smoke, fumes or noxious gases in such quantity or of such a nature as to be injurious to public health.

6. No person shall accumulate or deposit any refuse, garbage, excreta, manure, offal or other offensive matter, in a manner likely to become injurious to health.

7. A Health Officer may enter any premises at any reasonable hour to inspect the sanitary conditions thereof and may give such orders and directions as he may deem necessary to carry out the purposes of these regulations.

8. No person shall

- (a) spit in any conveyance, premises or place used by the public, except into receptacles provided for the purpose;
- (b) discharge into any public place, sewer, drain, ditch, water course, stream, river or channel any chemicals, chemical substances or their residues, fuel oil or other inflammable substances which might cause damage from explosion or might in any other way prove dangerous to health; or

- (c) except as provided in these regulations, deposit any dead animal, manure, excreta, refuse, garbage, offal, liquid waste or other offensive matter in any conveyance, premises or place used by the public.

Housing

9. No building used for human habitation shall be
- (a) nearer than 450 m to a waste disposal ground, or
 - (b) upon any site, the soil of which has been made up of any refuse, unless such refuse has been removed from the site or has been consolidated or the site has been disinfected in every case and the site has been approved by a Health Officer.
10. (1) Where in the opinion of a Health Officer a building or part of a building is in such an insanitary condition as to make it dangerous to the health of the occupants, he may give the owner reasonable notice to make such alterations or take such action as may be necessary to remedy such condition, and where the owner refuses or neglects to do so, the Health Officer may declare the building to be unfit for human habitation and in that event he shall placard it accordingly, whereupon it shall be vacated within 24 hours of such placarding.
- (2) Where a building or part of a building has been placarded pursuant to subsection (1), no person shall
- (a) remove the placard, or
 - (b) occupy such building or part of the building after the expiration of 24 hours from the time it was placarded.
11. No person shall carry on in a building or part of a building used for human habitation any trade or business involving the storing, sorting, processing or packing of rags, bones or other refuse.
12. (1) A building used for human habitation shall be deemed to be insanitary if there is not in all sleeping rooms an air space of 11 m³ for each occupant 10 years of age or over and 5.5 m³ for each occupant under 10 and over one year of age.
- (2) Where in his opinion it is necessary to do so due to special circumstances, a Health Officer may exempt any class of habitation from the requirements of subsection (1).

Water supplies

13. Every incorporated municipality shall provide one or more wells or other sources of water supply for the use of the inhabitants and shall be responsible for the safety of such supply.

14. Every well or other source of water supply and every source of ice cut for use as water, that is provided

(a) for the inhabitants of an incorporated municipality, pursuant to section 13,

(b) in connection with the manufacture for sale of food or drink, or

(c) for the occupants of any factory, school, church, theatre, community hall, hospital or nursing station, or of any building where the public has access or in which a trade or business is conducted employing more than 2 persons,

shall be subject to inspection by a Health Officer, who may issue such directions as he sees fit to ensure the safety of the water obtained therefrom.

15. Every well shall be

(a) located at least 30 m distant from any source of pollution and where possible on higher ground;

(b) protected from contamination by surface water and from ground water infiltration to a depth of 3 m; and

(c) provided with a suitable cover to keep out foreign matter, animals or vermin.

16. The inlet of any pipe to withdraw water for human consumption or ablution from any stream, river or channel shall be located at least 30 m upstream from any sewage outfall or from any other source of pollution, unless a Health Officer shall otherwise direct.

17. Ice cut for use as water for human consumption or ablution shall be

(a) obtained from a source located at least 150 m upstream from any sewage outfall or from any other source of pollution, unless a Health Officer directs otherwise, and

(b) stored in such a manner as to be protected from contamination.

Disposal of excreta

18. Every incorporated municipality shall provide for the use of the inhabitants a system for the collection and disposal of human excreta and shall operate such system in such a manner as will prevent the spread of disease.

19. Every owner of a building used for human habitation shall provide on the premises adequate toilet facilities to the satisfaction of a Health Officer.

20. Every owner of a factory, school, church, theatre, community hall, hospital or nursing station, or of any building where the public has access or in which a trade or business is conducted employing more than 2 persons, shall

provide on the premises adequate toilet facilities to the satisfaction of a Health Officer.

21. No sewerage system, septic tank or cesspool shall be constructed, operated or maintained that the effluent therefrom discharges

- (a) in a location or in a manner likely to be injurious to health;
- (b) into any stream, river, channel, water course or lake without the written permission of a Medical Health Officer; or
- (c) less than 30 m downstream from the inlet of any pipe withdrawing water for human consumption or ablution.

22. Every indoor toilet shall be

- (a) screened or otherwise protected against insects or animals;
- (b) well ventilated; and
- (c) maintained in a sanitary condition.

23. Every outdoor toilet shall be

- (a) located at least 30 m downstream from any well or the inlet of any water pipe drawing water for human consumption or ablution;
- (b) located at least 6 m from any building used for human habitation or in which food is stored, prepared, manufactured or consumed;
- (c) screened or otherwise protected against insects or animals;
- (d) well ventilated; and
- (e) maintained in a sanitary condition.

24. Notwithstanding sections 19, 20 and 23, a Health Officer may prohibit the establishment, operation or maintenance of any outside toilet at a place where, in his opinion, such toilet is likely to endanger public health.

Disposal of garbage and other wastes

✓ 25. Every incorporated municipality shall provide for the use of the inhabitants a scavenging system for the collection and disposal of garbage and refuse and such system shall be operated and maintained to the satisfaction of a Medical Health Officer.

26. The occupant of every factory, school, church, theatre, community hall, hospital and nursing station, and of every building used for human habitation or in which any trade or business is conducted or where the public has access, shall provide an adequate number of containers for the reception of garbage and refuse.

27. Every garbage and refuse container shall be
- (a) constructed of impervious material;
 - (b) so designed as to be easily cleaned;
 - (c) provided with a close-fitting cover capable of keeping out insects or animals;
 - (d) located in such a position in the premises as not to give rise to offensive odours; and
 - (e) emptied at regular intervals and the contents conveyed to a waste disposal ground.
- ✓ 28. Every incorporated municipality shall provide adequate waste disposal grounds for the disposal of all garbage, refuse, excreta and other waste matter and shall cause such waste materials to be burned, buried or covered with a layer of earth or other innocuous material as necessary to decompose the matter or thing deposited thereon and prevent the breeding of flies.
29. Every waste disposal ground shall be
- (a) located at least 90 m from any public road allowance, railway, right-of-way, cemetery, highway or thoroughfare;
 - (b) located at least 450 m from any building used for human occupancy or for the storage of food; and
 - (c) situated at such a distance from any source of water or ice for human consumption or ablution that no pollution shall take place.
30. Every person who owns, constructs, operates or maintains, as the case may be, an installation, building, place or thing that is subject to these regulations and that does not comply with any of the requirements thereof, shall be deemed to create, establish or maintain an insanitary condition in respect to such installation, building, place or thing.

APPENDIX B

Department of Transportation Regulations

PART III

BIRD HAZARDS

3.1 GENERAL

Birds of all types are hazardous to aircraft in the air because they can, through collisions with the aircraft, cause structural damage, loss of engine power, and possibly crashes and human deaths. The hazard created by birds is greatest at and in the vicinity of airports due to the concentration of aircraft activity close to the ground, where the majority of birds fly.

Airports are naturally attractive areas to many species of birds because the wide open, short grass areas provide the basic elements of security from predators and humans, a place to nest and loaf (just generally sit about) and access to food and water sources. Programs at Transport Canada operated airports effectively reduce this natural attraction of birds to airport lands, primarily through major habitat management and manipulation projects, as well as through day to day vigilance and the use of bird-scaring techniques. While these on-airport activities are effective, they can be neutralized by the presence of attractive land use or activities outside the airport boundary. Hazardous bird types will be persistent in their attempts to use the airport as a convenient stopover and resting place before or after feeding at a nearby location. It is therefore important that land uses in the general airport-surrounding area be regulated with the same goal as on-airport land use, to minimize the attraction to birds.

The following information provides guidelines on the acceptability of different land use practices for the vicinity of airports and should only be included upon the expert advice of a bird hazard specialist. General land use practices have been evaluated on their relative attractiveness to the traditionally hazardous bird species.

3.2 EXTREMELY HAZARDOUS LAND USE PRACTICES

- 3.2.1 (a) The following land use practices are extremely attractive to bird species that are:
- (i) a high hazard to aircraft because of their larger size, behavioral characteristics (flocking, soaring), and their preference for airport environments, and
 - (ii) far-ranging in their daily food-searching activities.
- (b) These practices are NOT RECOMMENDED FOR AREAS 8.0 KM (5 MILES) OR LESS, FROM THE AIRPORT REFERENCE POINT. At large airports, more than one reference point may be established for the purpose of defining the area. These are:
- (i) Food Waste Landfill Sites, and
 - (ii) Coastal Commercial Fish Processing Plants.

3.3 MODERATELY HAZARDOUS LAND USE PRACTICES

3.3.1 (a) The following land use practices are moderately hazardous to airport activities because they attract bird species that:

- (i) are of moderate hazard to aircraft because of their smaller size, behavioral characteristics, and not particularly far-ranging in their food-searching activities, and/or
- (ii) are of concern as aircraft hazards chiefly during limited time spans only, i.e., migration, infrequent climatic conditions.

(b) These practices are NOT RECOMMENDED FOR AREAS 3.2 KM (2 MILES) OR LESS, FROM THE AIRPORT REFERENCE POINT. At some airports, more than one reference point may be established for the purpose of defining the area.

(i) Agricultural Practices

Not RecommendedSuggested Alternatives(A) Crops (see also Section C-
Other Activities)

Grains: Barley
Oats
Wheat
(particularly Durum)

Rye
Buckwheat
Flax

Canola

Corn
Sunflower

Timothy
Alfalfa
Clover

Fruits: Berries
Cherries
Grapes
Apples

Vegetables
(except potatoes)

(B) Livestock

Feedlots: Beef Cattle
Piggeries

Pasture-fed
Livestock

(ii) Commercial Activities

Outdoor (Drive-In) Theatres

(III) Managed and/or Supplemented Natural Habitats
(Refuges, Sanctuaries)

Migratory Waterfowl Refuges/Feeding Stations/Crops
(see (i)(A))

Designated Game - Mammal Refuges

3.4 OTHER ACTIVITIES

Other land use practices may be attractive to birds during only a very short period due to some particular aspect of their management. Also, some normally acceptable land use activities may become attractive to birds through mismanagement. Airport authorities should be aware of the basic attractants and how apparently unattractive activities may pose a hazard. The list below provides a guide to such basic attractants, the typical land use activities where they may be found, and suggested remedial actions. In these cases, remedial action (if attainable) is a viable alternative to the exclusion of a particular land use from an area around the airport.

<u>Attraction</u>	<u>Typical Activities</u>	<u>Suggested Remedial Action</u>
Food Garbage	- Restaurants (indoor/outdoor) - Picnic Areas	- improve maintenance/disposal - covered garbage containers
Freshly Tilled/ Plowed Soil	- Cropping Activities - Sod farming	- plow/till at night
High Insect/Mouse Activity	- Grass and Hay cutting activities - Baling (before and after) of hay	- cut/bale at night - remove bales as soon as possible
Livestock Manure Piles	- Barnyards - Stables - Racetracks - Fairgrounds - Game Farms	
Lagoons	- Sewage Lagoons - Stormwater Retention Ponds	

APPENDIX C

Thurber Engineering Geotechnical Investigation Report

CLYDE RIVER SEWAGE LAGOON
GEOTECHNICAL INVESTIGATION

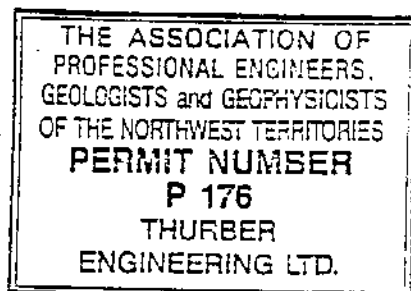
Report Submitted

to

GOVERNMENT OF THE NORTHWEST TERRITORIES
MUNICIPAL AND COMMUNITY AFFAIRS
IQALUIT, NWT

Thurber Engineering Ltd.
Yellowknife, NWT

M.C. Harris, P.Eng.
Review Engineer



October 18, 1991
File: 15-23-47

R.C. Cook, P.Eng.
Project Engineer

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SECTION 1

INTRODUCTION

1.1 General

This report presents the results of a geotechnical investigation carried out in connection with the design and construction of a new sewage lagoon in the community of Clyde River, NWT.

The work was carried out in accordance with GNWT Service Contract 290739 and at the direction of Mr. Rick Armstrong, Municipal and Community Affairs, Baffin Region. Verbal authorization to proceed was received from Mr. Armstrong on August 27, 1991.

The use of this report is subject to the Statement of General Conditions which is included at the end of the text. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for the proper use and interpretation of this report.

1.2 Proposed Development

The proposed development, as we understand from the drawings provided, will involve the construction of a sewage lagoon and access road with provision for the addition of a future sewage lagoon. The proposed lagoon will be designed to hold a volume of approximately 19500m³ with an average fluid depth of 2.35 m.

In addition, the development will include a solid waste disposal area, bulky metal storage and a honey bag dump site.

The geotechnical recommendations were specifically prepared for the sewage lagoon site.

SECTION 2

METHOD OF INVESTIGATION

2.1 Field Program

The field investigation was carried out under the direction and supervision of Mr. R. Lachance, of Thurber Engineering Ltd. A total of four test pits were excavated on September 16, 1991, using a front end loader provided and operated by the Hamlet. The test pits were excavated approximately at the locations specified by Reinders Northern as shown on Drawing No. 1, Appendix A.

The subsurface conditions were logged based on a visual examination of the test pit walls and on representative samples taken from the excavated material. Test Pit logs are presented in Appendix B along with the Modified Soil Classification System and a description of the symbols and terms used to describe the test pit logs.

2.2 Laboratory Testing

Visual classifications and water content determinations were completed on all samples. Atterberg Limit tests and grain size analyses were carried out on selected samples to determine their suitability as berm material.

Laboratory test results are presented on the Test Pit logs in Appendix B.

SECTION 3

SITE DESCRIPTION

3.1 Surface Conditions

The proposed sewage lagoon site is to be located on a presently undisturbed area of native ground immediately west of the existing garbage dump site. The ground surface is generally flat lying to gently sloping tundra with numerous boulders and cobbles visible on the surface. The tundra cover is approximately 0.1 m thick at the test pit locations.

3.2 Subsurface Conditions

A wide range of soils were encountered in the test pit excavations at the proposed lagoon site. Test Pits 91-1, 91-2, and 91-3 consist primarily of clay materials with a range in plasticity from low to high with variable sand and silt content. The clay is generally light grey, silty with a trace of some sand, some gravel and a trace of organics.

Silty sand with some gravel was found in TP91-4 and at the bottom of all other test pits.

All test pits were terminated when permafrost was encountered at depths ranging from 0.8 m to 1.1 m below ground surface. Given the time of year, these depths are representative of the maximum active layer thaw for this year.

3.3 Groundwater

Water was encountered in TP91-3 at a depth of 0.7 m at completion of digging. Conditions in TP91-1 were very soft however, no free water was encountered. Groundwater encountered at this site is primarily a result of runoff and active layer thaw.

3.4 Permafrost

Permafrost was encountered at depths ranging from 0.8 m to 1.1 m at the test pit locations. Excavations into the permafrost were only possible for a few centimetres with the available equipment. Samples of the permafrost taken from these top few centimetres indicate a high excess ice content. The bagged samples turned to water with traces of soil when thawed. The potential for thaw settlement of the new lagoon is therefore a concern. As well the excavation is likely to be very wet and soft as the permafrost thaws.

SECTION 4

GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

4.1 General

We understand from Municipal and Community Affairs that construction of the proposed sewage lagoon is presently planned as a cut and fill operation utilizing dozer equipment. In view of the fact that sand was encountered under a portion of the site and the proposed construction methods, it is not considered feasible to construct a conventional earth berm lagoon without suffering significant seepage (or leakage) through the berm.

We further understand that the costs associated with installing a flexible membrane liner are high and therefore this option is not suitable to the GNWT. In addition, proper installation and maintenance of a flexible liner may not be adequately achieved with local equipment and personnel.

It is therefore recommended that the lagoon berms be constructed with sufficient width so that the permafrost table will aggrade (rise) into the berms and create a permafrost bowl to retain the sewage. With this design it will be required to maintain a minimum 2 m freeboard height if seepage is to be minimized.

It should be understood that the rate of permafrost aggradation is not known. Without a detailed geothermal analysis, we are unable to predict how long it will take for the required rise in the permafrost table to occur. It is, therefore, strongly recommended that a series of thermistors be installed in the berms at various depths to monitor freezeback.

Since the lagoon will be containing sewage which is environmentally hazardous, pond filling should be delayed until permafrost levels in the berms are confirmed.

Detailed recommendations are provided in the following sections.

4.2 Berm Construction

As discussed, berm construction will be carried out by Cat dozer equipment utilizing a cut and fill procedure.

It is recommended that pond depth be created by excavating into the permafrost, rather than building berms above existing grade, to the maximum extent possible. If construction is begun in July as planned, it should be

CASH FLOW/PROJECT BUDGET

1991 Construction of Access Road	\$41,000.
1992 Construction of Lagoon and solid waste dump site (not including 1991 Access Road Programme)	\$303 938.

Note: The 1991 and 1992 budgets have been adjusted for inflation.

METHOD OF ASSESSING COSTS INCURRED

To enable MACA to assess whether the costs incurred by the Hamlet during the construction period coincide with the project funding, the Hamlet should complete daily/weekly record sheets. These sheets should record cost of material used, manhours and hours worked by the construction equipment. The forms used should be the standard Government of Northwest Territories construction record sheets. During the periodic site visits an assessment should be made to determine the percent of the project completed. By comparing the information, it will be possible to assess whether the project cost is on schedule or whether extra costs have been incurred. This will provide MACA with a method of determining the funding due to the Hamlet.

SUMMARY AND RECOMMENDATIONS

1. That the access road and adjacent ditch construction be completed to end of sewage lagoon site in 1991 by the Hamlet Works Department according to the budget outlined on Page 22.
2. We strongly recommend that the Hamlet do not construct a temporary sewage pond, in 1992 but construct the lagoon as detailed. For a small additional cost in 1992/93 they will have a sewage lagoon which will serve the community for many years.
3. That construction of all works be completed in the 1992 construction season. The excavation for the lagoon should be started as soon as possible in the spring, as the speed of excavation is dependant on the thawing rate of the exposed permafrost.

The lagoon berms should be complete by August and the lagoon left until the next spring to allow the permafrost bowl to form. Since the lagoon will contain sewage, which is environmentally hazardous, the lagoon should not be used until the permafrost level in the berm is confirmed.

4. It may be possible for the lagoon to be used before the next spring if a series of thermistors are installed in the berms at various depths to monitor the aggradation of the permafrost table.
5. That discussions take place with Transport Canada concerning the regulations that landfill sites not be located within 8 km from airports. Transport Canada have indicated that each case in the North West Territories is considered individually.

possible to execute a staged excavation where permafrost is continually removed as it thaws.

Our test pit observations indicate that this excavation is likely to be very wet and soft. It is very likely that heavy equipment will get bogged down in the thawing permafrost. The contractor should be prepared to install a sump(s) and pump(s) in order to provide drainage and maintain a reasonably dry excavation.

Since the lagoon construction will create a permanent depression in the permafrost table, it will be important to prevent seasonal active layer melt water from collecting in this depression. This may be achieved by constructing perimeter berms to a minimum height of 2.0 m above existing ground. This will allow the permafrost to rise above its present level and isolate the lagoon from active layer melt water.

A geothermal analysis has not been carried out, as this was not part of our scope of work, to determine the required berm thickness in order to achieve the necessary permafrost aggradation. However, based on past experience, we recommend a minimum crest width of 10 m with 4:1 horizontal to vertical interior slopes and 3:1 horizontal to vertical exterior slopes.

It is recommended that all tundra and other organic soil be removed from the entire area for the reservoir, prior to placing any fill.

All fill for berm construction should consist of unfrozen, inorganic soil. Boulders in excess of 300 mm diameter should be avoided in the fill.

Fill should be placed in lifts not exceeding 300 mm in thickness and compacted as well as possible with available equipment. A minimum of 6 passes with a large dozer should be used for compaction if a vibratory roller is not available.

4.3 Slope Protection

It is recommended that both the interior and exterior slopes be protected from erosion. The slopes should be carefully trimmed to the recommended slopes and compacted prior to placing any granular protection. Ideally, a 200 mm thickness of rip-rap should be placed on the slope. The following gradation limits are recommended:

PARTICLE SIZE
(MM)

FRACTION FINER
BY WEIGHT (%)

100
50
30
10
5

100
70 - 100
15 - 50
0 - 30
0 - 10

It is recognized that rip-rap meeting the above requirements may be prohibitively expensive to produce. As an alternative, a clean well graded pit run gravel with a minimum thickness of 300 mm may be used.

4.4 Freeboard

It is recommended that the lagoon be designed with a minimum freeboard of not less than 2.0 m. This greater than normal freeboard is suggested for several reasons. Most importantly, this will accommodate the seasonal thaw (lowering of permafrost table within the berm) yet maintain the permafrost above the high water line. In addition, a large freeboard will provide further protection from erosion damage.

As a cautionary note, it should be recognized that the permafrost below the site could not be excavated significantly and has not been thoroughly examined for excess ice content. The potential for thaw settlement of the lagoon base in particular is not well defined. Observations in one test pit, however, indicate high excess ice immediately below the active layer.

Some thaw settlement is expected to occur, particularly under the pond base, however, the magnitude of this settlement cannot be accurately estimated from the available data. This thaw settlement is expected to cause some cracking at the toe of the berms.

The relatively large freeboard recommended will accommodate some thaw settlement of the berms.

4.5 Closure

This report has been prepared on the basis of information obtained from four shallow test pits excavated on the site. It has been assumed that the information from the test pits is representative of the entire site.

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This report has been prepared in accordance with generally accepted geotechnical engineering practices in this area. No other warranty, expressed or implied, is made.

2. BASIS OF THE REPORT

This report has been prepared for the specific site, design objective, development and purpose that was described to Thurber Engineering Ltd. ("TEL") by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the report are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to TEL. Unless TEL is specifically requested by the Client to review and revise the report in light of such alteration or variation.

3. USE OF THE REPORT

The information and opinions expressed in this report are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THIS REPORT OR ANY PORTION THEREOF WITHOUT TEL'S EXPRESS WRITTEN CONSENT. TEL WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTY(ES) AS APPROVED USERS. The contents of this report remain the copyright property of TEL, who authorizes only the Client and Approved Users to make copies of the report, and only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof, or any copy of the report or portion thereof, to any other party without the express written permission of TEL.

4. COMPLETE REPORT

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to TEL by the Client, communications between TEL and the Client, and to any other reports prepared by TEL for the Client relative to the specific site described in the report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS, AND OPINIONS EXPRESSED IN THE REPORT, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. TEL CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

5. INTERPRETATION OF THE REPORT

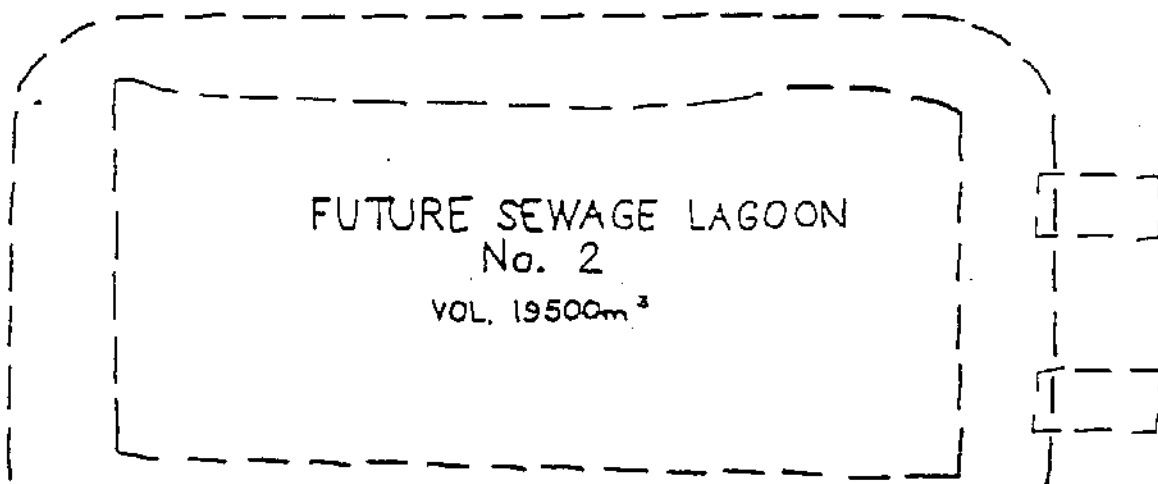
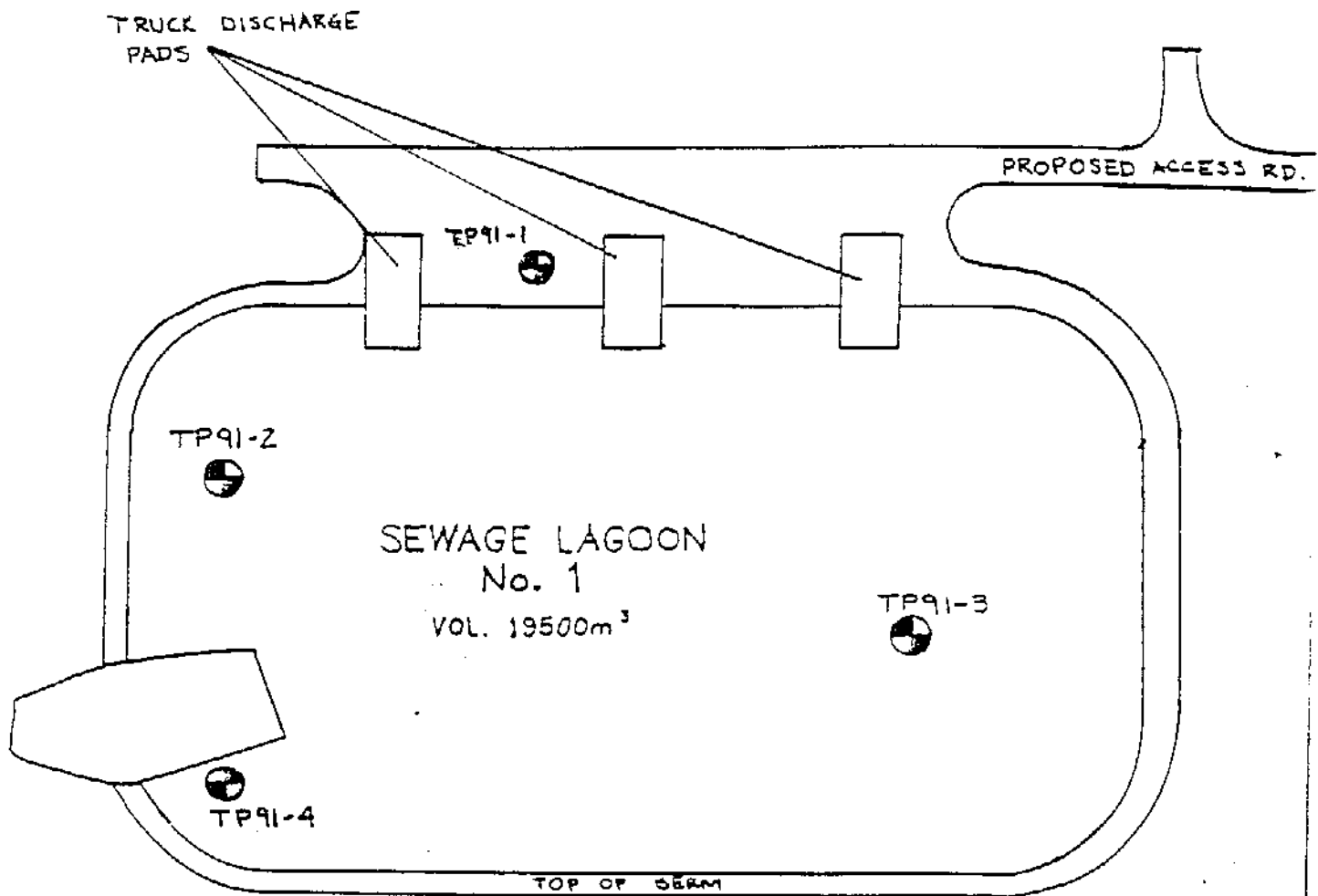
(a) Nature and Exactness of Soil Description: Classification and identification of soils, rocks, and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from these systems have been used they are specifically mentioned. Classification and identification of the type and condition of soils, rocks and geologic units are judgmental in nature. Accordingly, TEL cannot warrant or guarantee the exactness of the descriptions of insitu ground conditions set forth in the Report.

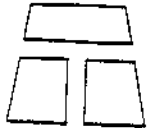
(b) Logs of Test Holes, Pits, Trenches, etc.: The test hole logs are a record of information obtained from field observations and laboratory testing of selected samples as well as an interpretation of the likely subsurface stratigraphy at the test hole sites. In some instances normal sampling procedures do not recover a complete or any sample. Soil, rock or geologic zones have been interpreted from the available data. The change from one zone to another, indicated on the logs as a distinct line, may be transitional. The same limitations apply to test pit and other logs.

(See over...)

APPENDIX A
DRAWINGS

⊙ Approximate Test Pit Locations



DESIGNED	GNWT - MUNICIPAL AND COMMUNITY AFFAIRS	 THURBER
DATE 18/10/91	<p>TEST PIT LOCATIONS</p> <p>PROPOSED SEWAGE LAGOON - CLYDE RIVER, NWT</p>	
APPROVED		
SCALE 1:1000		
DRAWING NO 1		

APPENDIX B
TEST PIT LOGS

SYMBOLS AND TERMS USED ON TEST LOGS

1. VISUAL TEXTURAL CLASSIFICATION OF MINERAL SOILS

<u>CLASSIFICATION</u>	<u>APPARENT PARTICLE SIZE</u>
Boulders	Greater than 200mm
Cobbles	75mm to 200mm
Gravel	5mm to 75mm
Sand	Not visible to 5mm
Silt	Non-Plastic particles, not visible to the naked eye
Clay	Plastic particles, not visible to the naked eye

2. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

<u>DESCRIPTIVE TERM</u>	<u>APPROXIMATE UNDRAINED SHEAR STRENGTH</u>
Very soft	Less than 10 kPa
Soft	10 to 25 kPa
Firm	25 to 50 kPa
Stiff	50 to 100 kPa
Very Stiff	100 to 200 kPa
Hard	200 to 300 kPa
Very Hard	Greater than 300 kPa





} Modified from
National Building
Code

3. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

<u>DESCRIPTIVE TERM</u>	<u>STANDARD PENETRATION TEST (Number of Blows per 300mm)</u>
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

} Modified from
National Building
Code



LEGEND FOR TEST HOLE LOGS

- Water content (% by weight) as determined on soil samples
-  Disturbed bag or split spoon sample
-  Undisturbed Shelby Tube sample or core from UTM core barrel
-  No recovery
-  Number of blows per 300mm for Standard Penetration Test
- Cu Undrained Shear Strength determined by unconfined compression test
- Cvane Shear Strength determined by pocket vane
- Cpen Shear Strength determined by pocket penetrometer
- ± Water Level

SYMBOLS AND TERMS USED ON TEST LOGS (CON'T)

4. PERMAFROST DESCRIPTION

4.1 LEGEND FOR TEST HOLE LOGS

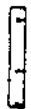
- 4.2
- | | |
|---|---------------|
|  | Soil Frozen |
|  | Soil Unfrozen |

5. PERMAFROST CLASSIFICATION

<u>Ice Content</u>	<u>Graph Symbol*</u>	<u>Description</u>
Ice not visible by eye	{ Mf	Poorly Bonded or Friable
	{ Mbn	Well Bonded - No Excess Ice
	{ Mbe	Well Bonded - Excess Ice
Visible ice less than 2.5 cm thick	{ Ux	Individual Ice Crystals or Inclusions
	{ Uc	Ice Coating on Particles
	{ Ur	Random or Irregularly Oriented Ice
	{ Us	Stratified or Distinctly Oriented Ice
	{ Uu	Ice Pattern Not Known
Visible ice greater than 2.5 cm thick	{ ICE+ soil type	Ice with Soil Inclusions
	{ ICE	
	ICE	Ice without Soil Inclusions

* Numbers in graph symbol column refer to the estimated percent visible ice content by volume.

6. THERMISTOR DESCRIPTION



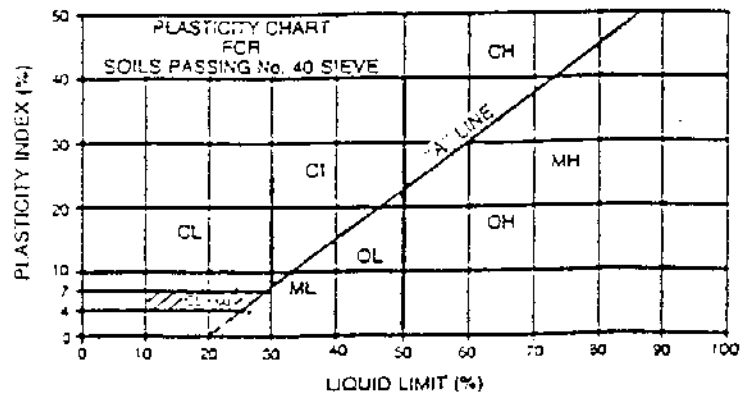
Thermistor string installed.
Dot indicates depth of each thermistor.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAX.	DIVISION	GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS THEIR GRAIN SIZE IS LARGER THAN NO. 40 SIEVE	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	GW		WELL GRADED GRAVELS, LITTLE OR NO FINES.	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
		GP		POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.	NOT MEETING ABOVE REQUIREMENTS	
		GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES.	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
		GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES.		ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
	SANDS MORE THAN HALF FINE GRAINS GRATER THAN NO. 4 SIEVE	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.	$C_u = \frac{D_{60}}{D_{10}} > 5$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
		SP		POORLY GRADED SANDS, LITTLE OR NO FINES.	NOT MEETING ABOVE REQUIREMENTS	
		SM		SILTY SANDS, SAND-SILT MIXTURES.	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
		SC		CLAYEY SANDS, SAND-CLAY MIXTURES.		ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
FINE GRAINED SOILS THEIR GRAIN SIZE IS SMALLER THAN NO. 40 SIEVE	SILTS BELOW "A" LINE OR NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50\%$	MH			
	CLAYS ABOVE "A" LINE OR PLASTICITY CHART NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL			
		$30\% < W_L < 50\%$	CI			
		$W_L > 50\%$	CH			
	ORGANIC SILTS & CLAYS BELOW "A" LINE OR CHART	$W_L < 50\%$	OL		WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED IT IS DESIGNATED BY THE LETTER "P" E.G. SP IS A MIXTURE OF SAND WITH SILT OR CLAY.	
		$W_L > 50\%$	OH			
	HIGHLY ORGANIC SOILS		PT		PEAT AND OTHER HIGHLY ORGANIC SOILS. STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE.	

SPECIAL SYMBOLS

	BEDROCK (UNDIFFERENTIATED)		OVERBURDEN (UNDIFFERENTIATED)
	SANDSTONE		SILTSTONE
	SHALE		CLAYSTONE
	LIMESTONE		
	CONGLOMERATE		
	COAL		



- ALL SIEVE SIZES MENTIONED ON THIS CHART ARE U.S. STANDARD, A.S.T.M. E.11.
- BOUNDARY CLASSIFICATIONS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE GIVEN COMBINED GROUP SYMBOLS. E.G. GW-GC IS A WELL GRADED GRAVEL SAND MIXTURE WITH CLAY BINDER BETWEEN 5% AND 12%.

THURBER CONSULTANTS LTD.

Geotechnical Engineers

CALGARY EDMONTON VANCOUVER VICTORIA

CLIENT: YUKON MUNICIPAL AND COMM. AFFAIRS PROJECT: NEW SEWAGE LAGOON - CLYDE RIVER TESTHOLE No. TP91-1	
WELL ID: WET OF CLYDE RIVER LOCATION: SEE DRAWING NO. 1, APPENDIX A Project No: 15-23-47	
METHOD: FRONT END LOADER DATE EXCAVATED: SEPTEMBER 16, 1991 ELEVATION: 0.00 (m)	
PIPE TYPE: <input checked="" type="checkbox"/> SHIELD TUBE <input type="checkbox"/> SPT <input type="checkbox"/> NO RECORD <input type="checkbox"/> A-CASING <input type="checkbox"/> W GRAB <input type="checkbox"/> CORE	

DEPTH (m)	SOIL TYPE	SPT (blows/300mm)	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0.0					0.0
0.5					0.5
1.0					1.0
1.5					1.5
2.0					2.0
2.5					2.5
3.0					3.0
3.5					3.5
4.0					4.0
4.5					4.5
5.0					5.0
5.5					5.5
6.0					6.0
6.5					6.5
7.0					7.0
7.5					7.5
8.0					8.0
8.5					8.5
9.0					9.0
9.5					9.5
10.0					10.0

REMARKS: -top soil for test and open, sand extends down 0.6m	0- light grey, silty, some sand, trace to some gravel, trace organics 1- -very soft below 0.6m 2- -very soft below 0.6m END OF TEST PIT AT 0.6m PERMAFROST AT 0.6m
---	--

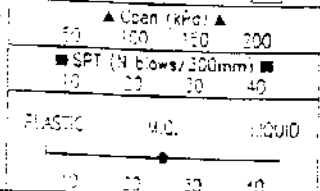
CLIENT: MUNICIPAL AND COMM AFFAIRS
 PROJECT: NEW SEWAGE LAGOON - OLIVE RIVER
 TESTHOLE No. PG 1-2
 LOCATION: SEE DRAWING NO. 1 APPENDIX A
 Project No: 15-33-47
 METHOD: FRONT END LOADER
 DATE EXCAVATED: SEPTEMBER 16, 1991
 ELEVATION 0.00 (m)
 SAMPLE TYPE: SHELBY TUBE ☒ SPT ☒ NO RECOVERY ☒ A-CASING ☒ GRAB ☒ CORE

DEPTH (m)	SAMPLE TYPE	SAMPLE / SPT (m)	REMARKS	USC	SOIL DESCRIPTION	DEPTH (m)
0.0					TUNDRA	0.0
0.5				SM	SAND, light grey, silty, some gravel, trace organics	0.5
1.0				CI	CLAY (RL)	1.0
1.5					light grey, silty, some fine sand, trace to some gravel, occasional boulders	1.5
2.0					-sandy, some gravel	2.0
2.5				SM		2.5
3.0					END OF TEST DEPTH 3.0m	3.0
3.5					PERMAFROST AT 3.0m	3.5
4.0						4.0
4.5						4.5
5.0						5.0
5.5						5.5
6.0						6.0
6.5						6.5
7.0						7.0
7.5						7.5
8.0						8.0
8.5						8.5
9.0						9.0
9.5						9.5
10.0						10.0

Thurber Engineering Ltd.
 Yellowknife, N.W.T.

COMPLETION DEPTH 10.0 m
 DATE DRILLED: 16/09/91
 LOGGED BY RL
 REVIEWED BY NH
 Page 1 of 1

CLIENT: MUNICIPAL AND COMM. AFFAIRS PROJECT: NEW SEWAGE LAGOON - RYEGATE RIVER TESTHOLE No. TPQ1-3
 DRILL CO: HAMLET OF RYEGATE RIVER LOCATION: SEE DRAWING NO. 1, APPENDIX A Project No: 15-23-47
 METHOD: FRONT END LOADER DATE EXCAVATED: SEPTEMBER 18, 1991 ELEVATION 0.00 (m)
 SAMPLE TYPE: ☒ SHELLY TUBE ☒ SPT ☒ NO RECOVERY ☒ A-CORING ☒ GRAB ☒ CORE



REMARKS

SOIL DESCRIPTION

DEPTH (m)	SAMPLE TYPE	SAMPLE/SP (N)	REMARKS	SOIL DESCRIPTION	DEPTH (m)
0.0					0.0
0.5				CLAYEY SILT	0.5
1.0				CLAYEY SILT, silty, sandy, trace gravel and organics.	1.0
1.5					1.5
2.0					2.0
2.5					2.5
3.0					3.0
3.5					3.5
4.0					4.0
4.5					4.5
5.0					5.0
5.5					5.5
6.0					6.0
6.5					6.5
7.0					7.0
7.5					7.5
8.0					8.0
8.5					8.5
9.0					9.0
9.5					9.5
10.0					10.0

Too soft for front end loader, hand excavate below 0.5m.

Very silty and sandy, some gravel

END OF TEST PIT AT 10.1m
 PERMAFROST AT 1.1m
 WATER LEVEL AT 0.7m

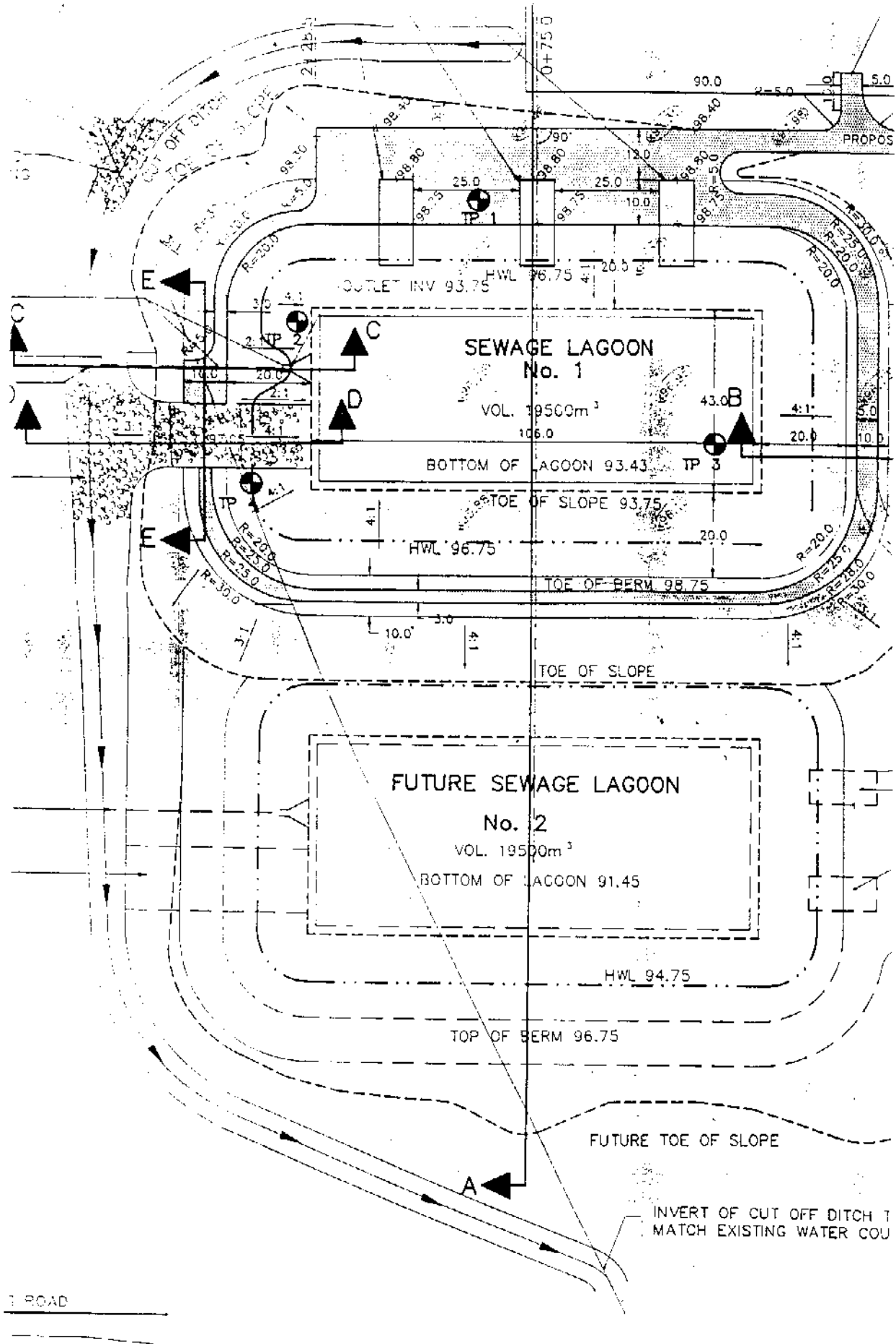
CLIENT: MUNICIPAL AND COMM. AFFAIRS		PROJECT: NEW SEWAGE LAGOON - CLYDE RIVER		TESTHOLE No. TP91-4	
DRILL CO.: HAMLET OF CLYDE RIVER		LOCATION: SEE DRAWING NO. 1, APPENDIX A		Project No: 15-23-47	
METHOD: FRONT END LOADER		DATE EXCAVATED: SEPTEMBER 16, 1991		ELEVATION 0.00 (m)	
SAMPLE TYPE: <input checked="" type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> SPT		<input checked="" type="checkbox"/> NO RECOVERY <input checked="" type="checkbox"/> A-CASING		<input checked="" type="checkbox"/> GRAB <input checked="" type="checkbox"/> CORE	

DEPTH (m)	SAMPLE TYPE	SAMPLE / SPT (N)	FLUIDITY			REMARKS	USC	SOIL DESCRIPTION	DEPTH (m)
			FLUIDITY	M.C.	LIQUID				
0.0								TUNDRA	0.0
0.5								SAND light grey, trace clay, gravel and silt	0.5
1.0								END OF TEST PIT AT 1.0m PERMAFROST AT 1.0m	1.0
1.5									1.5
2.0									2.0
2.5									2.5
3.0									3.0
3.5									3.5
4.0									4.0
4.5									4.5
5.0									5.0

Thurber Engineering Ltd. Yellowknife, N.W.T.		COMPLETION DEPTH 1.0 m	DATE DRILLED: 16/09/91
LOGGED BY RL	REVIEWED BY NH	Page 1 of 1	

- 5015 - 5 272 - 81 400 - - - 0320 58 -

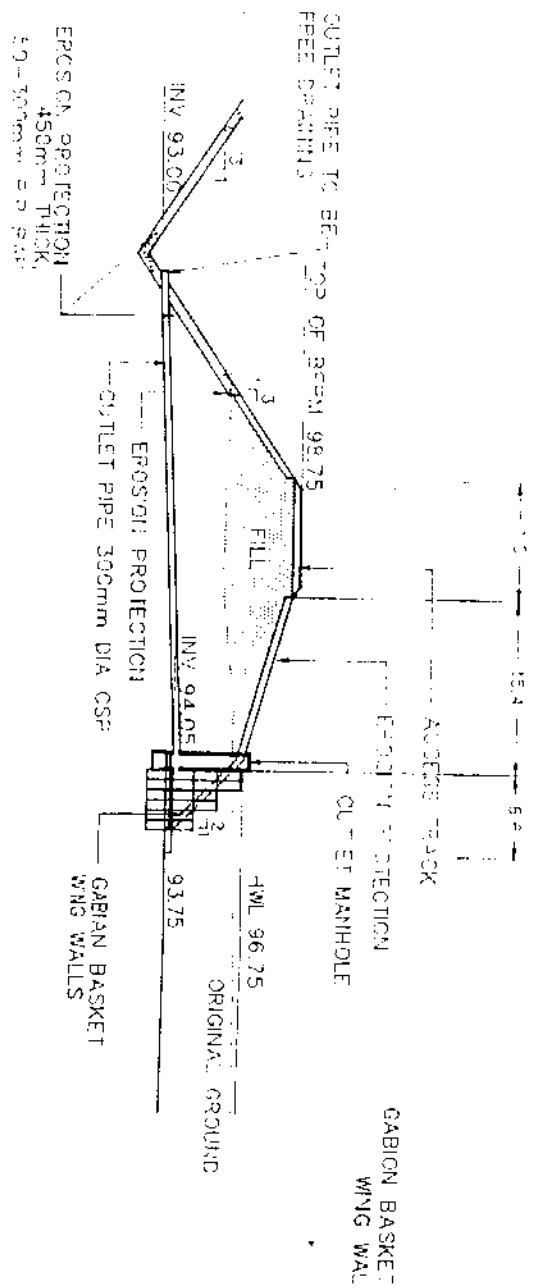
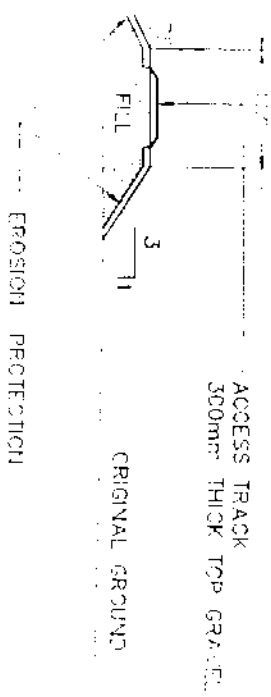
LAGOON
1



[illegible]

Tc.2

ALL MATERIAL CLEAN WELL GRADED
PIT RUN GRAVEL. ALL BASKETS
TO BE SECURELY TIED TO ADJACENT
BASKETS WITH GALVANIZED WIRE TIES



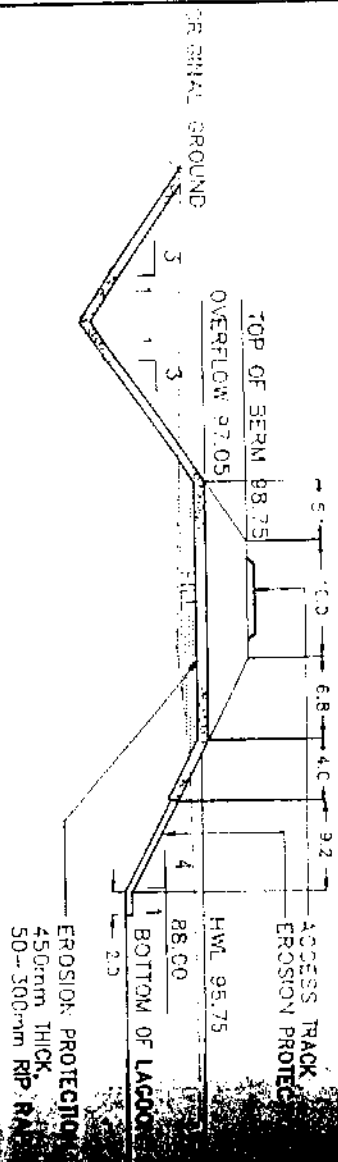
SECTION B-B

SECTION C-C



ACCESS TRACK
300mm THICK TOP GRAVEL

GABION BASKET
WING WALL



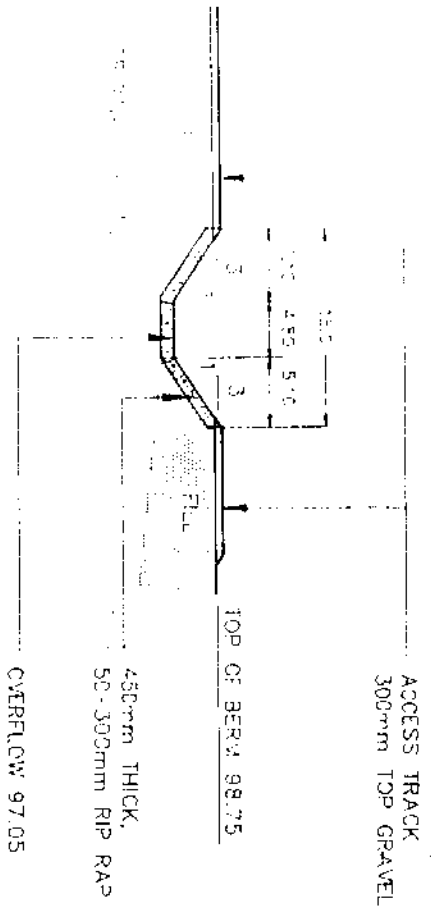
SECTION D-D

END OF EROSION

TOE OF SLOPE

PLAN

OUTLET MANH



SECTION E-E





Government
of Canada

Gouvernement
du Canada

MEMORANDUM

NOTE DE SERVICE

Clyde River

TO
A

A. Theriault
District Manager
Baffin District

FROM
DE

Jennifer Letourneau
A/Regional Manager
Water Resources Division

SUBJECT
OBJET

MUNICIPAL LICENCES
CAPE DORSET / CLYDE RIVER / POND INLET

SECURITY - CLASSIFICATION - DE SECURITE

OUR FILE - N / REFERENCE

YOUR FILE - V / REFERENCE

DATE
May 31, 1991

Thank you for the correspondence related to the unlicensed municipalities.

These MACA Capital Plan schedules will be brought to the Water Board's attention in the near future. When the municipalities will be licensed cannot be predicted at this time, however, the Water Board has an informal arrangement with MACA whereby pre-design and design plans for facilities not yet licensed are submitted to the Board for general review and comment.

I would suggest that you advise and encourage MACA to follow that route until such time the Board can licence the municipalities.

Jennifer Letourneau
Jennifer Letourneau

c.c. F. Adlem

PB/dab

UNLIC.MUN

J. Letourneau
Regional Manager
Water Resources

May 14, 1991

MEMORANDUM

May 26/91 - 8:10pm
P. Bannon
Prepare response
Thanks
J.



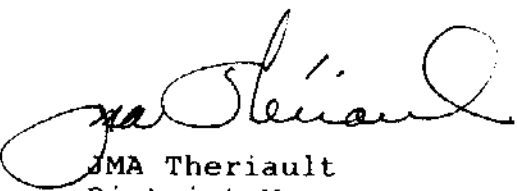
B9545-5-N5L4-0572(U)
B9545-5-C15
B9545-5-C97

0572
Clyde River
CAPE DOC

Municipal Licenses
Cape Dorset / Clyde River / Pond Inlet

Ref: A) MACA 20/22-609-340 d 9 May 91
B) Our B1195-8 d 13 May 91

1. You will wish to note the correspondence exchanged between our office and the Department of MACA (Baffin Region) referred to above.
2. I would appreciate your advice and considerations as to what the best initial steps would be to seek some form of parallel activity which would lead to the licensing of the communities of Cape Dorset, Clyde River and Pond Inlet on a schedule which would co-relate and co-ordinate itself with the development program outline provided by Mr. Armstrong.
3. May I have your views at your earliest convenience.


JMA Theriault
District Manager
Baffin District

cc. F. Adlem
Director of Operations



Northern Affairs Program
PO Box 100
Iqaluit, N.W.T.
XOA OHO

May 13, 1991

Rick Armstrong
Municipal & Community Affairs
Government of the NWT
Iqaluit, NWT
XOA OHO

Your file Votre référence

Our file Notre référence

B1195-8
B9545-5-N4L4-0640
NSL4-0572 (U)
C15
C97

Baffin Region Sanitation Projects - 1991/92

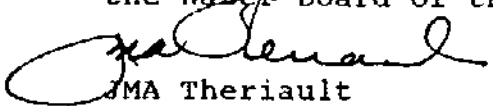
Ref: Your 20/22-609-340 d 9 May 91

1. Thank you for the information provided in your letter of 9 May 91. You may wish to note the following comments:

a) Broughton Island - I believe that you are fully familiar with previous correspondence and documentation relevant to considerations given by our Department (Northern Affairs Program) and the Water Board when the planning process was initially undertaken. If required we will be pleased to prepare an info package, gathered from our files, which would confirm and identify previous documentation, information and guidelines provided the community of Broughton Island. The Water Board has previously approved the relocation of the dumpsite. This authorization was qualified by the Water Board in regards to the requirements for submission of drainage control plans.

b) Clyde River / Cape Dorset / Pond Inlet

The activities related to the development of improved facilities at these three communities are noted with interest. We naturally would appreciate being kept informed of any further developments and activities undertaken or considered at those locations. As you are aware all three communities are presently unlicensed. I believe that it would be beneficial to all concerned if licensing considerations were given in a parallel fashion to the development of new and / or improved facilities and related services. I will do my best to keep you informed of any progress in this regard following consultation with our Water Management Branch in Yellowknife and by relationship, the Water Board of the NWT.


JMA Theriault
District Manager
Baffin District

Canada

-0640
-0572
-C97
-C15



Northwest
Territories Baffin Region
Municipal and Community Affairs
20/22-609-340

RECEIVED

MAY 13 1991

Indian & Northern Affairs
Canada
/ IQUALUIT, N.W.T.

May 9, 1991

Andy Theriault,
Indian and Northern Affairs,
Iqaluit, N.W.T.
XOA OHO

SUBJECT: Baffin Region Sanitation Projects 1991/92

To keep you informed as to what work is being done in the Hamlets on sanitation projects here's a list:

1. BROUGHTON ISLAND - completion of the roadworks to the new location of the dumpsite and sewage lagoon.
2. CLYDE RIVER - extension of the road from the new dumpsite to a temporary sewage pond.
3. CAPE DORSET - construction of access roadway, sewage lagoon and dumpsite at the new site.
4. POND INLET - design of access roadworks, sewage lagoon and dumpsite. Construction is to commence in 1992/93.

Reinders Northern has been hired as a consultant to do design work on three of the projects. Construction on projects will be undertaken by the Hamlet works department in the communities involved.

Please let us know what's planned by your department with regards to barrel crushing.

Yours sincerely,

Rick Armstrong
Rick Armstrong
Municipal Technical
Officer



Government
of Canada

Gouvernement
du Canada

MEMORANDUM

NOTE DE SERVICE

CR PA

TO: Andy Theriault
District Manager
Iqaluit

FROM: Floyd Adlem
Director
DE Operations

SUBJECT: Waste Management Program
OBJET: Clyde River

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE — N / RÉFÉRENCE

YOUR FILE — V / RÉFÉRENCE
B5563-17

DATE
1991 06 06

Just a note on the letter you received from Elijah Palitug with his proposal to clean up Cape Christian. You were correct to pass this on to the GNWT, however, in the second paragraph he implies that buildings (number unknown) will be taken from Cape Christian to the community. If this is his intention, we need to keep in mind that this site harboured a considerable amount of PCBs and the buildings may well be contaminated. It would be prudent to alert GNWT to this situation.

It is our position that buildings exhibiting any contamination cannot be reused unless they are made safe. We are not prepared to try and make any buildings safe for other users so that we can have them removed. Therefore, if we are aware of contamination or feel there is any possibility of contamination, disposal is our only option. It is our understanding from EP that buildings with less than 50 ppm contamination can be burned.

If GNWT is considering a different position I would like to know. It could result in some conflict. Perhaps you could discuss this with Jim Noble and let me know if I should take up the subject with GNWT Pollution Control here in Yellowknife.

Thank you.

Floyd

cc: B. A. Rail