TABLE 5-9 COST ESTIMATES FOR RECOMMENDED UPGRADES			
Recommended Upgrade	**Materials**	**Labour**	**Total**
1. Hard wire wet well light.	$200	$400	$600
2. Paint exterior of buildings.	N/A	N/A	$22,000
3. Relocate low temp. switches.	$400	$400	$800
4. Install high temp. alarms.	$700	$800	$1,500
5. Replace boiler water with treated water.	$5,000	$4,000	$9,000
6. Chlorine area ventilation.	$400	$800	$1,200
7. Compliance with codes.	N/A	N/A	N/A
8. Check condition of supply line.	$3,700	$1,400	$5,100
9. Installing 10 backflow preventers.	$5,500	$4,000	$9,500
10. Replace 5 valves in access vaults.	$6,500	$2,000	$8,500
11. Remove electrical equipment from 30 access vaults and provide alternate power source.	$5,000	$15,000	$20,000
12. Repair sewage flowmeter.	$0	$400	$400
13. Upgrade electrical equipment in comminutor building.	$5,000	$4,000	$9,000
14. Upgrade sewage building heating and ventilation.	$2,000	$2,000	$4,000
15. Upgrade ventilation in buildings for adequate combustion air (to be confirmed).	N/A	N/A	$5,000
16. Obtain a ruling on acceptability of sewage discharge from Department of Health.	$0	$0	$0

NOTES:

Item 2 - Refer to Table 5-8.
Item 5 - Includes installation of pumps for injection of treatment chemicals.
Item 7 - Requires ruling from applicable authorities to confirm scope.
Item 11 - Portable generator as alternate power source.
Item 12 - Repair materials already purchased.
Item 16 - Based on ruling that current practise is acceptable.

To convert from a completely piped system to a completely trucked system may be perceived as a decrease in service by the system users. This criteria reflects the community's opinion of the current system and proposed system changes.

The Hamlet, representing the community as a whole, has indicated that they do not want a trucked system and desire a piped system with better reliability than the current system. The scoring of this criteria reflects this opinion.

Low Potential for Contamination - 7

A contaminated water source can cause health problems to the consumers of the water, therefore, it is important to minimize the potential for contamination. While it is important to be aware of the potential and evaluate the options accordingly, system design and operating practises can prevent an occurrence of contamination. Due to its importance and the ability to reduce the risk of occurrence, this criteria receives a weight of 7.

Current Capacity for Projected Demands - 6

While this is an important selection criteria, all options will use the same water source. For this reason and because improvements required to provide sufficient capacity are reflected in the life cycle cost for the facility, this criteria received a medium weight.

Expandability - 6

The historical population growth in Resolute Bay is expected to continue. Therefore, expansion of water and sewer systems should eventually be required. This criteria evaluates the complexity and cost of future expansions of the options.

Ease of O&M - 6

This criteria evaluates the complexity of the required O&M procedures for each option. Therefore, this criteria also evaluates the suitability of each option for increased maintenance to be done by Hamlet residents. Options with complicated or sophisticated O&M requirements will receive lower scores for this criteria.

Maximize Local Employment Opportunities - 5

Making employment opportunities available to the residents of Resolute Bay is an important issue to both the community and GNWT. However, employment is a consequence of a water and sewer system, not its primary purpose. Therefore it will receive a middle ranking.

Sewage Treatment Adaptability - 5

The issue of whether Resolute Bay's sewage discharge meets current requirements of the Public Health Act and Fisheries Act has not yet been resolved by the governing authorities. Regardless of whether it meets current requirements, it is possible that future requirements could be more stringent with effluent quality requirements more stringent than the current discharge levels. The adaptability of the sewage treatment system to meet future standards should therefore be part of the evaluation criteria and has been given a medium weighting.

Low Environmental Impact - 3

The issue of negative environmental impact is important to the residents of Resolute Bay, the GNWT, and the Federal Government. However, any water supply or sewage disposal system in Resolute Bay is regulated by the Public Health Act, NWT Waters Act, Northern Inland Waters Regulations and the Community's Water License which include regulation of the environmental impact of these facilities. Because environmental impact of any option will be minimized, this criteria was given a relatively low score.

6.3 EVALUATION

To evaluate the water and sewer options for Resolute Bay, each option will now be assessed a score from 1 to 10 as to the degree or extent that it fulfils each of the weighted criteria listed in Section 6.2. The product of the weight and score of each of the criteria are then summed to give a total weighted score for each option. The results of the evaluation are contained in Table 6-1.

From the results of the total weighted scores in Table 6-1, the water supply and sewage disposal systems which best meet the needs of Resolute Bay for the next 20 year period is a trucked system with the truckfill station located at Char Lake and a sewage lagoon located near the bay. The option utilizing existing storage space for truck garages scored slightly higher than the option with a new garage.

TABLE 6-1
EVALUATION OF OPTIONS

Criteria	Weight		Options: Piped System: Leave As Is	Piped System: Partial Upgrade	Piped System: New Buried Pipes	Piped System: New Utilidor	Trucked System: Char Lake With New Garage	Trucked System: Char Lake With Existing Garage	Trucked System: Signal Hill With New Garage	Trucked System: Signal Hill With Existing Garage
MUST CRITERIA		Yes/No								
• Satisfy Fire Flow Requirements			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Satisfy Current Sewage Discharge Regulations			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WANT CRITERIA										
• Low Life Cycle Cost	10	Score	10	9	2	1	5	5	8	6
		Weighted Score	100	90	20	10	50	50	80	60
• High Reliability	9	Score	2	4	7	6	10	10	8	8
		Weighted Score	18	36	63	54	90	90	72	72
• Community Acceptance	8	Score	3	8	10	8	1	1	1	1
		Weighted Score	24	64	80	64	8	8	8	8
• Low Potential for Contamination	7	Score	4	7	8	8	9	9	9	9
		Weighted Score	28	49	56	56	63	63	63	63
• Current Capacity for Projected Demands	6	Score	6	6	8	8	10	10	10	10
		Weighted Score	36	36	48	48	60	60	60	60
• Expandability	6	Score	4	6	6	4	10	10	8	8
		Weighted Score	24	36	36	24	60	60	48	48
• Ease of O&M	6	Score	1	3	6	6	10	10	8	8
		Weighted Score	6	18	36	36	60	60	48	48
• Sewage Treatment Adaptability	5	Score	1	3	6	6	8	8	8	8
		Weighted Score	5	15	30	30	40	40	40	40
• Maximize Local Employment	5	Score	2	4	5	5	10	10	10	10
		Weighted Score	10	20	25	25	50	50	50	50
• Low Environmental Impact	3	Score	4	6	8	8	5	6	4	5
		Weighted Score	12	18	24	24	15	18	12	15
TOTAL WEIGHTED SCORE			**263**	**382**	**418**	**371**	**496**	**499**	**481**	**464**

7.3 RECOMMENDED UPGRADES

A list of recommended upgrades to the existing water and sewer facilities, if they are to be used in the "as is" condition, is contained in Section 3.7 of this report. When the preferred servicing option is confirmed, this list should be reviewed to determine the upgrades required for the facilities which will remain in operation.

8.3 DECOMMISSIONING ABANDONED FACILITIES

Once the transition to a trucked system is complete, the facilities which will no longer be required should be decommissioned in order to leave them in a condition which is safe to the community and the environment. A Decommissioning Plan must be approved by both the Department of Health and the NWT Water Board although there currently are no specific guidelines for decommissioning.

The requirements for decommissioning which should be considered in preparing the Decommissioning Plan are described in Section 4.4 of this report.

9.0 REFERENCES

1. Allen, 1993. Letter dated July 31, 1993 from R.W. Allen, MD, MPH, Medical Health Officer, Baffin Region to George Eckalook, Mayor of Resolute Bay.

2. Armstrong, 1995. Government of the NWT, Municipal and Community Affairs. Personal communication, September 1995.

3. Canada Gazette, 1993. Department of Indian Affairs and Northern Development, Government of Canada printed in the Canada Gazette Part II, Volume 127, No. 13. "Northern Inland Waters Regulations."

4. Chesworth, 1994. Letter dated September 28, 1994 from Delia Chesworth, GNWT, DPWS Project Officer to UMA Engineering Ltd.

5. Chesworth et al, 1995. Letter dated March 28, 1995 from Delia Chesworth, GNWT, DPWS Project Officer to UMA Engineering Ltd.

6. B. Collins, 1994. NWT Water Board, Department of Indian Affairs and Northern Development, Government of Canada. Personal communication, October 1994.

7. E. Collins, 1994. Government of Canada, Environment Canada, Environmental Engineering. Personal communication, September 1994.

8. Department of Health, 1992. Department of Health, Government of the NWT. Public Health Act; P-22, Public Sewerage Systems Regulations, Interpretation and P-23, Public Water Supply Regulations, Interpretation.

9. DIAND, 1991. Department of Indian Affairs and Northern Development, Government of Canada. 40-41 Elizabeth II Chapter 39, Northwest Territories Waters Act.

10. DIAND, 1994. Paul Smith, DIAND NWT Region, Nunavut District. Municipal Water Use Inspection Form, May 27, 1994.

42. UMA, 1975. Underwood McLellan & Associates Limited (UMA Engineering), Specifications for The Construction of Water Intake Pumphouse, Water Treatment Plant and Sewage Treatment Plant, Resolute Bay, NWT and Specifications for Supply and Erection of Metal Buildings, Resolute Bay, NWT prepared for Government of the Northwest Territories, Department of Public Works.

43. UMA, 1977. Underwood McLellan & Associates Limited (UMA Engineering), Operation and Maintenance Manuals for Resolute Bay New Townsite Char Lake Water Intake Pumphouse; Water Treatment & Storage Facility; and Water and Sewer Servicing System prepared for Government of the Northwest Territories, Department of Public Works.

44. UMA, 1993. UMA Engineering Ltd. "Grise Fiord Sewage Disposal Improvements", November 1993.

45. UMA, 1993. UMA Engineering Ltd. "Municipal Wastewater Treatment Technologies Capable of Achieving Compliance with the Fisheries Act in the Northwest Territories."

46. UMA, 1995. UMA Engineering Ltd. "Iqaluit, NWT - Sewage Treatment Improvements, Preliminary Engineering Report."

47. Water Board, 1986. Municipal Guidelines Sub-Group of the NWT Water Board Technical Advisory Committee. "Report on the Upgrading of the Guidelines for Municipal Type Wastewater Discharges in the Northwest Territories", March 1986.

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

APPENDIX I
CALCULATIONS AND COST ESTIMATES

PIPED SYSTEMS
COST ESTIMATES

UMA Engineering Ltd.

ESTIMATE SHEET

PROJECT: Resolute Bay Infrastructure Assessment

FILE NUMBER: 1315-172-00-02-3.1

BY:	DATE	SHEET
Kevin Ness	1994 09 29	1 OF 1

Partial Piped System Upgrade

Item	Description	Unit	Approx. Quantity	Unit Price	Total
1.	Replace sewer mains				
1.1	AV-12 to AV-13	lin.m	30	$520	$15,600
1.2	AV-14 to AV-15	lin.m	40	$520	$20,800
1.3	AV-15 to AV-16	lin.m	60	$520	$31,200
1.4	AV-16 to AV-17	lin.m	85	$520	$44,200
2.	Replace water mains				
2.1	AV-21 to AV-30	lin.m	40	$520	$20,800
2.2	AV-30 to AV-29	lin.m	60	$520	$31,200
2.3	AV-9 to AV-10	lin.m	45	$520	$23,400
2.4	AV-10 to AV-11	lin.m	85	$520	$44,200
3.	Regrade access vaults (9,10,11,12,13,14,15,16,17,21,29,30)	each	12	$9,000	$108,000
4.	Replace Valves AV-3	each	3	$6,000	$18,000
5.	New vault markers	per AV	30	$1,500	$45,000
6.	Repair vault leaks	per AV	30	$1,000	$30,000
7.	Replace sewer cleanout lids	per AV	30	$500	$15,000
8.	Remove corroded electrical	per AV	30	$500	$15,000
9.	Portable genset	each	1	$4,000	$4,000
	TOTAL				$466,400

UMA Engineering Ltd.

ESTIMATE SHEET

PROJECT: Resolute Bay Infrastructure Assessment

FILE NUMBER: 1315-172-00-02-3.1

BY:	DATE	SHEET
Kevin Ness	1994 09 29	1 OF 1

Total System Replacement - Buried Mains

Item	Description	Unit	Approx. Quantity	Unit Price	Total
1.	Replace single trench mains	lin.m	680	$520	$353,600
2.	Replace double trench mains	lin.m	1680	$930	$1,562,400
3.	Replace access vaults	each	30	$46,000	$1,380,000
4.	Replace services	each	50	$8,300	$415,000
	TOTAL				$3,711,000

UMA Engineering Ltd.

ESTIMATE SHEET

PROJECT: Resolute Bay Infrastructure Assessment

FILE NUMBER: 1315-172-00-02-3.1

BY:	DATE	SHEET
Kevin Ness	1995 08 01	1 OF 1

Total System Replacement - Above Ground Utilidor

Item	Description	Unit	Approx. Quantity	Unit Price	Total
1.	Replace single and double trench mains	lin.m	2360	$1,500	$3,540,000
2.	Remove access vaults	each	30	$2,000	$60,000
3.	Replace services	each	50	$8,300	$415,000
4.	Additional backfill material	cu.m	200	$25	$5,000
5.	Road crossings (with liftstation)	each	6	$40,000	$240,000
6.	Sewage holding tank and pump for buildings	bldg	50	$4,200	$210,000
	TOTAL				$4,470,000

UMA Engineering Ltd.

ESTIMATE SHEET

PROJECT: Resolute Bay Infrastructure Assessment

FILE NUMBER: 1315-172-00-02-3.1

BY:	DATE	SHEET
Ken Johnson	1995 10 06	1 OF 1

Construction of Continuous Discharge Sewage Lagoon - Piped Services

Item	Description	Unit	Approx. Quantity	Unit Price	Total
1.	Overburden removal	lump sum	N/A	N/A	$3,000
2.	Excavation	lump sum	N/A	N/A	$5,000
3.	Dyke construction	cu.m	12,000	$25	$300,000
4.	Impermeable liner	cu.m	2,500	$16	$40,000
5.	Riprap	lump sum	N/A	N/A	$20,000
6.	Overflow	lump sum	N/A	N/A	$10,000
7.	Inlet	lump sum	N/A	N/A	$25,000
8.	Discharge (pipe and valve)	lump sum	N/A	N/A	$30,000
9.	Outfall	lin.m	1,000	$450	$450,000
10.	Screening Plant	lump sum	N/A	N/A	$100,000
11.	Access road	lump sum	N/A	N/A	$10,000
12.	Signage	lump sum	N/A	N/A	$1,000
13.	Surface drainage	lump sum	N/A	N/A	$2,000
14.	Decommissioning existing building	lump sum	N/A	N/A	$4,000
15.	Contingency/engineering (40%)	lump sum	N/A	N/A	$400,000
	TOTAL				**$1,400,000**

TRUCKED SYSTEM
COST ESTIMATES

Resolute Bay - Water Sewer Assessment Report

Calculation of cost to operate trucked water and sewer services

Options:
1. Truckfill facility at Char Lake Pumphouse
2. Truckfill facility at Signal Hill Facility
3. New truck storage garage
4. Use existing sewage treatment plant building for truck storage garage

Calculations based on "Appendix D - Trucked Systems Time and Costing Model of "General Terms of Reference for a Community Water and Sanitation Services Study" (MACA, 1986)

1. Number of Trucks Required

$$NV_{Water} = \frac{POP}{2145}\left(0.0795\,VPCD + 0.0102\,VPCD \times D + 1.37\right)$$

POP = 231 (Average of 1996 to 2016 population)
VPCD = 90 LPCD
D = 2.7 km Char Lake
D = 1.0 km Signal Hill

Char Lake

$$NV = \frac{231}{2145}\left[0.0795(90) + 0.0102(90)(2.7) + 1.37\right]$$

$$= 1.19$$

Signal Hill

$$NV = \frac{231}{2145}\left[0.0795(90) + 0.0102(90)(1.0) + 1.37\right]$$

$$= 1.02$$

The values of NV over 1.0 indicate that the standard 4500 Litre truck tank is not sufficient for the future demands of the community. However

UMA Engineering Ltd.
Engineers & Planners

Client _____

Design Calculations

Project _____

DATE _____ BY _____ JOB No. _____ SHEET 1 OF _____

the 4500 Litre tanks should be sufficient for the initial projected demands

Sewage

$$NV = \frac{POP}{2145}\left[0.0557\ VPCD + 0.0102\ VPCD \times D + 0.98\right]$$

POP = 231 (Average of 1996 to 2016 population)
VPCD = 90 Lpcd (Assume same as water demand)
D = 1.8 km

$$NV = \frac{231}{2145}\left[0.0557(90) + 0.0102(90)(1.8) + 0.98\right]$$

$$NV = 0.82$$

The standard 4500 Litre tanks will be sufficient for project demands past the population level of 231 provided the distance from the community does not exceed 1.8 km.

2. HOURS PER YEAR TO SERVICE COMMUNITY

Water

$$CT = (EL)(NB)\left[\left(\frac{C \times CSF}{VS \times VUF}\right)\left(\frac{2 \times D}{S} + \frac{VS}{60 \times R} + \frac{TT}{60}\right) + \frac{DB}{1000 \times SB} + \frac{C \times CSF}{60 \times RB} + \left(\frac{TTB}{60} \times NTB\right)\right]$$

EL = 1.5 (GNWT standard)
NB = 60 buildings
C = 2250 Litres
CSF = 0.85 (GNWT standard)
VS = 4500 Litres
VUF = 0.95 (GNWT standard)
D = 2.7 km Char Lake
= 1.0 km Signal Hill
S = 30 km/hr (GNWT Standard)
R = 1000 Lit/min " "
TT = 4 min " "

DB = 30m (GNWT standard)
SB = 10 km/hr " "
RB = 340 L/min " "
TTB = 3 min " "
NTB = 1 (most building containers are smaller than truck containers)

Char Lake

$$CT = (1.5)(60)\left[\left(\frac{2250 \times 0.85}{4500 \times 0.95}\right)\left(\frac{2 \times 2.7}{30} + \frac{4500}{60 \times 1000} + \frac{4}{60}\right) + \frac{30}{1000 \times 10} + \frac{2250 \times 0.85}{60 \times 340} + \left(\frac{3}{60} \times 1\right)\right]$$

$CT = 26.16$ hours

Signal Hill

$$CT = (1.5)(60)\left[\left(\frac{2250 \times 0.85}{4500 \times 0.95}\right)\left(\frac{2 \times 1.0}{30} + \frac{4500}{60 \times 1000} + \frac{4}{60}\right) + \frac{30}{1000 \times 10} + \frac{2250 \times 0.85}{60 \times 340} + \left(\frac{3}{60} \times 1\right)\right]$$

$CT = 21.60$ hours

$$F = \frac{NOPB \times VPCD}{C \times CSF} \times 365$$

NOPB = 4 persons
VDCD = 90 LPCD
C = 2250 Litres
CSF = 0.85

$$F = \frac{(4)(90)}{(2250)(0.85)} \times 365$$

$F = 68.7$ per year

$THRS = CT \times F$

$CT = 26.16$ hours Char Lake
$= 21.60$ hours Signal Hill
$F = 68.7$ per year

$THRS = 26.16 \times 68.7$

$THRS = 1797$ hours/yr Char Lake

$THRS = 21.60 \times 68.7$

$THRS = 1484$ hours/yr Signal Hill

Sewage

$$CT = (EL)(NB)\left[\left(\frac{C \times CSF}{VS \times VUF}\right)\left(\frac{2 \times D}{S} + \frac{US}{60 \times R} + \frac{TT}{60}\right) + \frac{DB}{1000 \times SB} + \frac{C \times CSF}{60 \times RB} + \left(\frac{TTB}{60} \times NTB\right)\right]$$

$EL = 1.5$ (GNWT standard)
$NB = 60$ buildings
$C = 4500$ Litres
$CSF = 0.85$ (GNWT standard)
$VS = 4500$ Litre
$VUF = 0.95$ (GNWT standard)
$D = 1.8$ km
$S = 30$ km/hr (GNWT standard
$R = 450$ L/min " "
$TT = 4$ min " "
$DB = 30$ m " "
$SB = 10$ km/hr " "
$RB = 340$ L/min " "
$TTB = 3$ min " "
$NTB = 1$ (most building containers are smaller than truck tanks)

$$CT = (1.5)(60)\left[\left(\frac{4500 \times 0.85}{4500 \times 0.95}\right)\left(\frac{2 \times 1.8}{30} + \frac{4500}{60 \times 450} + \frac{4}{60}\right) + \frac{30}{1000 \times 10} + \frac{4500 \times 0.85}{60 \times 340} + \left(\frac{3}{60} \times 1\right)\right]$$

UMA Engineering Ltd.
Engineers & Planners

Client _____

Design Calculations

Project _____

DATE _____ BY _____ JOB No. _____ SHEET 4 OF _____

CT = 50.10 hours

$$F = \frac{NOPB \times VPCD}{C \times CSF} \times 365$$

NOPB = 4 persons
VPCD = 90 Lpcd (assume same as water demand)
C = 4500 L
CSF = 0.85

$$F = \frac{4 \times 90}{4500 \times 0.85} \times 365$$

= 34.35 per year

THRS = CT x F

CT = 50.10 hours
F = 34.35 per year

THRS = 50.10 x 34.35

= 1721 hours/yr

3. VEHICLE CAPITAL COSTS

Water

$$VCRF = \frac{DR(1+DR)^{EL}}{(1+DR)^{EL} - 1}$$

DR = 0.08 (8%)
EL = 8 years (for truck)

$$VCRF = \frac{0.08(1+0.08)^8}{(1+0.08)^8 - 1}$$

= 0.174