FERGUSON SIMEK CLARK
ENGINEERS AND ARCHITECTS

Our File: 2002-1000-055
January 14, 2003

Phyllis Beaulieu
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU, X0B 1J0

Re: Resolute Bay Application - background information

Dear Phyllis:

Please find enclosed copies of the following reports:

Volume 1 - Utilidor Upgrade, Dillon 1999
Volume 2 - Water System Building Assessment, Dillon 1999
Volume 3 - Sewage Treatment and Future Expansion, Dillon 1999

Yours truly,

Michelle MacLeod

Michelle MacLeod, B. Tech. Env.
Environment Department
Ferguson Simek Clark

030114 NWB3RES Utilidor Upgrade - ILAE

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Volume 1 - Utilidor Upgrade

Final Report - Revision 1

May, 1999

Volume 1 - Utilidor Upgrade
Resolute Bay, NT

Public Works & Services,
Government of the Northwest Territories

98-5748-01-01

Submitted by

Dillon Consulting Limited

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1.0 INTRODUCTION

1.1 General

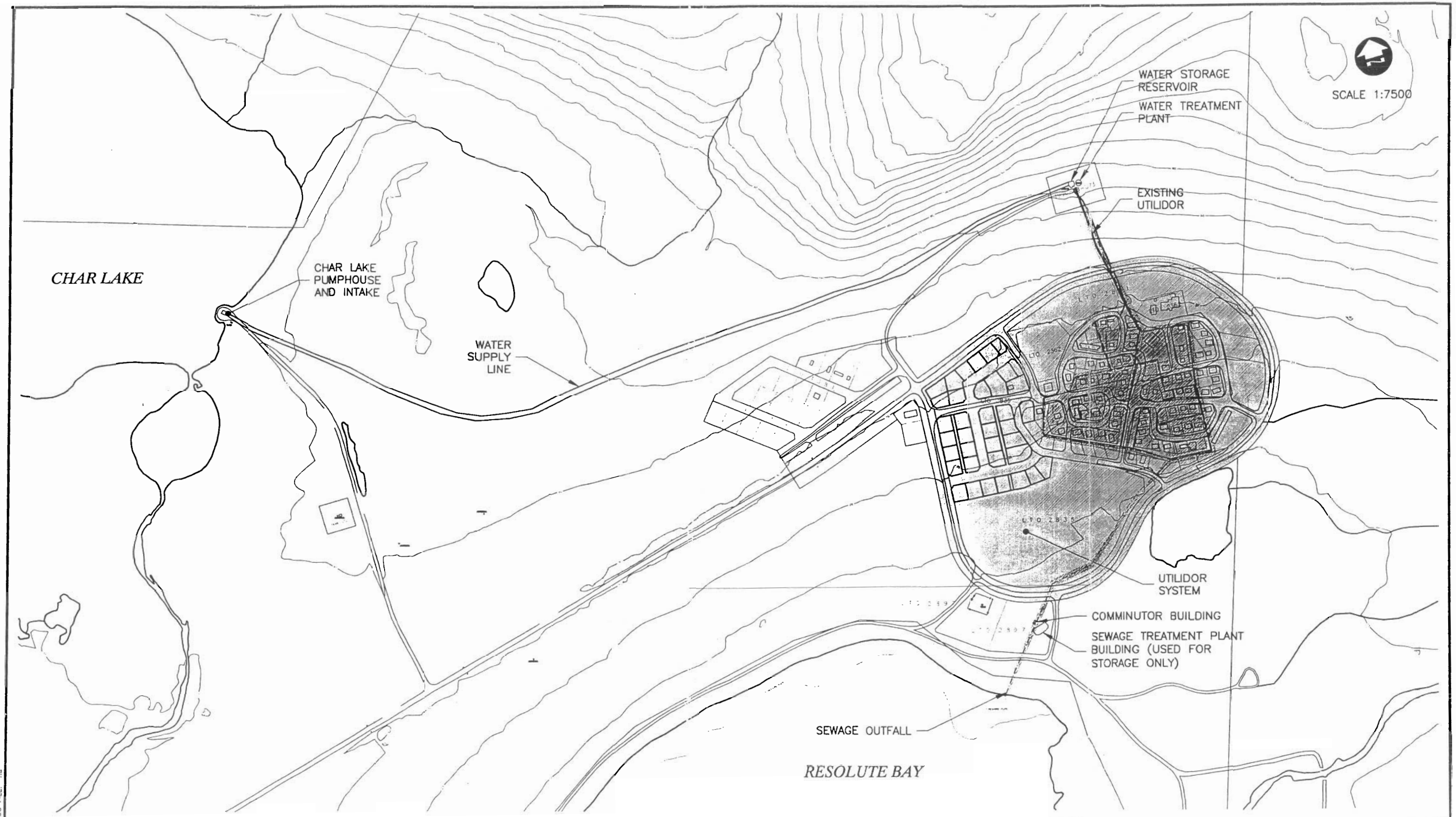
The Hamlet of Resolute Bay is serviced by a water supply system that uses a utilidor system to deliver water to houses and commercial users, and collect the sewage from these users. The water supply and sewage disposal systems are comprised of several components, namely:

- The raw water source known as Char Lake
- The Char Lake pumphouse
- The water supply line from the Char Lake pumphouse to the Water Treatment Plant (WTP)
- The utilidor system that is comprised of the water distribution system and the sewage collection system
- The Sewage Treatment Plant
- The sewage outfall.

The above components are shown in **Figure 1.1** and will be described in more detail in the body of the report. Previous studies (UMA 1996) assessed each of the system components for condition, expected remaining life and required remedial action to be undertaken to extend the current facility life to 20 years. The results of this study indicated that in general the facility components are well maintained, and will meet the Hamlet's requirements for the next 20 years. The exception is the utilidor system that has experienced a number of failures over the past 5 to 7 years. The increase in failures is of significant concern to the utilidor maintainers and the Hamlet Council.

The GNWT, Department of Municipal and Community Affairs (MACA) owns the assets of the water and sewer systems. The Department of Public Works & Services (DPW&S) completes the operation and maintenance on the systems. The GNWT has identified the transfer of the community assets to the communities as a priority. In this vein, the GNWT intends to transfer the water and sewer system to the Hamlet of Resolute Bay. Prior to the transfer of the facilities, the systems are to be upgraded to meet the requirements of the Hamlet for the 20 year design life. Dillon was retained to review the system in this light, and develop an upgrading plan for the sewage and water systems assuming that the piped distribution system will be maintained in the community. Three reports were produced, namely;

Volume 1 - Utilidor Upgrade
Volume 2 - Water System Building Assessment
Volume 3 - Sewage treatment and Future System Expansion



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DILLON CONSULTING

PROJECT: HAMLET OF RESOLUTE BAY UTILIDOR UPGRADE

TITLE: WATER SUPPLY AND SEWAGE DISPOSAL SYSTEM

PROJECT NUMBER: 98-5748

DATE: OCT 98

FIGURE NUMBER: FIG 1.1

1.2 Scope of work

The scope of work for this volume relates to the utilidor system. A summary of the scope of work is described below:

- Complete a review of the existing documentation.
- Complete a site investigation to update the previous work.
- Debrief the system operator on his concerns, and review the system operator's records of the system.
- Develop a list of required upgrades to be completed to have the system meet the Hamlet's system needs for the next 20 years and complete cost estimates for these upgrades.

2.0 EXISTING DATA REVIEW

2.1 Community Data

Resolute Bay is located on the south coast of Cornwallis Island and is about 1,660 km north east of Yellowknife and 1,550 Km north west of Iqaluit. The community is located at latitude N74-43-01 and longitude W94-58-10 (NAV CANADA). The average daily minimum and maximum temperatures for July and January are 1.3°C & 6.8°C and -35.8°C & -28.5°C respectively. An average of 50.4 mm of rainfall and 97.3 cm of snowfall for a total of 139.6 mm of precipitation is received each year (Environment Canada).

The community was founded in the early 1970's when it was decided to relocate the existing community from the beach area near the existing south camp to the present location. The development of the community and the initial infrastructure was based on a projected population of some 1,500 people. The expected growth was not realized and the current population is slightly less than 200 persons.

2.2 Population Projection

To be able to develop the system requirements it is necessary to determine the design flow rates for the piped system. The flow rates are based on the population of the community and the expected per capita consumption. The historic populations and per capita water use rates are based on the records found at the Hamlet's office, MACA's records and in previous reports (UMA, 1993, 1996). The population projections are based on the data supplied by the Bureau of Statistics. These are as follows:

Table 2.2.1
Population Projects from the Bureau of Statistics

Year	Population
1991	171
1992	174
1993	178
1994	181
1995	184
1996	197
2001	224
2006	238

The consumption is based on the formula developed by MACA (MACA, 1986) and on the historic

consumption of the community. The formulae for predicting water consumption of communities with piped water distribution and populations less than 2,000 people is:

$$\text{Daily Consumption} = 225*(1 + 0.00023 * (\text{Population})) * \text{Population}$$

Based on this formula and the population projections shown in Table 2.2.1, the projected annual consumption for the Hamlet of Resolute Bay for the next 20 years can be predicted. The system uses bleed water from the watermains to provide freeze protection to the sewermains. The bleed water is not metered. The total water pumped into the system is metered, and the individual consumers are metered. The resultant of the water supplied to the system and the metered volume of the consumers is the total of the system losses. The total system losses include the bleed water, losses due to watermain breaks, and water losses within the system. Prior to 1996, this value was fairly constant at approximately 38,000 m^3 per year. As a result of increased problems with the system the amount of bleed water has increased in 1996 to 52,000 m^3 and again in 1997 to 56,000 m^3. At the time of reporting, the Hamlet was projecting an annual total consumption for 1998/99 of 55,000 m^3 of which 45,000 m^3 would be the bleeders and other system losses. For the purposes of water consumption projections the value of 45,000 m^3 of bleed water and other system losses is used. The projected annual consumption is shown in **Table 2.2.2.**

2.3 System Description

The following is a description of the complete water and sewage system from the up gradient intake to the down gradient sewer outfall. **Figure 2.1** illustrates this system in a schematic diagram.

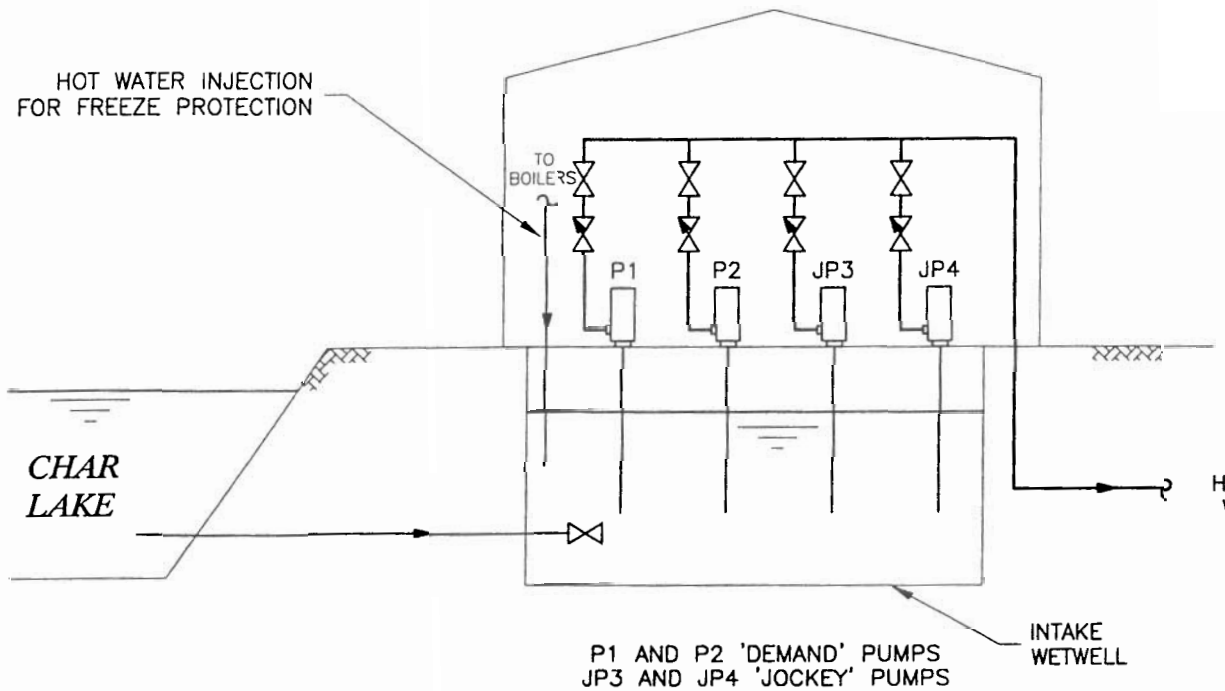
Char Lake

- A ductile iron gravity intake line extends from Char Lake to wet wells in the Char Lake Pump House.
- Char Lake Pump House tempers the water using a hot water injection into the wet wells. Diesel fired boilers are used to heat the injection water. The tempered water is pumped through the 150 mm heat traced and insulated HDPE Water Supply Main to the Water Storage Reservoir at the Water Treatment Plant (WTP).
- Two jockey pumps and two demand pumps are operated in the Char Lake Pump House. Typically one jockey pump operates 24 hours a day, with one demand pump coming on for less than one hour per day. The second jockey pump and second demand pump are on-line standby pumps and are brought on-line automatically if the first pump fails.
- The Char Lake Pump House pumps are controlled from a level controller located in the Water Storage Reservoir. The controller has a high level alarm, jockey pump off, jockey pump on, demand pump off, demand pump on, and low level alarm control levels.
- A standby diesel engine generator is situated in the Char Lake Pump House in case of loss of power to the Pump House.

Table 2.2.2
Population and Consumption Projections

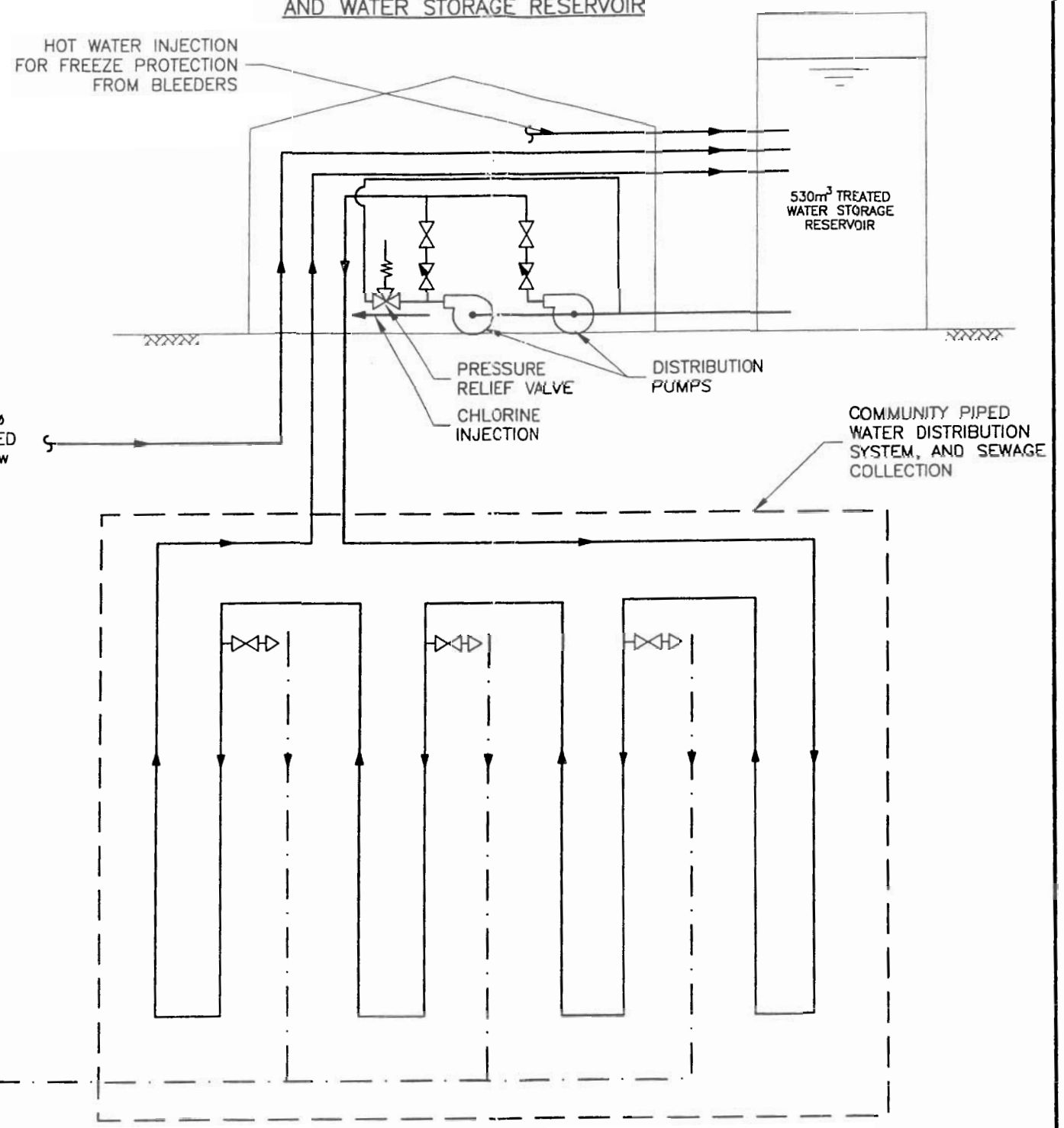
Design Year	Year	Population	Growth Rate	Consumtion lcd	Consumption Annual (historic)	Consumption Annual (MACA)	Bleeders Annual	Total Volume (Historic)	Total Volume (MACA)	Daily Average (Historic)	Daily Average (MACA)
	1991	171		145	9,050,175		38,400,000	47,450,175		130,000	
	1992	174	0.0175	145	9,208,950		38,400,000	47,608,950		130,435	
	1993	178	0.0230	145	9,420,650		38,400,000	47,820,650		131,015	
	1994	181	0.0169	145	9,579,425		38,400,000	47,979,425		131,450	
	1995	184	0.0166	145	9,738,200		38,400,000	48,138,200		131,885	
	1996	197	0.0707	145	10,426,225	16,911,678	51,868,684	62,294,909	68,780,362	142,106	188,439
	1997	205	0.0406	145	10,849,625	17,629,425	55,801,509	66,651,134	73,430,934	152,881	201,181
	1998	209	0.0195	145	11,061,325	17,989,204	45,000,000	56,061,325	62,989,204	123,288	172,573
0	1999	214	0.0239	145	11,325,950	18,439,779	45,000,000	56,325,950	63,439,779	123,288	173,808
1	2000	221	0.0327	145	11,696,425	19,072,170	45,000,000	56,696,425	64,072,170	123,288	175,540
2	2001	224	0.0136	145	11,855,200	19,343,762	45,000,000	56,855,200	64,343,762	123,288	176,284
3	2002	227	0.0134	145	12,013,975	19,615,693	45,000,000	57,013,975	64,615,693	123,288	177,029
4	2003	228	0.0044	145	12,066,900	19,706,413	45,000,000	57,066,900	64,706,413	123,288	177,278
5	2004	233	0.0219	145	12,331,525	20,160,576	45,000,000	57,331,525	65,160,576	123,288	178,522
6	2005	237	0.0172	145	12,543,225	20,524,587	45,000,000	57,543,225	65,524,587	123,288	179,519
7	2006	238	0.0042	145	12,596,150	20,615,684	45,000,000	57,596,150	65,615,684	123,288	179,769
8	2007	239	0.0042	145	12,649,298	20,707,204	45,000,000	57,649,298	65,707,204	123,288	180,020
9	2008	240	0.0042	145	12,702,671	20,799,148	45,000,000	57,702,671	65,799,148	123,288	180,272
10	2009	241	0.0042	145	12,756,269	20,891,518	45,000,000	57,756,269	65,891,518	123,288	180,525
11	2010	242	0.0042	145	12,810,093	20,984,318	45,000,000	57,810,093	65,984,318	123,288	180,779
12	2011	243	0.0042	145	12,864,144	21,077,548	45,000,000	57,864,144	66,077,548	123,288	181,034
13	2012	244	0.0042	145	12,918,423	21,171,212	45,000,000	57,918,423	66,171,212	123,288	181,291
14	2013	245	0.0042	145	12,972,931	21,265,310	45,000,000	57,972,931	66,265,310	123,288	181,549
15	2014	246	0.0042	145	13,027,669	21,359,846	45,000,000	58,027,669	66,359,846	123,288	181,808
16	2015	247	0.0042	145	13,082,638	21,454,821	45,000,000	58,082,638	66,454,821	123,288	182,068
17	2016	248	0.0042	145	13,137,839	21,550,239	45,000,000	58,137,839	66,550,239	123,288	182,329
18	2017	249	0.0042	145	13,193,273	21,646,100	45,000,000	58,193,273	66,646,100	123,288	182,592
19	2018	250	0.0042	145	13,248,941	21,742,407	45,000,000	58,248,941	66,742,407	123,288	182,856
20	2019	251	0.0042	145	13,304,843	21,839,163	45,000,000	58,304,843	66,839,163	123,288	183,121

CHAR LAKE INTAKE PUMPHOUSE

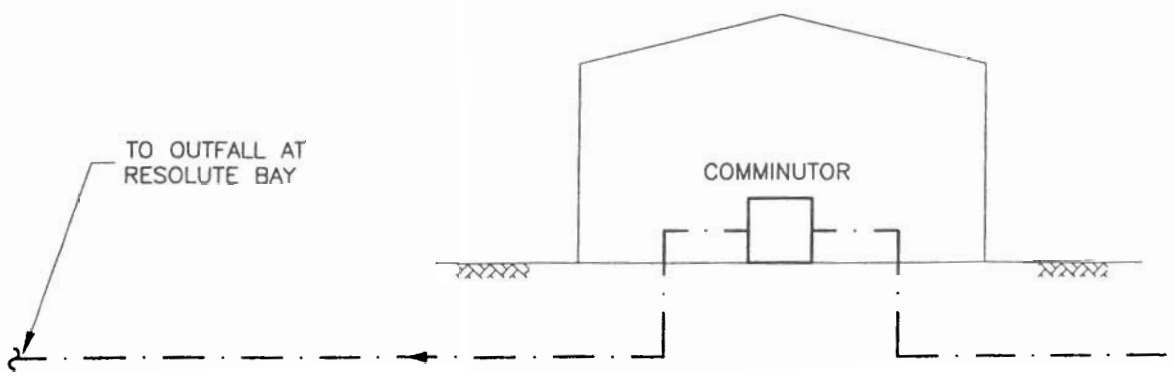


1.88km LONG 150mm ø HEAT TRACED & INSULATED WATER SUPPLY MAIN c/w 5 ACCESS VAULTS

SIGNAL HILL WATER TREATMENT PLANT AND WATER STORAGE RESERVOIR



SEWAGE COMMUNITION BUILDING



LEGEND

- WATERMAIN BLEEDERS
- WATER
- SEWER

DILLON CONSULTING

PROJECT	HAMLET OF RESOLUTE BAY UTILIDOR UPGRADE
TITLE	EXISTING SYSTEM SCHEMATIC
PROJECT NUMBER	98-5748
DATE	OCT 98
FIGURE NUMBER	FIG 2.1

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Water Treatment Plant

- The Water Storage Reservoir is a steel 530 m^3 vertical steel tank constructed above grade. The tank is insulated and is freeze protected by the use of hot water injection.
- The Water Treatment Plant uses diesel fired boilers to provide tempering water for the Water Storage Reservoir hot water injection.
- The distribution water to the community is chlorinated using calcium hypochloride through injection pumps.
- The WTP uses pumps to provide distribution flow. The pressure is maintained at approximately 170 kPa (25 psi) at the WTP (October 1998 reading), and approximately 600 kPa (85 to 90 psi) at the low end of distribution system. The difference between the discharge pressure and the low end main pressure is the result of the static head difference in the mains due to elevation changes. The supply pump runs continuously at a constant rate of 1,700 rpm. The flow to the distribution mains is not regulated. Whatever water is not used within the distribution system is returned to the reservoir through the 150 mm return line.

Utilidor

- The distribution system is a looped HDPE insulated pipeline. The pipes are mostly 200 mm in diameter with two sections of 150 mm supply line and a 150 mm return line.
- Water is supplied to users (approximately 60 buildings) through a 20 mm copper heat traced (Stage 1A only) and insulated services. A return service is also installed from each building to the water main. Flow is moved continuously through the supply and return services by a small recirculation pump (1/4 h.p.) located in each building.
- The return water is directed back to the Water Storage Reservoir.
- The building sewage is collected using 100 mm insulated HDPE sewers to the sewer mains.
- The water and sewer services are in a common insulated jacket. The latent heat from the recirculation of the water services is used to freeze-protect the sewer service.
- Bleed water from the water mains is also used to provide freeze protection to the sewer mains during power failures when the water service recirculation pump is not operating
- The sewer mains are gravity run 150 mm insulated HDPE. These are installed in the same trench as the watermain.
- The sewermains and watermains are accessed through common concrete cast in place Access Vaults (AVs). The AVs contain all valves, hydrants, pipe connections and sewer clean outs.
- The sewer main is freeze-protected by the use of bleed water from the watermain to the sewermain. The bleeders are unmetered and located in the AVs.

Sewage Discharge

- The sewer mains join at the low end of the community and flow by gravity to a comminutor building.
- The sewage is macerated in this facility and discharged by gravity through an outfall pipe to the

shore line of the marine environment.

There have been several changes to the system since the original design. Some of these changes have been incorporated into the O&M manuals. The changes recorded during the site investigation completed on October 20 to 22, 1998 are from the discussions with the DPW Maintainer, Mr. Neil MacDonald, the Hamlet Administration, Mr. Dan Leman & Mr. Alexander, and from the existing documentation are as follows:

- A heat trace has been installed in the Water Supply Line from the Char Lake Pump House to the WTP in 1993. Five access vaults have been installed along this line as well. (Record Drawings)
- Two jockey pumps have been installed in the Char Lake Pump House.
- The utilidor heat trace system was abandoned in 1984 due to corrosion problems.(UMA, 1996)
- All electrical devices and service were removed from the Access Vaults in 1998. This includes the sump pumps, heat trace, and AV heaters. (N. Macdonald)
- The line to Block 1 is abandoned due to a freeze-up prior to 1986. The Health Centre water service currently uses the abandoned water main as a carrier pipe. The other buildings in this area are connected to the water and sewer mains between AV2 & 3. (N. MacDonald) The sewer service to the Health Centre is still in operation (D. Leman).
- The Hydrant in AV 20 was removed prior to 1986.
- AV 15 was never installed during the original construction. (N. MacDonald)
- A new hydrant was installed in 1998 in AV 13, (N. MacDonald)
- The valves in AV3 were replaced in 1998. These are the valves that were indicated to leak in the UMA 1996 report, but were incorrectly identified as AV2 valves in the UMA report (N. MacDonald).
- A new valve was installed in AV30 in 1998. This allows the section of main between AV21 and AV30 to be shut off. (N. MacDonald)
- The ventilation systems for the WTP and Char lake Pump House have been disabled and are blocked up in the winter. Combustion air for the facility burners is supplied through building envelope infiltration. It is reported by the DPW Maintainer that the buildings are very leaky and have poor insulation.

With respect to the utilidor system, there are no known changes made from the original construction other than the changes noted above. The complete system description and components is found in three sets of O&M Manuals. Copies of these manuals are stored in the community, DPW&S Iqaluit, and DPW&S Yellowknife.

2.4 System Deficiencies

The previous assessment of the facility as a whole was completed by UMA and documented in a report dated 1996. The report identified a number of concerns with the utilidor system, some of which have been addressed through the maintenance of the system while others are still outstanding. **Table 2.4.1** lists the deficiencies noted in the UMA report, and the changes that have occurred with respect to these deficiencies since the writing of the UMA report.

Table 2.4.1
Reported System Deficiency Update

	Deficiency Noted in 1996	Current Status
1.	Heat trace controllers, AV heaters, and sump pumps in AV's are non-functioning due to corrosion.	These components stopped working in 1985. All derelict components were removed in 1998, and will not be replaced.
2.	Concern with a potential sewer crossover into the watermain through the AV bleeders.	No action taken.
3.	Valves in AV 2 are leaking.	These were reported incorrectly, and are actually in AV 3. These valves were replaced in 1998.
4.	Suspected bad pipe joints in the mains due to construction techniques.	This was suggested in the UMA 1996 report based on anecdotal information from the Hamlet/DPW&S Maintainer. However, a review of the known breaks to date (see Section 3) indicates that there is no reason to suspect that there is bad joint construction. The concern over the number of breaks in recent years, however, persists.
5.	Improve the circulation in the mains.	No action taken.

3.0 UTILIDOR SYSTEM CONDITION ASSESSMENT

3.1 Detailed Description

The utilidor system was constructed in two phases known as Stage 1A and Stage 1B in 1977 and 1978 respectively. **Figure 1.1** shows the layout of the utilidor system, the phases of the construction, the pipe sizes and the main flow directions. The following is a list of the material components used for the construction of the utilidor.

Table 3.1.1
Utilidor Materials

Component	Material	Approx Quantity
Watermain	200 mm insulated PE series 125	Stage 1A - 1333 m Stage 1B - 633 m Total 1966 m
Watermain	150 mm insulated PE series 125	Stage 1 A - 323 m Stage 1B - 204 m Total 527 m
Sewermain	150 mm insulated PE series 45	Stage 1A - 1541 m Stage 1B - 762 m Total 2303 m
Building Water Services	2 @ 20 mm copper type K tubing c/w insulation	60 buildings
Building Water Appurtenances	18 mm Neptune meter 20 mm Pressure reducing valve - singer model 140 Armstrong Circulator 20 mm ½ H.P. pump	1 per building
Building Sewer Services	100 mm insulated PE pipe	1 per building
Water main Connections	200 mm x 2@20mm I.P. tap Ductile Iron Service Sleeve	1 per connection
Sewer main Connections	100 mm sewer service saddle	1 per building
Access Vaults	Concrete Cast in Place, c/w 50 mm insulation	Stage 1A - 22 Stage 1B - 9 Total 31
	200 mm Valves - Lug type	1 per direction of piping in AV
	Sewer clean out & cover	1 per direction of piping in AV
	Hydrant c/w valve - MaCavity	Stage 1A - 5 Stage 1B - 5 Total 10
	Frost cover	1 per AV
	Frame and cover	1 per AV

3.2 Utilidor Repair History

3.2.1 Repair History

The DPW&S Maintainer provided a description of the repairs that have been made to the utilidor system over the years. In total 12 repair clamps have been installed on the main system. Ten of the repair clamps have been installed on the water mains and two on the sewer mains. The Maintainer, Mr. Neil MacDonald, has been in Resolute Bay since 1986. The exact years of the repairs are not recorded; however, he provided an indication of which repairs occurred prior to his arrival in the community. Further, he indicated that there were no repairs completed on the mains in the first five years of his service in the community. The following is a list of the locations of the repair clamps as noted by the DPW&S Maintainer. The approximate location of the breaks is shown in **Figure 3.2.1**.

Table 3.2.1
Record of Main Repairs

From	To	Distance	Comments
AV21	AV30	6 m from AV21	Watermain, repair clamp, prior to 1986, split in pipe
		18 m from AV21	Watermain, repair clamp, prior to 1986, split in pipe
		6 m from AV21	Sewermain, repair clamp, since 1991, collapsed pipe
		18 m from AV21	Sewermain, repair clamp, since 1991, collapsed pipe
AV30	AV29	12 m from AV30	Watermain, 600 mm long repair clamp over a 500 mm long split in pipe, since 1991
AV3	AV2	Mid point	Watermain, prior to 1986
AV4	AV5	At AV 4	Watermain pipe flange broke in AV. Replaced with new 2.5 meter section of pipe and repair clamp installed 2.5 m from AV, since 1991
AV10	AV11	At AV10	Watermain pipe flange broke in AV. Replaced with new 2.5 meter section of pipe and repair clamp installed 2.5 m from AV, since 1991
AV9	AV10	9 m from AV 9	Watermain, approx. 400 mm split, since 1991
		18 m from AV 9	Watermain, approx. 400 mm split, since 1991
AV5	AV6		Watermain, small crack 50 mm to 75 mm long, since 1991
AV27	AV28	At 90 bend	Watermain, small split, since 1991
AV20	AV22		Frozen due to no flow condition and is reported to be a result of the pit orifice system.

	FROM	TO	DISTANCE	COMMENTS
A	AV-21	AV-30	6m FROM AV-21	Watermain, Repair Clamp, Prior to 1986, split in pipe
B			18m FROM AV-21	Watermain, Repair Clamp, Prior to 1986, split in pipe
C			6m FROM AV-21	Sewermain, Repair Clamp, Prior to 1986, collapsed pipe
D			18m FROM AV-21	Sewermain, Repair Clamp, Prior to 1986, collapsed pipe
E	AV-30	AV-29	12m FROM AV-30	Watermain, 600mm long repair clamp over a 500mm long split in pipe, since 1991
F	AV-3	AV-2	MIDPOINT	Watermain, Prior to 1986
G	AV-4	AV-5	AT AV-4	Watermain pipe flange broke in AV. Replaced with new 2.5m section of pipe and repair clamp installed 2.5m from AV, since 1991
H	AV-10	AV-11	AT AV-10	Watermain pipe flange broke in AV. Replaced with new 2.5m section of pipe and repair clamp installed 2.5m from AV, since 1991
I	AV-9	AV-10	9m FROM AV-9	Watermain, Approx. 400mm split, since 1991
J			18m FROM AV-9	Watermain, Approx. 400mm split, since 1991
K	AV-5	AV-6		Watermain, small crack 50mm-75mm long, since 1991
L	AV-27	AV-28	AT 90° BEND	Watermain, small split, since 1991
M	AV-14	AV-13	MIDPOINT	Sewermain, small dip in road over main
N	AV-25	AV-23	AT ROAD CROSSING	Sewermain, dip in road
O	AV-12	AV-11	ALONG SECTION	Sewermain is sagged and needs regrading
P	AV-19	AV-21	ALONG SECTION	Sewermain, slow flow requires a lot of bleeding

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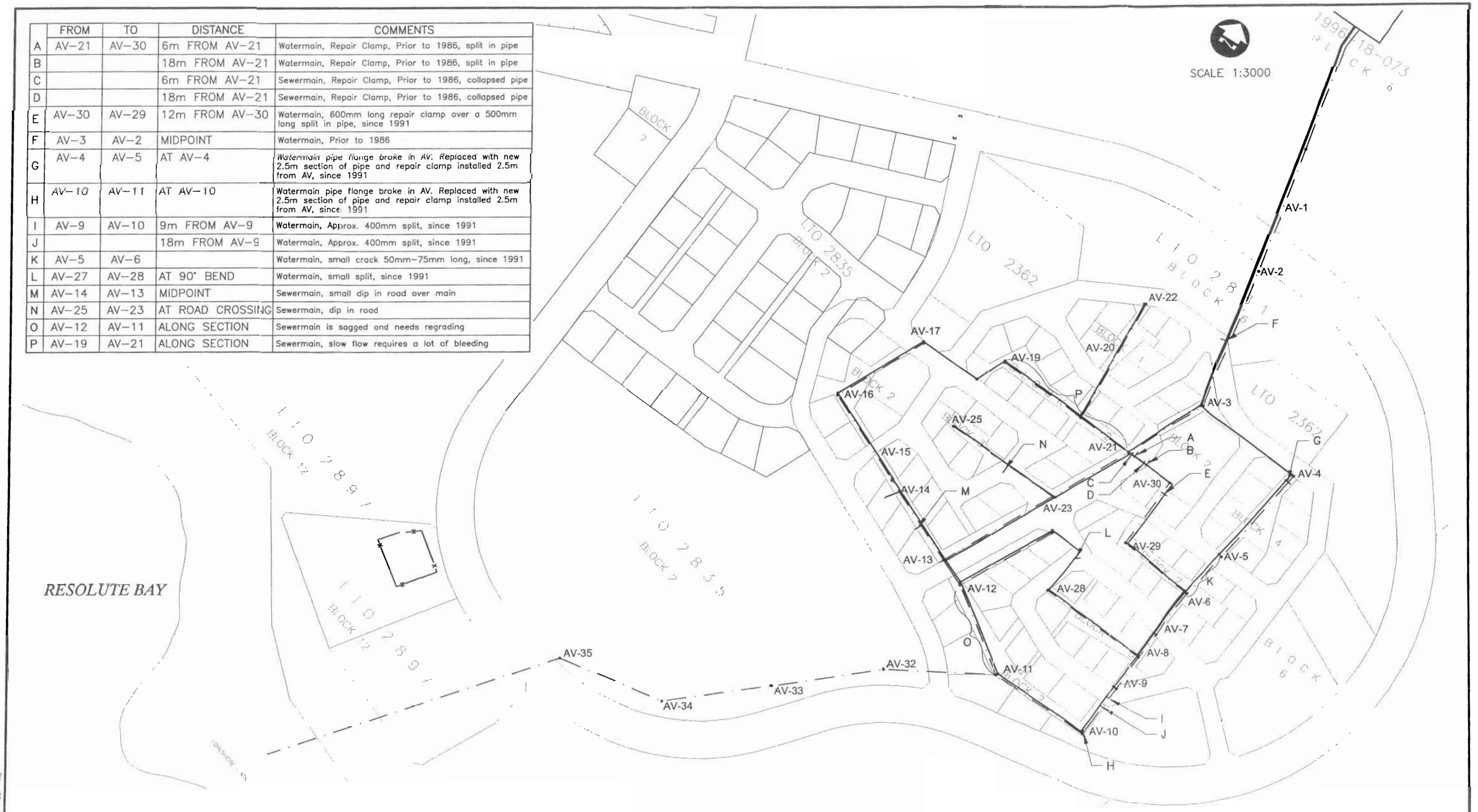

LEGEND

AV-13 ACCESS VAULT NUMBER

WATER

SEWER

DILLON CONSULTING

PROJECT	HAMLET OF RESOLUTE BAY UTILIDOR UPGRADE
TITLE	WATER SUPPLY AND SEWAGE BREAK LOCATIONS
PROJECT NUMBER	98-5748
DATE	OCT 98
FIGURE NUMBER	FIG 3.2.1

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BASE NAME b.dwg LOG FILE na

3.2.2 Break Assessment

All split pipes have split along the top of the pipe, or just off the centre line of the top of the pipe. Except for the two repairs that were made to the pipe flange in the AVs all other repairs were made in the pipe away from the pipe joints. To develop remedial repairs for the utilidor system it is useful to determine the most likely cause of the pipe failures. Through the identification of the probable cause, the likely areas of future failures and the likely rate of failures can be developed. There are several possible failure mechanisms; namely,

- Poor construction methods or materials
- "Freeze Back"
- Excessive operating pressures
- Water hammer
- Ground movement

Poor Construction or Materials

The UMA 1996 report suggests that the pipe failures may be due to poor construction of the butt fused joints in the pipe. This was based on the report from the Hamlet that the breaks had occurred at the joints, and appeared to be joint failure. However, during discussions with the DPW&S Maintainer (N. MacDonald), it was determined that except for the failures in the AVs, none of the failures have been at a joint. The failures have all been longitudinal splits of the pipe, and this is not consistent with the premise that the pipes are failing at the joints. Therefore it is unlikely that the cause of the pipe failures is related to poor butt fusing of the pipe during construction.

Freeze Back

Over a number of years, Agra Earth and Environmental (under the name HBT Agra Limited) completed studies on the pipe failures in Iqaluit, NT. These failures were characterized by the mains becoming out of round or oval shaped. The mechanism proposed by Agra is increased soils pressures on the top of the pipes due to the freezing of the ground around the utilidor system. This is termed a "Freeze Back" failure. The failures in the Agra HBT study were all in the sewer mains. There were no noted failures related to the freeze back failure method in the watermains of the study area. The failures in the sewer mains had serval common characteristics; these include:

- Ground water was encountered at all sites,
- Failures between 2 and 10 years after installation,
- Series 45 HDPE piping,
- Presence of silt in soils,
- Shallow pipes, with the pipe located in the active layer of the soils.

The failures of the pipes in Resolute Bay do not appear to be consistent with the failure mechanisms described in the Agra reports. The Resolute Bay failures are occurring some 20 years after installation; the failures are in the watermains series 125, not the sewer mains series 45; and the Resolute Bay mains are not in the active layer. Therefore the freeze back mechanism is not considered the likely cause of the watermain failures.

Excessive Operating Pressures

Watermains can be damaged from excessive operating pressures. The main pressures are not metered, and as such there are not any records of the main pressures prior to or after a main break. There is a pressure relief valve (PRV) located at the WTP. This PRV is set to 200 kPa (30 psi). This valve was checked by the DPW&S Maintainer in September 1998, and noted to be operating properly. Over-pressuring of the mains from the WTP is therefore considered unlikely.

Water Hammer

Water hammer is a cause for pipe system failure. This is produced by the sudden closure of a valve on the pipe system, and the shock wave produced from this action. Normally, the pipe system will fail at a bend, valve, or tee within the system where the shock wave from the water hammer is cause to change direction or velocity. As the recorded breaks do not occur at these locations, it is unlikely that this is the mechanism for failure.

Ground Movement

Differential settlement of the ground that supports the piping system can cause stresses on the pipe system, particularly where the piping system enters/exits a building or structure. Based on the report of the two breaks at the AV structures, it is highly probable that this is the mechanism of failure for these two breaks.

Settlement of the piping within the pipe trench is also a common occurrence. The settlement can be created by frost heaving, thaw settlement, erosion of the pipe bedding material, and consolidation of the sub-soils. In addition to the repairs on the watermains, there are sections of the sewer main that have poor flow characteristics. This is possibly due to settlement of the sewer pipe, poor pipe grade or blockages. Table 3.2.2 is a listing of these areas.

Table 3.2.2
Sewermain Flow Problem Locations

From	To	Distance	Comments
AV 14	AV 13	Mid point	Sewermain, small dip in road over main.
AV 25	AV 23	At road Crossing	Sewermain, dip in road.
AV 12	AV 11	Along section	Sewermain is sagged and needs regrading.
AV 19	AV 21	Along section	Sewermain, slow flow requires a lot of bleeding.

These problem areas are most likely due to the differential ground movement around the piping. It could also be due to ovalling of the pipe caused by the Freeze Back failure mechanism, but as this has not been noted by the maintainers to date, the freeze back mechanism is considered an unlikely cause.

The utilidor was constructed over phases known as Stage 1A and Stage 1B. The limits of each year's construction is shown on Figure 3.2.1. Stage 1A was completed in 1977, and Stage 1B was completed in 1978. All the repair clamps have been placed on piping installed under the Stage 1A phase of the work. Sewermain settlement would appear to be more predominant in the Stage 1B area, but it does appear in both stages.

The fact that the Stage 1A area is the only location for the watermain breaks is significant. It strongly suggests that there is a difference in the two systems' design, construction, operation or the foundation soils that would cause the failures in one area but not the other. To assess the cause of this phenomena the Record Drawings, O & M Manuals, construction records and photographs were reviewed. The results of the review are:

- The record drawings indicate that the design of the system was completed by the same firm, UMA. The design layout and details are very simular for all components of the utilidor installation. From this it can be concluded that there is little or no difference in the design of the system.
- The two stages are operated as one system, therefore system operation is an unlikely cause.
- The construction was completed under the same specifications, and the same rigour of testing. There are no noted differences in the manner in which the two stages were constructed, therefore construction methods is an unlikely cause.
- A review of airphotos from 1959 indicates that there appears to be a difference in the natural ground conditions between Stage 1A and Stage 1B. Stage 1A has areas were it appears ground water is seeping out, and creating wet areas. When this airphoto is overlayed with the developed community (**Figure 3.2.2**) there is a correlation between the "wet" seepage areas and the problems areas of the utilidor.

Water in the foundation soils of the pipes can be a cause for long term pipe problems. The available water allows for frost leave, ice lensing, and freeze - thaw ground movements. These in turn create localized stresses on the pipes on an annual basis. Continued movement over time will create fatigue, increased stresses and ultimately pipe failures.

There is also anecdotal evidence to support that there is ground water flow. The AVs are reported to have continued infiltration from the spring thaw to November each year. The infiltration continues after the spring run off is finished and is noted to be below the active layer. Further, there are reports of water seeping into excavations in the piping area up to 2 to 3 metres below the ground surfaces.

Though the cause of the pipe failures can not be determined with certainty, it is most likely that the failures were due to ground water flow, and the stresses placed on the pipes due to the freeze action of the ground water which creates ground movements.

3.2.3 Commentary

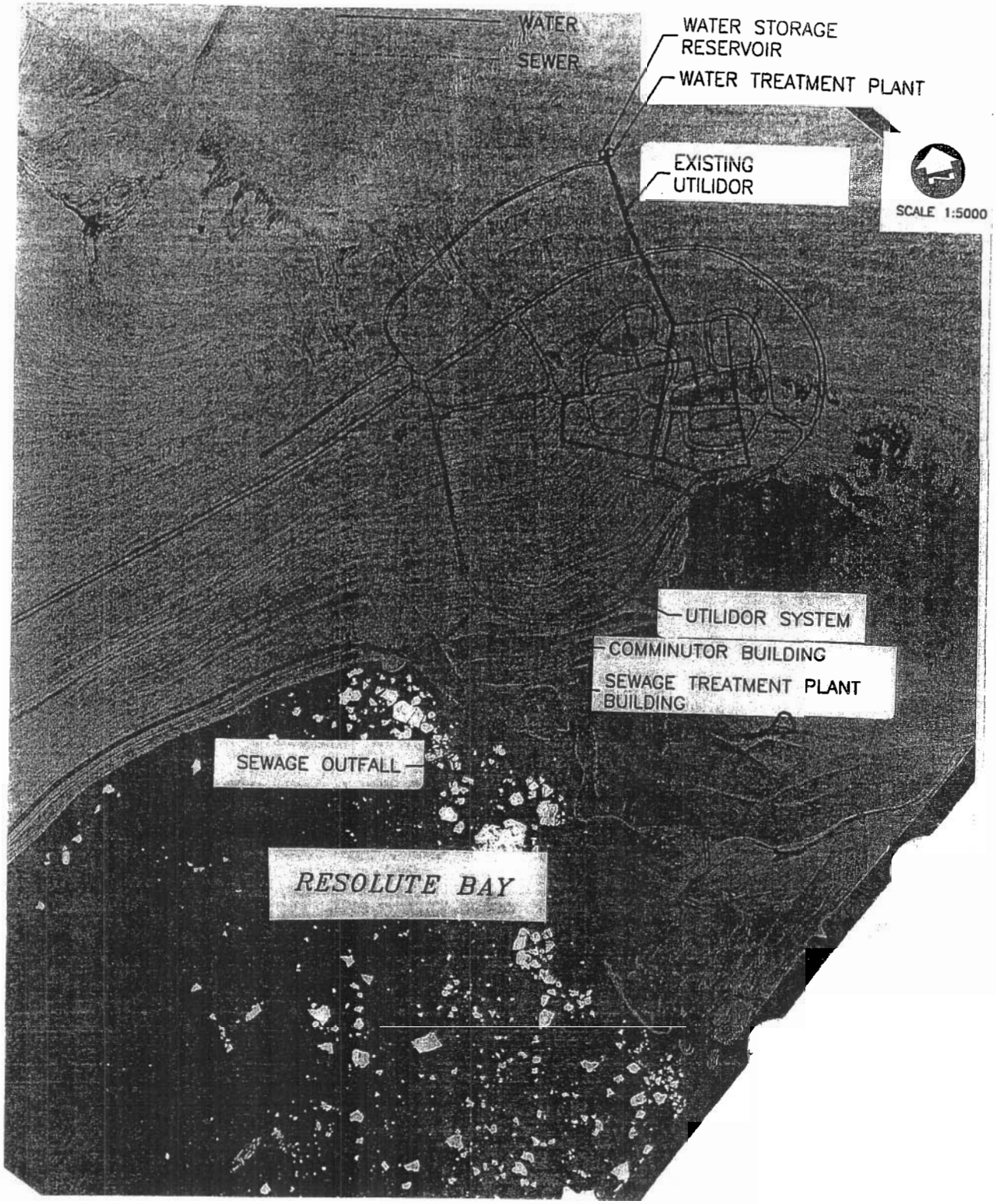
The number of breaks in the system in any given year is not unusual for the age of the system. In assessing water and sewer piping systems, a break frequency of less than 1 break/kilometre/year is considered to be good performance. Municipalities use the break frequency per kilometre per year to develop capital plans for system upgrades. In large systems, a break frequency of 3 or 4 is often the value required prior to the link being replaced.

The total number of breaks per link is also used as a means to develop repair requirements. A break frequency of 4 or 5 breaks per link is often used as a value to indicate the link needs replacement.

In Resolute Bay there are 2 links that meet the above values for replacement. These are from AV21 to 30 m past AV30 and AV8 to AV10. These repairs would cover 8 of the 12 recorded breaks. These sections should take priority over other pipe replacement sections.

During discussions with the Hamlet and DPW&S Maintenance, it was noted that the concern with the main breaks is not mainly related to the number of breaks, but is related to the risk of system failure in the event of a break. The system is not designed to allow for sections of the utilidor to be shut down and have the remainder of the system operate. Should a failure occur, there is a risk that the loss of the system could create a long term no flow condition in the system. This could result in system freeze up and loss of water supply, fire protection, and sewage disposal to the Community as a whole.

Given this risk, it may be prudent to complete upgrades at a break frequency sooner in Resolute Bay than is typically used for piped systems elsewhere. The cost for upgrading sections of the system is developed in Section 6 of this report.



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BASE NAME: a.dwg LOG FILE: na

DILLON CONSULTING

PROJECT	HAMLET OF RESOLUTE BAY UTILIDOR UPGRADE
TITLE	EXISTING AIR PHOTO BEFORE DEVELOPMENT
PROJECT NUMBER	98-5748
DATE	NOV 98
FIGURE NUMBER	FIG 3.2.2

3.3 Regulatory Compliance of the Utilidor System

3.3.1 The Public Health Act

The NWT Public Health Act (PHA) regulates the supply of potable water to consumers, and the methods for the collection of waste in the NWT. The applicable sections of the PHA are the "Consolidation of Public Water Supply Regulations, P-23" (PHA P - 23) and the "Consolidation of Public Sewerage Systems Regulations" (PHA P - 22). No other sections of the Public Health Act would relate directly to the water supply and sewage collection system. With respect to the utilidor system the requirements are set out in the in Part III of the PHA-P23.

The utilidor meets the requires of Part III of PHA-P23 except for the requirements of section 20.9 which states:

> "Where water and sewer pipes are contained in a utilidor, there shall be adequate provision for drainage in order to prevent contamination of the water supply during repairs to the system."

The AV's contain both water and sewer pipes. The sewer clean out covers have been removed to allow infiltration water to drain out of the AVs. This is an annual problem, as each spring run off water enters the AV and must be removed. This occurs from about June to October (N. MacDonald) and then the remaining water is pumped out of the AVs. The clean out cover remains open year round. This creates concern that in the event of a water main break a negative pressure in the watermain can be created within an upstream AV from a syphoning effect of the down stream main. If the watermain is not completely sealed, or during the repair of the water main, there is the possibility of cross contamination from the open sewer clean out. This is greatly reduced if the AV is pumped dry, the clean out is closed and sealed and the area disinfected prior to the start of any maintenance on the water main system.

3.3.2 Occupational Health and Safety

Occupation Health and Safety Act (OH&S) regulates the entry into confined spaces. The AVS are clearly considered to be a confirmed entry location and require the appropriate safety requirements. These requirements include:

- A metre to detect and monitor gases in the AV during the entry into this space. Gases of concern are methane from the sewage, and for low oxygen levels. The maintainers are not supplied with these meters.
- Safety harness and extraction equipment. These devises are required to remove a person from the AV in the event of injury or if the person becomes unconscious. This equipment is required to be on hand and used for entry into the AVS

3.4 Summary of Assessment

The assessment of the utilidor system identified a number of areas that require upgrading for the system to meet the 20 year design life. In addition to the upgrades of the utilidor system, there are several issues outstanding from the UMA report. A summary of these is as follows:

Component	Deficiency
Access Vaults	Requires confined entry provisions. *
	Concern with open sewer clean outs needs to be addressed.
	Concern with cross over of sewer through bleeders to watermain.
Watermains	Increasing break frequency is a concern of the Hamlet.
	System needs to be assessed for circulation for future capacity. **
Sewermains	Areas of poor flow are a concern of the operators and require frequent maintenance and increased bleed water.

* IT's understood that DPW&S had addressed this issue at the time of the final report. This issue will not be carried forth.

** Volume 3 address this issue.

4.0 REMEDIAL SYSTEM NEEDS

4.1 Upgrade Requirements

The water and sewage system in Resolute Bay has previously been assessed by UMA, and the findings of that assessment are in the 1996 report. Several of the recommendations from the UMA report have been completed, while others are outstanding. For the purpose of providing an overall picture of the current upgrading requirements, the outstanding issues from the UMA report are brought forward. The following sections describe the utilidor system upgrade requirements, the alternatives to the upgrades and the recommendations for the upgrades.

Access Vaults

Confined Entry

The access vaults are considered a confined entry location and may contain hazardous gas. A safety harness and retrieval device is required, as well as a gas monitor. The operators require training in the proper use of this equipment. Safety harnesses cost approximately $200 per harness. A safety lifting device is approximately $5,000. The gas monitoring equipment is approximately $2,000. The training can be received from Workmens' Compensation Board, usually at no cost to the owner.

Open Sewer Clean Outs

The sewer clean outs are opened to allow the infiltration water to exit the AV. The use of sump pumps in the AV has been attempted, but failed due to corrosion of the electronic components.

A) One method of sealing the existing AV is through modifications to the AV structure and piping. The piping has been installed with the pipe insulation passing through the concrete wall of the AV. Developing a water tight seal between the concrete and the pipe insulation jacket is not possible at this penetration. The pipe insulation through the wall would need to be removed and a "puddle flange" fused to the pipe. The puddle flange would then be cast into the concrete wall of the AV. Additional insulation would be install on the outside of the AV at the new pipe penetration to provide freeze protection to the pipe.

B) Additional water sealing can be placed on the outer surface of the AV to prevent water penetrating the AV through cracks in the concrete and pipe penetrations. Although the AV structures inspected are all in good condition, there are always small fissures and cracks in concrete that will allow penetration of water. A water tight seal can be added to the outside of the AV using a mastic sealant. This sealant would encompass the AV and seal to the insulation jacket of the piping. Any cracks or fissures in the pipe insulation will be a point of future infiltration. The floor of the AV can not be sealed through this approach.

C) The original design used a sump pump to remove any infiltration water from the AV and pump it into a 25 mm nipple attached to the sewer pipe. The electrical supply, sump pump, AV heaters, and all controllers located in the AV corroded and became unusable. The design drawings and specifications indicate that the electrical components were to be water tight. A similar system could be reinstalled using updated equipment that may provide better long term service than the original system. The new system would require:

- Electrical service to each AV
- A panel board and metre in each AV
- A sump pump and controller in each AV

D) The installation of a new water tight AV. These are produced from either HDPE or steel and are now the more typical standard than the concrete AV for utilidors. All piping would need to be disconnected and re-instated in the new AV with water tight penetrations. Table 4.1.1 shows an assessment of the above options.

E) Adhearance to an O&M process that will minimize risk of contamination of the water supply. This would include dewatering the AV, sealing the sewers prior to repair, and disinfecting the work area with a bleach solution.

Table 4.1.1
Assessment of AV Sealing Options

Option	A - Seal Penetrations	B - Seal AV from Outside	C - Install Sump Pump	D - Install New AV	E - O&M Procedures
Long Term Reliability	Poor - there will still be some infiltration, and the operators will, likely leave the sewer clean outs open to remove the water in the AV	Poor - there will still be some infiltration, and the operators will, likely leave the sewer clean outs open to remove the water in the AV	Good - The sump pump will require replacement every 5 years. The system should operate for 20 years.	Excellent - New AV construction can provide long term water tight seals.	Good - there remains a 5 light opportunity for contamination in extreme circumstances.
Ease Of Construction	Difficult - Will require the existing AV to be excavated to the foundation. The system will need to be shut down a number of time to complete the work. Work can only be completed in the summer.	Difficult - Will require the existing AV to be excavated to the foundation. Work can only be completed in the summer.	Easy - All work can be completed within the AV. No disruption of services. Work can be completed through out the year, though would be easier in the summer months.	Difficult - Will require the existing AV to be excavated to the foundation. Work can only be completed in the summer.	No construction required. Requires supply to pump and portable generator.
Risk of Failure	High - There will still be some infiltration. The amount will be dependant on the rigour of care taken during the remedial work.	High - There will still be some infiltration. The amount will be dependant on the rigour of care taken during the remedial work.	Medium - the original system failed after ten years of operation. There is a risk that the new system could experience the same corrosion problems.	Low - There has been good success with the newer AV construction in other communities (Iqaluit, Rankin Inlet)	Low - There has been no replacement problems to date.
Estimated Construction Cost	$20,000 per AV	$12, 000 per AV	$8,000 per AV	$50,000 per AV	$5,000 Total
Life Cycle Cost	$20.000 per AV	$12,000 per AV	$20,000 per AV	50,000 per AV	

Options A and B are eliminated due to the poor long term reliability of the repairs. Option C has high O&M costs related to pump replacement every 2 years, plus power demands. Option D has high capital

cost. Option E has provided good service for 20 some years, has the lowest capital and life cycle costs, and is recommended for a continued use.

Cross over through Bleeders

There is a requirement to install check valves on all the bleeders. This is a fairly simple operation, and could be completed during routine maintenance on the system. The cost for the check valves is $200 per valve. The installation would be approximately 1 to 2 hours per AV bleeder.

Water Mains

Increase in Break Frequency

The upgrading alternatives described in this section assume that the piped system will be maintained. Other alternatives to the piped system were investigated in the 1996 UMA report and are not repeated herein. Based on the number of breaks in the system in the past five years, there is a need to complete an upgrade of the piping system. Six scenarios were reviewed for this upgrade these are shown in Table 4.1.2.

Table 4.1.2
Cost Estimates for Pipeline Replacements

Scenario		Description	Estimated Cost
1	Partial replacement of Water and Sewer Lines	Replace the water and sewer lines in the Stage 1a area in the sections that there have been previous breaks. Replacement will include the AV in these sections. Pipes replaced at same depth as current system. This includes AV 4 to AV 5, AV 5 to AV 6, Av6 to AV 7, AV7 to AV8, AV8 to AV9, AV9 to AV10, AV10 to AV11, AV21 TO AV30, AV 30 to AV29, AV29 to AV6.	$1,380,000
2	Replacement of Water mains in areas of previous breaks.	Replace the water mains only in the areas of previous breaks. The water mains will be installed in new AV and installed with a minium of cover (1.0 m). This includes AV21 to AV30, AV2 to AV3, AV4 toAV5, AV9 to AV10, AV10 to AV11, AV5 to AV6, AV30 to AV29.	$1,100,000

Scenario		Description	Estimated Cost
3	Replace the sewer mains where there is poor flow.	Replace the sewer mains in the sections of the lines where poor flow has been noted in the past. This includes, AV14 to AV13, AV25 to AV23, AV12 to AV11, AV19 to AV21.	$310,000
4	AV 20 to AV 22 Replacement.	Replace the section of the utilidor that has been abandoned. Use recirculation pump.	$275,000
5	Break Repairs.	Remove the existing repair clamps and install sections of butt fused pipes complete with insulation and heat shrink jacket.	$150,000

The cost estimates shown above include a 20% contingency and a 15% engineering factor. The detailed section by section estimate is shown in Appendix B.

Table 4.1.3 shows a summary of the possible upgrades for the system.

Table 4.1.3
Summary of Remedial Work

Component	Deficiency	Remedial Action	Estimated Costs
Access Vaults	Requires confined entry provisions.	Provide safety harness and retrieval device. Provide safety gas monitoring meter and operator training.	7,000
	Concern with open sewer clean outs needs to be addressed.	Provide pump and portable generator	5,000
	Concern with cross over of sewer through bleeders to watermain.	Install check valves.	20,000
Water Mains	Increasing break frequency is a concern of the Hamlet.	Replace mains with poor performance.	1,100,000
Sewer Mains	Areas of poor flow are a concern of the operators and require frequent maintenance and increased bleed water.	Replace existing sewers in poor flow sections.	310,000
Water & Sewer Mains	Abandoned lines in Block 1.	Replace mains.	275,000
TOTAL	**Remedial Work**		**1,717,000**

- 31 total AV in system. 14 AV's replaced as part of sewer and water line up grades, 6 AV's have only water or sewer (not both).

4.2 Prioritization

The previous section developed some $1,717,000 in upgrades that could be completed to the water and sewer system. Not all of these upgrades carry the same importance nor are all necessary in the near future unless conditions change. Some require immediate attention, others may not be completed for several years, while others can be omitted without adversely effecting the system. To prioritize the upgrading requirement, a set of criteria is required. The set has been developed for this system.

Priority	Description	Comments
1	Risk to Human Health Concerns	The maintenance for good health is a fundamental importance for the delivery of water and sewer services. These should be completed as soon as possible in the program.
2	Minimize risk of failure to the system	Work that can be under taken to reduce the potential future risk of the system is of high priority. These should be completed early in the program.
3	Reduce future emergency repair costs.	This is the basis for sound economic management of a system. A dollar spent on maintenance can save several dollars spend on emergency or more costly repairs. Should be scheduled in 1 to 5 year of program.
4	Reduce operating costs	The infusion of capital funds can make a system more efficient, and therefore reduce the future O&M costs. To be implemented at the discretion of the owner.

It is also recognized that the GNWT has a limit to the available capital to be spent on this system in any given year. For the purposes of this assessment it is assumed that budget of $1,000,000 is available. Based on the above prioritization criteria Table 4.2.1 illustrate the capital plan to upgrade the existing sewer and water system.

Table 4.2.1
Capital Plan - Year 1

	Component	Remedial Action	Priority	Estimated Cost
1	Access Vaults	Install Check Valves and Flowmeters on Bleeders	1	$20,000
2		Sewer Cross over in AV due to open Sewer clean outs	1	$5,000
3	Water mains	Replace Sections with history of increased breaks AV 21 to AV30, AV30 to AV29, AV 8 to AV9 and AV9 to AV10.	2	$700,000
4		Replace AV20 to AV22.	3	$275,000
		Total		**$1,000,000**

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APPENDIX A

Cost Estimate Data

FALL ARREST EQUIPMENT

ANCHORAGE CONNECTORS

New!

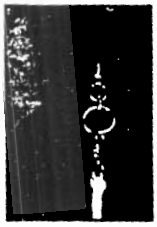
MILLER EQUIPMENT

Anchorage connectors meet the many needs and applications of fall protection users in construction, industrial and maintenance markets. These connectors must be attached to a structure that can support a 5,000 pound static pull and can only be used by one worker. All the anchorage connectors meet the requirement of OSHA 1926.502 and ANSI Z10.14

A. D-BOLT ANCHOR

Unique D-shape is designed specifically to eliminate rollout. Made of drop forged steel, cadmium/zinc plating and forged steel. Single attached fastener with nut & washer is easy to install and can be mounted in a variety of positions. Ideal with the retractable lifelines. Maximum working load of 310 lbs.

B. BEAM CLAMP



The beam clamp is a steel anchorage connector designed for use with horizontal I-beams, S-beams and W-beams. This steel rated construction also features a swivel attachment ring to prevent twisting of the worker's lanyard or connecting device. Clamps come in two sizes: Model SD006 fits beams up to 9" wide: Model SD007 can be used on beams 9 to 12 1/2" wide. Working load of 310 lbs. maximum. Colour: Red with black handle.

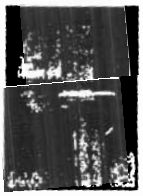
C. WEBBING/HOOK ANCHOR

Designed for versatile anchoring to scaffolding, pipe or angle iron. Features a large, 2 7/8" snap hook for easy one-hand installation and a ring to accommodate the connecting device. No tools required. Forged steel, zinc plated hardware with 1 3/4" nylon webbing.

D. HOOK ANCHOR W/SHOCK ABSORBER

This anchorage connector offers the same benefits as Model SD008, but includes a *Sofstop™* shock absorber to reduce the forces of falling.

E. CROSS-ARM STRAP

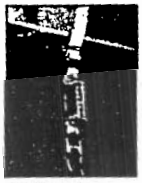


Designed to wrap around I-beams and other structures forming a secure attachment point for lanyards and other connecting devices. Manufactured from 2" nylon webbing for maximum strength, the strap features a 2" forged D-ring on one end which slips through a 3" D-ring on opposite end to form a secure anchor. Available in 6 feet length.

F. BEAM TROLLEY

Steel beam trolley creates an anchorage point that moves with the work for maximum mobility. Accommodates I-beams from 3" to 8" wide, and is ideally suited for the attachment of lanyards, carabiners and retractable lifelines. Working load 310 lbs.

G. CROSS-ARM STRAP W/SHOCK ABSORBER



Designed to form a secure, low cost anchorage point for various connecting devices. Features 2" nylon webbing, forged D-rings and an integral *Sofstop™* shock absorber which greatly reduces the force of falling. Install on beams, pipes and railings is easily accomplished. No tools required.

Key	Model No.	Description	Each
A	SD001	D-Bolt anchor	$ 61.02
B	SD006	Beam clamp, 9" wide	352.00
	SD007	Beam clamp, 12 1/2" wide	505.00
C	SD008	Webbing/hook anchor	122.00
	SD538	Hook anchor w/shock absorber	151.00
D	SD009	Cross-arm strap	34.97
E	SD010	Beam trolley	324.00
F	SD539	Cross-arm strap w/shock absorber	112.00

CONFINED SPACE RESCUE SYSTEMS

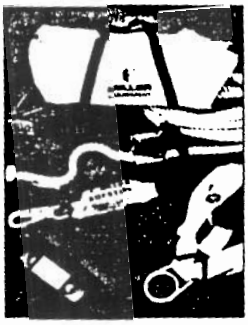
Accessing confined spaces involves a number of life threatening hazards, including the possibility of a vertical fall or being overcome by fumes or gases. Confined space access, rescue and retrieval systems are designed to provide a safe means of accessing a confined space area. In an emergency, confined space systems allow rescuers to retrieve injured or unconscious workers without exposing themselves to similar potential hazards.

Confined space systems meet all applicable OSHA, CSA and ANSI standards. A standard confined space system for fall protection and emergency retrieval. Includes a retrieval/retracting lifeline, 7 foot tripod, pulley block, winch bracket and a full body harness. Where primary access is unavailable, a drum winch can be used as primary access into the confined space. In addition to the drum winch, a retrieval lifeline is used as a secondary backup for fall protection and rescue. The drum winch can be used to lower and raise materials after the worker has accessed the confined space, while still ensuring rescue in the event of an emergency.

Model No.	Description	Each
SE139	7' Aluminum telescopic tripod 10,000 lbs. rated	$ 1003.00
SA057	Bi-directional retrieval/retracting lifeline S/S wire 60'	2468.00
SD698	Tripod mounting bracket	326.00
SD699	Pulley block	263.00
SD700	Drum winch 55' galvanized steel wire and bracket	1055.00
SA046	Full body harness, one size	89.44

ROOF ANCHOR KITS

New!

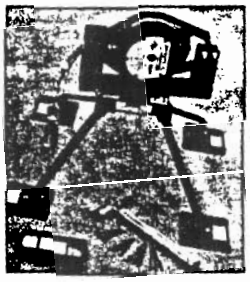


Installs on steep-pitched or flat surface roofs. When roofing is complete, it is easily removed and ready for the next job. Includes 25 foot or 50 foot 5/8" nylon rope lifeline, carabiner, rope grab with 24" *Sofstop™* shock absorbing lanyard, *DuraLite* harness (fits medium to extra large), two reusable roof anchors, 20 pan head sheet metal screws, instructions, instructional video, and carrying bag. Replacement roof anchor brackets with screws available. Meets OSHA regulations.

Model No.	Description	Each
SD011	Roofer's kit, 25'	$491.00
SD012	Roofer's kit, 50'	508.00
SD013	Roof anchor brackets	28.56

ROOFSTRIDER KIT

New!



Kit is easily installed with a hammer and features 360° rotation for great working mobility and provides workers with constant protection through long, hard hours of work. Built to perform, protect, under tough conditions and on steep roofing angles. The retractable lifeline unit easily attaches to the four-legged roof mounting assembly with two integral push pins. The foot *pad on the roof mounting assembly* are easily adjustable to fit variable roof pitches and should be attached to a roof with 16d nails. System must be installed in accordance with the manufacturer's instructions. Allowing hands free worker mobility, the locking snap hook of the retractable lifeline unit attaches to the back dee ring of the roofer's harness. If a slip or fall should occur, the inertia brakes of the retractable lifeline unit activate, keeping cable payout to two feet or less. The complete kit consists of a self-contained 25 foot or 50 foot retractable lifeline, four-legged roof mounting assembly, *DuraLite* Harness, 24 16d cement-coated nails, instructions, instructional video, and carrying bag. Complies with OSHA's Construction Fall Protection Standard 1926.500.

Model No.	Description	Each
SD541	Roof strider Kit, 25'	$2053.00
SD542	Roof strider Kit, 50'	2072.00

CSA Z94.1.92 APPROVED HARD HATS (A-SAFE)

Weighs less than 19.5 ozs. High-density polyethylene outer shell provides all-round limited impact and penetration protection. Universal slots will accept all attachments. Expanded polystyrene inner shell prevents injuries from lateral, side and back impacts. Choice of ratchet or pinlock type suspension. 6 point pinlock suspension system comes with 2 adjustment levels for headband on front and rear tab for additional stability and comfort. 4 point pinlock self-sizing suspension is also available. Sliding mechanism on rear tabs allow for centering of helmet on head. Crown pad and sweatband for user comfort. Meets CSA Z94.1.92.

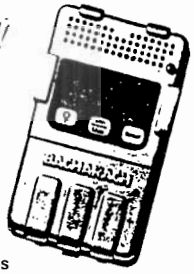
Model No.	Suspension	Colour	Each 1	Each 12
SA650	Ratchet	Sky Blue	$31.31	$28.18
SA651	Ratchet	White	31.31	28.18
SA652	Ratchet	Yellow	31.31	28.18
SC064	Pinlock	White	$23.55	$21.20
SC065	Pinlock	Yellow	23.55	21.20

Other colours available upon request.

PERSONAL GAS MONITORS & AIR MONITORS

PERSONAL GAS MONITOR

New!



Features:

- Available in one, two, or three gas models
- High visibility LCD shows continuous gas identification
- Adjustable audible and visual alarms
- Simple operation with one-step zeroing
- Automatic calibration
- Interchangeable alkaline or NiCad batteries
- Rugged and lightweight

Simple and intuitive, the *Bodyguard* monitor detects the presence of oxygen, combustibles and toxic gases. It is available as a one-gas, two-gas or three-gas monitor, and can easily be upgraded in the field for any combination of gases.

Two versions are now available. The basic unit simply displays gases and battery life. The only button is for the backlight. This unit is ideal for confined space entry and applications where user interface is minimal, such as oil, and petroleum refining, waste water treatment, coal mines and general industry.

The advanced version includes peak displays and the option of latching alarms for use in similar applications. On both versions, buttons are clearly marked for easy identification.

Rugged and water resistant, the *Bodyguard* monitor can withstand the most abusive conditions. Adjustable audible and visual alarms help to ensure user safety.

Bodyguard uses alkaline or nickel-cadmium batteries. Battery packs are interchangeable and easily replaceable. The water-resistant case is made of high-strength alloy, coated for added durability. Visual alarms on the front and bottom of the instrument ensure visibility from all angles. The audible alarm uses alternating tones to make sure it can be heard in noisy environments. Built-in diagnostics continually monitor the functionality of the unit. A confidence light on the bottom of the instrument lets the user know that it is working properly.

Each *Bodyguard* comes with a calibration cup, screwdriver and a durable leather case. The case provides added protection and allows the *Bodyguard* to be carried easily on a belt, harness or shoulder strap. A Confined Space Kit is available for mobile applications like construction, utilities and hazmat teams. It includes a hand-aspirated pump, tubing and personal alarm packaged in a durable *Pelican*-brand case for storing the instrument and accessories.

Specifications:

Gases Detected & Range:

Oxygen:	0 - 30%
Combustible Gases:	0 - 100% LEL (0 - 5% CH4)
Carbon Monoxide:	0 - 999 ppm
Hydrogen Sulfide:	0 - 500 ppm
Sampling Method:	Diffusion; pump (optional)
Power Supply:	2 "AA" alkaline or NiCad battery pack
Battery Life:	10 - 12 hours
Operating Conditions:	-4 to 122°F (-20 to 50°C); 0 to 99% RH, non-condensing
Dimensions:	2.87" x 1.62" x 4.73" (7.3 x 4.1 x 12.0 cm)
Weight:	14 oz (392 g)
Safety Rating:	Intrinsically safe for use in Class I, Division 1 & 2, Groups A, B, C and D and Class II, Divisions 1 & 2, Groups E, F and G hazardous areas. UL, MSHA, CSA and CENELEC approvals pendings.

Model No.	Description	Each
BASIC UNITS		
HM550	1 Gas Personal Monitor, O_2	$1165.00
HM551	1 Gas Personal Monitor, LEL	1195.00
HM552	1 Gas Personal Monitor, CO	1265.00
HM553	1 Gas Personal Monitor, H_2S	1265.00
HM554	2 Gas Personal Monitor, O_2, LEL	1495.00
HM555	3 Gas Personal Monitor, O_2, LEL, CO	1795.00
HM556	3 Gas Personal Monitor, O_2, LEL, H_2S	1795.00
ADVANCED UNITS		
HM557	1 Gas Personal Monitor, O_2	$1240.00
HM558	1 Gas Personal Monitor, LEL	1265.00
HM559	1 Gas Personal Monitor, CO	1340.00
HM560	1 Gas Personal Monitor, H_2S	1340.00
HM561	2 Gas Personal Monitor, O_2, LEL	1560.00
HM562	3 Gas Personal Monitor, O_2, LEL, CO	1860.00
HM563	3 Gas Personal Monitor, O_2, LEL, H_2S	1860.00
ACCESSORIES		
HM564	Confined Space Kit	$375.00
HM565	Calibration Kit	210.00

PERSONAL GAS MONITOR

New!

Features:

- Capable of monitoring 10 different gases
- High visibility LCD shows continuous gas concentrations
- Audible and visual alarms
- Easy to operate
- Water resistant
- Interchangeable alkaline or NiCad batteries
- Compact and lightweight

The *Canary* offers personal protection in a compact, reliable instrument. Portable monitoring for 10 different gases allows you the freedom to work in any environment without the worry of atmospheric hazards. A factory installed, gas specific sensor on the top of the instrument monitors the surrounding air to alert you to changes in air quality.

Ten gas versatility makes this instrument easily adaptable for monitoring in a variety of hazardous areas. The range of industry applications is vast including steel manufacturing, pulp and paper mills, oil and petrochemical refineries, water and wastewater treatment, chemical plants, offshore drilling, and more.

Weighing just 10 ounces, the *Canary* is easily carried in a shirt pocket or with its convenient belt clip. An optional carrying case with neck strap is also available.

A red flashing LED and audible alarm let the user know when a dangerous situation occurs and an LCD display gives accurate readings of the amount of gas encountered. Once the gas concentration has dropped out of alarm range, the *Canary* automatically resets. A push-button backlight and dust and water resistant case allow you to work under many conditions.

For added security, a green LED confidence light flashes every three seconds, letting you know the instrument is working properly and battery levels are adequate. The *Canary* can be powered by four "AA" size alkaline batteries or a rechargeable Nicad pack.

Maintenance on the *Canary* is fast and easy, to get you on the job quickly and allow you to make necessary changes in the field. Zeroing the *Canary* can be done in just one step. Simply open the cover below the display and adjust the preset zero until the display shows the correct reading. Sensor replacement can also be done with minimum effort. Remove the back cover and batteries, unplug the used sensor and replace it with a new sensor.

Specifications:

Gases Detected & Range:

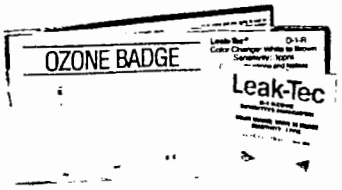
Oxygen:	0 - 25% O_2
Methane:	0 - 100% LEL CH_4
Carbon Monoxide:	0 - 500 ppm CO
Hydrogen Sulfide:	0 - 50 ppm H_2S
Sulfur Dioxide:	0 - 10 ppm SO_2
Chlorine:	0 - 5 ppm Cl_2
Nitrogen Dioxide:	0 - 10 ppm NO_2
Hydrogen Chloride:	0 - 10 ppm HCl_2
Hydrogen Cyanide:	0 - 25 ppm HCN
Ammonia:	0 - 50 ppm NH_3
Sampling Method:	Diffusion
Power Supply:	4 "AA" alkaline or NiCad battery pack
Operating Conditions:	14 to 122°F (-10 to 50°C); 0 to 90% RH, non-condensing
Dimensions:	2.5" x 1.5" x 4.5" (6.4 x 3.8 x 11.4 cm)
Weight:	Less than 10 oz (268 g)
Safety Rating:	Intrinsically safe for use in Class I, Division 1, Groups A, B, C and D. CSA certified.

Model No.	Description	Each
HM566	Personal Gas Monitor, O_2	$595.00
HM567	Personal Gas Monitor, CH_4	855.00
HM568	Personal Gas Monitor, CO	870.00
HM569	Personal Gas Monitor, H_2S	870.00
HM570	Personal Gas Monitor, SO_2	895.00
HM571	Personal Gas Monitor, Cl_2	930.00
HM572	Personal Gas Monitor, NO_2	930.00
HM573	Personal Gas Monitor, HCl_2	980.00
HM574	Personal Gas Monitor, HCN	980.00
HM575	Personal Gas Monitor, NH_3	980.00

AIR MONITORS

The monitor shows an immediate colour change in the presence of a specific gas. Compare colour on badge to chart which indicates OSHA and ACGIH time limit values, to find precise accumulation or exposure to the substance. No laboratory analysis required. Ideal for monitoring areas for accumulation and ceilings, for monitoring critical joints, and for sampling the environment to indicate the ppm present. Exposed monitors may be retained as a permanent record.
Note: Supplied in cartons of 10 badges.

Model No.	Critical Level	Toxic Substance	Colour Change	Each
HD654	25 ppm	Ammonia	Yellow - Blue	$48.00
HF169	1 ppm	Chlorine	White - Yellow	48.00
HF746	.1 ppm	Hydrazine	White - Yellow	48.00
HF902	10 ppm	Hydrogen Sulfide	White - Brown	48.00
HK247	5 ppm	Nitrogen Dioxide	White - Yellow	48.00
HF278	.1 ppm	Ozone	White - Brown	48.00
HF223	50 ppm	Carbon Monoxide	Tan - Black	48.00



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REGULATION FIRST AID KITS CONT.

NEW BRUNSWICK FIRST AID KITS

Component Product Description	Contents CSST plus 1 - 9 Emp.	10 - 100 Emp.
First aid manual	1	1
Scissors 5 1/2"	1	1
Tweezers	1	1
Assorted safety pins (12)	1	1
Plastic adhesive strips 3/4" x 3" sterile	-	25
Plastic adhesive strips 1" x 3" sterile	25	25
Gauze pad sterile 4" x 4"	5	24
Gauze bandage 3" x 10 yds.	-	4
Gauze bandage 2" x 10 yds.	1	-
Pressure bandage 4" sterile	2	4
Triangular bandage	2	6
Adhesive tape 1" x 10 yds.	1	2
Eye pad oval sterile	2	4
Peroxide 100 ml.	1	1
P.E.G. water soluble burn ointment 65 g.	1	1
Latex gloves (1 pair)	1	1
Emersafe pocket mask	1	1
Cotton tipped applicators 3" (100)	1	1
Hand cleansers	24	36
Tongue depressors	2	6

Model No.	No. of Employees	Box Dimensions W" x H" x D"	Unit/ Box	Each
PLASTIC				
SD790	1 - 9	10 x 7 x 3	16	$29.74
SD791	10 - 100	13.5 x 9.5 x 3	36	57.51
METAL				
SD792	1 - 9	7 x 10 x 3	16	$43.55
SD793	10 - 100	13.5 x 9.5 x 3	36	65.83
BULK REFILLS				
SD794	For 1 - 9 employees			$26.13
SD795	For 10-100 employees			41.82

NEWFOUNDLAND & LABRADOR FIRST AID KITS

Component Product Description	Contents 1 - 5 Emp.	6 - 14 Emp.	15 - 200 Emp.
First Aid manual	1	1	1
Accident record book	1	1	1
Instrument kit in unit box	1	1	1
		(12) pack safety pins (1) splinter tweezers (1) pair scissors	
Pressure bandage, 4" sterile	2	2	6
Plastic strips, 1" x 3" sterile	12	16	32
Gauze pad sterile, 3" x 3"	12	16	32
Triangular bandage	4	6	6
Adhesive tape 1" x 5 yds.	-	1	2
Tubular dressing w/applicator	-	-	1
Fingertips large sterile	-	-	10
Knuckle bands sterile	-	-	10
Peroxide 100 ml.	1	1	1
Adhesive tape 1/2" x 5 yds.	1	-	-
Pair latex gloves	1	1	1

Model No.	No. of Employees	Box Dimensions W" x H" x D"	Unit/ Box	Each
PLASTIC				
SD796	1 - 5	7.5 x 5 x 3.5	10	$15.61
SD797	6 - 14	10 x 7 x 3	16	20.87
SD798	15 - 200	10 x 10 x 3	24	45.27
METAL				
SD799	1 - 5	7.5 x 5 x 3	10	$27.85
SD800	6 - 14	7 x 10 x 3	16	33.11
SD801	15 - 200	10 x 10 x 3	24	50.53
BULK REFILLS				
SD802	For 1 - 5 employees			$12.16
SD803	For 6 - 14 employees			15.61
SD804	For 15 - 200 employees			29.58

NORTHWEST TERRITORIES FIRST AID KITS

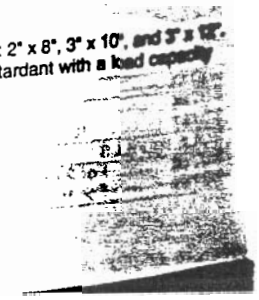
Optional items not included in kits, should be ordered separately.

Component Product Description	Contents Kit #1	Kit #2	Kit #3
First Aid manual	1	1	1
Accident record book	1	1	1
Latex gloves large (1 pair)	5	5	5
Instant cold pack	-	-	3
Emersafe pocket mask / one way valve	2	2	1
Fabric adhesive strips 3/4" x 3" sterile	50	100	100
Fabric adhesive strips 1" x 3" sterile	50	100	100
Gauze pad 2" x 2" sterile	-	12	12
Gauze pad 3" x 3" sterile	6	6	54
Pressure bandage 2" sterile	-	-	6
Pressure bandage 3" sterile	-	-	6
Pressure bandage 4" sterile	1	1	6
Field dressing 6" sterile	-	4	-
Pressure bandage 6" sterile	-	5	-
Combine pad 7 1/2" x 8" sterile	-	-	6
Combine pad 8" x 10" sterile	1	5	5
Eye pad oval sterile	2	6	6
Double adhesive strips for eye pads	2	3	6
Elastic bandage 3" x 5 yds.	1	3	6
Elastic pressure bandage 6" sterile	1	1	1
Gauze bandage 2" x 5 yds.	6	10	10
Gauze bandage 1" x 10 yds.	-	1	1
Adhesive tape 1" x 5 yds.	1	1	2
Esmarch bandage 1 box	-	-	2
Safety pins assorted	12	12	12
Antiseptic sachet *Benzalkonium*	6	12	12
Antiseptic green soap 50 ml.	-	-	1
Eye wash 8 oz. sterile	-	-	1
Eye dropper	-	-	1
Eye bath	-	-	1
Eye shield	-	-	2
Tongue depressor I.W.	-	-	12
Tweezers 3 1/2"	1	1	1
X-fine splinter tweezers 4.5"	-	-	1
Scissor angled lister	1	1	1
Wire splint 3 5/8" x 24"	-	1	2
Scrub (nail) brush	-	1	1
Kidney basin stainless steel	-	-	1
Steri strip skin closure 1/4" x 3"	-	-	5
Triangular bandage	2	3	12
Ammonia inhalants	-	-	20
Burn Free dressing	-	12	-
OPTIONAL ITEMS			
*Blanket, 100% wool	-	-	3
*Wood splints (set of 6)	-	-	1
**Burn Free* emergency burn trauma kit	-	-	1
*Collapsible stretcher	-	-	1

Model No.	No. of Kit	Box Dimensions L" x W" x D"	Unit/ Box	Each
PLASTIC				
SD805	#1	10 x 10 x 3	24	$47.00
METAL				
SD806	#1	10 x 10 x 3	24	$ 52.26
SD807	#2	15.5 x 12 x 4.5	-	124.00
SD808	#3	14.5 x 16.5 x 6.5	-	196.00
BULK REFILLS				
SD809	For kit #1			$ 31.31
SD810	For kit #2			96.86
SD811	For kit #3			148.00

OPTIONAL ITEMS Model No.	Description	Each
SE082	Blanket, 100% wool, 54" x 90"	$ 58.01
SE077	Wood splints (set of 6 assorted)	3.68
SD857	*Burn Free* burn trauma kit	197.00
SC408	Collapsible stretcher	213.00

Blanket: 100% red wool. 54" x 90".
Wooden splints: Sets of six assorted sizes; 2 of each: 2" x 8", 3" x 10", and 3" x 12".
Collapsible stretcher: Fibre reinforced vinyl, fire retardant with a load capacity of 400 lbs. In carrying case.



Cost Estimates

					Scenario 1 Total Replacement					Scenario 2 Water & Sewer for Various Lines				
Start AV	End AV	W/M Length (m) 200 mm	150 mm	S/M Length 150 mm (m)	W & S (m)	W Only (m)	S Only (m)	Unit Cost ($/m)	Extension ($)	W & S (m)	W Only (m)	S Only (m)	Unit Cost ($/m)	Extension ($)
WTP	2	205.1	205.1	205.1	205.1			$1,927	$395,228					$0
2	3	118.3	118.3	118.3	118.3			$1,927	$227,964					$0
3	4	93.3				93.3		$1,717	$160,196					$0
4	5	86.6		86.6	86.6			$1,927	$166,878	86.6			$1,927	$166,878
5	6	41.5		41.5	41.5			$1,927	$79,971	41.5			$1,927	$79,971
6	7	41.5		41.5	41.5			$1,927	$79,971	41.5			$1,927	$79,971
7	8	22.9		22.9	22.9			$1,927	$44,128	22.9			$1,927	$44,128
8	9	29.6		29.6	29.6			$1,927	$57,039	29.6			$1,927	$57,039
9	10	46		46	46			$1,927	$88,642	46			$1,927	$88,642
10	11	83.8		83.8	83.8			$1,927	$161,483	83.8			$1,927	$161,483
11	12	78.6		78.6	78.6			$1,927	$151,462					$0
12	27	86		86	86			$1,927	$165,722					$0
27	28	69.2				69.2		$1,717	$118,816					$0
28	8	91.1		91.1	91.1			$1,927	$175,550					$0
3	21	70.7		70.7	70.7			$1,927	$136,239					$0
21	30	41.8		41.8	41.8			$1,927	$80,549	41.8			$1,927	$80,549
30	29	60.7		60.7	60.7			$1,927	$116,969	60.7			$1,927	$116,969
29	6	66.8		66.8	66.8			$1,927	$128,724	66.8			$1,927	$128,724
11	32			91.1	91.1		91.1	$1,542	$140,476					$0
32	33			91.3	91.3		91.3	$1,542	$140,785					$0
33	34			88.1	88.1		88.1	$1,542	$135,850					$0
34	35			39.8	39.8		39.8	$1,542	$61,372					$0
35	STP			60	60		60	$1,542	$92,520					$0
Stage 1a Total		1333.5	323.4	1541.3	1541.3	162.5	370.3		$3,106,532	521.2	0	0		$1,004,352
Stage 1b														
22	20		105.2	105.2	105.2			$1,927	$202,720					$0
25	23		98.3	98.3	98.3			$1,927	$189,424					$0
21	20	48.2		48.2	48.2			$1,927	$92,881					$0
20	19	76.45		76.45	76.45			$1,927	$147,319					$0
19	18	24.2				24.2		$1,717	$41,551					$0
18	17	50.9				50.9		$1,717	$87,395					$0
17	16	80.4		80.4			80.4	$1,542	$123,977					$0
16	14	83.2		83.2			83.2	$1,542	$128,294					$0
14	13	78.2		78.2			78.2	$1,542	$120,584					$0
13	12	23.3		23.3			23.3	$1,542	$35,929					$0
13	23	98.2		98.2			98.2	$1,542	$151,424					$0
23	21	70.3		70.3			70.3	$1,542	$108,403					$0
Stage 1b Total		633.35	203.5	761.75	328.15	75.1	433.6		$1,429,903					$0
Totals		1966.85	526.9	2303.05	1869.45	237.6	803.9		$4,536,435	521.2	0	0		$1,004,352

	Unit Costs ($/m)
W&S Replacement	$1,927
Water Only	$1,717
Sewer Only	$1,542

	Unit Costs ($/m)
W&S Replacement	$1,927
Water Only	na
Sewer Only	na

Cost Estimates

					Scenario 3 Water Only with Min. Cover Various Pipes					Scenario 4 Replace Sewer Main where Poor Flow				
		W/M Length (m)		S/M Length	W & S	W Only	S Only	Unit Cost	Extension	W & S	W Only	S Only	Unit Cost	Extension
Start AV	End AV	200 mm	150 mm	150 mm (m)	(m)	(m)	(m)	($/m)	($)	(m)	(m)	(m)	($/m)	($)
WTP	2	205.1	205.1	205.1					$0					$0
2	3	118.3	118.3	118.3					$0					$0
3	4	93.3							$0					$0
4	5	86.6		86.6		86.6		$1,550	$134,230					$0
5	6	41.5		41.5		41.5		$1,550	$64,325					$0
6	7	41.5		41.5		41.5		$1,550	$64,325					$0
7	8	22.9		22.9		22.9		$1,550	$35,495					$0
8	9	29.6		29.6		29.6		$1,550	$45,880					$0
9	10	46		46		46		$1,550	$71,300					$0
10	11	83.8		83.8		83.8		$1,550	$129,890					$0
11	12	78.6		78.6					$0			78.6	$771	$60,601
12	27	86		86					$0					$0
27	28	69.2							$0					$0
28	8	91.1		91.1					$0					$0
3	21	70.7		70.7					$0					$0
21	30	41.8		41.8		41.8		$1,550	$64,790					$0
30	29	60.7		60.7		60.7		$1,550	$94,085					$0
29	6	66.8		66.8		66.8		$1,550	$103,540					$0
11	32			91.1					$0					$0
32	33			91.3					$0					$0
33	34			88.1					$0					$0
34	35			39.8					$0					$0
35	STP			60					$0					$0
Stage 1a Total		1333.5	323.4	1541.3	0	521.2	0		$807,860	0	0	78.6		$60,601
Stage 1b														
22	20		105.2	105.2					$0					$0
25	23		98.3	98.3					$0			50	$771	$38,550
21	20	48.2		48.2					$0			48.2	$771	$37,162
20	19	76.45		76.45					$0			76.45	$771	$58,943
19	18	24.2							$0					$0
18	17	50.9							$0					$0
17	16	80.4		80.4					$0					$0
16	14	83.2		83.2					$0					$0
14	13	78.2		78.2					$0			40	$771	$30,840
13	12	23.3		23.3					$0					$0
13	23	98.2		98.2					$0					$0
23	21	70.3		70.3					$0					$0
Stage 1b Total		633.35	203.5	761.75					$0					$165,495
Totals		1966.85	526.9	2303.05	0	521.2	0		$807,860	0	0	78.6		$226,096

Unit Costs ($/m)	
W&S Replacement	na
Water Only	$1,550
Sewer Only	na

Unit Costs ($/m)	
W&S Replacement	na
Water Only	na
Sewer Only	$771

Cost Estimates

					Scenario 5 Replace W & S Mains from AV20 to AV22				
Start AV	End AV	W/M Length (m) 200 mm	150 mm	S/M Length 150 mm (m)	W & S (m)	W Only (m)	S Only (m)	Unit Cost ($/m)	Extension ($)
WTP	2	205.1	205.1	205.1					$0
2	3	118.3	118.3	118.3					$0
3	4	93.3							$0
4	5	86.6		86.6					$0
5	6	41.5		41.5					$0
6	7	41.5		41.5					$0
7	8	22.9		22.9					$0
8	9	29.6		29.6					$0
9	10	46		46					$0
10	11	83.8		83.8					$0
11	12	78.6		78.6					$0
12	27	86		86					$0
27	28	69.2							$0
28	8	91.1		91.1					$0
3	21	70.7		70.7					$0
21	30	41.8		41.8					$0
30	29	60.7		60.7					$0
29	6	66.8		66.8					$0
11	32			91.1					$0
32	33			91.3					$0
33	34			88.1					$0
34	35			39.8					$0
35	STP			60					$0
Stage 1a Total		1333.5	323.4	1541.3	0	0	0		$0
Stage 1b									
22	20		105.2	105.2	105.2			$1,927	$202,720
25	23		98.3	98.3					$0
21	20	48.2		48.2					$0
20	19	76.45		76.45					$0
19	18	24.2							$0
18	17	50.9							$0
17	16	80.4		80.4					$0
16	14	83.2		83.2					$0
14	13	78.2		78.2					$0
13	12	23.3		23.3					$0
13	23	98.2		98.2					$0
23	21	70.3		70.3					$0
Stage 1b Total		633.35	203.5	761.75					$202,720
Totals		1966.85	526.9	2303.05	0	0	0		$202,720

	Unit Costs ($/m)
W&S Replacement	$1,927
Water Only	na
Sewer Only	na

Northwest Territories Keewatin Region

From: Joe Hidalgo, P. Eng.
Project Management
Department of Public works and Services
Fax Number: (~~819~~) 645-2116
Phone Number: (~~819~~) 645-5013

867

Date: Oct. 23, 1998

TO: KIRK GUENTHER, P. ENG.
Company: DILLON CONSULTING LTD. YELLOWKNIFE, NT
Fax Number: (867) 873-3328

Total Number of Pages Including Cover: 7

Your Reference: Unit Prices for Nuuk Subdivision.

Message:

Here are the prices that you were requesting. Our plane was delayed, we almost flew over Rankin Inlet because of bad weather here as always.

Joe

NUVUK SUBDIVISION
RANKIN INLET
Phase 3, 1998

LIST OF UNIT PRICES
UNIT PRICE CONTRACT
SCHEDULE OF QUANTITIES AND
UNIT PRICE TABLE

CONSULTANT

APPENDIX D
Page 1 of 6

ITEM NO	DESCRIPTION	PAYMENT CLAUSE	EST QUANTITY	UNIT	UNIT PRICE	EXTENSION	RTL Tender UNIT PRICE	RTL Tender EXTENSION	Sanajiit Tender UNIT PRICE	Sanajiit Tender EXTENSION	Kudlik Tender UNIT PRICE	Kudlik Tender EXTENSION
	Part A - Mains & Services (Sts. 7 & 8)											
A1	Rock Excavation, If Req'd	02211 16.1	100	cu m	$60	$6,000	$140.00	$14,000.00			$70.00	$7,000.00
A2	Pre-test Inspection, If Req'd	02211 16.2	1	L.S.	$1,000	$1,000	$8,500.00	$8,500.00			$3,000.00	$3,000.00
A3	Mob / Demob for Rock Excavation If Req'd	02211 16.3	1	L.S.	$ 4,000	$4,000	$4,800.00	$4,800.00	$5,000.00	$5,000.00	$25,000.00	$25,000.00
A4	Rock Locating/Verification	02211 16.4	640	m	$ 5	$3,200	$15.00	$9,600.00			$5.50	$3,520.00
A5	Install 200mm dia Watermain Common Trench	02666 13.1	660	m	165	$108,900	$450.00	$297,000.00	$204.00	$134,640.00	$165.00	$108,900.00
A6	Install 200mm dia Watermain Single Main	02666 13.2	35	m	165	$5,775	$450.00	$15,750.00	$247.00	$8,645.00	$330.00	$11,550.00
A7	Install 200mm dia Sanitary Sewer Common Trench	02667 13.1	351	m	165	$57,915	$450.00	$157,950.00	$204.00	$71,604.00	$165.00	$57,915.00
A8	Install 150mm dia Sanitary Sewer Common Trench	02667 13.1	273	m	165	$45,045	$450.00	$122,850.00	$204.00	$55,692.00	$165.00	$45,045.00
A9	Install 150mm dia Sanitary Sewer Single Main	02667 13.2	5	m	165	$825	$450.00	$2,250.00	$408.00	$2,040.00	$330.00	$1,650.00
A10	Supply 200mm HDPE Sewer/Water	02666/02667 13.3	1,046	m	210	$219,660	$128.00	$133,888.00	$375.15	$183,205.90	$127.60	$133,469.60
A11	Supply 150mm HDPE Sewer	02667 13.3	278	m	135	$37,530	$99.00	$27,522.00	$121.70	$33,832.60	$96.80	$26,910.40
A12	Supply Access Vaults	02725										
	- AV 98-18	14.1	1	L.S.	40000	$40,000	$37,000.00	$37,000.00	$39,447.45	$39,447.45	$34,771.00	$34,771.00
	- AV 98-19		1	L.S.	40000	$40,000	$33,000.00	$33,000.00	$35,203.38	$35,203.38	$35,252.80	$35,252.80
	- AV 98-20		1	L.S.	40000	$40,000	$46,000.00	$46,000.00	$49,063.29	$49,063.29	$50,479.00	$50,479.00
	- AV 98-21		1	L.S.	40000	$40,000	$46,000.00	$46,000.00	$49,532.65	$49,532.65	$50,259.00	$50,259.00
	- AV 98-22		1	L.S.	40000	$40,000	$37,000.00	$37,000.00	$38,606.69	$38,606.69	$38,278.90	$38,278.90
	- AV 98-23		1	L.S.	40000	$40,000	$44,000.00	$44,000.00	$46,824.79	$46,824.79	$41,882.50	$41,882.50
	- AV 98-WLP		1	L.S.	33000	$33,000	$39,000.00	$39,000.00	$41,212.59	$41,212.59	$36,333.00	$36,333.00
A13	Supply & Install Ladders on Avs 94-1 to 94-3 and 95-1 to 95-17	07725 14.2	20	Each	400	$8,000	$860.00	$17,200.00	$277.20	$5,544.00	$308.00	$6,160.00
A14	Install Access Vaults	02725 14.3	7	Each	9000	$63,000	$10,000.00	$70,000.00	$7,142.86	$50,000.02	$6,600.00	$46,200.00
A15	Over-excavation (if requ'd).	02221 14.2	100	cu m	10	$1,000	$16.50	$1,650.00	$10.00	$1,000.00	$11.00	$1,100.00
A16	Granular Backfill (Load Haul and Place) (If required)	02221 14.5	400	cu m	15	$6,000	$58.00	$23,200.00	$16.00	$6,400.00	$22.00	$8,800.00
A17	Crushed Road Gravel (Supply and Install) (If required)	02221 14.6	200	cu m	50	$10,000	$70.00	$14,000.00	$66.00	$13,200.00	$22.00	$4,400.00
A18	Mobilization/Demobilization	01500 2.4	1	L.S.	250000	$250,000	$300,000.00	$300,000.00	$208,850.00	$208,850.00	$484,362.13	$484,362.13
Subtotal Part A - Page 1						"A" $1,102,650		$1,702,160.00		$1,079,945.16		$1,262,239.33

NUVUK SUBDIVISION
RANKIN INLET
Phase 3, 1998

LIST OF UNIT PRICES
UNIT PRICE CONTRACT
SCHEDULE OF QUANTITIES AND
UNIT PRICE TABLE

APPENDIX D
Page 2 of 6

ITEM NO	DESCRIPTION	PAYMENT CLAUSE	EST. QUANTITY	UNIT	UNIT PRICE	EXTENSION						
	Part A - Mains & Services (Sts. 7 & 8)											
A19	Install 100mm dia Water Service Carrier Pipe c/w 2-25mm dia water service pipes	02565 13.1	690	m	200	$138,000	$315.00	$217,350.00	$219.04	$151,137.60	$143.00	$98,670.00
A20	Install 150mm dia Water Service Carrier Pipe c/w 1-25mm dia and 1-50mm dia water service pipes	02665 13.1	40	m	250	$10,000	$315.00	$12,600.00	$219.04	$8,761.60	$143.00	$5,720.00
A21	Install 100mm dia Sewer Service	02665	690	m	200	$138,000	$315.00	$217,350.00	$219.04	$151,137.60	$143.00	$98,670.00

CONSULTANT RTL SAN. KUDLIK

A27	Install 150mm dia Sewer Service	1.3.1 02565	40	m	200	$8,000	$315.00	$12,600.00	$219.04	$8,761.60	$143.00	$5,720.00
A23	Supply 25mm Water Service Pipe	1.3.1 02565	2,074	m	2	$4,148	$1.00	$2,074.00	$1.21	$2,509.54	$1.87	$3,878.38
A24	Supply 50mm Water Service Pipe	1.3.2 02665	40	m	10	$400	$4.00	$160.00	$5.97	$238.80	$2.90	$116.00
A25	Supply 100mm Water Service carrier pipe	1.3.2 02665	690	m	80	$55,200	$51.00	$35,190.00	$353.55	$243,949.50	$52.80	$36,432.00
A26	Supply 150mm Water Service carrier pipe	1.3.2 02665	40	m	100	$4,000	$71.00	$2,840.00	$104.00	$4,160.00	$71.50	$2,860.00
A27	Supply 100mm HDPE Sewer Service	1.3.2 02665	690	m	80	$55,200	$51.00	$35,190.00	$301.45	$208,000.50	$52.80	$36,432.00
A28	Supply 150mm HDPE Sewer Service	1.3.2 02665	40	m	100	$4,000	$71.00	$2,840.00	$104.00	$4,160.00	$71.50	$2,860.00
A29	Supply and Install Connection To services in existing houses	1.3.2 02665	22	ea	5000	$110,000	$3,990.00	$87,780.00	$2,701.60	$59,435.20	$11,000.00	$242,000.00
Subtotal Part A - Page 2					"B"	$516,948		$825,974.00		$842,751.94		$930,358.38
Total Part A					"A"+"B"="C"	$1,629,798		$2,328,134.00		$1,922,197.10		$1,795,599.71
	Part B - Services for Sts 4 & 5 (Provisional)											
B30	Install 100mm. dia. Water Service Carrier Pipe c/w 2-25mm dia. water service pipes	02665 1.3.1	885	m	200	$177,000	$190.00	$169,150.00	$373.00	$153,105.00	$143.00	$126,555.00
B31	Install 100mm dia Sewer Service	02665 1.3.1	885	m	200	$177,000	$190.00	$168,150.00	$173.00	$153,105.00	$143.00	$126,555.00
B32	Supply 25mm Water Service Pipe	02665 1.3.2	2,034	m	2	$4,068	$1.00	$2,034.00	$1.26	$2,562.84	$1.87	$3,803.58
B33	Supply 100mm Water Service carrier pipe	02665 1.3.2	885	m	80	$70,800	$51.00	$45,135.00	$222.31	$196,744.35	$52.80	$46,728.00
B34	Supply 100mm HDPE Sewer Service	02665 1.3.2	885	m	80	$70,800	$51.00	$45,135.00	$60.78	$53,790.30	$52.80	$46,728.00
B35	Supply and Install Connection To services in existing houses	02665 1.3.2	33	ea	5000	$165,000	$11,000.00	$363,000.00	$3,801.60	$125,452.80	$8,937.50	$294,937.50
Total Part B - Services (Provisional)					"D"	$664,668.00		$791,604.00		$684,760.29		$645,307.08
Tender Summary												
Total Part A - Mains & Services (Streets 7 & 8)					"C"	$1,629,798.00		$2,328,134.00		$1,922,197.10		$1,795,599.71
Total Part B - Services Streets 4 & 5 (Provisional)					"D"	$664,668.00		$791,604.00		$684,760.29		$645,307.08
Total Tender					"C"+"D"="E"	$2,294,466.00		$3,119,738.00		$2,606,957.39		$2,440,906.79
GST					7% X "E"="F"	$160,612.62		$218,381.66		$182,487.02		$170,863.27
Total Tender (including GST)					"E"+"F"	$2,455,078.62		$3,338,119.66		$2,789,444.41		$2,611,767.06

PH III

PH 3

177,477.22

TO 250 BONKIN INLET P.03/07

CONSULTANT RTL SAN. KOLLEK

A20	Install 150mm dia Water Service Carrier Pipe c/w 125mm dia and 150mm dia water servic	02665 1.3.1	140	m	250	$35,000	$315.00	$44,100.00	$219.04	$30,665.60	$143.00	$20,020.00
A21	Install 100mm dia Sewer Service	02665 1.3.1	610	m	200	$122,000	$315.00	$192,150.00	$219.04	$133,614.40	$143.00	$87,230.00
A22	Install 150mm dia Sewer Service	02665 1.3.1	140	m	200	$28,000	$315.00	$64,100.00	$219.04	$30,665.60	$143.00	$20,020.00
A23	Supply 25mm Water Service Pipe	02665 1.3.1	1,533	m	2	$3,066	$1.00	$1,533.00	$1.23	$1,885.59	$1.87	$2,865.71
A24	Supply 50mm Water Service Pipe	02665 1.3.2	140	m	10	$1,400	$4.00	$560.00	$4.58	$641.20	$2.90	$406.00
A25	Supply 100mm Water Service carrier pipe	02665 1.3.2	610	m	80	$48,800	$51.00	$31,110.00	$255.88	$156,086.80	$52.00	$32,208.00
A26	Supply 150mm Water Service carrier pipe	02665 1.3.2	140	m	100	$14,000	$71.00	$9,940.00	$89.93	$12,590.20	$71.50	$10,010.00
A27	Supply 100mm HDPE Sewer Service	02665 1.3.2	610	m	80	$48,800	$51.00	$31,110.00	$266.47	$162,546.70	$52.00	$32,208.00
A28	Supply 150mm HDPE Sewer Service	02665 1.3.2	140	m	100	$14,000	$71.00	$9,940.00	$89.93	$12,590.20	$71.50	$10,010.00
A29	Supply and Install Connection to services in existing houses	02665 1.3.2	28	ea	5000	$140,000	$3,990.00	$111,720.00	$3,251.60	$91,044.80	$8,937.50	$250,250.00
Subtotal Part A - Page 2					"H"	$577,066.00		$668,413.00		$785,945.49		$552,456.71
Total Tender					"G"+"H"="I"	$1,831,441.00		$2,460,025.00		$2,163,441.83		$1,932,473.77
GST					7% X "I"="J"	$128,200.87		$173,601.75		$151,440.93		$135,273.16
Total Tender (including GST)					"I"+"J"	$1,959,641.87		$2,653,626.75		$2,314,882.76		$2,067,746.93

PA. 4 Difference

NUVUK SUBDIVISION
RANKIN INLET
Phase 5, 2000

LIST OF UNIT PRICES
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UNIT PRICE TABLE

CONSULTANT RTL SAN KUDLIK

APPENDIX D

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ITEM NO	DESCRIPTION	PAYMENT CLAUSE	EST QUANTITY	UNIT	UNIT PRICE	EXTENSION	RTL Tender UNIT PRICE	RTL Tender Ext. EXTENSION	Sanajut Tender UNIT PRICE	Sanajut Tender Ext. EXTENSION	Kudlik Tender UNIT PRICE	Kudlik Tender Ext. EXTENSION
	Part A - Mains & Services (Sts. 1 & 6)											
A1	Rock Excavation, If Req'd	02211 16.1	100	cu m	$80	$8,000	140 00	14000 00			22 00	2200 00
A2	Predrain Inspection, If Req'd	02211 16.2	1	L.S	$1,000	$1,000	8500 00	8500 00			550 00	550 00
A3	Mob / Demob for Rock Excavation, If Req'd	02211 16.3	1	L.S.	$ 4,000	$4,000	4800.00	4800 00	5000 00	5000 00	5500 00	5500 00
A4	Rock Locating/Verification	02211 16.4	600	m	$ 5	$3,200	15 00	9000 00			5 50	3520 00
A5	Install 200mm dia Watermain Common Trench	02668 13.1	750	m	165	$123,750	450 00	337500 00	204 00	153000 00	165 00	123750 00
A7	Install 200mm dia Sanitary Sewer Common Trench	02667 13.1	225	m	165	$37,125	450 00	101250 00	204 00	45900 00	165 00	37125 00
A8	Install 150mm dia Sanitary Sewer Common Trench	02667 13.1	438	m	165	$72,270	450 00	197100.00	204 00	89352.00	165 00	72270 00
A9	Install 150mm dia. Sanitary Sewer Single Main	02667 13.2	52	m	165	$8,580	450 00	23400 00	408 00	21216 00	330 00	17160 00
A10	Supply 200mm HDPE Sewer/Water	02666,02667 13.3	972	m	210	$204,120	132.00	128304 00	175.30	170391 60	127 60	124027 20
A11	Supply 150mm HDPE Sewer	02667 13.3	490	m	135	$66,150	102.00	49980.00	130.95	64165.50	96 80	47432 00
A12	Supply Access Vaults	02725										
	- AV 00-35	14.1	1	L.S.	40000	$40,000	39000.00	39000.00	40810 65	40810.65	37739.90	37739 90
	- AV 00-36		1	L.S.	40000	$40,000	41000.00	41000 00	42698.91	42698 91	40540.50	40540 50
	- AV 00-37		1	L.S.	40000	$40,000	46000 00	46000 00	48288.89	48288.89	52707 60	52707 60
	- AV 00-38		1	L.S	40000	$40,000	35000.00	35000 00	36721.29	36721 29	39552 70	39552 70
	- AV 00-39		1	L.S.	40000	$40,000	36000.00	36000 00	37495 69	37495 69	35491 50	35491 50
	- AV 00-40		1	L.S.	40000	$40,000	46000 00	46000 00	48748 69	48748 69	49868 50	49868 50
	- AV 00-41		1	L.S.	40000	$40,000	39000 00	39000 00	41035.05	41035.05	42484 10	42484 10
A14	Install Access Vaults	07725 14.3	7	Each	9000	$63,000	10000 00	70000 00	7000.00	49000 00	6600.00	46200 00
A15	Over excavation (If req'd).	02221 14.2	100	cu.m.	10	$1,000	16.50	1650 00	10 00	1000 00	11 00	1100 00
A16	Granular Backfill (Load Haul and Place) (If required)	02221 14.5	240	cu m	15	$3,600	58 00	13920 00	16 00	3840 00	16 50	3960 00
A17	Crushed Road Gravel (Supply and Install) (If required)	02221 14.6	240	cu.m.	50	$12,000	70 00	16800 00	16 00	3840 00	22 00	5280 00
A18	Mobilization/Demobilization	01500 2.4	1	L.S.	$250,000	$250,000	124300.00	124300.00	32000.00	32000 00	199637 52	199637 52
Subtotal Part A - Page 1						"K" $1,137,795		$ 1,383,104 00		$ 934,534 27		894506 90

NUVUK SUBDIVISION
RANKIN INLET
Phase 5, 2000

LIST OF UNIT PRICES
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APPENDIX D

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ITEM NO	DESCRIPTION	PAYMENT CLAUSE	EST. QUANTITY	UNIT	UNIT PRICE	EXTENSION						
	Part A - Mains & Services (Sts. 1 & 6)											
A19	Install 100mm dia. Water Service Carrier Pipe c/w 2-25mm dia. water service pipes	02668 13.1	420	m	200	$84,000	315.00	132300.00	219 00	91980.00	143 00	60060 00
A20	Install 150mm dia. Water Service Carrier Pipe c/w 1-25mm dia. and 1-50mm dia. water service pip	02668 13.1	250	m	250	162,500	315 00	78750 00	219.00	54750.00	143 00	35750 00

CONSULTANT RTL SANAJIIT KUDLIK

A21	Instal 100mm dia Sewer Service	02665 1.3.1	420	m	200	$84,000	315.00	132300 00	219 00	91980 00	143.00	60060 0
A22	Instal 150mm dia Sewer Service	02665 1.3.1	250	m	200	$50,000	315.00	78750.00	219.00	54750 00	143 00	35750 0
A23	Supply 25mm Water Service Pipe	02665 1.3.2	1,325	m	2	$2,650	1 00	1325 00	1.32	1749.00	1.87	2477 5
A24	Supply 50mm Water Service Pipe	02665 1.3.2	250	m	10	$2,500	4.00	1000 00	5 26	1315 00	2 90	725 0
A25	Supply 100mm Water Service carrier pipe	02665 1.3.2	420	m	80	$33,600	51 00	21420 00	213.43	89640 60	52 80	22176 0
A26	Supply 150mm Water Service carrier pipe	02665 1.3.2	250	m	100	$25,000	71 00	17750.00	91.89	22972 50	71 50	17875 0
A27	Supply 100mm HDPE Sewer Service	02665 1.3.2	420	m	80	$33,600	51.00	21420.00	216.78	91047 60	52 80	22176 0
A70	Supply 150mm HDPE Sewer Service	02665 1.3.2	250	m	100	$25,000	71.00	17750 00	222 19	55547 50	71.50	17875 0
A29	Supply and Install Connection To services in existing houses	02665 1.3.2	24	ea	5000	$120,000	3990 00	95760 00	3251 60	78038 40	8937 50	214500 0
Subtotal Part A - Page 2					"L"	$522,850		$ 558,525 00		$ 633,770.60		$ 489,424 7
Total Tender					"K"+"L"="M"	$1,660,645		$ 1,981,629.00		$ 1,568,274 07		$ 1,404,021 2
GST					7% X "M"="N"	$116,245		$ 138,714.03		$ 109,779.24		$ 103,691.4
Total Tender (including GST)					"M"+"N"	$1,776,890		$ 2,120,343.03		$ 1,678,054 11		$ 1,507,902 7

Pg. 5

TENDER SUMMARY

Total Tender (including GST) Phase 3 (from Page 2 of 6)		"E"+"F"	$2,455,078 62	$ 3,338,119.66	$ 2,789,414.41	$ 2,611,767 0
Total Tender (including GST) Phase 4 (from Page 4 of 6)		"I"+"J"	$1,959,641.87	$ 2,653,626.75	$ 2,314,882 76	$ 2,067,746 9
Total Tender (including GST) Phase 5 (from above)		"M"+"N"	$1,776,890 15	$ 2,120,343 03	$ 1,678,054.11	$ 1,587,902 7
TOTAL TENDER ALL PHASES (including GST)			$6,191,610.64	$ 8,112,089 44	$ 6,782,381.28	$ 6,267,416 7
TOTAL TENDER ALL PHASES (Excluding GST)			$ 5,786,552.00	$ 7,581,392 00	$ 6,338,674 09	$ 5,857,398 8
	BIP LOCAL			$ 1,132,500 00	$ 6,034,804 60	$ 5,068,828 9
	NORTHERN			$ 3,770,742.47	$ 60,000 00	$ 112,149 5
	OTHER			$ 2,678,149.53	$ 186,500 00	$ 654,205 6
	TOTAL			$ 7,581,392 00	$ 6,281,304 60	$ 5,835,184 1
	BIP Local			$ (226,500 00)	$ (1,206,960 92)	$ (1,013,765 7
	BIP Northern			$ (565,611.37)	$ (9,000 00)	$ (16,822 4
Adjusted Tender (Excluding GST)				$ 6,789,280.63	$ 5,122,713.17	$ 4,826,810.6
Adjusted Tender (including GST)				$ 7,264,530.27	$ 5,481,303 09	$ 5,164,687 3
	Vaults			$ 987,000.00	#REF!	$ 758,340 0
	Mains			$ 675,366 00	#REF!	$ 562,505 4
	Services			$ 243,152 00	#REF!	$ 171,013 4
				$ 1,905,518 00	#REF!	$ 1,491,858 8

Pg. 3
Pg 4
Pg 5

COST ESTIMATES FOR RESOLUTE WATER AND SEWER CONSTRUCTION AND RETROFITTING.

ASSUMPTIONS:

1. NO ROCK EXCAVATION WILL BE REQUIRED. THE BACKFILLED EXISTING TRENCH CAN BE EXCAVATED AND REUSED.
2. WHERE APPLICABLE REMOVAL OF EXISTING WATER/SEWER LINES WILL COST EXTRA.
3. LOCAL CONTRACTOR WILL BID ON THE JOB, THEREFORE MOB/DEMOB COST WILL BE LOCAL

NOTE: ANY OTHER ASSUMPTIONS THAT ARE USED WILL BE NOTED IN ESTIMATE.

4. SERVICE LINES WILL BE REUSED, BUT SERVICE SADDLES WILL BE NEW

SCENARIO 1 - TOTAL WATER/SEWER REPLACEMENT

(1) WATER MAIN SUPPLY AND RETURN LINES

i. SUPPLY

2 LINES x $175/m/LINE
= $350/m

ii. INSTALLATION

$450/TRENCH/m x 1 TRENCH
= $450/m

NOTE: THIS IS A TRENCH FOR SEWER ALSO (COMMON)

ASSUME: COST FOR 150 IS SIMILAR TO 200 PIPE AS THERE IS ONLY A SMALL PORTION OF 150 PIPE REQUIRED.

iii. SEWER MAIN

1 LINE X $ 175 /m /LINE
= $175 /m

iv. ACCESS VAULTS

	-SUPPLY VAULT	$40,000
COUNTED 30 AV's ON PROJECT	-SUPPLY VAULT APPURTENCES	900
	-INSTALL VAULTS	10,000
		$50,900 /AV

NOTE: ONE ACCESS VAULT ALLOCATE PER SECTION OF TRENCH ie AV a TO AV b.

PER UNIT PRICE $776/m

v. MOB/DEMOB $210,000 LUMP SUM
$107/m

vi. REMOVE AND DISPOSE OF EXISTING PIPES

ASSUME: LANDFILL WILL ACCEPT SCRAP PIPING WITHOUT CHARGE TO CONTRACTOR.

TRENCHING IS ALREADY ACCOUNTED FOR IN ITEM ii. PIPE NEEDS TO BE CUT AND HAULED TO DUMP. SERVICE CONNECTIONS NEED TO BE DETTACHED, PARTS TO BE SALVAGED WHERE APPLICABLE, IE, SLIP ON FLANGES, SADDLES ETC.

(a) DETACH SERVICES
$50 / DETTACHMENT OF CONNECTION
IE. AV4 TO AV6 — ≈ 15 CONNECTIONS

15 x $50 = $750
$750 / 128m = $5.90

(b) CUTTING AND SALVAGING (420 ft = 128m)
12 m LENGTHS TO MANAGE
128 m / 12 m/CUT ≈ 11 CUTS
$30 / CUT x 11 = $330 $330/128 m
NOTE: INCLUDES SALVAGING. = $2.60/m

(c) HAUL & DISPOSE
ASSUME TANDEMS AVAILABLE
APX 10 SECTIONS PER TANDEM
(1 SECTION IS 3 PIPES)
LOAD AND HAUL TO LANDFILL
$200 / LOAD (2 HRS OF TRUCK TIME AND LOADER TIME)

$200 / LOAD ÷ 128 m / LOAD
= $1.60 / m

SUM a, b, c FOR $/m for ITEM vi.

($5.90 + $2.60 + $1.00) / m = $10.1 / m

vii. SUPPLY AND INSTALL SERVICE CONNECTIONS TO WATER AND SEWER

ASSUME EXISTING SERVICE LINES WILL REMAIN. ALL THAT IS REQUIRED ARE SADDLES FOR CONNECTIONS, CONNECTING TO EXISTING, AND SOME FILLING TO MAINS.

$200 / SADDLE
$200 / EXCAVATION & COVER
$100 / LABOUR

$500 / CONNECTION

$500/c x 15 CONNECTIONS = $7,500

$7500 / 128 m ≈ $58.60 / m

TOTAL ITEMS FOR $/m COST OF ENTIRE REPLACEMENT.

i. + ii + iii + [(iv. x No. AUs) / TOTAL m] + (v. / TOTAL m) + vi + vii = $/m

$350/m + $450/m + $175/m
+ [($50,900/AV x 30 AV) / 1966.85 m] → $776/m

+ $210,000 / 1966.85 m + $10.10/m + $58.60/m

= $975/m + $776/m + $106.8/m + $68.7/m

= $1927/m BOTH WATER & SEWER REPLACEMENT

WATER ONLY

INCLUDES
- SUPPLY 2 WATER LINES
- TRENCHING / INSTALLATION
- ACCESS VAULTS
- MOB / DEMOB
- REMOVE / DISPOSE OF EXISTING W/M
- NEW SADDLES & RECONNECT SERVICES

$350/m + $450/m + $776/m + $107/m
+ $10.10/2 /m + $58.60/2 /m

1/2 WORK OF BOTH FOR REMOVE & DISPOSE

1/2 WORK OF BOTH FOR RECONNECTION

= $1717/m

SEWER ONLY

INCLUDES
- SUPPLY 1 SEWER LINE
- TRENCHING / INSTALLATION
- ACCESS VAULTS
- MOB / DEMOB
- REMOVE DISPOSE EXISTING SEWER
- NEW SADDLES / RECONNECT

$450 + 175 + 776 + 107 + 5 + 29

= $1542/m

SCENARIO 2

REPLACE FROM AV4 TO AV10 ✓
AV10 TO AV11 ✓
AV21 TO AV6 ✓
FOR BOTH WATER AND SEWER.

$1927/m PER SCENARIO 1.

SCENARIO 3

REPLACE W/M's ONLY FOR
AV4 TO AV10
AV10 TO AV11
AV21 TO AV6

CONSTRUCT IN SHALLOW TRENCH ≤ 1 m COVER.

i. W/M SUPPLY
$350/m (P.1)

ii. INSTALLATION
- APX. 1/2 DEPTH OF EXISTING TRENCH
- INSTALLATION REMAINS THE SAME ↓ REFLECT LESS EXCAVATION

$452/m × 60% ≐ $270/m (P.1)

iii NONE

iv. ACCESS VAULT COST IS CONSTANT WITH LENGTH STILL (P.2)

$776/m

v. MOB/DEMOB SAME $107/m

vi REMOVE & DISPOSE OF EXISTING PIPES
~~NONE~~ SOME
- ASSUME EXISTING W/MS CAN REMAIN IN PLACE ABANDONED.
- ACCOUNT FOR AV's. REMOVAL AND SERVICE DISCONNECTIONS.

(a) DETACH SERVICES
$5.9/m (P. 2)

(b) SOME PIPE CUTTING AT MH'S ETC.
ONLY 40% OF THE WORK
0.4 x $2.60/m ≐ $1.00/m

(c) HAUL AND DISPOSE
APX. 60% WORK $1.50/m

a+b+c = $7.9/m

vii. SERVICE CONNECTIONS TO WATER ONLY
2/3 WORK of P. 3
$\frac{2}{3}$ x 58.6/m ≐ $39/m

TOTAL ITEMS FOR WATER LINE REPLACEMENT ≒ 1m BELOW GRADE.

i + ii + iv. + v. + vi + vii

(350 + 270 + 776 + 107 + 7.9 + 39) $/m

≐ $1550/m

SCENARIO 4

REPLACE SEWERS AT DIPS.
ASSUME ACCESS VAULTS WILL REMAIN IN PLACE. MUST REMOVE AND DISPOSE OF EXISTING

i. NO W/M
ii. INSTALLATION $450/m
iii. SEWER $175/m
iv. NONE
v. MOB/DEMOB $107/m

vi. REMOVE DISPOSE OF EXISTING PIPE $10.1/m

vii. SUPPLY & INSTALL SERVICE CONNECTIONS TO SEWER

APX 1/2 WORK
1/2 x $58.60/m ≐ $29/m

TOTAL ITEMS
ii + iii + v. + vi + vii
= $(450 + 175 + 107 + 10.1 + 29)
≐ $771/m

SAGS ON SEGMENTS
✓ AV14 - AV13
✓ AV25 - AV23
✓ AV12 - AV11
AV19 AV20 AV21

APX. DIST TO REPLACE
40m
50m → 10m MORE TO REFLECT POOR
78.6m - ALL } EQUATION)
ALL PER DWG.

SCENARIO 5

REPLACE WATER & SEWER FROM AV20 TO AV22

SAME COST ESTIMATES AS FOR SCENARIO 1.

$1927/m