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TEMAGAMI PRESSURE SEWER SYSTEM

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by

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ABSTRACT

This report gives the results of a two-year monitoring program on a shallow-buried low-pressure sewer system for a community of 140 buildings in Northern Ontario, namely the town of Temagami, Ontario.

Monitoring equipment was installed to record data on energy consumption, and related power costs were calculated for heat-traced pipes and individual grinder pumping units. Pump cycles, ground temperatures, sewage flow, ambient temperature during cold weather, sewer main temperatures and sewer main pressures were also monitored. Results indicate that energy consumption is generally less than anticipated.

Grinder pumps were found to be sensitive to long-term storage prior to installation. Monitoring of system operation is essential to maintain reliability and for early identification of potential problems. In addition, preventative maintenance and preparation for emergencies are important considerations for such shallow-buried systems.

The program demonstrated on a quantitative basis that a shallow-buried pressure sewer system is suitable for servicing a community located in rocky terrain.

Objet: Contrôle du réseau d'égouts à basse pression à Temagami (Ontario)

SOMMAIRE

Ce rapport présente les résultats d'un programme de contrôle d'une durée de deux ans visant un réseau d'égouts à basse pression enfoui peu profondément, à Temagami, collectivité de 140 immeubles du nord de l'Ontario.

Le matériel de contrôle a été installé afin de recueillir des donées en matiére de consommation d'énergie; les coûts s'y rattachant ont été calculés dans le cas des tuyaux chauffés et des pompes à broyeur.

On a également surveillé les cycles de pompage, la température du sol, l'ecoulement des eaux usées, la température ambiante par temps froid, ainsi que la température et la pression dans la conduite maîtresse. D'aprés les résultats, la consommation d'énergie est, en général, moins élevée que prévu.

Les pompes à broyeur peuvent être endgommagées par un long entreposage avant leur installation. En outre, l'entretien préventif et la préparation pour les cas d'urgence sont d'importantes considérations dans le cas de ce genre de réseau enfoui presqu'au ras du sol.

Le programme a démontré, du point de vue quantitatif, que ce système est propre à desservir une collectivité située en terrain accidenté.

Le contrôle du fonctionnement du réseau est nécessaire afin d'assurer la fiabilité du système et du prévoir trés tôt les problèmes éventuels.

SUMMARY

This report contains the results of a two-year monitoring program to review and document the performance of the Temagami low-pressure sewer system from October 1979 through September 1981. Two interim reports were submitted to Canada Mortgage and Housing Corporation and the Ontario Ministry of the Environment. The information in those reports has been incorporated into this final report with a comparison of annual and seasonal operation and maintenance data and costs included.

From the information gathered, the main aspects relating to the operation and maintenance of the pressure sewer system are summarized as follows:

- System Operation

Since commissioning in March 1979, the sewer system has operated continuously.

  - System operating difficulties were generally minor, and were readily handled by the system operator, C. Humphrey of Temagami Electric Ltd.

- Operating Costs

  - Costs for public and private portions of the system were generally as estimated. Higher costs for the public sewer heat tracing were due to the unanticipated Hydro rate structure, but are not excessive. During discussions with Hydro representatives, it was recommended that the Town of Temagami should request that sewer system power costs be billed

as a single charge rather than individual invoices for each of the seventeen power points, thus avoiding excessive demand charges. This suggestion was relayed to the Temagami Works Dept. on 13 Nov. 1981. A comparison of actual costs vs. estimated costs is presented in Section 3.2

- Pressure Sewer System Hydraulic Profile

Pressures recorded indicated that the actual average hydraulic gradient was very close to the design gradient, and therefore acceptable (see Drawing P2 in rear pocket of this report). These findings confirmed a number of assumptions made during the design phase.

- Sewage Temperatures

Temperatures in the sewer mains were found to be at least 3-5°C above freezing during the winter months, providing reasonable reserve heat for emergency conditions, such as an extended power outage.

- Soil Temperatures

Temperatures in the vicinity of the shallow-buried pipe (0.5 - 1 m deep) were found to be 0°C , indicating no untoward heat losses from the insulated pipe.

Sewage Flows

At the conclusion of the monitoring period, and with most buildings on line, daily sewage flow was only 535 L/building/day (120 Imp. gallon/building/day). As 25% of users are commercial or government facilities, this unit sewage generation rate is considered to be quite low. It also reflects minimal infiltration which affects most gravity sewers.

- Repair and Maintenance

Pre-servicing of stored grinder pumps was found to be particularly important to ensure reliable operation. A program of operating each pump and confirming pumping capability, power draw and proper operation of controls before installation was initiated on March 1980.

Although some repair and upgrading of the system was required after the initial operating period through 1980, reliable operation of the sewer system was not affected.

- Benefits of the Monitoring Program

The 30-month monitoring program provided base data on system energy consumption, performance operability and design (temperature and pressure profiles, etc.), together with grinder-pump performance, operation and maintenance requirements, and related operation and maintenance costs. These data will be useful in assessing the original design parameters, and will provide a solid basis for modifying and improving design and operation of future installations.

Also, information gathered indicates that, while systematic monitoring and preventative maintenance of low-pressure sewer systems are very important, the technical capability required by operation and maintenance personnel is not excessive.

The Temagami installation is not classified as a high-technology system.

- Conclusions

The monitoring program indicated that this type of pressure sewer system, having operated continuously under actual conditions over a period of 30 months, was very reliable. The success is attri-

buted to appropriate system design; physical suitability of piping, insulation, and equipment elements; and to first-class operation and maintenance by the system operator. Strict supervision during the construction stage of any future system should be emphasized to ensure reliable operation of sensitive system components such as heat-tracing cables.

Preventative maintenance and preparation for emergencies are vital considerations for such shallow-buried systems.

The monitoring program has demonstrated that low-cost shallow-buried pressure-sewer systems are suitable for servicing communities located on difficult terrain, namely rocky, hilly, soggy and low lying.

In contrast to Temagami, shallow-buried water and sewer systems were constructed in Rose Blanche, Newfoundland in 1977. This town is located on the south-west part of Newfoundland and is characterized by hilly terrain, low-lying boggy areas, and rock outcrops. Excavation in rock for pipelines occurred over only 30% of the sewer and water-main routes and mainly along narrow residential streets where no alternative routes were available. A three-year monitoring study carried out by James F. MacLaren Limited from 1978-1981 confirmed that reliable performance of shallow-buried systems could be achieved by identifying the particular design requirements for a specific site. Since commissioning in 1978, the Rose Blanche systems have remained in service without interruption, despite winter storms and extended power outages. Operating and maintenance costs for the Rose Blanche water and sewer systems have been low, approximately the same as residential water and sewage charges in Toronto.

1.0 INTRODUCTION

1.1 General

Under the terms of the contract of 22 November 1979 between Canada Mortgage and Housing Corporation and James F. MacLaren Limited, a two-year monitoring program was to be carried out under the overview of Ontario's Ministry of the Environment following construction and commissioning of a low-pressure sewer system at Temagami, Ontario. The primary objectives of this monitoring program were to:

- Assess the design criteria and principles used in the design of of the system.
- Assess system operation, performance and reliability.
- Assess system operation and maintenance requirements.
- Document and evaluate system operation and maintenance costs and capital costs.

This report focuses on system operating characteristics, maintenance requirements, costs, and significant problems. Recommendations for upgrading and refining the pressure sewer system have been made to improve system reliability and efficiency, and to provide first-hand operating data.

1.2 Background (See Dwg. P2 in rear pocket)

System design was based on the need to provide sewage collection and disposal for 150 existing buildings, with a capacity for handling flows from up to 190 buildings required by future construction.

The distribution of buildings in the town presently connected to the low-pressure sewer system is as follows:

•	Residential	106
•	Commercial - retail stores	16
	- restaurants	2
	- hotel	1
	- service stations	4
•	Government (municipal, provincial)	11
	TOTAL:	140

1.2.1 Description of Sewer System

An individual, electrically-operated, sewage grinder-pump is installed at each building, and operates automatically with respect to the level in the integral 200 litre holding tank. Buildings are connected to the main public sewer pipeline by 37 mm diameter branch lines. Branch lines are insulated and electrically heat-traced for cold weather protection. At buildings where high volumes are generated, duplex pumps and/or larger capacity holding tanks are provided.

Sewer mains (50, 75 and 100 mm diameter) convey wastes under pressure to a waste stabilization pond for treatment. All sewer mains are insulated and heat-traced. Twenty main-line thermostats are provided to control the sewage temperature at 4 to 5°C. Once initiated, heat-trace cable operation is automatic.

For sequential start-up of the sewer mains in below-freezing weather; for air purging and draining of the mains; and for backflushing if necessary, main line valves and branch valves are provided throughout the system. Provision is also made for temperature and pressure monitoring at various points along the mains.

Treatment of sewage is accomplished at the waste stablization pond located at the north end of O'Connor Drive. The treated effluent discharges into Snake Island Lake.

1.2.2 System Elements

The pressure sewer consists of polyethylene piping in sizes from 37 to 100 mm and includes both mains and individual house connections. To maintain system integrity, the house connections are installed to the inside of the individual buildings rather than to private property lines as is the conventional practice. The major elements of the system are:

• 37 mm piping	3800 metres
• 50 mm piping	2200 metres
• 75 mm piping	1165 metres
• 100 mm piping	980 metres
• Valve chambers	29
• Grinder pump manholes	56

Major system elements were supplied by the following

- P.E. Piping – Dupont of Canada Ltd.
- Pipe Insulation – Shaw Pipe Protection Ltd.
- Heat Trace Cable – Thermon Canada Ltd.
- Grinder Pump Units – Environment 1 Ltd/ITT Grinnell

1.2.3 Material Specifications

- Pipe: High-density PE pipe, Type 3506, Series 100 - CGSB specification 41-GP-25M

- Insulation: Polyurethane - rigid foam - ASTM specification D1622 - Shaw Insul-8

- Outer Jacket: 45 mil high density polyethylene

- Trace Cable: Thermon Econotrace constant wattage cable. (8 to 12 watts per metre depending on pipe size)

- Trace Cable Control: Control thermostat with setting of 5°C. High temperature protection cut-off thermostat set at 27°C.

1.3 Monitoring Program

1.3.1 Monitoring Equipment - Monitoring equipment was installed at representative locations to record the following information:

- Pressure and temperature in sewer mains (chart recorders at three locations).

- Energy consumption of sewer main electric heat-tracing (kWh meters at seventeen locations).

- Grinder-pump energy consumption, number of cycles, and branch line pressure during operation (kWh meters, chart recorders at six locations).

- Operation duration of branch line electric heat-tracing (hour meters at ten locations).

- Daily minimum and maximum ambient temperatures during cold season (min-max thermometer).

- Soil temperatures at various depths to 2.5 metres during cold season (monitoring station, located near Valve Chamber #21)

1.3.2 Data Collection - Data was collected daily, weekly or monthly depending on monitoring equipment output. Pressure, temperature and grinder pump cycles were automatically recorded on recording charts. Energy consumption was obtained by reading the meters monthly. All data have been documented for future reference.

1.3.3 Data from Other Sources - To supplement data acquired directly from the monitoring equipment, the following information was obtained from other sources:

- The magnetic flowmeter at Valve Chamber #30 - sewage flows.

- Power outages.

- Public sewer maintenance.

- Private sewer maintenance.

- General problems, complaints, etc.

2. SYSTEM OPERATION

2.1 General

At the time of preparation of this report, most of the 140 buildings had been connected into the sewer system. In early 1981, a number of homes and businesses located to the east of Valve Chamber #3 were acquired by Sherman Mines Limited and sewer service to these homes was terminated.

2.2 Operating Characteristics

2.2.1 System - Since system commissioning in April 1979, all portions of the sewer mains have remained continuously in service. A number of branch lines were found to be blocked when grinder pump service was initiated. This was due to freezing of residual water left from contractor testing. Thawing was accomplished in 3 to 5 hours, (depending on branch line length) by activating the associated branch line heat-tracing cable.

2.2.2 Grinder-Pumps - During the period April 1979 to March 1980, servicing was required on fifteen grinder-pumps, as shown in Table 2.1. The grinder pumps were on site by November 1977, being received in partial shipments during the previous six months. Consequently, the pumping units were in storage for at least 12 months and, in some cases, up to 18 months prior to installation. The storage facility was an unused enclosed curling rink, without heat.

Since the number of callbacks (15 or 18%) for service to the pumps installed between November 1979 and April 1980 (83 units) was considered to be excessive, a program of pre-installation servicing was instituted by the municipality in March 1980 under which each grinder-pump was inspected and operated at a maintenance facility prior to being installed and put on line. After implementation of the pre-servicing program, callbacks were reduced to only 3 of the next 41 pumping units

TABLE 2.1

GRINDER PUMP SERVICING RECORD
(Apr. 1979 - Mar. 1980)

Date	Building Number	Pump Serial Number	Type of Failure	Repairs	Probable Cause of Failure
Apr. 79	100	14698	• Damaged pump stator	• Replaced	Unknown
Apr. 79	15	14666	• Poor connection in motor control circuit	• Repaired	Damaged during transport, or manufacturer's quality control
Sep. 79	15	14650	• Faulty motor starter • Cracked adaptor assembly	• Replaced • Replaced	Damaged during transport or handling
Jul. 79	55	14626	• Faulty motor thermal protector	• Replaced thermal protector and start timer	Quality control at source
Dec. 79 and Jan. 80	29	14604	• Damaged anti-syphon valve and pump stator (2)	• Replace valve and stator	Frozen branch line
Apr. 79	123	14682	• Damaged anti-syphon valve	• Replaced	Damaged during transport or handling
Oct. 79	227	14612	• Loose tie rod	• Complete core rebuild	Vibration during transport
Oct. 79 Nov. 79	230 230	14555 14561	• Damaged pump seals and pump stator	• Overhaul	Influent quality (strong detergents, bleaches, etc. used at laundromat)
Mar. 80	-	14670	• Pre-installation inspection	• Replaced - Discharged line assembly - Seating rings - Grommets - Gasket - Housing assembly	Damaged during transport

NOTE: Five additional units were serviced.

installed or only 7%. It is believed that most malfunctions were a result of the long-term storage prior to installation or rough handling during transport to the site. It was concluded that for future installations, consideration should be given to:

1. providing a small pre-servicing facility where grinder-pumps can be serviced and operated before installation

2. minimizing extended periods of storage of units (say 2 months maximum)

2.2.3 Monitoring Equipment Operation - At five of six locations where chart recorders were installed to record grinder-pump frequency of operation and branch line pressure, charts were changed once a month, rather than weekly, to avoid bothering the building residents. It was found that data recorded at these five locations were acceptable due to the relatively few number of pump cycles per day. At the sixth location (Building #230) recorder charts were changed weekly. This building is a hotel and laundromat generating large quantities of effluent with corresponding high number of start-stop cycles by duplex pumps. Two of the six recorders were inoperative for short periods of time in December 1979. The reason the recorders stopped could not be established. It is suspected that power to the units was shut off.

The operation of the three main line pressure/temperature recorders was consistently satisfactory throughout the monitoring period. Some malfunctions occurred from time to time but the outages were generally of short duration which did not affect the accuracy of the overall data.

2.4 Operating Data

2.4.1 General - Operating data were gathered on a regular basis for the following system functions:

- Public sewer heat-tracing energy consumption (seventeen locations).

- Public sewer temperature and pressure (three locations).

- Individual grinder-pump energy consumption (ten locations).

- Individual branch line energy consumption (ten locations).

- Individual grinder-pump start-stop cycles and operating pressures (six locations).

- Soil temperatures near Valve Chamber #21 (November 1980 - April 1981).

In addition, daily min/max ambient temperatures were recorded during the cold weather seasons (January through March 1980 and November 1980 through April 1981).

Data on sewage flows, system maintenance and repair were obtained from various other sources.

2.4.2 Public Sewer Heat-Tracing Energy Consumption - Summarized in Table 2.2. Detail computation sheets for the data is attached as Appendix 1.

The data presented in Table 2.2 is discussed in Section 3, together with average "time-on" of system heat-tracing and operating costs.

2.4.3 Public Sewer Temperature and Pressure Measurements - Results of the temperature and pressure scan at valve chambers are presented in Table 2.3.

TABLE 2.2

PUBLIC SEWER MAINS HEAT TRACING ENERGY CONSUMPTION

Number	Traced Pipe Diameter (mm)	Total Tracer Power Rating (kW)	Total Hours on/% Time on *							
			Jan. 80 (14 days)	Feb. 80 (24 days)	Mar. 80 (36 days)	Apr.80 (28 days)	Jan. 81 (15 days)	Feb. 81 (31 days)	Mar. 81 (32 days)	Apr. 81 (30 days)
1	50	2.012	310/92	318/55	343/40	795/100	293/81	845/100	890/100	820/100
2	50	2.208	91/27	32/6	97/11	77/11	190/53	181/24	318/41	18/3
3	50,75	3.76	117/35	199/35	220/25	170/25	332/92	122/16	106/13	0/0
4	50	1.728	150/45	174/30	87/10	0/0	41/11	58/8	52/7	12/2
5	50,75	4.126	138/41	160/28	114/13	102/15	514/100	524/70	584/76	126/18
7	75,100	3.788	42/13	26/5	26/3	28/4	45/13	90/12	92/12	34/5
(1)8	50	0.358	-/-	-/-	-/-	-/-	-/-	56/8	28/4	168/23
10	50,75	5.624	78/22	224/39	96/11	43/6	0/0	2/.27	0/0	4/.5
14	50,75	3.18	192/62	198/34	167/19	135/20	60/17	72/10	6/1	0/0
16/18	50.75	4.3	33/11	21/4	0/0	9/1	95/26	84/11	88/11	26/4
21	100	2.43	108/35	185/9	272/13	177/26	765/100	580/80	654/85	551/77
22	100	4.52	144/46	111/19	157/18	2/.3	544/100	562/76	644/84	547/76
23	100	3.496	29/9	9/2	13/2	3/.5	23/6	14/2	6/1	3/.4
25	50,75	2.995	50/16	10/2	83/10	154/23	70/19	80/11	57/7	50/7
26	50	2.38	(3)-/0	(3)-/-	441/51	353/53	0/0	0/0	0/0	0/0
28	50	2.8	86/28	54/9	136/16	96/14	46/13	43/6	46/6	25/4
(2)29/30	50,75, 100	7.725	(3)-/-	549/95	549/64	176/26	1455/100	775/100	847/100	816/100

Notes

1 kWh meter inoperative Jan.80-Jan.81.
2. Includes 350 watt enclosure heater assumed to operate 18 hrs/day during cold season.
3. Readings faulty.
* See Appendix I for detailed data.

TABLE 2.3

PRESSURE SEWER - TEMPERATURE AND
PRESSURE MEASUREMENTS AT VALVE CHAMBERS

Chamber Number	Line Temp (°C)	Line Pressure (kPa)*	Remarks
2	6-8	62-69	-
3	6-7	83	Chamber flooded
5	15-16	90-97	6" water in chamber
10	9-10	69-76	Chamber flooded
12	10	47-55	Chamber flooded
18	8-10	55	Some water in chamber
19	-	-	No gauge connections
21	6-8	52-83	
29	-	-	No gauge connections
30	12-15	14	Some water in chamber

Scans carried out: 12 & 13 February, 1980
15 & 16 April, 1981
23 & 24 June, 1981

* 6.9 kPa = 1 psi

2.4.4. Individual Branch Line and Grinder-Pump Energy Consumption - Energy consumption data for branch line heat-tracing at ten locations are summarized in Table 2.4. Energy consumption for the ten representative grinder-pumps is presented in Section 3 together with operating costs.

2.4.5 Individual Grinder-Pump Start-Stop Cycles - Tabulation of grinder-pump cycles at six buildings is presented in Table 2.5. These data were reviewed and summarized as total cycles over a particular period and average cycles per day over the entire monitoring period.

2.4.6 Individual Grinder-Pump Operating Discharge Pressure - Data on grinder-pump operating discharge pressure at six locations are presented in Table 2.6.

2.4.7 Public Sewer Temperature and Pressure - Tables 2.7 and 2.8 contain typical monthly temperature and pressure data in the sewer mains from October 1979 through September 1981.

2.4.8 Ambient Temperatures and Freezing Degree Day - Daily min/max ambient temperatures and freezing degree days are presented in Table 2.9.

During the months of January 1980, and January 1981 the minimum daily ambient air temperature approached the lowest design temperature of -40°C.

2.4.9 Soil Temperature Monitoring Program - A soil temperature monitoring station was installed near Valve Chamber #21 with thermocouples located at various depths down to 2.5 m. Periodic readings were taken from November 1980 through April 1981.

Results of this monitoring program are presented in Table 2.10 (6 pages).

TABLE 2.4

PRIVATE SEWER LINES HEAT TRACING ENERGY CONSUMPTION

Building Number	Service Line Length (m)	Total Tracer Power Rating (kW)	Average Time On (Hrs/day) Feb. 80 (23 days)	Mar. 80 (30 days)	Apr. 80 (24 days)	May 80 (29 days)	Oct. 80 (27 days)	Nov. 80 (43 days)	Dec. 80 Jan. 81 (27 days)	Jan. 81 (28 days)	Feb. 81 (32 days)	Mar. 81 (30 days)	Apr. 81 (29 days)	May 81 (29 days)
18	18.3	.115	4.7	1.9	1.6	0.5	0	0	0.17	0.24	1.4	1.4	1	0
55	22.2	.140	8.8	1.1	2.9	0.2	0.14	18.9	0	0	0	0	0	0
79	51.5	.324	10.8	9.6	7.1	1.2	0.6	3	1.4	8.3	7.8	10.6	11.4	1.8
100	7.6	.048	24	23.2	23.7	0(1)	0	0	0	0	0	0	0	0
107	65.8	.415	8.9	7.9	7.3	0.3	0.25	1.2	4.3	5.1	7.8	3.4	1.4	0.07
117	27.4	.174	0	0	0	0	0	0.2	0.02	0	0.19	0	0	0
201	2.4	.015	0	0	0	0	0	0	0	0	0	0	0	0
218	15.2	.096	24	20.7	24	-(2)	0	0	0	0	0	0	0	0
228	20.4	.129	3	2.1	0.8	0.04	0	0.03	1.4	1.7	1	1	0.02	0
230	7.3	.046	6	4.6	1.7	1	0	2.6	10.9	5.7	2.2	1	0.25	0.09

(1) Heating trace circuit turned off
(2) Thermostat malfunction

Notes

1 Tracer rating = 6.3 W/m
2 Service line $\emptyset$ = 37 mm
3 See Appendix II for detailed data

TABLE 2.5

GRINDER PUMP CYCLE FREQUENCY

Number	Oct.79-Mar.80 (182 days)	Apr.80-Mar.81 (365 days)	Apr.81-Sept.81 (183 days)	Average Cycles Per Day (Oct.79-Sept.81)
18 House	1262	2880	1846	8
55 House	4606	6620	2892 (2)	20 (4)
79 House	1027	2413	2251	8
201 MNR	726 (1)	5585	3309	16 (5)
228 Rest.	544 (1)	6050	4584	18
230 Hotel Laundromat	2456 (1)	18230	9317 (3)	49

(1) for 60 days
(2) for 150 days
(3) for 145 days
(4) leak in building plumbing at this house
(5) continuous running fixture in this building

TABLE 2.6

TYPICAL PRESSURE AT GRINDER-PUMP DISCHARGE

1 Oct. 79 - 31 Mar. 80 (12-78 houses on line)

Building Number	Typical System Pressure (Pump Off) kPa	Pressure at Pump Start-up kPa	Typical Operating Pressure (Pump On) kPa
18*	69-90	173-262	104-138
55	41-62	117-186	69-90
79	14-28	62-90	28-55
201	83-97	104-138	104-117
228	41-69	138-173	62-90
230	69-83	104-145	83-104

1 Apr. 80 - 31 Mar. 81 (78-114 houses on line)

18*	62-90	97-131	69-104
55	21-48	138-173	35-76
79	14-28	62-90	28-55
201	69-83	117-138	97-117
228	41-69	138-173	62-90
230	48-83	104-138	69-90

1 Apr. 81 - 30 Sept. 81 (114-140 houses on line)

18*	55-69	124-166	76-97
55	62-83	97-124	69-90
79	14-35	69-104	28-48
201	55-69	138-173	62-90
228	48-69	173-207	76-97
230	62-83	207-242	69-104

* Lowest building on trunk line.

Note: 6.9 kPa = 1 psi

TABLE 2.7

TYPICAL SEWAGE TEMPERATURE (°C)

	V.C. #5	V.C. #21	V.C. #30
October 1979	10-15	-	-
November	7-10	-	-
December	4-7	-	-
January 1980	4-9	-	-
February	5-9	-	-
March	6-9	-	-
April	-	5-11	-
May	-	10-18	-
June	-	11-17	-
July	18-21	17-20	18-19
August	18-21	17-21	12-20
September	12-22	10-21	12-19
October	10-13	8-11	8-12
November	6-9	7-8	5-8
December	4-7	4-7	3-5
January 1981	4-15	4-10	3-5
February	11-15	9-11	4-9
March	10-15	10-11	5-8
April	13	10-14	9-12
May	13-16	13-18	12-16
June	14-18	16-20	15-18
July	16-23	18-24	16-22
August	16-23	20-23	20-22
September	16-23	20-22	20-23

TABLE 2.8

TYPICAL SEWER MAIN PRESSURE (kPa)

	V.C. #5	V.C. #21	V.C. #30
October 1979	35-100	-	-
November	45-90	-	-
December	50-100	-	-
January 1980	50-105	-	-
February	49-110	-	-
March	55-110	-	-
April	-	48-53	-
May	-	48-76	-
June	-	48-76	-
July	97-138	48-76	21-35
August	97-131	48-76	21-35
September	90-124	41-70	21-35
October	90-117	41-76	21-35
November	83-110	41-62	21-35
December	80-124	35-62	21-28
January 1981	83-110	41-70	14-28
February	90-131	41-70	14-35
March	83-124	48-76	14-35
April	144-190	83-124	20-41
May	138-203	83-124	20-48
June	138-241	83-124	20-41
July	138-210	69-138	20-41
August	152-224	83-138	20-41
September	138-224	83-138	20-41

Notes: 1. 6.9 kPa = 1 psi.
2. system static head = approx. 30.4 kPa.

TABLE 2.9

AMBIENT TEMPERATURES (°C)* AND
FREEZING DEGREE DAYS (FDD)

Date	January 1980 Min.	Max.	FDD	February Min.	Max.	FDD	March Min.	Max.	FDD
1	-14	- 1	7.5	-24	-14	19	-30	0	15
2	-14	- 1	7.5	-27	-14	20.5	-30	0	15
3	-20	-12	16	-27	-14	20.5	-31	3	14
4	-29	-11	20	-27	-14	20.5	- 8	5	1.5
5	-22	-18	20	-24	-12	18	-12	2	5
6	-22	-18	20	-26	-11	18.5	-24	2	11
7	-22	-18	20	-26	- 7	14.5	-23	5	9
8	-22	-18	20	-24	- 6	15	-20	5	7.5
9	-27	-12	19.5	-24	- 2	13	-20	5	7.5
10	-24	- 7	16.5	-24	- 2	13	-21	5	8
11	- 9	4	2.5	-24	- 2	13	-14	-3	8.5
12	-23	- 7	15	-22	- 1	11.5	-24	0	12
13	-23	- 7	15	-19	- 1	10	-25	0	12.5
14	-23	- 7	15	-17	- 0	8.5	-11	0	3
15	-24	- 6	15	-24	1	11	-15	5	5
16	- 7	- 1	4	-30	- 7	18.5	-15	5	5
17	- 6	2	2	-30	- 7	18.5	-22	7	7.5
18	- 5	4	0.5	-30	- 7	18.5	-10	6	2
19	-19	- 5	12	-19	0	9.5	-21	9	6.5
20	-19	- 5	12	-14	3	5.5	-21	13	4
21	-19	- 5	12	-18	-12	15	- 3	6	- 1.5
22	-19	- 5	12	-24	- 7	16.5	- 5	5	0
23	-27	-17	22	-22	- 1	11.5	- 5	5	0
24	-27	-19	23	-22	- 1	11.5	-10	3	3.5
25	-30	-17	23.5	-22	- 1	11.5	- 8	5	1.5
26	-24	- 6	15	-39	-14	26.5	- 6	8	- 1
27	-24	- 6	15	-16	-11	13.5	- 5	6	- 0.5
28	-24	- 6	15	-33	-18	25.5	- 4	6	- 1
29	-26	-17	21.5	-33	-18	25.5	- 8	8	0
30	-29	-16	22.5				- 8	8	0
31	-27	-14	20.5				-12	13	- 0.5

* Obtained from min/max thermometer located at Temagami Electric
(Thermometer read at 0800-0990 hrs. 1600-1800 hrs)

TABLE 2.9 (Cont'd..2)

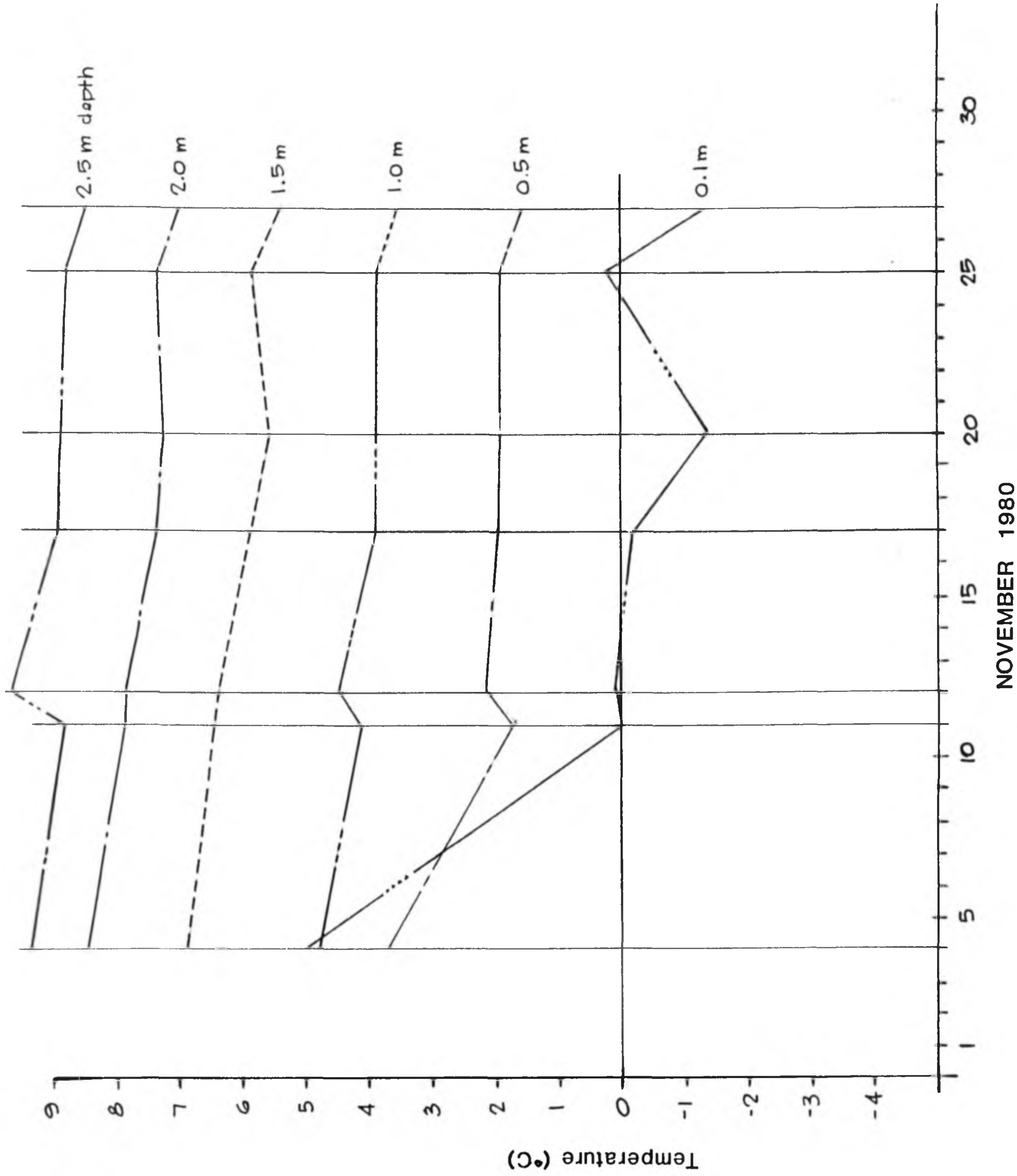
AMBIENT TEMPERATURES (°C) AND FREEZING DEGREE DAYS (FDD)

Date	November 1980			December			January 1981		
	Min.	Max.	FDD	Min.	Max.	FDD	Min.	Max.	FDD
1				- 5	5	0			
2				-13	-3	8			
3	- 2	12	-5	-24	-8	16			
4	0	11	-5.5	-26	-6	16			
5	- 6	0	3	-23	-3	13	-39	-10	24.5
6	- 4	3	0.5				-20	-3	11.5
7	- 6	1	2.5				-22	-18	20
8				-18	-6	12	-29	-14	21.5
9				-13	-5	9	-23	-6	14.5
10	- 7	-3	5	-15	-8	11.5			
11	- 5	-2	3.5	-31	-12	20.5			
12	- 7	-1	4	-28	-8	18	-30	-9	19.5
13	- 3	0	1.5				-22	-8	15
14	- 6	0	3				-22	-5	13.5
15				-20	-11	15.5	-15	-1	8
16				-29	- 7	18	-23	-4	13.5
17	- 8	-1	4.5	-35	- 3	19			
18	-14	-3	8.5	-23	-10	16.5			
19	-11	0	5.6	-27	- 5	16	-23	-1	12
20	0	3	-1.5				-20	2	9
21	- 2	1	0.5				-22	-2	12
22	- 7	2	2.5	-33	- 5	19	- 7	2	2.5
23				-10	- 1	5.5	-12	-1	6.5
24				-23					
25	-11	-4	7.5						
26	- 9	0	4.5				-19	-	7.5
27	- 5	-3	4				-22	-7	14.5
28	- 5	-1	3				-26	-5	15.5
29							-25	-6	15.5
30							-28	-6	13.5
31									

TABLE 2.9 (Cont'd..3)

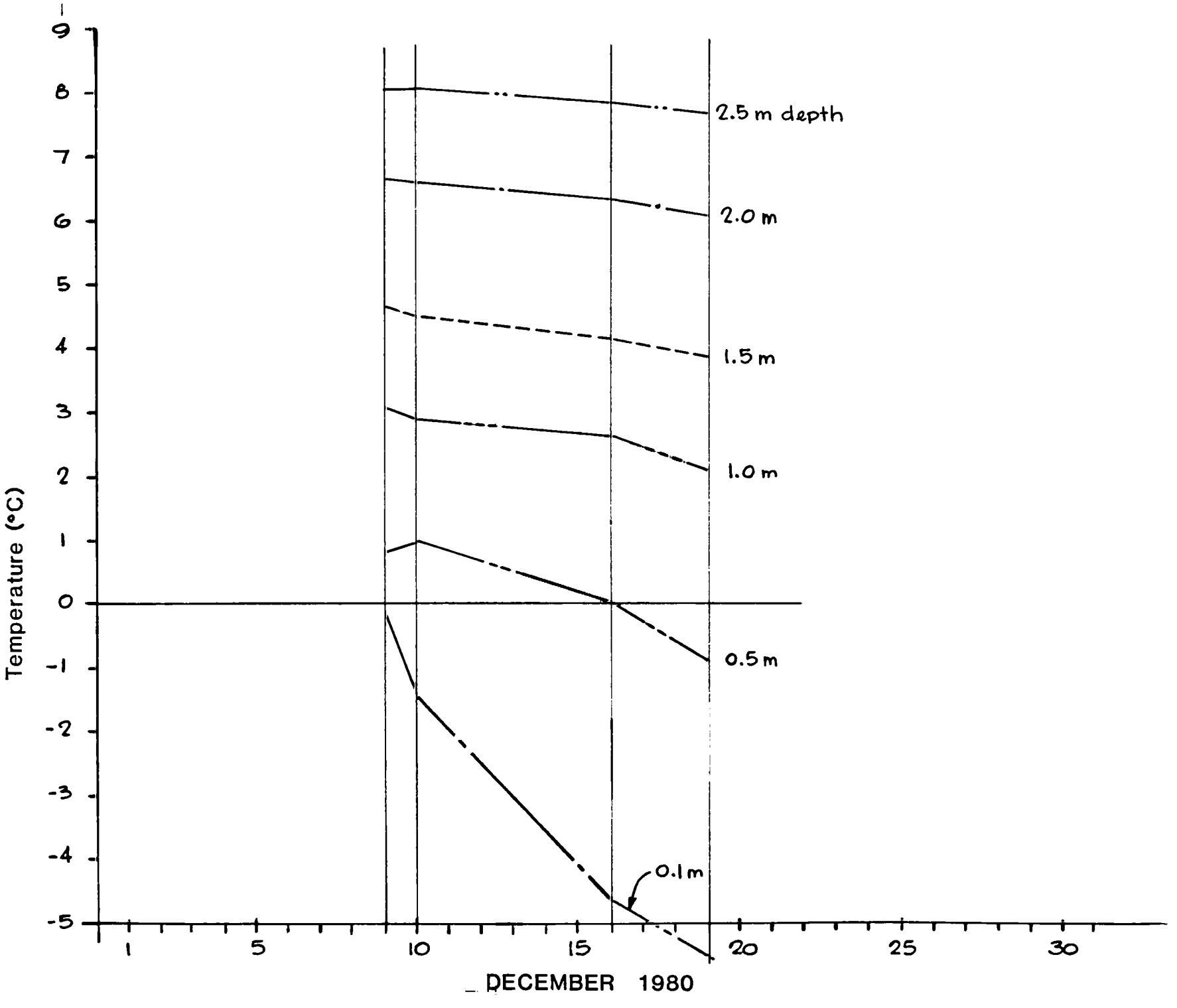
AMBIENT TEMPERATURES (°C) AND FREEZING DEGREE DAYS (FDD)

Date	February 1981 Min.	Max.	FDD	March Min.	Max.	FDD	April Min.	Max.	FDD
1							- 1	15	- 7
2				-11	0	5.5	- 3	10	- 3.5
3	-32	-17	24.5	-19	- 3	11	- 3	19	- 8
4	-31	-16	24.5	-21	- 4	12.5			
5	-33	- 6	19.5	-13	- 1	7			
6	-13	- 1	7	-15	- 4	9.5	- 9	9	0
7							- 8	13	- 2.5
8							1	12	- 7
9	-20	- 5	12.5	- 3	7	-2	0	14	- 7
10	-20	- 5	12.5	- 7	- 1	4	- 6	10	- 2
11	- 9	4	2.5	-16	5	5.5			
12	-26	-11	18.5	- 9	3	3			
13	-24	- 5	14.5	-10	2	4	- 6	17	- 5.5
14							- 5	3	1
15							-16	- 1	8.5
16	-14	10	2	-28	- 1	14.5	- 5	17	- 6
17	2	5	-3.5	-22	- 4	13			
18	4	11	-7.5	-27	- 1	14			
19	2	9	-5	-14	7	3.5			
20	2	7	-4.5	- 4	10	-3	-12	2	5
21							-14	6	4
22							- 8	12	- 2
23	- 7	7	0	- 8	11	-1.5	- 1	2	- 0.5
24	- 3	5	-1	- 4	12	-4	- 3	4	- 0.5
25	- 4	4	0	-11	14	-1.5			
26	- 9	- 2	5.5	-11	12	-0.5			
27	-14	12	1	- 7	10	-1.5	- 5	17	- 6
28							- 4	17	- 6.5
29							0	16	- 8
30				-10	8	1	- 5	11	- 3
31				- 2	12	-5			



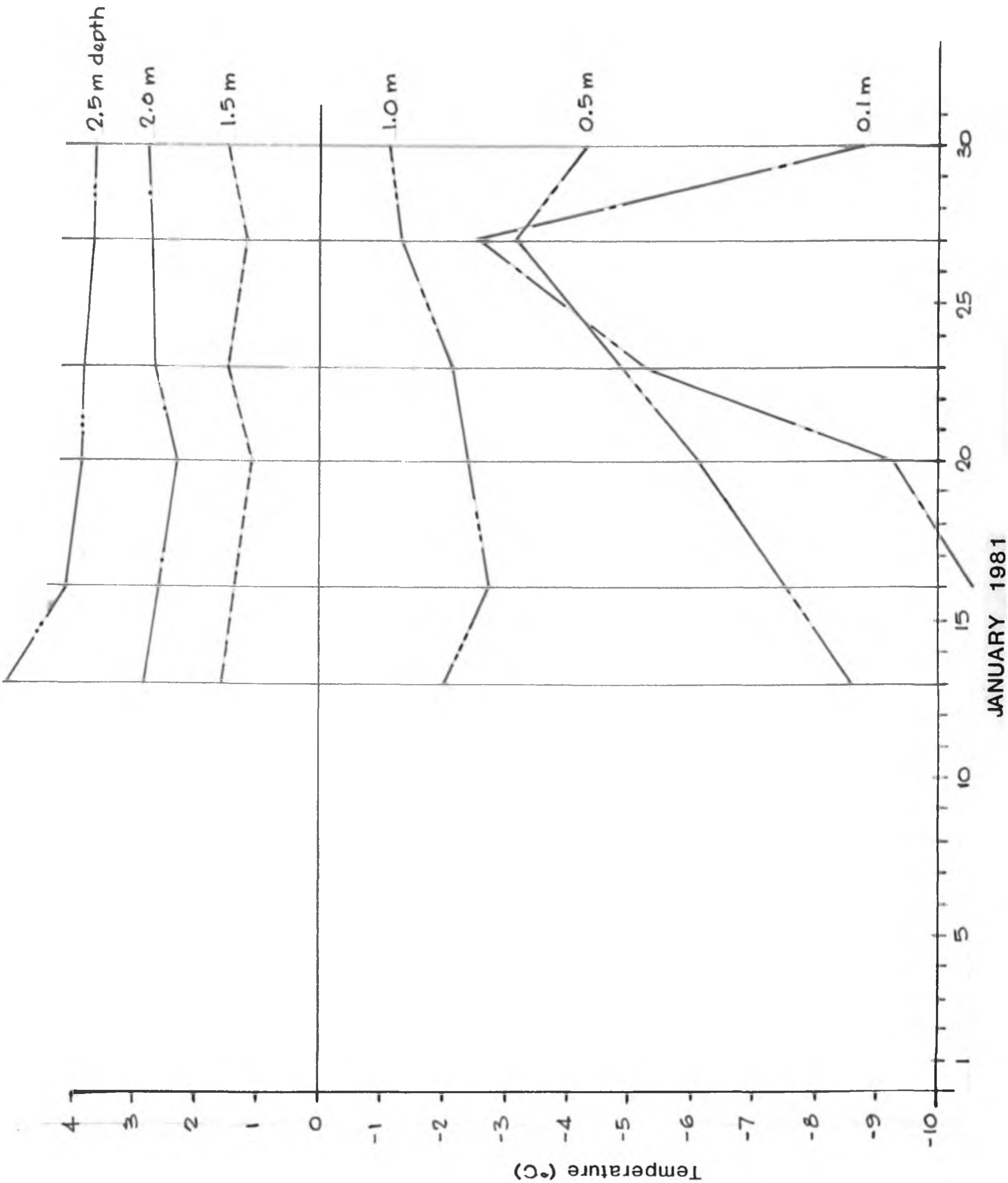
SOIL TEMPERATURES

Table 2-10



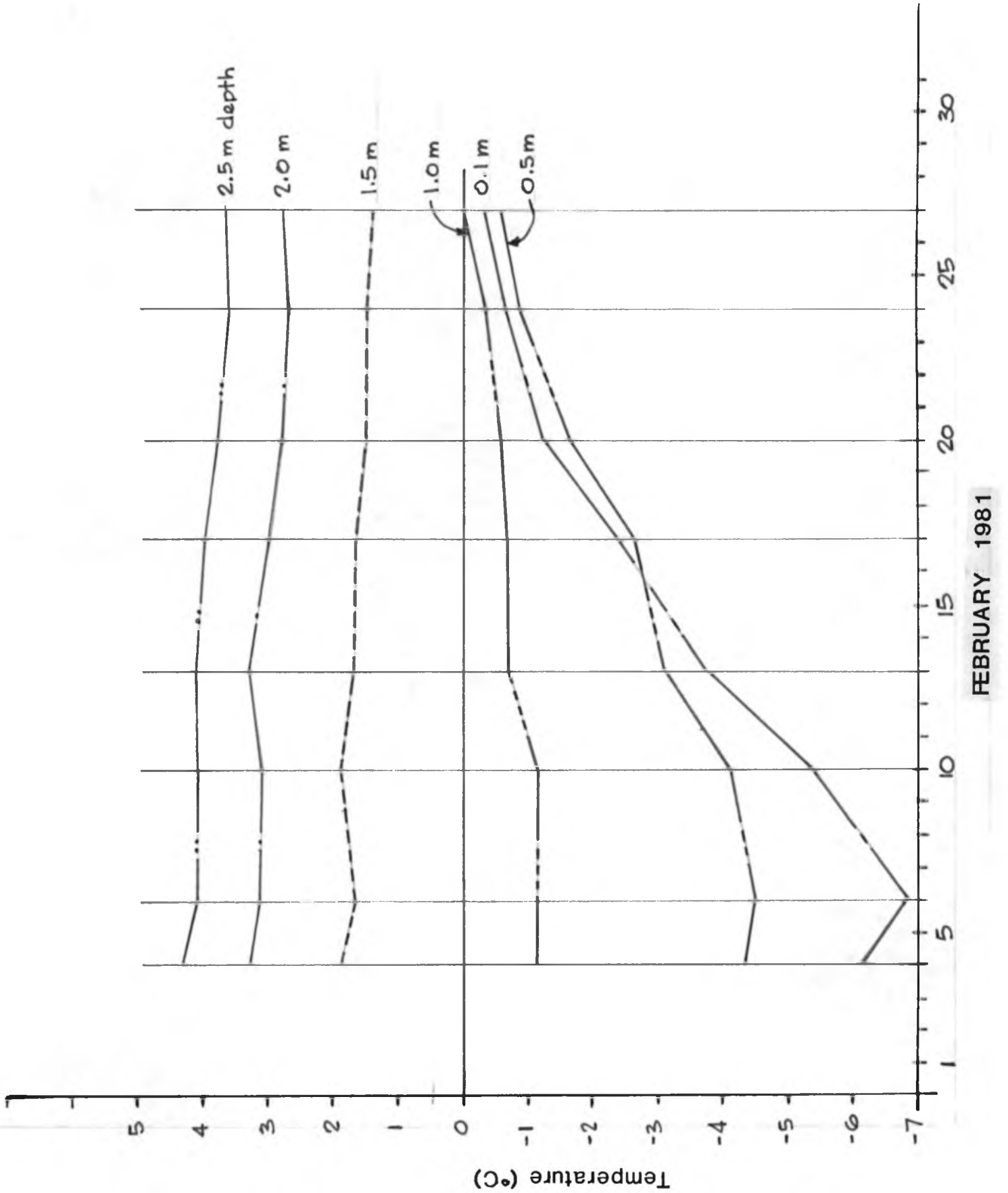
SOIL TEMPERATURES

Table 2-10



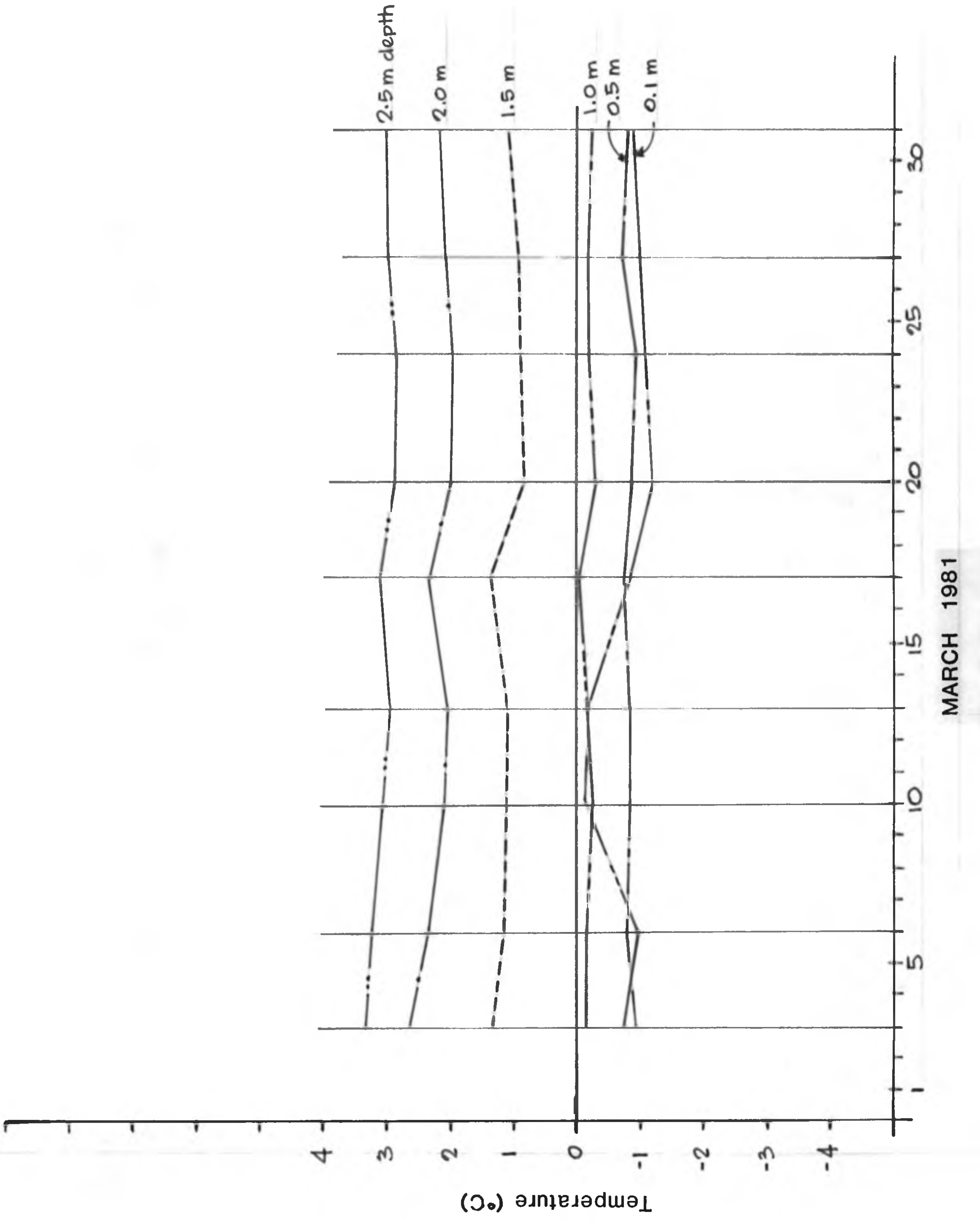
SOIL TEMPERATURES

Table 2-10



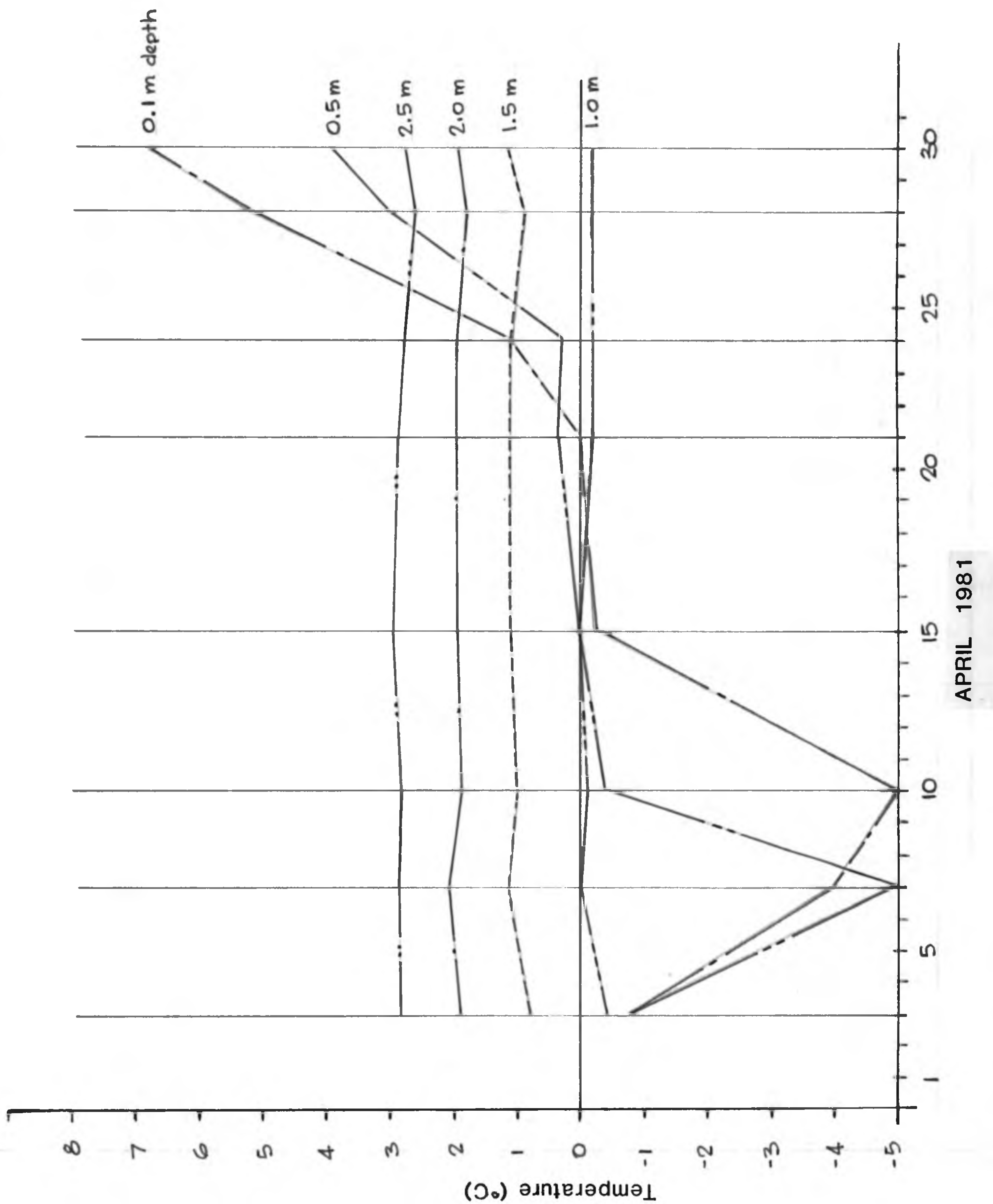
SOIL TEMPERATURES

Table 2-10



SOIL TEMPERATURES

Table 2-10



SOIL TEMPERATURES

Table 2-10

2.4.10 Average Daily Sewage Flow - As available, daily sewage flow to the waste stabilization pond was obtained from the magnetic flow meter/recorder located at Valve Chamber #30 and is tabulated in Table 2.11. Some operating problems occurred with the recording portion of the instrument and the accuracy of data gathered prior to November 1980 should be considered questionnable.

2.5 Analysis of Data

2.5.1 Public Sewer Heat-Tracing Energy Consumption - At Meter Nos. 1, 5, 21, 22, 29/30, some readings indicated consumption greater than the power draw if the heat tracing was operating 100% of the time.

At Meter No. 1 it is probable that the installed length of heat tracing is greater than that shown. Energy consumption at Meter Nos. 5, 21, 22, and 29/30 for the period January 15-30/1981 have been disregarded. Remaining readings at Meter No. 29/30 are consistently greater than 100% due to power consumption of the electrical enclosure heater.

These readings have been disregarded and the monthly average "on-time" for the entire system has been assumed at the locations.

A review of the detailed data sheets (see Appendix I) shows consistent variations in the meter readings from month-to-month, which confirms the reliability of the data. It is noted that at six locations where energy consumption is the highest (i.e. on-time generally greater than 60%) there is a significant length of sewer main upstream of the monitoring point where there are no branch lines coming into the sewer. This condition would permit the greatest opportunity for heat loss and is reflected in the higher than average energy requirement for these portions of the sewer mains.

TABLE 2.11

AVERAGE DAILY SEWAGE FLOW
(Litres)

	Average Daily Flow	No. of Buildings On-Line	Average LPD Per Building
October 1979**	41,369	20	2,068
November**	38,641	30	1,288
December**	38,868	47	827
January 1980**	35,459	51	695
February**	37,277	60	621
March**	25,617	78	328
April**	14,729	85	173
May**	9,597	89	108
June**	7,101	90	79
July*	-	98	-
August*	-	100	-
September*	-	102	-
October*	-	102	-
November*	-	105	-
December	44,142	105	420
January 1981	29,922	105	285
February	29,149	110	265
March	33,022	114	290
April	58,948	117	504
May	46,046	118	390
June	67,131	120	559
July	66,285	125	530
August	75,377	133	567
September	75,918	140	542

* flow meter inoperative July - November 1980
** meter calibration questionable

2.5.2 Public Sewer Temperature and Pressure Scan - Pressure and temperature readings, taken at eight locations in February 1980, April 1981 and June 1981, confirm the reliability of readings recorded at the three pressure/temperature recorders (V.C. 5, 21 and 30). Sewage temperatures were betwen 6 and 16°C and line pressures varied from 14 to 97 kPa (see Table 2.3).

2.5.3 Grinder-Pump and Branch Line Energy Consumption - Heat tracing at four of the branch lines being monitored was noted not to be operating at any time. These locations were visited and the thermostats and circuits were checked for proper operation. It was concluded that operation was consistent with the branch line installation at buildings 117 & 201.

At Building Nos. 100 and 218, the thermostat and/or heat tracing were found to be faulty.

Operation durations for other monitored locations were consistent from month to month (see Tables 2.4, 3.2 and 3.3), confirming the reliability of the data.

Grinder-pump energy consumption includes an integral continuously operating resistance heater (20 watts). Energy consumption continues to be less than expected, based on the number of pump cycles recorded (see Section 3).

2.5.4 Grinder-Pump Cycle Frequency - Pump cycles recorded during the period (8 to 18 cycles/day/bldg. over monitoring period) were consistent with those presented in the two interim reports. Cycles at Building No. 230 (hotel and laundromat) continue to be high (49 cycles/day/average) and it is likely that these units will require service more frequently than pumps in normal service.

2.5.5 Public Sewer Temperature and Pressure - In June 1981, two additional pressure/temperature recorders were installed near Valve Chambers No. 5 and 30 to supplement data being recorded at Valve Chamber No. 21. These units have functioned well throughout the monitoring period and the data are considered to be reliable.

2.5.6 Soil Temperatures - Review of soil temperature data indicates that maximum frost penetration is approximately 1.2 metres and temperatures below that depth remain constant during the winter.

2.5.7 Sewage Flows - Daily sewage flows recorded from April to June 1980 appear to be unreasonably low and were disregarded as being inaccurate. In late June 1980 the flow recorder was damaged when the intrument enclosure was struck by lightning. Repair and calibration were completed in November 1980. After repair, sewage flows were checked manually using a 45 gallon drum at the discharge near the lagoon. Records from December 1980 are considered to be accurate.

2.6 Repair and Maintenance

Repair and maintenance to the pressure sewer system are carried out generally on an as-required basis. To date, buried portions of the system have been virtually trouble-free. Main malfunctions have been individual grinder-pump failures, flooding valve chambers and manholes, and, malfunctioning of portions of sewer main heat tracing.

In the first interim report on system operation, a number of system repair and upgrading requirements were noted. Subsequently, in July 1980, a complete electrical and mechanical inspection of the sewer system was carried out to determine system condition. The results of this inspection are presented in Appendix III. To date the only modification carried out has been in the installation of a small electrical dewatering pump in Valve Chamber #7 along with some minor repairs (insulation replacement) at other valve chambers.

3. OPERATION AND MAINTENANCE/REPAIR COSTS

3.1 Operating Cost Data

Operating costs are presented in Tables 3.1, 3.2 and 3.3 for the following:

- Public sewers heat-tracing electrical power costs.
- Private branch line heat-tracing electrical power costs (ten representative locations).
- Grinder-pump electrical power costs (ten representative locations).

3.2 Review of Operating Costs

3.2.1 Public Sewers - During the first cold-weather period monitored (January - March 1980), energy consumption was found to average 261 kWh/day or approximately 73% of original estimates. Actual power costs for this period averaged $18.93/day compared to $12.50/day estimated in the original design report. The higher than estimated cost for operation of the public sewer heat tracing is attributable to the method of charging by the Hydro authority. For the first 250 kWh consumed each month at each of the seventeen meter locations, a charge of 10.6¢/kWh is made. Remaining consumption is charged at a rate of 3.56¢/kWh. The number of buildings on line in January and March 1980 was 51 and 84 respectively.

Energy consumption for the second cold-weather period (December 1980 - April 1981) was found to average 455 kWh/day or approximately 121% of original estimates. It is noted that by close scrutiny of the system during the latter part of 1980, the system operator was able to delay activating the sewer main heat tracing circuits until 3 December 1980 so that the total energy consumption during the cold weather season of 1980-

1981 was about 67,000 kWh versus the seasonal estimate of 72,000 kWh. Again, the high daily power cost ($21.11 actual versus $12.50/day estimated) is attributable to the higher cost for initial 250 kWh of energy consumption at each meter. The number of buildings on line during December 1980 and April 1981 was 105 and 117 respectively.

3.2.2 Private Sewer Branch Lines - Review of operating costs for the ten representative branch lines being monitored indicated that annual operating costs range between 0 and 125% of original estimates with the average cost being $2.72/yr or 30% of the design estimate. A summary of the ten branch line heat tracing operating costs is presented in Table 3.2.

3.2.3 Grinder-Pump Operating Costs - Operating costs for grinder-pumps at all but one (hotel/laundromat) of the monitored locations were found to be close to original estimates (i.e. 1.5¢ day) over a period of one year. A summary of grinder pump operating costs over the monitoring period is presented in Table 3.3.

3.3 Repair and Maintenance Costs

3.3.1 System - Maintenance and emergency repairs are carried out on an as-required basis by a local employee of MOE Operations Division, with some assistance from Town forces.

As previously noted, a comprehensive mechanical and electrical inspection was carried out in July 1980 to identify system repairs and/or upgrading requirements. A budget of $2500 was provided by MOE Operations, Sudbury to do some of the repairs and install a dewatering pump in Valve Chamber No. 7.

Costs for repairing individual grinder pumps are covered by a fund set up by the Town of Temagami based on a monthly charge of $5.00 per building.

3.3.2 Grinder-Pumps - As discussed in Section 2.2.2, eighteen grinder-pumps were repaired during the period April 1979 through July 1981.

Typical material costs for service and repair to a grinder-pump varied from $50.00 for replacement of the stator (rubber boot) to approximately $1,000 for a major repair (i.e. complete overhaul of the pump core).

TABLE 3.1

PUBLIC SEWER HEAT TRACING OPERATING COST

Period	Total kWh Consumed	Estimated Cost $*	Estimated Cost/day $
Jan. 1980 (15 days)	6,242	467.24	34.63
Feb. (24 days)	6,926	453.02	18.87
Mar. (36 days)	6,940	480.58	13.35
Apr. (29 days)	6,930	442.46	15.26
Dec. 80 - Jan. 81 (59 days)	21,200	944.80	16.99
Feb. (28 days)	16,130	786.74	28.10
Mar. (32 days)	17,130	799.20	24.22
Apr. (30 days)	12,890	593.28	19.78

Total cost for heating season (3 Dec. 1980 - 30 Apr. 1981)
= $3,124.02 ($20.97/day)

* Based on power cost of 10.6¢ kWh for first 250 kWh and 3.56¢/kWh for remainder at each meter.

TABLE 3.2

PRIVATE SEWER (BRANCH-LINE) HEAT-TRACING OPERATING COSTS
(1 January -28 April, 1980: 119 days)

Building Number	Service Line Length (m)	Total Tracer Power Rating (kWh)	Total Operating Hours	Total Energy Consumption (kWh)	Total Cost(1) $	Average Cost Per Day $
18	18.3	0.120	223.2	27	0.96	0.008
55	22.2	0.146	343.1	50	1.78	0.015
79	51.5	0.338	892.6	302	10.75	0.09
100	7.6	0.050	2053.3	103	3.67	0.03
107	65.8	0.432	652.7	282	10.04	0.084
117	27.4	0.180	0.1	0	0	0
201	2.4	0.016	0.1	0	0	0
218	15.2	0.100	2272.2	227	8.08	0.068
228	20.4	0.134	175.0	23	0.82	0.007
230	7.3	0.048	312.9	15	0.53	0.004

(1) Based on power cost of 3.56¢/kWh.

TABLE 3.2 (Cont'd)

PRIVATE SEWER (BRANCH-LINE) HEAT-TRACING OPERATING COSTS
(28 April 1980 - 30 April 1981: 367 days)

Building Number	Service Line Length (m)	Total Tracer Power Rating (kWh)	Total Operating Hours	Total Energy Consumption (kWh)	Total Cost(1) $	Average Cost Per Day $
18	18.3	0.120	143.3	17	0.61	0.002
55	22.2	0.146	518.2	76	2.71	0.007
79	51.5	0.338	729	247	8.79	0.024
100	7.6	0.050	0	0	0	0
107	65.8	0.432	742	321	11.43	0.031
117	27.4	0.180	10.2	2	0.07	0
201	2.4	0.016	0	0	0	0
218	15.2	0.100	381	38	1.35	0.004
228	20.4	0.134	165.2	22	0.78	0.002
230	7.3	0.048	864.6	42	1.50	0.004

(1) Based on power cost of 3.56¢/kWh.

TABLE 3.3

GRINDER PUMP OPERATING COSTS
(February 1980 - September 1981: 597 days)

Building Number	Total Energy Consumption (kWh)	Total Operating Cost $ (1)	Average Operating Cost/Pump/Day $	Typical Annual Operating Cost/Pump $
18	84	2.99	0.005	1.83
55	304	10.82	0.019*	6.94
79	221	7.87	0.013	4.75
100	283	10.07	0.023**	8.40
107	248	8.83	0.015	5.48
117	219	7.80	0.013	4.75
201	274	9.75	0.016	5.84
218 (2)	386	13.74	0.023	8.40
228 (2)	274	9.75	0.016	5.84
230 (2)	1380	49.13	0.082	29.94

* for 565 days
** for 444 days (house unoccupied May-September 1981)

Notes:

1) Based on power cost of 3.56¢/kWh
Includes power consumption of pump core resistance heater (20W) operating continuously

2) Dual pumps installed at these locations; costs shown are for one pump only

4. ASSESSMENT OF SYSTEM DESIGN AND OPERATION

4.1 Design and Operating Criteria

System criteria forming the basis for design of the Temagami sewer system are:

- shallow-buried low-pressure sewer system with a nominal capacity of 267,000 L/day (average per capita rate of 300-330 L/day).

- use of insulated piping with electrical heat-tracing to provide heat input during periods of cold weather.

- use of individual grinder-pumps in buildings capable of direct pumpage to a waste stabilization pond.

4.2 Operating Requirements

Operating requirements of the pressure sewer system included scouring out system high points at least once per day to avoid increasingly restrictive air pockets. This is accomplished by structuring the sewer system similar to a Christmas tree and progressively building-up flow from bottom to top to maintain a maximum velocity of .45 to 2 m/s.

Maximum velocity is related to the number of simultaneously operating grinder pumps which has been determined from EPA tests to be 10 pumps (@ 11 USgpm each) for a pressure sewer system with 147 to 179 pumps connected. On this basis, the maximum velocity in a 100 mm dia. pressure-sewer main would be .975 m/s.

Field data gathered during the monitoring period confirms that:

a) Adequate scouring is occurring as indicated by the reasonable and repeatable pressures recorded in the mains

(20 - 224 kPa). This obtains even though daily sewage flows are well below system design capacity (76,000 L/d in September 1981 vs. 267,000 L/d capacity).

b) Actual system hydraulic gradient is very close to the design gradient, and is somewhat less upstream of Valve Chamber No. 13 (See Drawing P2 of 17 in the rear pocket of this report).

4.3 System and Equipment Performance and Reliability

Since commissioning in March 1979 the sewer system has remained in continuous service without any major malfunction. A number of valve chambers were found to be less than water-tight and sewer main heat tracing malfunctioned in four locations. These deficiencies did not adversely affect overall system performance or general reliability. Specific aspects of system performance are discussed below:

- Hydraulics: Pressure profiles taken periodically confirm that simultaneous pump operation is close to that expected (i.e. up to 10 pumps operating at any time). Syphon breakers at two high points are functioning properly. No clogging has occurred in the system - attributable to adequate velocity and pre-grinding of sewage.

- Grinder pump settings: Although interior location of grinder-pumps is preferrable for physical protection and ease of maintenance, the exterior installations (approximately 30%) have operated with reasonable reliability.

- Pump Selection: The positive-displacement grinder pump is considered to be particularly appropriate for use in residential and light-commercial use; one location (hotel-laundromat) was found to generate flows in quantities which required the pump to cycle approx. 50 cycles/day. The high number of operating

cycles along with the harsh nature of the wastewater has resulted in a number of breakdowns in this particular pump.

- Valve Chambers: During construction, greater attention should be given to ensuring that valve chambers are free from water.

- Cold Weather Operation: The freeze-protection components functioned satisfactorily in maintaining temperatures in the mains reasonably above freezing, thereby providing adequate reserve heat for emergency situations. Surveillance of system temperature throughout the cold-weather period by operating personnel would permit fine-tuning of heat input resulting in reduced power costs.

- Private Sewer Branches: Electric heat tracing on individual branch lines to buildings was found to be capable of thawing a frozen branch line, left full of water during construction, in 3 to 5 hours.

4.4 Piping System

The piping system comprises mains and branches of high-density polyethylene pipe in the size range of 37 mm to 100 mm dia., joined by thermal butt-fusion; together with prefabricated polyurethane insulation system with black polyethylene jacket, heat-trace raceway, and electric heat-tracer.

In general, this system supplied by "DuPont Canada Ltd." performed very well in carrying out its required functions of transporting sewage and keeping it warm in winter. There were no significant problems over the monitoring period.

The following specifics are noted:

- leakage was virtually non-existent; for example - only one leak was found in the original pressure testing of the installed piping system.

- the piping was able to withstand an inadvertent freezing of a 30 m long section of 75 mm dia. main: the heat-tracer with insulation system was able to thaw this section within a reasonable time period of 3 to 5 hours.

- the flexibility of the piping enabled the contractor to route the pipe around rocky outcrops and minimize installation costs.

- hydraulic capacity was generally as anticipated.

- scum build-up was not experienced, a concern during the design phase.

- heavy truck loading on shallow-buried piping was not a problem.

- expansion and contraction provisions were adequate (e.g. snaking in trenches).

- heat-loss was minimal and on the order expected - indicating a very good insulation system.

- electrical energy consumption for mains was reasonable, and on the order expected.

- electrical-trace wire of "Therman" manufacture was generally satisfactory, although a number of failures were experienced. It was difficult to pin-point the exact

location of the failures, and even more difficult to replace the tracer.

- mechanical thermostats by "Thermon" were found to be inaccurate, resulting in considerable wastage of electricity. Electronic thermostats should be used on mains in the future.

- heat-trace raceways were susceptible to becoming flooded with water from leaky valve chambers. Improved sealing of raceways ends where heating cables exit at valve chambers is required, together with tighter chambers.

4.5 Operation and Maintenance Requirements

4.5.1 General operation and maintenance requirements were not specifically addressed in the original report of September 1976. Based on information and data obtained during the monitoring period, the following recommendations can be made:

- Grinder-pump pre-servicing: Since a small pump testing/repair facility is required for dealing with pump maintenance and repair, the facility should be set up early to pre-service and operate grinder-pumps prior to installation.

- System monitoring: Period monitoring of the sewer system should be carried out with particular atention given to:

  - operation of heat tracing circuits and controls

  - inspection of valve chambers for proper valve operation; insulation condition; entrance of ground and surface water.

- obtaining temperatures and pressures in sewer mains on a regular basis during cold weather for early warning of potential problems such as clogging, faulty heat tracing, etc.

4.5.2 Heat Tracing Cable Failures

At a number of locations, failure of the heat tracing cable occurred due to the entrance of water into the cable raceway. To prevent this condition occurring in future installations, special care should be taken to seal the raceway where heating cables exit (such as in valve chambers). Also, recent improvements in heating cable sheathing may provide better protection against damage from raceway flooding.

4.5.3 Periodic Monitoring of Electrical Circuits

Failure of electrical heat-tracing circuits may result in inadequate heat input for freeze protection of pipelines in emergency situations.

As previously noted, seasonal checking of all system electrical circuits for proper operation should be carried out. Periodic monitoring of sewer temperatures should be carried out during cold weather at points provided in valve chambers to confirm that temperatures are at least 4°C above freezing.

4.5.4 Potential Hazard from a Faulty Electrical Circuit
(in flooded valve chamber)

On one occasion electrical shocks from a valve were received by maintenance personnel while performing routine monitoring. The cause was determined to be from a faulty heat tracing circuit. As a matter of policy, electrical circuits should be turned off before personnel enter a valve chamber. In addition, circuits should be checked seasonally for proper operation.

4.6 Supervision During Construction

During construction of the sewer system, a number of difficulties were encountered which could be generally attributed to the prototype nature of this shallow-buried pressure sewer system or, in some cases, to the special requirements of the particular site.

The following areas should be carefully dealt with in future design and construction of similar systems:

1. Pipe Joints: Care should be taken to maintain the heat tracing cable raceway on the lower half of the pipe when making joints.

2. Joint Insulation: Where couplings are used to join small diameter pipe, half-shell insulators should allow for the increased outside diameter while still providing the specified insulation thickness.

3. Branch Connections: Review the real need for shut-off valves on branch lines since the metallic compression-type connectors and shut-off valves are susceptible to freezing.

4. Electrical Code: Because of the special aspects of this type of sewer system, discussions should be held with the local Hydro authority at the design stage to minimize delay and avoid extra costs later.

5. Pipe Wrapping: Although heat-shrink sleeves are satisfactory for waterproofing insulation at pipe joints on straight pipe runs, a more flexible wrapping material is appropriate at complex assemblies such as branch tees: the material used at Temagami was "Tapecoat 20", an asphalt impregnated wrapping used extensively in the gas pipeline industry.

6. Control Thermostats: Proper thermostat calibration should be established before installation and thermostat operation should be checked after installation to verify that the capillary tube has not been damaged.

7. Grinder-Pump Manholes: A detailed survey should be done to confirm that grinder-pumps can in fact be installed in building interiors. Where exterior installations are required, packaged prefabricated fiberglass stations should be considered as an alternative to precast concrete manholes.

8. Building and Backfilling: Careful inspection of pipe bedding and backfilling is required to ensure that no prohibited material is used which could damage the outer wrapping of pre-insulated pipe.

9. Valve Chambers: Subject to confirmation, future designs should minimize the number of valve chambers since they could very well represent the major maintenance item in the system (e.g. potential for flooding).

4.7 Capital, Operating and Maintenance Costs

4.7.1 Capital Cost of Pressure-Sewer Installation

The original cost estimate for the pressure-sewer was $424,000. as presented in the MacLaren Conceptual Design Transmittal of September 1976. The estimate included supply and installation of 4500 metres of sewer mains and 1800 metres of service lines to buildings. Pipe was to be pre-insulated and fitted with heat-tracing. Allowance was made for some additional items such as special treatment of piping at highway crossings and miscellaneous elements such as pipe fittings, branch connections, etc.

The lowest tender was $917,000. in July 1977 by Raken Construction Ltd. This included all elements of the pressure-sewer system including heat-tracing, electrical controls, valves and chambers, grinder pump manholes, etc. This tender was accepted and works began.

During construction the extent and location of rock above and near the ground surface confirmed that the cost for installation of a conventional (gravity) sewer system would have been in the order of two times the cost of this pressure-sewer system. The pressure-sewer system's inherent flexibility permitted locating piping to the best advantage during construction. Substantially lower installation costs can result.

4.7.2 Operating and Maintenance Costs

4.7.2.1 General

While actual seasonal energy consumption on the public portion of the sewer system was less than the original estimate, the cost for power was greater due to the unanticipated rate structure used by the local Hydro authority (see Section 3.2.1). As discussed in Sections 3.2.2 and 3.2.3, operating costs for the private portions of the system were monitored at ten buildings and found to be close to the original estimate.

Maintenance costs for the private portions of the sewer sytem were related to repair and eventual replacement of grinder pumps. The estimated cost for maintenance and replacement (25 year life cycle) for a grinder pump was $110.00 per year. Up to 28 October 1981, with 138 grinder-pumps installed, 23 units had required service or repair. As previously discussed, pump malfunctions were signicantly reduced after the implementation of a pre-servicing programme in March 1980. During the period from April 1980 through September 1981, fifty-two pre-serviced units were installed and eight service calls were made for minor repairs, such as stator replacement or small control element replacement. The Town of Temagami presently assesses each user $60.00 per pump/year to maintain a fund to partially cover the cost of service and repair to the grinder pumps.

Annual maintenance costs for the public sewers were estimated to be $2500 in September 1976 (excluding grinder pumps). After the initial operating period of March 1979 through July 1980 a thorough mechanical and electrical inspection was carried out to assess system condition and operation. The results of these inspections are included in Appendix III. Deficiencies consisted of flooding at nineteen valve chambers; faulty operation of heat tracing circuits (5 lengths of heat tracing and 4 thermostats) at sewer locations; and repairs required to chamber covers at ten locations. System operation has not been significantly affected by these malfunctions. Costs associated with upgrading the sewer system

(i.e. dealing with the above noted malfunctions) are expected for a prototype installation but not for a typical shallow buried pressure-sewer.

4.7.2.2 Summary of Operating and Maintenance Costs

Annual operating and maintenance costs for the public and private portions of the pressure-sewer system are summarized in Table 4.1.

TABLE 4.1

ANNUAL OPERATING AND MAINTENANCE COSTS

Services	-	public sewers heat tracing	$3,124.00 (1980-81)
(Electricity)	-	branch line heat-tracing	$0-$11.00/Bldg.
	-	grinder pump (residential)	$2.00-$8.00/pump
		(other)	$6.00-$30.00/pump
Materials	-	minor/major repairs (system)	$1,000.00±
	-	grinder pumps	$60.00/pump
Labour	-	operation (½ manday/week) @$20.00/hr	$4,160.00
	-	maintenance (1 manday/week) @$20.00/hr	$8,320.00

APPENDIX I

PUBLIC SEWER MAINS

HEAT TRACING ENERGY CONSUMPTION

JANUARY 1980 TO APRIL 1981

Table 2-2
3/3

PUBLIC SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	× TOTAL HOURS ON	× % TIME ON	TRACED PIPE DIA. (IN.)	
1	3802 x10	3740 x10	620	14	153' @ 4w/ft 350' @ 4w	2.012	310	92	2	
2	2916	2896	200	14	552' @ 4w	2.208	91	27	2	
3	3515	3471	440	14	300',290', 350' @ 4w	3.76	117	35	2 & 3	
4	2921	2895	260	14	432' @ 4w	1.728	150	45	2	
5	3461	3404	570	14	372' @ 2.5 w 399'+400' @ 4w	4.126	138	41	2 & 3	
7	0722	0706	160	14	399',274',274' @ 4w	3.788	42	13	3 & 4	
8	0106	0092	–	14	143' @ 2.5 w	0.358	–	–	2	
10	3146	3102	440	15	703' + 703' @ 4w	5.624	78	22	2 & 3	
14	4148	4087	610	13	255' + 540' @ 4w	3.18	192	62	2 & 3	
16/18	0958	0944	140	↓	250'+500' @ 4w 220'+300' @ 2.5	4.3	33	11	2 & 3	
21	2817	2768	490		395' @ 4w 380' @ 2.5 w	2.43	108	35	4	
22	0720	0655	650		580' + 550' @ 4 w	4.52	144	46	4	
23	1232	1222	100		236' + 638' @ 4w	3.496	29	9	4	
25	0028	0013	150		438' @ 2.5 w 450' @ 4w	2.995	50	16	2 & 3	
26	0983	0827	1560		595' @ 4w	2.38	–	–	2	FAULTY
28	7588	7564	240		700' @ 4w	2.8	86	28	2	
29/30	8683	8238	4450 *	↓	250' @ 4w 875'+900' @ 4w	7.725	–	–	2,3&4	FAULTY

JAMES F. MacLAREN LIMITED
TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Present Reading Date: 31 JAN. 80
Previous Reading Date: 17, 18, 19 JAN. 8
Recorded by: C. HUMPHREY

* INCLUDES 350 watt ENCLOSURE HEATER ASSUMED TO OPERATE 18hrs/day.

Table 2-2
3/3

PUBLIC SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	
1	3866x10	3802 x10	640	24	153' @ 4w/ft 350' @ 4w	2.012	318	55	2	
2	2923	2916	70		552' @ 4w	2.208	32	6	2	
3	3590	3515	750		300',290', 350' @ 4w	3.76	199	35	2 & 3	
4	2951	2921	300		432' @ 4w	1.728	174	30	2	
5	3527	3461	660		372' @ 2.5 w 399'+400' @ 4w	4.126	160	28	2 & 3	
7	0732	0722	100		399',274',274' @ 4w	3.788	26	5	3 & 4	
8	0108	0106	-		143' @ 2.5 w	0.358	-	-	2	FAULTY
10	3272	3146	1260		703' + 703' @ 4w	5.624	224	39	2 & 3	
14	4211	4148	630		255' + 540' @ 4w	3.18	198	34	2 & 3	
16/18	0967	0958	90		250'+500' @ 4w 220'+300' @ 2.5	4.3	21	4	2 & 3	
21	2862	2817	450		395' @ 4w 380' @ 2.5 w	2.43	185	9	4	
22	0770	0720	500		580' + 550' @ 4 w	4.52	111	19	4	
23	1235	1232	30		236' + 638' @ 4w	3.496	9	2	4	
25	0031	0028	30		438' @ 2.5 w 450' @ 4w	2.995	10	2	2 & 3	
26	1128	0938	1900		595' @ 4w	2.38	-	-	2	FAULTY
28	7603	7588	150		700' @ 4w	2.8	54	9	2	
29/30	9128	8683	4450 *	▼	250' @ 4w 875'+900' @ 4w	7.725	549	95	2,3&4	

JAMES F. MacLAREN LIMITED
TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Present Reading Date: 24 FEB. 1980
Previous Reading Date: 31 JAN. 1980
Recorded by: C. HUMPHREY

* INCLUDES 350 watt ENCLOSURE HEATER ASSUMED TO OPERATE 18hrs/day.

Table 2-2 PUBLIC SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

1/3

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	
1	3935 x10	3866 x10	690	36	153' @ 4w/ft 350' @ 4w	2.012	343	40	2	
2	2945	2923	220		552' @ 4w	2.208	97	11	2	
3	3673	3590	830		300',290', 350' @ 4w	3.76	220	25	2 & 3	
4	2966	2951	150		432' @ 4w	1.728	87	10	2	
5	3574	3527	470		372' @ 2.5 w 399'+400' @ 4w	4.126	114	13	2 & 3	
7	0742	0732	100		399',274',274' @ 4w	3.788	26	3	3 & 4	
8	0109	0108	-		143' @ 2.5 w	0.358	-	-	2	FAULTY
10	3326	3272	540		703' + 703' @ 4w	5.624	96	11	2 & 3	
14	4264	4211	530		255' + 540' @ 4w	3.18	167	19	2 & 3	
16/18	0967	0967	0		250'+500' @ 4w 220'+300' @ 2.5	4.3	0	0	2 & 3	
21	2928	2862	660		395' @ 4w 380' @ 2.5 w	2.43	272	31	4	
22	0841	0770	710		580' + 550' @ 4 w	4.52	157	18	4	
23	1240	1235	50		236' + 638' @ 4w	3.496	13	2	4	
25	0056	0031	250		438' @ 2.5 w 450' @ 4w	2.995	83	10	2 & 3	
26	1233	1128	1050		595' @ 4w	2.38	441	51	2	
28	7641	7603	380		700' @ 4w	2.8	136	16	2	
29/30	9575	9128	4470*		250' @ 4w 875'+900' @ 4w	7.725	549	64	2,3&4	

JAMES F. MacLAREN LIMITED
TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Present Reading Date: 31 MARCH 80
Previous Reading Date: 24 FEB. 80
Recorded by: C. HUMPHREY

* INCLUDES 350 watt ENCLOSURE HEATER ASSUMED TO OPERATE 18 hrs/day.

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMARKS
1	4095x10	3935x10	1600	28	153' @ 4w/ft 350' @ 4w	2.012	795	100	2	
2	2962	2945	170		552' @ 4w	2.208	77	11	2	
3	3737	3673	640		300',290', 350' @ 4w	3.76	170	25	2 & 3	
4	2966	2966	0		432' @ 4w	1.728	0	0	2	
5	3616	3574	420		372' @ 2.5 w 399'+400' @ 4w	4.126	102	15	2 & 3	
7	0743	0742	10		399',274',274' @ 4w	3.788	28	4	3 & 4	
8	0109	0109	0		143' @ 2.5 w	0.358	0	0	2	
10	3350	3326	240		703' + 703' @ 4w	5.624	43	6	2 & 3	
14	4307	4264	430		255' + 540' @ 4w	3.18	135	20.	2 & 3	
6/18	0971	0967	40		250'+500' @ 4w 220'+300' @ 2.5	4.3	9	1	2 & 3	
21	2971	2928	430		395' @ 4w 380' @ 2.5 w	2.43	177	26	4	
22	0842	0841	10		580' + 550' @ 4 w	4.52	2	0.3	4	
23	1241	1240	10		236' + 638' @ 4w	3.496	3	0.5	4	
25	0102	0056	460		438' @ 2.5 w 450' @ 4w	2.995	154	23	2 & 3	
26	1217	1133	840		595' @ 4w	2.38	353	53	2	
28	7668	7641	270		700' @ 4w	2.8	96	14	2	
9/30	9711	9575	1360		250' @ 4w 875'+900' @ 4w	7.725	176	26	2,3&4	

AMES F. MacLAREN LIMITED

EMAGAMI PRESSURE SEWER MONITORING PROGRAMME

28 days = 672 hrs.

Present Reading Date: APRIL 28 1980

Previous Reading Date: MARCH 31 1980

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

TER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMAR
1	4154 x10	4095 x10	590	15	153' @ 4w/ft 350' @ 4w	2.012	293	81	2	HEAT TRACING
2	3004	2962	420		552' @ 4w	2.208	190	53	2	TURNED ON JAN. 15 1981
3	3863	3738	1250		300',290', 350' @ 4w	3.76	332	92	2 & 3	
4	2973	2966	70		432' @ 4w	1.728	41	11	2	
5	3831	3619	2120		372' @ 2.5 w 399'+400' @ 4w	4.126	514	100	2 & 3	
7	0760	0743	170		399',274',274' @ 4w	3.788	45	13	3 & 4	
8	0104	0109	IGNORED		143' @ 2.5 w	0.358	–	–	2	
10	3350	3350	0		703' + 703' @ 4w	5.624	0	0	2 & 3	
14	4326	4307	190		255' + 540' @ 4w	3.18	60	17	2 & 3	
18	1012	0971	410		250'+500' @ 4w 220'+300' @ 2.5	4.3	95	26	2 & 3	
21	3163	2977	1860		395' @ 4w 380' @ 2.5 w	2.43	765	100	4	
22	1088	0842	2460		580' + 550' @ 4 w	4.52	544	100	4	
23	1253	1241	80		236' + 638' @ 4w	3.496	23	6	4	
25	0123	0102	210		438' @ 2.5 w 450' @ 4w	2.995	70	19	2 & 3	
26	1217	1217	0		595' @ 4w	2.38	0	0	2	
28	7681	7668	130		700' @ 4w	2.8	46	13	2	
30	0974	9850	11240		250' @ 4w 875'+900' @ 4w	7.725	1455	100	2,3&4	

ES F. MacLAREN LIMITED

PRESSURE SEWER MONITORING PROGRAMME

15 days = 360 hrs.

Present Reading Date: JAN. 30 1981

Previous Reading Date: JAN. 15 1981

Recorded by:

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMARK
1	4324 x10	4154 x10	1700	31	153' @ 4w/ft 350' @ 4w	2.012	845	100	2	
2	3044	3004	400		552' @ 4w	2.208	181	24	2	
3	3909	3863	460		300',290', 350' @ 4w	3.76	122	16	2 & 3	
4	2983	2973	100		432' @ 4w	1.728	58	8	2	
5	4047	3831	2160		372' @ 2.5 w 399'+400' @ 4w	4.126	524	70	2 & 3	
7	0794	0760	340		399',274',274' @ 4w	3.788	90	12	3 & 4	
8	0106	0104	20		143' @ 2.5 w	0.358	56	8	2	
10	3351	3350	10		703' + 703' @ 4w	5.624	2	0.27	2 & 3	
14	4349	4326	230		255' + 540' @ 4w	3.18	72	10	2 & 3	
6/18	1048	1012	360		250'+500' @ 4w 220'+300' @ 2.5	4.3	84	11	2 & 3	
21	3304	3163	1410		395' @ 4w 380' @ 2.5 w	2.43	580	80	4	
22	1342	1088	2540		580' + 550' @ 4 w	4.52	562	76	4	
23	1258	1253	50		236' + 638' @ 4w	3.496	14	2	4	
25	0147	0123	240		438' @ 2.5 w 450' @ 4w	2.995	80	11	2 & 3	
26	1217	1217	0		595' @ 4w	2.38	0	0	2	
28	7693	7681	120		700' @ 4w	2.8	43	6	2	
9/30	1573	0974	5990		250' @ 4w 875'+900' @ 4w	7.725	775	100	2,3&4	

GES F. MacLAREN LIMITED

MAGAMI PRESSURE SEWER MONITORING PROGRAMME

28 days = 672 hrs

Present Reading Date: FEB. 27 1981

Previous Reading Date: JAN 30 1981

Recorded by: _____ Sheet # 2 of 5

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMARKS
1	4503 x10	4324 x10	1790	32	153' @ 4w/ft 350' @ 4w	2.012	890	100	2	
2	3076	3044	320		552' @ 4w	2.208	318	41	2	
3	3949	3909	400		300',290', 350' @ 4w	3.76	106	14	2 & 3	
4	2992	2983	90		432' @ 4w	1.728	52	7	2	
5	4288	4047	2410		372' @ 2.5 w 399'+400' @ 4w	4.126	584	76	2 & 3	
7	0829	0794	350		399',274',274' @ 4w	3.788	92	12	3 & 4	
8	0107	0106	10		143' @ 2.5 w	0.358	28	4	2	
10	3351	3351	0		703' + 703' @ 4w	5.624	0	0	2 & 3	
14	4351	4349	20		255' + 540' @ 4w	3.18	6	1	2 & 3	
5/18	1086	1048	380		250'+500' @ 4w 220'+300' @ 2.5	4.3	88	11	2 & 3	
21	3463	3304	1590		395' @ 4w 380' @ 2.5 w	2.43	654	85	4	
22	1633	1342	2910		580' + 550' @ 4 w	4.52	644	84	4	
23	1260	1258	20		236' + 638' @ 4w	3.496	6	1	4	
25	0164	0147	170		438' @ 2.5 w 450' @ 4w	2.995	57	7	2 & 3	
26	1217	1217	0		595' @ 4w	2.38	0	0	2	
28	7706	7693	130		700' @ 4w	2.8	46	6	2	
9/30	2227	1573	6540		250' @ 4w 875'+900' @ 4w	7.725	847	100	2,3&4	

ES F. MacLAREN LIMITED

AGAMI PRESSURE SEWER MONITORING PROGRAMME

32 days = 768 hrs.

Present Reading Date: MAR. 31 1981

Previous Reading Date: FEB. 27 1981

Recorded by:

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMAR
1	4668 x10	4503 x10	1650	30	153' @ 4w/ft 350' @ 4w	2.012	820	100	2	
2	3080	3076	40		552' @ 4w	2.208	18	2.5	2	
3	3949	3949	0		300',290', 350' @ 4w	3.76	0	0	2 & 3	
4	2994	2992	20		432' @ 4w	1.728	11.6	1.6	2	
5	4340	4288	520		372' @ 2.5 w 399'+400' @ 4w	4.126	126	17.5	2 & 3	
7	0832	0829	130		399',274',274' @ 4w	3.788	34.3	4.8	3 & 4	
8	0113	0107	60		143' @ 2.5 w	0.358	167.6	23.3	2	
10	3353	3351	20		703' + 703' @ 4w	5.624	3.6	0.5	2 & 3	
14	4351	4351	0		255' + 540' @ 4w	3.18	0	0	2 & 3	
/18	1097	1086	110		250'+500' @ 4w 220'+300' @ 2.5	4.3	25.6	3.6	2 & 3	
21	3597	3463	1340		395' @ 4w 380' @ 2.5 w	2.43	551.4	76.6	4	
22	1880	1633	2470		580' + 550' @ 4 w	4.52	546.5	75.9	4	
23	1261	1260	10		236' + 638' @ 4w	3.496	2.9	0.4	4	
25	0179	0164	150		438' @ 2.5 w 450' @ 4w	2.995	50.1	7	2 & 3	
26	1217	1217	0		595' @ 4w	2.38	0	0	2	
28	7713	7706	70		700' @ 4w	2.8	25	3.5	2	
9/30	2857	2227	6300		250' @ 4w 875'+900' @ 4w	7.725	815.5	100	2,3&4	

ES F. MacLAREN LIMITED

ANGAMI PRESSURE SEWER MONITORING PROGRAMME

30 DAYS = 720 hrs.

Present Reading Date: APR. 30 1981

Previous Reading Date: MAR. 31 1981

Recorded by:

Sheet #

5 of 5

APPENDIX II

MONTHLY ENERGY CONSUMPTION FOR

PRIVATE SERVICE LINE HEAT TRACING

AND GRINDER-PUMPS

(10 LOCATIONS)

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3	112.26	0	112.26	4	0010	0	10	.36	50 gallon simplex
55*	22.2	210.20	0	210.20	7.5	0026	0	26	.93	"
79*	51.5	258.3	0	258.3	9.2	0011	0	11	.39	"
100	7.6	747.6	0	747.6	26.7	0025	0	25	.89	"
107	65.8	214.6	0	214.6	7.7	0012	0	12	.43	"
117	27.4	.1	0	.1	—	0013	0	13	.46	"
201*	2.4	.1	0	.1	—	0014	0	14	.5	"
218	15.2	810.4	0	810.4	28.9	0012	0	12	.43**	100 gal. duplex
228*	20.4	72.0	0	72.0	2.6	0015	0	15	.54**	100 gal. duplex
230*	7.3	144.4	0	144.4	5.2	0089	0	89	3.18**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Recorded by: D. GALLEY

Present Reading Date: 24 FEB. 80

Previous Reading Date: —

28 DAYS (ASSUMED)

Sheet # 1

Table 2-2
3/3

PUBLIC SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	
1	3866x10	3802 x10	640	24	153' @ 4w/ft 350' @ 4w	2.012	318	55	2	
2	2923	2916	70		552' @ 4w	2.208	32	6	2	
3	3590	3515	750		300',290', 350' @ 4w	3.76	199	35	2 & 3	
4	2951	2921	300		432' @ 4w	1.728	174	30	2	
5	3527	3461	660		372' @ 2.5 w 399'+400' @ 4w	4.126	160	28	2 & 3	
7	0732	0722	100		399',274',274' @ 4w	3.788	26	5	3 & 4	
8	0108	0106	–		143' @ 2.5 w	0.358	–	–	2	FAULTY
10	3272	3146	1260		703' + 703' @ 4w	5.624	224	39	2 & 3	
14	4211	4148	630		255' + 540' @ 4w	3.18	198	34	2 & 3	
16/18	0967	0958	90		250'+500' @ 4w 220'+300' @ 2.5	4.3	21	4	2 & 3	
21	2862	2817	450		395' @ 4w 380' @ 2.5 w	2.43	185	9	4	
22	0770	0720	500		580' + 550' @ 4 w	4.52	111	19	4	
23	1235	1232	30		236' + 638' @ 4w	3.496	9	2	4	
25	0031	0028	30		438' @ 2.5 w 450' @ 4w	2.995	10	2	2 & 3	
26	1128	0938	1900		595' @ 4w	2.38	–	–	2	FAULTY
28	7603	7588	150		700' @ 4w	2.8	54	9	2	
29/30	9128	8683	4450 *	▼	250' @ 4w 875'+900' @ 4w	7.725	549	95	2,3&4	

JAMES F. MacLAREN LIMITED
TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Present Reading Date: 24 FEB. 1980
Previous Reading Date: 31 JAN. 1980
Recorded by: C. HUMPHREY

* INCLUDES 350 watt ENCLOSURE HEATER ASSUMED TO OPERATE 18hrs/day.

Table 2-2
1/3

PUBLIC SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	
1	3935 x10	3866 x10	690	36	153' @ 4w/ft 350' @ 4w	2.012	343	40	2	
2	2945	2923	220		552' @ 4w	2.208	97	11	2	
3	3673	3590	830		300',290', 350' @ 4w	3.76	220	25	2 & 3	
4	2966	2951	150		432' @ 4w	1.728	87	10	2	
5	3574	3527	470		372' @ 2.5 w 399'+400' @ 4w	4.126	114	13	2 & 3	
7	0742	0732	100		399',274',274' @ 4w	3.788	26	3	3 & 4	
8	0109	0108	-		143' @ 2.5 w	0.358	-	-	2	FAULTY
10	3326	3272	540		703' + 703' @ 4w	5.624	96	11	2 & 3	
14	4264	4211	530		255' + 540' @ 4w	3.18	167	19	2 & 3	
16/18	0967	0967	0		250'+500' @ 4w 220'+300' @ 2.5	4.3	0	0	2 & 3	
21	2928	2862	660		395' @ 4w 380' @ 2.5 w	2.43	272	31	4	
22	0841	0770	710		580' + 550' @ 4 w	4.52	157	18	4	
23	1240	1235	50		236' + 638' @ 4w	3.496	13	2	4	
25	0056	0031	250		438' @ 2.5 w 450' @ 4w	2.995	83	10	2 & 3	
26	1233	1128	1050		595' @ 4w	2.38	441	51	2	
28	7641	7603	380		700' @ 4w	2.8	136	16	2	
29/30	9575	9128	447 0*	↓	250' @ 4w 875'+900' @ 4w	7.725	549	64	2,3&4	

JAMES F. MacLAREN LIMITED
TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Present Reading Date: 31 MARCH 80
Previous Reading Date: 24 FEB. 80
Recorded by: C. HUMPHREY

* INCLUDES 350 watt ENCLOSURE HEATER ASSUMED TO OPERATE 18 hrs/day.

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMARK
1	4095x10	3935x10	1600	28	153' @ 4w/ft 350' @ 4w	2.012	795	100	2	
2	2962	2945	170		552' @ 4w	2.208	77	11	2	
3	3737	3673	640		300',290', 350' @ 4w	3.76	170	25	2 & 3	
4	2966	2966	0		432' @ 4w	1.728	0	0	2	
5	3616	3574	420		372' @ 2.5 w 399'+400' @ 4w	4.126	102	15	2 & 3	
7	0743	0742	10		399',274',274' @ 4w	3.788	28	4	3 & 4	
8	0109	0109	0		143' @ 2.5 w	0.358	0	0	2	
10	3350	3326	240		703' + 703' @ 4w	5.624	43	6	2 & 3	
14	4307	4264	430		255' + 540' @ 4w	3.18	135	20.	2 & 3	
16/18	0971	0967	40		250'+500' @ 4w 220'+300' @ 2.5	4.3	9	1	2 & 3	
21	2971	2928	430		395' @ 4w 380' @ 2.5 w	2.43	177	26	4	
22	0842	0841	10		580' + 550' @ 4 w	4.52	2	0.3	4	
23	1241	1240	10		236' + 638' @ 4w	3.496	3	0.5	4	
25	0102	0056	460		438' @ 2.5 w 450' @ 4w	2.995	154	23	2 & 3	
26	1217	1133	840		595' @ 4w	2.38	353	53	2	
28	7668	7641	270		700' @ 4w	2.8	96	14	2	
29/30	9711	9575	1360		250' @ 4w 875'+900' @ 4w	7.725	176	26	2,3&4	

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

28 days = 672 hrs.

Present Reading Date: APRIL. 28 1980

Previous Reading Date: MARCH 31 1980

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMARKS
1	4154 x10	4095 x10	590	15	153' @ 4w/ft 350' @ 4w	2.012	293	81	2	HEAT TRACING
2	3004	2962	420		552' @ 4w	2.208	190	53	2	TURNED ON JAN. 15 1981
3	3863	3738	1250		300',290', 350' @ 4w	3.76	332	92	2 & 3	
4	2973	2966	70		432' @ 4w	1.728	41	11	2	
5	3831	3619	2120		372' @ 2.5 w 399'+400' @ 4w	4.126	514	100	2 & 3	
7	0760	0743	170		399',274',274' @ 4w	3.788	45	13	3 & 4	
8	0104	0109	IGNORED		143' @ 2.5 w	0.358	-	-	2	
10	3350	3350	0		703' + 703' @ 4w	5.624	0	0	2 & 3	
14	4326	4307	190		255' + 540' @ 4w	3.18	60	17	2 & 3	
18	1012	0971	410		250'+500' @ 4w 220'+300' @ 2.5	4.3	95	26	2 & 3	
21	3163	2977	1860		395' @ 4w 380' @ 2.5 w	2.43	765	100	4	
22	1088	0842	2460		580' + 550' @ 4 w	4.52	544	100	4	
23	1253	1241	80		236' + 638' @ 4w	3.496	23	6	4	
25	0123	0102	210		438' @ 2.5 w 450' @ 4w	2.995	70	19	2 & 3	
26	1217	1217	0		595' @ 4w	2.38	0	0	2	
28	7681	7668	130		700' @ 4w	2.8	46	13	2	
30	0974	9850	11240		250' @ 4w 875'+900' @ 4w	7.725	1455	100	2,3&4	

ES F. MacLAREN LIMITED

MASSEY PRESSURE SEWER MONITORING PROGRAMME

15 days = 360 hrs.

Present Reading Date: JAN. 30 1981

Previous Reading Date: JAN. 15 1981

Recorded by:

Sheet # 2 of 5

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMARKS
1	4324 x10	4154 x10	1700	31	153' @ 4w/ft 350' @ 4w	2.012	845	100	2	
2	3044	3004	400		552' @ 4w	2.208	181	24	2	
3	3909	3863	460		300',290', 350' @ 4w	3.76	122	16	2 & 3	
4	2983	2973	100		432' @ 4w	1.728	58	8	2	
5	4047	3831	2160		372' @ 2.5 w 399'+400' @ 4w	4.126	524	70	2 & 3	
7	0794	0760	340		399',274',274' @ 4w	3.788	90	12	3 & 4	
8	0106	0104	20		143' @ 2.5 w	0.358	56	8	2	
10	3351	3350	10		703' + 703' @ 4w	5.624	2	0.27	2 & 3	
14	4349	4326	230		255' + 540' @ 4w	3.18	72	10	2 & 3	
6/18	1048	1012	360		250'+500' @ 4w 220'+300' @ 2.5	4.3	84	11	2 & 3	
21	3304	3163	1410		395' @ 4w 380' @ 2.5 w	2.43	580	80	4	
22	1342	1088	2540		580' + 550' @ 4 w	4.52	562	76	4	
23	1258	1253	50		236' + 638' @ 4w	3.496	14	2	4	
25	0147	0123	240		438' @ 2.5 w 450' @ 4w	2.995	80	11	2 & 3	
26	1217	1217	0		595' @ 4w	2.38	0	0	2	
28	7693	7681	120		700' @ 4w	2.8	43	6	2	
9/30	1573	0974	5990		250' @ 4w 875'+900' @ 4w	7.725	775	100	2,3&4	

AGRES F. MacLAREN LIMITED

EMAGAMI PRESSURE SEWER MONITORING PROGRAMME

28 days = 672 hrs

Present Reading Date: FEB. 27 1981

Previous Reading Date: JAN 30 1981

Recorded by:

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMARK
1	4503 x10	4324 x10	1790	32	153' @ 4w/ft 350' @ 4w	2.012	890	100	2	
2	3076	3044	320		552' @ 4w	2.208	318	41	2	
3	3949	3909	400		300',290', 350' @ 4w	3.76	106	14	2 & 3	
4	2992	2983	90		432' @ 4w	1.728	52	7	2	
5	4288	4047	2410		372' @ 2.5 w 399'+400' @ 4w	4.126	584	76	2 & 3	
7	0829	0794	350		399',274',274' @ 4w	3.788	92	12	3 & 4	
8	0107	0106	10		143' @ 2.5 w	0.358	28	4	2	
10	3351	3351	0		703' + 703' @ 4w	5.624	0	0	2 & 3	
14	4351	4349	20		255' + 540' @ 4w	3.18	6	1	2 & 3	
5/18	1086	1048	380		250'+500' @ 4w 220'+300' @ 2.5	4.3	88	11	2 & 3	
21	3463	3304	1590		395' @ 4w 380' @ 2.5 w	2.43	654	85	4	
22	1633	1342	2910		580' + 550' @ 4 w	4.52	644	84	4	
23	1260	1258	20		236' + 638' @ 4w	3.496	6	1	4	
25	0164	0147	170		438' @ 2.5 w 450' @ 4w	2.995	57	7	2 & 3	
26	1217	1217	0		595' @ 4w	2.38	0	0	2	
28	7706	7693	130		700' @ 4w	2.8	46	6	2	
9/30	2227	1573	6540		250' @ 4w 875'+900' @ 4w	7.725	847	100	2,3&4	

32 days = 768 hrs.

Present Reading Date: MAR. 31 1981

Previous Reading Date: FEB. 27 1981

Recorded by: _____ Sheet #

TABLE 2-1

PRESSURE SEWER MAINS - HEAT TRACING ENERGY CONSUMPTION (MONTHLY)

METER #	PRESENT READING (kWh)	PREVIOUS READING (kWh)	TRACER ENERGY CONSUMPTION (kWh)	NO. OF DAYS	LENGTH AND RATING OF TRACER RUN (ft. @ W/ft.)	TOTAL TRACER POWER RATING (kW)	TOTAL HOURS ON	% TIME ON	TRACED PIPE DIA. (IN.)	REMAR
1	4668 x10	4503 x10	1650	30	153' @ 4w/ft 350' @ 4w	2.012	820	100	2	
2	3080	3076	40		552' @ 4w	2.208	18	2.5	2	
3	3949	3949	0		300',290', 350' @ 4w	3.76	0	0	2 & 3	
4	2994	2992	20		432' @ 4w	1.728	11.6	1.6	2	
5	4340	4288	520		372' @ 2.5 w 399'+400' @ 4w	4.126	126	17.5	2 & 3	
7	0832	0829	130		399',274',274' @ 4w	3.788	34.3	4.8	3 & 4	
8	0113	0107	60		143' @ 2.5 w	0.358	167.6	23.3	2	
10	3353	3351	20		703' + 703' @ 4w	5.624	3.6	0.5	2 & 3	
14	4351	4351	0		255' + 540' @ 4w	3.18	0	0	2 & 3	
/18	1097	1086	110		250'+500' @ 4w 220'+300' @ 2.5	4.3	25.6	3.6	2 & 3	
21	3597	3463	1340		395' @ 4w 380' @ 2.5 w	2.43	551.4	76.6	4	
22	1880	1633	2470		580' + 550' @ 4 w	4.52	546.5	75.9	4	
23	1261	1260	10		236' + 638' @ 4w	3.496	2.9	0.4	4	
25	0179	0164	150		438' @ 2.5 w 450' @ 4w	2.995	50.1	7	2 & 3	
26	1217	1217	0		595' @ 4w	2.38	0	0	2	
28	7713	7706	70		700' @ 4w	2.8	25	3.5	2	
9/30	2857	2227	6300		250' @ 4w 875'+900' @ 4w	7.725	815.5	100	2,3&4	

ES F. MacLAREN LIMITED

AGAMI PRESSURE SEWER MONITORING PROGRAMME

30 DAYS = 720 hrs.

Present Reading Date: APR. 30 1981

Previous Reading Date: MAR. 31 1981

Recorded by:

APPENDIX II

MONTHLY ENERGY CONSUMPTION FOR

PRIVATE SERVICE LINE HEAT TRACING

AND GRINDER-PUMPS

(10 LOCATIONS)

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3	112.26	0	112.26	4	0010	0	10	.36	50 gallon simplex
55*	22.2	210.20	0	210.20	7.5	0026	0	26	.93	"
79*	51.5	258.3	0	258.3	9.2	0011	0	11	.39	"
100	7.6	747.6	0	747.6	26.7	0025	0	25	.89	"
107	65.8	214.6	0	214.6	7.7	0012	0	12	.43	"
117	27.4	.1	0	.1	—	0013	0	13	.46	"
201*	2.4	.1	0	.1	—	0014	0	14	.5	"
218	15.2	810.4	0	810.4	28.9	0012	0	12	.43**	100 gal. duplex
228*	20.4	72.0	0	72.0	2.6	0015	0	15	.54**	100 gal. duplex
230*	7.3	144.4	0	144.4	5.2	0089	0	89	3.18**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Recorded by: D. GALLEY

Present Reading Date: 24 FEB 80

Previous Reading Date: —

28 DAYS (ASSUMED)

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3	169.81	112.26	57.55	1.9	0022	0010	12	.4	50 gallon simplex
55*	22.2	244.0	210.20	33.8	1.1	0039	0026	13	.4	"
79*	51.5	647.0	258.3	388.7	12.9	0021	0011	10	.3	"
100	7.6	1447.6	747.6	700	23.3	0032	0025	7	.2	"
107	65.8	452.8	214.6	238.2	7.9	0022	0012	10	.3	"
117	27.4	.1	.1	ϕ		0024	0013	11	.4	"
201*	2.4	.1	.1	ϕ		0026	0014	12	.4	"
218	15.2	1433	810.4	622.6	20.8	0022	0012	10	.3**	100 gal. duplex
228*	20.4	136.4	72.0	64.4	2.1	0024	0015	9	.3**	100 gal. duplex
230*	7.3	281.1	144.4	136.7	4.6	0143	0089	54	1.8**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. CALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 25 MAR. 80

Previous Reading Date: 24 FEB. 80

30 DAYS

Sheet # 2

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3	208.3	169.8	38.5	1.4	0028	0022	6	.2	50 gallon simplex
55*	22.2	313.8	244.0	69.8	2.5	0041	0039	2	.07	"
79*	51.5	817.3	647.0	170.3	6.1	0028	0021	7	.25	"
100	7.6	2014.9	1447.6	567.3	20.3	0045	0032	13	.46	"
107	65.8	628.6	452.8	175.8	6.3	0031	0022	9	.32	"
117	27.4	.1	.1	ϕ		0034	0024	10	.36	"
201*	2.4	.1	.1	ϕ		0038	0026	12	.43	"
218	15.2	2010.3	1433	577.3	20.6	0040	0022	18	.64**	100 gal. duplex
228*	20.4	155.3	136.4	18.9	.7	0035	0024	11	.39**	100 gal. duplex
230*	7.3	321.9	281.1	40.8	1.5	0188	0143	45	1.61**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

***Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 18 APR. 80

Previous Reading Date: 25 MAR. 80

24 DAYS

Sheet # 3

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3	223.2	208.3	14.9	1.5	0033	0028	5	.5	50 gallon simplex
55*	22.2	343.1	313.8	29.3	2.9	0046	0041	5	.5	"
79*	51.5	892.6	817.3	75.3	7.5	0031	0028	3	.3	"
100	7.6	2053.3	2014.9	38.4	3.8	0050	0045	5	.5	"
107	65.8	652.7	628.6	24.1	2.4	0035	0031	4	.4	"
117	27.4	.1	.1	ϕ		0039	0034	5	.5	"
201*	2.4	.1	.1	ϕ		0042	0038	4	.4	"
218	15.2	2272.2	2010.3	261.9	26.2	0051	0040	11	1.1**	100 gal. duplex
228*	20.4	175.0	155.3	19.7	1.9	0038	0035	3	.3**	100 gal. duplex
230*	7.3	321.9	321.9	ϕ		0204	0188	16	1.6**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 28 APR. 80

Previous Reading Date: 18 APR. 80

10 DAYS

Sheet # 4

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3	238.4	223.2	15.2	.5	0044	0033	11	.3	50 gallon simplex
55*	22.2	348.1	343.1	5	.2	0062	0046	16	.5	"
79*	51.5	931.4	892.6	38.8	1.2	0042	0031	11	.3	"
100	7.6	2053.3	2053.3	ϕ		0064	0050	14	.4	"
107	65.8	661.0	652.7	8.3	.3	0048	0035	13	.4	"
117	27.4	.1	.1	ϕ		0053	0039	14	.4	"
201*	2.4	.1	.1	ϕ		0057	0042	15	.5	"
218	15.2	2652.9	2272.2	FAULTY		0082	0051	29	.9**	100 gal. duplex
228*	20.4	176.4	175.0	1.4	.04	0059	0038	21	.7**	100 gal. duplex
230*	7.3	351.4	321.9	29.5	.9	0270	0204	66	2.1**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Recorded by: D. GALLEY

Present Reading Date: 30 MAY 80

Previous Reading Date: 28 APR 80

32 DAYS

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3	238.4	238.4	ϕ	0	0046	0044	2	.06	50 gallon simplex
55*	22.2	348.1	3481	ϕ	0	0078	0062	16	.5	"
79*	51.5	932.1	932.1	ϕ	0	0053	0042	11	.34	"
100	7.6	2053.3	2053.3	ϕ	0	0078	0064	14	.44	"
107	65.8	663.3	661.0	2.3	0.07	0060	0048	12	.38	"
117	27.4	.1	.1	ϕ	0	0067	0053	14	.44	"
201*	2.4	.1	.1	ϕ	0	0070	0057	13	.41	"
218	15.2	2652.9	2652.9	ϕ	0	—	—	—	—**	100 gal. duplex
228*	20.4	176.4	176.4	ϕ	0	0060	0059	1	.03**	100 gal. duplex
230*	7.3	351.4	351.4	ϕ	0	0334	0270	64	2**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 1 JULY 80

Previous Reading Date: 30 MAY 80

32 DAYS

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3			ϕ		0049	0046	3	.09	50 gallon simplex
55*	22.2			ϕ		0105	0078	27	.77	"
79*	51.5			ϕ		0078	0053	25	.71	"
100	7.6			ϕ		0104	0078	26	.74	"
107	65.8			ϕ		0073	0060	13	.37	"
117	27.4			ϕ		0080	0067	13	.37	"
201*	2.4			ϕ		0087	0070	17	.49	"
218	15.2			ϕ		0168	0082	86 (FOR 66 DAYS)	1.3 **	100 gal. duplex
228*	20.4			ϕ		0080	0060	20	.57 **	100 gal. duplex
230*	7.3			ϕ		0407	0334	73	2.09 **	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 5 AUG. 80

Previous Reading Date: 1 JULY 80

35 DAYS

Sheet # 7

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3			ϕ		0051	0049	2	.07	50 gallon simplex
55*	22.2			ϕ		0124	0105	19	.68	"
79*	51.5			ϕ		0078	0078	0	0	"
100	7.6			ϕ		0106	0104	2	.07	"
107	65.8			ϕ		0084	0073	11	.39	"
117	27.4			ϕ		0090	0080	10	.36	"
201*	2.4			ϕ		0100	087	13	.46	"
218	15.2			ϕ		0273	0168	105	3.75**	100 gal. duplex
228*	20.4			ϕ		0090	0080	10	.36**	100 gal. duplex
230*	7.3			ϕ		0470	0407	63	2.25**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Recorded by: D. GALLEY

Present Reading Date: 2 SEPT. 80

Previous Reading Date: 5 AUG. 80

28 DAYS

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3			ϕ		0053	0051	2	.0	50 gallon simplex
55*	22.2			ϕ		0139	0124	15	.6	"
79*	51.5	935.3	932.1	3.2	.1	0087	0078	9	.3	"
100	7.6			ϕ		0117	0106	11	.4	"
107	65.8			ϕ		0095	0084	11	.4	"
117	27.4			ϕ		0109	0090	19	.7	"
201*	2.4			ϕ		0112	0100	12	.4	"
218	15.2			ϕ		—	0273	—	**	100 gal. duplex
228*	20.4			ϕ		0108	0090	18	.7 **	100 gal. duplex
230*	7.3			ϕ		0544	0470	74	2.7 **	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: P. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 29 SEPT. 80

Previous Reading Date: 2 SEPT. 80

27 DAYS

Sheet # 9

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3			∅		0055	0053	2	.07	50 gallon simplex
55*	22.2	352.1	348.1	4	.14	0156	0139	17	.6	"
79*	51.5	951.7	935.3	16.4	.59	0097	0087	10	.36	"
100	7.6			∅		0129	0117	12	.43	"
107	65.8	670.6	663.5	7.1	.25	0107	0095	12	.43	"
117	27.4			∅		0110	0109	1	.04	"
201*	2.4			∅		0123		11	.4	"
218	15.2			∅		-	-	-	-**	100 gal. duplex
228*	20.4			∅		0127	0108	19	.67**	100 gal. duplex
230*	7.3			∅		0594	0544	50	1.79**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 27 OCT. 80

Previous Reading Date: 29 SEPT. 80

28 DAYS

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3			ϕ		0057	0055	2	.07	50 gallon simplex
55*	22.2	861.3	352.1	509.2	18.2	0167	0156	9	.33	"
79*	51.5	1032.2	951.7	80.5	2.9	0117	0097	20	.74	"
100	7.6			ϕ		0140	0129	11	.41	"
107	65.8	703.5	670.6	32.9	1.2	0118	0107	11	.41	"
117	27.4	4.3	.1	3.2	.1	0120	0110	10	.37	"
201*	2.4			ϕ		0135	0123	12	.44	"
218	15.2			ϕ		-	0298	-	- **	100 gal. duplex
228*	20.4	177.1	176.4	.7	.03	0139	0127	12	.44 **	100 gal. duplex
230*	7.3	421.0	351.4	69.6	2.5	0	0594	46	1.7 **	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 24 NOV 80

Previous Reading Date: 27 OCT 80

28 DAYS

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3	245.8	238.5	7.3	.17	0061	0057	4	.09	50 gallon simplex
55*	22.2	861.3	861.3	ϕ		0186	0167	19	.4	"
79*	51.5	1397.0	1032.2	364.8	8.5	0122	0117	5	.11	"
100	7.6			ϕ		0170	0140	30	.64	"
107	65.8	902.9	703.5	201.4	4.3	0135	0118	17	.36	"
117	27.4	5.2	4.3	.9	.02	0135	0120	15	.32	"
201*	2.4			ϕ		0152	0135	17	.36	"
218	15.2			ϕ		0225	0298	—	— **	100 gal. duplex
228*	20.4	241.1	177.1	64	1.36	0153	0139	14	.3 **	100 gal. duplex
230*	7.3	933.3	421.0	512.3	10.9	0760	0640	120	2.55 **	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 6 JAN. 81

Previous Reading Date: 24 NOV. 80

43 DAYS

Sheet # 12

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3	252.2	245.8	6.4	2.1	0063	0061	2	.08	50 gallon simplex
55*	22.2			ϕ		0202	0186	16	.67	"
79*	51.5	1622.0	1397.0	225	9.4	0130	0122	8	.33	"
100	7.6			ϕ			0170		.62	"
107	65.8	1041.0	902.9	138.1	5.8	0143	0135	8	.33	"
117	27.4			ϕ		0145	0135	10	.42	"
201*	2.4			ϕ		0162	0152	10	.42	"
218	15.2			ϕ			0225	—	—**	100 gal. duplex
228*	20.4	285.9	241.1	44.8	1.9	0161	0153	8	.33**	100 gal. duplex
230*	7.3	1087.6	933.3	154.3	6.4	0814	0763	54	2.3**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 30 JAN. 81

Previous Reading Date: 6 JAN. 81

24 DAYS

Sheet # 18

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3		252.2			—	0063	—	—	50 gallon simplex
55*	22.2			ϕ		0207	0202	5	.18	"
79*	51.5	1839.2	1622.	217.2	7.76	0140	0130	10	.36	"
100	7.6			ϕ		0204	0170	(55 DAYS) 34	.62	"
107	65.8	1252.5	1041.0	211.5	7.55	0157	0143	6	.21	"
117	27.4	10,3	5.2	5.1	.19	0153	0145	8	.28	"
201*	2.4			ϕ		0174	0162	12	.43	"
218	15.2			ϕ		0243	0225	(55 DAYS) 18	.32**	100 gal. duplex
228*	20.4	313.4	285.9	27.5	.98	0170	0161	9	.32**	100 gal. duplex
230*	7.3	1147.8	1087.6	60.2	2.15	0850	0814	36	1.28**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 27 FEB. 81

Previous Reading Date: 30 JAN. 81

28 DAYS

Sheet # 14

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3	336.7	252.2	(60 DAYS) 84.5	1.4	0067	0063	(61 DAYS) 4	.07	50 gallon simplex
55*	22.2			ϕ		0226	0207	19	.59	"
79*	51.5	2177.3	1839.2	338.1	10.6	0151	0140	11	.34	"
100	7.6			ϕ		0281	0204	77	2.41	"
107	65.8	1353.7	1252.5	101.2	3.4	0171	0157	14	.44	"
117	27.4			ϕ		0164	0153	11	.34	"
201*	2.4			ϕ		0187	0174	13	.41	"
218	15.2			ϕ		0260	0243	17 (35 DAYS)	.53**	100 gal. duplex
228*	20.4	339.5	313.4	26.1	.9	0181	0170	11	.34**	100 gal. duplex
230*	7.3	1179.1	1147.8	31.3	1	0889	0850	39	1.22**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Recorded by: D. GALLEY

Present Reading Date: 31 MAR. 81

Previous Reading Date: 27 FEB. 81

32 DAYS

Sheet # 15

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	HEAT TRACING METER RDG.(HRS.) PREVIOUS	HEAT TRACING METER RDG.(HRS.) DURATION	AVERAGE TIME ON (HRS/DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	GRINDER PUMP METER RDG.(kWh) PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3	366.7	336.7	30	1	0070	0067	3	.1	50 gallon simplex
55*	22.2			ϕ		0243	0226	17	.57	"
79*	51.5	2520.6	2177.3	343.3	11.4	0163	0151	12	.4	"
100	7.6			ϕ		0283	0281	2	.07	"
107	65.8	1394.7	1353.7	41	1.4	0184	0171	13	.43	"
117	27.4			ϕ		0175	0164	11	.37	"
201*	2.4			ϕ		0202	0187	15	.5	"
218	15.2			ϕ		0271	0260	(27 DAYS) 11	.41**	100 gal. duplex
228*	20.4	340.2	339.5	.7	.02	0192	0181	11	.37**	100 gal. duplex
230*	7.3	1186.5	1179.1	7.4	.25	0923	0889	34	1.13**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

***Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 30 APR. 81

Previous Reading Date: 31 MAR 81

30 DAYS

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3			ϕ		0073	0070	3	.1	50 gallon simplex
55*	22.2			ϕ		0258	0243	15	.52	"
79*	51.5	2572.7	2520.6	52.1	1.8	0174	0163	11	.38	"
100	7.6			ϕ		0284	0283	1	.03	"
107	65.8	1399.6	1394.7	4.9	.17	0198	0184	14	.48	"
117	27.4			ϕ		0185	0175	10	.34	"
201*	2.4			ϕ		0216	0202	14	.48	"
218	15.2			ϕ		0295	0271	24	.83**	100 gal. duplex
228*	20.4			ϕ		0203	0192	11	.38**	100 gal. duplex
230*	7.3	1189.2	1186.3	2.7	.09	0968	0923	45	1.55**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 29 MAY 81

Previous Reading Date: 30 APR. 81

29 DAYS

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3			ϕ		0076	0073	3	.08	50 gallon simplex
55*	22.2			ϕ		0277	0258	19	.5	"
79*	51.5			ϕ		0189	0174	15	.39	"
100	7.6			—		—	0284	—	—	"
107	65.8			ϕ		0213	0198	15	.39	"
117	27.4			ϕ		0205	0185	20	.5[illegible]	"
201*	2.4			ϕ		0234	0216	18	.47	"
218	15.2			—		—	0295	—	—**	100 gal. duplex
228*	20.4			ϕ		0219	0203	16	.42**	100 gal. duplex
230*	7.3			ϕ		1062	0968	94	2.47**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Recorded by: _____

Present Reading Date: 7 JULY 81

Previous Reading Date: 29 MAY 81

38 DAYS

Sheet # 18

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.** (kWh)	REMARKS
18*	18.3			ϕ		0078	0076	2	.1	50 gallon simplex
55*	22.2			ϕ		0289	0277	12	.5	"
79*	51.5			ϕ		0199	0189	10	.4	"
100	7.6			ϕ		0277	—	—	—	"
107	65.8			ϕ		0223	0213	10	.4	"
117	27.4			ϕ		0207	0205	2	.1	"
201*	2.4			ϕ		0245	0234	11	.5	"
218	15.2			ϕ		0358	0295	(62 DAYS) 63	1.1**	100 gal. duplex
228*	20.4			ϕ		0233	0219	14	.6**	100 gal. duplex
230*	7.3			ϕ		1121	1062	59	2.5**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: _____

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

**Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 31 JULY 81

Previous Reading Date: 7 JULY 81

24 DAYS

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG. (HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG. (kWh) PRESENT	PREVIOUS	ENERGY CONS. (kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3			ϕ		0081	0078	3	.1	50 gallon simplex
55*	22.2			ϕ		0304	0289	15	.5	"
79*	51.5			ϕ		0200	0199	1	.04	"
100	7.6			ϕ		AWAY	0277	–	–	"
107	65.8			ϕ		0234	0223	11	.4	"
117	27.4			ϕ		AWAY	0207	–	–	"
201*	2.4			ϕ		0269	0245	24	.9	"
218	15.2			ϕ		0362	0358	4	.1**	100 gal. duplex
228*	20.4			ϕ		0252	0233	19	.7**	100 gal. duplex
230*	7.3			ϕ		1386	1121	265	9.5**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

*Dual pumps installed: energy consumption shown is for one pump only.

*Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 28 AUG. 81

Previous Reading Date: 31 JULY 81

28 DAYS

PRIVATE SERVICE LINE - HEAT TRACING & GRINDER PUMP ENERGY CONSUMPTION (MONTHLY)

BLDG. NO.	SERVICE LINE LENGTH (m)	HEAT TRACING METER RDG.(HRS.) PRESENT	PREVIOUS	DURATION	AVERAGE TIME ON (HRS/ DAY)	GRINDER PUMP METER RDG.(kWh) PRESENT	PREVIOUS	ENERGY CONS.(kWh)	AVERAGE DAILY ENERGY CONS.*** (kWh)	REMARKS
18*	18.3			ϕ		0084	0081	3	.09	50 gallon simplex
55*	22.2			ϕ		VACANT	0304	—	—	"
79*	51.5			ϕ		0221	0200	21	.64	"
100	7.6			ϕ		AWAY		—	—	"
107	65.8			ϕ		0248	0234	14	.42	"
117	27.4			ϕ		0229	0207	(61 DAYS) 22	.36	"
201*	2.4			ϕ		0274	0269	5	.15	"
218	15.2			ϕ		0376	0362	14	.42**	100 gal. duplex
228*	20.4			ϕ		0277	0252	25	.76**	100 gal. duplex
230*	7.3			ϕ		1480	1386	94	2.85**	2-100 gal. simplex

JAMES F. MacLAREN LIMITED

TEMAGAMI PRESSURE SEWER MONITORING PROGRAMME

Recorded by: D. GALLEY

*Pressure/event recorder locations

**Dual pumps installed: energy consumption shown is for one pump only.

***Includes pump core resistance heater (20w) operating continuously.

Notes: 1. Tracing rating: 2 w/ft.
2. Service line dia.: 1-1/2"

Present Reading Date: 30 SEPT. 81

Previous Reading Date: 28 AUG. 81

33 DAYS

APPENDIX III

RESULTS OF ELECTRICAL AND MECHANICAL INSPECTION - JULY 1980

ELECTRICAL INSPECTION - TEMAGAMI LOW PRESSURE SEWER

July 30, 1980

APPENDIX III

VALVE CHAMBER NO. 1

Thermostat A

- Functions properly
- 240 volt heat tracer west: Volts - 238
  Amps - 3.91
  Megger - ∞
- Metering cabinet leaks and needs paint
- Thermostat cabinet needs paint and lock needs oil.

Thermostat B

- Functions properly
- 240 volt heat tracer towards VC #3: Volts - 238
  Amps - 8.14
  Megger - 0 to grd.

VALVE CHAMBER NO. 2

- Metering cabinet needs paint
- Thermostat cabinet needs paint

Thermostat A

- Functions properly
- 240 volt heat tracer west (BLK): Volts - 237
  Amps - 1.41
  Megger - 15 M Ω to grd.

- 240 volt heat tracer east (Yel) Volts - 237
  Amps - 8.55
  Megger - ∞

VALVE CHAMBER NO. 3

- Metering cabinet needs paint
- Thermostat cabinet was hit with backhoe and needs complete overhaul

Thermostat A (Electronic) Does not function properly.

- 240 volt heat tracer towards VC #1: Volts - 244
  Amps - 6.13
  Megger - 0 to grd.
- Thermostat sensor TH-3 and TH-4 have 0 ground fault.

Thermostat B Does not function properly

- 240 volt heat tracer toward VC #4: Volts - 244
  Amps - 3.25
  Megger - 0 to grd.

Thermostat C (Electronic) Does not function properly

- 240 volt heat tracer towards VC #5: Volts - 244
  Amps - 9.32
  Megger - 0 to grd.
- Thermostat sensors TH-1, TH-2, TH-3, TH-4, Meg 0 to grd.
- Thermostat contactor is overheating

VALVE CHAMBER NO. 4

- Metering cabinet needs paint
- Thermostat cabinet needs paint

Thermostat A - Functions properly

- 240 volt heat tracer towards VC #3 - Volts - 241
  Amps - 7.72
  Megger - ∞ to grd.

VALVE CHAMBER NO. 5

- Metering cabinet needs paint
- Thermostat cabinet needs paint
- 1-1/4" conduit below metering cabinet is broken

Thermostat A - Functions properly

- 240 volt heat tracer towards VC #3: Volts - 238
  Amps - 8.04
  Megger - ∞ to grd.

Thermostat B - Functions properly

- 240 volt heat tracer towards VC #7 - Volts - 238
  Amps - 4.22
  Megger - 0 to grd.

Thermostat C - Functions properly

- 120 volt heat tracer towards VC #6 - Volts - 116
  Amps - 4.38
  Megger - 1 meg. ohm to grd.

VALVE CHAMBER NO. 7

- Thermostat cabinet needs paint
- Metering cabinet: Broken conduit
  Panel needs repairs
  Needs paint.

Thermostat A - Functions properly

- 240 volt heat tracer towards VC #5: Volts - 238
  Amps - 4.52
  Megger - 0 to grd.

Thermostat B - Functions properly

- 240 volt heat tracer towards VC #13: Volts - 238
  Amps - 5.33
  Megger - 0 to grd.

Thermostat C - Functions properly

- 240 volt heat tracer towards VC #9 - Volts - 238
  Amps - 3.93
  Megger - 0 to grd.

VALVE CHAMBER NO. 8

- Metering cabinet needs paint
- Thermostat cabinet needs paint

Thermostat A - Does not function properly

- 120 V heat tracer west: Volts - 120
  Amps - 3.68
  Megger - 0 to grd.

VALVE CHAMBER NO. 10

- Metering cabinet needs paint
- Thermostat cabinet needs paint.

Thermostat A - Functions properly

- 240 V heat tracer south: Volts - 244
  Amps - 1.18
  Megger - 0 to grd.

Thermostat B - Functions properly

- 240 volt heat tracer towards VC #12: Volts - 244
  Amps - 3.75
  Megger - 0 to grd.

VALVE CHAMBER NO. 14

- Metering cabinet needs paint
- Thermostat cabinet needs paint.

Thermostat A - Functions properly

- 240 volt heat tracer towards VC #15: Volts - 239
  Amps - 5.01
  Megger - ∞ to grd.

Thermostat B - Functions properly

- 240 volt heat tracer towards VC #5: Volts - 239
  Amps - 9.31
  Megger - ∞

VALVE CHAMBER NO. 16

- Metering cabinet needs paint
- Thermostat cabinet needs paint

Thermostat A - Functions properly

- 120 volt heat tracer towards VC #17: Volts - 118
  Amps - 5.48
  Megger - 0 to grd.

Thermostat B - Functions properly

- 240 volt heat tracer towards VC #14: Volts - 240
  Amps - .15
  Megger - 0 to grd.

VALVE CHAMBER NO. 18

- Metering cabinet needs paint
- Thermostat cabinet needs paint
- 1-1/4" conduit broken on metering cabinet

Thermostat A - Does not function properly (Electronic)

- All sensor terminals have grd. fault
- 120 volt heat tracer north: Volts - 119
  Amps - 7.30
  Megger - 0 to grd.

Thermostat B - Functions properly (Electronic)

- All sensor terminals have grd. fault
- 120 volt heat tracer towards VC #16: Volts - 119
  Amps - 3.56
  Megger - 0 to grd.

Thermostat C - Functions properly

- 240 volt heat tracer towards VC #19: Volts - 240
  Amps - .03
  Megger - 0 to grd.

VALVE CHAMBER NO. 21

- Metering cabinet needs paint
- Thermostat cabinet meeds paint.

Thermostat A - Functions properly

- 240 volt heat tracer towards VC #13: Volts - 240
  Amps - 8.07
  Megger - ∞ to grd.

Thermostat B - Functions properly

- 120 volt heat tracer towards VC #20: Volts - 119
  Amps - 7.91
  Megger - ∞ to grd.

VALVE CHAMBER NO. 22

- Metering cabinet needs paint
- Thermostat cabinet needs paint.

Thermostat A - Faulty lampholder but stat functions properly

- 240 volt heat tracer towards VC #23: Volts - 238
  Amps - 10.05
  Megger - ∞ to grd.

Thermostat B - Functions properly

- 240 volt heat tracer towards VC #21: Volts - 238
  Amps. - 9.87
  Megger - ∞ to grd.

VALVE CHAMBER NO. 23

- Metering cabinet needs paint
- Thermostat cabinet needs paint

Thermostat A - Found thermostat tripped on overload

- 240 volt heat tracer towards VC #30: Volts - 241
  Amps - short circuit
  Megger - 0 to grd.

Thermostat B - Functions properly

- 240 volt heat tracer towards VC #22: Volts - 241
  Amps - 4.86
  Megger - ∞ to grd.

VALVE CHAMBER NO. 25

- Metering cabinet needs paint
- Thermostat cabinet needs paint.

Thermostat A - Functions properly

- 120 volt heat tracet towards VC #27: Volts - 117
  Amps - 7.68
  Megger - ∞ to grd.

Thermostat B - Faulty lampholder and does not function properly

- 240 volt heat tracer towards VC #24: Volts - 238
  Amps - 9.27
  Megger - ∞ to grd.

VALVE CHAMBER NO. 26

- Metering cabinet needs paint.
- Thermostat cabinet needs paint.

Thermostat A - Functions properly

- 240 volt heat tracer east: Volts - 241
  Amps - .45
  Megger - 0 to grd.

VALVE CHAMBER NO. 28

- Metering cabinet needs paint
- Thermostat cabinet needs paint.

Thermostat A - Functions properly

- 240 volt heat tracer towards VC #29: Volts - 243
  Amps - 13.92
  Megger - 10 meg. ohms

VALVE CHAMBER NO. 29

- Metering cabinet needs paint
- Thermostat cabinet needs paint.

Thermostat A - Functions properly

- 240 volt heat tracer towards VC #28: Volts - 235
  Amps - 4.29
  Megger - ∞ to grd.

Thermostat B - Functions properly

- 120 volt heat tracer towards VC #30: Volts - 118
  Amps - 5.19
  Megger - ∞ to grd.

VALVE CHAMBER NO. 30

- Metering cabinet needs paint
- Thermostat cabinet needs paint

Thermostat A - Found thermostat tripped on overload

- 240 volt heat tracer towards VC #25: Volts - 237
  Amps - short circuit
  Megger - 0 to grd.

Thermostat B - Faulty lampholders and stat does not function properly

- 240 volt heat tracer towards VC #23: Volts - 237
  Amps - 11.6
  Megger - 0 to grd.

Thermostat C - Faulty lampholders and stat does not function properly

- 240 volt heat tracer towards #31: Volts - 237
  Amps - 12.56
  Megger - 0 to grd.

Flow Meter: Functioning properly at time of inspection

MECHANICAL INSPECTION - TEMAGAMI LOW PRESSURE SEWER

NOTE: All flooded chambers were pumped out for inspection.

VALVE CHAMBER NO. 1 *

- Pressure: 5 psi
- Temperature: 72°F
- Chamber completely flooded with ground water
- P.E. tape in poor condition
- Insulation in poor condition
- Threads stripped for cover
- Plywood rotting on frost cover
- No leaks

VALVE CHAMBER NO. 2

- Pressure: 7 psi
- Temperature: 60°F
- 6" of groundwater in chamber
- P.E. tape OK
- Insulation in good condition
- Plywood cover in good condition
- No leaks
- Complaint from home owner about location of chamber

VALVE CHAMBER NO. 3 *

- Pressure: 12 psi
- Temperature: 60°F
- Metal cover damaged from snowplow and heavy traffic
- Chamber completely flooded with groundwater
- P.E. tape in poor condition
- Insulation in poor condition
- Electrical junction boxes below water level and in poor condition
- No leaks

VALVE CHAMBER NO. 4

- Pressure: 0 psi
- Temperature: 60°F
- 6" of groundwater in chamber
- Plywood cover in good condition but very hard to remove
- P.E. tape in good condition
- Insulation in good condition
- No leaks

VALVE CHAMBER NO. 5 ✳

- Pressure: 12 psi
- Temperature: 68°F
- 24" of sewage in chamber
- Metal lid has bolts missing and some holes are stripped
- P.E. tape in poor condition
- Insulation in poor condition
- Could not find any leaks

VALVE CHAMBER NO. 6 ✳

- No pete's plug for pressure and temperature monitor
- 24" of groundwater in chamber
- P.E. tape in poor condition
- Insulation in poor condition
- Bolts missing on metal cover
- No leaks

VALVE CHAMBER NO. 7 ✳

- Pressure: 15 psi
- Temperature: 70°F
- Chamber completely flooded with groundwater
- Cover is changed to standard manhole cover
- Insulation in poor condition
- P.E. tape in poor condition

VALVE CHAMBER NO. 8 ✳

- Completely flooded with sewage
- 2" bleed valve siezed
- Unable to use pete's plug for pressure & temperature
- P.E. in poor condition
- Insulation in poor condition
- Two broken studs for plywood cover
- Plywood cover in good condition

VALVE CHAMBER NO. 9 ✳

- Pressure: 15 psi
- Temperature: 58°F
- Completely flooded with groundwater
- Insulation in poor condition
- P.E. tape in poor condition

VALVE CHAMBER NO. 10 ✳

- Pressure: 12 psi
- Temperature: 67°F
- Insulation in poor condition
- P.E. tape in poor condition
- Chamber completely flooded with groundwater

VALVE CHAMBER NO. 12 ✳

- Pressure: 8 psi
- Temperature: 62°F
- Chamber completely flooded with groundwater
- P.E. tape in poor condition
- Insulation in poor condition
- Chamber has been raised approx. 24" because of landscaping in the area.

VALVE CHAMBER NO. 13

- Pressure: 11 psi
- Temperature: 70°F
- Chamber completely flooded with groundwater
- Accumulated rocks and gravel in chamber
- P.E. tape in poor condition
- Insulation in poor condition
- Metal cover in poor condition from snowplow

VALVE CHAMBER NO. 14

- Pete's plug missing for pressure and temperature monitor
- Chamber flooded with groundwater
- Electrical shocks were received from valve handle
- P.E. tape in poor condition
- Insulation in poor condition
- Bolts missing and metal cover damaged from snowplow

VALVE CHAMBER NO. 15

- Pressure: 2.5 psi
- Temperature: 62°F
- Plywood cover damaged from snowplow
- 6" of groundwater in chamber
- 7 studs broken for plywood cover
- P.E. tape in good condition
- Insulation in good condition

VALVE CHAMBER NO. 16

- Pressure: 0 psi
- Temperature: 70°F
- Chamber completely flooded with groundwater
- Bolts missing and cover damaged from snowplow
- Frost cover missing
- Accumulated rocks and gravel in chamber
- Insulation and P.E. tape in poor condition

VALVE CHAMBER NO. 17

- Pressure: 2.5 psi
- Temperature: 62°F
- 3 ft. of groundwater in chamber
- Insulation and P.E. tape in poor condition

VALVE CHAMBER NO. 18

- Pressure: 10 psi
- Temperature: 74°F
- 2 ft. of water in chamber
- Electrical junction boxes below water level
- Accumulated rocks and gravel in chamber
- Insulation and P.E. tape in very poor condition

VALVE CHAMBER NO. 19

- Pressure and temperature not taken because of missing pete's plug
- 12" of groundwater in chamber
- Bolts missing on metal cover
- Insulation and P.E. tape in poor condition

VALVE CHAMBER NO. 20

- Pressure: 10 psi
- Temperature: 60°F
- 6" of groundwater
- Chamber in good condition

VALVE CHAMBER NO. 21

- Pete's plug missing for pressure and temperature monitor
- 6" of groundwater in chamber
- Insulation and P.E. tape in poor condition
- Bolts missing on metal cover

VALVE CHAMBER NO. 22

- Pete's plug not installed for pressure and temperature
- Anti-syphon valve not operating
- 6" of groundwater in chamber
- Insulation and P.E. tape in poor condition

VALVE CHAMBER NO. 23

- Pressure: 0 psi
- Temperature: 65°F
- 3" of groundwater in chamber
- Insulation and P.E. tape in poor condition
- Plywood cover damaged
- Studs and nuts are missing for plywood cover

VALVE CHAMBER NO. 24

- Pressure: 0 psi
- Temperature: 60°F
- 2" of groundwater in chamber
- Insulation, P.E. tape and cover in good condition

VALVE CHAMBER NO. 25

- Pressure: 0 psi
- Temperature: 65°F
- 2 ft. of groundwater in chamber
- Insulation and P.E. tape in poor condition

VALVE CHAMBER NO. 26

- Pressure: 0 psi
- Temperature: 60°F
- Chamber completely flooded with sewage
- Insulation and P.E. tape in poor condition

VALVE CHAMBER NO. 27

- Pressure: 0 psi
- Temperature: 60°F
- 12" of groundwater in chamber
- Insulation and P.E. tape in good condition

VALVE CHAMBER NO. 28

- Pressure: 25 psi
- Temperature: 60°F
- 2 ft. of groundwater in chamber
- Insulation and P.E. tape in good condition

VALVE CHAMBER NO. 29

- Pete's plug missing for pressure and temperature monitor
- 6" of groundwater in chamber
- Anti-syphon valve in good condition
- Insulation and P.E. tape in good condition

VALVE CHAMBER NO. 30

- Pressure: 5 psi
- Temperature: 60°F
- 12" of groundwater in chamber
- Plywood cover damaged from snowplow
- Insulation and P.E. tape in poor condition

VALVE CHAMBER NO. 31

- Pressure: 0 psi
- Temperature: 65°F
- 2 ft. of sewage in chamber
- Insulation and duct tape in very good condition

OUTLET CHAMBER (LAGOON)

- Valves and chamber in good condition
- Covers missing on valve boxes.

NOTE: - Branch lines and branch thermostats were not inspected
- Valve boxes for corporation stops located on roadways are causing damage to saddles on main sewer line.

APPENDIX IV

PUBLIC SEWER MAINS HEAT TRACING
OPERATING COSTS

TABLE 3-1

PUBLIC SEWER HEAT TRACING OPERATING COST

17, 18, 19 Jan. - 31 Jan. 1980 (13 - 15 days)

Meter No.	Total Tracer Power Rating (kW)	Tracer Energy Consumption (kWH)	Operating Hours	Total $ Cost (1)	Average Cost per Day $
1	2.012	620	310	39.67	2.83
2	2.208	200	91	21.20	1.51
3	3.760	440	117	33.26	2.38
4	1.728	260	150	26.86	1.92
5	4.126	570	138	37.89	2.71
7	3.788	160	42	16.96	1.21
8	0.358	40	112	0.76	0.05
10	5.624	440	78	33.26	2.22
14	3.180	610	192	39.32	3.02
16/18	4.300	140	33	14.84	1.14
21	2.430	490	108	35.04	2.70
22	4.520	650	144	40.74	3.13
23	3.496	100	29	10.60	0.82
25	2.995	150	50	15.90	1.22
26	2.380	267	112	27.11	2.09
28	2.800	240	86	25.44	1.96
29/30	7.725	865	112	48.39	3.72
		6242 (415 kWh/day)	TOTAL	$467.24	$34.63

Remarks: - average "on-time" = 33%

- energy consumption at meters Nos. 8, 26 and 29/30 estimated

$5000 for 8½ months or $600/month average

(1) Based on power cost of 10.6¢/kWh for first 250 kWh/month and 3.56¢/kWh for remainder, at each meter.

TABLE 3-1

PUBLIC SEWER HEAT TRACING OPERATING COST

1 - 24 Feb. 1980 (24 days)

Meter No.	Total Tracer Power Rating (kW)	Tracer Energy Consumption (kWH)	Operating Hours	Total $ Cost (1)	Average Cost per Day $
1	2.012	640	318	40.38	1.68
2	2.208	70	32	7.42	0.31
3	3.760	750	199	44.30	1.85
4	1.728	300	174	28.28	1.18
5	4.126	660	160	41.10	1.71
7	3.788	100	26	10.60	0.44
8	0.358	43	121	4.59	0.19
10	5.624	1260	224	62.46	2.60
14	3.180	630	198	40.03	1.67
16/18	4.300	90	21	9.54	0.40
21	2.430	450	185	33.62	1.40
22	4.520	500	111	35.40	1.48
23	3.496	30	9	0.33	0/01
25	2.995	30	10	0.33	0.01
26	2.380	288	121	27.85	1.16
28	2.800	150	54	15.90	0.66
29/30	7.725	935	121	50.89	2.12
		6926 (286/day)	TOTAL	$453.02	$18.87

Remarks: - average "on-time" = 21%

- energy consumption at meters Nos. 8, 26 and 29/30 estimated

(1) Based on power cost of 10.6¢/kWh for first 250 kWh/month and 3.56¢/kWh for remainder, at each meter.

TABLE 3-1

PUBLIC SEWER HEAT TRACING OPERATING COST

25 Feb. - 31 Mar. 1980 (36 days)

Meter No.	Total Tracer Power Rating (kW)	Tracer Energy Consumption (kWH)	Operating Hours	Total $ Cost (1)	Average Cost per Day $
1	2.012	690	343	42.16	1.17
2	2.208	220	97	23.32	0.65
3	3.760	830	220	47.15	1.31
4	1.728	150	87	15.90	0.44
5	4.126	470	114	34.33	0.95
7	3.788	100	26	10.60	0.29
8	0.358	47	130	4.98	0.14
10	5.624	540	96	36.82	1.02
14	3.180	530	167	36.47	1.01
16/18	4.300	0	0	0	0
21	2.430	660	272	41.10	1.14
22	4.520	710	157	42.88	1.19
23	3.496	50	13	5.30	0.15
25	2.995	250	83	26.50	0.74
26	2.380	309	130	28.60	0.79
28	2.800	380	136	31.13	0.86
29/30	7.725	1004	130	53.34	1.48
		6940 (192/day)	TOTAL	$480.58	$13.35

Remarks: - average "on-time" = 15%

- energy consumption at meters Nos. 8, 26 and 29/30 estimated

(1) Based on power cost of 10.6¢/kWh for first 250 kWh/month and 3.56¢/kWh for remainder, at each meter.

TABLE 3-1

PUBLIC SEWER HEAT TRACING OPERATING COST

(MAR. 31 - APR. 28, 1980) 28 days.

Meter No.	Total Tracer Power Rating (kW)	Tracer Energy Consumption (kWH)	Operating Hours	Total Cost (1)	Average Cost per Day $
1	2.012	1600	795	74.56	
2	2.208	170	77	18.02	
3	3.760	640	170	43.94	
4	1.728	0	0	0	
5	4.126	420	102	32.55	
7	3.788	10	28	1.06	
8	0.358	0	0	0	
10	5.624	240	43	25.44	
14	3.180	430	135	32.91	
16/18	4.300	40	9	4.24	
21	2.430	430	177	32.91	
22	4.520	10	2	1.06	
23	3.496	10	3	1.06	
25	2.995	460	154	33.98	
26	2.380	840	353	47.50	
28	2.800	270	96	27.21	
29/30	7.725	1360	176	66.02	
		6930 (247/day)	TOTAL =	$442.46	$15.26/day

1. Based on power cost of 10.6¢/kWh for first 250 kWh/month and 3.56¢/kWh for remainder, at each meter.
2. Energy consumption at meters #8, 26 and 29/30 estimated.

TABLE 3-1

PUBLIC SEWER HEAT TRACING OPERATING COST

JAN. 30, 1981)

Dec 3, 1980 - 59 days

Meter No.	Total Tracer Power Rating (kW)	Tracer Energy Consumption (kWH)	Operating Hours	Total Cost (1)	Average Cost per Day $
1	2.012	590	293	38.60	
2	2.208	420	190	32.55	
3	3.760	1250	332	62.10	
4	1.728	70	41	7.42	
5	4.126	2120	514	93.07	
7	3.788	170	45	18.02	
8	0.358	–	–	–	
10	5.624	0	0	0	
14	3.180	190	60	20.14	
16/18	4.300	410	95	28.64	
21	2.430	1860	765	83.82	
22	4.520	2460	544	105.18	
23	3.496	80	23	8.48	
25	2.995	210	70	22.26	
26	2.380	0	0	0	
28	2.800	130	46	13.78	
29/30	7.725	11240	1455	417.74	
		21200	TOTAL =	$944.80	$16.99 /day
		(360 day)			

1. Based on power cost of 10.6¢/kWh for first 250 kWh/month and 3.56¢/kWh for remainder, at each meter.
2. Energy consumption at meters #8, 26 and 29/30 estimated.

TABLE 3-1

PUBLIC SEWER HEAT TRACING OPERATING COST

(JAN. 30 - FEB 27, 1981) 28 days

Meter No.	Total Tracer Power Rating (kW)	Tracer Energy Consumption (kWH)	Operating Hours	Total Cost (1)	Average Cost per Day $
1	2.012	1700	845	78.12	
2	2.208	400	181	31.84	
3	3.760	460	122	33.98	
4	1.728	100	58	10.60	
5	4.126	2160	524	94.50	
7	3.788	340	90	29.70	
8	0.358	20	56	2.12	
10	5.624	10	2	1.06	
14	3.180	230	72	24.38	
16/18	4.300	360	84	30.42	
21	2.430	1410	580	67.70	
22	4.520	2540	562	108.02	
23	3.496	50	14	5.30	
25	2.995	240	80	25.44	
26	2.380	0	0	0	
28	2.800	120	43	12.72	
29/30	7.725	5990	775	230.84	
		16130 (570/day)	TOTAL =	786.74	= $28.10/day

1. Based on power cost of 10.6¢/kWh for first 250 kWh/month and 3.56¢/kWh for remainder, at each meter.
2. Energy consumption at meters #8, 26 and 29/30 estimated.

TABLE 3-1

PUBLIC SEWER HEAT TRACING OPERATING COST

(27 FEB. - 31 MAR. 1981) 32 days.
28

Meter No.	Total Tracer Power Rating (kW)	Tracer Energy Consumption (kWH)	Operating Hours	Total Cost (1)	Average Cost per Day $
1	2.012	1790	890	81.32	
2	2.208	320	318	28.99	
3	3.760	400	106	31.84	
4	1.728	90	52	9.54	
5	4.126	2410	584	103.40	
7	3.788	350	92	30.06	
8	0.358	10	28	1.06	
10	5.624	0	0	0	
14	3.180	20	6	2.12	
16/18	4.300	380	88	31.13	
21	2.430	1590	654	74.20	
22	4.520	2910	644	121.20	
23	3.496	20	6	2.12	
25	2.995	170	57	18.02	
26	2.380	0	0	0	
28	2.800	130	46	13.78	
29/30	7.725	6540	847	250.42	
		17,130 (535 day)	TOTAL =	$799.20 =	$ 24.22/day

1. Based on power cost of 10.6¢/kWh for first 250 kWh/month and 3.56¢/kWh for remainder, at each meter.
2. Energy consumption at meters #8. 26 and 29/30 estimated.

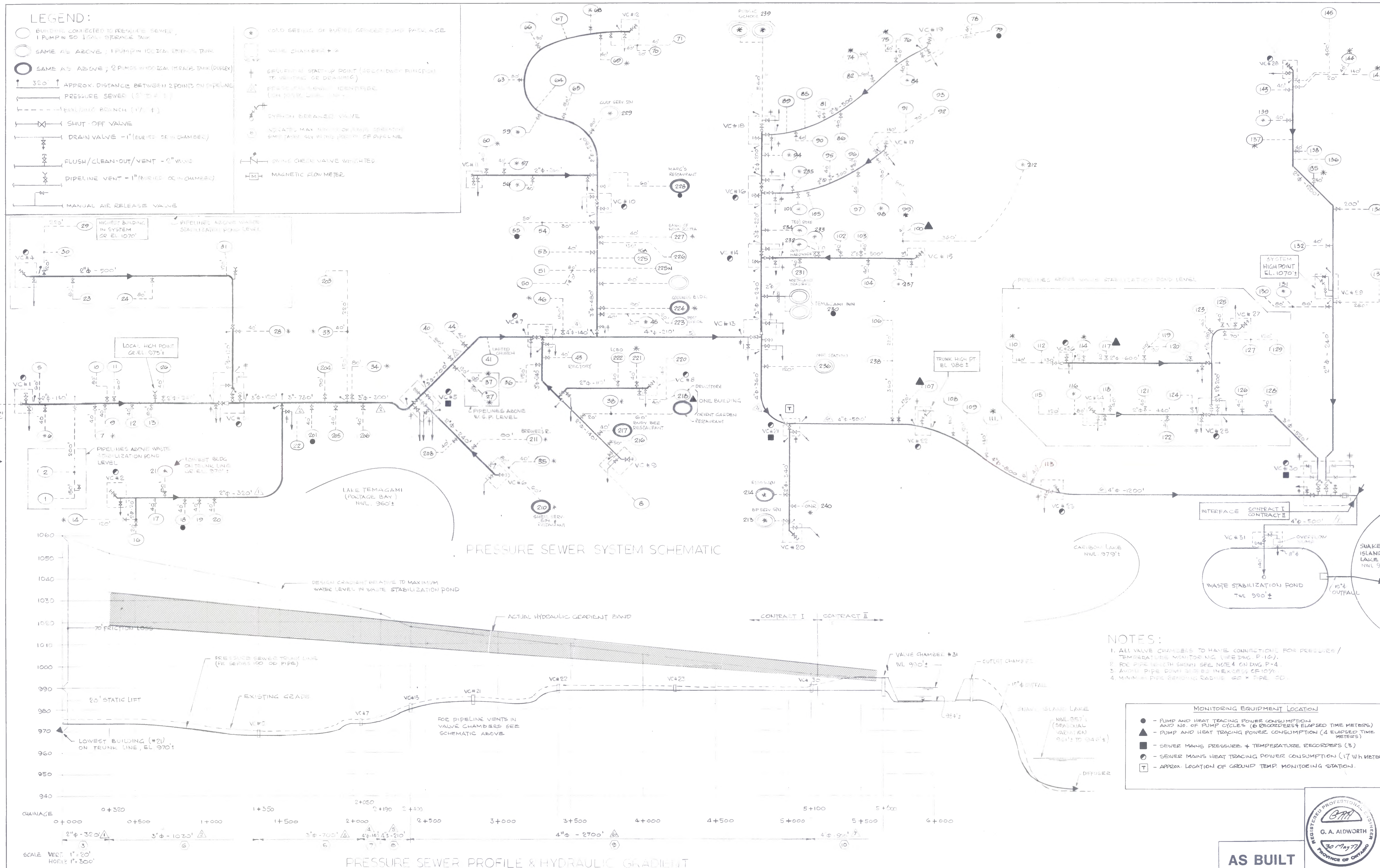
TABLE 3-1

PUBLIC SEWER HEAT TRACING OPERATING COST

(1 APR. - 30 APR. 1981) 30 days

Meter No.	Total Tracer Power Rating (kW)	Tracer Energy Consumption (kWH)	Operating Hours	Total Cost (1)	Average Cost per Day $
1	2.012	1650	820	76.34	
2	2.208	40	18	4.24	
3	3.760	0	0	0	
4	1.728	20	12	2.12	
5	4.126	520	126	36.11	
7	3.788	130	34	13.78	
8	0.358	60	168	6.36	
10	5.624	20	4	2.12	
14	3.180	0	0	0	
16/18	4.300	110	26	11.66	
21	2.430	1340	551	65.30	
22	4.520	2470	547	105.53	
23	3.496	10	3	1.06	
25	2.995	150	50	15.90	
26	2.380	0	0	0	
28	2.800	70	25	7.42	
29/30	7.725	6300	816	245.44	
		12,890 (428/day)	TOTAL = $593.38		= $19.78/day

1. Based on power cost of 10.6¢/kWh for first 250 kWh/month and 3.56¢/kWh for remainder, at each meter.
2. Energy consumption at meters #8, 26 and 29/30 estimated.



AS BUILT

NO.	REVISIONS	DATE	INTLS
2	LOCATION OF MONITORING EQUIPMENT	JAN.82	RS
1	AS BUILT	JUN'79	

ONTARIO
MINISTRY OF THE ENVIRONMENT
PROJECT 1-0274-71

TEMAGAMI
SANITARY SEWERAGE SYSTEM
CONTRACT I

SYSTEM SCHEMATIC AND HYDRAULIC GRADIENT

JAMES F. MacLAREN LIMITED
CONSULTING ENGINEERS, PLANNERS AND SCIENTISTS
WINDSOR · LONDON · WATERLOO · TORONTO

DATE APRIL 1977
SCALE AS SHOWN
DRAWN BY L M
CHECKED BY G. A. A.
DRAWING No. P-2 of 17

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