TOWN OF LIVERPOOL WATER SURVEY
SUMMER WORKS PROGRAM 1977

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Water Planning & Management Division
N.S.Dept. of the Environment
SEPTEMBER, 1977

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INTRODUCTION:

Liverpool is situated approximately 90 miles by paved highway 103 southwest of Halifax on the South Shore of Nova Scotia. Founded in 1759, the town has a present population of 3,654 people (1971 census). The major industries of the area are pulp and paper, fishing, and ship repair.

Water from Town Lake has been used to supply the community since the late 1890's. The Lake is situated one and a half miles to the west from the center of town at an elevation of 204 feet above average sea level for the point of extraction. Using the difference in elevation, the town system is gravity fed.

In 1967, Mr. Eric Millard, P.L.S., the town engineer in reply to a A.D.B. Water Resources Study questionnaire stated that people living on dead ends complained of sediment and odour. In a 1974 call for engineering proposals for the improvement of the water supply and distribution system, Vaclav Matatko, P.Eng., town engineer, made a statement of the problem.

> "Within the last 4-5 years, the town of Liverpool has been experiencing a water supply and quality problem which has become particularly acute within the last year or so. Firstly, the town suspects that due to the age and condition of the transmission lines from the town and or the distribution system within the town, that water is being lost due to leaks in the system. Secondly, that perhaps the present watershed is inadequate to supply the water that is required by present demands."

From the study carried out in 1974, Canadian-British Consultants Limited concluded:

(1) The present consumption of the town of Liverpool is less than the reliable yield of Town Lake.

(2) Profligate water consumption is bringing the town closer to the point where an expensive augmentation of the supply will be necessary.

(3) The transmission mains were examined and found to be in poor hydraulic condition.

It was also suggested in their report that the Department of Public Health was concerned about the quality of water supplied to the town of Liverpool and consideration should be given to converting entirely to a groundwater supply, since this would probably reduce the degree of treatment.

Since the consultants report, many leaks have been discovered and repaired but there is at present a 35% loss problem. Also a program of conservation has been carried out by major consumers and through periodic flushing the quality of the water has improved on dead ends.

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In 1977 the town engineer, V.Matatko, stated that there is a bacterial and colour problem especially during the spring and fall turnovers.

GEOLOGY (Figure 1):

1. Bedrock: The study area is underlain by lower Ordovician Goldenville quartzite. A diabase dyke occurs to the north of Town Lake.

2. Surficial: Surficial deposits consist of stratified sands and gravels of esker, kame, and outwash structure around Town Lake. A glacial till covers much of the remaining area. Sands and gravels tend to be from 5 to 30 feet thick with till ranging from 5 to 15 feet in thickness.

HYDROLOGY: 1. Surface Water

(a) Quantity: Town Lake is a groundwater recharge lake of 101 acres in a 588 acre watershed. The maximum volume of storage available in the lake is 195 million gallons as computed by Canadian British Consultants Ltd. (Figure 2).

(b) Quality: Chemical analysis of raw water samples taken in 1974 and 1975 are within the limits set by the Canadian Drinking Water Standards except for manganese and colour. Raw water samples taken from Town Lake have coliform bacteria counts ranging from 20 to in excess of 10,000 depending on the time of the year and climate.

(c) Ownership: In 1964 the Nova Scotia Water Authority defined and prescribed 450 acres of land around and including Town Lake for use as the town of Liverpool water supply. The town of Liverpool owns 100% of this area.

2. Groundwater

(a) Quantity : Several test wells were drilled in 1974 in the sands and gravels near Town Lake. The test wells encountered 18 to 23 feet of sand and gravel. In June of 1977 available saturated thickness of test wells 1 to 4 was from 10 to 15 feet. Transmissibilities calculated from pump tests conducted during June and July 1977 follow:

WELL	TRANSMISSABILITY	
	DRAWDOWN	RECOVERY
1	4,774.0 gpd/ft	10,050.5 gpd/ft
2	5,353.3 gpd/ft	5,353.3 gpd/ft
3	5,500.0 gpd/ft	6,187.5 gpd/ft
4	7,165.7 gpd/ft	4,687.9 gpd/ft
5	5,076.9 gpd/ft	6,000.0 gpd/ft

The total area of sand and gravel with similar hydrologic qualities is approximately 200 acres.

The following is a table of yields and numbers of wells needed to produce the required yield based on various transmissibilities and saturated thicknesses.

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Transmissibility	4,500 gpd/ft	6,000 gpd/ft	8,000 gpd/ft
Saturated Thickness	Yield Per Well (Number of wells for 600 gpm)		
5 ft.	8.52 gpm (70)	11.36 gpm (53)	15.15 gpm (40)
10 ft.	17.05 gpm (35)	22.73 gpm (26)	30.30 gpm (20)
15 ft.	25.57 gpm (24)	34.09 gpm (18)	45.45 gpm (13)

The underlying quartzite bedrock tends to yield 1-3 igpm in wells of the region. A well constructed in August 1977 for the Town was drilled 165 feet yielding an estimated 65 igpm. An aquifer pump test has not been conducted on the well. Although this well has good quality water, these bedrock wells tend to have higher than recommended limits of iron and manganese.

(b) Quality: Chemical analysis taken during the pump tests of June and July 1977 are within the accepted limits set by the Canadian Drinking Water Standards except for manganese in several samples. Bacteriologic samples of the test wells have not been taken.

(c) Ownership: Ownership of some of the sand and gravel areas around the lake has been contested during 1977.

CONCLUSIONS:

1. A groundwater system may reduce colour and bacteria problems.
2. A groundwater system would need to consist of many wells with a complex and expensive pumping system.
3. Chemical water quality is poorer in the distribution system than that of the lake. Therefore much of the water quality problem occurs in the distribution system.
4. Treatment of groundwater will have to be similar to that of the lake water for chemistry.
5. A groundwater system is unfeasible.
6. Money would be better spent on repair of the distribution system and treatment than on a groundwater system.

RECOMMENDATIONS:

1. Several test pits or wells be constructed near the present outlet from the lake to test transmissibility of the sand and gravel.

2. If good transmissibility is found in this area an infiltration gallery be constructed using the sand and gravel as a natural filter system.

3. Regardless of the results of 1 and 2, repair or reconstruct the distribution system.

4. If 1 and 2 fail to improve the water quality proper treatment of the water should begin.

Figure I

GEOLOGY

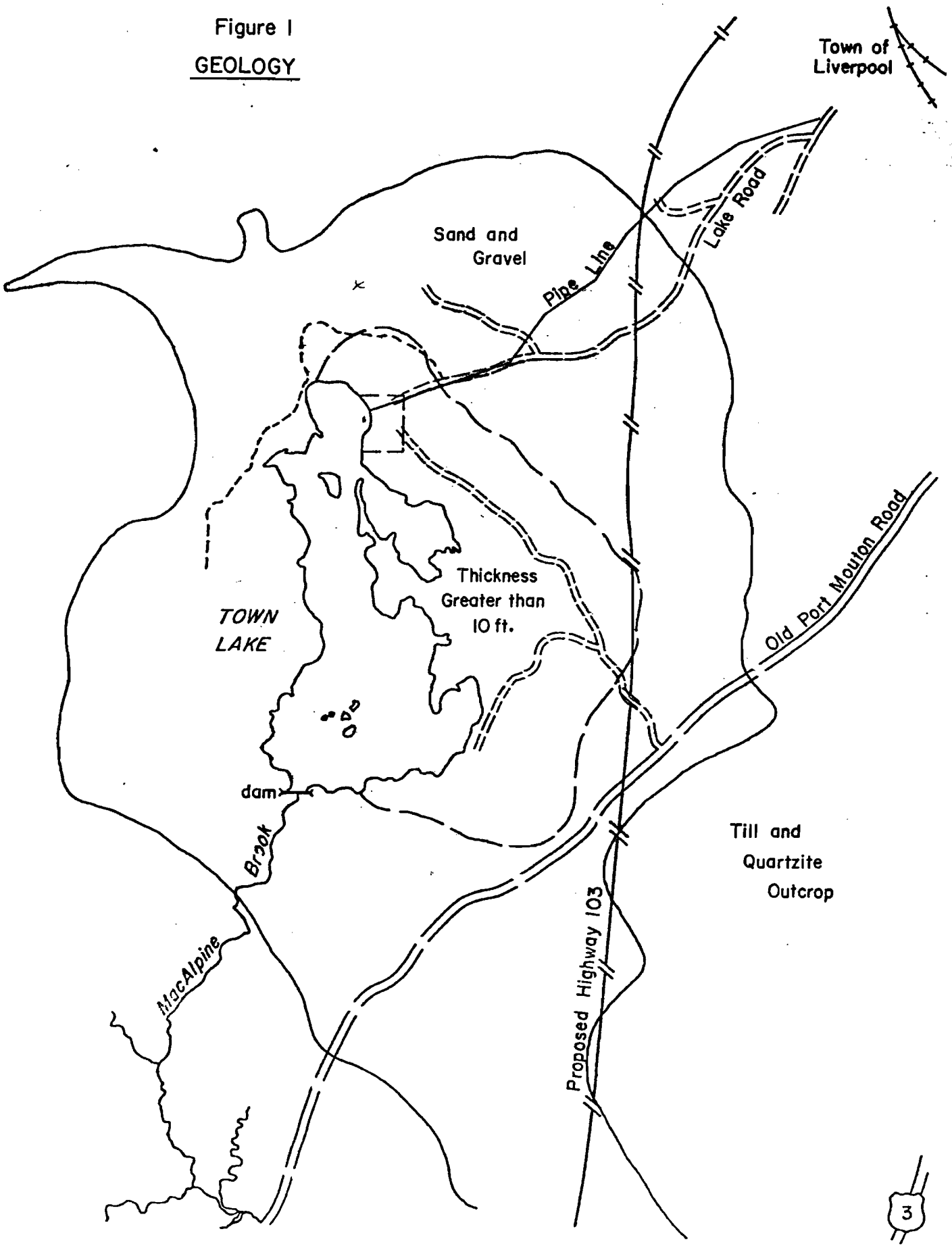


Figure 2
WATERSHEDS

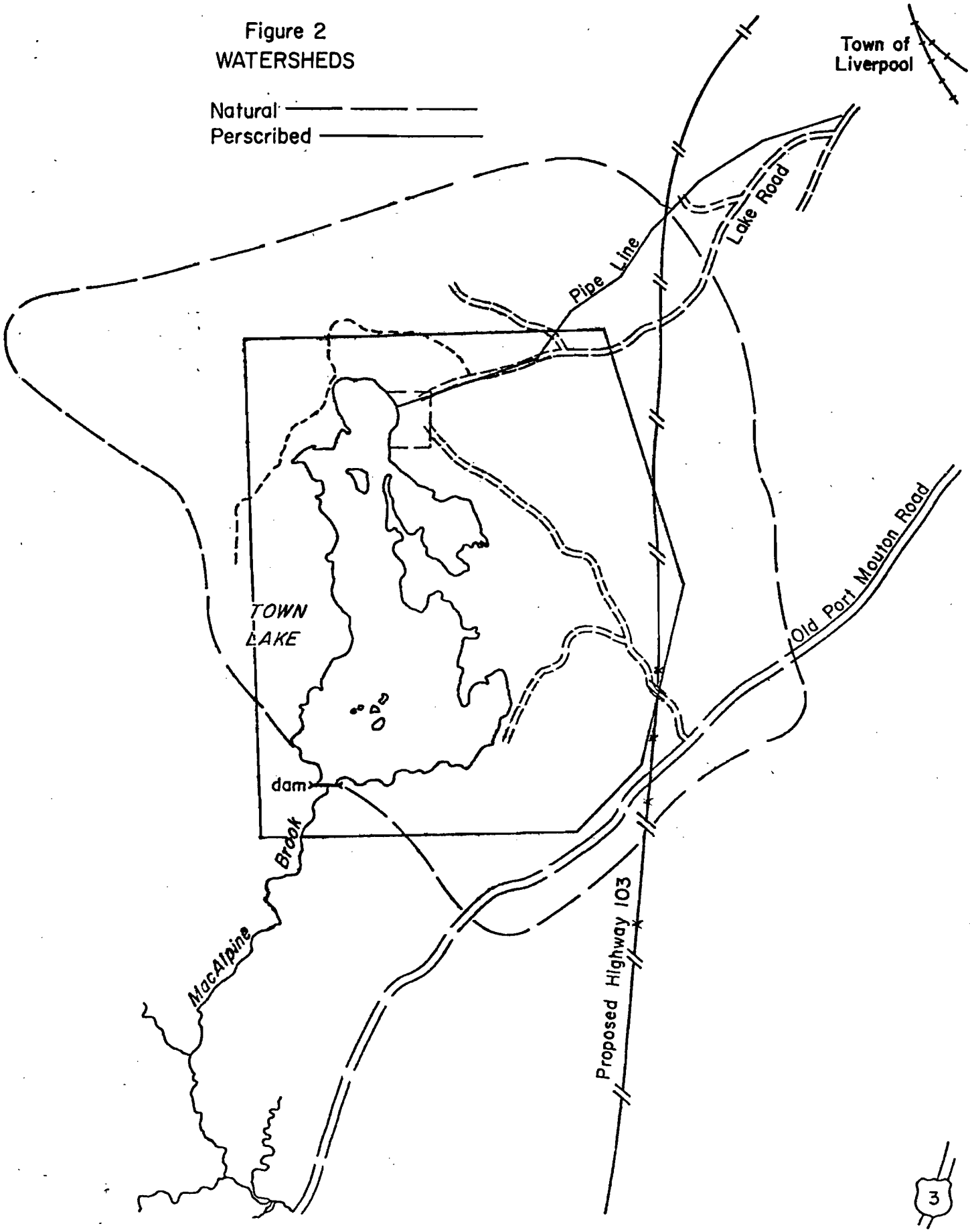
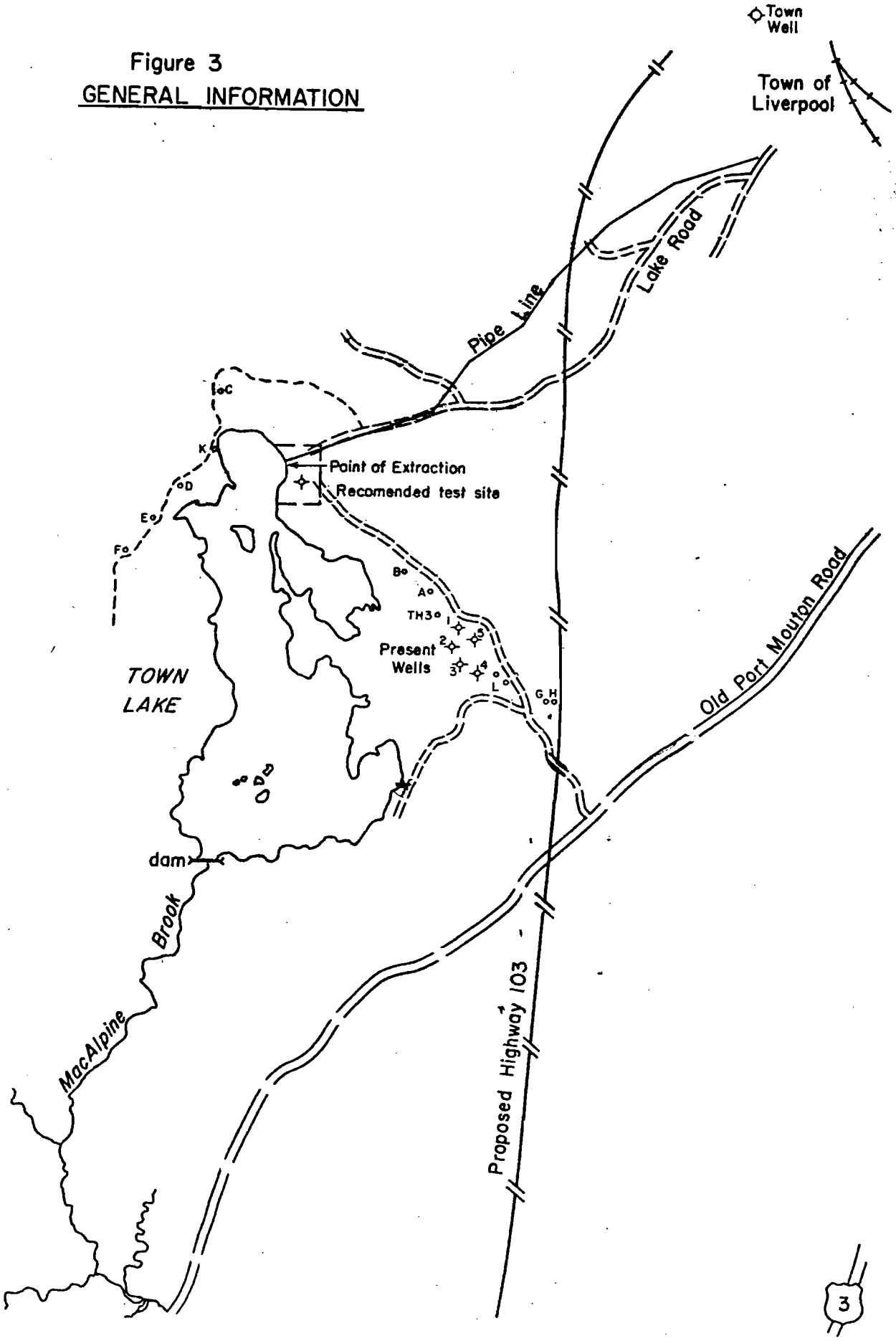
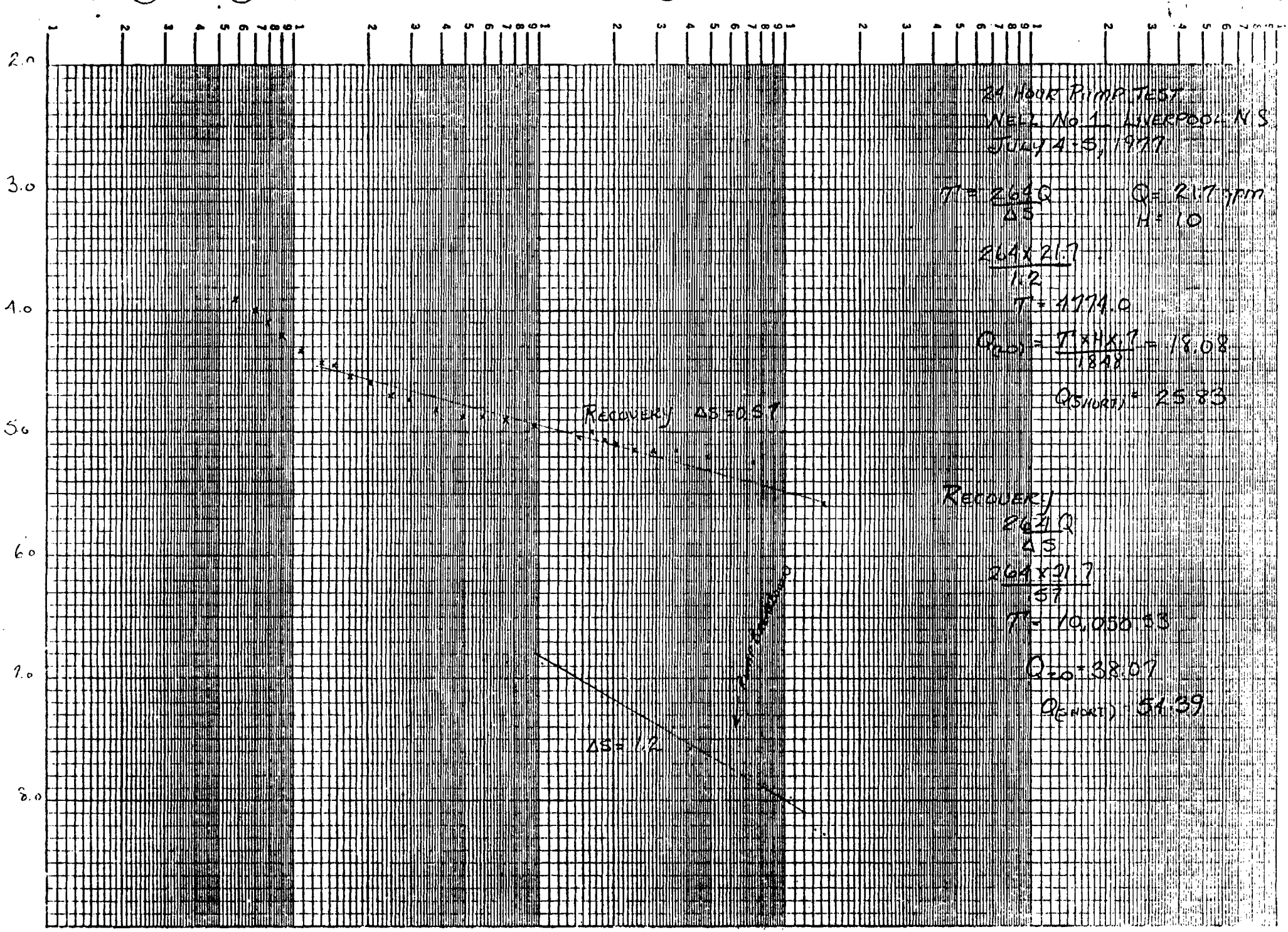


Figure 3

GENERAL INFORMATION




24 HOUR PUMP TEST
WELL No 1 LIVERPOOL N.S.
JULY 4-5, 1977
T = 264Q / ΔS
Q = 21.7 IGPM
H = 10
264 x 21.7 / 1.2
T = 4774.0
Q(20) = T x H x 1 / 1848 = 18.08
Q(SHORT) = 25.83
RECOVERY ΔS = 0.57
RECOVERY
264Q / ΔS
264 x 21.7 / .57
T = 10,056.53
Q20 = 38.07
Q(SHORT) = 54.39
ΔS = 1.2
2.0
3.0
1.0
5.0
6.0
7.0
8.0

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Power Dev **MEASURED BY:**

LOCATION OF PROJECT Liverpool **WELL LOCATION:** Hawes Pit

STATUS Pumping well 1 (pumping or observation well) **R =** (distance from pumping well in feet and direction) **DATE** Jul 4th **PAGE** 1

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
	9:00 AM	0	2.86						
		1	3.57						21.7 GPM
		2	3.68						Temp. 42°F
		3	3.75						
		4	3.89						
		5	3.98						
		6	4.15						
		7	4.25						
		8	4.50						
		9	4.89						
		10	5.20						
		15	5.60						
		20	5.95						
		25	6.30						
		30	6.40						
		40	6.60						
		50	6.72						
	10:00	60	6.84						
		75	6.86						
		90	"						
		106	6.88						
	11:00	120	6.89						
		150	6.97						
	12:00	180	7.15						

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: [illegible] **MEASURED BY:**

LOCATION OF PROJECT [illegible] **WELL LOCATION:** [illegible]

STATUS Pumping well #1 (pumping or observation well) **R =** (distance from pumping well in feet and direction) **DATE** July 4/77 **PAGE** 2

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
		210	7.21						
	1	240	7.30						
	1:20	300	7.31						
	2.00	360	7.40						
	4.00	420	7.58						
	5.00	480	7.66						
	6.00	540	7.68						
	7.00	600	7.71						Pump stalled for some unknown reason. Pump has not been working well all day. Off for about 10 minutes.
	8.00	660	7.55						
	9.00	720	7.70						
	11:	840	7.86						
		960	7.93						
		1080	7.97						
		1200	8.13						
		1320	8.24						
		1440	8.28						

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

Recovery

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: [illegible] **MEASURED BY:**

LOCATION OF PROJECT: Sunnyvale **WELL LOCATION:** Gravel Pit

STATUS Pumping well 1 **R =** **DATE** July 5/77 **PAGE** 1

(pumping or observation well) (distance from pumping well in feet and direction)

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
[illegible]	[illegible]	0	8.28						
		1	5.59						
		2	5.23						
		3	5.2						
		4	5.15						
		5	5.14						
		6	5.13						
		7	5.1						
		8	5.07						
		9	5						
		10	5.05						
		15	4.95						
		20	4.9						
		25	4.88						
	[illegible]	30	4.88						
		40	[illegible]						
		50	4.73						
	[illegible]	60	4.7						
		75	4.6						
	[illegible]	90	4.55						
		105	4.45						
	[illegible]	120	4.43						
	[illegible]	150	4.38						
	[illegible]	180	4.2						

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

Recovery

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Crew **MEASURED BY:**

LOCATION OF PROJECT: Sunnyside **WELL LOCATION:** Mud Lake

STATUS: Pumping well #1 (pumping or observation well) **R =** (distance from pumping well in feet and direction) **DATE:** July 5/77 **PAGE** 2

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
	1:30	210	4.1						
	1:50	240	4						
	2:00	300	3.9						
	2:30	360	3.8						
	2:50	420	3.9						
		480							
		540							
		600							
		660							
		720							
		840							
		960							
		1080							
		1200							
		1320							
		1440							

WATER ASSAY CC-9

Victoria General Hospital
Department of Pathology

ENVIRONMENTAL CHEMISTRY
Division of Clinical Chemistry
5788 University Ave., Hfx., N. S. B3H 1V8
Phone 424-2844

Report To: [illegible]

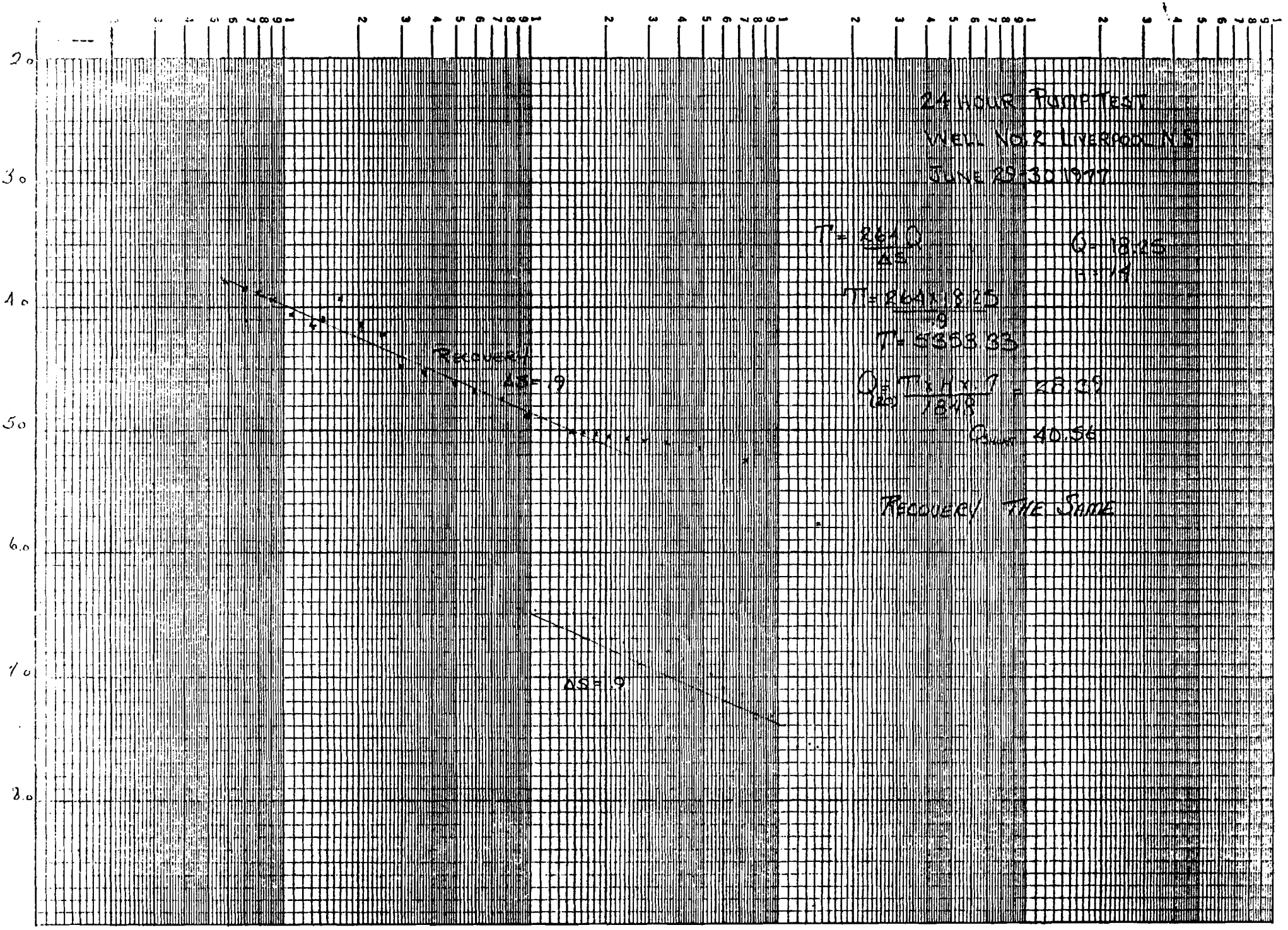
Bill To: [illegible]

OWNER [illegible]
LOCATION [illegible]
SOURCE [illegible]
GRID
DATE TAKEN [illegible]
COLLECTED BY
SAMPLE # [illegible]

√	DETERMINATION	RESULT mg/litre	RESULT meq/litre	√	DETERMINATION	RESULT	
	Sodium	2.9			Total Solids	24	mg/litre
	Potassium	0.4			Total Dissolved Solids	24	mg/litre
	Calcium	3.5			Colour	10	T.C.U.
	Magnesium	1.0			Turbidity	2.5	J.T.U.
	Hardness (as $CaCO_3$)	13			Conductivity	49	umho/cm
	Alkalinity (as $CaCO_3$)	10			pH	6.5	UNITS
	Sulfate	5					
	Chloride	6.4					
	Fluoride	0.1					
	Silica, reactive	2.9					
	Phosphate, ortho	0.02					
	Nitrate + Nitrite (as N)	0.1			Total Organic Carbon		mg/litre
	Ammonia (as N)	<0.1					
	Arsenic	<0.005					
	Iron	0.03					
	Manganese	0.03					
	Lead	<0.005					
	Copper	0.01					
	Zinc	0.1					

FIELD DATA	Remarks:	DATE
Temp:		Rec'd
pH:		Comp'd
Iron:		
		CHEMIST

FORM 639
115, 14, 2/74



NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY Water Supply Div **MEASURED BY:**

LOCATION OF PROJECT Sunnyside **WELL LOCATION:** Sabot Pit

STATUS Observation well 2 (pumping or observation well) **R =** (distance from pumping well in feet and direction) **DATE** June 29/77 **PAGE** 1

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
		0	2.92						Discharge is 18.25 GPM
		1	3.59						Light on measuring tape
		2	4.60						didn't work properly at
		3	5.44						times so it would go on
		4	5.45						for no reason.
		5	"						
		6	5.50						
		7	5.60						
		8	5.64						
		9	5.67						
		10	5.70						
		15	5.90						
		20	5.93						
		25	6.02						
		30	6.05						
		40	6.15						
		50	6.17						
		60	6.21						
		75	6.35						
		90	6.45						
		105	6.48						
		120	6.49						
		150	6.50						
		180	6.53						

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

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WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: [illegible] **MEASURED BY:**

LOCATION OF PROJECT Lunenburg **WELL LOCATION:** Gravel Pit

STATUS Pumping well # 2 **R =** **DATE** [illegible] **PAGE** 2
(pumping or observation well) (distance from pumping well in feet and direction)

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
		210	6.70						Rain Began at 8:15 P.M.
	2.30	240	6.72						
	3.30	300	6.80						
	4.30	360	6.80						
	5.30	420	6.86						
	6.30	480	6.90						
	7.30	540	6.98						
	8.30	600	7.09						
	9.30	660	7.11						
	10.30	720	7.13						
	11.30	840	7.20						
	2.30	960	7.33						
	4.30	1080	7.40						
	6:30	1200	7.58						
	8:30	1320	7.55						
	10:30	1440	7.57						

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

RECOVERY

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: [illegible] MEASURED BY:

LOCATION OF PROJECT: [illegible] WELL LOCATION: Gravel Pit

STATUS: Pumping well #2 (pumping or observation well) R = (distance from pumping well in feet and direction) DATE: June 30/77 PAGE: 1

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
	10:30	0	7.57						
		1	5.77						
		2	5.25						
		3	5.15						
		4	5.10						
		5	5.09						
		6	5.07						
		7	5.06						
		8	5.04						
		9	5.02						
	10:40	10	5.01						
		15	4.87						
		20	4.72						
		25	4.69						
	11:00	30	4.62						
		40	4.52						
		50	4.48						
	11:30	60	4.22						
		75	4.14						
	12:00	90	3.92						
		105	4.10						
	12:30	120	4.15						
	1:00	150	4.08						
	1:30	180	3.95						

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

RECOVERY

WATER LEVEL MEASUREMENTS (FIELD)

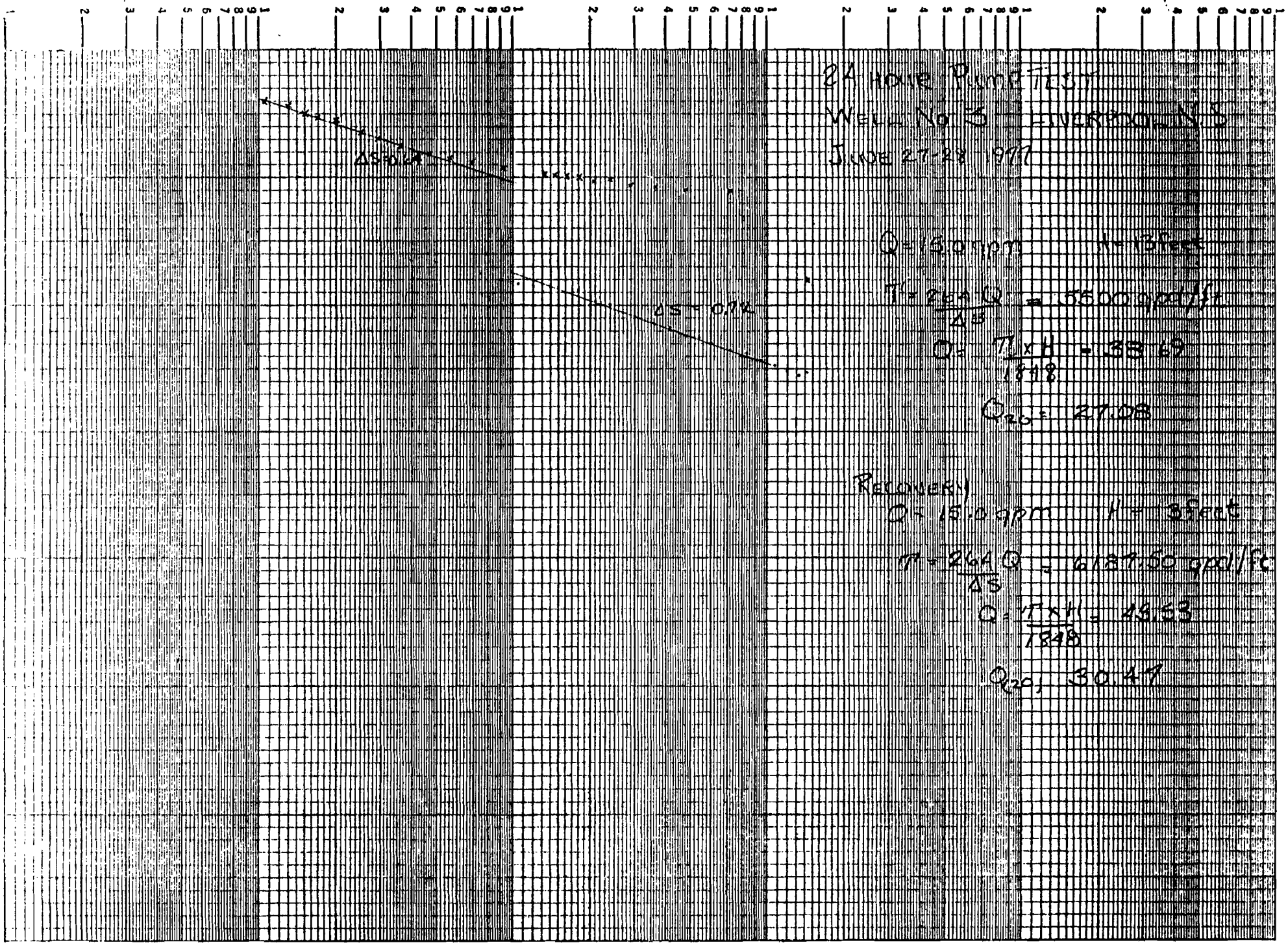
TEST CONDUCTED BY: [illegible] MEASURED BY:

LOCATION OF PROJECT: Lingwood WELL LOCATION: Hand Pit

STATUS: Pumping well 2 R = DATE: Jun 30 PAGE: 2

(pumping or observation well) (distance from pumping well in feet and direction)

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
	[illegible]	210	3.90						
	[illegible]	240	3.85						
	[illegible]	300	3.80						
	[illegible]	360							
		420							
		480							
		540							
		600							
		660							
		720							
		840							
		960							
		1080							
		1200							
		1320							
		1440							
	[illegible]		3.78						



NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Corp. MEASURED BY:

LOCATION OF PROJECT: Lunenburg WELL LOCATION: Gravel Pit

STATUS: Pumping Well #3 (pumping or observation well) R = (distance from pumping well in feet and direction) DATE: June 27/77 PAGE 1

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
June 27	11:[illegible] AM	0			2.25				Measure pt = steel
		1			2.28				casing top
		2			2.30				
		3			2.32				Q = 15 GPM
		4			2.35				constant head tank
		5			2.40				
		6			2.40				
		7			2.41				
		8			2.41				
		9			2.42				
		10			2.45				
		15			2.42				
		20			2.48				Temperature =
		25			2.55				
		30			2.60				
		40			2.65				
		50			2.67				
	12:00	60			2.70				
	[illegible]	75			2.75				
	[illegible]	90			2.80				
	12 45	105			2.83				
	1:00	120			2.84				
	1:30	150			2.85				
	2:00	180			2.89				

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Crew **MEASURED BY:**

LOCATION OF PROJECT Sunnyside **WELL LOCATION:** Mined Pit

STATUS Pumping well #3 (pumping or observation well) **R =** (distance from pumping well in feet and direction) **DATE** June 27/74 **PAGE** 2

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
	2:30	210			2.97				
	3.00	240			3.00				
	4:00	300			3.09				
		360			3.14				
	6:00	420			3.18				
		480			3.24				
	8:00	540			3.25				
		600			3.30				
		660			3.33				
	11.00	720			3.36				
1:00		840			3.38				
[illegible]	1:00	900			3.44				
[illegible]	[illegible]	1080			3.49				
[illegible]	5:00	1200			3.52				
[illegible]	7:00	1320			3.55				
	11:00	1440							
	9:30	1320			3.47				
	11:00	1440			3.51				

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

RECOVERY

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Crew MEASURED BY:

LOCATION OF PROJECT: Lunenburg WELL LOCATION: Gravel Pit

STATUS: Pumping well #3 (pumping or observation well) R = (distance from pumping well in feet and direction) DATE: June 28/77 PAGE 1

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
June 28/77		0	2.7						
	Min 0 1/2 Sec 0	1	2.11						
		2	2.1						
		3	2.07						
		4	2.06						
		5	2.02						
		6	2.04						
		7	2.01						
		8	2.01						
		9	1.99						
		10	1.98						
		15	1.93						
		20	1.88						
		25	1.85						
		30	1.82						
		40	1.76						
		50	1.7						
		60	1.65						
		75	1.55						
		90	1.53						
		105	1.5						
		120	1.44						
		150	1.4						
		180							

WATER ASSAY CC-9

Victoria General Hospital
Department of Pathology

ENVIRONMENTAL CHEMISTRY
Division of Clinical Chemistry
5788 University Ave., Hfx., N. S. B3H 1V8
Phone 424-2844

Report To: [illegible]

OWNER [illegible]
LOCATION [illegible]
SOURCE [illegible]
GRID [illegible]
DATE TAKEN [illegible]
COLLECTED BY [illegible]
SAMPLE # [illegible]

Bill To: [illegible]

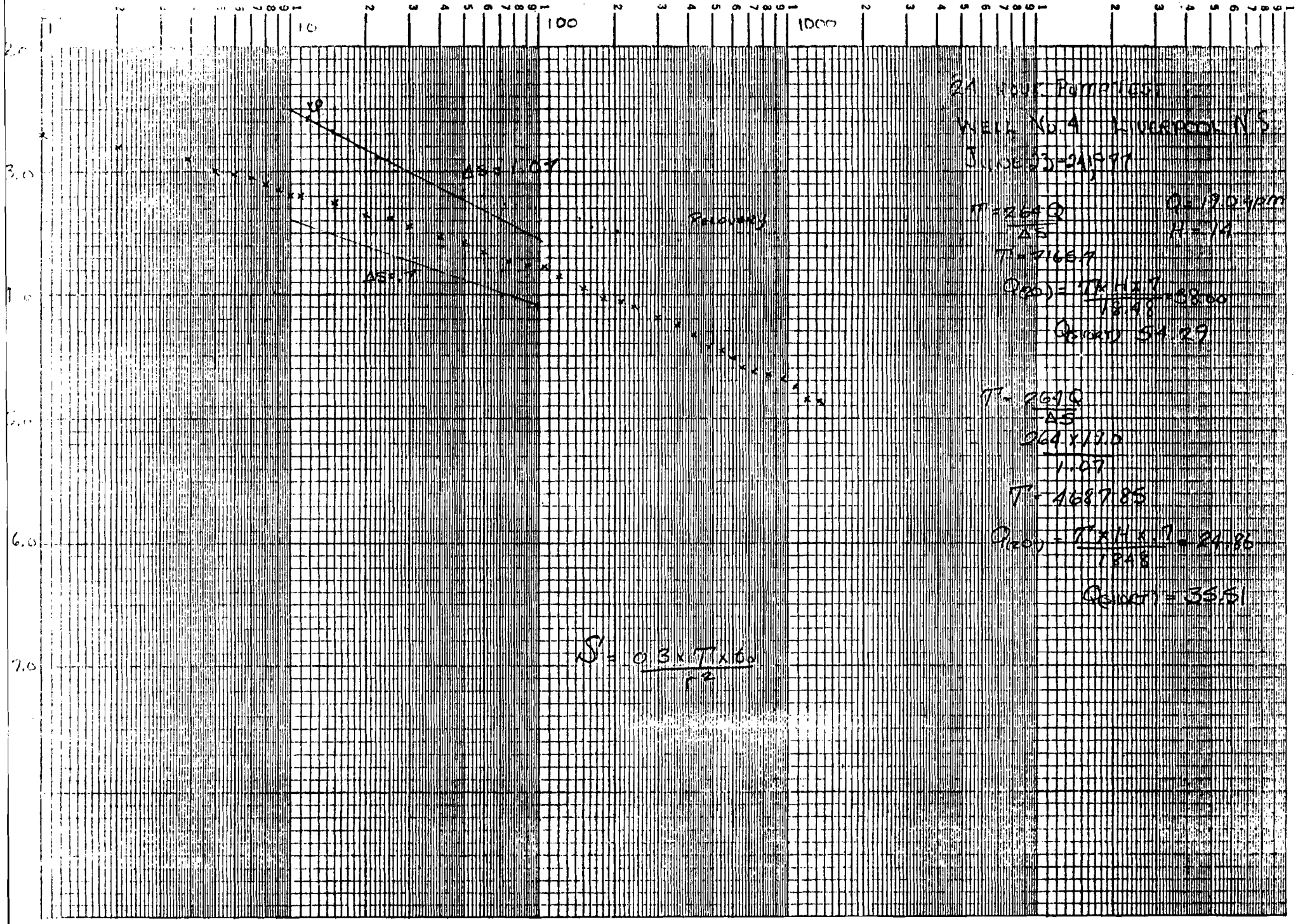
✓	DETERMINATION	RESULT mg/litre	RESULT meq/litre
	Sodium	4.8	
	Potassium	0.4	
	Calcium	2.1	
	Magnesium	1.2	
	Hardness (as $CaCO_3$)	10	
	Alkalinity (as $CaCO_3$)	13	
	Sulfate	2.8	
	Chloride	7.1	
	Fluoride	<0.1	
	Silica, reactive	9.5	
	Phosphate, ortho	<0.02	
	Nitrate + Nitrite (as N)	<0.1	
	Ammonia (as N)	<0.1	
	Arsenic	0.005	
	Iron	0.05	
X	Manganese	0.04	
	Lead	0.006	
	Copper	<0.005	
	Zinc	[illegible]	

✓	DETERMINATION	RESULT	
	Total Solids	[illegible]	mg/litre
	Total Dissolved Solids	[illegible]	mg/litre
	Colour	5	T.C.U.
	Turbidity	0.[illegible]	J.T.U.
	Conductivity	[illegible]7	umho/cm
	pH	6.[illegible]	UNITS
	Total Organic Carbon		mg/litre

RECEIVED
JUL 29 [illegible]
NOVA SCOTIA DEPT. OF ENVIRONMENT

FIELD DATA	Remarks:	DATE
Temp:	[illegible]	Rec'd [illegible]
pH:	[illegible]	Comp'd [illegible]
Iron:		
		CHEMIST

FORM 639
115, 14, 2/74



NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Crew MEASURED BY:

LOCATION OF PROJECT Liverpool WELL LOCATION: Gravel Pit

STATUS Pumping Well # 4 (pumping or observation well) R = (distance from pumping well in feet and direction) DATE June 23/77 PAGE 1

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
June 23	10:00	0			2.7				Measure pt = 1' below casing top
		1			2.8				
		2			2.9				
		3			3.0				Q = 19 gpm ±1.05
		4			3.01				Constant head tank
		5			3.05				
		6			3.10				First 20 minutes difficult
		7			3.15				to measure due to bubbling from
		8			3.15				excess water in head tank.
		9			3.20				(overflow discharge) Fluctuate M ±.05
	10:10	10			3.20				AFTER ±.02 Temp 40°
		15			3.25				
		20			3.35				
		25			3.39				
	10:30	30			3.45				
		40			3.57				
		50			3.58				
	11:00	60			3.64				
		75			3.71				
	11:30	90			3.76				
		105			3.79				
	12:00	120			3.85				
		150			3.95				
	1:00 pm	180			4.03				

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Crew **MEASURED BY:**

LOCATION OF PROJECT Liverpool **WELL LOCATION:** Gravel Pit

STATUS Pumping well #4 (pumping or observation well) **R =** (distance from pumping well in feet and direction) **DATE** June 23/77 **PAGE** 2

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
	1:30	210			4.06				Water Temp = 40°F
	2:00 pm	240			4.10				
	3:00	300			4.20				
	4:00	360			4.26				
	5:00	420			4.33				
	6:00	480			4.41				
	7:00	540			4.45				
	8:00	600			4.51				
	9:00	660			4.60				
	10:00	720			4.62				
	12:00	840			4.65				
June 24/77	2:00	960			4.69				Water Sample Taken
	4:00	1080			4.75				at — 8:00 AM
	6:00	1200			4.83				well #4.
	8:00	1320			4.86				
	10:00	1440							8:20 pump turned off
									Pump had no oil

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

RECOVERY

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Crew MEASURED BY:

LOCATION OF PROJECT Liverpool WELL LOCATION: Gravel Pit

STATUS Well #4 (pumping or observation well) R = (distance from pumping well in feet and direction) DATE June 24/77 PAGE 03

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
June 24/77	8:20	0			3.6				8:20 pump turned off. Pump had no oil
		1			3.59				
		2			3.57				
		3			3.56				
		4			3.55				
		5			3.5				
		6			3.49				
		7			3.48				
		8			3.45				
		9			3.38				
	8:30	10			3.35				
		15			3.3				
		20			3.27				
		25			3.2				
	8:50	30			3.15				
		40			3.1				
		50			3.0				
	9:20	60			2.9				
		75			2.82				
	9:50	90			2.73				
		105			2.68				
	10:20	120							
	10:50	150							
	11:20	180							

WATER ASSAY CC-9

Department of Pathology

ENVIRONMENTAL CHEMISTRY
Division of Clinical Chemistry
5788 University Ave., Hfx., N. S. B3H 1V8
Phone 424-2844

Report To:

Bill To:

OWNER

LOCATION

SOURCE

GRID

DATE TAKEN

COLLECTED BY

SAMPLE #

√	DETERMINATION	RESULT mg/litre	RESULT meq/litre
	Sodium	4.6	
	Potassium	0.4	
	Calcium	1.0	
	Magnesium	1.1	
	Hardness (as $CaCO_3$)	6.6	
	Alkalinity (as $CaCO_3$)	56	
	Sulfate	40	
	Chloride	82	
	Fluoride	<0.1	
	Silica, reactive	1.2	
	Phosphate, ortho	0.02	
	Nitrate + Nitrite (as N)	<0.1	
	Ammonia (as N)	<0.1	
	Arsenic	0.005	
☒	Iron	0.04	
	Manganese	0.05	
	Lead	0.005	
	Copper	<0.005	
	Zinc	[illegible]	

√	DETERMINATION	RESULT	
	Total Solids	21	mg/litre
	Total Dissolved Solids	20	mg/litre
	Colour	5	T.C.U.
	Turbidity	0.5	J.T.U.
	Conductivity	44	umho/cm
	pH	6.0	UNITS
	Total Organic Carbon		mg/litre

RECEIVED
JUN 21 1977
NOVA SCOTIA DEPT. OF ENVIRONMENT

FIELD DATA
Temp:
pH:
Iron:

Remarks:

General Analysis
Drilling/Test: Friarell 74

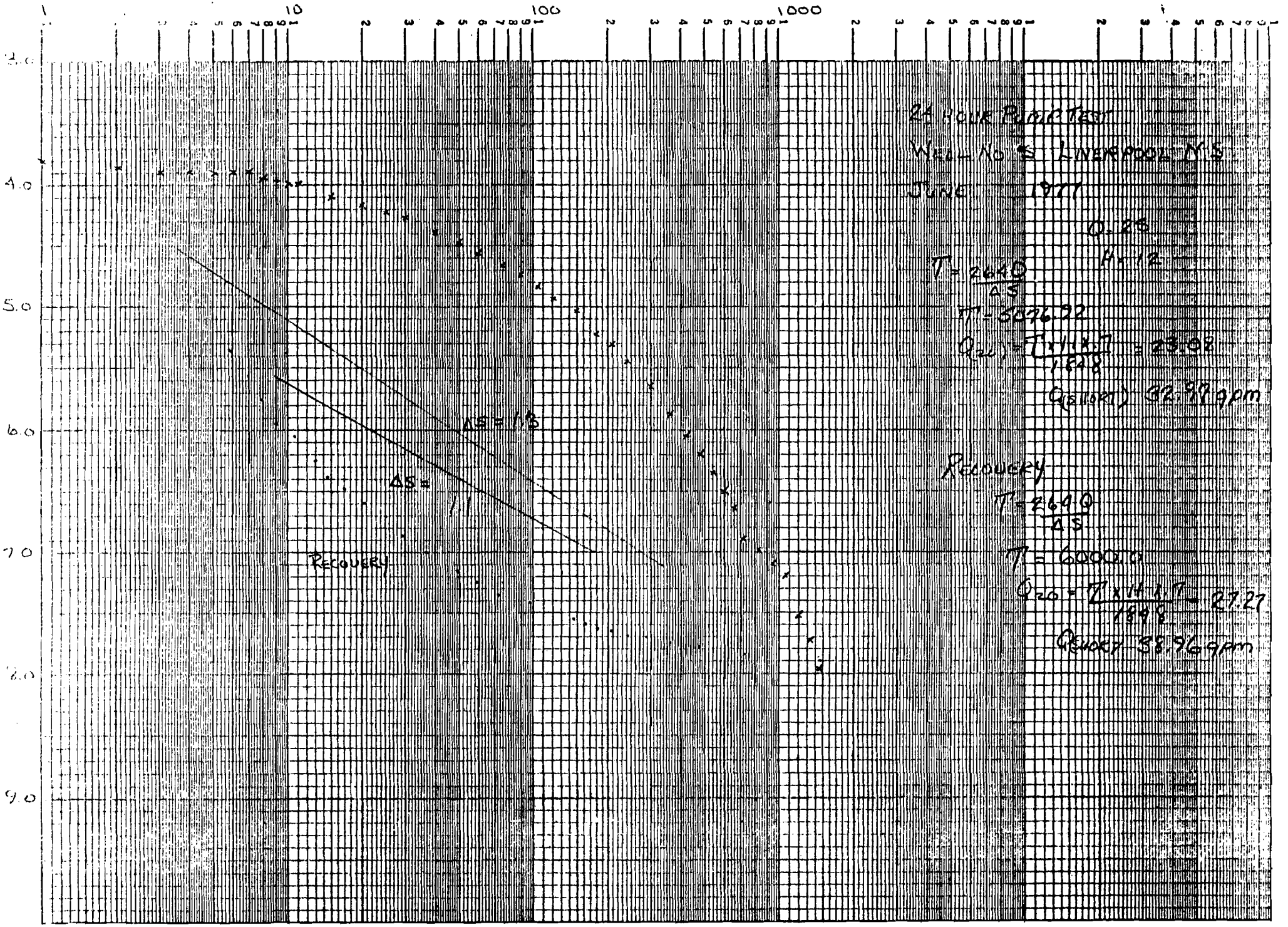
DATE

Rec'd

Comp'd

CHEMIST

FORM 639
115, 14, 2/74



NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: [illegible] MEASURED BY:

LOCATION OF PROJECT: Liverpool WELL LOCATION: Gravel pit

STATUS: Pumping Well #5 (pumping or observation well) R = (distance from pumping well in feet and direction) DATE: June 21/77 PAGE: 1

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at: Meas. Point	Tape Reading at: Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
June 21/77	9:30 am	0			3.8 feet				Meas. pt = 1' stand
		1			3.85				casing top
		2			3.90				
		3			3.90				Q = 25.0 igpm
		4			3.90				Constant head tank
		5			3.90				
		6			3.90				
		7			3.95				
		8			3.98				
		9			4.0				
	9:40	10			4.0				
		15			4.1				
	9:50	20			4.17				
		25			4.22				
	10:00	30			4.28				
		40			4.40				
		50			4.48				
	10:30	60			4.57				
		75			4.68				
	11:00	90			4.73				
		105			4.82				
	11:30	120			4.92				
		135			5.03				
	12:30 pm	180			5.23				

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Crew **MEASURED BY:**

LOCATION OF PROJECT Liverpool **WELL LOCATION:** Gravel Pit

STATUS PW #5 (pumping or observation well) **R =** (distance from pumping well in feet and direction) **DATE** June 21/77 **PAGE** 2

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
		210			5.3				Water temp 38°F 25 GPM
	1:30 pm	240			5.45				
	2:30	300			5.65				
	3:30	360			5.88				
	4:30	420			6.05				Water temp 38 F
	5:30	480			6.20				
	6:30	540			6.35				
	7:30	600			6.50				
	8:30	660			6.65				Water temp 38 F
	9:30	720			6.90				
	11:30	840			7.00				
June 22/77	1:30 am	960			7.10				
	3:30 am	1080			7.20				
	5:30 am	1200			7.53				
	7:30 am	1320			7.72				Water temp
	9:30 am	1440			7.97				Water temp 38°F
									Water Sample taken
									at 9:25 AM

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

RECOVERY

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Crew MEASURED BY: Water Survey Crew

LOCATION OF PROJECT Liverpool WELL LOCATION: Canal Pit

STATUS Well #5 (pumping or observation well) R = (distance from pumping well in feet and direction) DATE [illegible] PAGE [illegible]

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
June 22/77	9:30am	0			7.97				
		1			7.90				
		2			7.84				
		3			7.78				
		4			7.75				
		5			7.70				
		6			7.69				
		7			7.65				
		8			7.62				
		9			7.59				
	[illegible]	10			7.56				
		15			7.41				
	9:50	20			7.34				
		25			7.25				
	[illegible]	30			7.16				
		40			7.00				
		50			6.86				
	[illegible]	60			6.70				
		75			6.60				
	11:00	90			6.49				
		105			6.39				
	11:30	120			6.25				
	[illegible]	150			6.07				
	12:30	150			5.95				

NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT - WATER PLANNING & MANAGEMENT DIVISION

RECOVERY

WATER LEVEL MEASUREMENTS (FIELD)

TEST CONDUCTED BY: Water Survey Crew **MEASURED BY:** Water Survey Crew

LOCATION OF PROJECT Liverpool **WELL LOCATION:** Gravel Pit

STATUS Well #5 (pumping or observation well) **R =** (distance from pumping well in feet and direction) **DATE** June 22/77 **PAGE** 4

Date	Time hrs. & mins.	Elapsed time in mins.	Tape Reading at Meas. Point	Tape Reading at Water level	Depth to water in feet	Draw-down in feet	Q = discharge gals/min		REMARKS (i.e. pump adjustments, water temp. static levels, etc.)
	1:00	210	5.75						
	1:30 PM	240	5.57						
	2:30	300	5.35						
	3:30	360							
	4:30	420							

WATER ASSAY CC-9

Victoria General Hospital
Department of Pathology

ENVIRONMENTAL CHEMISTRY
Division of Clinical Chemistry
5788 University Ave., Hfx., N. S. B3H 1V8
Phone 424-2844

Report To: [illegible]

OWNER [illegible]
LOCATION Liverpool
SOURCE [illegible]
GRID
DATE TAKEN [illegible]
COLLECTED BY [illegible]
SAMPLE # [illegible]

Bill To: [illegible]

✓	DETERMINATION	RESULT mg/litre	RESULT meq/litre
	Sodium	5.0	
	Potassium	0.5	
	Calcium	2.8	
	Magnesium	1.0	
	Hardness (as $CaCO_3$)	11	
	Alkalinity (as $CaCO_3$)	9.0	
	Sulfate	1.0	
	Chloride	2.0	
	Fluoride	<0.1	
	Silica, reactive	9.0	
	Phosphate, ortho	0.02	
	Nitrate + Nitrite (as N)	0.2	
	Ammonia (as N)	<0.1	
	Arsenic	<0.005	
	Tannin/Lignin	<0.1	
	Iron	0.06	
X	Manganese	0.07	
	Lead	<0.005	
	Copper	<0.005	
	Zinc	[illegible]	

✓	DETERMINATION	RESULT	
	Total Solids	[illegible]	mg/litre
	Total Dissolved Solids	[illegible]	mg/litre
	Colour	10	T.C.U.
	Turbidity	[illegible]	J.T.U.
	Conductivity	[illegible]	umho/cm
	pH	[illegible]	UNITS
	Total Organic Carbon		mg/litre

FIELD DATA
Temp:
pH:
Iron:

Remarks:

DATE
Rec'd
Comp'd

CHEMIST

FORM 639
115, 14, 2/74

Test Hole.

#	Depth	Log
1	14	0 – 8 cl & bldrs, 8 – 14 gravel
2	16	0 – 6 sand, 6 – 16 gravel
3	22	0 – 18 gravel 18 – 22 sand
4	17	0 – 5 clay coarse gravel, 5 – 17 gravel
5	16	0 – 16 bldrs – (no water)
6	17	0 – 5 cl & crse gravel, 5 – 17 gravel
7	15	0 – 7 clay & coarse gravel, 7 – 15 gravel
8	20	0 – 6 clay & coarse gravel, 6 – 20 gravel
9	17	0 – 12 bldrs, 12 – 14 gravel, 14 – 17 mud
10	20	0 – 12 bldrs, 12 – 16 gravel, 16 – 18 sand 18 – 20 coarse gravel
11	17	0 – 12 bldrs, 12 – 17 gravel
12	17	0 – 12 mud & gravel, 12 – 17 mud & gravel (no water)
13	20	0 – 10 mud & gravel, 10 – 20 gravel
14	20	0 – 12 gravel, 12 – 20 sand & gravel no H2O
15	24	0 – 14 gravel, 14 – 20 sand & bldrs, 20 – 24 mud (6 – 14 gravel to 14 – 20)
16	12	6 – 12 gravel & boulders (no H2O)

Drilled Wells

#1 1 0 – 6 gravel, 6 – 14 fine gravel, 14 – 20 sd & gravel (30 gpm)

1A 2 0 – 8 gravel, 8 – 14 sd & gravel, 14 – 23 sd & gravel

1B 0 – 14 gravel

1C 3 0 – 14 sd & gravel, 14 – 22 gravel.

1D 4 0 – 12 sd & gravel, 12 – 20 gravel 30 gpm

1E 0 – 12 sd & gravel, 12 – 18 gravel.

#2 (#7) 0 – 4 sand, 4 – 9 sd & gravel, 9 – 12 crse gravel (15 gpm)

#2A (#8) 0 – 6 sd & gravel, 6 – 11 gravel.

#5 Dug ~ 1½ mos ago – 16 feet. 4' diam to 12" plastic pipe inside

Developed w/ jetting