ANNUAL REPORT 1964

BELLEVILLE

water pollution control plant

DIVISION OF PLANT OPERATIONS
Ontario Water Resources Commission

ONTARIO WATER RESOURCES COMMISSION

OFFICE OF THE GENERAL MANAGER

Members of the Belleville Local Advisory Committee,
City of Belleville.

Gentlemen:

We are pleased to provide you with the 1964 Operating Report for the Belleville Water Pollution Control Plant, OWRC Project No. 61-S-84.

By continuing the mutual cooperation which has existed in the past, we can look forward to greater progress in the field of water pollution control.

Yours very truly,

D. S. Caverly,
General Manager

General Manager,
Ontario Water Resources Commission.

Dear Sir:

It is with pleasure that I present to you the Annual Report of the Belleville Water Pollution Control Plant, OWRC Project No. 61-S-84 for 1964.

This report presents design data, outlines operating problems encountered and summarizes in tables, charts and graphs all significant flow and cost data.

Yours very truly,

B. C. Palmer, P. Eng.,
Director,
Division of Plant Operations.

FOREWORD

This report describes the operation of this project for the year 1964. It includes a detailed description of the project, summary of operation, graphs and charts showing quality and quantity information, and project cost data.

This information will be of value to the municipality in assessing the adequacy of the works in meeting existing requirements and in projecting its capability to meet future expected demands. The cost information will be of particular interest to those concerned with developing and maintaining revenue structures.

The preparation of this report has been a cooperative effort of several groups within the Division of Plant Operations. These include the Statistical Section, Brochures Officer and the Regional Supervisor. However, the primary responsibility for the content has been with the Regional Operations Engineer. He will be pleased to discuss all aspects of this report with the municipality.

B. C. Palmer, P. Eng.,
Director,
Division of Plant Operations.

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BELLEVILLE

water pollution control plant

operated for

THE CITY OF BELLEVILLE

by

THE ONTARIO WATER RESOURCES COMMISSION

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801 Bay Street Toronto 5

'64 REVIEW

It is the intent of this report to give significant data on the operation of the Belleville Water Pollution Control Plant. The year 1964 was the second year of full operation at this plant.

The average daily flow to the plant in 1964 was 4.9 million gallons per day. This was an increase of 1.1 million gallons per day over the 1963 average. Hydraulically, the plant is severely overloaded. It is designed to treat an average flow of 3.0 million gallons per day, about 2 million gallons per day less than the actual flow during 1964.

The operating costs for the plant in 1963 were $42,884.97 and the estimated sewage flow for that year was 1400 million gallons or $30.64 for treating each million gallons. During 1964, 1880 million gallons were treated at a cost of $41,246.10 or $21,94 for each million gallons. The decrease in cost per million gallons for 1964 was primarily due to the increased flows.

Operating costs were increased in 1964 for power, repairs and maintenance. Operating costs that were decreased in 1964 were fuel and chlorine. Fuel was decreased because of increased sewage gas production which is used as a fuel. The chlorine costs were decreased because the deposit paid for chlorine cylinders in 1963 was credited to the operating costs in 1964.

Sludge hauling costs were also decreased in 1964. Re-tendering of sludge hauling reduced this cost from 57 cents per cubic yard to 50 cents per cubic yard.

During the summer of 1964 wastes from the American Optical Company (Canada) Limited were introduced to the plant. This waste contains a prominent concentration of ferric oxide which has imparted a rouge colour to the grit and primary tanks. Since the waste is rather high in solids, it may create a problem in the digestion process. Presently the solids concentration in the digesters is at a maximum and a further increase due to this waste could create problems.

The plant was inspected routinely by head office engineers and technicians during 1964 and found to be in a clean, attractive and satisfactory condition.

GLOSSARY

BOD	biochemical oxygen demand (a measure of organic content)
cfm	cubic feet per minute
comminution	shredding of solids into small fragments
DWF	dry weather flow
effluent	outflow
flocculation	bringing very small particles together to form a larger mass (the floc) before settling
fps	feet per second
gpcd	gallons per capita per day
gpm	gallons per minute
grit	sand, dust, stones, cinders and other heavy inorganic material
influent	inflow
lin. ft.	lineal feet
mgd	million gallons per day
mlss	mixed liquor suspended solids
ppm	parts per million
ss	suspended solids
TDH	total dynamic head (usually refers to pressure on a pump when it is in operation)

HISTORY
1957 - 1964

INCEPTION

In 1957, an engineering report was prepared by the consulting engineers, Gore and Storrie Limited, for the construction of sanitary sewers and treatment facilities for the City of Belleville and the immediate Townships of Sidney and Thurlow. In 1960, the firm of Gore & Storrie Limited was engaged to prepare plans and specifications for the project.

APPROVAL

In 1961, the City of Belleville signed an agreement with the Ontario Water Resources Commission to finance, construct and operate the plant.

CONSTRUCTION

The construction of the project was started in 1961 and, by the end of 1962, the Division of Plant Operations took over the operation.

TOTAL COST

$2,379,600.00.

Project Staff

D. Little
Chief Operator

Operators: C. Culkin
K. F. Matousek

COMMENTS

On August 27, 1962, Mr. Don Little was hired as Chief Operator of the plant. Mr. Little spent several weeks in Brantford as part of an "in service" training program before commencing his duties at the Belleville plant. Mr. Little successfully completed the operators' courses offered by the Ontario Water Resources Commission in December of 1964 with a grade B standing.

Mr. Matousek and Mr. Culkin were both hired as operators on November 19, 1962.

The staff has operated the plant in an efficient and satisfactory manner.

Description of Project

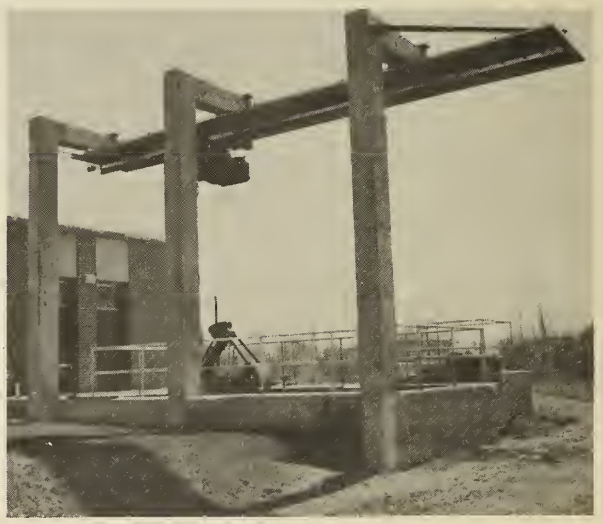
PUMPINGS STATIONS

The waste from the west and central sections of the City of Belleville is directed to the Front Street pumping station. From the Front Street pumping station, the waste is pumped via an 18 inch force main to the influent chamber of the grit tank.

The waste from the eastern section of the City of Belleville is directed to the pumping station on the plant grounds from which it is pumped to the influent chamber of the grit tank via a 14 inch force main.

INFLUENT WORKS

Compressed air is forced into the grit chamber in such a manner as to impart a roll to the tank contents. The velocity of the roll is controlled so that the grit settles to the bottom of the hopper while the organic material stays

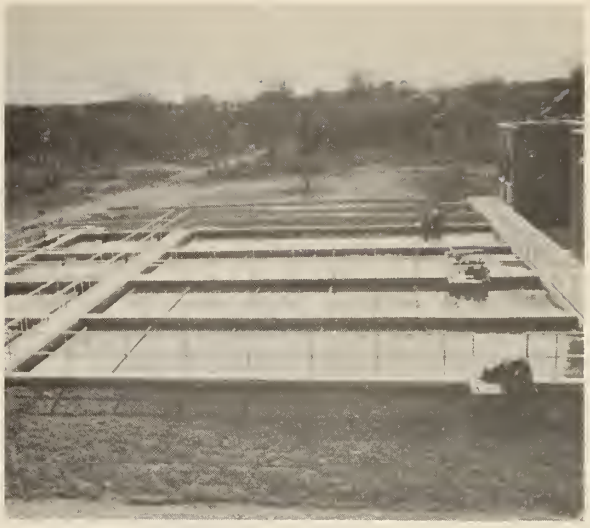


INFLUENT WORKS

in suspension and passes through the grit chamber. The grit is removed from the bottom of the tank by a manually operated clam bucket and placed on a truck for hauling away.

PRIMARY SEDIMENTATION TANKS

From the grit tank the waste is directed through a barminutor into the settling tanks. It is retained in the settling tanks for approximately six hours at design flow. Approximately 65 percent of the suspended solids in the incoming sewage settles to the bottom of the settling tanks. Each settling tank is equipped with two sludge scrapers, one longitudinal scraper and one traverse scraper. These scrapers move the settled solids to a hopper located at the front of the tank. The sludge is pumped automatically from the hopper to the digestion tank at a pre-set time interval.



PRIMARY TANKS

DIGESTERS

SLUDGE DIGESTION TANKS

The Belleville Sewage Treatment Plant utilizes two stage digestion. There are two digesters, one primary tank 45 feet in diameter and one secondary tank 45 feet in diameter. The piping to the digesters is so arranged that raw sludge can be pumped to either tank and digested sludge can also be removed from either tank.

Both digesters have fixed covers. The primary digester contents are mixed with compressed digester gas and also circulated through a heat exchanger to maintain the tank contents at approximately 90° F.

PLANT PUMPING STATION

PROJECT COSTS

TOTAL CAPITAL COST: $2,224,978.00

The total cost to the municipality during 1964 was as follows:

Net Operating	$	41,246.10
Debt Retirement		14,423.00
Reserve		14,064.00
Interest Charged		40,063.74
TOTAL	$	109,796.84

RESERVE ACCOUNT

Balance at January 1, 1964	$	8,302.35
Deposited by Municipality		14,064.00
Interest Earned		750,00
	$	23,116.54
Less Expenditures		965.47
Balance at December 31, 1964	$	22,151.07

LONG TERM DEBT: The municipality's long term debt to the OWRC, revised December 31, 1964 was $716,123.

MONTHLY COSTS

MONTH	TOTAL EXPENDITURE	PAYROLL	CASUAL PAYROLL	FUEL	POWER	CHEMICAL	GENERAL SUPPLIES	EQUIPMENT	REPAIRS & MAINTENANCE	*SUNDRY	WATER
JAN	1964.32	1006.30		84.37	640.61		125.84			54.34	52.86
FEB	2054.40	1006.30		104.25	632.18		73.10	10.37	9.43	176.92	41.85
MARCH	2189.71	1006.30		231.76	506.16		91.47			320.92	33.10
APRIL	2221.95	1011.91		346.52	584.74		133.52		38.99	52.24	54.03
MAY	(1300.65)	1519.48		112.59	665.84		29.38	13.91	113.07	(3819.18*)	64.26
JUNE	15151.05	1311.43			617.29	(900.00)	14.25			14047.39	60.69
JULY	4504.31	1071.10			539.02		74.71		78.28	2596.72	144.48
AUG	2194.12	1046.78			539.26	61.74	117.28		6.02	284.87	138.17
SEPT	7173.95	1046.78			590.43	5168.80	134.42	12.11		47.54	173.87
OCT	2462.45	1046.78			488.34		237.92		237.90	303.99	147.52
NOV	2362.84	1046.78		111.20	540.83		38.35	67.38	198.17	197.24	162.89
DEC	267.65	1570.17		109.90	1077.95	(3600.00)	281.27	16.24	535.85	187.24	89.03
TOTAL	41246.10	13690.11		1100.59	7422.65	730.54	1351.51	120.01	1217.71	14450.23	1162.75

* SUNDRY INCLUDES SLUDGE HAULING COSTS WHICH WERE $520.38

BRACKETS INDICATE CREDIT

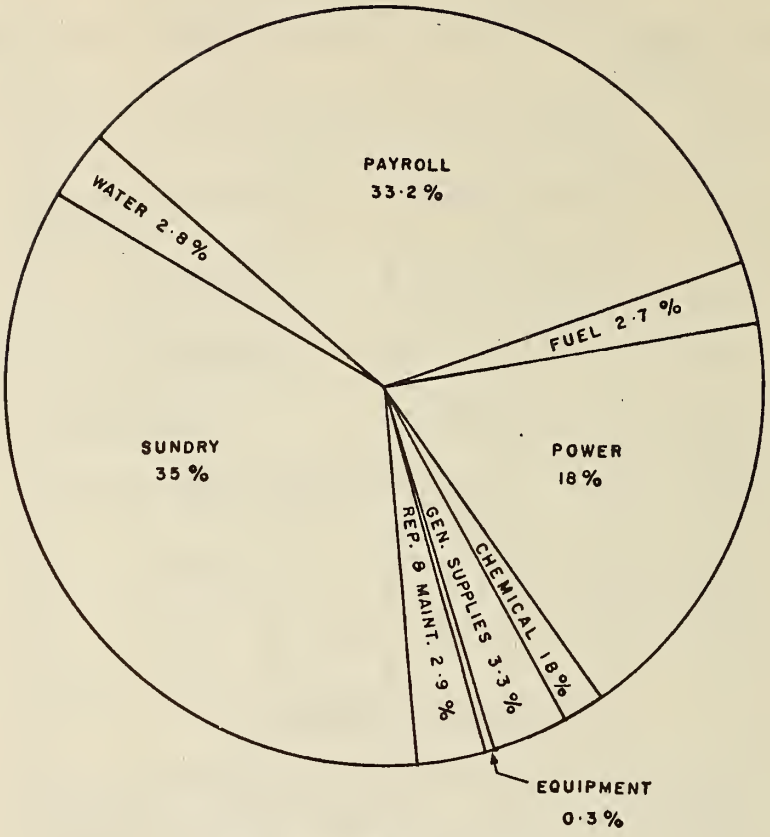
NOTE: LARGE CREDIT IN MAY WAS DUE TO A REVISION OF TAX BILLINGS FOR 1963; LARGE EXPENDITURE IN JUNE INCLUDED $10,064.82 FOR 1964 TAXES.

YEARLY COSTS

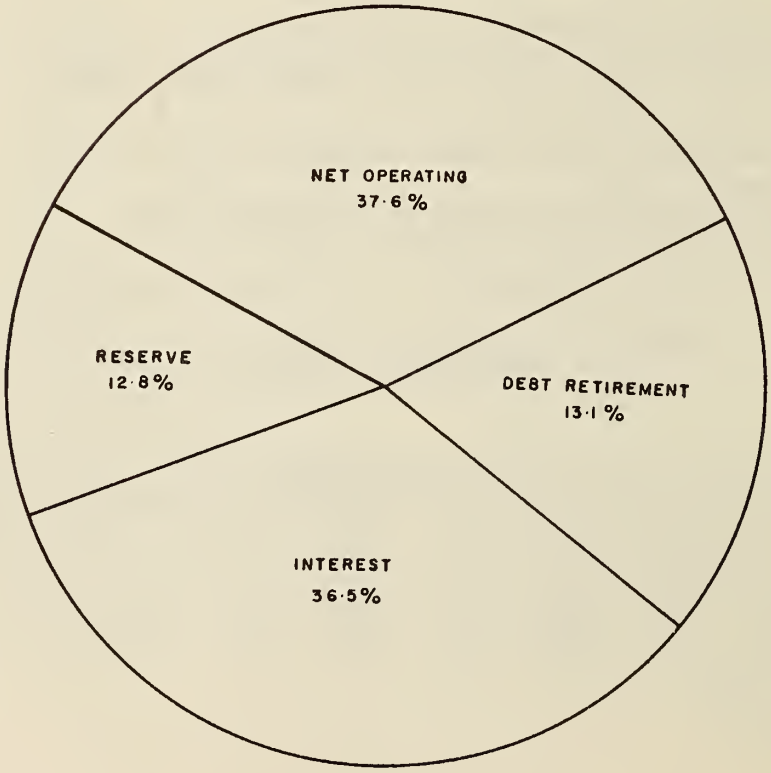
YEAR	M.G. TREATED	TOTAL COST	COST PER FAMILY PER YEAR	COST PER MILLION GALLONS	COST PER L.B. OF BOD REMOVED
1963	1400	$42,885	$30.64	$5.46	6 CENTS
1964	1880	$41.246	$21.94	$5.25	2 1/2 CENTS

BASED ON POPULATION OF 8,094
AND 3.9 PERSONS PER FAMILY.

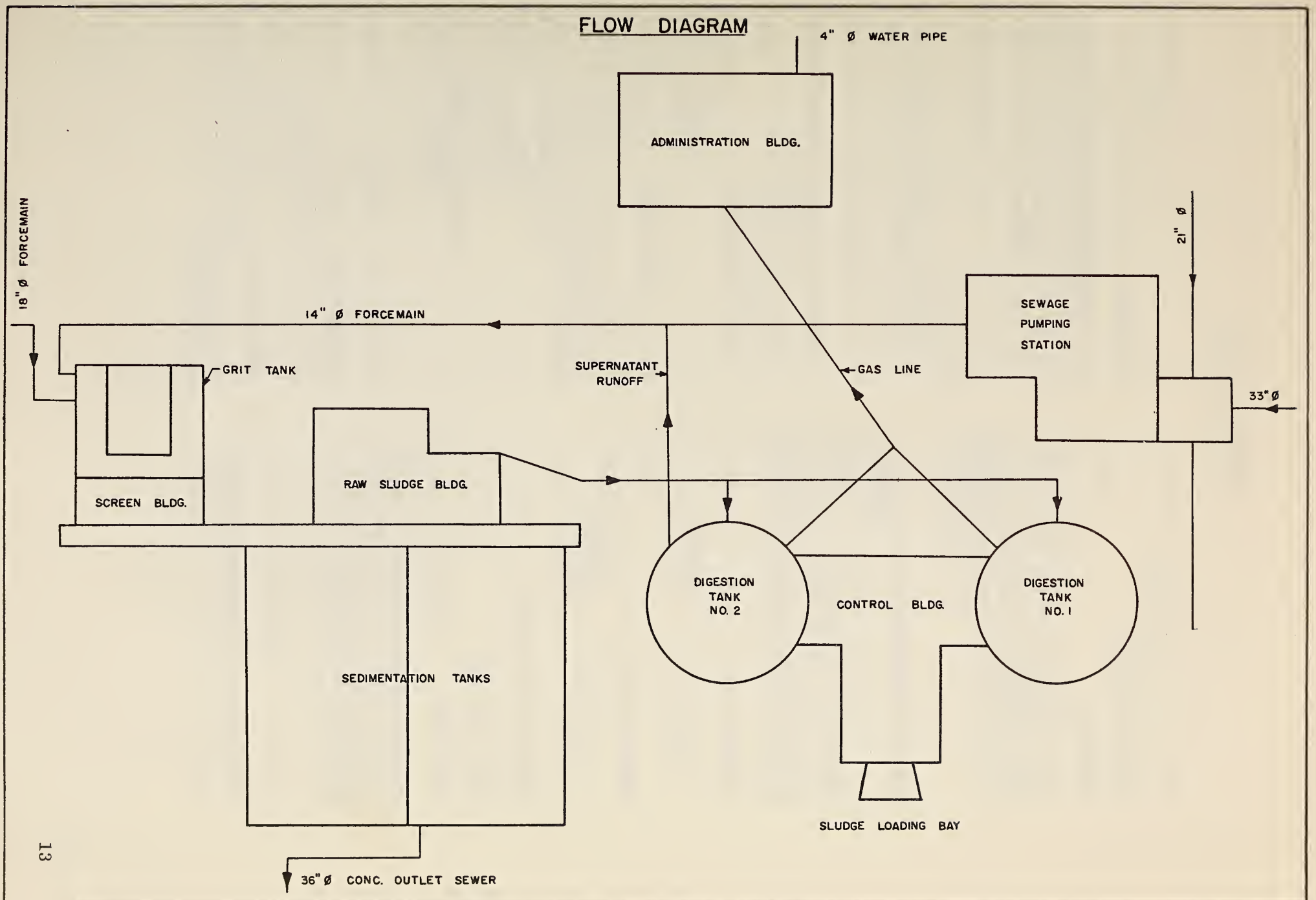
1964 OPERATING COSTS



TOTAL ANNUAL COST



Technical Section


FLOW DIAGRAM
4" Ø WATER PIPE
ADMINISTRATION BLDG.
18" Ø FORCEMAIN
21" Ø
14" Ø FORCEMAIN
SEWAGE PUMPING STATION
GRIT TANK
SUPERNATANT RUNOFF
GAS LINE
33" Ø
SCREEN BLDG.
RAW SLUDGE BLDG.
DIGESTION TANK NO. 2
CONTROL BLDG.
DIGESTION TANK NO. 1
SEDIMENTATION TANKS
SLUDGE LOADING BAY
36" Ø CONC. OUTLET SEWER

Design–Data

DESIGN CRITERIA

GENERAL

Type of Plant - Primary treatment plant.

Design Population - 30,000 persons initially with provision for extension to 60,000 persons.

Average Design Plant Flow - 3,000,000 gals/day.

Maximum Design Plant Flow - 9,000,000 gals/day.

Per Capita Flow - 100 gallons per day.

Five Day BOD -

Raw Sewage	-	225 PPM
Removal	-	30%

Suspended Solids -

Raw Sewage	-	260 PPM
Removal	-	65%

PRIMARY TREATMENT

GRIT REMOVAL

Type of Unit

Aerated grit tank designed to include the doubling of the primary sedimentation tanks. Grit removed by grab bucket and trucked from site. Aeration of grit tank through air nozzles.

One unit - 24' x 14' x 12'6".

Liquid Volume - 26,200 Imperial gallons.

Retention at Design Flow - 12.5 minutes.

Screening

One mechanically cleaned bar screen with 3/8" clear spacing between bars and one hand cleaned by-pass bar screen with 1 1/4" clear spacing between bars.

Chicago Pump Company Barminutor - Model "C".

PRIMARY SEDIMENTATION TANKS

Four rectangular units - 70' x 18' x 12'

Volume - 377,500 Imperial gallons.

Retention at Design Flow - 3.0 hours.

Surface Settling Rate - 600 gallons per sq. foot of tank per day.

Weir Overflow Rate - 11,000 gallons per lineal ft. of weir per day.

Sludge Collectors - Longitudinal sludge collectors and cross sludge collectors manufactured by the Rex Chainbelt Co. collect sludge to single hoppers in each settling tank.

Scum Troughs - Manually operated.

Outfall Works

300 feet of 33 inch concrete pipe.

1179 feet of 36 inch concrete pipe.

The outfall sewer also acts as a chlorine contact chamber.

Chlorination

One vacuum type chlorinator.

Fisher & Porter - Model 70C3410B

Present Capacity - 1,000 pounds of chlorine per day.

Digester System

Two digesters - 45 feet in diameter by 25 feet high employing two stage digestion.

Volume - 80,000 cubic feet.

Digester Loading - 2.65 cubic feet per capita.
- 1.91 pounds solids per cubic feet of tank per month.

Heat Exchanger

1,000,000 B. T. U.'s per hour.

Recirculation of gas in first stage tank by gas compressor with capacity of 150 cfm. Gas withdrawn used for plant and sludge heating as available.

PUMPING STATIONS

Front Street Pumping Station

Unit No. 1

Pump -

One 10" x 8" Worthington variable speed centrifugal sewage pump.

Model - 8 FLV - 16

Impeller size - 14 1/2 inches.

Capacity - 3.0 MGD @ 55 foot head.
RPM - 1200

Motor -

English Electric

Electric Machinery Magnetic Ampli-Speed Drive - Model MDM-15 - float controlled. Volts - 550/60/3 - HP - 50 RPM - 1200

Unit No. 2

Pump -

One 8" x 6" Worthington constant speed centrifugal pump - Model 6FLV-15 Impeller size - 13 1/8 inch.

Capacity - 2.0 MGD @ 55 foot head.

RPM - 1200

Motor -

English Electric

Volts - 550/60/3

HP - 40

RPM - 1200

Unit No. 3 - (Standby)

Pump -

One 10" x 8" dual driven sewage pump.

Model - 12CMCV-1

Impeller size - 14 inch.

Capacity - 4.0 MGD @ 55 foot head.

Johnson - Model SE110 - Type III right angle drive.

Motor -

Lister Model No. FR-6 diesel engine and English Electric.

Volts - 550/60/3

HP - 60

RPM - 1200

PUMPING STATION - PLANT SITE

Unit No. 1

Pump -

One - 10 x 8 inch Worthington variable speed centrifugal sewage pump.

Model - 8FLV-16

Impeller size - 12 7/8 inches.

Capacity - 3.0 MGD @ 35 foot head.

RPM - 1200

Motor

English Electric

Electric Machinery Magnetic Ampli-Speed Drive.

Model - MDM-13

Volts - 550/60/3

HP - 30

RPM - 1200

Unit No. 2

Pump -

One 8" x 6" Worthington constant speed centrifugal pump.

Model - 6FLV-15

Impeller size - 12 inches.

Capacity - 2.0 MGD 35 foot head.

RPM - 1200

Motor -

English Electric

Volts - 550/60/3

HP - 25

RPM - 1200

Unit No. 3 - (Standby)

Pump -

One 10" x 8" centrifugal sewage pump.

Model - 8 FLV-16

Impeller size - 12 5/8 inches.

Capacity - 3.0 MGD 35 foot head.

Johnson - Model SC-50 - Right angle drive.

Dundas Street West Pumping Station

Unit No. 1

One 4" x 3" Worthington centrifugal pump.

Model - 3FLV-8

Impeller size - 7 1/2 inches.

Capacity - 0.5 MGD @ 40 foot head.

RPM - 1800

Motor -

English Electric

Volts - 550/60/3

HP - 7 1/2

RPM - 1800

Unit No. 2 - (Standby)

Pump -

One 8" x 6" Worthington dual driven centrifugal sewage pump.

Unit No. 2 - (Standby) - Continued

Model 6FLV-15

Impeller size - 11 7/8 inches.

Capacity - 1.5 MGD @ 40 foot head.

RPM - 1200

Johnson - Model 5B-36 - Type III right angle drive.

Motor -

Lister diesel engine and English Electric.

Volts - 550/60/3

HP - 25

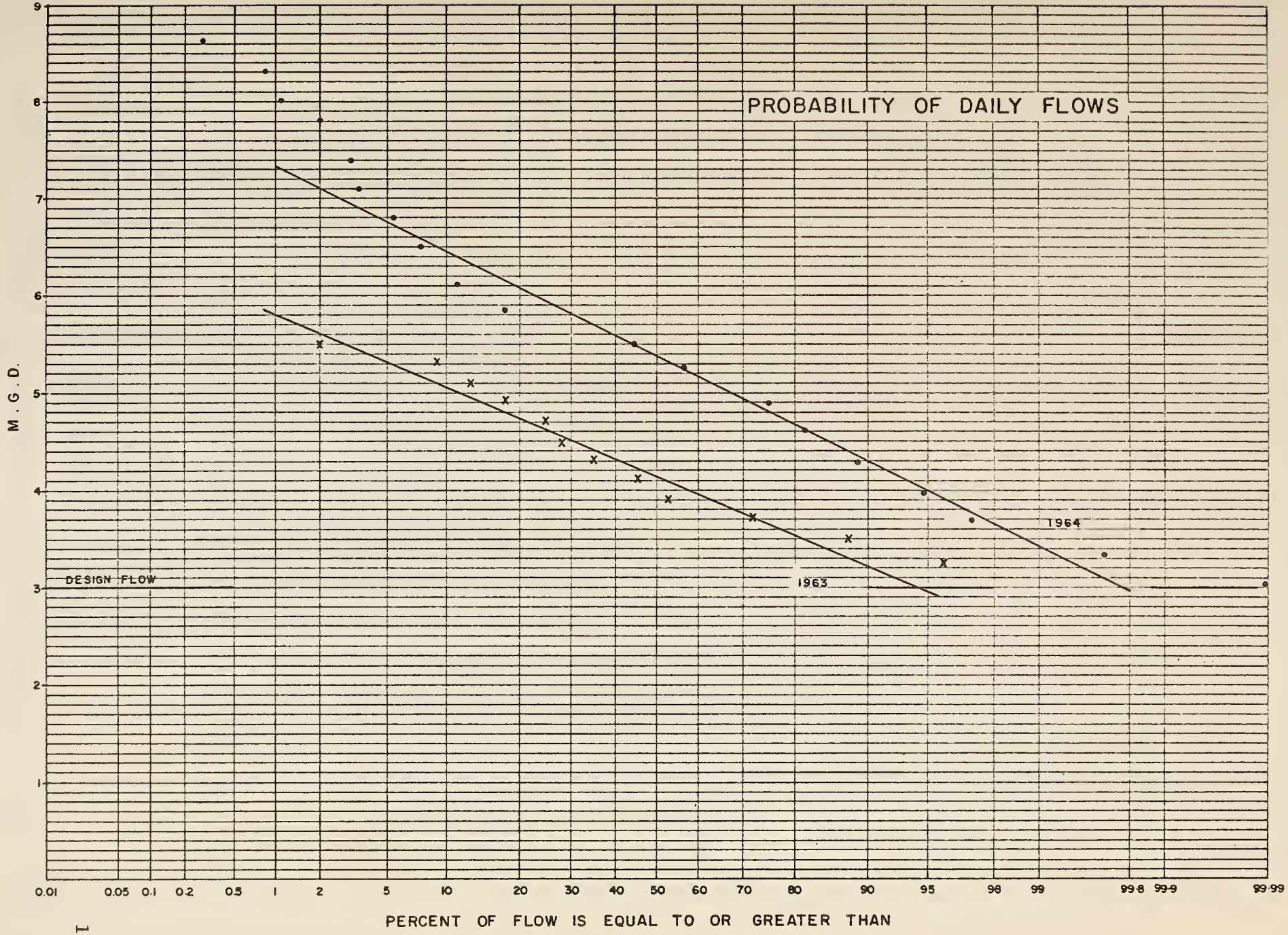
RPM - 1200

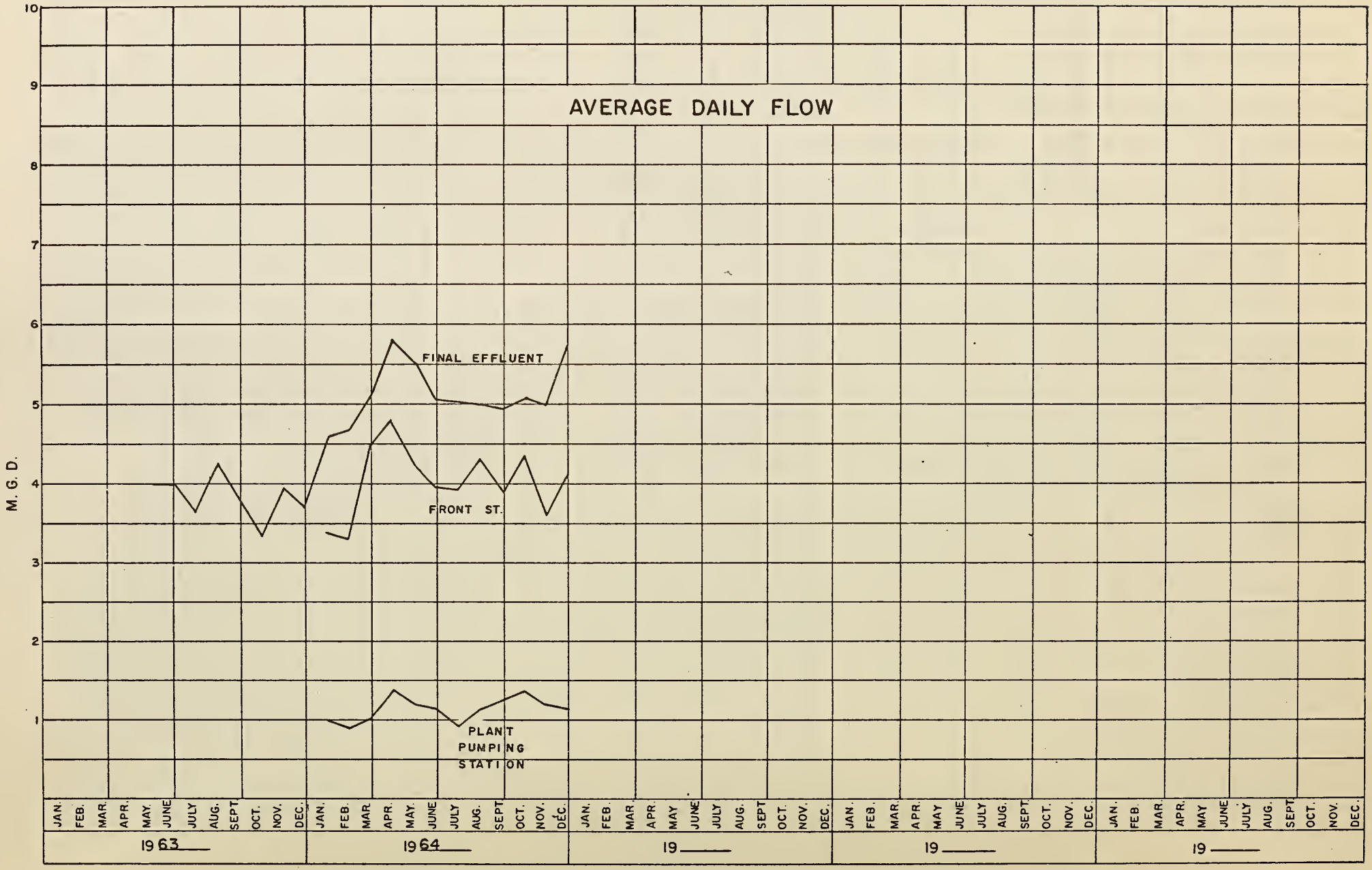
Process Data

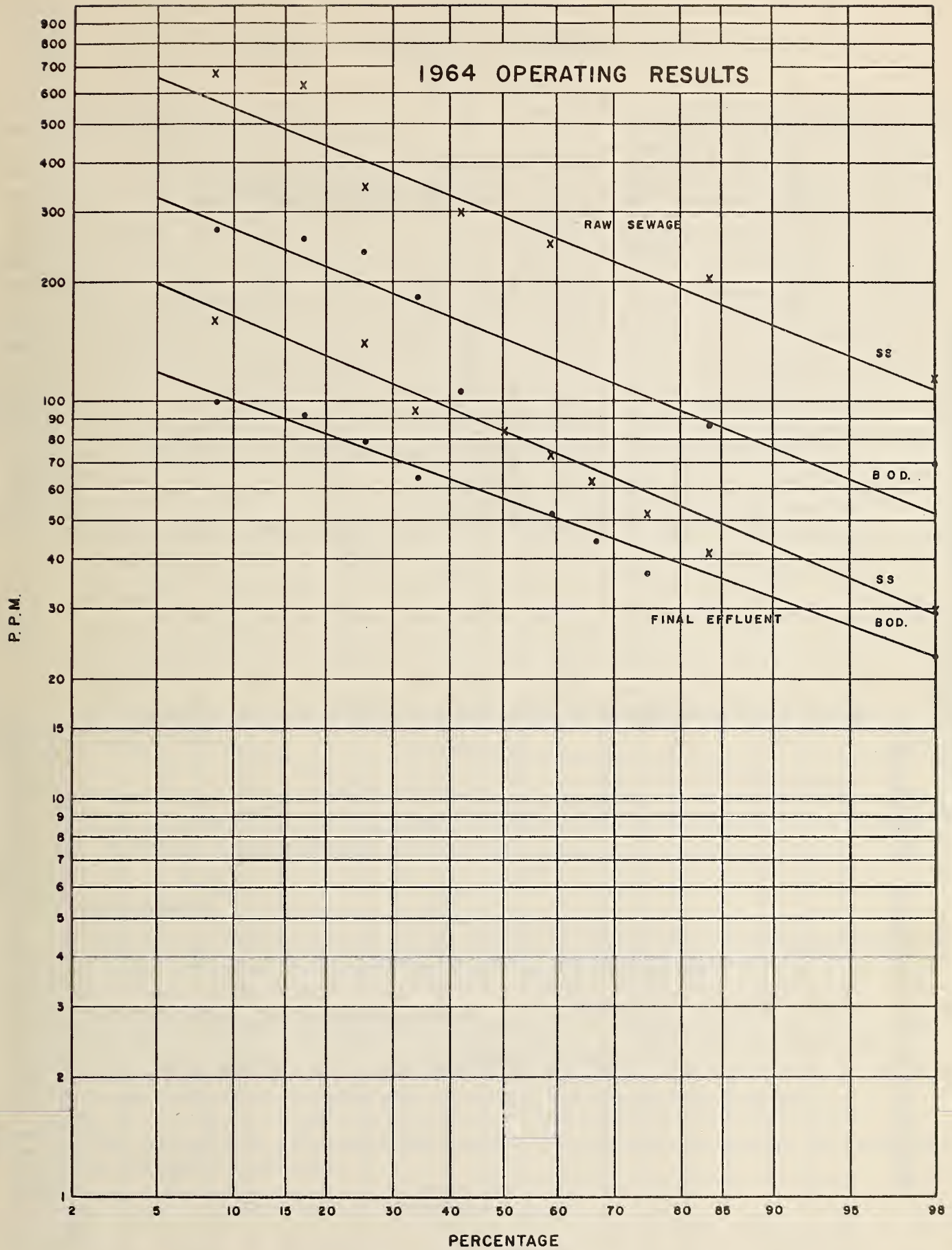
Sewage flows to the Belleville Water Pollution Control Plant increased substantially in 1964. This is shown quite clearly on the graph of average monthly flows.

It should be noted from the probability plot that in 1963, 50 percent of the time the flow was 4.2 million gallons per day, while in 1964, 50 percent of the time the flow was 5.3 million gallons per day.

The 1964 probability plot has a steeper slope than the 1963 plot. This indicates that higher flows are received more frequently.

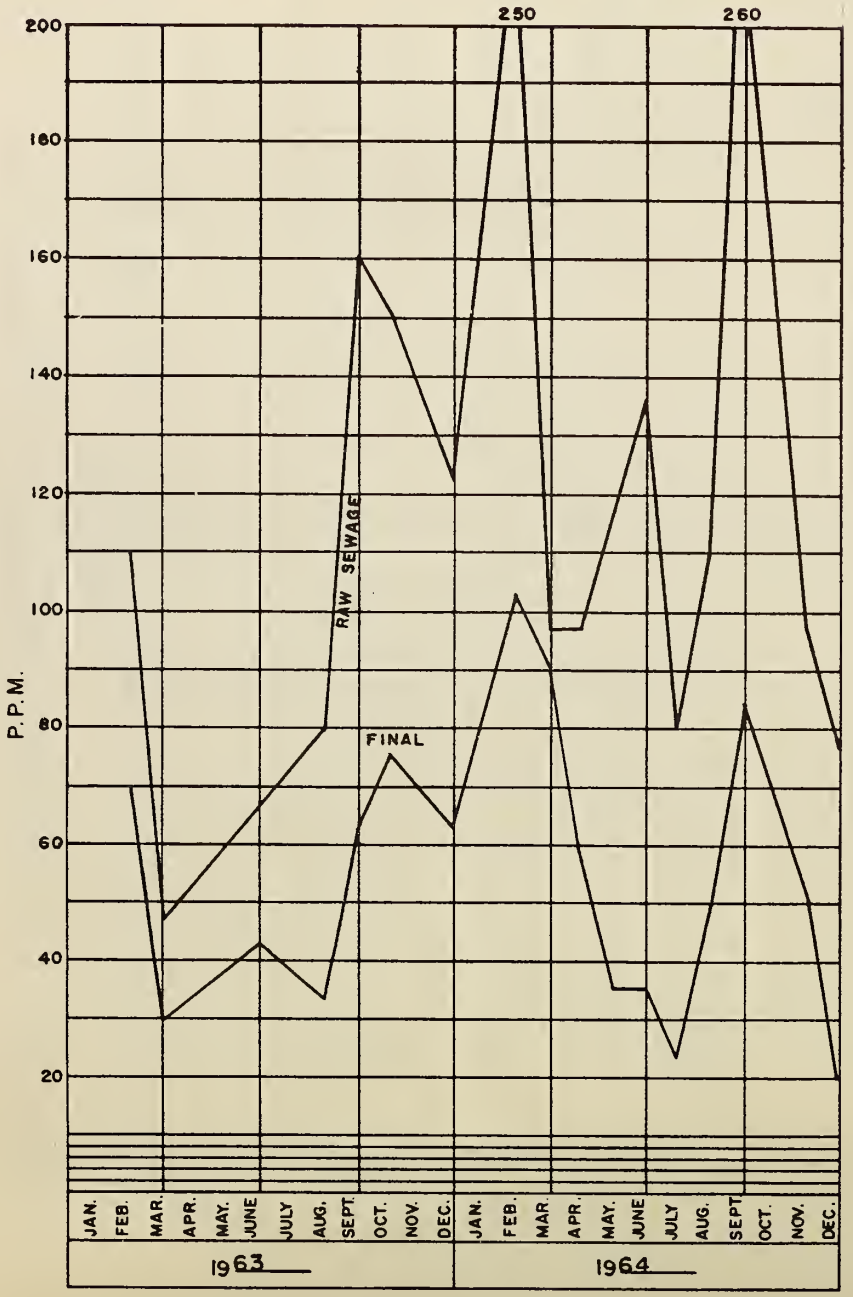

PROBABILITY OF DAILY FLOWS
M . G . D.
9
8
7
6
5
4
3
2
1
DESIGN FLOW
1964
1963
0.01
0.05
0.1
0.2
0.5
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.8
99.9
99.99
PERCENT OF FLOW IS EQUAL TO OR GREATER THAN


AVERAGE DAILY FLOW
M. G. D.
10
9
8
7
6
5
4
3
2
1
FINAL EFFLUENT
FRONT ST.
PLANT
PUMPING
STATION
JAN. FEB. MAR. APR. MAY. JUNE JULY AUG. SEPT OCT. NOV. DEC.
1963
1964
19
19
19

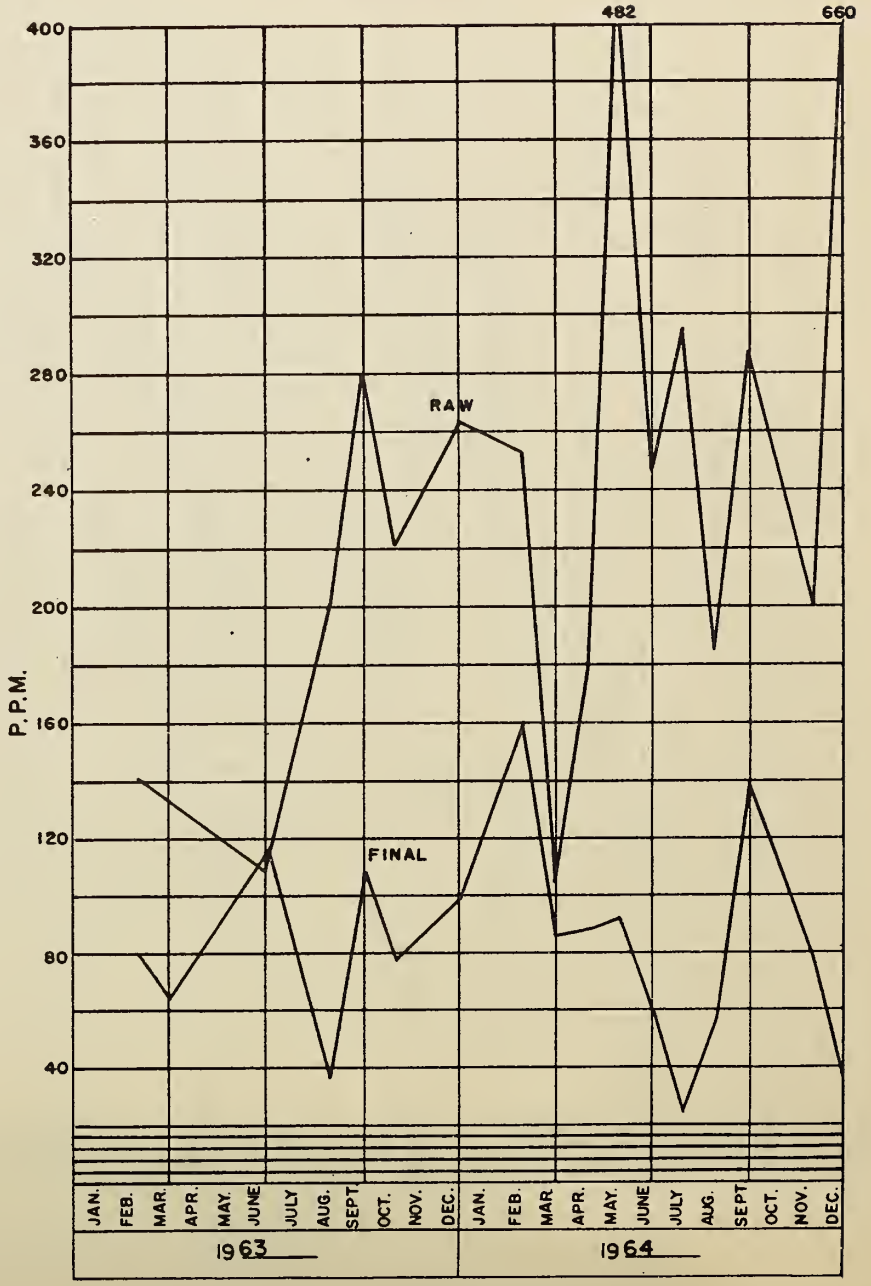

1964 OPERATING RESULTS
RAW SEWAGE
SS
BOD.
FINAL EFFLUENT
SS
BOD.
P.P.M.
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
15
10
9
8
7
6
5
4
3
2
1
2
5
10
15
20
30
40
50
60
70
80
85
90
95
98
PERCENTAGE
PERCENT OF SAMPLES EQUAL TO OR GREATER THAN

MONTHLY VARIATIONS

Biochemical Oxygen Demand



Suspended Solids



GRIT, B.O.D AND S.S. REMOVAL

MONTH	B. O. D.				S. S.				GRIT REMOVAL CU. FT.
	INFLUENT P.P.M.	EFFLUENT P.P.M.	% REDUCTION	TONS REMOVED	INFLUENT P.P.M.	EFFLUENT P.P.M.	% REDUCTION	TONS REMOVED	
JAN.	140 *	54	61.5	61.3	289	82	71.5	147.5	842
FEB.	250	102	59	100.1	254	158	37.5	64.9	216
MAR.	96	90	6	4.7	104	86	17.5	14.2	135
APR.	96	58	39.5	33.2	176	88	50	76.9	135
MAY	164	34	79.0	112.4	482	92	81.0	337.8	-
JUNE	180	34	81.0	110.8	246	62	74.5	139.6	135
JULY	78	22	71.5	43.5	294	24	92.0	209.8	36
AUG.	108	46	57.5	48.2	188	56	70.0	102.5	-
SEPT.	260	82	68.5	132.8	288	136	52.5	113.4	-
OCT.	140 *	54	61.5	67.5	289	82	71.5	162.5	1348
NOV.	96	50	50.0	34.6	200	79	60.5	91.0	162
DEC.	76	18	76.5	51.3	660	35	94.5	552.8	-
TOTAL	-	-	-	808.3	-	-	-	1945.5	3009
AVG.	140	54	61.5	67.4	289	82	71.5	162.1	251

* Average substituted value.

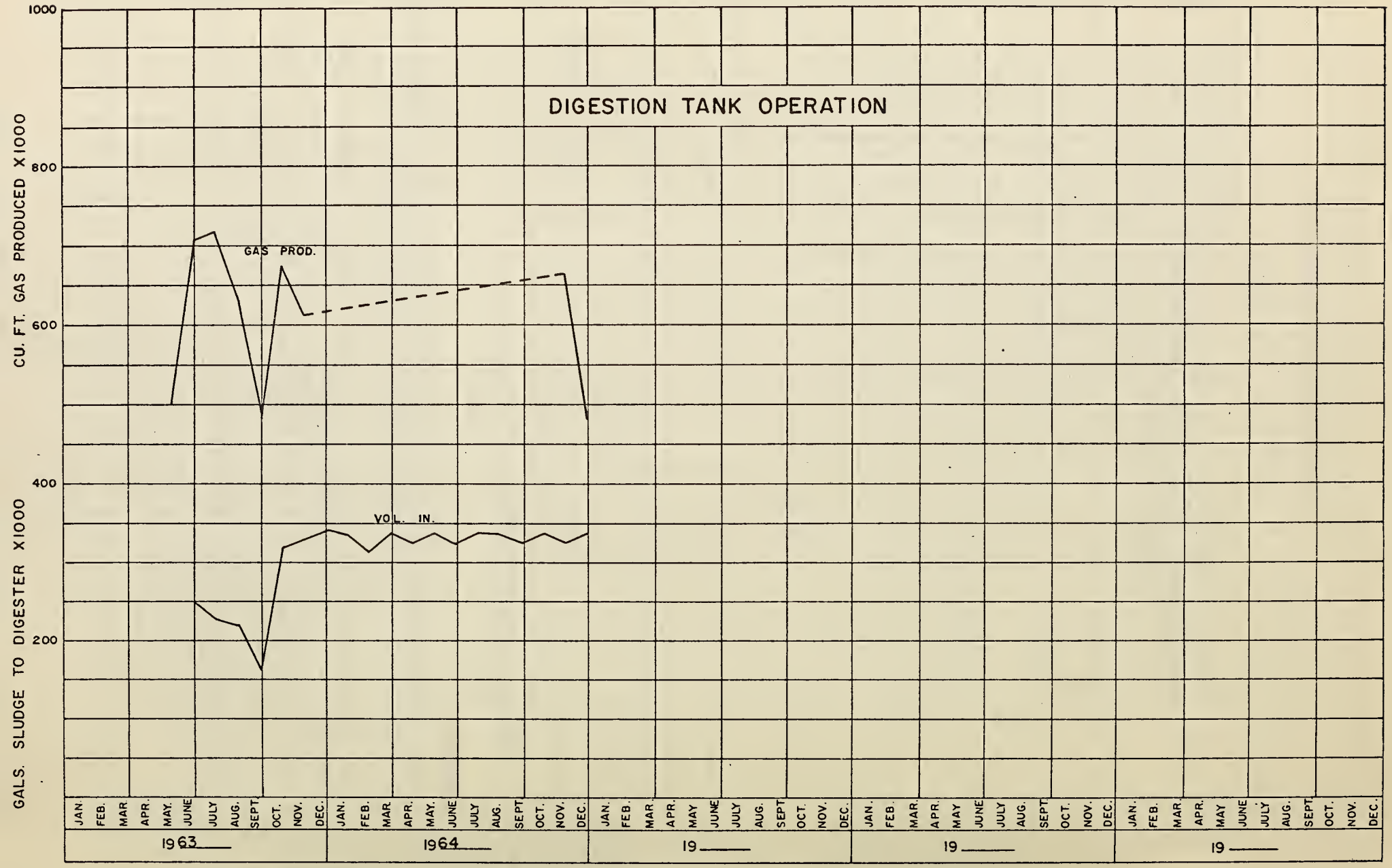
COMMENTS

The average BOD concentration in the raw sewage during 1964 was 140 ppm. This is an increase over the average BOD concentration of 1963 of 105 ppm.

The average SS concentration in the raw sewage in 1964 was 289 ppm. This is also an increase over the 1964 average of 192 ppm.

During 1964 approximately 808 tons of BOD and 1945 tons of SS were removed from the waste which would otherwise have found their way into the Bay of Quinte.

The average BOD reduction in 1964 was 61.5 percent while the average SS reduction in 1964 was 71.5 percent.


DIGESTION TANK OPERATION
CU. FT. GAS PRODUCED X1000
GALS. SLUDGE TO DIGESTER X1000
1000
800
600
400
200
GAS PROD.
VOL. IN.
JAN. FEB. MAR APR. MAY. JUNE JULY AUG. SEPT OCT. NOV. DEC.
1963
1964
19
19
19

DIGESTER OPERATION

MONTH	SLUDGE TO DIGESTERS			SLUDGE FROM DIGESTERS			GAS PRODUCED 1000'S Cu. Ft.
	1000'S CU. FT.	% SOLIDS	% VOL. MAT.	1000'S CU. FT.	% SOLIDS	% VOL. MAT	
JAN.	54.33	-	-	4.65	-	-	-
FEB.	50.82	2.06	-	4.33	-	-	-
MAR.	54.33	2.31	-	-	7.65	-	-
APR.	52.58	2.74	-	-	9.82	-	-
MAY	54.33	3.68	-	.80	4.78	-	-
JUNE	52.58	2.84	-	1.13	-	-	-
JULY	54.33	2.43	-	4.49	12.90	-	-
AUG.	54.33	1.31	-	-	1.32	-	-
SEPT.	52.56	4.45	2.88	2.40	1.54	0.54	-
OCT.	54.33	-	-	2.08	-	-	-
NOV.	52.58	2.22	1.72	5.61	11.69	5.08	667.39
DEC.	54.33	1.00	0.61	9.78	8.60	1.42	484.34
TOTAL	641.43	-	-	35.27	-	-	1151.73
AVG.	53.45	2.50	1.74	2.96	7.29	2.35	*575.86

* Average on two months' data

COMMENTS

In 1964, 641, 430 cubic feet of raw sludge was pumped to the digesters. Assuming an average concentration of 2.50 percent solids in the raw sludge, the amount of dry solids pumped to the digesters would be 1,000,000 pounds.

Difficulty was experienced with the gas meter during the first 10 months of 1964. However, during November and December, 1,151,000 cubic feet of gas were metered. The gas produced amounted to 13.0 cubic feet for each pound of volatile matter destroyed.

CHLORINATION

MONTH	PLANT FLOW (MG)	POUNDS CHLORINE	DOSAGE RATE (P.P.M)
JANUARY	142.50	-	-
FEBRUARY	135.30	-	-
MARCH	158.10	-	-
APRIL	174.80	-	-
MAY	172.98	* 1365 (7)	3.49
JUNE	151.80	5499	3.62
JULY	155.40	6280	4.04
AUGUST	155.31	5495	3.54
SEPTEMBER	149.19	5570	3.73
OCTOBER	157.00	5905	3.76
NOVEMBER	150.40	-	-
DECEMBER	176.90	-	-
TOTAL	1879.68	30114	-
AVERAGE	156.64	5019	3.73

*7 days chlorination

COMMENTS

Chlorination is practiced at the Belleville Water Pollution Control Plant for disinfection of the final effluent. The chlorination period begins on May 15 and ends November 1. A residual of 0.5 ppm of chlorine is maintained to reduce the bacterial count in the final effluent.

CONCLUSIONS

A heavy hydraulic overloaded condition was experienced at the plant throughout 1964.

RECOMM

Steps should be t into the plant.


ONTARIO WATER RESOURCES COMMISSION