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A Study of Municipal Wastewater Toxicity, Mission Pollution Control Centre, July, 1976.

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A STUDY OF MUNICIPAL WASTEWATER TOXICITY, MISSION POLLUTION CONTROL CENTRE, JULY, 1976

by

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ABSTRACT

A wastewater toxicity study of the Mission Pollution Control Centre was conducted by personnel of the Environmental Protection Service, Pacific Region.

The objectives of the survey, carried out from July 5 to 9, 1976 were as follows:

1. to determine the extent of toxicity removal achieved by the sewage treatment plant,
2. to determine the effect of chlorination on the toxicity of the effluent,
3. to relate the toxicity of the influent, effluent and final chlorinated effluent to the concentrations of certain known toxic substances and
4. to determine the incidence and the extent of removal of polychlorinated biphenyls.

The studies also included the collection of information concerning such factors as plant design and actual loading, chlorine dosage and residual, and the extent of sewer line infiltration. This information was collected to assist in interpreting data gathered for the objectives listed above.

This report contains the results of bioassay determinations and chemical analyses of samples collected during the survey at different treatment plant locations.

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LIST OF ABBREVIATIONS

BOD_5	5 day biochemical oxygen demand
$CaCO_3$	Calcium Carbonate
Cl_2	Chlorine
Cu. ft.	Cubic feet
FC	Fecal coliforms
GLC	Gas liquid chromatography
g/l	Grams per Liter
hr	Hour(s)
Imp MGD	Million Imperial Gallons per Day
l	Liter(s)
LAS	Linear Alkylate Sulfonate
lb BOD_5/day/lb MLSS	Pounds of BOD_5 per day per pound of MLSS
LC_{50}	50th percentile lethal concentration
MF	Membrane Filtration - Bacterial count
mg/l	Milligrams per Liter
MLSS	Mixed Liquor Suspended Solids
mm	Millimeter(s)
NFR	Non Filterable Residue
PCB	Polychlorinated Biphenyls
PCC	Pollution Control Centre
ppb	Parts per Billion
ppm	Parts per Million
Tc	Toxicity Concentration
TRC	Total Residual Chlorine
TU	Toxic Units
µg/l	Micrograms per Liter

CONCLUSIONS

Based on data collected at the Mission Pollution Control Centre from July 5 to July 9, 1976 the following conclusions can be made:

1. The treatment plant (activated sludge) was responsible for complete removal of the toxicity associated with the raw sewage samples. This was mainly attributable to the reduction of the anionic surfactant concentration by biological treatment.

2. Chlorination of the effluent did not result in an increase in toxicity. However as discussed in sections 4.1.3 and 4.2 the chlorine residuals maintained in the effluent would be insufficient to result in any increase in toxicity.

3, The average raw sewage PCB concentration was .052 ppb. The treatment system reduced PCB levels an average of 43.5%. All PCB concentrations encountered were significantly low.

1. INTRODUCTION

The District of Mission, located in the Fraser Valley, had an estimated population of 14,683 in 1976(1). The Mission Pollution Control Center serves a population of approximately 9,000. Some areas in the district are presently in the process of connecting to the sewer system. The sanitary and storm sewer systems are completely separate. There are no major industries discharging wastewater to the sewer system. Economic activity is mainly associated with service to the agricultural resources in the area plus some activity in lumber and food processing.

The objectives of the survey, carried out from July 5 to 9, 1976 were as follows;

1) to determine the extent of toxicity removal achieved by the sewage treatment plant,

2) to determine the effect of chlorination on the toxicity of the effluent

3) to relate the toxicity of the influent, effluent and final chlorinated effluent to the concentrations of certain known toxic substances and

4) to determine the incidence and the extent of removal of polychlorinated biphenyls.

The survey consisted of the following programs;

1) a 4 day composite sampling program,

2) a 12 hr grab sampling program,

3) a 24 hour chlorine residual monitoring program and,

4) general plant operation data collection.

Additional municipal wastewater toxicity studies were conducted at other locations in the Pacific Region during 1976. These surveys were conducted to collect information regarding the ability of various types of sewage treatment systems to remove or reduce wastewater toxicity and to establish the toxicity concentrations involved in each case.

1.1 Mission Pollution Control Centre, Plant Description

The Mission PCC is a high rate activated sludge plant with a design dry weather flow of 0.9 Imp MGD. The treatment components include an aerated degritter, barminutor, 2 aeration tanks, 2 secondary clarifiers and a chlorine contact tank. A flow diagram showing sample point locations is presented in Figure 1. At the design dry weather flow of 0.9 Imp MGD the treatment plant has a total hydraulic retention time of 9.7 hr. The general operation characteristics of the Mission PCC are outlined in Table 1. The waste activated sludge is digested in a primary and a secondary aerobic digester as shown in Figure 1. The final digested sludge is transfered to sludge drying beds.

The waste activated sludge transfer line from one secondary clarifier and the return sludge lines to the aeration tanks have not been included in the flow diagram. In addition, the aerobic digesters contain decanting chambers for supernatant return.

1.2 Plant Operation

Treatment Plant performance data for Mission PCC as provided by the plant operator is given in Table 2. This data represents the monthly averages of two - 4 hour composites over a one year period. The treatment plant accomplished overall BOD_5 and NFR (formerly SS) removal efficiencies of 83% and 74% respectively. Average daily flow and precipitation data have also been included. It should be noted that the number of sewer line connections steadily increased during the period covered in Table 2.

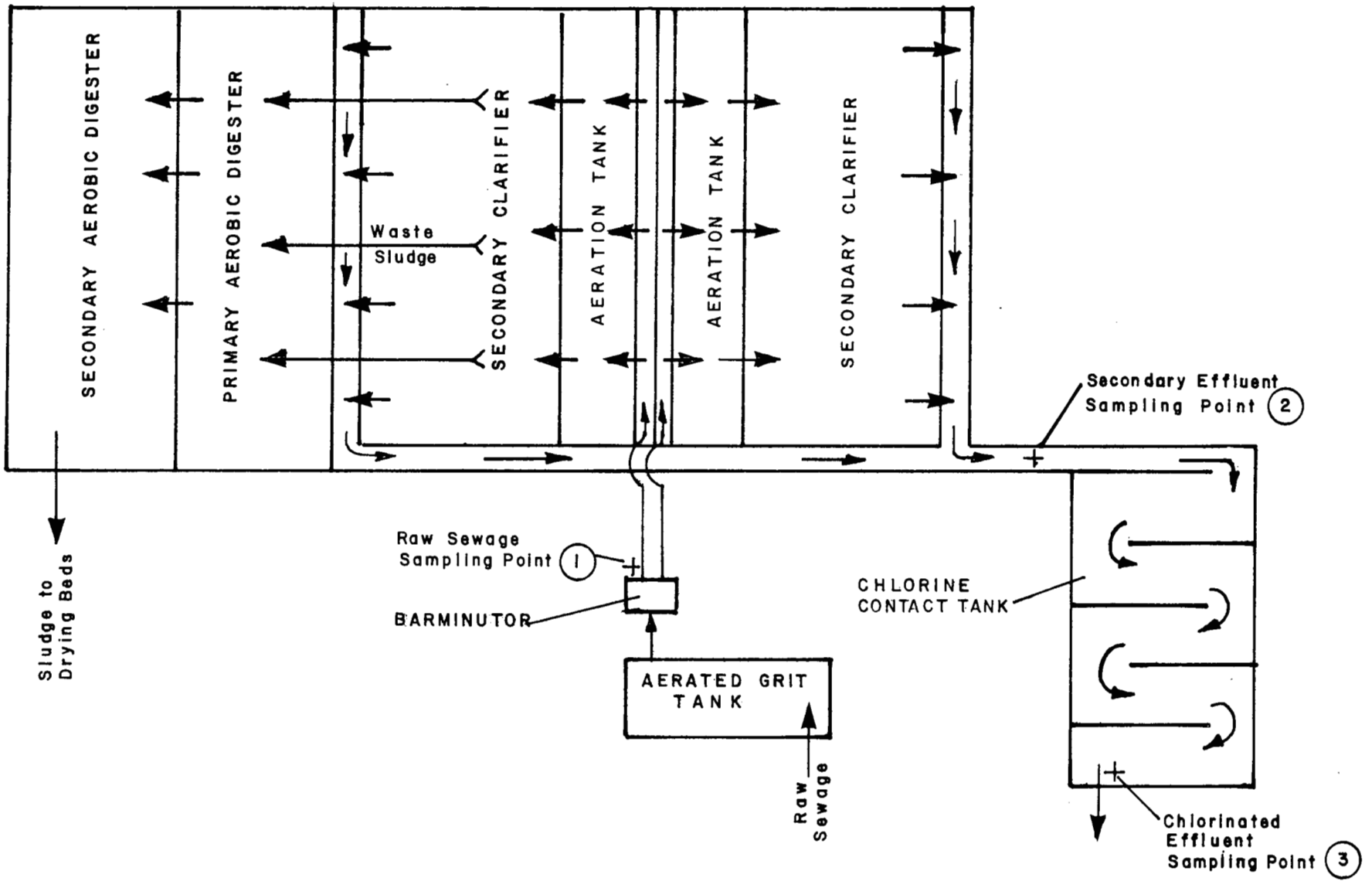

FIGURE I MISSION POLLUTION CONTROL CENTRE - FLOW DIAGRAM AND SAMPLE POINT LOCATIONS

TABLE 1

OPERATIONAL CHARACTERISTICS OF THE MISSION PCC

Design Average Dry Weather Flow	0.9 Imp MGD
Design Peak Wet Weather Flow	3.0 Imp MGD

Treatment Components

a) Aerated Degritter
b) Barminutor
c) Aeration Tanks 2 Parallel
d) Secondary Clarifier 2 Parallel
e) Chlorine Contact Tank

Average Flow (June 1, 1975 - May 30, 1976)	=	0.68 Imp MGD
June , 1976	=	0.61 Imp MGD

RETENTION TIMES

	Average DWF	Average Flow (June, 1976)
Degritter Tank	5 min	7.4 min
Aeration Tanks	3 hours	4.4 (excluding recycle)
Secondary Clarifiers	5.8	8.5 (excluding recycle)
Chlorine Contact Tank	0.8	1.2
	9.7 hours	14.2 hours

Raw Sewage Average BOD_5 (June 1975-May 1976)	=	144 mg/l
Average Mixed Liquor Suspended Solids (MLSS)	=	2240 (June, 1976)
Aeration Tank Volume	=	17850 cu ft
Food to Microorganisms Ratio	=	0.35 lb BOD_5/day.lb MLSS

Sludge Digestion Components
1) Primary Aerobic Digester 23,000 cu ft
2) Secondary Aerobic Digester 23,000 cu ft
3) Sludge Drying Beds

Chlorinator - Flow Porportional Control - checked daily

Point of Discharge - Fraser River

TABLE 2 TREATMENT PLANT PERFORMANCE DATA JUNE 1975 TO MAY 1976*

	Influent		Effluent				
Month	BOD_5 mg/l	NFR mg/l	BOD_5 mg/l	NFR mg/l	FC MF/100ml	Average Daily Flow Imp MGD	Average Daily Precip. mm
June, 1975	236	169	23	17	12,500	0.39	2.24
July	225	194	43	25	450,000	0.39	1.41
August	132	85	40	39	475,000	0.38	4.80
September	183	223	23	33	825	0.39	0.34
October	92	121	24	45	210	0.52	12.14
November	81	85	26	46	135	0.82	8.75
December	70	83	12	19	7550	1.05	11.32
January, 1976	122	58	19	38	535	1.13	8.23
February	150	78	22	40	2700	0.95	6.23
March	141	58	26	16	590	0.77	4.38
April	157	230	22	38	160	0.77	4.38
May	132	126	13	22	205	0.62	4.43
Average	144	126	25	33	79,200	0.68	

* Monthly average based on two - 4hr composite samples

2. PROCEDURES AND METHODS

2.1 Sampling Program

The time proportional 24 hr composite samples were collected at three treatment plant locations as follows:

1. The raw sewage sample was taken from the inlet channel just past the barminutor, prior to the aeration tanks.
2. The secondary effluent sample was taken from the clarifier overflow channel prior to the chlorine addition point.
3. The chlorinated effluent sample was taken from the chlorine contact tank adjacent to the point of discharge to the outfall.

All composite samples consisted of 1.1 ℓ aliquots taken every 10 minutes using an Eagle Signal timer assembly and a submersible pump.

The composite sample aliquots were collected in 45 gallon polyethylene barrels. The 24 hr composite sampling program commenced at 0800 hr July 5 and ended at 0800 hr July 9, 1976.

The raw sewage and chlorinated effluent grab samples were taken from the same locations as the composites and were collected every 2 hrs. on July 8, 1976 from 0800 to 2000 hr.

2.2 Analyses

Table 3 lists the analytical parameters for the 24 hour composite sampling program. Table 4 lists the analytical parameters for the grab sampling program.

The contents of each composite sample barrel were well mixed prior to sample division. The samples for chemical analysis, including metals, were divided into sample bottles and preserved as outlined in the Environment Canada Pollution Sampling Handbook. Samples for bioassay analysis were placed in four - five gallon plastic jerry cans. All samples were delivered within 3 hours to the Environment Canada laboratory facilities. Sample analysis for all parameters except metals and PCB's commenced within 5 hours of

TABLE 3 ANALYTICAL PARAMETERS - 24 HOUR COMPOSITE SAMPLING PROGRAM

Parameter	Abbreviation	Units	
Total Phosphate	TPO_4	mg/l	P
Ammonia	NH_3	mg/l	N
Nitrate	NO_3	mg/l	N
Nitrite	NO_2	mg/l	N
Total Alkalinity	-	mg/l	$CaCO_3$
Chemical Oxygen Demand	COD	mg/l	
Total Organic Carbon	TOC	mg/l	C
pH	-	0-14	pH units
Non Filterable Residue	NFR	mg/l	
Anionic Surfactants	-	mg/l	LAS
Total Residue	TR	mg/l	
Cyanide	CN	mg/l	
Phenol	-	mg/l	
Oil & Grease	-	mg/l	
Polychlorinated Biphenyls	PCB	ppb	
Bioassay	LC_{50}	%	
Metals			
Total Mercury	Hg	ug/l	
Copper, Total & Dissolved	Cu	mg/l	
Iron, Total & Dissolved	Fe	mg/l	
Nickel, Total & Dissolved	Ni	mg/l	
Lead, Total & Dissolved	Pb	mg/l	
Zinc, Total & Dissolved	Zn	mg/l	
Aluminum, Total & Dissolved	Al	mg/l	
Cadmium, Total & Dissolved	Cd	mg/l	
Manganese, Total & Dissolved	Mn	mg/l	
Chromium, Total & Dissolved	Cr	mg/l	

TABLE 4 ANALYTICAL PARAMETERS - GRAB SAMPLING PROGRAM

Parameter	Abbreviation	Units	
Total Phosphate	TPO_4	mg/l	P
Ammonia	NH_3	mg/l	N
Nitrate	NO_3	mg/l	N
Nitrite	NO_2	mg/l	N
Non Filterable Residue	NFR	mg/l	
Chemical Oxygen Demand	COD	mg/l	
Anionic Surfactants	-	mg/l	LAS
Total Resiude	TR	mg/l	
Total Organic Carbon	TOC	mg/l	C

completion of each sampling day. Grab samples collected on July 8 were separated into the proper container, preserved as required and stored at 4°C before being delivered on July 9 at 1100 hr with the 24 hour composite samples.

2.2.1 Chemical Analyses. The chemical parameters including metals as listed in Tables 3 and 4 were analyzed as described in the Environment Canada Pacific Region Laboratory Manual.

2.2.2 Polychlorinated Biphenyls Analysis PCB. Samples for PCB were collected in one gallon amber glass bottles containing 50 ml hexane as a preservative. Basically the analysis involves acetone: hexane extraction, filtration, purification and electron capture GLC analysis. The detection limit for a one gallon sample is approximately 0.005 ppb.

2.2.3 Bioassay Determination (96 hr LC_{50}). The static fish bioassay test gives an approximate numerical value to the biological toxicity of wastewater. It is defined as the concentration of a measureable lethal agent (in this case wastewater) required to kill the 50th percentile in a group of test organisms over a period of 96 hours.

The static bioassay test consists of a series of 30 l glass vessels containing different sample dilutions with 6-9 Rainbow Trout (*Salmo gairdneri*) per test vessel. The test vessels were placed in a controlled environment room with the temperature maintained at 14.0 ± 1.0°C and a photo period limited to 16 hours per 24 hours. The bioassay test procedures calls for samples with pH values below 6.0 or above 8.0 to be neutralized to a pH of 7; however pH adjustment was not required for any of the samples collected. All samples were aerated prior to the test, and continuously for the 96 hour period. Pre-test aeration times are listed with the test results in Table 5. The fish loading density in each vessel was 0.5 g/l. The percent mortality and percent dilution were plotted on semi log paper to establish an LC_{50} value.

2.3 Chlorine Residual Monitoring

The chlorine residual monitoring program consisted of grab sampling the chlorinated effluent (sample point no. 3) every hour for

24 hours from 1900 hr July 5 to 1800 hr July 6 and determining the total residual chlorine concentration.

The determination of TRC was done using a Wallace & Tiernan Amperometric Titrator series A-790013. The fundamental procedure used is a Back Titration method involving the neutralization of an oxidizing agent (free iodine) with a reducing agent (phenylarsine oxide solution) of known strength, in the presence of potassium iodide.

Total residual chlorine as determined by the amperometric Back Titration method determines the concentration of compounds in the wastewater containing active chlorine which consist of monchloramines, dichloramines and hypochlorous acid.

3 RESULTS

3.1 Bioassay Results

The static fish bioassay results obtained from the 24 hr composite samples are included in Table 5 (page 19). The results are expressed as both a 96 hr LC_{50} as defined earlier and a toxicity concentration Tc. The toxicity concentration (expressed in toxic units, TU) can be calculated for effluent discharges as follows:

$$Tc = \frac{100\%}{96\ hr \quad LC_{50}\ (\%)}$$

Therefore a Tc of unity is equivalent to an LC_{50} of 100%. The toxicity concentration concept becomes useful when comparing effluents that produce less than 50 percent mortality at the 100% concentration in the bioassay test. A Tc value in this case can be determined by plotting the percent mortality of test fish versus the Tc values for the various test dilutions.

3.2 Chemical Analyses Non Metals - Results

The chemical analysis non-metals results obtained from the 24 hour composite samples are listed in Appendix I. A comparison of these results and the treatment level involved with each sample is illustrated in Figures 2 and 3. The values plotted in this comparison represent the mean value from the 4-24 hour composite samples. The chemical analysis non-metal results obtained from the grab sampling program are outlined in Appendix II.

3.3 Chemical Analyses metals - Results

The results of the metal analyses including total and dissolved for the 24 hour composite sampling program are presented in Appendix I.

3.4 Chlorine Residual Monitoring Results

The results of the 24 hour chlorine residual monitoring program are illustrated in Figure 4. The flow proportional control device maintained the TRC within a range of non-detectable to 1.80 mg/l, and with a mean of 0.38 mg/l. The TRC was non-detectable for 10 hours from 2100 hr July 5 to 0700 hr July 6.

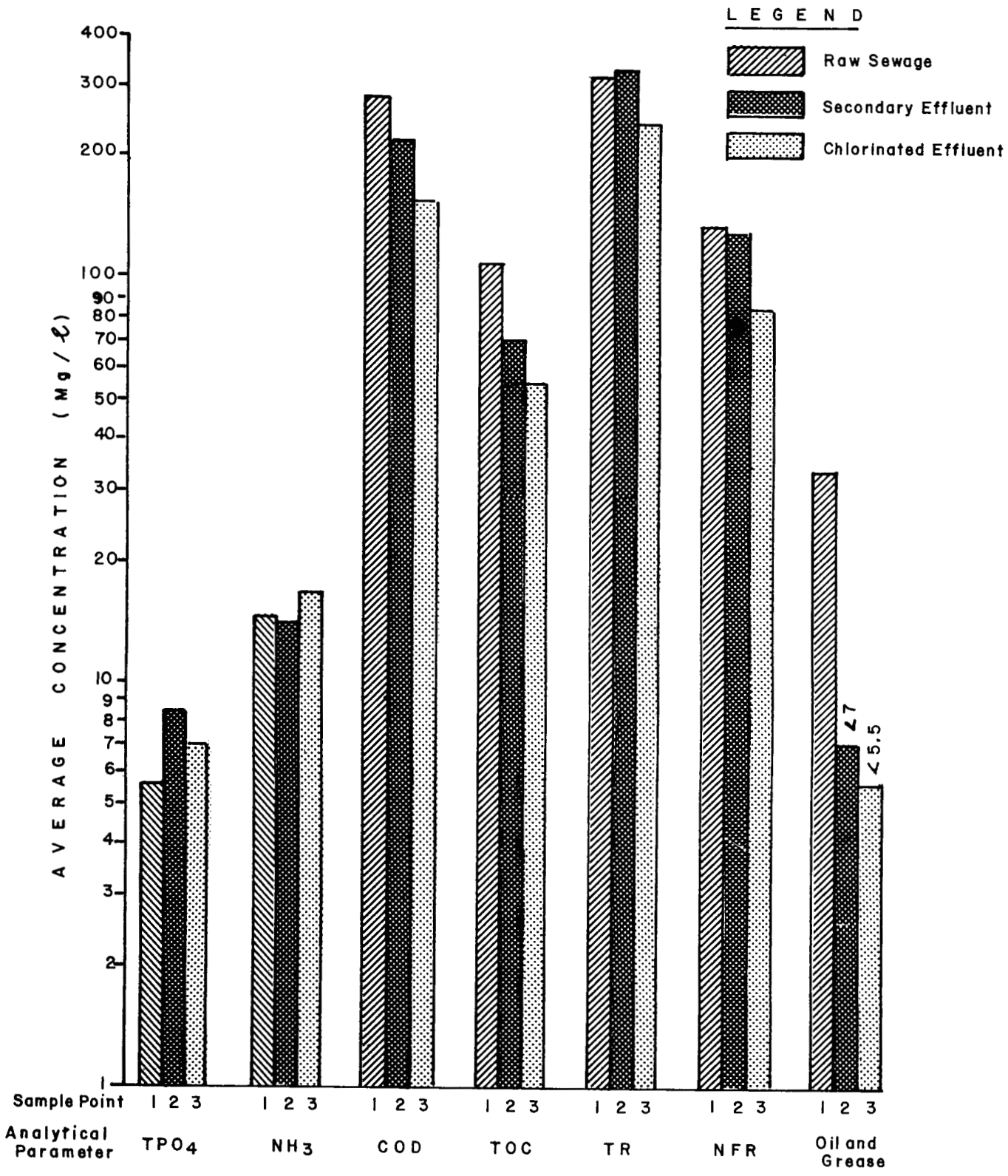

FIGURE 2 COMPARISON OF ANALYTICAL RESULTS AND TREATMENT LEVEL

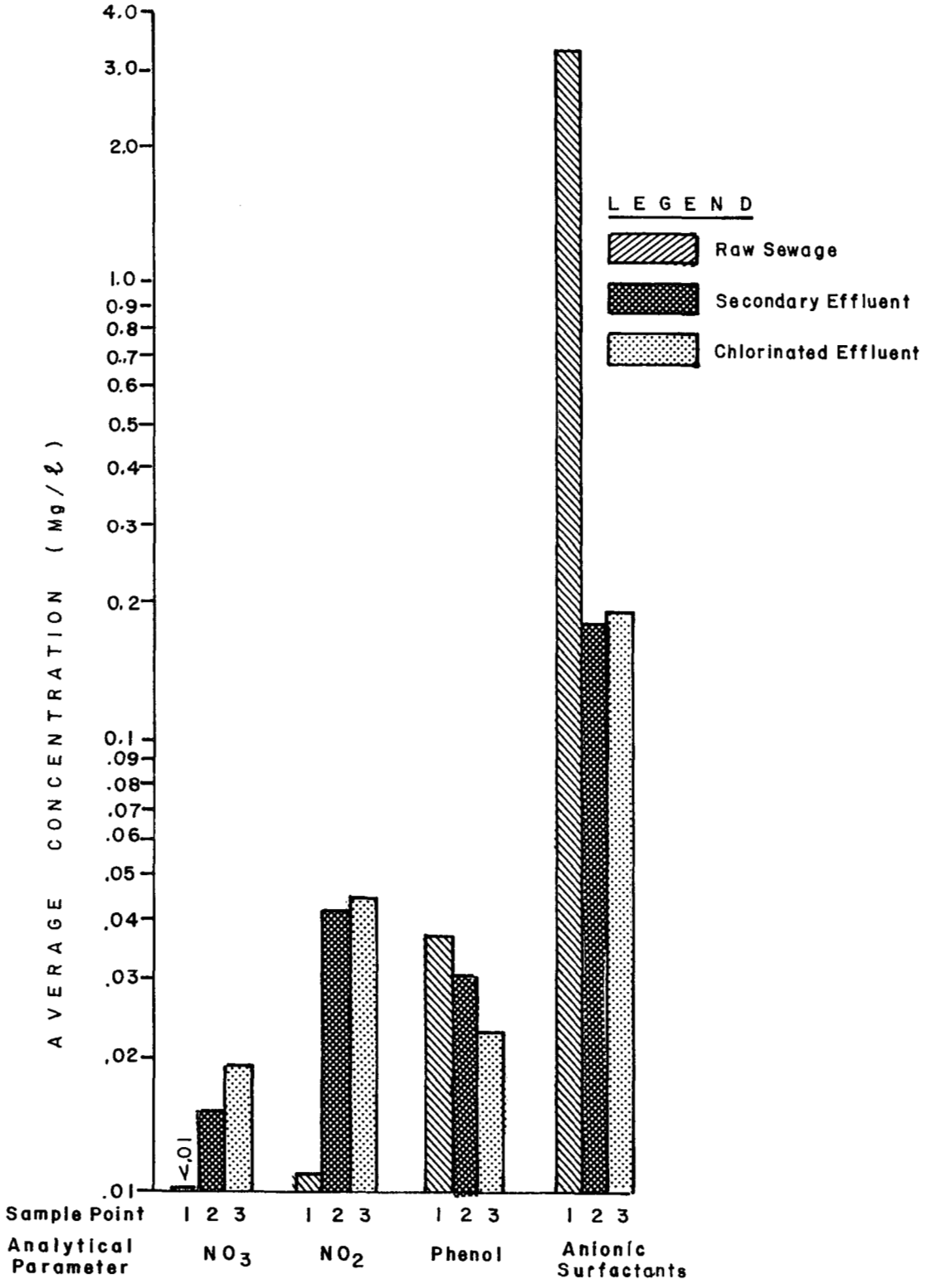

FIGURE 3 COMPARISON OF ANALYTICAL RESULTS AND TREATMENT LEVEL

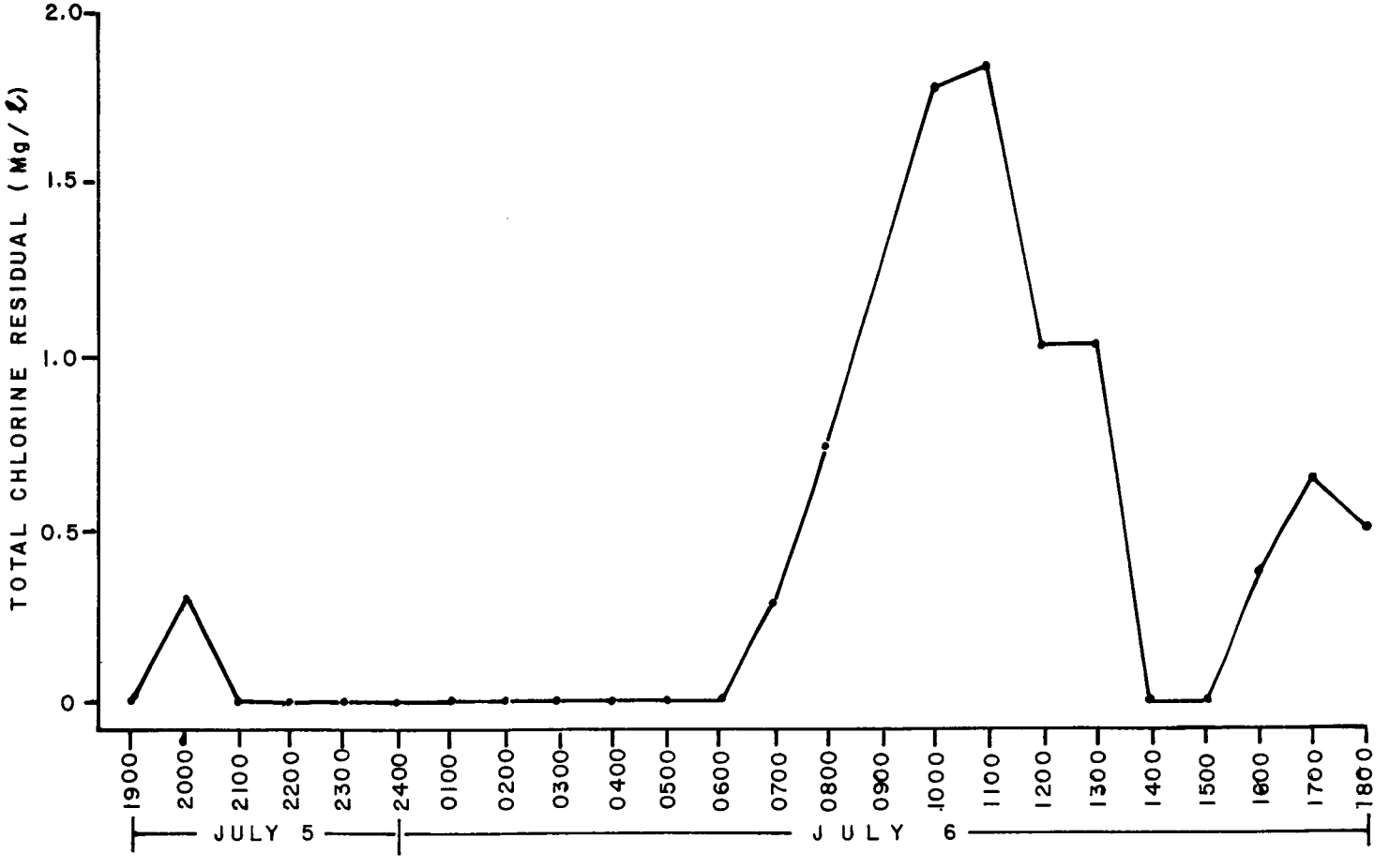

FIGURE 4 24-HOUR CHLORINE RESIDUAL MONITORING PROGRAM

3.5 Polychlorinated Biphenyls Results

The results of the PCB analysis for the 24 hr composite sampling program are listed in Appendix I. All levels encountered were significantly low. The treatment plant was responsible for a 43.5% reduction in PCB levels from influent to effluent.

3.6 Daily Flowrates, Chlorine Dosages and Precipitation

Daily flowrates, chlorine dosages and precipitation from July 1, 1975 - June 30, 1976 have been plotted in Appendix III.

This plot illustrates that a direct correlation exists between precipitation and daily flowrate, indicating an excessive amount of inflow and/or infiltration into the sewer system.

As pointed out earlier, the number of sewer line connections gradually increased over the period covered in the plot, this would tend to increase the domestic sewage contribution to the total daily flow.

Figure 5 illustrated the instantaneous flow readings for the Mission PCC from 0800 hr July5 to 0600 hr July 12. During this period, peak flows of approximatedly 0.85 Imp MGD occured at 1100 - 1200 hr and low flows of 0.2 - 0.3 Imp MGD occured at 0600 hr.

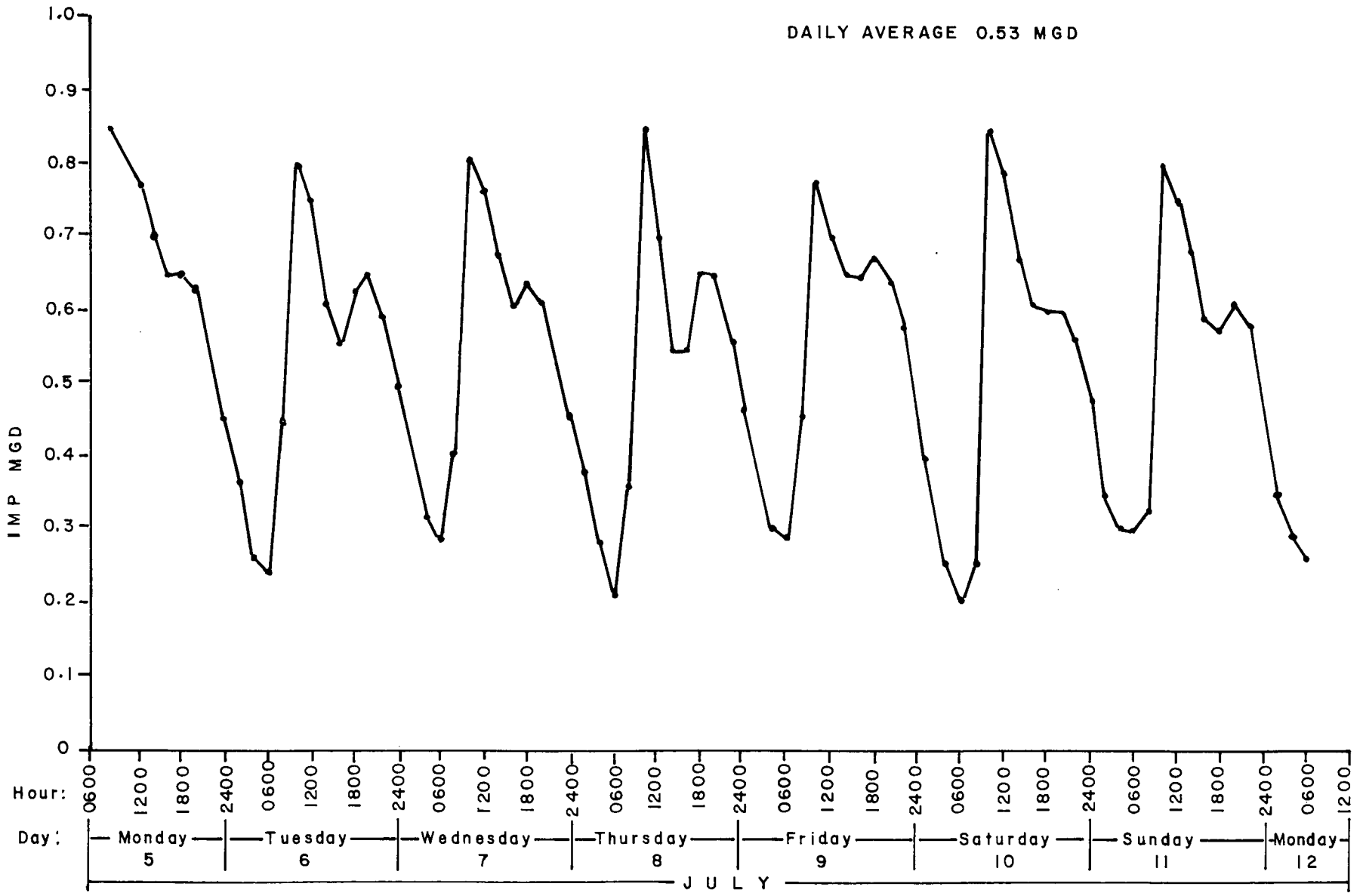

FIGURE 5 DISTRICT OF MISSION PCC - FLOW RATES, July 5-12, 1976

4 DISCUSSION

4.1 Bioassay Evaluation

Municipal wastewaters in general contain a wide variety of chemical constituents readily known to be toxic to fish. The most common constituents exerting toxicity include ammonia, cyanide, sulfides, chlorine and chloramine, phenols, surfactants and several heavy metals which include copper, zinc, chromium and nickel. Other factors such as temperature, pH, hardness, alkalinity and dissolved oxygen tend to modify the toxicity produced by various chemical constituents. However as outlined earlier the bioassay test conditions are controlled so that pH,temperature,and dissolved oxygen do not themselves effect toxicity. The chemical analyses results for the individual composite samples were examined with reference to the literature to determine those factors responsible for toxicity. Following is a discussion of those factors deemed responsible for the bioassay results encountered in the survey.

4.1.1 Ammonia Toxicity. The common sources of ammonia in wastewater are:

1. urine, which contains urea (H_2NCOH_2N) which in turn readily hydrolyzes to ammonia;
2. organic matter containing protein and amino acids which decomposes under bacterial action yielding ammonia;
3. chemical plants and cleaning establishments which release ammonia to the sewer system; and,
4. household cleaning agents.

The toxicity of ammonia and ammonium salts to fish is directly related to the amount of un-ionized ammonia in solution. Ammonia establishes a pH dependent equilibrium in solutions as follows:

$$NH_3 + nH_2O \rightleftharpoons NH_3 \cdot nH_2O \rightleftharpoons NH_4^+ + OH^- + (n-1)H_2O$$

Emerson, et al (2) have outlined a set of equilibrium calculations for determining the un-ionized ammonia in solution under varying conditions of pH and temperature. The un-ionized ammonia concentrations for the 24 hour composite samples have been calculated

according to this set of equations and are reported in Table 5. In addition, this table lists the bioassay results and the major toxic constituents involved for each composite sample.

Mayo et al (3) state that 0.006 mg/l N un-ionized ammonia may be considered to be the desirable upper level for extended fish exposure. A level of 0.025 mg/l un-ionized ammonia has been stated as the maximum that fish can tolerate (4). Lloyd and Orr (5) reported that 0.44 mg/l un-ionized ammonia caused 100% mortality in Salmo gairdneri in 96 hours.

The un-ionized ammonia levels reported in Table 8 fall within the 0.025-0.44 mg/l range and therefore would be expected to contribute significantly to wastewater toxicity. However, as pointed out by Esvelt, Kaufman & Selleck (6) factors in addition to un-ionized ammonia may be associated with the toxicity of ammonia. A full discussion of these factors is beyond the scope of this report.

4.1.2 Surfactant Toxicity. Detergents are common components of sewage and industrial effluents, derived in largest amounts from household cleaning agents. Surfactants can be divided as being either anionic, cationic or non-ionic. In current detergent formulas, the primary toxic active agent is LAS (linear alkylate sulfonates) an anionic surfactant. The surfactant analysis conducted during this survey was carried out specifically for LAS.

The toxicity of LAS tends to increase in hard water, and increase as the carbon chain length increases (6).

Thatcher and Santer (7) found 96 hr LC_{50} values for LAS of 3.3-6.4 mg/l for five species of fish. Dolan and Hendricks determined an LC_{50} of 5.9 mg/l LAS for bluegill sunfish (8). The anionic surfactant concentrations for the raw sewage samples as outlined in Table 5 would be expected to contribute to wastewater toxicity.

TABLE 5 COMPARISON OF ANALYTICAL AND BIOASSAY RESULTS

Sample Points	Date	LC_{50}	Tc	NH_3	Un-Ionized NH_3	Anionic Surfactants	pH	Alkalinity	Pretest Aeration
	July	%	TU	mg/l N	mg/l N	mg/l LAS		mg/l $CaCO_3$	hr
Raw Sewage	6	87	1.15	14	.028	3.9	6.9	130	19
	7	100	1.0	14	.045	2.9	7.1	120	24
	8	+	-	15	.048	3.2	7.1	119	17.5
	9	NT[2]	-	15	.038	3.5	7.0	110	25
Secondary Effluent	6	NT	-	10	.025	0.22	7.0	110	0
	7	NT	-	15	.060	0.11	7.2	130	0
	8	NT	-	14	.045	0.14	7.1	112	17.5
	9	NT	-	18	.057	0.25	7.1	111	25
Chlorinated Effluent	6	NT	-	12	.030	0.13	7.0	110	0
	7	NT	-	22	.110	0.13	7.3	125	0
	8	NT	-	15	.060	0.22	7.2	118	17.5
	9	NT	-	18	.057	0.29	7.1	107	24

1 According to Emmerson et al (2)
+ LC_{50} not established 33% mortality at 100% concentration
2 NT Non toxic at 100% concentration

4.1.3 Chlorine Toxicity. The toxicity of chlorine and other chlorinated compounds such as chloramines and chlorinated hydrocarbons has been thoroughly documented in the literature. Martens and Servizi (10) observed that the toxicity of primary treated sewage to sockeye salmon was increased several fold whenever chlorine residuals were detected in the effluent. In field studies, residual chlorine levels above 0.02 mg/l were found likely to be toxic to rainbow trout and sockeye salmon using in-stream bioassay techniques (9).

The toxicity of chlorinated wastewater does not depend directly on the amount of chlorine added but on the concentration of residual chlorine remaining (10). Residual chlorine is commonly understood to mean the total concentration of compounds containing active chlorine which remain after free chlorine addition. These compounds consist of monochloramines, dichloramines and hypochlorous acid. In additon chlorine may combine with a variety of compounds in wastewater including cyanide, phenols and alkyl sulfonate, which are not detectable by the amperometric technique.

During the 24 hr chlorine residual monitoring program the TRC averaged 0.38 mg/l and had a range of non-detectable to 1.80 mg/l. Chlorine residual concentrations in the 24 hr composite samples were all at non-detectable levels. Chlorination of the effluent did not result in an increase in toxicity during this survey. However an increase in toxicity would be expected if the chlorine dosage had been higher.

The chlorine dosage averaged 2.52 mg/l over the one week period prior to the survey. The plant operator checked the chlorine residual daily (in the morning) and was maintaining a residual in the effluent of 0.2 mg/l as determined by the ortho-tolidine method.

4.2 Bioassay Summary

The raw sewage bioassay results are such that a mean LC_{50} cannot be calculated. July 6 and 7 samples exhibited LC_{50}'s of 87 and 100% respectively. The sample collected on July 8 had 33% mortality in the 100% concentration test vessel. The Tc for this particular sample would be less than 1.0. The raw sewage sample

on July 9 was non toxic at the 100% concentration. The toxicity associated with the raw sewage samples would be attributable mainly to the un-ionized ammonia and anionic surfactant concentrations.

The secondary effluent and chlorinated effluent composite samples were all non toxic at the 100% concentration, indicating that treatment is responsible for complete removal of the toxicity associated with the raw sewage. The removal of toxicity could be attributable to the reduction in the anionic surfactant concentrations (3.4 - 0.19 mg/l LAS). In reference to the chlorinated effluent samples, as pointed out in section 4.1.3, the TRC of the chlorinated effluent during the chlorine residual monitoring program was at a non-detectable level for 13 of the 25 samples. In addition the TRC's of all chlorinated effluent composite samples were non-detectable. Coupled with the high chlorine demand of the effluent (mean NFR=123 mg/l), chlorination in this case would not be expected to result in increased toxicity.

4.3 Plant Performance

As mentioned in section 1.2, the Mission PCC accomplished an overall BOD_5 reduction from June 1975 to May 1976 of 83%. Activated sludge plants are generally capable of reducing BOD_5 levels by 88-93% (11). During the survey period the plant was operating at 60% of design hydraulic capacity. The average NFR level in chlorinated effluent during the survey was 82 mg/l which is in excess of the Pollution Control Branch AA permit requirement of 60 mg/l.

Some operational problems were identified during the survey which resulted in the high NFR levels in the effluent. Most of the problems were associated with the high MLSS being maintained in the aeration tank. Sludge age was too long resulting in an over oxidized sludge which in turn caused deflocculation, pin floc and poor settleability. In addition rising sludge blankets in the clarifiers were observed during the survey resulting from the denitrification of accumulated sludge. The high solids levels in the effluent did not however result in any measureable increase in toxicity.

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APPENDIX I

COMPOSITE SAMPLING

ANALYTICAL RESULTS

a. Non Metals

b. Metals

APPENDIX I MISSION PCC COMPOSITE SAMPLE ANALYTICAL RESULTS

a. NON METALS

Sampling Point	Number
Raw Sewage	1
Secondary Effluent	2
Chlorinated Effluent	3

Analytical Parameter	Sampling Point	Date July 6	July 7	July 8	July 9
TPO_4 mg/l P	1	5.0	7.6	6.1	3.5
	2	5.0	3.9	21	3.5
	3	5.8	3.9	14	3.8
NH_3-N mg/l N	1	14	14	15	15
	2	10	15	14	18
	3	12	22	15	18
NO_3-N mg/l N	1	<.01	<.01	<.01	<.01
	2	.019	.019	.01	<.01
	3	.013	.033	.02	<.01
NO_2-N mg/l N	1	.009	.011	.013	.010
	2	.041	.071	.030	.026
	3	.027	.067	.050	.035
Alkalinity mg/l $CaCO_3$	1	130	120	119	110
	2	110	130	112	111
	3	110	125	118	107
pH	1	6.9	7.1	7.1	7.0
	2	7.0	7.2	7.1	7.1
	3	7.0	7.3	7.2	7.1
NFR mg/l	1	150	180	110	110
	2	87	52	260	90
	3	93	74	60	100
COD mg/l	1	280	330	280	260
	2	160	110	430	180
	3	170	130	130	180
Anionic Surfactants mg/l LAS	1	3.9	2.9	3.2	3.5
	2	0.22	.11	0.14	.25
	3	0.13	.13	0.22	.29
TR mg/l	1	180	770	310	300
	2	290	250	470	290
	3	280	200	250	250
TOC mg/l C	1	104	142	97	90
	2	50	40	137	47
	3	58	44	50	65

APPENDIX I MISSION PCC COMPOSITE SAMPLE ANALYTICAL RESULTS

a. NON METALS (cont'd)

Sampling Point	Number
Raw Sewage	1
Secondary Effluent	2
Chlorinated Effluent	3

Analytical Parameter	Sampling Point	Date July 6	July 7	July 8	July 9
CN mg/l	1	<.03	<.03	<0.3	<0.3
	2	<.03	<.03	<0.3	<0.3
	3	<.03	<.03	<0.3	<0.3
Phenol mg/l	1	*	.03	.03	0.05
	2	*	<.02	.04	0.03
	3	*	<.02	<.02	0.03
Oil & Grease mg/l	1	43	16	48	23
	2	<5	<5	13	<5
	3	5	<5	<5	7
PCB ppb	1	.031	.060	.078	.040
	2	.092	.018	.024	.013
	3	.027	.018	.030	.043

* Not Available

APPENDIX I MISSION PCC COMPOSITE SAMPLE ANALYTICAL RESULTS

B. METALS

Sampling Point	Number
Raw Sewage	1
Secondary Effluent	2
Chlorinated Effluent	3

T - Total
D - Dissolved

Analytical	Parameter	Sampling Point	Date July 6	July 7	July 8	July 9
Hg µg/l	T	1	0.27	0.28	0.28	0.37
		2	0.27	0.28	0.60	0.37
		3	0.40	0.23	0.28	0.37
Cu mg/l	T	1	0.08	0.08	0.07	0.06
		2	0.06	0.06	0.15	0.06
		3	0.05	0.05	0.05	0.06
Cu mg/l	D	1	0.03	0.03	0.01	0.03
		2	0.02	0.02	0.01	0.02
		3	0.01	0.01	0.02	0.01
Fe mg/l	T	1	1.3	2.0	1.9	1.2
		2	0.96	0.54	3.0	1.3
		3	0.95	0.74	0.97	1.2
Fe mg/l	D	1	0.46	0.83	0.66	0.37
		2	0.33	0.19	0.24	0.27
		3	0.37	0.11	0.29	0.26
Ni mg/l	T	1	<0.05	<0.05	<0.05	<0.05
		2	<0.05	<0.05	<0.05	<0.05
		3	<0.05	<0.05	<0.05	<0.05
Ni mg/l	D	1	<0.05	<0.05	<0.05	<0.05
		2	<0.05	<0.05	<0.05	<0.05
		3	<0.05	<0.05	<0.05	<0.05
Pb mg/l	T	1	<0.02	0.03	0.02	<0.02
		2	0.02	0.02	0.04	<0.02
		3	<0.02	<0.02	<0.02	<0.02
Pb mg/l	D	1	<0.02	<0.02	<0.02	<0.02
		2	0.05	<0.02	<0.02	<0.02
		3	<0.02	<0.02	<0.02	<0.02
Zn mg/l	T	1	0.23	0.21	0.11	0.34
		2	0.25	0.13	0.24	0.13
		3	1.0	0.12	0.13	0.11
Zn mg/l	D	1	0.40	0.48	0.15	0.04
		2	0.40	0.41	0.10	0.04
		3	0.29	0.26	0.29	0.06

APPENDIX I MISSION PCC COMPOSITE SAMPLE ANALYTICAL RESULTS

b. METALS (cont'd)

Sampling Point	Number
Raw Sewage	1
Secondary Effluent	2
Chlorinated Effluent	3

T - Total
D - Dissolved

Analytical	Parameter	Sampling	Date July 6	July 7	July 8	July 9
Al	T	1	0.8	0.9	1.1	0.6
mg/l		2	0.5	<0.3	1.9	0.6
		3	0.6	0.4	0.4	0.6
Al	D	1	<0.3	<0.3	<0.3	<0.3
mg/l		2	<0.3	<0.3	<0.3	<0.3
		3	<0.3	<0.3	<0.3	<0.3
Cd	T	1	<0.01	<0.01	<0.01	<0.01
mg/l		2	<0.01	<0.01	<0.01	<0.01
		3	<0.01	<0.01	<0.01	<0.01
Cd	D	1	<0.01	<0.01	<0.01	<0.01
mg/l		2	<0.01	<0.01	<0.01	<0.01
		3	<0.01	<0.01	<0.01	<0.01
Mn	T	1	0.07	0.08	0.09	0.07
mg/l		2	0.07	0.04	0.14	0.07
		3	0.06	0.05	0.08	0.08
Mn	D	1	0.05	0.08	0.07	0.06
mg/l		2	0.05	0.04	0.07	0.04
		3	0.05	<0.03	0.04	0.06
Cr	T	1	<0.02	<0.02	<0.02	<0.02
mg/l		2	0.02	0.02	0.03	<0.02
		3	<0.02	<0.02	<0.02	<0.02
Cr	D	1	0.02	<0.02	<0.02	<0.02
mg/l		2	0.03	0.02	<0.02	<0.02
		3	0.04	<0.02	<0.02	<0.02

APPENDIX II

GRAB SAMPLING

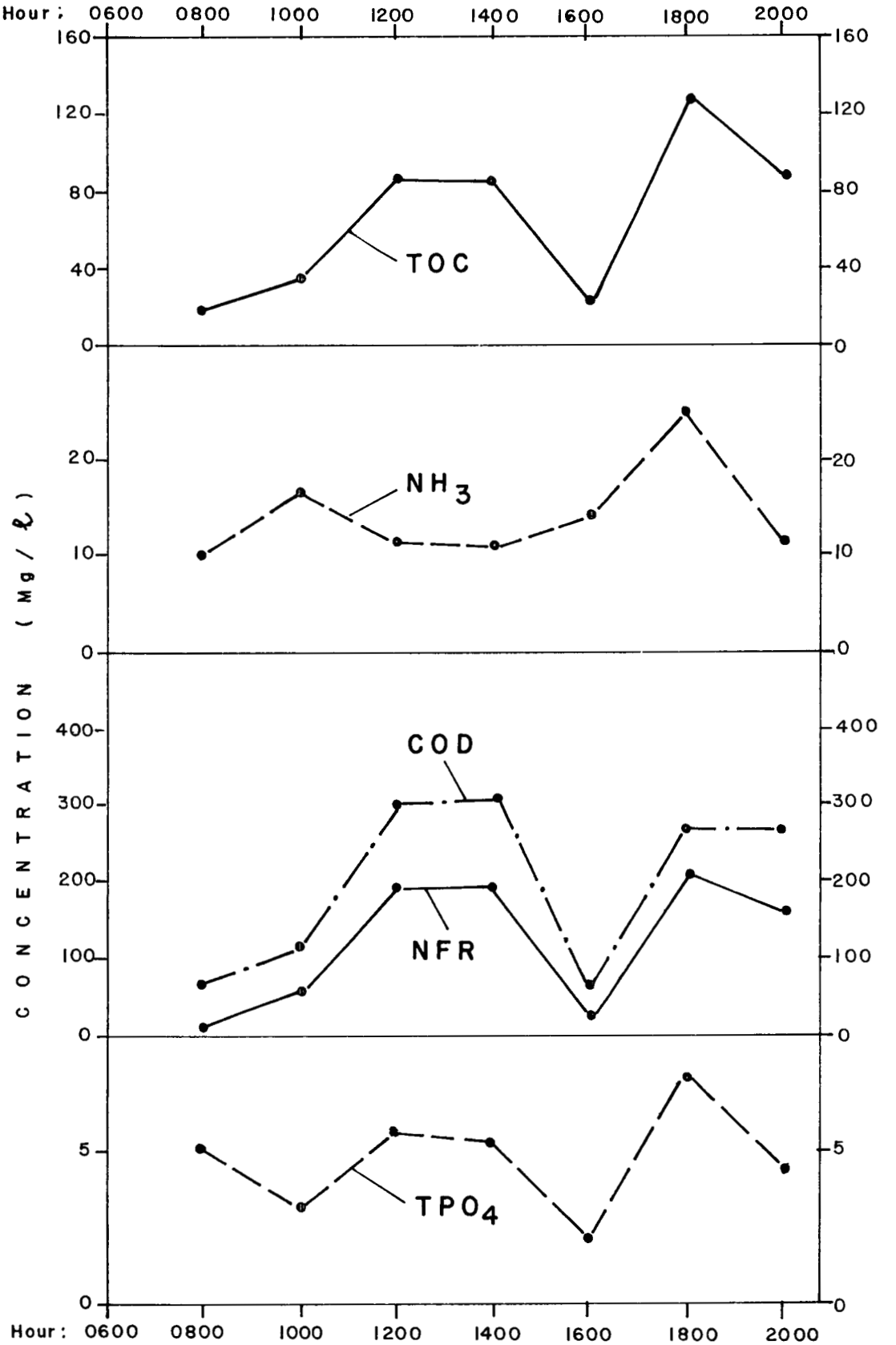
ANALYTICAL RESULTS

APPENDIX II MISSION PCC GRAB SAMPLE ANALYTICAL RESULTS

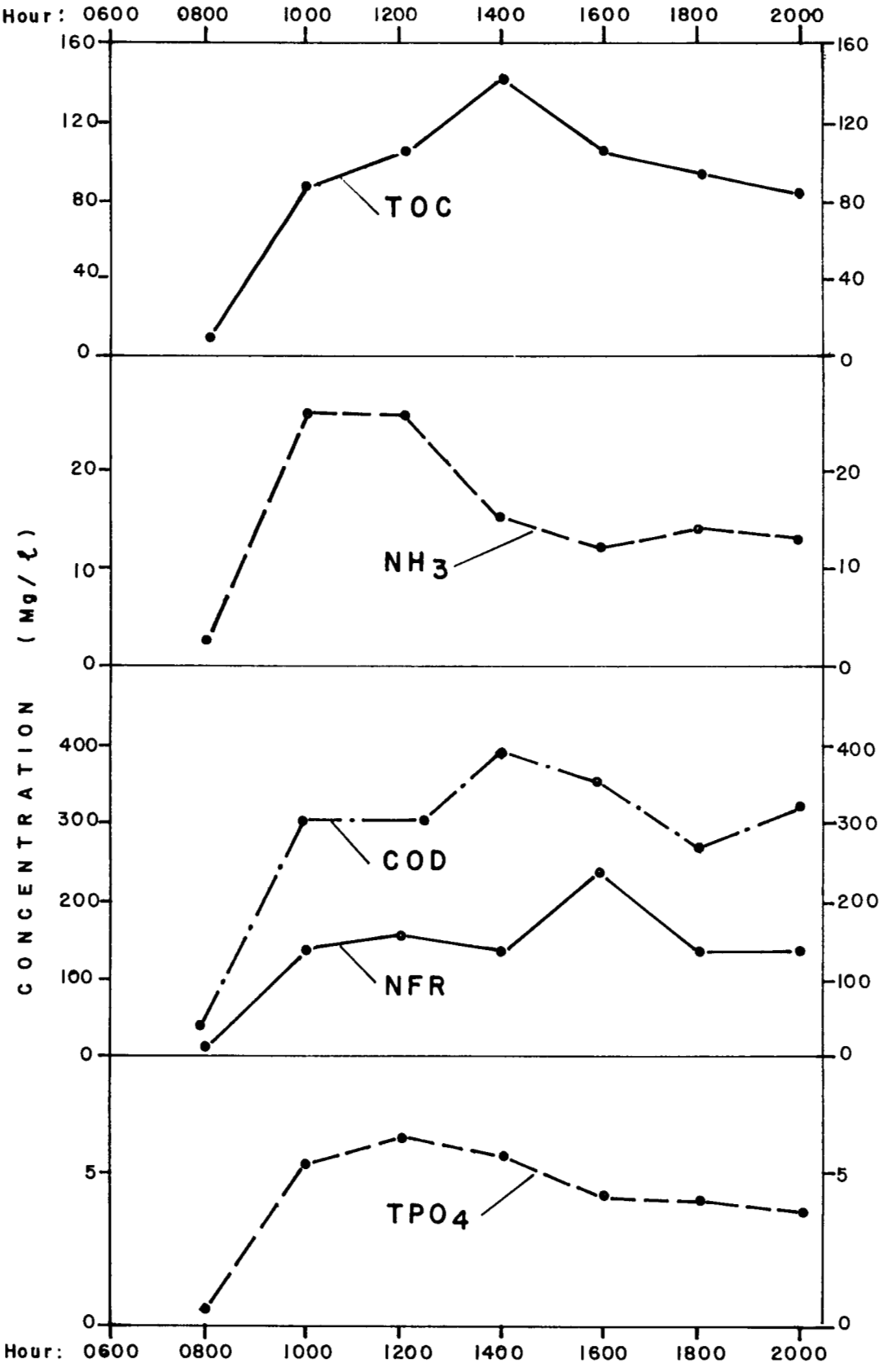
JULY 7, 1976

Sampling Point	Number
Raw Sewage	1
Chlorinated Effluent	3

Analytical Parameter	Sampling Point	Time (hr) 0800	1000	1200	1400	1600	1800	2000
TPO_4	1	0.55	5.2	6.1	5.3	4.1	4.1	3.7
mg/l P	3	5.0	3.2	5.4	5.2	2.2	7.5	4.5
NH_3- N	1	3.3	25	25	16	12	14	12
mg/l N	3	10	17	12	11	14	25	12
NO_3- N	1	0.63	<.01	<.01	<.01	<.01	<.01	<.01
mg/l N	3	<.01	<.01	<.01	<.01	<.01	<.01	<.01
NO_2- N	1	.065	.01	.013	.013	.013	.013	.013
mg/l N	3	.008	<.005	<.005	<.005	.008	.005	<.005
NFR	1	9	130	150	130	230	130	130
mg/l	3	16	63	190	190	23	220	170
COD	1	31	300	300	380	350	270	310
mg/l	3	66	120	300	320	69	270	270
TR	1	90	300	400	360	340	470	330
mg/l	3	160	190	340	360	160	570	370
Anionic Surfactants	1	.19	.50	.26	.34	.43	.44	.51
mg/l LAS	3	.21	.29	.21	.28	.47	.25	.27
TOC	1	8.0	86	106	142	108	94	82
mg/l	3	19.0	36	86	86	24	128	88



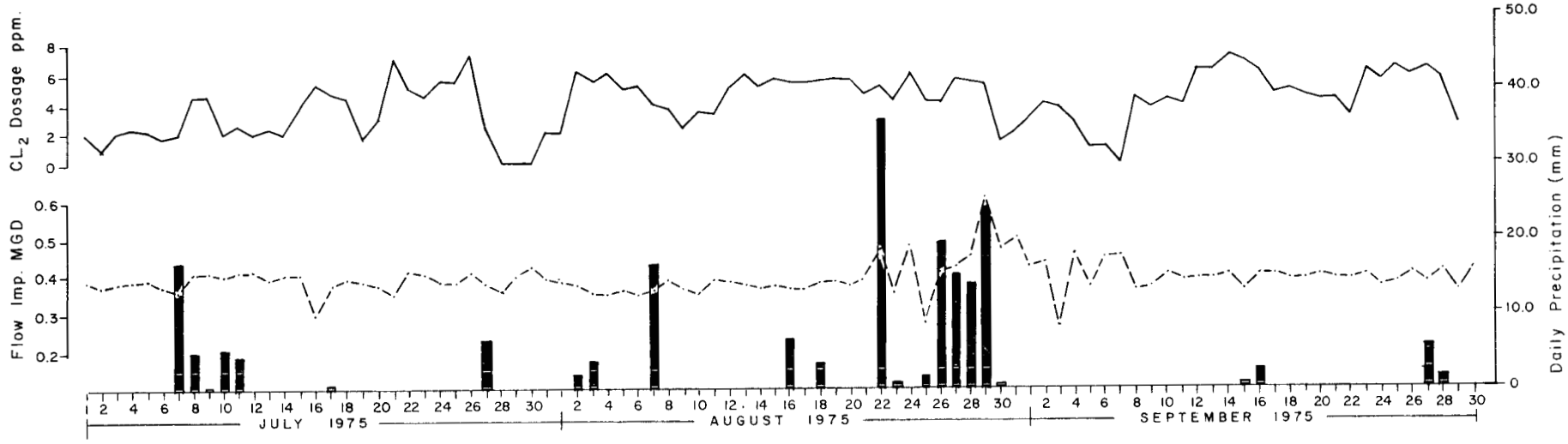
MISSION PCC - GRAB SAMPLING PROGRAM - CHLORINATED EFFLUENT - July 7, 1976

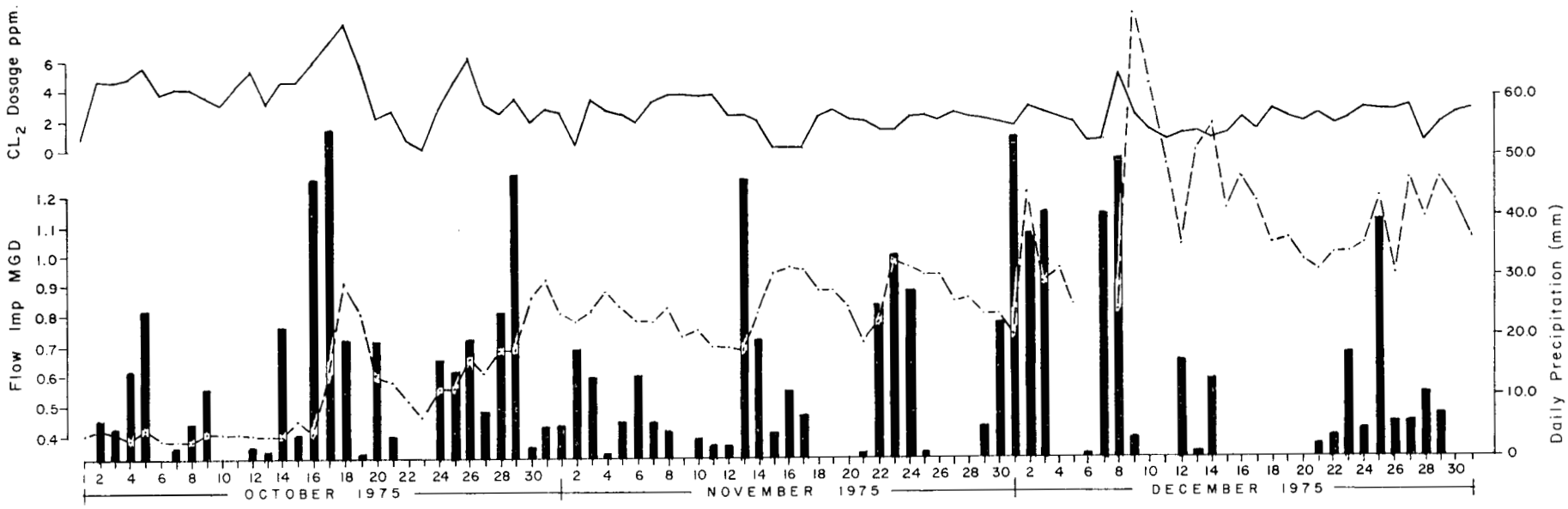


MISSION PCC - GRAB SAMPLING PROGRAM-
RAW SEWAGE - July 7, 1976

APPENDIX III

MISSION PCC DAILY FLOWS, CHLORINE DOSAGES AND PRECIPITATION JULY 1, 1975 TO JUNE 30, 1976


CL2 Dosage ppm.
Flow Imp. MGD
Daily Precipitation (mm)
JULY 1975
AUGUST 1975
SEPTEMBER 1975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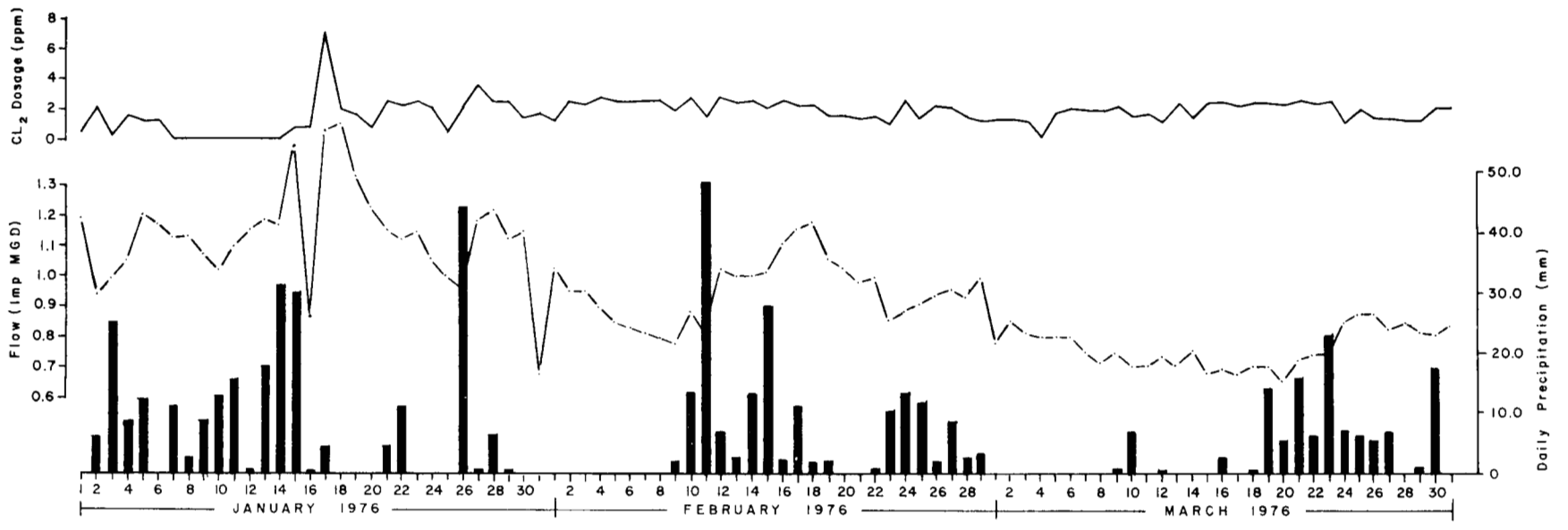
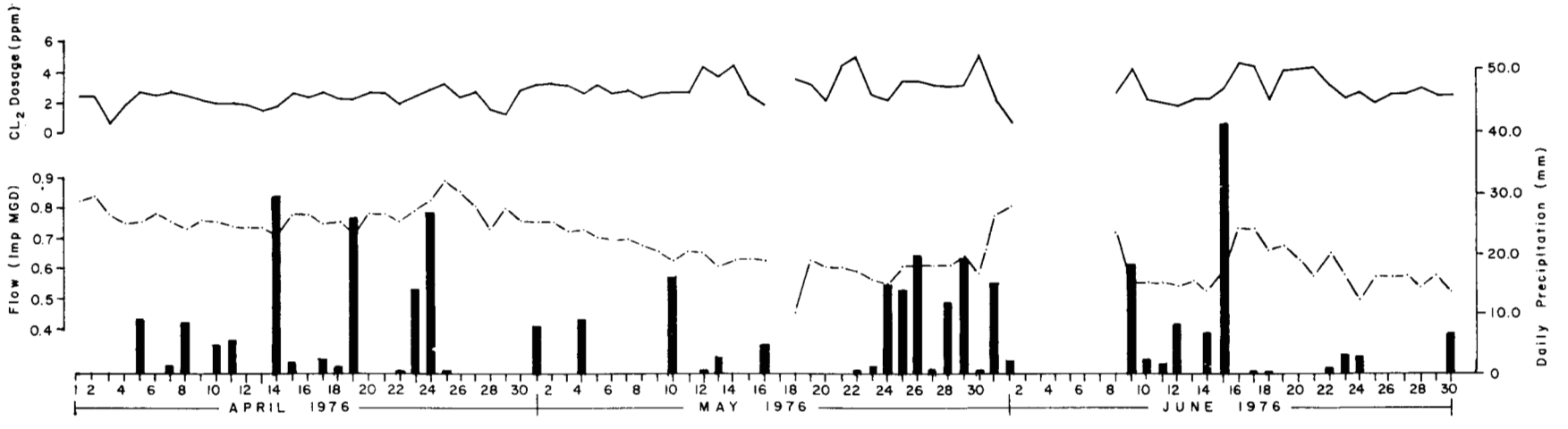
Flow Imp MGD
Daily Precipitation (mm)
OCTOBER 1975
NOVEMBER 1975
DECEMBER 1975


CL_2 Dosage (ppm)
Flow (Imp MGD)
Daily Precipitation (mm)
JANUARY 1976
FEBRUARY 1976
MARCH 1976


CL_2 Dosage (ppm)
Flow (Imp MGD)
Daily Precipitation (mm)
APRIL 1976
MAY 1976
JUNE 1976