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GANGES POLLUTION CONTROL CENTRE ASSESSMENT FEBRUARY 24-MARCH 1, 1987

REGIONAL PROGRAM REPORT 87-11

By

A. David

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TABLE OF CONTENTS

LIST OF TABLES

1 INTRODUCTION

An assessment of the operation and performance of the Ganges Pollution Control Centre was carried out from February 24 to March 1, 1987 by the Environmental Protection (EP), Protection and Conservation. This assessment was conducted in conjunction with a Shellfish Growing Water bacteriological survey to assess the impact of the discharge on the receiving environment. The new sewage treatment plant (STP) started operating in February 1986.

At the time of the survey, over 50% of the proposed sewer connections had been connected including the hospital, hotels and the fish plant. The flow through the plant, averaging 145 cu.m/d (32,000 IGPD) during the survey, represents 39% of the design flow capacity.

Twenty-four hour flow proportional composite samples of the raw, screened and final effluent were taken for 5 consecutive days. These samples were preserved on ice until delivery at the EP West Vancouver laboratory. The microbiology analyses were conducted at the EP Mobile Microbiology laboratory located at the Institute of Ocean Sciences at Sidney for the duration of the survey. The membrane filtration technique was use to determine fecal coliform concentrations.

An LT50 fish bioassay test on the plant effluent was conducted at the EP North Vancouver Laboratory.

2 PLANT DESCRIPTION

Ganges is a small community located in the central section of Saltspring Island in the Gulf Islands. The population of Ganges was 1,995 in the last census in 1981 compared with a total population of Saltspring Island of 5,445. The yearly population growth has been 2.17% for the past few years
(source: Capital Regional District).

Out of 157 total possible connections to the sewer system, 119 connections had been made (76%) including the major sources like the school, hospital, hotels and the fish plant. The 38 remaining connections represent mainly single dwellings. The sewered boundaries will be expanded in the near future. The present flow averages 145 cu.m/d (32,000 IGPD) versus a plant capacity of 455 cu.m/d (100,000 IGPD) and the provincial permit PE-5521 maximum discharge flow of 410 cu.m/d (90,000 IGPD). Presently, there are two lift stations in the collection system.

The sewage is then lifted to the sewage treatment plant and flows through a 60 cm (2 ft) wide rotating drum screen equipped with 1.6 mm (1/16 in) openings. The removed solids are hauled away to the municipal landfill on a regular basis. The screened influent flows through a de-grit trough before being discharged to the equalization tank. Two coarse bubbler tubes constantly aerate the wastewater. Two pumps on float level detectors pump from the equalization tank to the head of the rotating biological contactor (RBC). The RBC is a two section Aero-Surf model by Autotrol. Compressed air is the driving force rotating the bio-discs at an average speed of 1.3 revolution per minute (rpm). The RBC effluent flows to a square secondary clarifier. The scum is returned to the STP lift station and the sludge is pumped to the sludge holding tank for two minutes every four hours. The sludge is aerated and the supernatant, after settling, is allowed to flow back to the STP lift station. The sludge is hauled away twice a week to a dumping site under provincial permit.

The effluent from the clarifier flows through an ultraviolet (UV) disinfection unit. The Pure Water Systems ultraviolet purifier is equipped with 36 UV light tubes placed perpendicularly to the flow. Automatic scrapers clean the tubes at regular intervals. The UV intensity meter had not been installed.

The disinfected effluent flows to a 7.6 cm (3 in) Parshall flume where an ultrasonic flowmeter records the flow 24 hours a day. The liquid is then pumped through a 20 cm (8 in) diameter 4,570 metre (2.8 miles) long outfall to Ganges Harbour. The outfall is equipped with six diffusers 60 mm (2.4 in) in diameter spaced every 5 metres (16.4 ft) at a depth of 16 metres (52.5 ft) below mean low water. The diffuser pipes point north and south alternately.

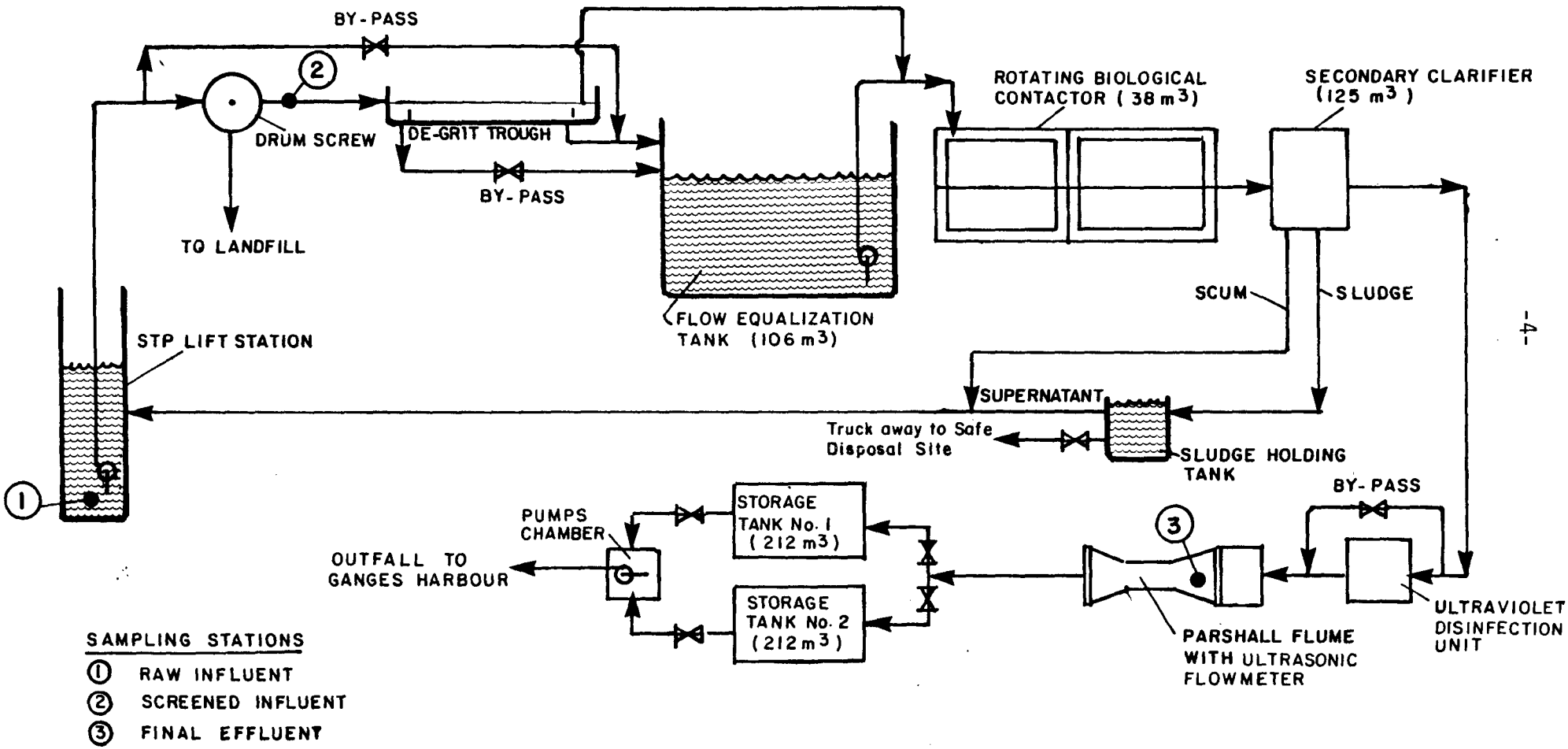

FIGURE I GANGES POLLUTION CONTROL CENTRE FLOW DIAGRAM

3 SAMPLING PROCEDURES AND METHODS

Automatic samplers (Sigma model #6201) were used to collect flow proportional twenty-four (24) hour composite samples of the raw sewage for three (3) days, the screened influent for two (2) days and the final effluent for five (5) days from February 24 to March 1, 1987 (see Figure 1 for sampling locations). The water samples were preserved as outlined in the Environmental Laboratory Manual (ref. 2). The samples were delivered to the EP West Vancouver Laboratory on March 4, 1987 for analyses.

Dissolved oxygen levels were taken at different locations through the plant using a YSI Model 51B oxygen meter. Chlorine and sulphite levels of the final effluent were determined using Hach kits. Bacteriology analyses were performed the day of sampling at EP Mobile Microbiology Laboratory stationed at the Institute of Ocean Sciences at Sidney during the survey.

A portable Model F-3000 Manning Dipper flowmeter was installed on the final effluent Parshall flume for five (5) days to determine the effectiveness of the flow equalization system.

4 PLANT EVALUATION

4.1 Flow Equalization

The primary objective of flow equalization is to dampen the diurnal flow variations to achieve a nearly constant flow rate through the treatment process. A secondary objective is to dampen the concentration and mass flow of wastewater constituents by blending the wastewater in the equalization tank resulting in a more uniform loading to the treatment system. The flow equalization does not work properly. Table 1 shows periods of no-flow through the treatment system mainly due to over-pumping or mechanical failures. Also, once a day, the operator turns off the pump in the equalization basin to stop introducing any more effluent during the batch chlorination/dechlorination stage in one of the two holding tanks.

Peak flows are also experienced. Two large pumps on float system lift the wastewater to the RBC. These two pumps are too large to allow constant flow through the plant on a 24 hour basis. The operator installed a small pump which can operate almost constantly leaving the larger pumps for emergency only. The small pump is not designed for this purpose and clogs regularly. The best design would eliminate flow variations.

The wastewater in the equalization tank is aerated to control odours using two coarse bubbler tubes. The degree of aeration for simple odor control appeared excessive and could represent an energy waste as well as contribute to the low wastewater temperature entering the RBC, hindering the treatment process.

TABLE 1 FLOW PATTERN THROUGH THE RBC AND SECONDARY CLARIFIER.

Dates	Periods with no-flow through the plant	Duration	Total
25/02/87	02:15 - 03:15	1 h.	
	04:30 - 06:30	2 h.	
	08:00 - 09:00	1 h.	4.5
	10:30- 11:00	.5 h.	
	13:30 - 16:00 (*)		
26/02/87	13:30 - 15:00 (*)		0 h.
27/02/87	05:00 - 06:30	.5 h.	
	09:00 - 10:00 (*)		
	10:30 - 10:45	.25 h.	2.5 h.
	11:15 - 13:00	1.75 h.	

(*) Discharge periods to Ganges Harbour.

4.2 Biological process The media on the RBC disks was black and thin all along its length. This indicates the presence of stressed bacteria which could be due to 1) lack of organic food, 2) low temperature of the influent to the RBC, 3) no-flow periods or 4) a combination of the above. The final effluent BOD's were higher than expected for this type of treatment (Table 2) and were also inconsistent ranging from 12 to 71 mg/l. The RBC hydraulic loading was 20 to 35 times lower than design values found in the literature (ref. 1) (Table 4). The dissolved oxygen in the first stage of the RBC was 3 to 5 times higher than values reported in the literature. This could be due to excessive aeration in the equalization tank and the air driven shaft. The wastewater temperature was 10.8°C which is lower than suggested values ranging from 13°C to 32°C for optimum efficiency. As noted in the literature (ref. 1), treatment efficiency decreases when wastewater temperatures decrease below 13°C.

The final effluent non-filterable residues (NFR) were also higher than expected (up to 39 mg/l) considering 1) the secondary clarifier had 2 to 4 times the required capacity, 2) sludge removal was done on an hourly regular basis and 3) the sides of the clarifier were cleaned everyday.

There was a 36% reduction in ammonia nitrogen with a sharp increase in nitrates showing the presence of nitrifier bacteria. Nitrification is not required at this treatment plant. The total phosphorus was not reduced but this is not a permit requirement.

Table 3 shows that EP results fall in the same range as CRD's results obtained in January and February 1987. This demonstrates EP results represent normal final effluent levels for that time of the year even though sampling conditions differed.

The bioassay test on the March 3,1987 final effluent showed no toxicity to rainbow trout underyearlings over a 96 hour exposure period at 100% concentration.

TABLE 2 EP ANALYTICAL RESULTS

Parameters	Raw Influent (Station 1)				Screened Influent (Station 2)		
	Feb.24-25	Feb.25-26	Feb.26-27	Ave.	Feb.27-28	Feb 28-Mar 1	Ave
Oxygen Demand/biochemical	170	170	180	173	165	205	185
Residue/non-filterable	161	160	150	157	70	111	90.5
Nitrogen/ammonia	9.3	19.1	22.3	16.9	27.2	24.2	25.7
Nitrogen/nitrite	.098	.186	<.005	.096	<.005	<.005	<.005
Nitrogen/nitrate	.559	1.764	.061	.795	.035	.056	.046
Phosphorus/total	6.7	9.6	9.7	8.7	10.8	9.5	10.2
Phosphorus/O-P04	5.3	7.1	8.1	6.8	9.2	7.5	8.4
PH	7.7	7.9	7.1	7.6	7.1	7.1	7.1

TABLE 2 (Continued)

Parameters	Final Effluent (Station 3)						
	Feb.24-25	Feb.25-26	Feb.26-27	Feb.27-28	Feb.28-Mar.1	Ave.	Percentage Reduction
Oxygen Demand/biochemical	39	14	71	12	21	31.4	82
Residue/non-filterable	38	38	39	15	32	32.4	79
Nitrogen/ammonia	10.5	9.9	10.1	11.6	11.7	10.8	36
Nitrogen/nitrite	.238	.156	.181	.243	.222	.208	--
Nitrogen/nitrate	20.4	20.9	17.6	19.7	21.6	20.2	--
Phosphorus/total	8.4	8.9	8.1	8.6	10.1	8.8	--
Phosphorus/O-P04	7.2	7.8	6.2	7.9	8.4	7.5	--
PH	7.0	6.8	6.6	6.7	6.6	6.7	--

All units in mg/l except pH (relative units).

TABLE 3 CRD ANALYTICAL RESULTS

Date	BOD (mg/l)	NFR (mg/l)
Jan 22/1987	14	25
Jan 29/1987	31	48
Feb 5/1987	26	39
Feb 12/1987	29	36
Average	25	37
Range	14-31	25-48

TABLE 4 UNITS CHARACTERISTICS

Drum screen	Width : 61 cm Spacings: 1.6 mm
De-grit chamber	Length: 6.0 m Width : 0.6 m Depth : 0.3 m
Equalization tank	Length: 8.0 m Width : 5.7 m Depth : 2.3 m Volume: 106 cu.m Retention time: 17.5 h
Rotating Biological Contactor:	Model : Autotrol Aero-Surf #701-252 No. of stages: 2 Surface area : 8 920 sq.m Volume : 38 cu.m Retention time: 6.3 h Loading : .0043 cu.m/sq.m.d [.08 to 16] Rotation velocity: 1.3 rpm [1 to 2] to Temperature : 10.8°C [13°to 32°C] Dissolved oxygen : first stage : 10.6 mg/l [2 to 3] second stage : 11.0 mg/l [4 to 8]
Secondary clarifier:	Width : 4.4 m Length: 4.4 m Depth : 4.3 m Volume: 121 cu.m Retention time: 20 h Overflow rate: 7.5 cu.m/sq.m.d [16 to 33]
Ultraviolet unit:	Model: Pure Water Systems with self-cleaning scrapers Rating: 99.9% inactivation at 0.4 cu.m/min (87 gpm) No. of quartz tubes: 36 UV intensity meter: not installed yet
Effluent storage tanks:	Number: 2 Width : 9 m Length: 9 m Depth : 2.6 m Volume: 212 cu.m each Retention time: 35 hours each tank
Outfall:	Length: 4570 m Depth : 16 m Diameter: 20 cm Number of diffusers: 6 Pipe capacity : 143.6 cu.m Diameter of diffusers: 60 mm Spacing between diffusers: 5 m End positioning: N 48°50' 3.84" W 123°26' 26.1"

N.B. All calculations based on the average flow of 145 cu.m/d (32,000 Imp gpd).
Values in brackets are design values obtained from reference 1.

4.3 **Disinfection** The disinfection unit is from Pure Water Systems. Its specifications indicate a 99.9% inactivation at a 87 gpm flow. The unit consists of 36 ultraviolet light tubes perpendicular to the flow. Automatic scrapers clean the tubes at regular intervals. The UV intensity meter was not installed at the time of the survey. A large number of small white worms were noticed mainly on the upstream side of the disinfection unit.

The fecal coliform values following the UV light unit varied considerably ranging from less than 10 to 1800 fecal coliforms (FC)/100 ml. These values could be directly related to the instantaneous effluent flow through the unit (Table 5). For flows less than 20 gpm, the disinfection unit was reliable with results less than 40 FC/100 ml. For flows higher than 20 gpm, the disinfection unit did not reduce the fecal counts to less than 70 FC/100 ml as described in PE-5521.

After the UV unit, the effluent is stored and kept agitated in one of two storage tanks until discharge to Ganges Harbour on a ebb tide. Prior to discharge, sodium hypochlorite is added and mixed approximately 30 minutes for disinfection purposes. Sodium thiosulphite is then added to eliminate any residual chlorine. On February 25, the final effluent after chlorination and dechlorination was disinfected to less than 10 FC/100 ml. The total residual chlorine was 0.1 mg/l and the sulphite level was 0.0 mg/l These results indicated that more sodium thiosulphite should have been added to eliminate all the residual chlorine.

TABLE 5 FECAL COLIFORM REDUCTIONS

Date	Time	Raw (FC/100ml)	Before UV (FC/100ml)	After UV (FC/100ml)	Percentage Reduction	After Cl_2&deCl_2 (FC/100ml)	Instantaneous Flow (IMP gpm)
24/02/87	13:30	440,000	30,000	410	98.6	-	42
25/02/87	13:45	470,000	7,000	<10	99.9	<10	0
26/02/87	09:30	20,000,000	50,000	330	99.3	-	32
27/02/87	09:40	4,500,000	23,000	310	98.7	-	42
28/02/87	11:30	3,800,000	53,000	<10	99.9	-	0
01/03/87	08:15	3,100,000	57,000	40	99.9	-	20
01/03/87	08:20	3,100,000	57,000	1,800	96.8	-	52
AVERAGE			36,700	415			
RANGE			7,000-57,000	<10-1800			0-52

4.4 Final Effluent Compliance with WMB Permit PE-5521 The level of compliance with the Waste Management Branch (WMB) permit PE-5521 for BOD and TSS were respectively 60% and 20% during the survey (Table 6). EP final effluent samples were 24 hour flow proportional composite compared to grab samples permitted by the provincial permit.

The discharge flow was less than the maximum permitted rate of 410 cu.m/d during the survey (Table 7). The effluent was also discharged on ebbing tides only as required in the permit.

The UV unit could not disinfect the final effluent to a level less than 70 FC/100 ml consistently. After chlorination and dechlorination, the fecal count was below 10 FC/100 ml.

TABLE 6 FINAL EFFLUENT COMPLIANCE WITH WMB PERMIT PE-5521

Permit levels	Days complied/No. of days	Percentage compliance
BOD : 25 mg/l	3 / 5	60
TSS : 25 mg/l	1 / 5	20
Flow: 410 cu.m/d	6 / 6	100
Fecal coliforms:		
i) less than 70 FC/100 ml after UV unit	3 / 7	43
ii) less than 70 FC/100 ml after UV, Cl_2 and deCl_2	1 / 1	100

TABLE 7 DAILY DISCHARGED VOLUMES TO GANGES HARBOUR

Date	Discharged Volumes (cu.m)	(IMP gal)
Feb. 24	120	26,400
Feb. 25	134	29,480
Feb. 26	215 *	47,200 *
Feb. 27	181	39,760
Feb. 28	129	28,430
Mar. 1	121	26,640
Average	150	32,985

* The final effluent was stored under EP's request for a dye test.

CONCLUSIONS

1. The final effluent BOD and NFR results met the WMB Permit requirements respectively 60% and 20% of the time.

2. The ultraviolet disinfection unit was not achieving disinfection to a level less than 70 FC/100 ml for all flow variations.

3. The final effluent was not toxic to fish at 100% concentration over a 96 hour exposure period.

4. The flow equalization system was not working properly due to the oversizing of the pumps lifting the wastewater to the RBC.

5. The batch chlorination was effective.

6. The aeration in the equalization tank appeared to be excessive and could be creating problems downstream.

7. The media on the RBC disk was black and thin showing an unhealthy and stressed bacteria population. This condition could be due to one or a combination of the following factors: 1) low organic loading, 2) low temperature of the influent to the RBC and 3) no-flow periods due to inefficient flow equalization.

RECOMMENDATIONS

1. The pumping from the equalization tank to the RBC should be made more flexible to allow an equal flow through the treatment plant 24 hours a day.

2. The UV intensity meter should be installed as soon as possible to determine if the intensity is up to specifications.

3. The dissolved oxygen level in the equalization tank should be kept to the minimum level required to control odours.

4. The operator should obtain a sulphite kit to determine if enough sodium thiosulphite is added to eliminate residual chlorine before discharging to Ganges Harbour.

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REFERENCES

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2. Environmental Laboratory Manual, Environment Canada, January, 1979.