ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
ENVIRONMENTAL PROTECTION
PACIFIC AND YUKON REGION

OPERATIONAL PERFORMANCE OF THE TSULQUATE SEWAGE TREATMENT PLANT AND THE AIRPORT SEWAGE TREATMENT PLANT AT PORT HARDY

Regional Program Report 87-03

By

A. David

OCTOBER 1986

ABSTRACT

The Tsulquate and the Airport Sewage Treatment Plants were evaluated over a 5-day period from June 9 to June 14, 1986. The plants were last evaluated in December 1978 as part of a shellfish survey of Hardy Bay and Beaver Harbour (EPS Regional Program Report 79-18).

In 1978, operational problems were found at the Tsulquate STP mainly due to the contact stabilization mode of operation and the large flows during wet weather. In 1982, the mode of operation was changed from contact stabilization to extended aeration allowing easier control for the STP operator. Since 1978, the Department of Highway's facilities, the homes along Beaver Harbour and the Fort Rupert Indian Reserve have connected to the Airport STP creating a larger load on the plant.

This report represents an assessment of the treatment plants under the above modified conditions. Recommendations are made to improve the final effluent quality and to protect the fishery resources in the Port Hardy coastal waters.

RÉSUMÉ

Les usines de traitement d'eaux usées Tsulquate et Aéroport furent évaluées pendant une période de 5 jours du 9 au 14 juin, 1986. Ces usines de traitement furent évaluées pour la dernière fois en décembre 1978 faisant partie d'une étude de la pêche de mollusques de la baie Hardy et de Beaver Harbour (SPE rapport régional 79-18).

En 1978, des problèmes opérationnels furent découverts à l'usine de traitement Tsulquate dû principalement au mode d'opération de stabilisation de contact et aux larges débits pendant les fortes pluies. En 1982, le mode d'opération fut changé de la stabilisation de contact à aération prolongée permettant un contrôle plus facile pour l'opérateur de l'usine de traitement. Depuis 1978, les facilités du département des routes, les maisons le long de Beaver Harbour et la réserve indienne de Fort Rupert furent connectées à l'usine de traitement Aéroport créant une charge plus grande sur celle-ci.

Ce rapport représente une évaluation des usines de traitement sous les conditions modifiées citées ci-dessus. Des recommandations sont apportées afin d'améliorer la qualité des effluents finaux et de protéger les ressources de poisson dans les eaux côtières de Port Hardy.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

m	Meter
cm	Centimeter
mm	Millimeter
cu·m	Cubic meter
cu·ft	Cubic foot
m^3	Cubic meter
m^2	Square meter
Imp·gpd	Imperial gallons per day
LC_{50}	Median lethal concentration
BOD	Biochemical oxygen demand
COD	Chemical oxygen demand
TOC	Total organic carbon
D.O.	Dissolved oxygen
mg/l	Milligram per liter
Kg	Kilogram
NFR	Non-filterable residue
TSS	Total suspended solids
SS	Suspended solids
ML	Mixed liquor
FNFR	Fixed non-filterable solids
VNFR	Volatile non-filterable residue
VSS	Volatile suspended solids
TR	Total residue
TVR	Total volatile residue
F/M	Food/microogranisms ratio
N	Nitrogen
P	Phosphorus
PO_4	Phosphate
hr	Hour
d	Day

1 INTRODUCTION

An assessment of the operation and performance of the Tsulquate and Airport Sewage Treatment Plants (STP's) at Port Hardy was carried out from June 9 to 14, 1986, by Environmental Protection (EP), Conservation and Protection.

Twenty-four hour composite samples of the raw influent and final effluent were taken for 5 consecutive days at both locations. These samples were preserved and kept cool until delivery at EP's West Vancouver Laboratory. One bioassay (LC_{50}) was run on the final effluent of both plants at EP's North Vancouver Laboratory. Bacteriological, dissolved oxygen, temperature and ammonia tests were performed on site for the raw and final effluent.

2 TSULQUATE STP (PE-385)

2.1 Plant Description

The Tsulquate STP installed in 1971 is an Ecodyne-Smith and Loveless Model 69-R-500. The reported plant nominal capacity is 1894 cu·m/day (416,700 Imp·gpd) on an average daily flow basis when operated in the contact stabilization mode, and 1264 cu·m/d (278,200 Imp·gpd) in the extended aeration mode.

The plant was operated in the extended aeration mode until about 1978 and then converted to the contact stabilization mode. In late 1982, the operation mode was returned to the original extended aeration to control sludge bulking problems encountered.

The plant services the townsite area extending as far south as the Quatse River as well as the Tsulquate Indian Reserve No. 4 just north of the treatment plant (Figure 1).

The treatment consists of coarse screening (1.5 inch or 3.8 cm spacings), aeration and settling (Figure 2). The final effluent is discharged to Hardy Bay through a 610 meter (2000 feet) long open ended outfall 0.3 m (12 inches) in diameter to a depth of 6.1 meters (20 feet). Sludge is returned to the aeration tank or wasted to the aerobic digester. Twice a week, stabilized sludge from the aerobic digester is discharged down the outfall. Sludge is then wasted from the final clarifier into the aerobic digester allowing the aeration tank solids content to be lowered. An ultrasonic flowmeter is installed on a V-notch weir at the chlorination chamber outlet and records flow on 7-day 24-hour charts.

Two air blowers are used alternatively allowing a spare blower to be available at all times in case of a breakdown.

Chlorination was stopped in 1983 due to the plant incapability to produce consistently high quality effluent because of 1) overloading during wet weather flow conditions and 2) discharge of digested sludge through the outfall. Hardy Bay is closed to shellfish harvesting under Schedule 1 Area 12-1 of the Pacific Shellfish Regulations (Figure 1).

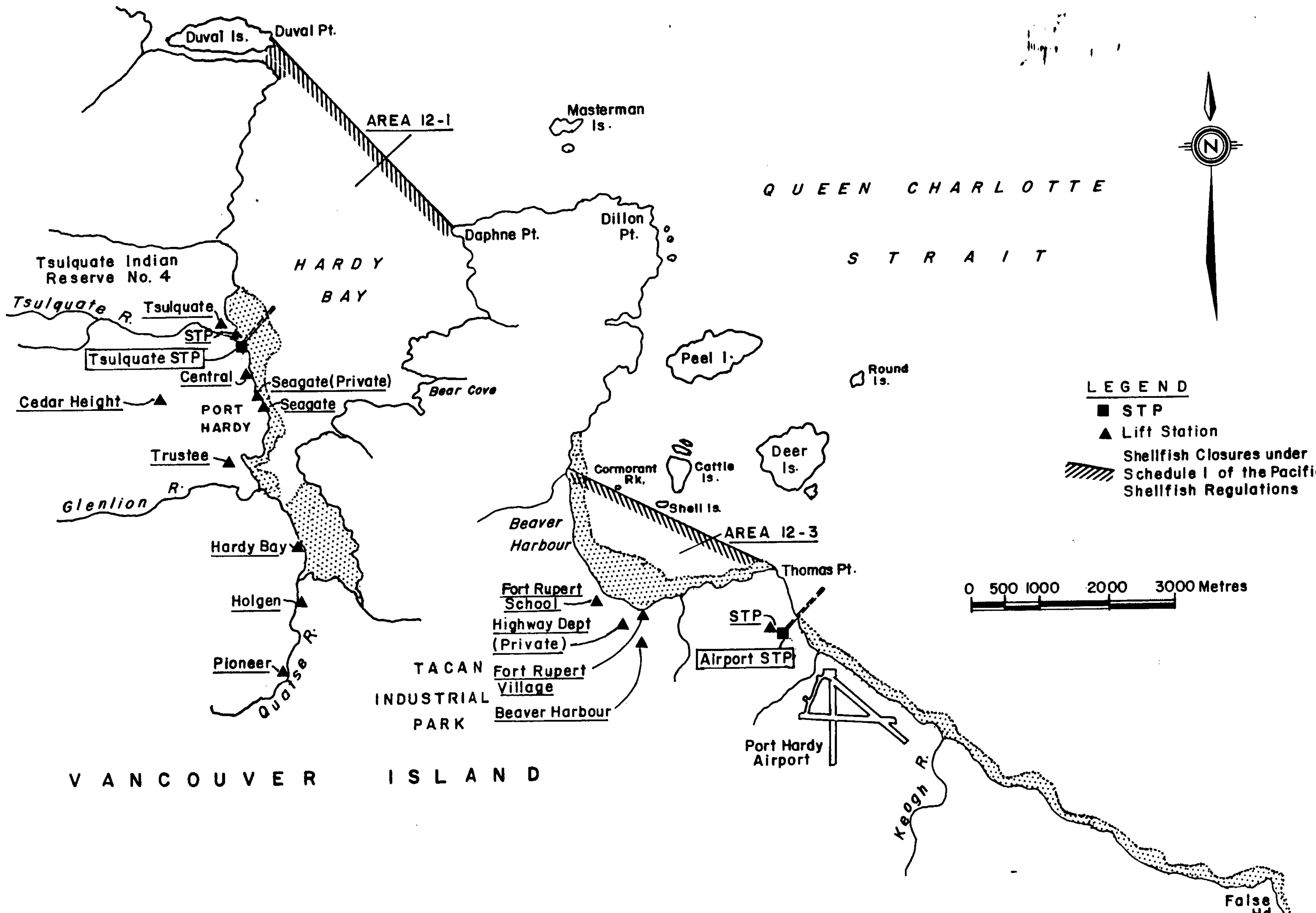

FIGURE I STP'S AND SEWAGE LIFT STATION LOCATIONS

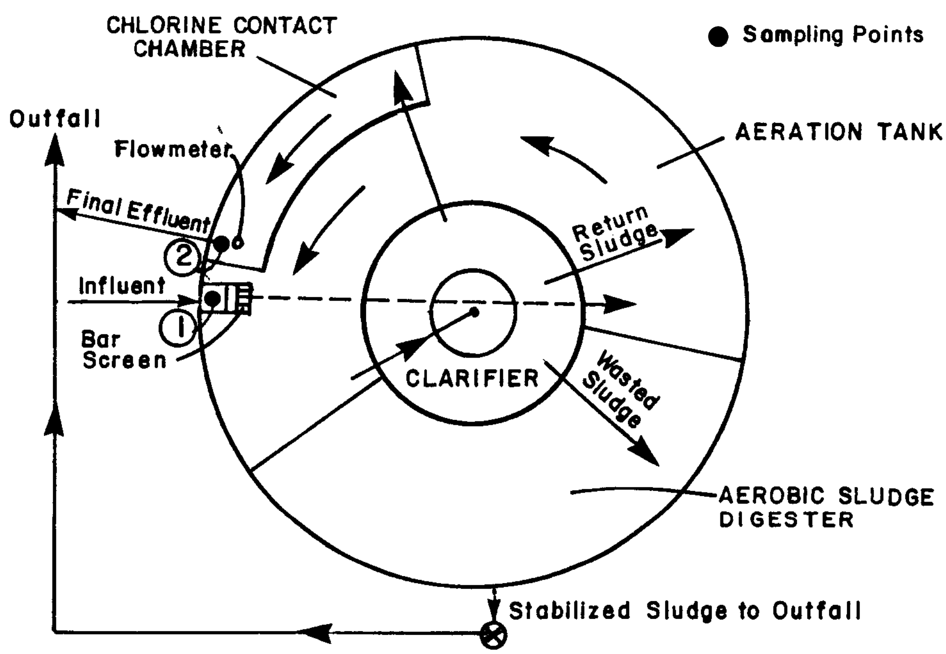

FIGURE 2 TSULQUATE STP FLOW DIAGRAM

TABLE 1 TSULQUATE STP ANALYTICAL RESULTS

PARAMETERS	DATE AND SAMPLE POINT											
	JUNE 10-11		JUNE 11-12		JUNE 12-13		JUNE 13-14		JUNE 14-15		AVERAGE	
	1	2	1	2	1	2	1	2	1	2	1	2
BOD	100	10	84	13	57	7	94	6	77	9	82	9
COD	352	55	327	60	32	65	450	70	357	75	304	65
TOC	103	17	67	19	63	17	109	21	84	19	85	19
NFR	95	25	81	37	105	37	188	22	127	30	119	30
FNFR	44.7	< 24.7	1.25	< 37.2	21.3	< 36.7	34.5	< 22.2	36.7	< 30.2	27.7	-
VNFR	50	< 5	79	< 5	84	< 5	154	< 5	91	< 5	92	< 5
TR	275	149	240	150	265	150	383	176	334	196	299	164
TVR	165	47	133	55	165	50	230	67	210	77	181	59
Ammonia (N)	21.3	18.8	17.9	19.9	20	20.5	19.9	20.5	22	19.4	20.2	19.8
Nitrite (N)	< 0.005	0.096	< 0.005	0.051	< 0.005	0.039	< 0.005	0.067	< 0.005	0.024	< 0.005	0.055
Nitrate (N)	.084	.174	0.026	0.050	0.013	0.031	< 0.005	0.048	0.018	0.007	0.029	0.062
Total PO_4 (P)	5.6	3.4	5.1	0.3	5	3.2	7.2	3.9	5.9	4.2	5.8	3.0
Oil & Grease	30.2	1.63	31.6	0.85	27.9	0.57	-	-	-	-	29.9	1.02
Surfactants	7.90	0.356	10.4	0.302	7.75	0.349	9.50	0.700	8.13	0.650	8.74	0.47
pH	7.2	7.2	7.1	7.2	7.2	7.3	7.0	7.3	7.1	7.2	7.1	7.2
Conductivity	420	420	385	400	415	410	410	405	430	420	412	411
Alkalinity	115	117	113	115	119	114	123	115	128	122	120	117

All units are in mg/l except for pH (rel. units) and conductivity (umho/cm)
All samples are 24 hour composites
(1) = Influent
(2) = Effluent

2.2 Discussion

The sampling points are shown in Figure 2. The effluent sampling point is located at the outlet of the chlorine contact chamber. Consequently, the effluent characteristics do not include the effect of the sludge discharged on a regular basis through the outfall.

Table 1 shows the analytical results. Final effluent BOD values varied from 6 to 13 mg/l for an average of 9 mg/l (89% reduction). NFR levels varied from 22 to 37 mg/l for an average of 30 mg/l (75% reduction). These values show an effluent of good quality but the solids levels when compared with the low BOD levels could indicate a settling problem.

Table 2 shows the STP characteristics. The detention time under average flow conditions was lower than the typical range values for an extended aeration activated sludge. The flows ranged from 1350 to 1500 cu·m/d (300,000 to 330,000 Imp·gpd) and can be considered as dry flow conditions because of the dry weather experienced during the survey (Table 13). The volumetric loading was within the typical range but at the lower end demonstrating that the organic loading was low for the aeration tank size.

The F/M ratio was high, when compared to design values for extended aeration, mainly due to the low MLSS maintained in the aeration tank but would be in the right range for a contact stabilization or conventional mode of operation. High F/M ratio usually result in a dispersed bacterial growth which is more difficult to settle leading to higher final effluent non-filterable residues. The MLSS results were well below the typical value range for extended aeration but fell into the contact stabilization category. The parameters show that this extended aeration plant is run with contact stabilization parameters.

The MLSS varied every day from a high value on Monday mornings (2000 to 2300 mg/l) before sludge wasting is accomplished to a second high value on Thursdays when a second batch of sludge is wasted to the aerobic digester (Table 3). Twice a week, approximately 90 cu·m (3150 cu·ft) of digested sludge was discharged from the digester through the outfall. Table 4 gives the return sludge characteristics.

TABLE 2 TSULQUATE STP CHARACTERISTICS

Population Served: approx. 3900
Average Flow: 1540 m^3/d

		TYPICAL VALUES(1)		
		EXTENDED AERATION	CONTACT STABILIZATION	CONVEN-TIONAL
Aeration Section				
Volume (m^3)	714			
Depth (m)	4.6			
Detention Time (hr) - avg. flow	11.0	18-36	CONTACT 1.0-3.0 STABIL. 3.0-6.0	3-5
MLSS (mg/l)	828-1340-413	3000-6000	1000-3000	3000-6000
MLVSS (mg/l)	738-1150-370			
F/M (kg BOD_5/kg MLVSS· day)	0.27-0.16-0.43	0.05-0.15	0.2-0.6	0.2-0.6
Volumetric Loading (kg BOD_5/m^3·day)	0.20-0.19-0.16	0.16-0.40	0.96-1.2	0.80-1.9
Clarification Section				
Volume (m^3)	347			
Depth (m)	4.6			
Radius (m)	4.9			
Detention Time (hr)	5.4		2-3	
Hydraulic Loading ($m^3/d/m^2$)	20.4		12-41	
Weir Loading (m^3/m·day)	50.0		max. 125-250	
Sludge Digestion Section				
Volume (m^3)	410			
Depth (m)	4.6			
Sludge Discharged Through Outfall (m^3/week)	appx. 180			
Detention Time (days)	16		15	

The D.O. levels fluctuated from 0.9 to 6.3 mg/l as the solid contents in the mixed liquor varied from 2000 to 600 mg/l (Table 3); acceptable D.O. levels range from 1.0 to 2.0 mg/l. Too much aeration is provided when D.O. levels exceed 2.0 mg/l and represents a waste of energy. An excess of aeration can also alter the floc formation and impede settling in the final clarifier.

TABLE 3 TSULQUATE STP AERATION TANK SOLIDS AND OXYGEN LEVELS

DATE	SLUDGE WASTING	MLNFR* (STP)	MLNFR* (EP)	MLVNFR* (EP)	MLFNFR* (EP)	D.O.*
June 2	No	2270	--	--	--	1.1
June 3	Yes	610	--	--	--	3.8
June 4	No	1400	--	--	--	1.8
June 5	No	1810	--	--	--	1.3
June 6	Yes	690	--	--	--	2.6
June 9	No	1980	--	--	--	0.9
June 10	Yes	700	--	--	--	6.3
June 11	No	1120	828	738	90	3.8
June 12	No	1780	1340	1150	183	0.9
June 13	Yes	--	413	370	43	6.1

* mg/l

TABLE 4 TSULQUATE STP RETURN SLUDGE CHARACTERISTICS

DATE	NFR (mg/l)	VNFR (mg/l)	FNFR (mg/l)
June 11	2230	1920	308
June 12	3360	2960	403
June 13	2880	2270	610
Average	2820	2380	440

The final clarifier had a detention time greater than the typical values, an hydraulic loading within the typical range and a low weir loading (Table 2). These values indicate that the clarifier should be able to handle up to twice the flow experienced during the survey without noticeable performance change. At peak periods of the day, high water level was observed on the outside of the V-notch crown creating an overflow over the notches. Solids on the surface were then allowed to escape the weir. This situation seemed to originate from a lack of head between the outside skirt of the crown and the chlorine contact chamber outlet. This lack of pressure head could result from 1) outlet pipe from the clarifier to the chlorine contact chamber being too small, 2) blockage in the outlet pipe from the clarifier or 3) V-notch at the outlet of the chlorine contact chamber being too high.

The fecal coliform levels were not reduced to the extent expected in a secondary treatment plant (Table 5). Further investigation is required to establish the reason for the inefficient removal of coliforms.

TABLE 5 FECAL COLIFORM LEVELS*

DATE	INFLUENT (fecal col./100 ml)	EFFLUENT (fecal col./100 ml)
June 11	4×10^6	2.3×10^6
June 12	8×10^6	1×10^6
June 13	4.2×10^6	6×10^5
Average	5.4×10^6	1.3×10^6

* using Membrane Filtration method

Although Table 6 indicates that the Tsulquate STP complied with the Waste Management Branch (WMB) permit with respect to BOD and TSS effluent quality during the survey, it is important to note: 1) the dry weather experienced during the survey did not permit an assessment of the plant performance under wet weather flows and 2) the sludge is discharged from the digester on a regular basis. Although little precipitation occurred during the survey, it is known that infiltration into the sewer system is a major problem. The district is pursuing a plan to correct the situation.

TABLE 6 TSULQUATE STP COMPLIANCE WITH WMB PE-385

PE-385: Maximum BOD = 45 mg/l
Maximum NFR = 60 mg/l

	NUMBER OF SAMPLES	PERCENT OF COMPLIANCE
BOD	5	100
NFR	5	100

At the time of the survey, the homemade automatic screen cleaning system was not operating properly and daily manual cleaning was required. Any solids accumulation on the screen created a backflow to the pump station.

Large amounts of grease and floatables were found at the surface of the secondary clarifier. This scum was manually removed instead of being returned to the aeration tank. The operator mentioned that once every 5 years the plant has to be emptied out to clean out the accumulated grit from the tank bottoms. The accumulated grit decreases the actual plant capacity and can also plug the air injectors as well as damage the pumps.

The bioassay test on the final effluent indicated that the effluent was not toxic to rainbow trout underyearlings over a 96 hour exposure period.

2.3 Conclusions

1. The Tsulquate STP was being operated in an extended aeration mode with contact stabilization characteristics.

2. The final effluent met the WMB permit levels for BOD and NFR during the survey period.

3. Excessive groundwater infiltration into the collection system overloads the STP during wet weather.

4. The final effluent was non-toxic to rainbow trout at 100% concentration.

5. Grit and grease accumulate in the plant and create operating problems.

6. Sludge disposal through the outfall is not an acceptable practice at this location where there are extensive clam beds.

7. Back-up flow at the secondary clarifier outlet causes the clarifier weir to be submerged during daily peak flows.

2.4 Recommendations

1. Efforts to minimize groundwater infiltration into the collection system should be pursued.

2. Headworks should be installed to remove grit and grease which is presently accumulating in the plant.

3. To allow the plant to operate satisfactorily in the extended aeration mode, the needed extra volume could be provided by using the existing aerobic digester. This procedure would allow flow fluctuations to be handle more effectively and would produce lesser amounts of sludge.

4. A new sludge digester and sludge disposal system should be added to eliminate sludge disposal through the outfall.

5. The V-notch at the chlorine contact chamber outlet should be lowered to create a larger head difference. This would prevent the clarifier overflow weir being submerged at peak flows. The ultrasonic water level meter should also be lowered the same distance.

3 PORT HARDY AIRPORT STP (PE-4168)

3.1 Plant Description

The Airport STP normally operates in the extended aeration mode and this was the case during the survey period (Figure 3). The STP has been in operation since 1977. The sewage was coarse screened (1.25 inch or 3.2 cm spacings), aerated and clarified before being discharged to the Queen Charlotte Strait through a 0.3 m (12 inch) 550 m (1800 feet) long single port outfall to a 18 m (60 feet) depth. The sludge accumulated in the clarifier is returned to the aeration section close to the influent inlet. According to the Waste Management Branch (WMB) Permit PE-4168, sludge may be wasted through the outfall on an ebbing spring tide. On average, sludge is wasted down the outfall once a month during right tide conditions. There is no aerobic sludge digester compartment (as compared to the Tsulquate STP). An ultrasonic flowmeter installed on the V-notch after the final clarifier records the flow on 7-day 24-hour charts.

Besides serving the Port Hardy Airport, this STP services the Beaver Harbour Community, the Airport Inn and the Fort Rupert Indian Village (Figure 1). The Tacan Industrial Park has a holding tank which is pumped out to the STP on a periodic basis.

3.2 Discussion

The sampling points are shown on Figure 3. There was no sludge wastage through the outfall during the survey period.

Table 7 shows the analytical results. BOD levels in the final effluent were less than 5 mg/l indicating high biochemical degradation (95% reduction). NFR values for the final effluent ranged from 38 to 49 mg/l indicating poor settling (63% reduction). The D.O. in the aeration tank was elevated (5 to 9 mg/l) which can contribute to poor settling and energy wastage (Table 9).

Significant nitrification reduced the ammonia level by 82%. The pH values dropped drastically from 7.2 in the influent to 3.7 in the effluent. The STP's pH meter indicated values ranging from 6.2 to 6.4 and differ from EP values. The alkalinity dropped dramatically from 125 to less than

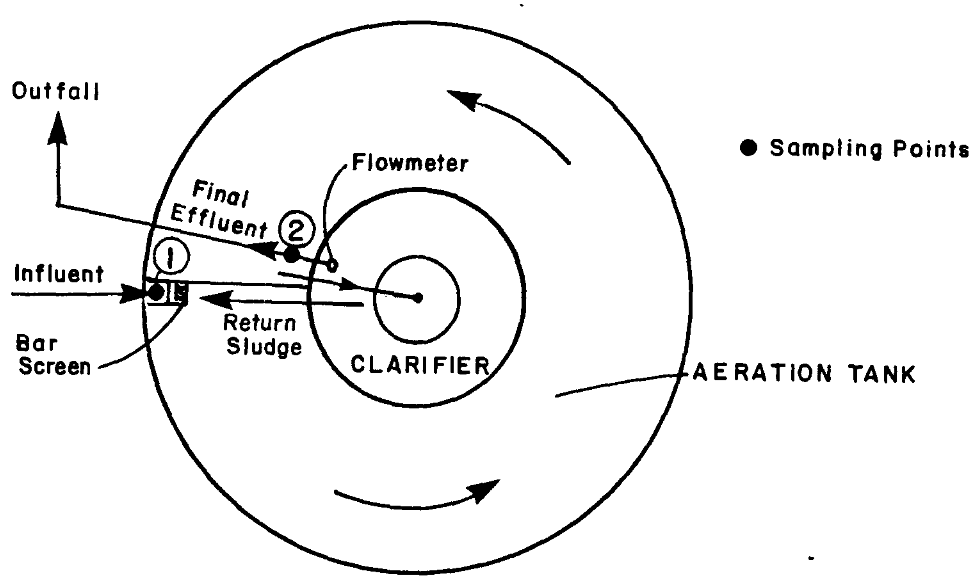

FIGURE 3 AIRPORT STP FLOW DIAGRAM

TABLE 7 AIRPORT STP ANALYTICAL RESULTS

PARAMETERS	DATE AND SAMPLE POINT											
	JUNE 10-11		JUNE 11-12		JUNE 12-13		JUNE 13-14		JUNE 14-15		AVERAGE	
	1	2	1	2	1	2	1	2	1	2	1	2
BOD	96	5	99	5	38	< 2	94	3	77	4	81	4
COD	416	65	362	65	312	80	386	85	283	60	352	56
TOC	99	21	73	20	72	20	104	24	63	18	82	21
NFR	111	48	105	38	120	38	98	47	157	49	118	44
FNFR	23.8	< 47.7	27.8	< 38.2	32	32.5	33.8	< 46.7	80.5	< 48.7	39.6	-
VNFR	87	< 5	78	< 5	88	6	65	< 5	77	< 5	79	5
TR	305	208	328	204	298	199	287	206	247	200	293	203
TVR	176	100	203	76	186	87	173	91	156	80	179	87
Ammonia (N)	18	3.9	19	4.1	17	3.04	16	2.52	15	2	17	3.1
Nitrite (N)	< 0.005	< 0.005	< 0.05	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Nitrate (N)	< 0.005	19.2	0.014	20.5	< 0.005	19.6	< 0.005	19.0	0.021	18.9	0.01	19.4
Total PO_4 (P)	6.1	5.08	5.6	5.44	5.97	5.12	5.43	5.15	3.8	4.8	5.4	5.1
Oil & Grease	73.9	0.38	90.3	0.69	91.9	0.50	-	-	-	-	85.4	0.52
Surfactants	10.0	0.175	8.90	0.128	10.3	0.145	10.1	0.143	7.43	0.182	9.3	0.155
pH	7.2	3.7	7.1	3.7	7.3	3.8	7.2	3.7	7.2	3.8	7.2	3.7
Conductivity	440	390	415	410	415	400	390	390	360	380	404	394
Alkalinity	133	< .5	125	< .5	126	< .5	123	< .5	120	< .5	125	< .5

All units are in mg/l except for pH (rel. units) and conductivity (umho/cm)
All samples are 24 hour composites
(1) = Influent
(2) = Effluent

0.5 mg/l (detection limit). Nitrification produces acidic conditions which which are counterbalanced by a depletion of alkalinity in the wastewater. Equations 1 and 2 show how nitrification favors acidic conditions (H^+ production resulting in low pH) and Equation 3 shows how the ammonia (NH_4^+) combines with the bicarbonate ion (HCO_3), instead of HCO_3^- combining with H^+ (Equation 4), to buffer pH changes (7).

Equation 1: $15CO_2 + 13NH_4^+ \longrightarrow 10NO_2^- + 3C_5H_7NO_2 + 23H^+ + 4H_2O$
Nitrosomonas

Equation 2: $5CO_2 + NH_4^+ + 10NO_2^- \longrightarrow 10NO_3^- + C_5H_7NO_2 + H^+$
Nitrobacter

Equation 3: $NH_4^+ + 1.83O_2 + 1.98HCO_3^- \longrightarrow 0.021C_5H_7NO_2 + 1.041H_2O + 0.98NO_3^- + 1.88H_2CO_3$

Equation 4: $HCO_3^- + H^+ \longrightarrow H_2CO_3$

Theoretically, approximately 7 mg/l of alkalinity as $CaCO_3$ is destroyed per milligram of ammonia oxidized (6). The average ammonia reduction being 14 mg/l during the survey, a 98 mg/l alkalinity would have been needed to buffer pH changes. The results show that the 125 mg/l alkalinity was not able to buffer the pH since the alkalinity was completely used up and pH dropped to 3.9. Sludge digestion could be releasing extra load of ammonia and decreasing the alkalinity more than anticipated.

Table 8 shows the Airport STP characteristics. The detention time was longer than typical values for extended aeration activated sludge indicating the plant is underloaded. The mixed liquor suspended solids met recommended values. The F/M ratio and volumetric loading were well below design values mainly because of the large size of the aeration tank compared to the flow.

The clarifier also exceeded all the typical design values due to its large size compared with the flow through the plant at the time of the survey. The flows varied from 420 to 440 cu·m/d (92,000 to 97,000 Imp·gpd) throughout the survey during which dry weather predominated (Table 13).

TABLE 8 AIRPORT STP CHARACTERISTICS

Population Served: approx. 1200
Average Flow: 440 m^3/day

		TYPICAL VALUES (1) FOR EXTENDED AERATION
Aeration Section		
Volume (m^3)	926	
Depth (m)	4.4	
Detention Time (hr)		
- avg. flow	50.5	18-36
MLSS (mg/l)	3990-3790-3950	3000-6000
MLVSS (mg/l)	3320-3180-3300	
F/M (kg BOD_5/kg MLSS·day)	0.013-0.017-0.011	0.05-0.15
Volumetric Loading (kg BOD_5/m^3·day)	0.044-0.053-0.036	0.16-0.40
		TYPICAL VALUES (2)
Clarification Section		
Volume (m^3)	334	
Depth (m)	3.7	
Radius (m)	5.0	
Circumference (m)	31.0	
Area (m^2)	79.6	
Detention Time (hr)		
- avg. flow	18.2	2-3
Hydraulic Loading ($m^3/d/m^2$)	5.5	12-41
Weir Loading (m^3/m·d)	14.2	max. 125-250

Tables 9 and 10 show the activated sludge and the return sludge characteristics are in the typical range for residues.

TABLE 9 AIRPORT STP ACTIVATED SLUDGE CHARACTERISTICS (AERATION TANK)

	JUNE 11	JUNE 12	JUNE 13	AVERAGE
NFR	3990	3790	3950	3910
VNFR	3320	3180	3300	3267
FNFR	672	612	656	647
D.O.	9.5	--	5.5*	7.5

All units are in mg/l
* after oxygen input adjustment on June 12

TABLE 10 AIRPORT STP RETURN SLUDGE CHARACTERISTICS

	JUNE 11	JUNE 12	JUNE 13
NFR	6400	25800*	7900
VNFR	5370	21500*	6320
FNFR	1030	4260*	1580

All units are in mg/l
* these values are not representative of the return sludge characteristics

Fecal coliform reductions were in the order of 100 which is an expected value for this type of treatment (Table 11).

Table 12 shows that the Airport STP complied with the Waste Management Branch Permit for BOD, NFR and flows during the time of the survey. However, these values do not account for sludge wastage through the outfall on regular basis.

The bioassay test indicates that the final effluent was toxic to rainbow trout underyearlings at a concentration of 46.1%. The toxicity seems to orginate from the low pH value of 3.9 which was explained previously.

The clarifier's overflow weir is corroded allowing the effluent to flow through instead of over the weir.

TABLE 11 FECAL COLIFORM LEVELS

DATE	INFLUENT (Fecal col./100 ml)	EFFLUENT (Fecal col./100 ml)
June 10	8×10^6	-
June 11	4×10^6	2×10^4
June 12	4.8×10^7	8.6×10^5
June 13	7×10^6	1.6×10^6
Average	1.7×10^7	8.3×10^5

* using Membrane Filtration method

TABLE 12 AIRPORT STP COMPLIANCE WITH WMB PE-4168

Permit PE-4168: Maximum BOD = 45 mg/l
Maximum NFR = 60 mg/l
Maximum Flow = 1250 m^3/d

	NUMBER OF SAMPLES	PERCENT OF COMPLIANCE
BOD	5	100
NFR	5	100
Flow	5	100

TABLE 13 RAINFALL AT PORT HARDY

DATE	RAINFALL (mm)	DATE	RAINFALL (mm)	
June 1	0	June 9	1.2	survey period (June 9 – June 14)
June 2	0	June 10	5.7	
June 3	0	June 11	0	
June 4	0.2	June 12	0	
June 5	2.8	June 13	0	
June 6	1.8	June 14	trace	
June 7	3.0	June 15	14.4	
June 8	0			

Reference: Atmospheric Environment Service, Environment Canada

3.3 Conclusions

1. The Airport STP is underloaded.

2. The final effluent met the WMB permit levels for BOD, NFR and flow during the survey period.

3. The final effluent was toxic to fish at a 46% concentration because of low pH. Low pH values are caused by the long aeration time creating a reduction of ammonia. This ammonia reduction, not required at this STP, favors low pH values once the buffering or alkalinity is completely used up by the ammonia.

4. The D.O. values in the aeration tank are too high. This practice could impede sludge settling and represents an energy waste.

5. The clarifier's overflow weir is seriously corroded.

3.4 Recommendations

1. The dissolved oxygen level in the aeration tank should be reduced to a 1 to 3 mg/l level.

2. The clarifier's overflow weir should be fixed or replaced.

3. pH readings at different locations in the aeration tank and clarifier should be done to confirm the findings and determine pH variations pattern.

4. If low pH values persist, half the aeration tank should be used to decrease nitrification and keep pH over 6.0. A wall should be installed and piping changed to accomodate the modifications.

4 GLOSSARY

pH: The reciprocal of the logarithm of the hydrogen-ion concentration. The concentration is the weight of hydrogen ions, in grams, per liter of solution. Neutral water, for example, has a pH value of 7 and a hydrogen-ion concentration of 10^{-7}.

Alkalinity: The capacity of water to neutralize acids, a property imparted by the water's content of carbonates, bicarbonates, hydroxydes, and occasionally borates, silicates, and phosphates. It is expressed in milligrams per liter of equivalent calcium carbonate.

REFERENCES

1. Water Pollution Control Federation, 1977. MOP/8 Wastewater Treatment Plant Design. Lancaster Press, Lancaster, Pa.

2. Jank, B.E., 1979. Overview to Biological Treatment. Wastewater Technology Centre, Burlington, Ontario.

3. Associated Engineering Services, 1983. Tsulquate Wastewater Treatment Plant Review, District of Port Hardy.

4. Kay and Ferguson, 1979. Shellfish Growing Water Sanitary Survey of the Vancouver Island Coastline from Duval Point to False Head, Including Hardy Bay and Beaver Harbour, British Columbia, 1978. Environmental Protection Service, Regional Program Report 79-18.

5. Water Pollution Control Federation, 1976. MOP/11 Operation of Wastewater Treatment Plants. Lancaster Press, Lancaster, Pa.

6. U.S. Environmental Protection Agency, 1975. Process Design Manual for Nitrogen Control. EPA.

7. Sawyer, C.N. and P.L. McCarty, 1978. Chemistry for Environmental Engineering. McGraw-Hill Book Company, Third Edition, USA.

8. APHA, ASCE, AWWA, WPCF, 1969. Glossary. Water and Wastewater Control Engineering.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the precious assistance of the following persons:

Mr. Dennis Dugas, lead hand for the District of Port Hardy, for his assistance during the field work and for the review of the report;

Mr. Bruce Ram, STP Operator, and Bob Crookall, Foreman for the District of Port Hardy, for their help in gathering needed information;

Mr. Dunc MacLaren, Technician for the Waste Management Branch in Nanaimo, for useful past information and review of the report;

Mr. Gil Bradshaw, Senior Technician with EP, for his valuable assistance in the collection, preparation, handling and testing of the samples; and,

Mr. Tom Tevendale, Head Municipal Section with EP, for reviewing and commenting on this report.