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MEMORANDUM
March 25, 1986

To: Darrel Anderson, Southwest Regional Office

From: Dale Clark DKC

Subject: Seashore Villa Wastewater Treatment Plant Limited Class II Inspection, July 1-2, 1985

ABSTRACT

On July 1 and 2, 1985, the Water Quality Investigations Section conducted a limited Class II inspection at the Seashore Villa wastewater treatment plant (WTP). During the inspection, the effluent biochemical oxygen demand (BOD_5) and total suspended solids (TSS) exceeded the National Pollutant Discharge Elimination System (NPDES) permit limits. Wastewater was observed to surge through the plant, resulting in solids loss and low mixed liquor suspended solids (MLSS) in the aeration basin. Chlorinated effluent was being recycled through the secondary clarifier. Overall, the facility did not appear to meet the NPDES permit requirements.

INTRODUCTION

A limited Class II inspection was done at the Seashore Villa WTP on July 1 and 2, 1985, at the request of the Ecology Southwest Regional Office (SWRO). The study objectives were to:

1. Describe plant operation and flow scheme.

2. Document plant loading and treatment efficiency.

3. Compare inspection data with the effluent limitations given in NPDES permit number WA-003806-7.

Limited Class II inspections are not designed to provide in-depth plant evaluations concerned with design and process control.

A receiving water study conducted along with this Class II inspection is documented in another report (Kendra and Determan, 1985).

This study was conducted by Dale Clark while the SWRO was represented by Darrel Anderson. The plant operator was not present during the inspection.

Memo to Darrel Anderson
Seashore Villa Wastewater Treatment Plant Limited Class II Inspection,
July 1-2, 1985

SETTING

The treatment plant is located on the west shore of the Johnson Point Peninsula about five miles north of Olympia (Figure 1). It serves the Seashore Villa mobile home park (population approximately 174) and a Department of Natural Resources (DNR) research laboratory located just south of the WTP.

The WTP is a package plant consisting of an aeration basin, secondary clarifier, two chlorine contact chambers, and a sludge storage tank (Figure 2). It is covered and fenced on all sides to prevent entry. Secondary treatment occurs using the extended aeration process. Clarifier solids are returned to the aeration basin or wasted to the sludge storage tank for holding and eventual pickup by a tank truck. Effluent is disinfected in the first chlorine contact chamber, flows into the second chamber to provide additional contact time, then discharged to Budd Inlet through a 275-yard-long, 3-inch line.

METHODS

Samples collected during the inspection given in Table 1. Sampling locations are shown in Figure 2.

The 24-hour composite samples were collected using Manning^{R} automatic composite samplers set to collect 250 mL every 30 minutes. Samples were placed on ice and shipped to the Ecology environmental laboratory at Manchester, Washington. Sample holding times and analytical methods approved by the U.S. Environmental Protection Agency (USEPA, 1982) or found in Standard Methods (APHA,AWWA, WPCF, 1985) were followed during the inspection.

Physical dimensions of the in-plant unit processes were measured to determine volume and calculate plant capacity. Sludge depth was measured with a "Sludge Judge"^{R} depth indicator. Flow measurement was attempted using a Manning^{R} dipper; however, the small size of the discharge line prevented accurate measurement. Flow was therefore estimated based on water-use records from the community well. The mean well flow was approximately 11,000 gallons per day (gpd), which is lower than expected for a community of this size. Five hundred gpd was added to the well flow to account for wastewater contribution from the DNR facility. Thus, the plant flow was estimated to be 11,500 gpd.

RESULTS AND DISCUSSION

Table 2 presents the analytical results and sludge depth measurements. The plant did not appear to be effectively treating the wastewaters. Table 3 confirms this observation by comparing expected removal rates to the removal rates observed during the inspection (Meta Systems, 1973). The observed removals were far less than the expected rates.

Table 3. Removal efficiencies, Seashore Villa STP, July 1-2, 1985.

Parameter	Expected[1/] Removal Rate (percent)	Observed Removal Rate (percent)
BOD	80	56
TSS	85	5
COD	80	36
Total Phosphorus	25	+15
Total Inorganic Nitrogen	35	+6

[1/] Meta Systems, 1973.

Table 4 compares inspection results with NPDES permit limits. Effluent BOD and TSS concentrations (mg/L) and loadings (lbs/day) exceeded permit limits. Fecal coliform (FC) concentration and pH were within acceptable ranges.

Table 5 includes physical measurements of the process units and compares the measurements with Ecology (1980) design criteria. The facility appears to have adequate physical capacity to handle the incoming waste load. The low MLSS concentration (800 - 1,000 mg/L) and high F:M ratio (0.16 - 0.19 lb BOD_5/D/lb MLSS) suggest that an increased MLSS concentration may be necessary to improve treatment.

During the survey, the following operational problems were observed:

1. A three-inch return line from chlorine contact chamber #1 was recycling chlorinated effluent to the secondary clarifier.

2. High effluent solids concentrations were resulting from solids washout of the secondary clarifier.

Prior to the inspection, a return line from the chlorine contact chamber #1 was left open, allowing chlorinated effluent to recycle into the secondary clarifier and eventually back to the aeration basin via the RAS line. The clarifier was tested for total residual chlorine. During aeration, 0.15 mg/L was detected, while none was detected when the aerators were off. The return may have had a negative impact on the plant's biological population. It is recommended that recycle of chlorinated effluent be prevented.

The high effluent solids concentration appeared to be related to operating characteristics of the aeration system. The aerator operated on a 45-minutes-on, 15-minutes-off cycle, with the RAS pumps operating during the "on" portion of the cycle. During the "on" cycle, mixed liquor in the aeration basin rose by approximately four inches. When the aerators stopped, the excess water in the basin (estimated at 670 gallons) surged into the secondary clarifier. Effluent grab samples taken during periods of surging had TSS values of 340

and 250 (mg/L)--well above NPDES permit limits and greater than the effluent composite concentration of 200 mg/L. This flushing action could cause the low MLSS concentration and poor treatment efficiency noted earlier in the report. It is recommended that the surging problem be corrected. A follow-up inspection (walk-through) performed on January 15, 1986, showed the surging and solids loss problems still existed.

Sludge deposits in the secondary clarifier and the chlorine contact chamber were minimal, probably due to the surging and solids loss already described (Table 5). Solids wasting at the facility occurs on an infrequent and irregular basis. This is expected in situations where washout problems routinely occur.

With available measuring equipment, accurate flow determination was not possible during the inspection. In addition, no reliable method exists for determining the DNR laboratory contribution. It is recommended that a method to measure DNR and treatment plant flows be devised and instituted.

Laboratory Review

It was not possible to split samples because the operator was absent. WTP laboratory analyses for BOD_5 are contracted to the Lacey-Olympia-Thurston County treatment facility (LOTT) laboratory; fecal coliform analyses are contracted to the Thurston County Health Department.

Refer to the Tamoshan Class II inspection (1986) for comparison of the laboratories.

RECOMMENDATIONS AND CONCLUSIONS

1. Correct surging in the aeration basin. The surging has resulted in a solids washout problem. The problem is probably a key factor contributing to low MLSS in the aeration basin and effluent exceeding the NPDES permit limit for BOD_5 and total suspended solids.

2. Discontinue the chlorinated effluent recycle from chlorine contact basin (#1) to the secondary clarifier.

3. Increase solids concentration (MLSS) in the aeration basin to improve biological treatment and reduce effluent BOD_5.

4. Measure flows in the WTP effluent line and the DNR influent line.

DC:cp

Attachments

LITERATURE CITED

APHA, AWWA, WPCF, 1985. Standard Methods for the Examination of Water and Wastewater, 16th Ed., APHA, Washington, D.C. 1268 pp.

Ecology, 1980. Criteria for Sewage Works Design. Ecology Repot DOE-78-5. February 1980 (revised October 1985). 357 pp.

Kendra, W. and T.A. Determan, 1985. Effects of Three Small Treatment Plants on Budd Inlet Receiving Waters. Ecology memorandum of November 6, 1985, to Tom Eaton, Olympia, WA. 22 pp.

Meta Systems, Inc., 1973. Effluent Changes. Prepared for the U.S. Environmental Protection Agency, Contract No. 68-01-0566.

U.S.EPA, 1982. Methods for Chemical Analysis of Water and Wastes. Environmental Monitoring and Support Laboratory, Cincinnati, OH. 298 pp.

Table 1. Sampling schedule for Class II facility inspection performed at Seashore Villa wastewater treatment plant, July 1-2, 1985. All values in mg/L unless otherwise noted.

			Field Analyses						Laboratory Analyses											
	Date	Time	pH (S.U.)	Spec. Cond. (umhos/cm)	Temp (°C)	Dissolved Oxygen	Sludge Depth (ft)	Residual Chlorine	pH (S.U.)	Spec. Cond. (umhos/cm)	COD	BOD_5	Soluble BOD_5	Nutrients (5)	Solids (4)	MLSS	Turbidity (NTU)	Alkalirity	Oil & Grease	Fecal Coliform (#/100 mL)
Grab Samples																				
Influent	7/01	1350	X	X	X															
	7/01	1450	X	X	X															
	7/02	1000	X	X	X															
	7/02	1155	X	X	X															
	7/02	1400	X	X	X														X	
Aeration Basin	7/01	1345				X														
	7/02	1120				X	X									X				
Clarifier	7/02	1130					X													
Chlorine Contact Chamber #1	7/02	1150					X													
Chlorine Contact Chamber #2	7/02	1150					X													
Effluent	7/01	1315	X	X	X	X		X												
	7/01	1400	X	X	X	X		X												
	7/01	1455	X	X	X	X		X												
	7/02	0945	X	X	X	X		X												
	7/02	1148	X	X	X	X		X												
	7/02	1405	X	X	X	X		X											X	X
Composite Samples																				
Influent	7/01	1310																		
	7/02	1100	X	X	X				X	X	X	X	X	X	X		X	X		
Effluent	7/01	1250																		
	7/02	1110	X	X	X				X	X	X	X	X	X	X		X	X		

Table 2. Analytical results, Ecology Class II facility inspection performed at Seashore Villa WTP, July 1-2, 1985.
All values in mg/L unless otherwise noted.

			Field Analyses						Laboratory Analyses																	
														Nutrients (5)					Solids (4)							
	Date	Time	pH (S.U.)	Spec. Cond. (umhos/cm)	Temp. (°C)	D.O.	Resid. Chl.	Sludge Depth (ft)	pH (S.U.)	Spec. Cond. (umhos/cm)	COD	BOD_5	Soluble BOD_5	NO_3-N	NO_2-N	NH_3-N	O-PO_4-P	T-PO_4-P	Total Solids	TNVS	TSS	TNVSS	MLSS	Turb. (NTU)	Alk. as $CaCO_3$	Resid. Oil & Grease	Fecal Coli. (col/100 mL)
Grab Samples																										
Influent	7/01	1350	6.7	580	18.2																					
	7/01	1450	7.0	540	18.2																					
	7/02	1000	7.0	560	17.9																					
	7/02	1155	7.3	750	17.5																					
	7/02	1400	7.2	435	18.0																				140	
Aeration Basin	7/01	1345				0.0																				
	7/02	1120				0.1		1.1														170,180	1,000; 800				
Secondary Clarifier	7/03	1300						2.0																		
Chlorine Contact Chamber(s) #1, #2	7/03	1300						1.0,1.3																		
Effluent	7/01	1315	6.7	580	18.2	1.2	3.5																			
	7/01	1400	6.8	575	18.2	1.1	2.7																			
	7/01	1455	6.7	575	18.2	0.6	2.5																			
	7/02	0945	6.9	540	17.9	0.3	1.2																			
	7/02	1148	6.6	890	18.3	1.2	1.3																			
	7/02	1405	6.7	585	18.4	1.1	2.7																		<1	100, 80
Composite Samples																										
Influent	7/01	1310																								
	7/02	1100[1]	8.3	520	3.0				6.5	751	450	270	120	0.2	<0.1	11.3	6.3	9.7	640	300	210	36		57	55		
Effluent	7/01	1250																								
	7/02	1110[1]	6.9	570	3.7				6.7	572	290	120	40	8.2	<0.1	4.0	10.1	11.2	610	360	200	47		120	150		

1/Composite sample container was full at time of sampling termination.

Table 4. Seashore Villa WTP loadings and comparison with NPDES permit limits. All mg/L unless otherwise noted.

Sample Type	Concentration	Flow (MGD)	lbs/day	Percent Removal	NPDES Effluent Limitations					
					Monthly Average			Weekly Average		
					mg/L	lbs/day	col/100 mL	mg/L	lbs/day	col/100 mL
Influent BOD5	270	0.0115	25.9							
Effluent BOD5	/120/	0.0115	/11.5/	56	30	3.8		45	5.6	
Influent TSS	210	0.0115	20.2							
Effluent TSS	/200/	0.0115	/19.2/	4.6	30	3.8		45	5.6	
Effluent FC	100 80						200 200			400 400
Effluent pH	6.6 - 6.9				shall not be outside the range of 6.0 - 9.0					

/ / = Exceeds NPDES permit limit, either monthly, weekly, or both.

Table 5. Comparison of inspection measurements to Ecology design criteria (1980) - Seashore Villa, July 1985.

		BOD_5		TSS	
Influent	Flow (MGD)	mg/L	lbs/day	mg/L	lbs/day
Inspection Measurements	0.0115	270	25.9	210	20.2

Aeration Basin

	Process Modification	Flow Regime	Mixed-Liquor Suspended Solids (mg/L)	F:M (lbs BOD_5/D/lb MLSS)	Detention Time (hr)	Aerator Loading (lb BOD/1000 ft^3 of Tank Volume)	Tank Size: Length (ft.)	Width (ft.)	Depth[2] (ft.)	Volume (gal.)
Inspection Measurements	extended aeration	complete mix	800, 1000	0.16 - 0.19	35.8	11.3	25	10.8	8.5	17,170
Ecology Criteria[3]			2,000-6,000	0.12[1]	10-24	10-25				

Secondary Clarifier

	Surface Overflow Rate: Average Flow (gpd/ft^2)	Peak Flow[5] (gpd/ft^2)	Solids Loading Rate[4]: Average Flow ($lbs/day/ft^2$)	Peak Flow[5] ($lbs/day/ft^2$)	Tank Size: Length (ft.)	Width (ft.)	Depth[2] (ft.)	Surface Area (ft^2)	Volume (gal.)
Inspection Measurements	177	532	1.3	4.0	10.8	6	8.5	64.8	4,120
Ecology Criteria[3]	200-400	800	25	40					

Chlorine Contact Chambers

Inspection Measurements	Detention Time (minutes): Flow (Minimum)	Peak Flow[5]	Tank size: Diameter (ft.)	Depth[2] (ft.)	Volume (gal.)
Chamber #1	60	20	3.2	8	480
Chamber #2	60	20	3.2	8	480
Total of #1 and #2	120	40			960
Ecology Criteria[3]	60	20			

[1] Criteria for F:M are 0.05 - 0.15 lb BOD_5/D/lb MLVSS. Assumption of 80% volatile solids in MLSS was made to convert criteria to 0.04 - 0.12 lb BOD_5/D/lb MLSS.

[2] Depth is depth of water and solids in tank.

[3] Ecology criteria are a general guideline of operation (Ecology, 1980).

[4] Assume 100% recycle to aeration basin.

[5] Estimated based on three times flow determined during inspection.

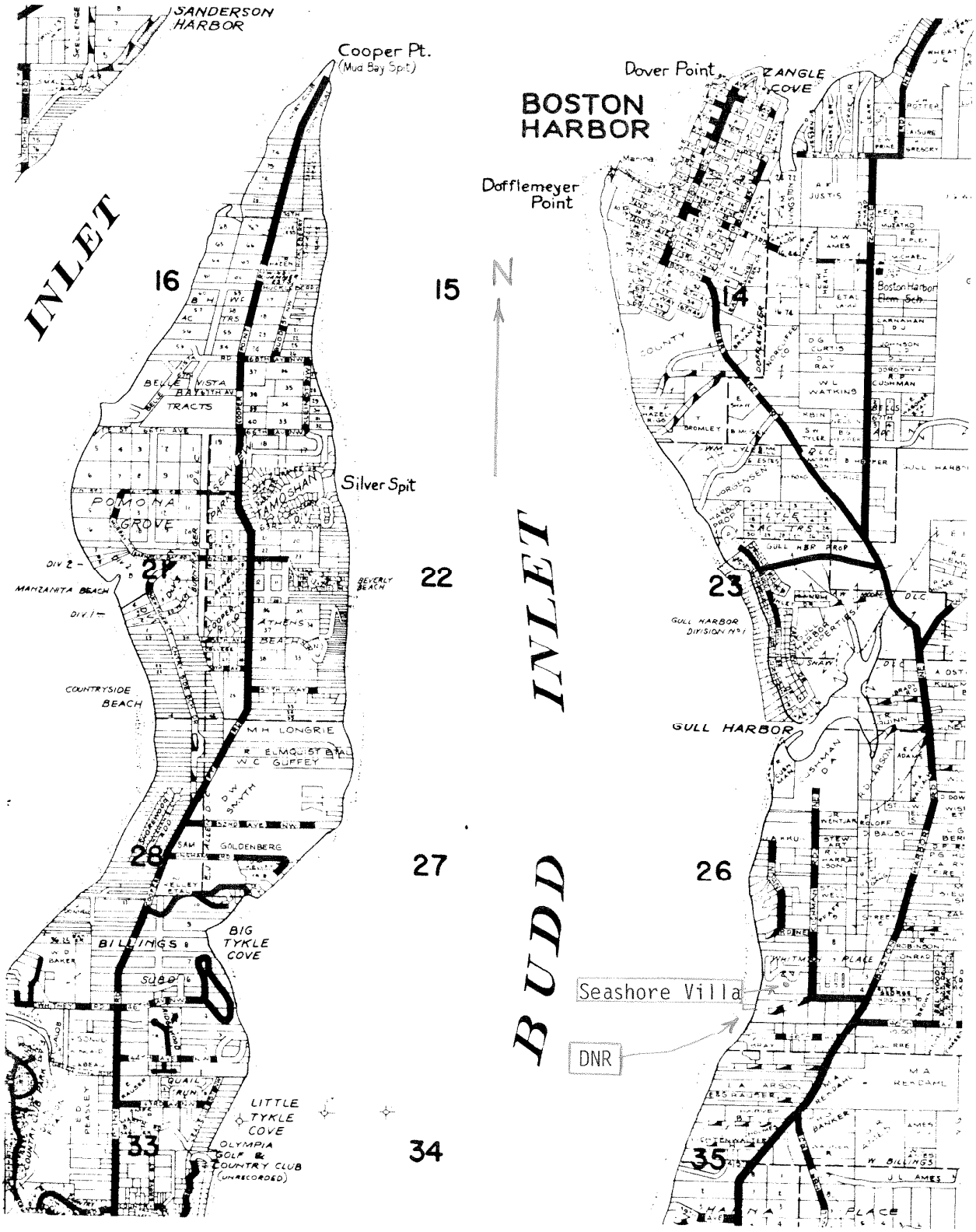

Figure 1. Locations of Seashore Villa WTP and Department of Natural Resources Laboratory, 1985.

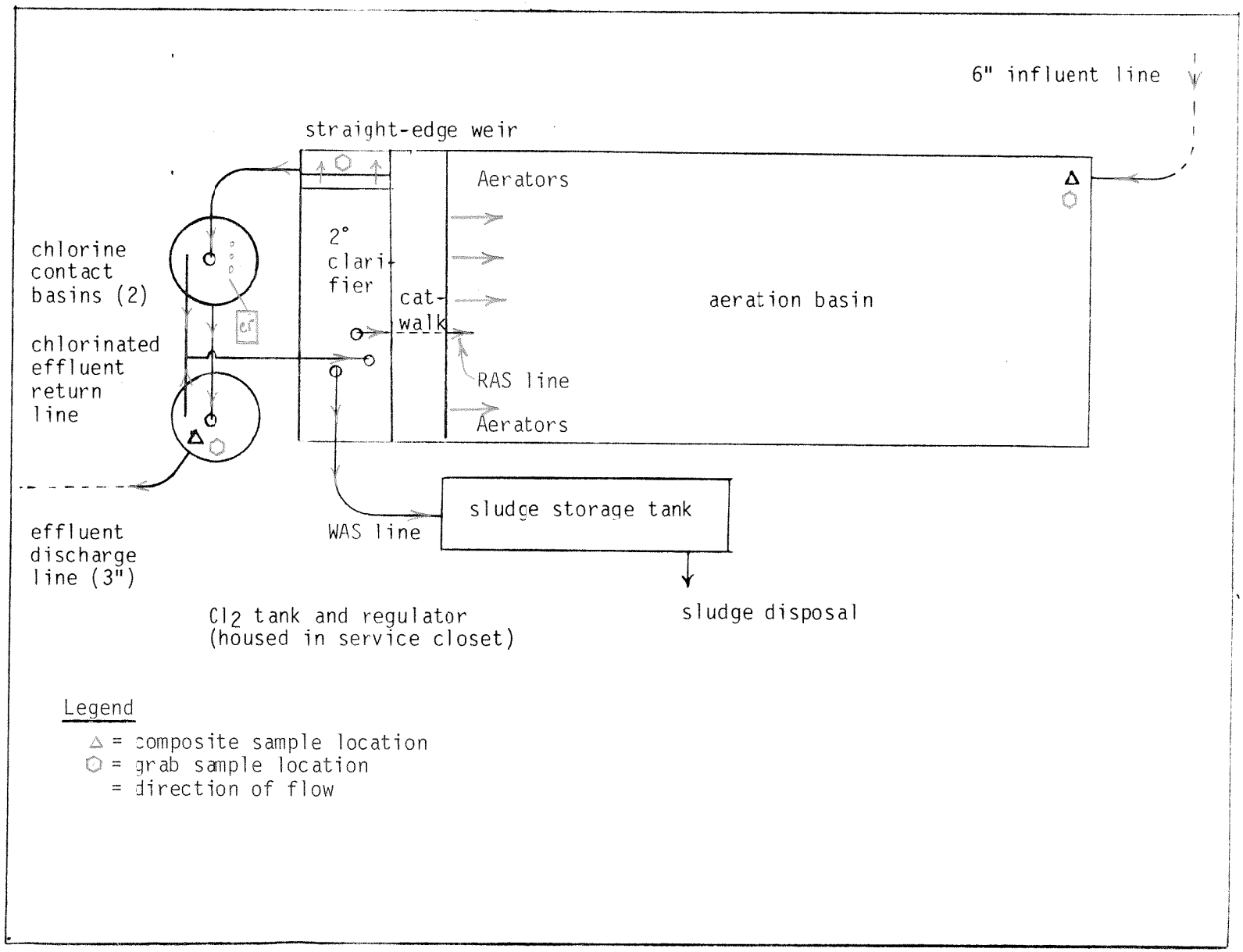

Figure 2. Flow scheme and sampling locations - Seashcre Villa, July 1985.