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TO: Jacques Faigenblum

FROM: Lisa Zinner

SUBJECT: Port Orchard Wastewater Treatment Plant Class II Inspection, January 1989

ABSTRACT

Ecology conducted a Class II Inspection of Port Orchard's Wastewater Treatment Plant (WTP) on January 17 - 19, 1989. Effluent quality was good. The plant met all NPDES permit requirements at the time of inspection. Several volatile organic contaminants were found in the influent and in the sludge. Bioassays using trout, Microtox, and *Rhepoxynius abronius* did not indicate an effluent or sediment toxicity. Fifty percent mortality of *Daphnia magna* in 100 percent effluent was observed; however the low hardness of the sample may have caused the observed effect. The mercury concentration was slightly elevated in the At Outfall sediment. Port Orchard lab techniques and results were acceptable.

INTRODUCTION

A Class II Inspection was conducted at the City of Port Orchard's Wastewater Treatment Plant (WTP) on January 17 - 19, 1989. Pat Hallinan and Keith Seiders from the Washington State Department of Ecology (Ecology) Compliance Monitoring Section and Mike Dawda from the Ecology Northwest Regional Office conducted the inspection. Despina Strong from the Ecology Manchester Laboratory assisted during the laboratory review portion of the inspection. Doug Martin, Chief WTP Operator, and Mark Morgan, WTP Laboratory Analyst, provided assistance during the inspection.

The City of Port Orchard is located on Sinclair Inlet in Kitsap County (Figure 1). The WTP provides sewage treatment service to the City of Port Orchard and Kitsap County Sewer District No. 5. Wastewater tributary to the facility is primarily domestic sewage from residential and light commercial activities. The plant discharges to Sinclair Inlet (Class AA Marine Water) via a 36-inch diameter, 1,800-foot long outfall with a multi port diffuser, as regulated by NPDES permit No. WA-002034-6.

The WTP provides secondary treatment with a conventional activated sludge system designed to treat an average flow of 2.8 mgd. The WTP includes the following major components: two bar screens, two aerated grit chambers, three primary clarifiers, two aeration basins, two secondary clarifiers, and two chlorine contact chambers (Figure 2). Primary and secondary sludge is treated in a two stage anaerobic sludge digester. The digested sludge is dewatered on a belt filter press at the facility, then composted by a private firm.

The Port Orchard WTP, upgraded from primary treatment in 1985, had never had an enhanced Class II Inspection. Prior to the inspection, toluene had been detected in WTP influent and digested sludge samples. The objectives of the inspection were to:

- Assess WTP effluent compliance with NPDES permit limits.
- Analyze WTP performance by determining plant loading and treatment efficiency.
- Determine WTP effluent toxicity using Trout, Microtox and *Daphnia magna* bioassays.
- Identify possible chemical pollutants in WTP influent, effluent, and digested sludge samples with a priority pollutant scan.
- Assess the impact of the WTP discharge on the receiving water sediments with chemical analysis for priority pollutants and toxicity testing using *Rhepoxynius abronius* and Microtox bioassays.
- Review lab procedures at the WTP to determine conformance to standard techniques. Split samples with the permittee to determine the comparability of laboratory results.

PROCEDURES

Ecology 24-hour composite samples were collected at two locations: influent prior to grit removal and effluent from the effluent line (Figure 2). Approximately 330 mLs of sample were collected at 30-minute intervals using ISCO composite samplers fitted with teflon tubing and glass sampling bottles. The composite samplers were cleaned for priority pollutant sampling prior to the inspection (Table 1). Grab samples of influent, effluent, primary sludge, digested sludge, and dewatered sludge were also collected. Field transfer blanks were collected for both grab and composite samples (Table 1).

The sampling schedule and parameters analyzed are included in Table 2, as well as the sample splits for Ecology and WTP laboratory analysis. All samples were kept on ice and delivered to the Manchester Laboratory. A summary of analytical methods and references is given in Appendix A, as well as the laboratory conducting the analysis.

Three bottom sediment samples were collected in Sinclair Inlet (see Figure 3): immediately at the outfall ("At Outfall"), approximately 100 yards away from the outfall ("Near Outfall"), and at a spot about one mile northeast of the outfall ("Sediment Control"). Sediment samples were collected with a 0.1 meter square van Veen sampler following recommended Puget Sound protocols (Tetra Tech, 1986). Samples consisted of three to four individual grabs in which the top two centimeters of sediment from each grab was removed, then composited. The composites were thoroughly mixed and then divided for separate analyses, except for samples for the volatile organic analyses (VOA) which were taken directly from the van Veen sampler. The stainless steel tools used in the collection of the sediment samples were cleaned using the composite sampler cleaning procedure. Table 2 includes sampling times and parameters analyzed.

The WTP's Parshall flume was checked for correct dimensions, installation, and maintenance. Ecology instantaneous flow measurements were made and compared to the WTP's flowmeter.

RESULTS AND DISCUSSION

Flow

Average flow during the inspection (1.75 mgd) was well within 85 percent of design capacity of the facility (2.4 mgd). An instantaneous check of the effluent flowmeter showed it was correctly calibrated. However, the mid-to-upper portion of the flume throat was bowed about 0.5 inch to 1 inch. This deformity may cause flow measurements to be high at peak flows if the water level reaches the height of the bowed section of the flume.

General Chemistry and NPDES Permit Compliance

The WTP was performing well during the inspection. A summary of the general chemistry results is given in Table 3. The effluent met permit limits for BOD, TSS, and pH (see Table 4). Effluent BOD and TSS concentrations were less than 10 mg/L and removal efficiencies exceeded 90 percent. However, one of three fecal coliform grab samples (1,000 per 100 mL) exceeded the weekly average permit limit of 400 per 100 mL. The high fecal count may have been due to sample or laboratory contamination, considering the other two fecal grab sample results were both under 6 per 100 mL and chlorine residuals should have been adequate for disinfection (see Table 3).

The conventional parameters of BOD and TSS indicated a well-treated, high quality effluent (Table 3). In contrast, effluent ammonia concentration was high (36 mg/L as N in the 24-hour composite) and nitrate-nitrite was low (0.6-0.7 mg/L as N), indicating that the WTP was not nitrifying during the inspection. The Port Orchard WTP does not have an ammonia limit in their NPDES permit. The acute water quality criteria based on total ammonia in saltwater is approximately 75 mg/L NH_3 as N and the chronic criteria is approximately 12 mg/L NH_3 as N

(EPA, 1989a) at typical Sinclair Inlet conditions (pH = 7.1, salinity = 30 g/kg, T = 14°C) (EPA, 1988). The ammonia concentration in the receiving water after dilution should be less than the chronic criteria.

The WTP was operating well below design capacity. The influent plant loadings for BOD and TSS were found to be approximately 35 and 32 percent of design criteria levels, respectively (Table 4). Flow was 63 percent of design criteria.

Priority Pollutant Scans - Water

Several VOAs were detected in the influent, though none were detected in the effluent (Table 5). The inspection found toluene (30 μg/L) and acetone (23 μg/L) in the WTP influent. Other volatiles detected in the influent included chloromethane, chloroform, benzene, ethylbenzene, and total xylenes. All of these compounds have a wide range of uses. Toluene, acetone, ethylbenzene, xylenes, and chloromethane are used as solvents. Also, toluene, ethylbenzene, and xylenes are components of gasoline. The source of volatile organic contaminants in the WTP influent should be investigated. High concentrations of these contaminants pose the threat of toxic shock to the activated sludge system and can cause air contamination through volatilization.

Several semi-volatile compounds were detected in the WTP influent as well (Table 5). Of these, only bis(2-ethylhexyl)phthalate (BEHP) was detected in the effluent. This compound is a common contaminant, present in most plastic products. The concentration of BEHP detected in the effluent (7 μg/L - estimated) was slightly greater than the 10^{-6} risk factor human health criteria for water from which organisms are taken for consumption (5.9 μg/L) (EPA, 1986). BEHP was also detected in the method blank at 3 μg/L; therefore, its presence may be due to contamination originating in the laboratory. The insecticide Lindane (gamma BHC) was found in both the influent and the effluent, but the effluent concentration was much less than the acute marine water quality criteria.

Heavy metals detected in the water samples included arsenic, copper, lead, and zinc. The effluent copper concentration (5 μg/L) exceeded the acute and chronic marine water quality criteria (2.9 μg/L) (EPA, 1986). All other effluent metal concentrations were less than acute and chronic water quality criteria.

Cyanide was detected at 8 and 4 μg/L in the WTP influent and effluent, respectively. The effluent level was four times greater than both the acute and chronic criteria for cyanide in marine waters (1 μg/L) (EPA, 1986).

A complete listing of priority pollutant scan results is included in Appendix B.

Effluent Bioassays

No significant acute toxicity was indicated by trout or Microtox tests of dechlorinated effluent (Table 6). Fifty percent mortality of *Daphnia magna* in 100 percent effluent resulted in a No Observable Effects Concentration (NOEC) of 30 percent effluent and a Lowest Observable Effects Concentration (LOEC) of 100 percent effluent. The hardness of the sample (77 mg/L as $CaCO_3$) was somewhat lower than the hardness preferred by the test organism (160-180 mg/L as $CaCO_3$) and may have caused the observed effect (Stinson, 1989). *Daphnia pulex* should be substituted for *Daphnia magna* in future biological toxicity testing due to the low hardness of the wastewater. Total reproduction of the *Daphnia magna* was not significantly different from the control at any of the test concentrations.

Sludge Analyses

Port Orchard dewatered sludge metals concentrations were typical of municipal WTP sludge when compared to data from previous Class II Inspections (Table 7: Hallinan, 1988). Distribution and marketing limits are presented for consideration of possible use after composting. The annual whole sludge land application rate (5 metric tons per hectare), as determined by the procedure in Appendix B of the proposed Standards for the Disposal of Sewage Sludge (EPA, 1989b), is limited by the copper and zinc concentrations in the dewatered sludge. An annual application rate of 45 metric tons per hectare would have been allowable based on the concentrations of the other metals in the sludge. The actual allowable application rate would depend on the final composition of the composted sludge.

Toluene was found in the sludge: 270, 50, and 19 mg/kg dry weight in the primary, digested, and dewatered sludge samples, respectively (Table 8). Acetone was also found in the sludge samples: 32, 11, and 5.6 mg/kg dry weight in the primary, digested, and dewatered sludge, respectively. Other volatiles detected at lower concentrations in the sludge included: chloromethane, methylene chloride, carbon disulfide, 2-butanone, tetrachloroethane, chlorobenzene, ethylbenzene, and total xylenes. Semi-volatile organics detected in the dewatered sludge included two phthalates (bis(2-ethylhexyl) and di-n-octyl). BEHP, a common plasticizer, was the organic found in the highest concentration in the dewatered sludge (170 mg/kg-dry weight). No PCBs or pesticides were detected in the dewatered sludge. None of the organics detected in the sludge samples are listed by EPA (for marketing and distribution) in its draft sludge management guidelines (EPA, 1989b).

Complete results of the priority pollutant scans of primary, digested, and dewatered sludge samples are given in Appendix C.

Sediment Chemistry

Acetone was the only volatile organic compound detected in the three sediment samples: 15, 16, and 17 μg/kg dry weight estimated for the Sediment Control, At Outfall, and Near Outfall, respectively (Table 9). The Washington State Sediment Management Criteria (Ecology, 1990) does not include acetone.

Phenol was estimated at 430 μg/kg dry weight in the control sediment, which is slightly greater than the marine sediment management criteria of 420 μg/kg dry weight. The detection limit for accurate quantitation of phenol was greater than the criteria for all three sediment samples: 990, 1100, and 1300 μg/kg dry weight for the Sediment Control, At Outfall, and Near Outfall, respectively.

The detection limits for accurate quantification of several other semi-volatile compounds (BNAs) were greater than the criteria for the Sediment Control and the At Outfall samples due to the low TOC concentration of the samples. A low TOC concentration is expected for sediment samples with a high sand content (88.0 and 73.3% sand-dry basis for the Sediment Control and At Outfall samples, respectively).

BEHP in both the Sediment Control and At Outfall samples (65 and 71 mg/kg TOC-estimated, respectively) was greater than the sediment management criteria (47 mg/kg-TOC). This compound was also detected in the method blank; therefore, its presence may be due to contamination originating in the laboratory.

The mercury content of the sediment at the outfall (0.98 mg/kg dry weight) was more than two times greater than the marine management criteria (0.41 mg/kg dry weight). All other metal concentrations were much less than the sediment criteria. Mercury was not detected in the WTP effluent.

The Final Draft Sediment Management Standards (Ecology, 1990) would require two acute and one chronic bioassay at all three sediment sites due to pollutant concentrations or quantification limits exceeding criteria. The standards classify the 10-day Amphipod (*Rhepoxynius abronius*) and any one of four other tests (pacific oyster, blue mussel, purple sea urchin, or sand dollar) as acute bioassays. Benthic infaunal abundance, juvenile worm (polychaeta *Neanthes arenaceodentata*), and Microtox are considered chronic bioassays.

Complete sediment chemistry results are listed in Appendix C.

Sediment Bioassays

Sediment bioassays were performed using the Microtox test and the 10-day Amphipod (*Rhepoxynius abronius*) test (Table 10). The Microtox analysis indicated low toxicity in all three sediment samples. Although the calculated EC_{50} data generated by the analysis for the At Outfall and Near Outfall samples appeared to indicate some toxicity, there was actually little decrease in light output noted in the analysis. This is a common occurrence in Microtox analyses when the method is used on samples of low toxicity. Therefore, these EC_{50} values are not an accurate indication of toxicity of the sediment samples. No significant differences in survival, avoidance, or reburial between the samples and laboratory control were noted in the 10-day Amphipod test.

Laboratory Review

Analytical agreement of split samples was acceptable except for the Inf-Eco TSS sample results (Table 11). The difference between Ecology's values and Port Orchard's values ranged from 1.5 percent (Inf-Eco, BOD) to as much as 43 percent (Inf-Eco, TSS). The agreement between compositors was very good for both the influent and effluent.

A review of Port Orchard's laboratory procedures did not indicate procedural problems. The only exceptions noted in the survey were that the compositor temperature during collection needed to be checked more frequently. Also, the survey indicated that an in-plant return line was located upstream of the influent sampling location. A sample point upstream may be more appropriate. The Laboratory Procedure Review Sheet is included in Appendix D.

RECOMMENDATIONS AND CONCLUSIONS

General Chemistry and NPDES Permit Compliance

Port Orchard's Wastewater Treatment Plant was performing satisfactorily during the Class II Inspection. All permit parameters were well within the NPDES permitted limits. Effluent ammonia levels indicated nitrification was not occurring at the plant during the inspection.

Priority Pollutant Scans - Water

Several volatile organic contaminants were found in the WTP influent, notably the solvents toluene and acetone. The source of volatile organic contaminants in the WTP influent should be investigated. High concentrations of these contaminants pose a threat of toxic shock to the activated sludge system and can cause air contamination through volatilization. None of the volatiles were detected in the effluent. BEHP, a common plasticizer, and the pesticide, Lindane, were detected in the effluent. Of the metals detected in the effluent (copper, lead, and zinc), only copper was found at a concentration greater than the EPA acute and chronic water quality criteria. Effluent cyanide concentration also exceeded both the acute and chronic criteria.

Effluent Bioassays

No effluent toxicity was indicated by the trout or Microtox bioassays. Fifty percent mortality of *Daphnia magna* in 100 percent effluent resulted in a NOEC of 30 percent effluent and a LOEC of 100 percent effluent; however, the hardness of the sample was somewhat lower than the hardness preferred by the test organism and may have caused the observed effect. *Daphnia* *pulex* should be substituted for *Daphnia magna* in future biological toxicity testing due to the low hardness of the wastewater.

Sludge Analyses

The metals detected in the dewatered sludge were found in concentrations typical of municipal activated sludge plant sludges. Toluene and acetone were detected in the dewatered sludge, as well as low levels of other volatiles and semi-volatile organics. BEHP was found in the highest concentration in the dewatered sludge. No PCBs or pesticides were detected.

Sediment Chemistry

Sediment monitoring results showed that the sediments at and near the outfall were relatively clean. Several high molecular weight polynuclear aromatics (HPAHs) were detected at low levels in the sediments. Mercury was found at a concentration greater than the Ecology draft management criteria at the outfall. Due to the elevated level of mercury found in the At Outfall sediment, two acute and one chronic bioassay would be required by the Final Draft Sediment Management Standards (Ecology, 1990).

Sediment Bioassays

Sediment biomonitoring showed little toxicity using Microtox and *Rhepoxynius abronius*.

Laboratory Review

In general, the sample splits compared well and the Port Orchard WTP laboratory review found few procedural problems. The influent sample should be collected upstream of any plant return lines.

REFERENCES

Ecology, 1990. Final Draft Sediment Management Standards. Chapter 173-204 WAC. Washington Department of Ecology, September 1990.

EPA, 1986. Quality Criteria for Water - 1986. EPA 440/5-86-001, 1986. Revised December, 1989.

EPA, 1988. Characterization of Spatial and Temporal Trends in Water Quality in Puget Sound. EPA 503/3-88-003, July 1988.

EPA, 1989a. Ambient Water Quality Criteria for Ammonia (Saltwater) - 1989. EPA 440/5-88-004, 1989.

EPA, 1989b. Standards for the Disposal of Sewage Sludge; Proposed Rule. 40 CFR Parts 257 and 503. February 1989.

Hallinan, P., 1988. Metal Concentrations Found During Ecology Inspections of Municipal Wastewater Treatment Plants. Ecology memorandum to John Bernhardt: April 11, 1988.

Stinson, M., 1989. Port Orchard Class II Inspection Results of *Daphnia magna* Bioassay. Memorandum to P. Hallinan, Washington State Department of Ecology, EILS, July 5, 1989.

Tetra Tech, 1986. Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound. Final Report #TC-3991-04; March 1986.

FIGURES

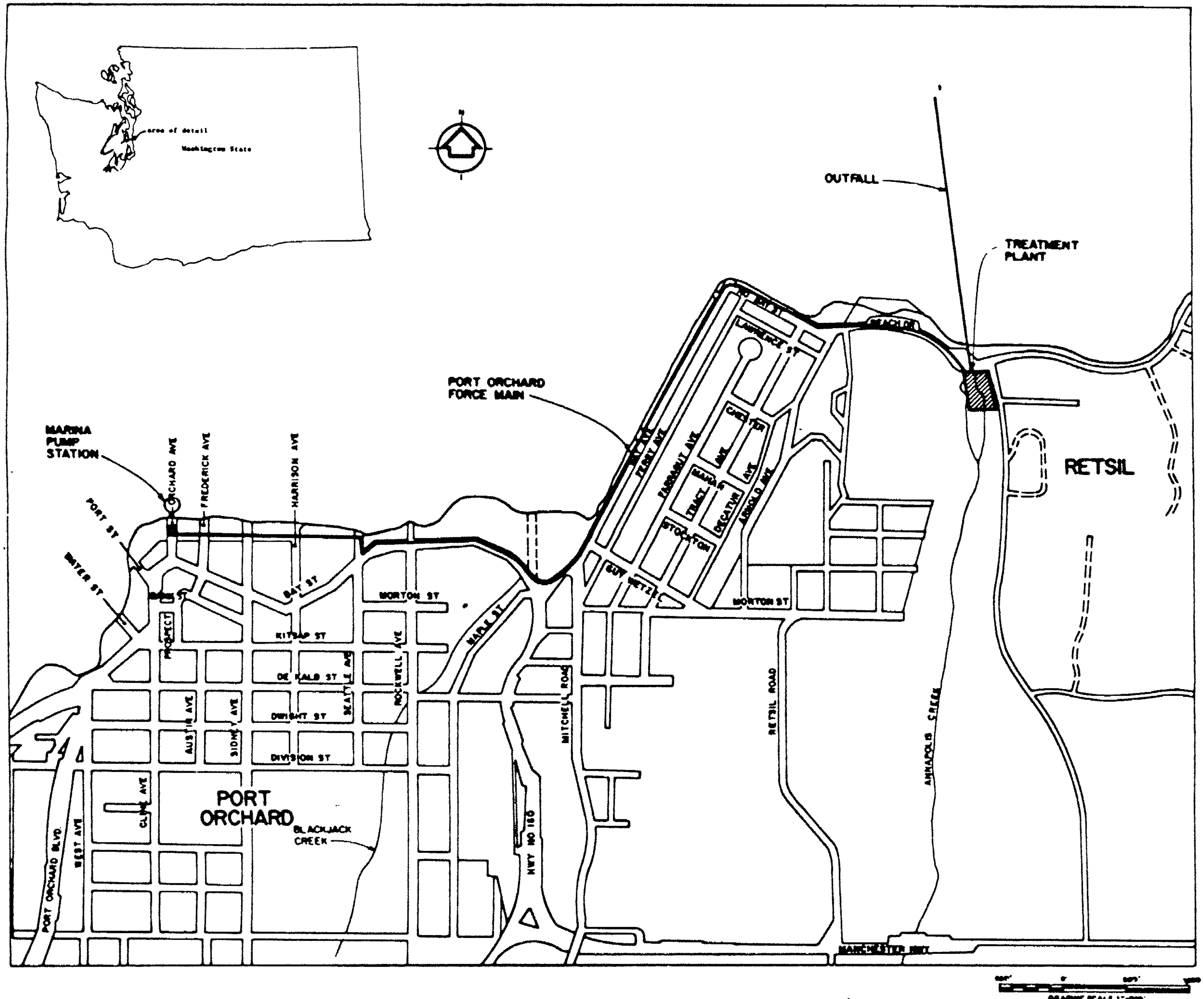

Figure 1 - Location Map - Port Orchard WTP - 1/89

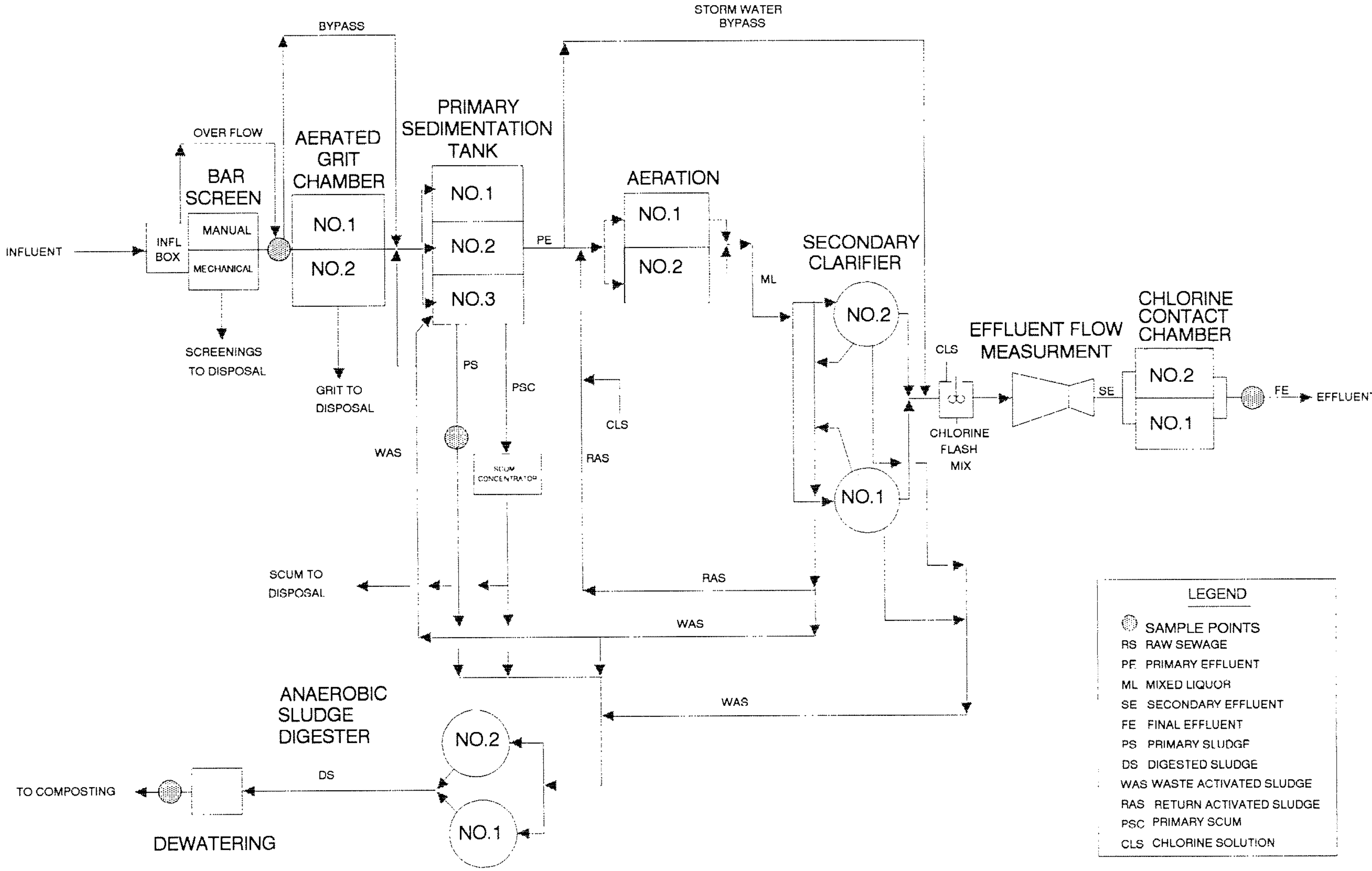

Figure 2 - Flow Schematic - Port Orchard WTP, 1/89

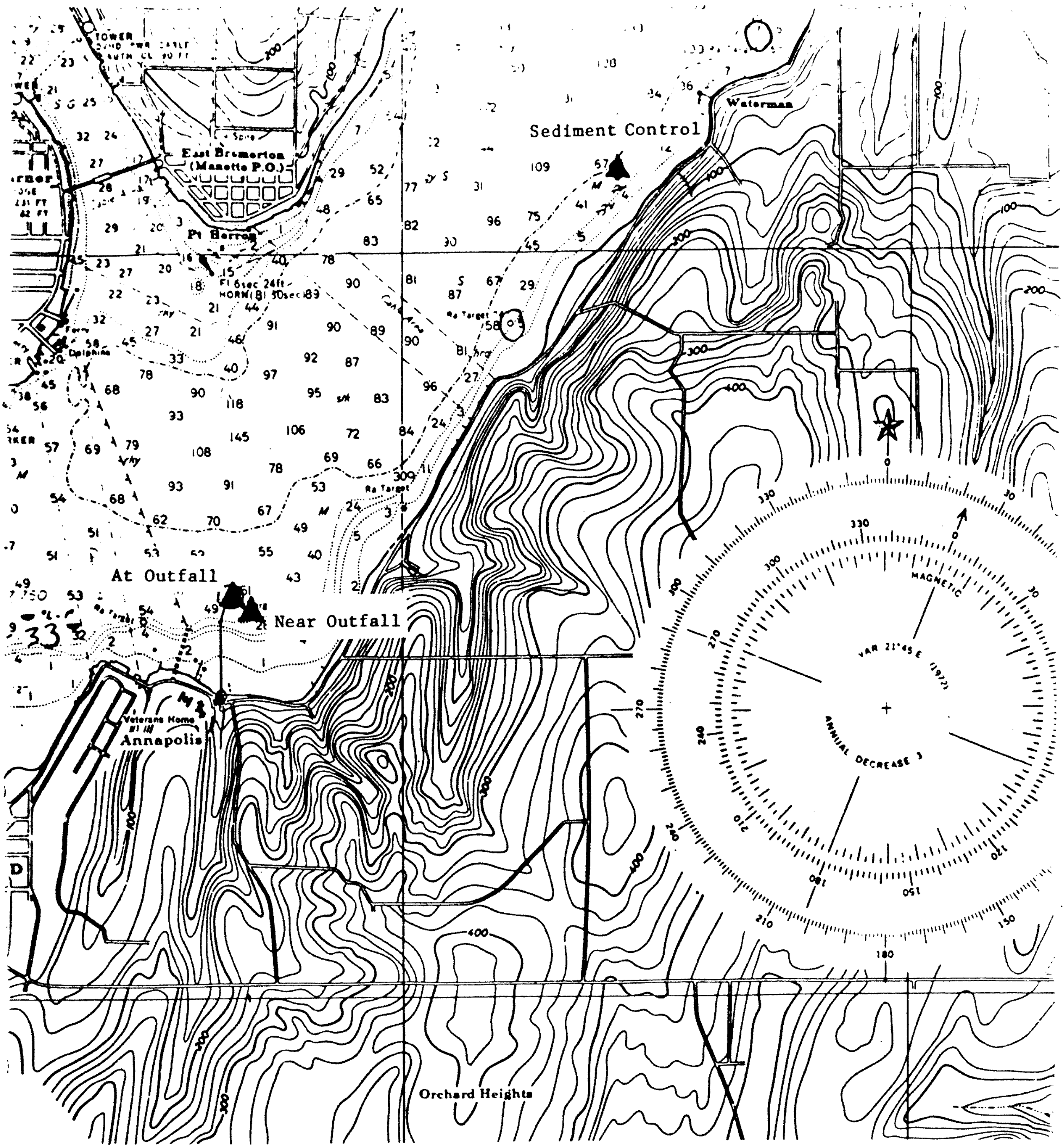

Figure 3 - Sediment Sample Sites - Port Orchard WTP, 1/89

TABLES

Table 1 – Priority Pollutant Cleaning and Field Transfer Blank Procedure – Port Orchard WTP, 1/89.

PRIORITY POLLUTANT SAMPLING EQUIPMENT CLEANING PROCEDURE

1. Wash with laboratory detergent.
2. Rinse several times with tap water.
3. Rinse with 10% nitric acid solution.
4. Rinse three (3) times with distilled/deionized water.
5. Rinse with high purity methylene chloride.
6. Rinse with high purity acetone.
7. Allow to dry and seal with aluminum foil.

FIELD TRANSFER BLANK PROCEDURE

1. Pour organic free water directly into appropriate bottles for parameters to be analyzed from grab samples (VOA).

2. Run approximately 1 liter of organic free water through a compositor and discard.

3. Run approximately 6 liters of organic free water through the same compositor and put the water into appropriate bottles for parameters to be analyzed from composite samples (BNA, Pesticide/PCB, and metals).

Table 2 - Sampling Schedule and Parameters Analyzed - Port Orchard WTP - 1/89.

Station:	Inf-PtO	Inf-Eco	Eff-PtO	Eff-Eco	Effluent Grab 1	Effluent Grab 2	Effluent Grab 3	Influent VOA Grab	Effluent VOA Grab	Primary Sludge	Digested Sludge	Dewatered Sludge	Sediment Control	At Outfall	Near Outfall
Type:	composite	composite	composite	composite	grab	grab	grab	grab	grab	grab	grab	grab	composite	composite	composite
Date:	01/18-19	01/18-19	01/18-19	01/18-19	01/18/89	01/18/89	01/19/89	01/18/89	01/18/89	01/18/89	01/18/89	01/18/89	01/17/89	01/17/89	01/17/89
Time:	N/A	9:10-8:40	N/A	9:00-8:30	9:40	14:30	10:32	10:15	9:44	11:40	11:56	13:58	15:45-17:05	11:54-13:14	14:05-14:55
Parameter Sample ID#:	038088	038087	038086	038085	038080	038081	038090	038093	038091	038094	038092	038089	038082	038083	038084
GENERAL CHEMISTRY															
Turbidity	E	E	E	E											
pH	E	E	E	E											
Conductivity	E	E	E	E											
Alkalinity	E	E	E	E											
Hardness			E	E											
SOLIDS															
TS	E	E	E	E											
TNVS	E	E	E	E											
TSS	EW	EW	EW	EW	E	E	E								
TNVSS	E	E	E	E											
BOD5	EW	EW	EW	EW											
Inhibited BOD			E	E											
COD	E	E	E	E	E	E	E								
TOC		E		E								E	E	E	E
NUTRIENTS															
NH3-N	E	E	E	E	E	E	E								
NO3+NO2-N	E	E	E	E	E	E	E								
Phosphorous - Total	E	E	E	E	E	E	E								
Fecal Coliform					E	E	E								
% Solids												E	E	E	E
Grain Size													E	E	E
PRIORITY POLLUTANTS															
BNAs		E		E								E	E	E	E
Pest/PCB		E		E								E	E	E	E
VOA								E	E	E	E	E	E	E	E
Metals		E		E								E	E	E	E
Cyanide		E		E									E	E	E
TOX				E											
BIOASSAYS															
Rainbow Trout				E											
Microtox				E									E	E	E
Daphnia magna				E											
Rhepoxynius abronius													E	E	E
FIELD OBSERVATIONS															
Temp					E	E	E	E	E						
pH					E	E	E	E	E						
Conductivity					E	E	E	E	E						
Chlorine residual															
Free:					E	E	E		E						
Total:					E	E	E		E						

E - Ecology analysis

W - WTP analysis

Table 3 – Summary of General Chemistry – Port Orchard WTP, 1/89.

Parameter	Station: / Sample ID#:	Inf-PtO 038088	Inf-Eco 038087	Eff-PtO 038086	Eff-Eco 038085	Effluent Grab 1 038080	Effluent Grab 2 038081	Effluent Grab 3 038090	Influent VOA 038093	Effluent VOA 038091
LABORATORY	**UNITS**									
Turbidity	NTU	34	32	3	4					
pH	S.U.	6.9	7.0	7.1	6.9					
Conductivity	umho/cm	500	540	520	530					
Alkalinity	mg/l as CaCO3	140	160	150	150					
Hardness	mg/l as CaCO3			70	88					
SOLIDS										
TS	mg/l	420	550	300	370					
TNVS	mg/l	230	220	200	190					
TSS	mg/l	140	120	9	8	8	15	7		
TNVSS	mg/l	18	24	1	1					
BOD5	mg/l	110	130	10	8					
Inhibited BOD	mg/l			5	6					
COD	mg/l	230	310	39	35	44	42	39		
TOC	mg/l		60		11					
NUTRIENTS										
NH3-N	mg/l as N	26	37	36	36	30	29	39		
NO3+NO2-N	mg/l as N	0.72	0.47	0.69	0.53	0.17	0.76	0.79		
T. Phosphorous	mg/l as P	1.7	3.6	3.9	2.9	0.93	1.6	3.5		
Fecal Coliform	#/100 ml					6	1000	3U		
FIELD										
pH	S.U.					7.1	7.2	7.0	7.5	7.1
Conductivity	umho/cm					454	460	470	670	454
Temperature	deg. C					11.6	11.7	10.8	13.5	11.6
Chlorine Residual										
Free:	mg/l					0.5	0.6	<0.1		0.5
Total:	mg/l					0.7	0.8	0.8		0.7

U - Compound was analyzed for but not detected at the given detection limit.

Table 4 – Comparison of Inspection Results to NPDES Permit Limits – Port Orchard WTP, 1/89.

Parameter	NPDES Permit Limits Monthly Average	NPDES Permit Limits Weekly Average	Inspection Data Ecology Composite	Inspection Data Grab Samples	Plant Loading Design Criteria	Plant Loading 85% of DC	Plant Loading Inspection Results
Influent BOD5							
(mg/l)			130				
(lbs/d)					5,400	4,590	1,897
Effluent BOD5							
(mg/l)	30	45	8				
(lbs/d)	700	1,050	117				
(% removal)	85		94				
Influent TSS							
(mg/l)			120				
(lbs/d)					5,400	4,590	1,751
Effluent TSS							
(mg/l)	30	45	8				
(lbs/d)	700	1,050	117				
(% removal)	85		93				
Fecal Coliform							
(#/100 ml)	200	400		6, 1000, 3U			
pH (S.U.)	6.0 - 9.0			7.1, 7.2, 7.0			
Flow (mgd)					2.8	2.4	1.75

U – Indicates compound was not detected at the given detection limit

Table 5 – Priority Pollutants Detected in Water Samples – Port Orchard WTP, 1/89.

Sample:	Influent	Effluent	Inf–Eco	Eff–Eco	EPA Water Quality Criteria+				
Sample ID#:	038093	038091	038087	038085					Human Health***
Type:	grab	grab	composite	composite	Marine Water		Fresh Water		Consumption of
Date:	01/18/89	01/18/89	01/18–19	01/18–19	Acute	Chronic	Acute	Chronic	Organisms Only
VOA Compounds (ug/l)									
Chloromethane	30				--	--	--	--	--
Acetone	23	2 J			--	--	--	--	--
Chloroform	1 J	1 J			--	--	28,900*	1,240*	470.8
Benzene	3 J				5,100*	700*	5,300*	--	71.28
Toluene	30				6,300*	5,000*	17,500*	--	301,941
Ethylbenzene	2 J				430*	--	32,000*	--	28,718
Total Xylenes	11				--	--	--	--	--
BNA Compunds (ug/l)									
Benzyl Alcohol			5 J		--	--	--	--	--
4–Methylphenol			27		--	--	--	--	--
Benzoic Acid			48 J		--	--	--	--	--
Diethylphthalate			7 J		--	--	--	--	118,019
Di–n–Butylphthalate			9 J		--	--	--	--	12,100
Butylbenzylphthalate			3 J		--	--	--	--	5,202
bis(2–Ethylhexyl)Phthalate			19 B	7 BJ	--	--	--	--	5.92
Total Phthalates					2,944*	3.4*	940*	3*	
Pesticides/PCBs (ug/l)									
Lindane			0.11	0.073	0.16	--	2.0	0.080	0.0625
Metals – Total Recoverable (ug/l)									
Arsenic**			1.7		2,319*(69)	13*(36)	850*(360)	48*(190)	0.14
Copper			38	5	2.9	2.9	15.7	10.6	--
Lead			9.5	3.1	140.0	5.6	69.4	2.7	--
Zinc			122	29	95.0	86.0	105.0	95.1	--
General (ug/l)									
Cyanide			8	4	1.0	1.0	22	5.2	--
TOX				80					

J Indicates an estimated value when result is less than specified detection limit.

B Indicates analyte was found in blank as well as sample.

* – Insufficient data to develop criteria, value presented is the LOEL (Lowest Observed Effect Level).

** – Criteria presented are for pentavalent(trivalent) species.

*** – Concentration at which consumption of aquatic organisms may result in an incremental increase of cancer risk over the lifetime of 1 in 1,000,000 (carcinogens only).

+ – EPA, 1986

Table 6 – Effluent Bioassay Results – Port Orchard WTP, 1/89.

Rainbow Trout 96-Hour Survival in 100% Effluent *(Oncorhynchus mykiss)*

	# of live test organisms		Percent
	Initial	Final	Mortality
Effluent	30	30	0
Control	30	30	0

Microtox

	EC50 (15 minutes at 15 C)
Dechlorinated Effluent	data not suitable for reduction*

Daphnia Magna 7-Day Survival and Reproduction

Dechlorinated Effluent

Concentration (%vol/vol)	Survival (%)	Total Reproduction**
Control	100	117
1.0% effluent	100	131
3.0% effluent	100	140
10.0% effluent	100	129
30.0% effluent	100	176
100.0% effluent	50	113
	NOEC = 30.0%	
	LOEC = 100.0%	
	LC50 = 100.0%	

*Normally considered an indication of lack of sample toxicity.

**Reproduction was not significantly different from the control in any of the test concentrations.

NOEC – No Observed Effect Concentration: the highest concentration of effluent that did not cause an observable effect.

LOEC – Lowest Observed Effect Concentration: the lowest concentration of effluent that caused an observable adverse effect.

EC50 – Concentration causing the tested effect to 50% of the organisms.

LC50 – Concentration lethal to 50% of the organisms.

Table 7 – Metals Detected in Dewatered Sludge – Port Orchard WTP, 1/89.

Sample:	Dewat'rd Sludge	Data From Previous Inspections*			Distribution and Marketing Pollutant Limits**
Sample ID#:	038089 (mg/kg dry)	Range (mg/kg dry)	Geometric Mean (mg/kg dry)	Number of Samples	(mg/kg dry)
Metals - Total					
Antimony	4.42	--	--	--	--
Arsenic	5.96	--	--	--	140
Cadmium	7.0	<0.1-25	7.6	34	180
Chromium	34.6	15-300	61.8	34	5300
Copper	408	75-1,700	398	34	460
Lead	135	34-600	207	34	1300
Mercury	3.61	--	--	--	400
Nickel	27	<0.1-62	25.5	29	780
Selenium	8.1	--	--	--	1600
Silver	41.0	--	--	--	--
Zinc	1270	165-3,370	1,200	33	1700
General					
Solids, Total (%)	19.1				
TOC (% dry basis)	25.0				

* Data collected during previous Class II inspections at activated sludge plants throughout Washington State (Hallinan, 1988).

** Concentration allowable at an annual whole sludge application rate of 5 metric tons per hectare (EPA, 1989b)

Table 8 – Priority Pollutant Organics Detected in Water and Sludge Samples – Port Orchard WTP, 1/89.

	Wastewater (ug/l)		Sludge (ug/kg dry)		
	Influent	Effluent	Primary	Digested	Dewatered
Sample ID #:	*	**	038094	038092	038089
VOA Compounds					
Chloromethane	30				76 J
Methylene Chloride			180 J		790
Acetone	23	2 J	32,000 M	11,000	5,600 M
Carbon Disulfide			220 J		48 J
Chloroform	1 J	1 J			
2-Butanone			7,200	2,400 J	1,200
Benzene	3 J				
Tetrachloroethene			330 J		
Toluene	30		270,000 M	50,000 M	19,000 M
Chlorobenzene					140
Ethylbenzene	2 J			280 J	73 J
Total Xylenes	11		720 J	1,700	460
Phthalates					
Diethylphthalate	7 J				
Di-n-Butylphthalate	9 J				
Butylbenzylphthalate	3 J				
bis(2-Ethylhexyl)Phthalate	19 B	7 BJ			170,000
Di-n-Octyl Phthalate					9,500 J
Miscellaneous					
Benzyl Alcohol	5 J				
4-Methylphenol	27				
Benzoic Acid	48 J				
4-Chloroaniline					21,000 J
Pesticides/PCBs					
Lindane	0.11	0.073			

* Influent sample #038093 for VOAs, #038087 for BNAs and Pesticides/PCBs.

** Effluent sample #038091 for VOAs, #038085 for BNAs and Pesticides/PCBs.

U Indicates compound was analyzed for but not detected at the given detection limit.

J Indicates an estimated value when result is less than specified detection limit.

B Indicates the analyte was found in the blank as well as the sample, possible/probable blank contamination.

M Indicates an estimated value of an analyte found and confirmed by analyst but with low spectral match parameters.

Table 9 – Priority Pollutants Detected in Sediment Samples – Port Orchard WTP, 1/89.

Sample:	Sediment Control		At Outfall		Near Outfall		Marine Sediment Management Chemical Criteria*	
Sample ID#:	038082		038083		038084			
	mg/kg-dry	mg/kg TOC	mg/kg-dry	mg/kg TOC	mg/kg-dry	mg/kg TOC	mg/kg-dry	mg/kg TOC
VOA Compounds								
Acetone	0.015 J		0.016 J		0.017 J		--	--
BNA Compounds								
Phenol	0.430 J		1.100 U		1.300 U		0.420	--
Benzoic Acid	0.400 J		0.150 J		0.240 J		0.650	--
Fluoranthene	0.990 U	250 U	0.120 J	17 J	0.310 J	31 J	--	160
Pyrene	0.990 U	250 U	0.210 J	30 J	0.470 J	47 J	--	1000
Benzo(a)Anthracene	0.990 U	250 U	1.100 U	160 U	0.210 J	21 J	--	110
Crysene	0.990 U	250 U	1.100 U	160 U	0.250 J	25 J	--	110
Benzo(b)Fluoranthene	0.990 U	250 U	1.100 U	160 U	0.170 J	17 J	--	--
Benzo(k)Fluoranthene	0.990 U	250 U	1.100 U	160 U	0.180 J	18 J	--	--
Total Benzofluoranthenes++	2.97	740	3.30	470	1.7	170	--	230
Benzo(a)Pyrene	0.990 U	250 U	1.100 U	160 U	0.230 J	23 J	--	99
HPAH+	11	2750	10	1430	4.4	440	--	960
bis(2-Ethylhexyl)Phthalate	0.260 BJ	65 BJ	0.500 BJ	71 BJ	0.180 BJ	18 BJ	--	47
Metals – Total								
Arsenic	2.42		3.93		5.53		57	--
Chromium	14.6		18.8		21.8		260	--
Copper	9.9		24.1		32.9		390	--
Lead	14		25		42		450	--
Mercury	0.06		0.98		0.23		0.41	--
Nickel	13		22		30		--	--
Zinc	31.7		50		66.5		410	--
General								
Cyanide	0.029		0.047		0.12		--	--
Solids, Total (%)	73.0		60.2		53.7		--	--
TOC (% dry basis)	0.4		0.7		1.0		--	--
Grain Size: (% dry basis)								
Gravel	<2		<2		<2		--	--
Sand	88.0		73.3		73.4		--	--
Silt	8.8		19.9		17.1		--	--
Clay	3.2		6.8		9.5		--	--

U Indicates compound was not detected at the given detection limit.
J Indicates an estimated value when result is less than specified detection limit.
B Indicates analyte was found in blank as well as sample.
* Ecology, 1990
\+ The HPAH criteria is applicable to the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Total Benzofluoranthenes, Benzo(a)pyrene, Indeno(1,2,3,-c,d)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perlyene.
++ Total Benzofluoranthenes criteria represents the sum of the "b", "j", and "k" isomers.
Note: shaded values indicate quantification limits greater than sediment management criteria

Table 10 – Sediment Bioassay Results – Port Orchard WTP, 1/89.

Microtox

	EC50 (15 minutes at 15 C)
Sediment Control	108.9%
At Outfall	0.8%, 31.0%*
Near Outfall	42.7%, 50.5%*

Amphipod 10-Day Survival, Avoidance, and Reburial *(Rhepoxynius abronius)*

	% Survival+	Avoidance++	% Reburial+++
Sediment Control	89	0.7	99
At Outfall	91	0.3	99
Near Outfall	94	0.2	100
Control	98	0.1	100

*Little decrease in light output was noted for At Outfall and Near Outfall tests. Low toxicity was indicated in testing. Tests were duplicated for verification.

+5 replicates of 20 organisms. No significant differences were detected between the control (collected at West Beach, Whidbey Island, Washington) and test sediments.

++Average number of amphipods on the surface per jar per day (out of a maximum of 20.0).

+++At the end of the 10 day exposure, surviving individuals were transferred to fingerbowls containing 2 cm of control sediment and clean seawater, and the number able to rebury within 1 hour was recorded

EC50 - concentration causing the tested effect to 50% of the organisms.

Table 11 – Comparison of Sample Splits – Port Orchard WTP, 1/89.

Sample	Sampler	Laboratory	BOD (mg/l)	TSS (mg/l)
Inf-PtO	Port Orchard	Port Orchard	119	162
(038088)		Ecology	110	140
Inf-Eco	Ecology	Port Orchard	132	208
(038087)		Ecology	130	120
Eff-PtO	Port Orchard	Port Orchard	9.8	9.6
(038086)		Ecology	10	9
Eff-Eco	Ecology	Port Orchard	11.8	10
(038085)		Ecology	8	8

APPENDIX A

Appendix A - Ecology Analytical Methods - Port Orchard WTP - 1/89.

Analyses	Method Used	Laboratory
GENERAL CHEMISTRY		
Turbidity	EPA, 1979: 180.1	Ecology; Manchester, WA
pH	EPA, 1979: 150.1	Ecology; Manchester, WA
Conductivity	EPA, 1979: 120.1	Ecology; Manchester, WA
Alkalinity	EPA, 1979: 310.1	Ecology; Manchester, WA
Hardness	EPA, 1979: 130.2	Ecology; Manchester, WA
SOLIDS		
TS	EPA, 1979: 160.3	Ecology; Manchester, WA
TNVS & TNVSS	EPA, 1979: 106.4	Ecology; Manchester, WA
TSS	EPA, 1979: 160.2	Ecology; Manchester, WA
BOD5	EPA, 1979: 405.1	Ecology; Manchester, WA
Inhibited BOD	EPA, 1979: 405.1	Ecology; Manchester, WA
COD	EPA, 1979: 410.1	Ecology; Manchester, WA
TOC, water	EPA, 1979: 415.1	Ecology; Manchester, WA
NUTRIENTS		
NH3-N	EPA, 1979: 350.1	Aquatic Research; Seattle, WA
NO3+NO2-N	EPA, 1979: 353.2	Aquatic Research; Seattle, WA
Phosphorous - Total	EPA, 1979: 365.1	Aquatic Research; Seattle, WA
% Solids	APHA, 1989: 2540G	Laucks Testing Labs; Seattle, WA
Grain Size	Tetra Tech, 1986	Laucks Testing Labs; Seattle, WA
TOC, solids	APHA, 1989: 5310	Laucks Testing Labs; Seattle, WA
PRIORITY POLLUTANTS		
Semivolatiles, water	EPA, 1984: 625	Ecova Laboratories; Redmond, WA
Semivolatiles, solids	EPA, 1986: 8270	Ecova Laboratories; Redmond, WA
Volatiles, water	EPA, 1984: 624	Ecova Laboratories; Redmond, WA
Volatiles, solids	EPA, 1986: 8240	Ecova Laboratories; Redmond, WA
Pest/PCBs, water	EPA, 1984: 608	Ecova Laboratories; Redmond, WA
Pest/PCBs, solids	EPA, 1986: 8080	Ecova Laboratories; Redmond, WA
Metals, water/solids	EPA, 1984: 200	Analytical Resources Inc; Seattle, WA
Cyanide	EPA, 1979: 335.3	Ecology; Manchester, WA
TOX, water	EPA, 1979: 450.1	Ecology; Manchester, WA
BIOASSAYS		
Rainbow Trout	Ecology, 1981	Ecology; Manchester, WA
Microtox	Beckman, 1982	Ecova Laboratories; Redmond, WA
Daphnia Magna	EPA, 1987	EVS Consultants; Seattle, WA
Rhepoxynius abronius	Swartz, 1985	EVS Consultants; Seattle, WA

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EPA, 1987. A Short-Term Chronic Toxicity Test Using Daphnia magna, EPA/600/D-87/080.

Swartz, R.C., et. al., 1985. Phoxocephalid Amphipod Bioassay for Marine Sediment Toxicity, ASTM STP 854, 1985.

Tetra Tech, 1986. Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, Prepared for Puget Sound Estuary Program.

APPENDIX B

Appendix B - Priority Pollutant Scans on Water Samples - Port Orchard WTP, 1/89.

Sample:	Influent		Effluent	
Sample ID#:	038093		038091	
Type:	grab		grab	
Date:	01/18/89		01/18/89	
VOA Compounds (ug/l)				
Chloromethane	30		10	U
Bromomethane	10	U	10	U
Vinyl Chloride	10	U	10	U
Chloroethane	10	U	10	U
Methylene Chloride	5	U	5	U
Acetone	23		2	J
Carbon Disulfide	5	U	5	U
1,1-Dichloroethene	5	U	5	U
1,1-Dichloroethane	5	U	5	U
1,2-Dichloroethene (total)	5	U	5	U
Chloroform	1	J	1	J
1,2-Dichloroethane	5	U	5	U
2-Butanone	10	U	10	U
1,1,1-Trichloroethane	5	U	5	U
Carbon Tetrachloride	5	U	5	U
Vinyl Acetate	10	U	10	U
Bromodichloromethane	5	U	5	U
1,2-Dichloropropane	5	U	5	U
cis-1,3-Dichloropropene	5	U	5	U
Trichloroethene	5	U	5	U
Dibromochloromethane	5	U	5	U
1,1,2-Trichloroethane	5	U	5	U
Benzene	3	J	5	U
Trans-1,3-Dichloropropene	5	U	5	U
Bromoform	5	U	5	U
4-Methyl-2-Pentanone	10	U	10	U
2-Hexanone	10	U	10	U
Tetrachloroethene	5	U	5	U
1,1,2,2-Tetrachloroethane	5	U	5	U
Toluene	30		5	U
Chlorobenzene	5	U	5	U
Ethylbenzene	2	J	5	U
Styrene	5	U	5	U
Total Xylenes	11		5	U

Appendix B (continued) – Port Orchard WTP, 1/89.

	Sample:	Inf–Eco		Eff–Eco	
	Sample ID#:	038087		038085	
	Type:	composite		composite	
	Date:	01/18–19		01/18–19	
BNA Compounds (ug/l)					
Phenol		10	U	10	U
bis(2-Chloroethyl)Ether		10	U	10	U
2-Chlorophenol		10	U	10	U
1,3-Dichlorobenzene		10	U	10	U
1,4-Dichlorobenzene		10	U	10	U
Benzyl Alcohol		5	J	10	U
1,2-Dichlorobenzene		10	U	10	U
2-Methylphenol		10	U	10	U
bis(2-chloroisopropyl)Ether		10	U	10	U
4-Methylphenol		27		10	U
n-Nitroso-Di-n-Propylamine		10	U	10	U
Hexachloroethane		10	U	10	U
Nitrobenzene		10	U	10	U
Isophorone		10	U	10	U
2-Nitrophenol		10	U	10	U
2,4-Dimethylphenol		10	U	10	U
Benzoic Acid		48	J	50	U
bis(2-Chloroethoxy)Methane		10	U	10	U
2,4-Dichlorophenol		10	U	10	U
1,2,4-Trichlorobenzene		10	U	10	U
Naphthalene		10	U	10	U
4-Chloroaniline		10	U	10	U
Hexachlorobutadiene		10	U	10	U
4-Chloro-3-Methylphenol		10	U	10	U
2-Methylnapthalene		10	U	10	U
Hexachlorocyclopentadiene		10	U	10	U
2,4,6-Trichlorophenol		10	U	10	U
2,4,5-Trichlorophenol		50	U	50	U
2-Chloronapthalene		10	U	10	U
2-Nitroaniline		50	U	50	U
Dimethyl Phthalate		10	U	10	U
Acenaphthylene		10	U	10	U
2,6-Dinitrotoluene		10	U	10	U
3-Nitroaniline		50	U	50	U
Acenaphthene		10	U	10	U
2,4-Dinitrophenol		50	U	50	U
4-Nitrophenol		50	U	50	U
Dibenzofuran		10	U	10	U
2,4-Dinitrotoluene		10	U	10	U
Diethylphthalate		7	J	10	U
4-Chlorophenyl-phenylether		10	U	10	U
Fluorene		10	U	10	U
4-Nitroaniline		50	U	50	U
4,6-Dinitro-2-Methylphenol		50	U	50	U
N-Nitrosodiphenylamine		10	U	10	U
4-Bromophenyl-phenylether		10	U	10	U

Appendix B (continued) – Port Orchard WTP, 1/89.

Sample:	Inf–Eco	Eff–Eco
Sample ID#:	038087	038085
Type:	composite	composite
Date:	01/18–19	01/18–19
Hexachlorobenzene	10 U	10 U
Pentachlorophenol	50 U	50 U
Phenathrene	10 U	10 U
Anthracene	10 U	10 U
Di-n-Butylphthalate	**9 J**	10 U
Fluoranthene	10 U	10 U
Pyrene	10 U	10 U
Butylbenzylphthalate	**3 J**	10 U
3,3'-Dichlorobenzidine	20 U	20 U
Benzo(a)Anthracene	10 U	10 U
bis(2-Ethylhexyl)Phthalate	**19 B**	**7 BJ**
Chrysene	10 U	10 U
Di-n-Octyl Phthalate	10 U	10 U
Benzo(b)Fluoranthene	10 U	10 U
Benzo(k)Fluoranthene	10 U	10 U
Benzo(a)Pyrene	10 U	10 U
Indeno(1,2,3-cd)Pyrene	10 U	10 U
Dibenz(a,h)Anthracene	10 U	10 U
Benzo(g,h,i)Perylene	10 U	10 U
Pesticides/PCBs (ug/l)		
alpha-BHC	0.050 U	0.059 U
beta-BHC	0.050 U	0.059 U
delta-BHC	0.050 U	0.059 U
Lindane	**0.11**	**0.073**
Heptachlor	0.050 U	0.059 U
Aldrin	0.050 U	0.059 U
Heptachlor epoxide	0.050 U	0.059 U
Endosulfan I	0.050 U	0.059 U
Dieldrin	0.10 U	0.12 U
4,4'-DDE	0.10 U	0.12 U
Endrin	0.10 U	0.12 U
Endosulfan II	0.10 U	0.12 U
4-4'-DDD	0.10 U	0.12 U
Endosulfan sulfate	0.10 U	0.12 U
4,4'-DDT	0.10 U	0.12 U
Methoxychlor	0.50 U	0.59 U
Endrin ketone	0.10 U	0.12 U
alpha-Chlordane	0.50 U	0.59 U
gamma-Chlordane	0.50 U	0.59 U
Toxaphene	1.0 U	1.2 U
Aroclor-1016	0.50 U	0.59 U
Aroclor-1221	0.50 U	0.59 U
Aroclor-1232	0.50 U	0.59 U
Aroclor-1242	0.50 U	0.59 U
Aroclor-1248	0.50 U	0.59 U
Aroclor-1254	1.0 U	1.2 U
Aroclor-1260	1.0 U	1.2 U

Appendix B (continued) – Port Orchard WTP, 1/89.

	Inf–Eco		Eff–Eco	
Sample:	Inf–Eco		Eff–Eco	
Sample ID#:	038087		038085	
Type:	composite		composite	
Date:	01/18–19		01/18–19	
Metals – Total Recoverable (ug/l)				
Antimony	1.0	U	1.0	U
Arsenic	1.7		1.0	U
Beryllium	1	U	1	U
Cadmium	2	U	2	U
Chromium	5	U	5	U
Copper	38		5	
Lead	9.5		3.1	
Mercury*	0.2	U	0.2	U
Nickel	10	U	10	U
Selenium	1.0	U	1.0	U
Silver	3	U	3	U
Thallium	1.0	U	1.0	U
Zinc	122		29	
General (ug/l)				
Cyanide	8		4	
TOX			80	

U - Indicates the compound was analyzed for but not detected at the given detection limit

J - Indicates an estimated value when result is less than specified detection limit

B- Indicates analyte was found in the blank as well as the sample, possible/probable blank contamination

M - Indicates an estimated value of analyte found and confirmed by analyst but with low spectral match parameters

UJ - Indicates compound was analyzed for but not detected at the given detection limit, and the internal standard on which the detection limit quantification was based was outside acceptance limits

APPENDIX C

Appendix C - Priority Pollutants Scans on Sludge and Sediment Samples - Port Orchard WTP, 1/89.

Sample:	Primary Sludge		Digested Sludge		Dewat'rd Sludge		Sediment Control		At Outfall		Near Outfall	
Sample ID#:	038094		038092		038089		038082		038083		038084	
Date:	01/18/89		01/18/89		01/18/89		01/17/89		01/17/89		01/17/89	
VOA Compounds (ug/kg-dry)												
Chloromethane	1600	U	2400	U	**76**	**J**	15	U	16	U	20	U
Bromomethane	1600	U	2400	U	250	U	15	U	16	U	20	U
Vinyl Chloride	1600	U	2400	U	250	U	15	U	16	U	20	U
Chloroethane	1600	U	2400	U	250	U	15	U	16	U	20	U
Methylene Chloride	**180**	**J**	1200	U	**790**		7	U	8	U	10	U
Acetone	**32000**	**M**	**11000**		**5600**	**M**	**15**	**J**	**16**	**J**	**17**	**J**
Carbon Disulfide	**220**	**J**	1200	U	**48**	**J**	7	U	8	U	10	U
1,1-Dichloroethene	800	U	1200	U	120	U	7	U	8	U	10	U
1,1-Dichloroethane	800	U	1200	U	120	U	7	U	8	U	10	U
1,2-Dichloroethene (total)	800	U	1200	U	120	U	7	U	8	U	10	U
Chloroform	800	U	1200	U	120	U	7	U	8	U	10	U
1,2-Dichloroethane	800	U	1200	U	120	U	7	U	8	U	10	U
2-Butanone	**7200**		2400	U	**1200**		15	U	16	U	20	U
1,1,1-Trichloroethane	800	U	1200	U	120	U	7	U	8	U	10	U
Carbon Tetrachloride	800	U	1200	U	120	U	7	U	8	U	10	U
Vinyl Acetate	1600	U	2400	U	250	U	15	U	16	U	20	U
Bromodichloromethane	800	U	1200	U	120	U	7	U	8	U	10	U
1,2-Dichloropropane	800	U	1200	U	120	U	7	U	8	U	10	U
cis-1,3-Dichloropropene	800	U	1200	U	120	U	7	U	8	U	10	U
Trichloroethene	800	U	1200	U	120	U	7	U	8	U	10	U
Dibromochloromethane	800	U	1200	U	120	U	7	U	8	U	10	U
1,1,2-Trichloroethane	800	U	1200	U	120	U	7	U	8	U	10	U
Benzene	800	U	1200	U	120	U	7	U	8	U	10	U
Trans-1,3-Dichloropropene	800	U	1200	U	120	U	7	U	8	U	10	U
Bromoform	800	U	1200	U	120	U	7	U	8	U	10	U
4-Methyl-2-Pentanone	1600	U	2400	U	250	U	15	U	16	U	20	U
2-Hexanone	1600	U	2400	U	250	U	15	U	16	U	20	U
Tetrachloroethene	**330**	**J**	1200	U	120	U	7	U	8	U	10	U
1,1,2,2-Tetrachloroethane	800	U	1200	U	120	U	7	U	8	U	10	U
Toluene	**270000**	**M**	**50000**	**M**	**19000**	**M**	7	U	8	U	10	U
Chlorobenzene	800	U	1200	U	**140**		7	U	8	U	10	U
Ethylbenzene	800	U	**280**	**J**	**73**	**J**	7	U	8	U	10	U
Styrene	800	U	1200	U	120	U	7	U	8	U	10	U
Total Xylenes	**720**	**J**	**1700**		**460**		7	U	8	U	10	U

Appendix C (continued) – Port Orchard WTP, 1/89.

	Dewat'rd Sludge		Sediment Control		At Outfall*		Near Outfall	
Sample ID#:	038089		038082		038083		038084	
Date:	01/18/89		01/17/89		01/17/89		01/17/89	
BNA Compounds (ug/kg-dry)								
Phenol	50000	U	430	J	1100	U	1300	U
bis(2-Chloroethyl)Ether	50000	U	990	U	1100	U	1300	U
2-Chlorophenol	50000	U	990	U	1100	U	1300	U
1,3-Dichlorobenzene	50000	U	990	U	1100	U	1300	U
1,4-Dichlorobenzene	50000	U	990	U	1100	U	1300	U
Benzyl Alcohol	50000	U	990	U	1100	U	1300	U
1,2-Dichlorobenzene	50000	U	990	U	1100	U	1300	U
2-Methylphenol	50000	U	990	U	1100	U	1300	U
bis(2-chloroisopropyl)Ether	50000	U	990	U	1100	U	1300	U
4-Methylphenol	50000	U	990	U	1100	U	1300	U
n-Nitroso-Di-n-Propylamine	50000	U	990	U	1100	U	1300	U
Hexachloroethane	50000	U	990	U	1100	U	1300	U
Nitrobenzene	50000	U	990	U	1100	U	1300	U
Isophorone	50000	U	990	U	1100	U	1300	U
2-Nitrophenol	50000	U	990	U	1100	U	1300	U
2,4-Dimethylphenol	50000	U	990	U	1100	U	1300	U
Benzoic Acid	240000	U	400	J	150	J	240	J
bis(2-Chloroethoxy)Methane	50000	U	990	U	1100	U	1300	U
2,4-Dichlorophenol	50000	U	990	U	1100	U	1300	U
1,2,4-Trichlorobenzene	50000	U	990	U	1100	U	1300	U
Naphthalene	50000	U	990	U	1100	U	1300	U
4-Chloroaniline	21000	J	990	U	1100	U	1300	U
Hexachlorobutadiene	50000	U	990	U	1100	U	1300	U
4-Chloro-3-Methylphenol	50000	U	990	U	1100	U	1300	U
2-Methylnapthalene	50000	U	990	U	1100	U	1300	U
Hexachlorocyclopentadiene	50000	U	990	U	1100	U	1300	U
2,4,6-Trichlorophenol	50000	U	990	U	1100	U	1300	U
2,4,5-Trichlorophenol	240000	U	4800	U	5300	U	6400	U
2-Chloronapthalene	50000	U	990	U	1100	U	1300	U
2-Nitroaniline	240000	U	4800	U	5300	U	6400	U
Dimethyl Phthalate	50000	U	990	U	1100	U	1300	U
Acenaphthylene	50000	U	990	U	1100	U	1300	U
2,6-Dinitrotoluene	50000	U	990	U	1100	U	1300	U
3-Nitroaniline	240000	U	4800	U	5300	U	6400	U
Acenaphthene	50000	U	990	U	1100	U	1300	U
2,4-Dinitrophenol	240000	U	4800	U	5300	U	6400	U
4-Nitrophenol	240000	U	4800	U	5300	U	6400	U
Dibenzofuran	50000	U	990	U	1100	U	1300	U
2,4-Dinitrotoluene	50000	U	990	U	1100	U	1300	U
Diethylphthalate	50000	U	990	U	1100	U	1300	U
4-Chlorophenyl-phenylether	50000	U	990	U	1100	U	1300	U
Fluorene	50000	U	990	U	1100	U	1300	U
4-Nitroaniline	240000	U	4800	U	5300	U	6400	U
4,6-Dinitro-2-Methylphenol	240000	U	4800	U	5300	U	6400	U
N-Nitrosodiphenylamine	50000	U	990	U	1100	U	1300	U
4-Bromophenyl-phenylether	50000	U	990	U	1100	U	1300	U

Appendix C (continued) – Port Orchard WTP, 1/89.

Sample:	Dewat'rd Sludge		Sediment Control		At Outfall*		Near Outfall	
Sample ID#:	038089		038082		038083		038084	
Date:	01/18/89		01/17/89		01/17/89		01/17/89	
Hexachlorobenzene	50000	U	990	U	1100	U	1300	U
Pentachlorophenol	240000	U	4800	U	5300	U	6400	U
Phenathrene	50000	U	990	U	1100	U	1300	U
Anthracene	50000	U	990	U	1100	U	1300	U
Di-n-Butylphthalate	50000	U	990	U	1100	U	1300	U
Fluoranthene	50000	U	990	U	**120**	**J**	**310**	**J**
Pyrene	50000	U	990	U	**210**	**J**	**470**	**J**
Butylbenzylphthalate	50000	U	990	U	1100	U	1300	U
3,3'-Dichlorobenzidine	99000	U	2000	U	2200	U	2600	U
Benzo(a)Anthracene	50000	U	990	U	1100	U	**210**	**J**
bis(2-Ethylhexyl)Phthalate	**170000**		**260**	**BJ**	**500**	**BJ**	**180**	**BJ**
Chrysene	50000	U	990	U	1100	U	**250**	**J**
Di-n-Octyl Phthalate	**9500**	**J**	990	U	1100	U	1300	U
Benzo(b)Fluoranthene	50000	U	990	U	1100	U	**170**	**J**
Benzo(k)Fluoranthene	50000	U	990	U	1100	U	**180**	**J**
Benzo(a)Pyrene	50000	U	990	U	1100	U	**230**	**J**
Indeno(1,2,3-cd)Pyrene	50000	U	990	U	1100	U	1300	U
Dibenz(a,h)Anthracene	50000	U	990	U	1100	U	1300	U
Benzo(g,h,i)Perylene	50000	U	990	U	1100	U	1300	U
Pesticides/PCBs (ug/kg-dry)								
alpha-BHC	80	U	24	U	27	U	32	U
beta-BHC	80	U	24	U	27	U	32	U
delta-BHC	80	U	24	U	27	U	32	U
Lindane	80	U	24	U	27	U	32	U
Heptachlor	80	U	24	U	27	U	32	U
Aldrin	80	U	24	U	27	U	32	U
Heptachlor epoxide	80	U	24	U	27	U	32	U
Endosulfan I	80	U	24	U	27	U	32	U
Dieldrin	160	U	48	U	53	U	64	U
4,4'-DDE	160	U	48	U	53	U	64	U
Endrin	160	U	48	U	53	U	64	U
Endosulfan II	160	U	48	U	53	U	64	U
4-4'-DDD	160	U	48	U	53	U	64	U
Endosulfan sulfate	160	U	48	U	53	U	64	U
4,4'-DDT	160	U	48	U	53	U	64	U
Methoxychlor	800	U	240	U	270	U	320	U
Endrin ketone	160	U	48	U	53	U	64	U
alpha-Chlordane	800	U	240	U	270	U	320	U
gamma-Chlordane	800	U	240	U	270	U	320	U
Toxaphene	1600	U	480	U	530	U	640	U
Aroclor-1016	800	U	240	U	270	U	320	U
Aroclor-1221	800	U	240	U	270	U	320	U
Aroclor-1232	800	U	240	U	270	U	320	U
Aroclor-1242	800	U	240	U	270	U	320	U
Aroclor-1248	800	U	240	U	270	U	320	U
Aroclor-1254	1600	U	480	U	530	U	640	U
Aroclor-1260	1600	U	480	U	530	U	640	U

Appendix C (continued) – Port Orchard WTP, 1/89.

Sample:	Dewat'rd Sludge	Sediment Control	At Outfall*	Near Outfall
Sample ID#:	038089	038082	038083	038084
Date:	01/18/89	01/17/89	01/17/89	01/17/89
Metals - Total (mg/kg-dry)				
Antimony	4.42	0.37 U	0.38 U	0.38 U
Arsenic	5.96	2.42	3.93	5.53
Beryllium	0.4 U	0.4 U	0.4 U	0.4 U
Cadmium	7.0	0.7 U	0.8 U	0.8 U
Chromium	34.6	14.6	18.8	21.8
Copper	408	9.9	24.1	32.9
Lead	135	14	25	42
Mercury*	3.61	0.06	0.98	0.23
Nickel	27	13	22	30
Selenium	8.1	0.39 U	0.37 U	0.38 U
Silver	41.0 U	1.1 U	1.1 U	1.1 U
Thallium	0.37	0.39 U	0.37 U	0.38 U
Zinc	1270	31.7	50	66.5
General				
Cyanide (ug/kg-dry)		29	47	120
Solids, Total (%)	19.1	73.0	60.2	53.7
TOC (% dry basis)	25.0	0.4	0.7	1.0
Grain Size: (%dry basis)				
Gravel		<2	<2	<2
Sand		88.0	73.3	73.4
Silt		8.8	19.9	17.1
Clay		3.2	6.8	9.5

U Indicates compound was analyzed for but not detected at the given detection limit.

J Indicates an estimated value when result is less than specified detection limit.

B This flag is used when the analyte is found in the blank as well as the sample. Indicates possible/probable blank contamination.

M Indicates an estimated value of analyte found and confirmed by analyst but with low spectral match parameters.

* Outfall Location: Latitude – 47 deg. 33'10"N, Longitude – 122 deg. 36'40"W

APPENDIX D

Laboratory Procedure Review Sheet

Discharger: Port Orchard WTP

Date: 11/8/89

Discharger representative: Doug Martin, Mark Morgan

Ecology reviewer: Pat Hallinan / Jessica Strong

Instructions

Questionnaire for use reviewing laboratory procedures. Circled numbers indicate work is needed in that area to bring procedures into compliance with approved techniques. References are sited to help give guidance for making improvements. References sited include:

Ecology = Department of Ecology Laboratory User's Manual, December 8, 1986.

SM = APHA-AWWA-WPCF, Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985.

SSM = WPCF, Simplified Laboratory Procedures for Wastewater Examination, 3rd ed., 1985.

Sample Collection Review

1. Are grab, hand composite, or automatic composite samples collected for influent and effluent BOD and TSS analysis?

2. If automatic compositor, what type of compositor is used? Manning
The compositor should have pre and post purge cycles unless it is a flow through type. Check if you are unfamiliar with the type being used.

3. Are composite samples collected based on time or flow?

4. What is the usual day(s) of sample collection? Tue, Wed, Thurs

5. What time does sample collection usually begin? 7:30-7:30

6. How long does sample collection last? 24 hrs

7. How often are subsamples that make up the composite collected? 30 minutes

8. What volume is each subsample? 200-300 mls

9. What is the final volume of sample collected? 2.5-3.0 gals

10. Is the composite cooled during collection? yes

11. To what temperature?
The sample should be maintained at approximately 4 degrees C (SM p41, #5b: SSM p2).

12. How is the sample cooled? ✓
Mechanical refrigeration or ice are acceptable. Blue ice or similar products are often inadequate.

13. How often is the temperature measured? should be checked
The temperature should be checked at least monthly to assure adequate cooling.

14. Are the sampling locations representative?

15. Are any return lines located upstream of the influent sampling location? plant recycle
This should be avoided whenever possible.

16. How is the sample mixed prior to withdrawal of a subsample for analysis? ✓
The sample should be thoroughly mixed.

17. How is the subsample stored prior to analysis? ✓
The sample should be refrigerated (4 degrees C) until about 1 hour before analysis, at which time it is allowed to warm to room temperature.

18. What is the cleaning frequency of the collection jugs? ✓
The jugs should be thoroughly rinsed after each sample is complete and occasionally be washed with a non-phospate detergent.

19. How often are the sampler lines cleaned? every week ✓
Rinsing lines with a chlorine solution every three months or more often where necessary is suggested.

pH Test Review

1. How is the pH measured?
A meter should be used. Use of paper or a colorimetric test is inadequate and those procedures are not listed in Standard Methods (SM p429).

2. How often is the meter calibrated? ✓
The meter should be calibrated every day it is used.

3. What buffers are used for calibration? 4, 7 ✓
Two buffers bracketing the pH of the sample being tested should be used.

If the meter can only be calibrated with one buffer, the buffer closest in pH to the sample should be used. A second buffer, which brackets the pH of the sample should be used as a check. If the meter cannot accurately determine the pH of the second buffer, the meter should be repaired.

BOD Test Review

1. What reference is used for the BOD test? ✓
   Standard ~~Methods~~ or the Ecology handout should be used.

2. How often are BODs run? 3x's a week
   The minimum frequency is specified in the permit.

3. How long after sample collection is the test begun? ✓
   The test should begin within 24 hours of composite sample completion (Ecology Lab Users Manual p42). Starting the test as soon after samples are complete is desirable.

4. Is distilled or ~~deionised~~ water used for preparing dilution water?

5. Is the distilled water made with a copper free still? ✓
   Copper stills can leave a copper residual in the water which can be toxic to the test (SSM p36).

6. Are any nitrification inhibitors used in the test? No What?
   2-chloro-6(trichloro methyl) pyridine or Hach Nitrification Inhibitor 2533 may be used only if carbonaceous BODs are being determined (SM p 527, #4g: SSM p 37).

7. Are the 4 nutrient buffers of powder pillows used to make dilution water?
   If the nutrients are used, how much buffer per liter of dilution water are added?
   1 mL per liter should be added (SM p527, #5a: SSM p37).

8. How often is the dilution water prepared? ✓
   Dilution water should be made for each set of BODs run.

9. Is the dilution water aged prior to use? ✓
   Dilution water with nitrification inhibitor can be aged for a week before use (SM p528, #5b).
   Dilution water without inhibitor should not be aged.

10. Have any of the samples been frozen? ✓
    If yes, are they seeded?
    Samples that have been frozen should be seeded (SSM p38).

11. Is the pH of all samples between 6.5 and 7.5?
    If no, is the sample pH adjusted?
    The sample pH should be adjusted to between 6.5 and 7.5 with 1N NaOH or 1N H_2SO_4 if 6.5 > pH >7.5 if caustic alkalinity or acidity is present (SM p529, #5e1: SSM p37).
    High pH from lagoons is usually not caustic. Place the sample in the dark to warm up, then check the pH to see if adjustment is necessary.

    If the sample pH is adjusted, is the sample seeded? ✓
    The sample should be seeded to assure adequate microbial activity if the pH is adjusted (SM p528, #5d).

12. Have any of the samples been chlorinated or ozonated? yes

If chlorinated are they checked for chlorine residual and dechlorinated as necessary?

How are they dechlorinated?

Samples should be dechlorinated with sodium sulfite (SM p529, #5e2: SSM p38), but dechlorination with sodium thiosulfate is common practice. Sodium thiosufate dechlorination is probably acceptable if the chlorine residual is < 1-2 mg/L.

If chlorinated or ozonated, is the sample seeded?

The sample should be seeded if it was disinfected (SM p528, #5d&5e2: SSM p38).

13. Do any samples have a toxic effect on the BOD test?

Specific modifications are probably necessary (SM p528, #5d: SSM p37).

14. How are DO concentrations measured?

If with a meter, how is the meter calibrated?

Air calibration is adequate. Use of a barometer to determine saturation is desirable, although not manditory. Checks using the Winkler method of samples found to have a low DO are desirable to assure that the meter is accurate over the range of measurements being made.

How frequently is the meter calibrated?

The meter should be calibrated before use.

15. Is a dilution water blank run?

A dilution water blank should always be run for quality assurance (SM p527, #5b: SSM p40, #3).

What is the usual initial DO of the blank?

The DO should be near saturation; 7.8 mg/L @ 4000 ft, 9.0 mg/L @ sea level (SM p528, #5b). The distilled or deionized water used to make the dilution water may be aged in the dark at ~20 degrees C for a week with a cotton plug in the opening prior to use if low DO or excess blank depletion is a problem .

What is the usual 5 day blank depletion?

The depletion should be 0.2 mg/L or less. If the depletion is greater, the cause should be found (SM p527-8, #5b: SSM p41, #6).

16. How many dilutions are made for each sample?

At least two dilutions are recommended. The dilutions should be far enough apart to provide a good extended range (SM p530, #5f: SSM p41).

17. Are dilutions made by the liter method or in the bottle?

Either method is acceptable (SM p530, #5f).

18. How many bottles are made at each dilution?

How many bottles are incubated at each dilution?

When determining the DO using a meter only one bottle is necessary. The DO is measured, then the bottle is sealed and incubated (SM p530, #5f2).

When determining the DO using the Winkler method two bottles are necessary. The initial DO is found of one bottle and the other bottle is sealed and incubated (Ibid.).

19. Is the initial DO of each dilution measured? ✓
What is the typical initial DO?
The initial DO of each dilution should be measured. It should approximate saturation (see #14).

20. What is considered the minimum acceptable DO depletion after 5 days?
What is the minimum DO that should be remaining after 5 days?
The depletion should be at least 2.0 mg/L and at least 1.0 mg/L should be left after 5 days (SM p531, #6: SSM p41).

21. Are any samples seeded?
Which?
What is the seed source? prim ef
Primary effluent or settled raw wastewater is the preferred seed. Secondary treated sources can be used for inhibited tests (SM p528, #5d: SSM p41).

How much seed is added to each sample? 2 mls
Adequate seed should be used to cause a BOD uptake of 0.6 to 1.0 mg/L due to seed in the sample (SM p529, #5d).

How is the BOD of the seed determined? ✓
Dilutions should be set up to allow the BOD of the seed to be determined just as the BOD of a sample is determined. This is called the seed control (SM p529, #5d: SSM p41).

22. What is the incubator temperature? ✓
The incubator should be kept at 20 +/- 1 degree C (SM p531, #5i: SSM p40, #3).

How is incubator temperature monitored? ✓
A thermometer in a water bath should be kept in the incubator on the same shelf as the BODs are incubated.

How frequently is the temperature checked? ✓ every day
The temperature should be checked daily during the test. A temperature log on the incubator door is recommended.

How often must the incubator temperature be adjusted? ✓
Adjustment should be infrequent. If frequent adjustments (every 2 weeks or more often) are required the incubator should be repaired.

Is the incubator dark during the test period? ✓
Assure the switch that turns off the interior light is functioning.

23. Are water seals maintained on the bottles during incubation? ✓
Water seals should be maintained to prevent leakage of air during the incubation period (SM p531, #5i: SSM p40, #4).

24. Is the method of calculation correct?
Check to assure that no correction is made for any DO depletion in the blank and that the seed correction is made using seed control data.

Standard Method calculations are (SM p531, #6):

for unseeded samples;

$$BOD\ (mg/L) = \frac{D1 - D2}{P}$$

for seeded samples;

$$BOD\ (mg/L) = \frac{(D1 - D2) - (B1 - B2)f}{P}$$

Where: D1 = DO of the diluted sample before incubation (mg/L)
D2 = DO of diluted sample after incubation period (mg/L)
P = decimal volumetric fraction of sample used
B1 = DO of seed control before incubation (mg/L)
B2 = DO of seed control after incubation (mg/L)

$$f = \frac{\text{amount of seed in bottle D1 (mL)}}{\text{amount of seed in bottle B1 (mL)}}$$

Total Suspended Solids Test Review

Preparation

1. What reference is used for the TSS test? ✓

2. What type of filter paper is used?
Std. Mthds. approved papers are: Whatman 934AH (Reeve Angel), Gelman A/E, and Millipore AP-40 (SM p95, footnote: SSM p23)

3. What is the drying oven temperature? a little high
The temperature should be 103-105 degrees C (SM p96, #3a: SSM p23).

4. Are any volatile suspended solids tests run?
If yes--What is the muffle furnance temperature? ✓
The temperature should be 550+/- 50 degrees C (SM p98, #3: SSM p23).

5. What type of filtering apparatus is used?
Gooch crucibles or a membrane filter apparatus should be used (SM p95, #2b: SSM p23).

6. How are the filters pre-washed prior to use? ✓
The filters should be rinsed 3 times with distilled water (SM p23, #2: SSM p23, #2).

Are the rough or smooth sides of the filters up? ✓
The rough side should be up (SM p96, #3a: SSM p23, #1)

How long are the filters dried? ✓
The filters should be dried for at least one hour in the oven. An additional 20 minutes of drying in the furnance is required if volatile solids are to be tested (Ibid).

How are the filters stored prior to use? ✓
The filters should be stored in a dessicator (Ibid).

7. How is the effectiveness of the dessicant checked? ✓
All or a portion of the dessicant should have an indicator to assure effectiveness.

Test Procedure

8. In what is the test volume of sample measured? ✓
The sample should be measured with a wide tipped pipette or a graduated cylinder.

9. Is the filter seated with distilled water? ✓
The filter should be seated with distilled water prior to the test to avoid leakage along the filter sides (SM p97, #3c).

10. Is the entire measured volume always filtered? ✓
The entire volume should always be filtered to allow the measuring vessel to be properly rinsed (SM p97, #3c: SSM p24, #4).

11. What are the average and minimum volumes filtered?

	Volume	
	Minimum	Average
Influent	25	
Effluent	250	

12. How long does it take to filter the samples?

	Time
Influent	
Effluent	quick

13. How long is filtering attempted before deciding that a filter is clogged?
Prolonged filtering can cause high results due to dissolved solids being caught in the filter (SM p96, #1b). We usually advise a five minute filtering maximum. ✓

14. What do you do when a filter becomes clogged? good ✓
The filter should be discarded and a smaller volume of sample should be used with a new filter.

15. How are the filter funnel and measuring device rinsed onto the filter following sample addition? ✓
Rinse 3x's with approximately 10 mLs of distilled water each time (? ?).

16. How long is the sample dried? ✓
The sample should be dried at least one hour for the TSS test and 20 minutes for the volatile test (SM p97, #3c; p98, #3: SSM p24, #4). Excessive drying times (such as overnight) should be avoided.

17. Is the filter thoroughly cooled in a dessicator prior to weighing? ✓
The filter must be cooled to avoid drafts due to thermal differences when weighing (SM p97, #3c: SSM p97 #3c).

18. How frequently is the drying cycle repeated to assure constant filter weight has ben reached (weight loss <0.5 mg or 4%, whichever is less: SM p97, #3c)?
We recommend that this be done at least once every 2 months. ✓

19. Do calculations appear reasonable? ✓
Standard Methods calculation (SM p97, #3c).

$$\text{mg/L TSS} = \frac{(A - B) \times 1000}{\text{sample volume (mL)}}$$

where: A= weight of filter + dried residue (mg)
B= weight of filter (mg)

Fecal Coliform Test Review

1. Is the Membrane Filtration ~~(MF)~~ or Most Probable Number (MPN) technique used?
   This review is for the MF technique.

2. Are sterile techniques used?

3. How is equipment sterilizated?
   Items should be either purchased sterilized or be sterilized. Steam sterilization, 121 degrees C for 15 to 30 minutes (15 psi); dry heat, 1-2 hours at 170 degrees C; or ultraviolet light for 2-3 minutes can be used. See Standard Methods for instruclions for specific items (SSM p67-68).

4. How is sterilization preserved prior to item use?
   Wrapping the items in kraft paper or foil before they are sterilized protects them from contamination (Ibid.).

5. How are the following items sterilized?

	Purchased Sterile	Sterilized at Plant
Collection bottles	✓	
Phosphate buffer	✓	
Media	✓	
Media pads		
Petri dishes		✓
Filter apparatus		✓
Filters		✓
Pipettes		✓
Measuring cylinder		✓
Used petri dishes		

6. How are samples dechlorinated at the time of collection?
   Sodium thiosulfate (1 mL of 1% solution per 120 mLs (4 ounces) of sample to be collected) should be added to the collection bottle prior to sterilization (SM p856, #2: SSM p68, sampling).

7. Is phosphate buffer made specifically for this test?
   Use phosphate buffer made specifically for this test. The phosphate buffer for the BOD test should not be used for the coliform test (SM p855, #12: SSM p66).

8. What kind of media is used?
   M-FC media should be used (SM p896, SSM p66).

9. Is the media mixed or purchased in ampoules?
   Ampoules are less expensive and more convient for under 50 tests per day (SSM p65, bottom).

10. How is the media stored?
    The media should be refrigerated (SM p897, #1a: SSM p66, #5).

11. How long is the media stored?
Mixed media ahould be stored no longer than 96 hours (SM p897, #1a: SSM p66, #5). Ampoules will usually keep from 3-6 months -- read ampoule directions for specific instructions.

12. Is the work bench disinfected before and after testing?
This is a necessary sanitazation procedure (SM p831, #1f).

13. Are forceps dipped in alcohol and flamed prior to use?
Dipping in alcohol and flaming are necessary to sterilize the forceps (SM p889, #1: SSM p73, #4).

14. Is sample bottle thoroughly shaken before the test volume is removed? The sample should be mixed thoroughly (SSM p73, #5).

15. Are special procedures followed when less than 20 mLs of sample is to be filtered?
10-30 mLs of sterile phosphate buffer should be put on the filter. The sample should be put into the buffer water and swirled, then the vacuum should be turned on. More even organism distribution is attained using this technique (SM p890, #5a: SSM P73, #5).

16. Are special procedures followed when less than 1 mL of sample is to be filtered?
Sample dilution is necessary prior to filtration when <1 mL is to be tested (SM p864, #2c: SSM p69).

17. Is the filter apparatus rinsed with phosphate buffer after sample filtration?
Three 20-30 mL rinses of the filter apparatus are recommended (SM p891, #5b: SSM p75, #7).

18. How soon after sample filtration is incubation begun?
Incubation should begin within 20-30 minutes (SM p897, #2d: SSM p77, #10 note).

19. What is the incubation temperature?
44.5 +/- 0.2 degrees C (SM p897, #2d: SSM p75, #9).

20. How long are the filters incubated?
24 +/- 2 hours (Ibid.).

21. How soon after incubation is complete are the plate counts made?
The counts should be made within 20 minutes after incubation is complete to avoid colony color fading (SSM p77, FC).

22. What color colonies are counted?
The fecal coliform colonies vary from light to dark blue (SM p897, #2e: SSM p78).

23. What magnification is used for counting?
10-15 power magnification is recommended (SM p898, #2e: SSM p78).

24. How many colonies blue colonies are usually counted on a plate?
    Valid plate counts are between 20 and 60 colonies (SM p897, #2a: SSM p78).

25. How many total colonies are usually on a plate?
    The plate should have <200 total colonies to avoid inhabition due to crowding (SM p893, #6a: SSM p63, top).

26. When calculating results, how are plates with <20 or >60 colonies considered when plates exist with between 20 and 60 colonies?
    In this case the plates with <20 or >60 colonies should not be used for calculations (SM p898, #3: SSM p78, C&R).

27. When calculating results how are results expressed if all plates have < 20 or > 60 colonies?
    Results should be identified as estimated.
    The exception is when water quality is good and <20 colonies grow. In this case the lower limit can be ignored (SM p893, #6a: SSM p78, C&R).

28. How are results calculated?
    Standard Methods procedure is (SM p893, #6a: SSM p79):

$$\text{Fecal coliforms/100 mL} = \frac{\text{\# of fecal coliform colonies counted}}{\text{sample size (mL)}} \times 100$$