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M E M O R A N D U M
March 28, 1984

To: John Bernhardt

From: Lynn Singleton and Gary Bailey

Subject: Penn Cove Park WTP and Receiving Water Survey

INTRODUCTION

This report documents results of the recent WDOE Penn Cove Park Wastewater Treatment Plant (WTP) and Receiving Water Survey. As you know, the Washington State Department of Social and Health Services (DSHS) completed a sanitary water quality survey in Penn Cove (DSHS, 1983) which generally looked at problems in the embayment. DSHS did not specifically address near-field receiving water impacts associated with the Penn Cove Park WTP. Addressing potential near-field effects was the major purpose of the present effort.

The specific objectives of the survey were to:

1. Perform a limited evaluation of the WTP's efficiency and compare it to the permitted treatment requirements.

2. Determine the chlorine contact time by dye addition.

3. Evaluate near-field receiving water impacts including conventional parameters and fecal coliform bacteria.

4. Locate the outfall site and visually evaluate any immediate impacts by SCUBA inspection.

5. Determine if shellfish or shorelines near Penn Cove Park WTP are affected by the wastewater.

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Penn Cove Park WTP is located on the north shore of Penn Cove near the mouth (Figure 1). It is a small Spiragester primary treatment plant which serves 152 households. This equates to a population of about 600 persons (Hayes, 1984). The community is comprised of family dwellings, and does not contain any industrial discharges. An infiltration problem exists during storm periods and, therefore, its flow may fluctuate widely; however, the current dry-weather average flow is 0.04 MGD. Effluent quality and disinfection efficiency may also fluctuate as a result. Disinfection is currently accomplished by a constant-feed chlorination system. Discharge to Penn Cove is via a 10-inch,865-foot gravity line which terminates at a depth of about 50 feet (MLLW). Chlorine contact time in the surcharged line may be quite long during low plant flow (Glynn, 1984).

METHODS

Wastewater Treatment Plant

Composite samplers set to collect a 250 mL sample every 30 minutes were installed at the inflow and unchlorinated effluent channels of the WTP at 1200 hours on February 6 and picked up at 1100 hours the following day. Samples were split with the WTP operator. The WDOE samples were analyzed for total suspended solids, biochemical oxygen demand, specific conductance, and pH by the Olympia Environmental Laboratory in Tumwater.

On February 6, 1984, a sample of chlorinated effluent was collected from a manhole about 200 feet from the chlorinator and tested for total residual chlorine (DPD method). Two dechlorinated fecal coliform samples were taken at approximately 1440 on 2/6/84 when the plant flow was 120,000 GPD (Glynn, 1984). For the dye test, 200 mL of Rhodamine WT dye were added to the effluent at the manhole site at 1318 hours.

Receiving Water Survey

Shellfish samples (Mytilus edulis) and near-shore water samples (grab) were collected from beach areas for MPN analysis. The stations were established at relatively even intervals between the plant site and the head end of the cove (Figure 1). These sites corresponded to areas in the circulation paths noted by DSHS (1983). Additional near-shore water quality samples were collected on February 7 from 0930 to 1030 hours (higher high tide at 0825). Three stations were sampled in the vicinity of the outfall, and a fourth, to the west, represented background conditions (Figure 1). Analysis included fecal coliforms (MF) at the surface; whereas samples obtained at 1 meter and the bottom were analyzed for fecal coliform (MF), total phosphorus; orthophosphate-P, nitrate-N, nitrite-N , ammonia-N, and dissolved oxygen. Salinity, temperature, and conductivity measurements were made in situ at the surface and 14 meters. Secchi disc measurements were also made at each location.

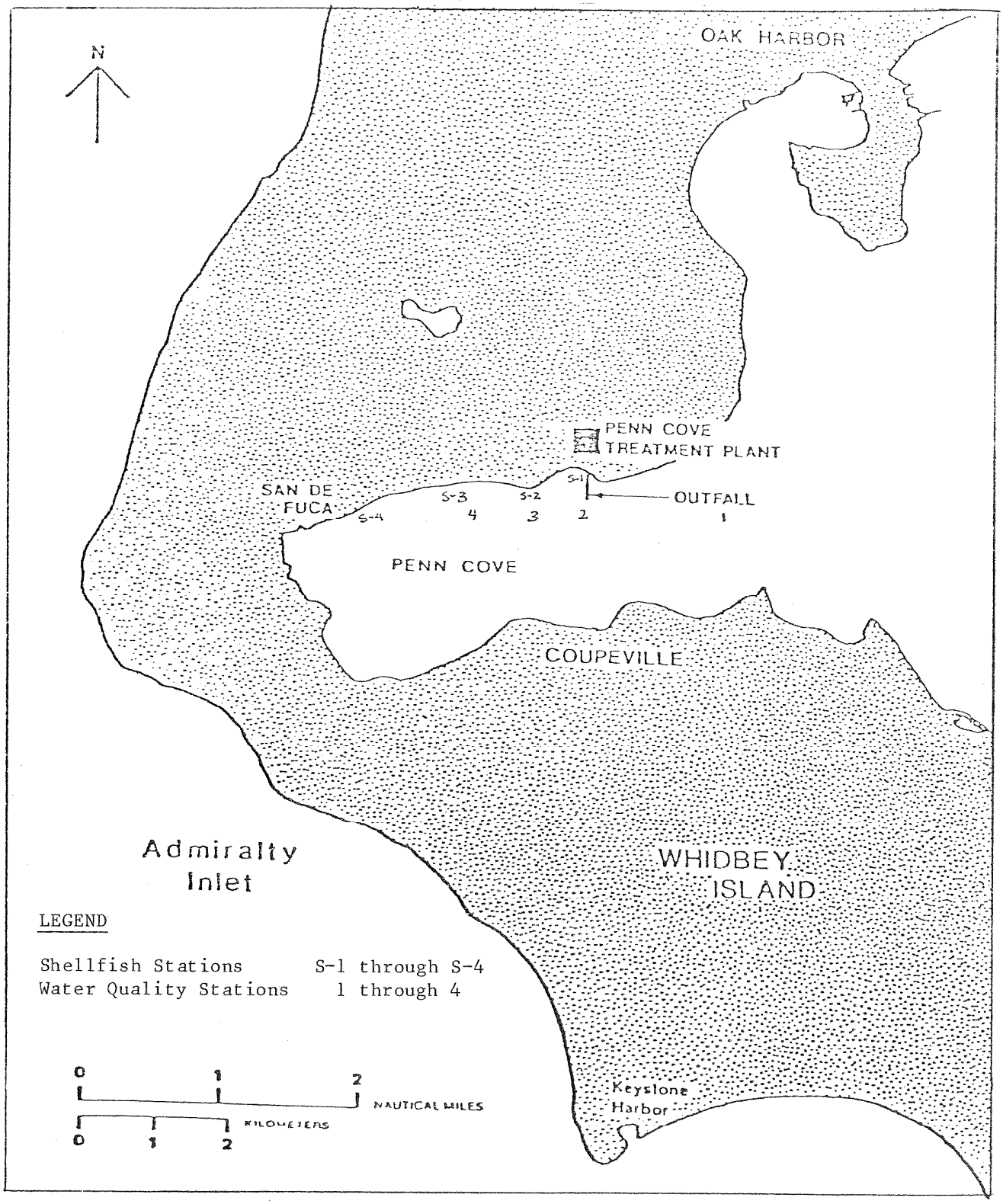

Figure 1. Sample station locations for the Penn Cove Park WTP and receiving water survey (2/6-7/84).

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All samples were placed on ice and delivered to the Olympia Environmental Laboratory within 24 hours as per U.S. EPA (1979).

The outfall site was to be inspected by two SCUBA divers. Two transects were made perpendicular to the predicted lie of the effluent line.

Results and Discussion

Wastewater Treatment Plant

The results of the composite samples are presented below in Table 1.

Table 1. Penn Cove Park WTP 24-hour composite results for 2/6-7/84 and the NPDES effluent limitations as per Docket No. DE 77-231.

Parameters	Influent	Effluent*	Limits**
Flow (MGD)	--	0.035	0.055
pH (S.U.)	8.3	7.6	6.5-8.5
Specific Conductance (umhos/cm)	2790	2880	--
BOD5 (mg/L)	260	94	165
TSS (mg/L)	160	110	115
Fecal Coliform (#/100 mL)	--	320 Est.*** 130,000***	700

*Represents a 4-hour composite due to an equipment malfunction.
**Monthly average limitations.
***Grab samples collected three minutes apart.

The plant appeared to be meeting its interim permit limitations for all parameters during the survey, with the exception of fecal coliforms. One coliform sample was in excess of the permitted levels. The effluent results were compromised by the failure of the composite sampler. Stopping about four hours after it was started, it may have affected the results by underestimating the load.

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The total residual chlorine at the manhole site (1300 hours) was 2.5 to 3.0 mg/L. When asked about the high residual, the operator indicated he usually tries to maintain a residual around 1.0 mg/L, but John Glynn had suggested he maintain a higher residual because of the bacterial problems the mussel growers occasionally experience in Penn Cove. The bacteria samples taken (approximate time 1440 hours) by John Glynn within three minutes of each other were 320 (est.) and 130,000 org/100 mL. Total residual chlorine was still in excess of 1.0 mg/L at a plant flow of 0.12 MGD (Glynn, 1984). The non-uniform nature of the solids in the discharge may explain the variable bacteria number because solids can potentially reduce disinfection efficiency. The effluent solids appear to increase with surges in plant flow.

The chlorine contact time of the outfall system is quite long. Nunnallee (1984) estimated it to be about 2 1/2 hours at the average plant flow. This was not verified by the dye test because the dye did not surface during the 2-hour and 45 minute period following the addition.

The specific conductance measurements of the wastewater indicated the plant has a saltwater infiltration problem. This would be a daily periodic problem for the plant. Inspection of the plant flow records and the tide table may indicate why daily peak flows occur when they do. A rough calculation using many assumptions indicates that seawater intrusion may be about 10 to 20 percent of the average plant flow; however, a more detailed analysis is needed to refine this estimate.

In general, the equipment at the plant appeared to be operable; however, the steel walkway over the Spiragester is unsafe due to corrosion.

Receiving Water Survey

Station 2 was situated over the estimated location of the outfall. The dyed wastewater never appeared at the surface during the two hours of monitoring, so the location was the best estimate possible based on distance from shore, water depth, and the discharge line design plans. As can be seen by the data in Tables 2 and 3, conditions at station 2 were very similar to the other stations sampled. The water clarity differences (secchi disk measurements) between Station 1 and the other stations is probably related to the rougher sea conditions present at that station during sampling, and not a real difference. The reason(s) for differences in ammonia-nitrogen at Station 1 are not apparent at this time. Bacteria levels at the deepwater stations were all within Class A standards.

An obvious density gradient (pycnocline) existed somewhere between the 1- and 14-meter depths. The outfall analysis (Nunnallee 1984) indicates that the strong stratification should prevent the wastewater from reaching the surface; however, it may nearly reach it at times. Circulation in Penn Cove is driven by tidal action, wind, and Skagit River inputs.

Table 2. Results of water quality samples collected in Penn Cove, WA. between 0930-1030 hours on February 7, 1984 (values in mg/L unless otherwise noted).

Station	Date	Depth (m)	Nitrate-N	Nitrite-N	Ammonia-N	O-PO4-P	T-PO4-P	Fecal Coliform (MF) (org/100 mL)	Dissolved Oxygen
1	2/7	0						1*	
		1	0.32	0.01**	0.15	0.04	0.04	1**	11.3
		60	0.38	0.01**	0.08	0.06	0.06	1*	6.3
2	2/7	0						1*	--
		1	0.36	0.01**	0.02	0.03	0.03	1*	11.3
		60	0.40	0.01**	0.02	0.05	0.05	1**	6.5
3	2/7	0						2*	
		1	0.36	0.01**	0.04	0.03	0.03	1*	11.4
		60	0.40	0.01**	0.07	0.06	0.06	1*	6.8
4	2/7	0						3*	
		1	0.36	0.01**	0.04	0.03	0.03	1*	11.4
		60	0.36	0.01**	0.01	0.04	0.04	1**	7.7

*Estimate
**"Less than" value.

Table 3. Physical and chemical *in situ* measurements made in Penn Cove, WA between 0930-1030 hours on February 7, 1984.

	Salinity (o/oo)	Conductivity (mmhos/cm)	Temperature (°C)	Secchi Disk (m)
Station 1				
Surface	14.7	15.9	6.0	
				3.5
14 meters	25.3	28.0	8.4	
Station 2				
Surface	14.6	16.0	5.9	
				4.0
14 meters	25.5	28.2	8.5	
Station 3				
Surface	14.7	16.0	5.9	
				4.2
14 meters	24.7	27.4	8.6	
Station 4				
Surface	14.7	15.9	6.0	
				4.2
14 meters	25.3	28.0	8.4	

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A visual inspection of the area immediately surrounding the outfall was not possible. As indicated previously in the text, the dye did not surface and the two SCUBA divers were unable to locate the outfall because of poor water visibility.

The MPN fecal coliform results from the near-shore shellfish and water samples (Table 4) indicate that shellfish marketability and Class A water quality standards are exceeded in some areas of Penn Cove. The standards are 230 org/100 g tissue and 14 org/100 mL water.

Table 4. Fecal coliform bacteria concentrations (MPN) from water (W) org/100 mL and Mytilus edulis tissue (T) org/100 g from Penn Cove, WA between 1500 and 1600 hours on February 6, 1984.

Station	Medium	Fecal Coliform Count
S-1	W	2
	T	80
S-2	W	2*
	T	230
S-3	W	46
	T	790
S-4	W	2
	T	130

*"Less than" value.

Bacterial counts in the shellfish appeared to generally increase along the middle part of the cove, then declined to acceptable levels at the innermost station (S-4). These data along with the WTP effluent bacteria concentrations and the circulation observations (DSHS, 1983) indicate that the Penn Cove Park WTP may be impacting or aggravating the sanitary conditions of the cove.

Summary

1. Penn Cove Park WTP experiences extremely variable waste characteristics which appear to aggravate the high effluent bacteria concentrations.

2. The WTP has a marine water infiltration problem

3. With the exception of bacteria, no near-field water quality impacts were observed. However, the survey was very limited and subtle effects or effects under different plant/environmental conditions were not evaluated.

4. The actual outfall site was not located, and the effluent did not appear to surface.

5. Shellfish located along the circulation path the effluent most likely follows, contained unacceptable levels of bacteria. Therefore, the Penn Cove Park WTP effluent may be affecting the sanitary quality of resident shellfish.

LRS:GB:cp

cc: Dave Nunnallee
John Glynn

REFERENCES

DSHS, 1983. Penn Cove Water Quality Study - September 12-22, 1983. Part 1: Sewage Treatment Plant Reliability and Non-Point Sources of Pollution. Wash. Dept Soc. & Health Svcs., Olympia WA. 30 pp + appendix.

Glynn, J., 1984. Wash. Dept. Ecology, Northwest Regional Office, Redmond, WA. personal communication.

Hayes, L., 1984. Penn Cove Park WTP operator, Penn Cove, WA. personal communication.

Nunnallee, D, 1984. Penn Cove Sewer District Mathematical Analysis of Outfall. Wash. Dept. of Ecology, Northwest Regional Office, Redmond, WA. 6 pp.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020. 460 pp.