Publication No. 84-e07

WA-22-4040

JOHN SPELLMAN
Governor

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
7272 Cleanwater Lane, LU-11 • Olympia, Washington 98504 • (206) 753-2353

MEMORANDUM
August 7, 1984

To: Darrel Anderson

From: Marc Heffner

Subject: Elma Sewage Treatment Plant (STP), Grays Harbor County, Class II Inspection, May 1-2, 1984

INTRODUCTION

The Elma STP is an aerated lagoon-type secondary facility. Treatment units include a bar screen, two aerated lagoons, a final clarifier, and a chlorine contact basin (Figure 1). The effluent is pumped through a long force main (approximately 1.5 miles) and discharged into the Chehalis River (Figure 2). Plant discharge is limited by NPDES permit #WA-002313-2.

The Class II inspection was requested primarily to review plant performance prior to issuing an updated NPDES permit. The present permit, which expired May 25, 1984, has been extended pending issue of an updated permit. The inspection was designed to:

1. Collect plant influent and effluent samples to evaluate plant performance.

2. Review plant laboratory procedures and split samples for WDOE and Elma STP laboratory analysis.

The inspection was conducted by Darrel Anderson (WDOE, Southwest Regional Office) and Brad Hopkins and Marc Heffner (WDOE, Water Quality Investigations Section). Quinton Boyer, the STP operator, represented the City of Elma.

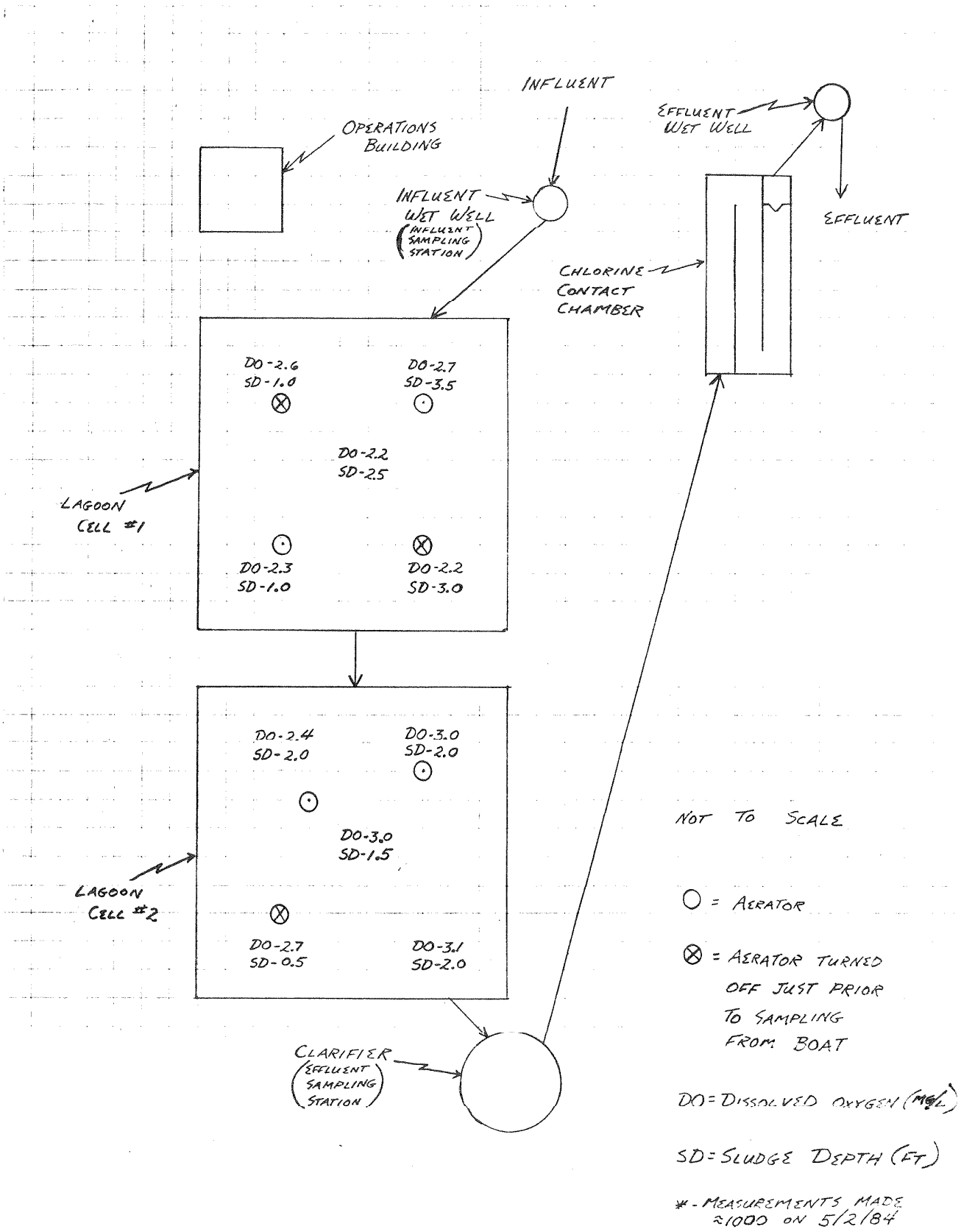

Figure 1. Plant schematic with lagoon dissolved oxygen and sludge depth measurements - Elma, May 1984.

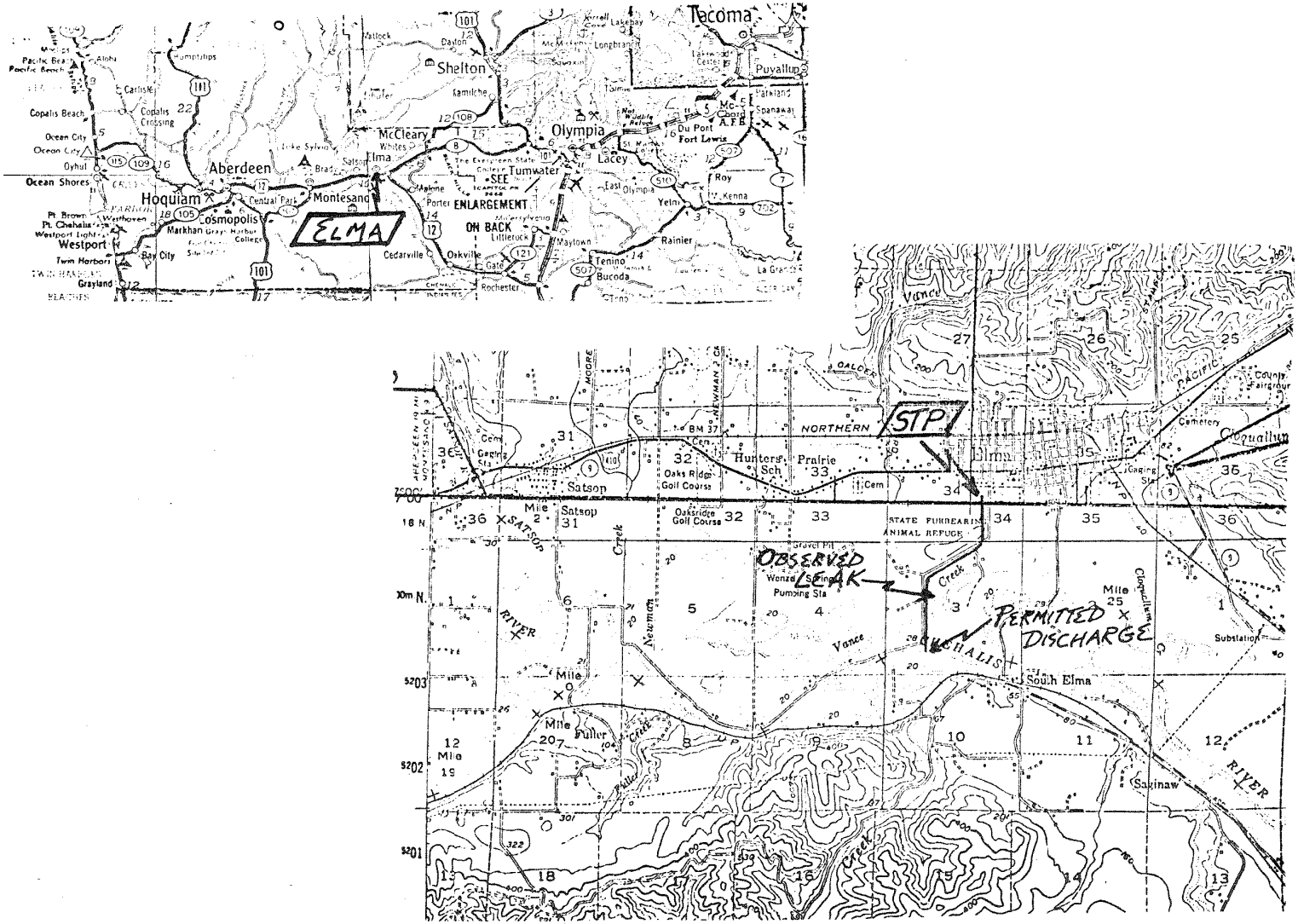

Figure 2. Elma STF location - Elma, May 1984.

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PROCEDURES

WDOE composite samplers were set up to collect influent and effluent samples (Figure 1). The samplers were started at approximately 1000 hours on May 1 to collect 200 mLs of sample every 30 minutes for 24 hours. The effluent sampler malfunctioned, so an effluent hand-composite sample was collected. The effluent sample composite consisted of four samples of equal volume collected at 45-minute intervals beginning at 1000 hours on May 2. The STP operator collected influent and effluent grab samples at approximately 1200 hours on May 2. Both the WDOE and Elma samples were split for WDOE and Elma laboratory analysis. Also, the operator delivered some of the samples to Ventron, a local industry, for analysis. WDOE laboratory results are presented on Table 1.

Table 1. WDOE laboratory results of split samples - Elma, May 1984.

Sample	Sampler	BOD_5 (mg/L)	COD (mg/L)	Solids (mg/L) TS	TNVSS	TSS	TNVSS	pH	Turb. (NTU)	Cond. (umhos/cm)	Nutrients (mg/L) NO_3-N	NO_2-N	NH_3-N	O-PO_4-P	T-PO_4-P	Alk. (mg/L)
Influent	WDOE*	130	220	450	200	85	28	7.7	99	358	0.60	<0.10	14	3.0	6.6	120
	Elma**	240	450	630	350	83	23	8.2	110	575	0.70	<0.10	12	3.3	8.6	170
Effluent	WDOE†	42	140	300	210	34	10	8.0	33	432	<0.10	<0.10	16	4.9	8.3	140
	Elma**	43	130	300	210	30	8	7.6	20	465	0.10	<0.10	18	5.1	7.7	140

*24-hour composite.
**Grab sample.
†Hand composite.

WDOE influent and effluent grab samples were collected for field analysis of temperature, pH, conductivity, and chlorine residual and for laboratory analysis for fecal coliforms in the effluent (Table 2). Also, a boat was utilized to collect surface samples for dissolved oxygen (D.O.) analysis (Winkler method) and to make sludge depth measurements (using a "Sludge Judge" core sampler) at several stations in each lagoon (Figure 1). Sludge depth measurements were also made in the clarifier and chlorine contact chamber.

Table 2. WDOE grab sample data - Elma, May 1984.

Sample	Date	Time	Temperature (°C)	pH (S.U.)	Conductivity (umhos/cm)	Chlorine Residual (mg/L) Free	Total	Fecal Coliforms (#/100 mL)
Influent	5/1	0940	15.3	7.5	405			
		1415	14.8	7.6	410			
	5/2	0950	13.4	7.4	295			
	5/1-2	Comp.	2.0	7.6	370			
Effluent	5/1	1000	12.8	7.5	440			
		1050				.1-.2	1.0-1.5	1 est.
		1415	13.1	7.3	435	.6	1.0	<1
	5/2	1000	12.4	7.6	420	.7	1.0-1.5*	<1

est. = estimated.
*Sample split with operator; his result - 1.5 mg/L.

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The plant did not have a functional flow meter at the time of the inspection. A WDOE flow measurement was made by setting up a Manning dipper flow meter in conjunction with the plant V-notch weir in the chlorine contact chamber.

Off-site facilities observed as part of the inspection included the plant bar screen and driving along the path of the effluent force main. The bar screen is located approximately 1/4 mile from the STP at the site of the old plant. The path of the effluent force main was followed until it entered a marshy area (Figure 2). The marshy area prevented observation of the permitted discharge site.

RESULTS AND DISCUSSION

The WDOE sample indicated that plant influent is relatively weak (Table 1). The BOD_5 (130 mg/L) and TSS (85 mg/L) concentrations suggest that some I/I is entering the system. The weather pattern during the inspection consisted of frequent showers at a time when soil moisture content was high. The script chart of the effluent flow made by the WDOE Manning dipper describes a fairly consistent flow during the inspection, which further leads one to suspect I/I occurrence (Figure 3). Although I/I was occurring, flow during the inspection (0.29 MGD) was well below both design (0.48 MGD) and permitted (0.35 MGD) flows.

At the time of the inspection, the plant had no flow meter. The operator was making instantaneous measurements at the weir and entering that as plant flow. The operator was measuring head directly at the weir rather than upstream out of the drawdown zone. Instantaneous measurements upstream of the drawdown zone should be made until a flow meter (including totalizer) is put on line. A flow meter should be put on line in the near future.

Table 3 compares WDOE inspection data to NPDES permit limits. The BOD_5 monthly average concentration limit, loading limit, and percent removal limit were exceeded during the inspection. Failure to meet the 30 mg/L BOD_5 limit during the inspection is difficult to explain. Lagoon sizing when compared to WDOE design criteria appeared more than adequate for the load being applied during the inspection (WDOE, 1978). D.O. concentration and sludge depth measurements in the lagoon were not indicative of a problem. It appears that some experimentation with adjustment of aeration schedules to optimize plant performance and meet permit limits should be undertaken by the operator. Increasing aeration should also increase mixing; thus a potential for better treatment resulting from more contact between wastewater and microbes exists. Changes in the aeration schedules should be noted in the plant log book so aeration rates can be associated with plant performance.

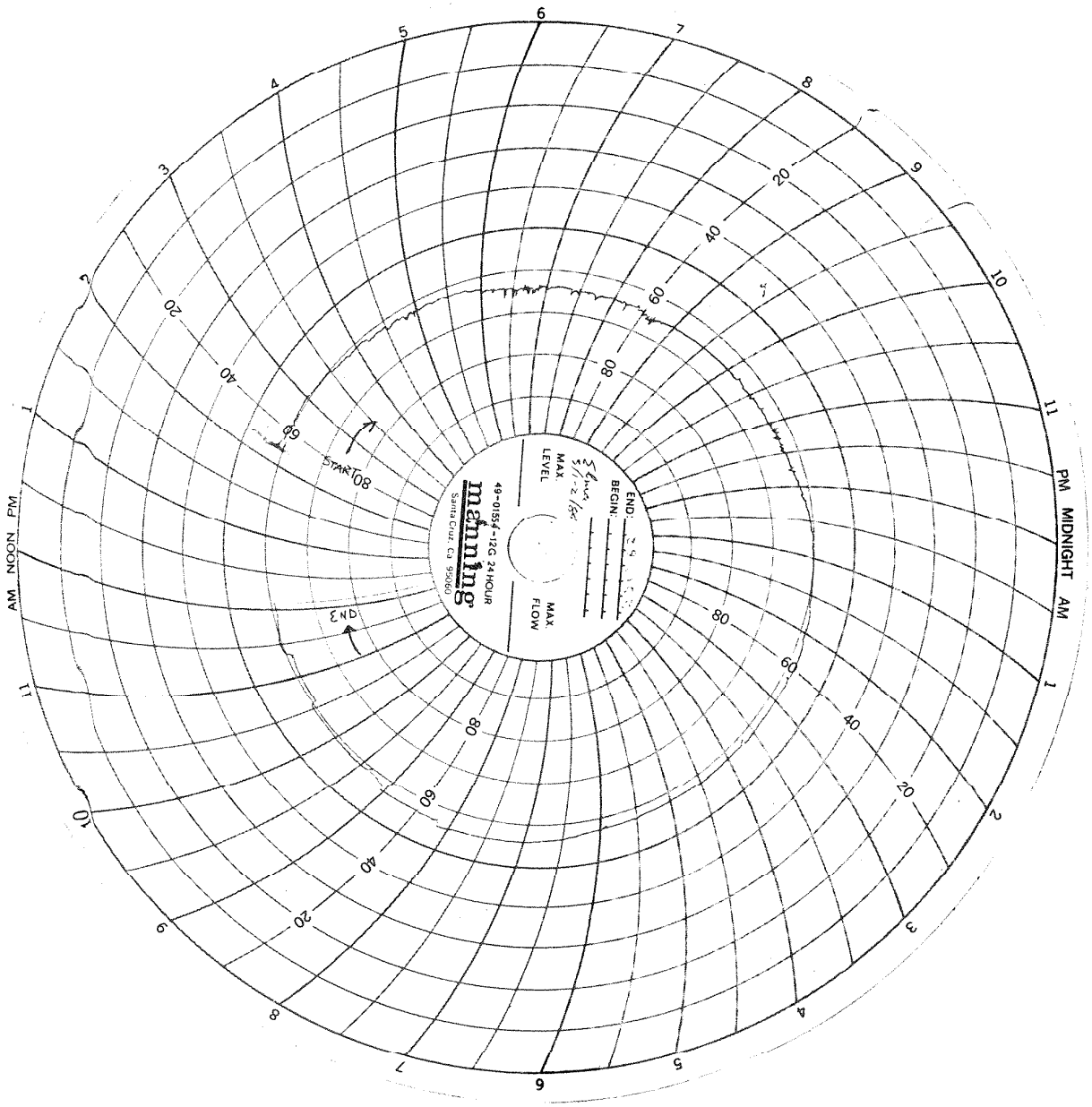

Figure 3. Script chart from WDOE Manning dipper - Elma, May 1984.

Table 3. Comparison of WDOE laboratory results with NPDES permit limits - Elma, May 1984.

	NPDES Permit		WDOE Analysis	
	Monthly Average	Weekly Average	WDOE Sample	Elma Sample
BOD_5 (mg/L)	30	45	42	43
(lbs/day)	88	132	102	104
(% removal)	85		68	82
TSS (mg/L)	75	113	34	30
(lbs/day)	219	330	82	73
Fecal Coliforms (#/100 mL)	200	400	<1†	
pH (S.U.)	$6.0 \leq pH \leq 10.5$		7.3 - 7.6†	
Flow (MGD)	0.35		0.29	

†Analysis of three WDOE grab samples, see Table 2 for actual results.

Sludge depth measurements were also made in the clarifier (sludge depth approximately 1 foot) and chlorine contact chamber (sludge depth approximately 6 inches). In both cases, sludge depths were minimal. The operator reported that the clarifier sludge is pumped out approximately once every six months, and that the sludge had not been pumped for some time prior to the inspection. The clarifier sludge level should be monitored when mixing in the lagoons is increased. If the unit continues being ineffective, bypassing the unit should be considered.

During the inspection only three aerators were positioned in lagoon cell 2. The operator reported that the fourth aerator was out of service for repairs and that such operation was not that unusual. Should servicing require plant operation with less than four aerators per cell (the design number) for more than a month per year, acquisition of a spare aerator for operation while another is being serviced is desirable. This would help the operator to maintain optimal mixing in the basins at all times.

To optimize plant performance, accurate laboratory analytical results and operations records are necessary. The laboratory review portion of the inspection demonstrated a need to improve laboratory techniques and record-keeping in order to improve operations. Specific problems included:

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Sampling

BOD_5 and TSS grab sample procedures complied with the permit requirement. Composite sampling, particularly for the influent sample, is preferred. The BOD_5 concentrations from the Elma (240 mg/L) and WDOE (130 mg/L) influent sample data are considerably different (Table 1). Grab samples are more susceptible to the periodic fluctuations in loading associated with sewage flows. A minimum of an eight-hour hand composite (equal volumes of sample collected every two hours) is suggested for the influent sample. If mechanical sampling equipment becomes available, 24-hour composites would be preferable. A 24-hour composite would probably more accurately describe the loading since the eight-hour sampling would coincide with the time period of loading from the schools. The high detention time associated with lagoon treatment tends to reduce the fluctuations in effluent quality, so effluent composite sampling is not as critical, but an eight-hour hand composite is still preferred to further reduce the risk of fluctuations biasing sampling data. Samples should be stored at 4°C during the sampling period and until approximately one hour before sample analysis begins.

BOD_5

The operator was not using a standard reference for procedural guidance when conducting the test. He reported that he relied on his knowledge and experience acquired by conducting the test, but appeared to do little review of references to supplement and update his methods. A copy of the current WDOE BOD test procedure methods was left with the operator for his review and use (WDOE, 1977). Potential sources of error noted during the discussion included:

1. Five-day sample D.O. concentrations are presently compared to the five-day D.O. concentration of the blank to determine sample D.O. depletion. Each sample dilution should be set up in triplicate with one bottle tested immediately to measure the initial D.O. and the other two bottles tested five days later to determine the oxygen depletion.

2. The most recent BOD_5 lab bench sheet noted an initial blank D.O. of 11.4 mg/L (above the desired range of 8.3 to 9.2 mg/L) and a five-day D.O. depletion of 0.6 mg/L in the blank (above the desired 0.2 mg/L maximum). Aging distilled water for one to two weeks in clean cotton-plugged containers in the dark prior to making dilution water should help remedy the blank D.O. problems.

3. The incubator should be plugged in and running the day before the test to assure that the proper temperature is reached prior to the test. This was not the case during the inspection. A log of the incubator temperatures should be kept daily during the BOD_5 test until incubator consistency is documented. A water bath with a thermometer placed on the shelf usually used for incubation is the preferred monitoring method.

4. The operator had difficulty interpreting data from one of his worksheets when asked to explain how BOD_5 calculations were done. Understandable worksheets are a must for accurate calculations and good documentation of laboratory results. Using the example worksheet included in the WDOE lab procedural guidelines as a model may be helpful (WDOE, 1977).

TSS

As with the BOD_5 test, a reference was not used for test procedures. Specific problems included:

1. Filter papers should be rinsed by running distilled water through them and then dried prior to use.

2. Filters should be weighed and dried on pans to avoid losing solids during the analytical process.

3. The temperature in the drying oven was 120°C at the time of the inspection, well above the approved 103 to 105°C range. The oven should be adjusted to the proper temperature and a log of the temperature kept to help assure reliable results.

pH

The bromothymol blue method, a colorimetric test, was being used for pH measurement at the STP. The greenish tint associated with lagoon effluent makes results from a colorimetric test suspect. Standard Methods notes that "the colorimetric method is suitable only for rough estimation" and states that "the glass electrode method is the standard technique" (APHA, 1980). The pH meter at the plant should be repaired or a new meter purchased and measurements made using a meter.

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Fecal Coliform

Elma contracts with the Grays Harbor County Laboratory for fecal coliform analysis. One sample per month was being sent in by the operator for analysis. A sample should be collected and analyzed weekly to conform with NPDES permit requirements.

Analytical results of the samples split with the Elma and Ventron laboratories are presented on Table 4. WDOE and Elma results comparison is considered good for the WDOE influent sample TSS analysis, the WDOE effluent sample BOD_5 and TSS analyses, and the grab sample total chlorine residual analysis; marginal for the WDOE influent sample BOD_5 analysis, the Elma influent sample BOD_5 analysis, and the Elma effluent sample BOD_5 and TSS analysis; and poor for the Elma influent sample TSS analysis. Worksheets were requested from the operator so calculations could be checked, but the worksheets sent did not correspond to the inspection time period--in fact the last entry on the TSS worksheet received was March 29, 1983. Worksheets to support DMR reporting should be available. It is suggested that the operator be requested to submit copies of his worksheets along with the DMR's until a good record-keeping policy is demonstrated.

Table 4. Comparison of laboratory results - Elma, May 1984.

		BOD_5 (mg/L)			TSS (mg/L)			Total Chlorine Residual (mg/L)	
Sample	Sampler	WDOE	Elma	Ventron	WDOE	Elma	Ventron	WDOE	Elma
Influent	WDOE	130	182.5	96	85	81	158		
	Elma	240	310	192	83	156	160		
Effluent	WDOE	42	36.8	16	34	36	96		
	Elma	43	33.1	---	30	39	---		
	Grab							1.0-1.5	1.5

WDOE and Ventron analytical results did not compare well (Table 4). Results of Ventron analysis of Elma STP samples should be identified as being done by Ventron when included on DMR submissions. Ventron analysis should be considered only a supplement to, rather than a replacement for, routine Elma STP operator testing.

Inspection of the bar screen and the force main route revealed one potential problem and one existing problem. The potential problem was the safety hazard associated with public access to the bar screen. The bar screen was in a shed that had no door. Limiting access by putting a locking door on the shed should eliminate the hazard. The existing problem was a leak in the force main, resulting in a substantial portion of the effluent going into Vance Creek (Figure 2). A grab sample of the discharge had a fecal coliform concentration of 23 mg/L and a total chlorine residual of <0.1 mg/L. The force main should be repaired so that the observed unpermitted discharge is eliminated.

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CONCLUSIONS AND RECOMMENDATIONS

During the Class II inspection, five basic problems were noted which were not in accordance with NPDES permit requirements. These included:

1. Discharge location - The effluent force main had ruptured resulting in an unpermitted discharge into Vance Creek. The force main should be repaired so discharge is only to the Chehalis River.

2. Fecal coliform count frequency - This test was being run monthly rather than weekly, as required by the permit. Test frequency should be increased.

3. Plant flows - The plant did not have an operable flow meter and totalizer. An operable meter should be installed and maintained.

4. BOD reduction - During the inspection, the BOD_5 load and concentration in the effluent exceeded NPDES monthly permit limits. DMRs submitted between May 1983 and April 1984 indicate that the monthly BOD_5 concentration limit was exceeded nine of twelve times. Operational modifications should be attempted to bring the plant into compliance. Keeping eight aerators on line (eight is the design number) and increasing aeration time to provide better mixing is a logical starting point to accomplish this.

5. Plant record-keeping and laboratory techniques - Good operational records and laboratory analytical results are necessary to correlate operational changes with plant efficiency. As noted in the discussion, laboratory techniques and record-keeping are of concern. Laboratory technique changes noted in the discussion should be made and accurate records maintained. To assist the operator in establishing good records, copies of laboratory worksheets and plant operation logs could be included along with the DMR submissions for WDOE review and comment for a period of time.

Correction of these deficiencies noted here and lab procedural problems noted in the discussion should be made in an effort to comply with the NPDES permit. After deficiencies are corrected, good maintenance practices should be followed to sustain an acceptable level of treatment.

MH:cp