

**CHEHALIS RIVER BASIN CLASS II INSPECTIONS AT
EIGHT NPDES PERMITTED DISCHARGERS
AUGUST 1991 - AUGUST 1992**

by
Tapas Das

December 1993

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Washington State Department of Ecology
Environmental Investigations and Laboratory Services Program
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ABSTRACT

A series of Class II inspections was conducted at three municipal wastewater treatment plants (WTPs), one industrial WTP, and four fish farms in the Chehalis River Basin over a period of one year beginning in August 1991. Centralia, Chehalis, and Darigold employ trickling filters, while Pe Ell uses an oxidation ditch. Each fish farm typically consists of rearing ponds and a settling basin. All facilities were operating reasonably well at the time of inspection, and met effluent discharge limitations with the following exceptions: 1) Centralia WTP did not meet the requirement of 85% removal for five-day biochemical oxygen demand (BOD₅) and total suspended solids (TSS) on August 26-27, 1991; 2) Chehalis effluent had high levels of residual chlorine; 3) Pe Ell WTP's removal efficiency for BOD₅ was marginally less than the 85% requirement, and the design flow was exceeded; and 4) Darigold WTP failed to meet permit limits for fecal coliform, residual chlorine, and TSS concentration, and BOD₅ and TSS loadings in effluent were excessive. A mixing zone evaluation may be required to confirm that dilution is sufficient to prevent ammonia, chloride, and chlorine toxicity at Darigold WTP. Centralia, Chehalis, Pe Ell, and Darigold WTPs all had assorted problems with sampling and lab procedures. Other recommendations for these facilities are included in this report. Effluents collected from the four fish farms met NPDES permit limits for settleable solids (SS) and TSS.

INTRODUCTION

A total maximum daily load (TMDL) study by the Environmental Investigations and Laboratory Services Program of Ecology is progressing in the Chehalis River Basin (Pickett, in prep.). In support of the study, Ecology's Watershed Assessments Section conducted Class II inspections at eight NPDES permitted dischargers in the study area. They include the following:

<u>Discharger</u>	<u>Type of Facility</u>	<u>NPDES Permit No.</u>	<u>Expiration Date</u>
Centralia	Municipal	WA-002089-2	7/9/90
Chehalis	Municipal	WA-002110-5	12/10/93
Pe Ell	Municipal	WA-002019-5	10/22/86
Darigold	Industrial	WA-003747-8	3/26/92
Swecker Salmon	Fish Farm	WAG-13-1006	1/26/95
Global Aqua (BR)	Fish Farm	WAG-13-1014	1/26/95
Global Aqua (SC)	Fish Farm	WAG-13-1007	1/26/95
Sea Farm of Washington	Fish Farm	WAG-13-1000	1/26/95

Among these permittees, three (Centralia, Pe Ell, and Darigold) have expired permits which have been administratively extended.

The inspections were conducted during August 26-28, September 9-11, and December 3-4, 1991; and July 20-21 and August 4-5, 1992. Altogether, three separate visits were made to collect samples at Centralia, Chehalis, and Darigold WTPs, while only one visit was made to Pe Ell and to each fish farm.

Objectives of the inspections were to:

1. provide effluent data to support the Chehalis River Basin TMDL assessment;
2. determine discharge rate at each facility;
3. determine waste loadings and removal efficiencies at Centralia, Chehalis, Pe Ell, and Darigold;
4. verify compliance with NPDES permit limits; and
5. evaluate permittee's self-monitoring by reviewing sampling and using sample splits at Centralia, Chehalis, Pe Ell, and Darigold WTPs.

Conducting the inspections were Tapas Das, Norm Glenn, Rebecca Inman, Chad Stüssy, and Bob Cusimano of Ecology's Watershed Assessments Section. The operators providing assistance were: Lora Lyons at Centralia, Robert Pinkerton at Chehalis, Derek Zock at Pe Ell, Frank Klobertanz at Darigold, Eric Johnson at Swecker Salmon Farm, Dan Rotter at Global Aqua at Black Lake, Greg Hudson at Global Aqua at Scatter Creek, and William St. Jean at Sea Farm of Washington. Figure 1 is a map of the basin showing the locations of the eight sites.

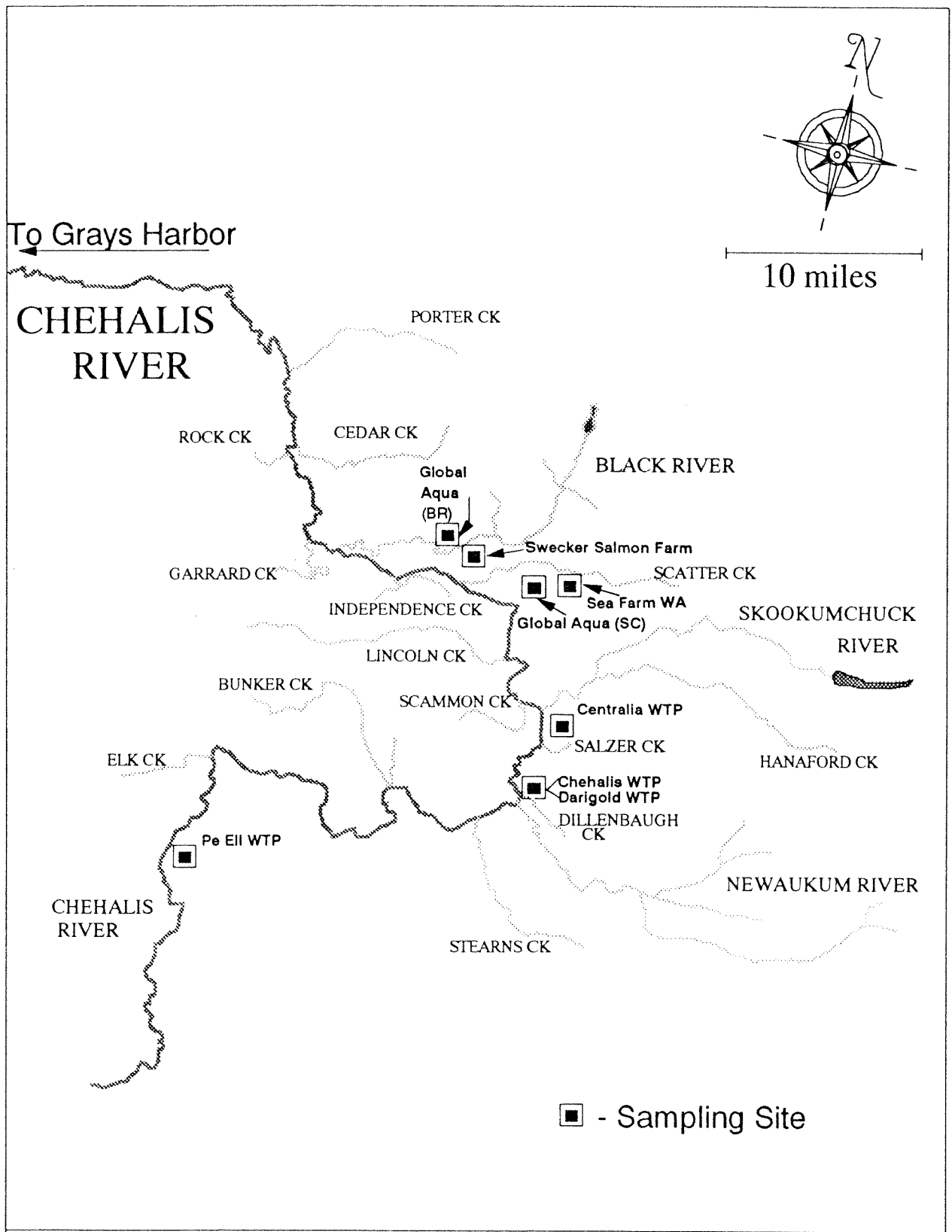


Figure 1. Location Map - Chehalis River Basin
Class II Inspections, 8/91-8/92

METHODS AND DATA QUALITY ASSURANCE

Sampling and Inspection Procedures

All sampling equipment was cleaned before use by washing with non-phosphate detergent and rinsing with tap water. Collection equipment was air-dried and wrapped in aluminum foil until used.

Grab and 24-hour composite samples of effluent were collected at the Centralia, Chehalis, Pe Ell, and Darigold WTPs. Composite samples of influent were also collected at these four dischargers to enable waste loadings and removal efficiencies to be calculated. Ecology's ISCO® composite samplers were installed within close proximity of these four discharger's samplers. During sampling on August 26-28, 1991, two consecutive 24-hour composite samples of influent and effluent were collected at the Centralia, Chehalis, and Pe Ell WTPs. A replicate effluent grab sample was collected at Centralia, Chehalis, Pe Ell, and Darigold (labeled _ T) to evaluate sampling and analytical variability.

Two consecutive 24-hour effluent composite samples were collected at Swecker, Global Aqua (BR), Global Aqua (SC), and Sea Farm of Washington. In addition, two concurrent 24-hour composite replicate samples (labeled _ T) were collected at Global Aqua (BR) to assess sampling and analytical variability. Hand composite samples were collected from all functional wells at the fish farms. Approximately 1 liter of water from each well was collected in a 2-gallon plastic container and thoroughly mixed before being bottled for analysis of selected parameters to provide background information. A summary of the sampling plan is given below:

Discharger	Sampling Date	Influent Sample Type	Effluent Sample Type
Centralia	8/26-28/91 7/20-21/92 8/4-5/92	C G + C C	G* + C G* + C G* + C
Chehalis	8/26-28/91 7/20-21/92 8/4-5/92	C G + C C	G* + C G* + C G* + C
Pe Ell	8/26-28/91	C	G* + C
Darigold	12/3-4/91 7/20-21/92 8/4-5/92	G + C G + C C	G* + C G* + C G* + C
Swecker	9/9-11/91	HC	C
Global Aqua (BR)	9/9-11/91	HC	C
Global Aqua (SC)	9/9-11/91	HC	C
Sea Farm	9/9-11/91	HC	C

C = 24-hr composite sample, G = Grab sample, * = Includes replicate sample, HC = Hand-composite of well water.

Parshall flumes and weirs were inspected for correct installation and critical dimensions. Instantaneous flows were determined by measuring depth of flow through the device and reading resultant flows from tables (ISCO®, 1985). Comparisons were then made to instantaneous readings on the plant flow recorders. Twenty-four-hour flows were also recorded from the totalizers by taking readings at the same hour on consecutive days. Flows at each fish farm were measured by using a Swoffer® current meter - Model 2100.

Ecology's ISCO® composite samplers were set to collect approximately 220 mL of sample every 30 minutes for 24 hours. Compositor bottles were kept continually iced during sample collection. All samples for analysis by Ecology were placed on ice until delivery to the Ecology Manchester Laboratory. A summary of the analytical methods and laboratories conducting the analyses is given in Table 1.

Data Quality Assurance

Laboratory quality assurance and quality control (QA/QC) methods are described by Huntamer and Hyre (1991) and Kirchmer (1988). Data quality and quality of the reporting were assured through careful attention to representativeness of samples collected, as well as accuracy (precision and bias), completeness, and comparability of data such that the stated objectives of the inspections were met. At the time of the inspections, permittee sampling locations appeared to be appropriate and representative, and Ecology's sampling was conducted in close proximity. Recommended holding times were met for all analyses performed except TOC. Due to equipment breakdown, some TOC analyses (sample lab Nos. 308310, -11, -15, -16, 308290, -91, -95, and -96) were not performed within the recommended holding time, and those results were flagged with "OHT" (over holding time).

Orthophosphate samples were filtered in the field using 0.45 micron filters and nalgene bottles. Equipment blanks were also prepared in the field at each site by exposing distilled water to the equipment used to filter the samples. The blanks were analyzed for orthophosphate only and indicated a trace of bias due to contamination. Two samples from Darigold (498024 and 328252) yielded orthophosphate concentrations greater than total phosphate concentrations. The Manchester Lab had no explanation for this anomaly (Thomson, 1993). Also from Darigold, sample 498024 yielded a higher soluble BOD₅ concentration than BOD₅ concentration. Again, Manchester Lab offered no explanation, thus these data should be used with caution.

Analyses of ultimate BOD (UBOD) were carried out in order to evaluate the long-term impact of oxygen demand in the receiving water as part of the TMDL study. The protocol for UBOD and the results will be given in a separate report (Pickett, in prep.).

Effluent composite samples were split at Centralia, Chehalis, Pe Ell, and Darigold for comparative analyses. No samples were split at the four fish farms. Effluent composite samples were split two ways, *i.e.*, both Ecology's and the permittee's samples were analyzed at both laboratories. Under proper circumstances, these two splits can produce revealing information about both sample representativeness and laboratory analytical techniques. Results from samples

Table 1. Chemical Analytical Methods and Laboratories - Chehalis River Basin Class II Inspections, 8/91-8/92.

Parameter	Method	Lab used
Turbidity	EPA, 1983: 180.1	Ecology; Manchester, WA
Conductivity	EPA, 1983: 120.1	Ecology; Manchester, WA
Alkalinity	EPA, 1983: 310.1	Ecology; Manchester, WA
Chlorophyll a		Ecology; Manchester, WA
Chloride	EPA, 1983: 330.0	Ecology; Manchester, WA
Hardness	EPA, 1983: 130.2	Ecology; Manchester, WA
SOLIDS4		
TS	EPA, 1983: 160.3	Ecology; Manchester, WA
TNVS	EPA, 1983: 160.3	Ecology; Manchester, WA
TSS	EPA, 1983: 160.2	Ecology; Manchester, WA
TNVSS	EPA, 1983: 160.2	Ecology; Manchester, WA
TDS	EPA, 1983: 160.1	Ecology; Manchester, WA
% Solids	APHA, 1989: 2540G	Sound Analytical Services, Inc; Tacoma, WA
% Volatile solids	EPA, 1983: 160.4	Sound Analytical Services, Inc; Tacoma, WA
BOD5	EPA, 1983: 405.1	Ecology; Manchester, WA
Oil & grease	EPA, 1983: 413.1	Ecology; Manchester, WA
TOC (water)	EPA, 1983: 415.2	Ecology; Manchester, WA
NUTRIENTS		
NH3-N	EPA, 1983: 350.1	Ecology; Manchester, WA
NO2+NO3-N	EPA, 1983: 353.2	Ecology; Manchester, WA
T-phosphorus	EPA, 1983: 365.1	Ecology; Manchester, WA
O-phosphate	EPA, 1983: 365.3	Ecology; Manchester, WA
T-persulfate nitrogen	Valderrama, 1981	Ecology; Manchester, WA
Fecal Coliform MF	APHA, 1989:9222D	Ecology; Manchester, WA
% Klebsiella	APHA, 17: 9222F	Ecology; Manchester, WA

collected by two different compositors (Ecology and the permittee) but analyzed at the same lab (e.g., Ecology) help address the issue of sample representativeness. Results from samples collected by the same compositor (e.g., Ecology) but analyzed at two different labs (Ecology and the permittee) help address the issue of lab performance.

RESULTS AND DISCUSSION

Discussion for each permittee progresses through four subjects, consistent with objectives 2-5 of the inspection(s). These objectives were:

- flow measurement,
- general chemistry results,
- comparison to NPDES permit limits, and
- comparison of sample splits (except for four fish farms).

Centralia WTP

The Centralia WTP's headworks consists of a Parshall flume, degrit tank, two comminutors and a manually cleaned bar screen (Figure 2). The headworks is followed by five primary clarifier tanks (operated in parallel) and two trickling filters (also operated in parallel). Trickling filter effluent is pumped to two parallel Parshall flumes which split the flow between two secondary clarifiers. The clarifiers serve a dual purpose as secondary clarifiers and chlorine contact chambers. The flumes measure the split flow and set flow proportional chlorine and sulfur dioxide (dechlorination) systems. Dechlorinated effluent is discharged to the Chehalis River. Sludge generated at this facility is dried in covered drying beds and applied to the land as a fertilizer.

Measurements taken of the critical dimensions of the influent 24-inch Parshall flume showed it was correctly installed. Comparison of Ecology's instantaneous flow measurements to discharger flowmeter readings were reasonably good (within 2-3%). Influent totalizer readings for the 24-hour time periods between August 26-27, 1991 and August 27-28, 1991 were 1.53 MGD and 1.59 MGD, respectively. An average flow of 1.56 MGD was used to calculate effluent mass loadings for comparison to permit limits. Totalizer readings for the 24-hour time periods of July 20-21, 1992 and August 4-5, 1992 were 1.21 MGD and 1.29 MGD, respectively. Again, the average flow (1.25 MGD) was used to calculate effluent mass loadings for comparison to permit limits.

Conventional pollutant data collected during 1991 and 1992 are tabulated in Tables 2 and 3, respectively. A reduction in ammonia in the treatment process suggested that some nitrification was taking place in the plant. However, effluent ammonia concentrations were sufficiently high to raise concerns about un-ionized ammonia toxicity in the receiving water. Acute and chronic

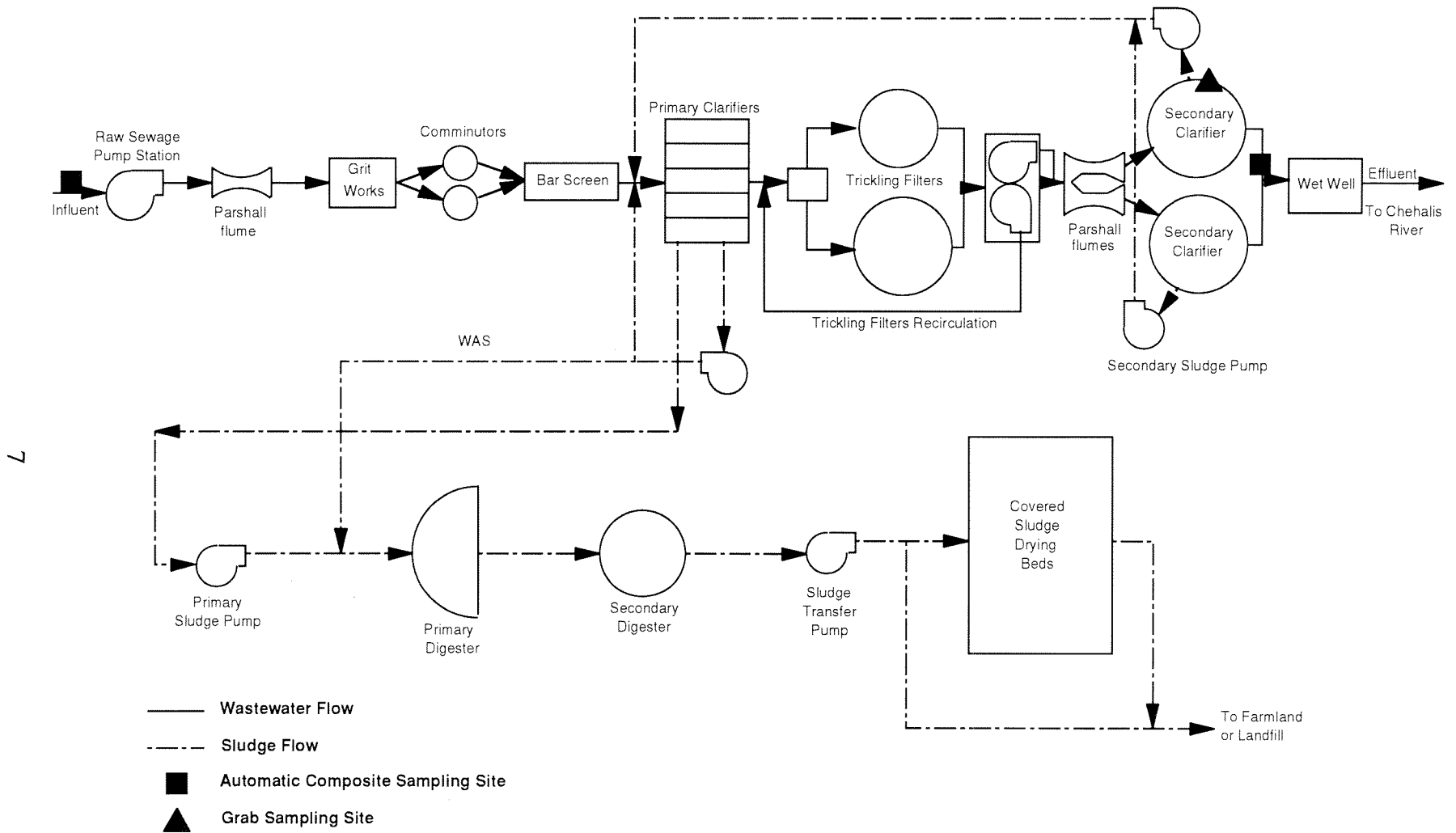


Figure 2. Plant Schematic and Sampling Locations - City of Centralia WTP, 8/91 - 8/92.

Table 2. General Chemistry Results, City of Centralia WTP - Chehalis River Basin Class II Inspections, 8/91

Location:	Blank1	Inf-E1	Inf-CN1	Eff-E1	Eff-CN1	Eff-1	Eff-T	Blank2	Inf-E2	Eff-E2	Eff-CN2	Eff-2	Eff-T
Type:	equipment	comp	comp	comp	comp	grab	grab	equipment	comp	comp	comp	grab	grab
Date:	8/27	8/26-27	8/26-27	8/26-27	8/26-27	8/27	8/27	8/28	8/27-28	8/27-28	8/27-28	8/28	8/28
Time:	1720	1030-1030	1050-1050	1105-1105	1105-1105	1130	1130	1740	020-102	1040-1040	1040-1040	1055	1105
Lab Log#:	358383	358384	358385	358386	358387	358388	358389	358483	358484	358486	358487	358488	358489
LABORATORY RESULTS													
Turbidity (NTU)				20	20					21		17	
Conductivity (µmho/cm)				527	527					515		489	
Chloride (mg/L)				48.0	46.7					41.0		41.4	
Chlorophyll a (µg/L)				< 1.0	4.8					4.7		4.6	
Pheophytin a (µg/L)				31.0	28.8					47.9		24.5	
TS (mg/L)		532	585	378	416								
TNVS (mg/L)		200	266	235	212								
TSS (mg/L)		139	162	26	37				145	28		16	
TNVSS (mg/L)		20	23	6	12								
BOD5 (mg/L)		194		30						39			
TOC (mg/L)				33.3	34.9					36.4		34.3	
NH3-N (mg/L)		19.1	18.9	12.9	12.8				20.4	14.9		12.0	
NO2+NO3-N (mg/L)		0.12	0.05 J	3.4	3.6				0.09	3.1		4.3	
T-Phosphorus (mg/L)		5.5	6.0	5.2	5.2				5.50	5.30		5.0	
T-Persulfate Nitrogen (mg/L)		27.2	29.9	20.0	20.1				28.0	23.1		20.6	
O-Phosphate (mg/L)	<0.01			3.79				0.021		4.5		3.9	
F-Coliform MF (#/100 mL)						34	56					13	19
FIELD OBSERVATIONS													
Flow (MGD)				1.53						1.59			
Temperature (°C)		ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	-
pH (S.U.)		ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	-
Conductivity (µmho/cm)		525	510	467	487	401	-	557	484	478	478	478	-
Dissolved Oxygen (ppm)						8.0						8.0	
Chlorine free (ppm)						<= 0.1						<= 0.1	
total (ppm)						<= 0.1						<= 0.1	

Inf - Influent, Eff - Effluent, E - Ecology sample, CN - Centralia sample, T - Ecology replicate sample

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

ND - No data; meter malfunction.

Table 3. General Chemistry Results, City of Centralia WTP - Chehalis River Basin Class II Inspections, 7/92-8/92

Location:	Inf-E	Inf-CN	Inf-I	Eff-I	Eff-T	Eff-E	Eff-CN	Eff-2	Inf-2	Eff-1	Eff-T	Eff-E	Eff-CN	Eff-2
Type:	comp	comp	grab	grab	grab	comp	comp	grab	grab	grab	grab	comp	comp	grab
Date:	7/20-21	7/20-21	7/20	7/20	7/20	7/20-21	7/20-21	7/21	7/21	8/4	8/4	8/4-5	8/4-5	8/5
Time:	0900-0900	0900-0900	0915	1000	1000	0910-0910	0910-0910	0855	0905	0830	0835	0830-0830	0830-0830	0840
Lab Log#:	308280	308281	308282	308283	308284	308285	308286	308287	308288	328230	328231	328232	328233	328234
LABORATORY RESULTS														
Turbidity (NTU)	70	70			21	23	23				22	22	22	
Conductivity (µmho/cm)	659	659			600	598	598				559	624	588	
Alkalinity (mg/L)	226	225			168	159	161				140	157	155	
Chloride (mg/L)					54.1	53.5	53.0				55.7	55.3	53.8	
Chlorophyll a (µg/L)					6.33	13.19	10.12				9.39	4.49	8.03	
TS (mg/L)	658	663			418	428	441				696	433	411	
TNVS (mg/L)	284	273			215	234	173				394	244	239	
TSS (mg/L)	200	232	210	28	21	29	25	21	250	33	28	30	27	31
TNVSS (mg/L)	30	41			3	5	3				<1	13	9	
TDS (mg/L)					364	344	342				297	328	310	
BOD5 (mg/L)	260	320	117	22	22	26	31	31	280	20	22	28	26	28
TOC (mg/L)	OHT	OHT			42.8	OHT	OHT				35.6	37.9	38.6	
NH3-N (mg/L)	28.5	27.9			17.0	18.2	17.9				11.8	16.2	16.4	
NO2+NO3-N (mg/L)	0.07	0.05			3.9	3.6	3.8				3.8	3.7	3.7	
T-Phosphorus (mg/L)	7.9	8.1			6.3	7.9	8.8				6.3	4.1	3.9	
T-Persulfate Nitrogen (mg/L)	38.0	39.5			24.9	22.2	22.6				21.3	25.1	25.6	
O-Phosphate (mg/L)					5.6	6.0	5.8				4.2	3.7	3.7	
Oil & Grease (mg/L)				4.5				9.2		2.2				5.4
F-Coliform MF (#/100 mL)				<14				32		13				41
FIELD OBSERVATIONS														
Flow (MGD)						1.21						1.29		
Temperature (°C)	4.8+	10.6+	20.6	20.3		8.0+	9.7+	20.3	21.1	19.7	-	7.6+	7.3+	19.9
pH (S.U.)	7.4+	7.4+	6.8	6.9		7.7+	7.7+	7.4	7.4	7.4	-	7.4+	7.4+	7.3
Conductivity (µmho/cm)	600	550	520	490		480	480	490	530	470	-	530	520	630
Chlorine free (ppm)				0.06*				0.02		<0.1	-	<0.1	<0.1	<0.1
total (ppm)				0.07*				0.02		<0.1	-	<0.1	<0.1	<0.1

Inf - Influent, Eff - Effluent, E - Ecology sample, CN - Centralia sample, T - Ecology replicate sample

* Measurement was taken postchlorination, but before dechlorination.

OHT - Over holding time.

+ Iced composite sample.

6

water quality criteria were about 5.6 and 0.76 mg-N/L, respectively (based on salmonid presence at pH = 8.0 S.U., and temp. = 20.0°C) (EPA, 1986). Concern over these toxicities would be minimized by a dilution factor of 2:1 at the edge of the acute and 15:1 at the edge of the chronic mixing zones, respectively. Similar high concentrations of ammonia in effluent were found during the July 1992 and August 1992 inspections (Table 3). A recent review of the city of Centralia mixing study by Pickett (1993a) evaluated effluent ammonia toxicities and discussed how to minimize these toxicities in the receiving water. Total persulfate nitrogen (TPN) levels in effluent were found in the range of 20-25 mg/L, which is the range expected in effluent following a conventional treatment process (EPA, 1985).

Comparisons of effluent parameters to permit limits for the three visits are presented in Tables 4 and 5. All BOD₅ and TSS results indicated a reasonably well treated effluent. Effluent met permit limits for BOD₅, TSS, fecal coliform, total residual chlorine, and pH at the time of all inspections. Removal efficiencies for BOD₅ and TSS during the August 26-27, 1991 inspection were less than the 85% requirement, but were better than the requirement during the July 20-21, 1992 and August 4-5, 1992 inspections. Low fecal coliform counts and very low total chlorine levels (at post-dechlorination) indicated that the discharger's disinfection and dechlorination methods were working efficiently.

Tables 6 and 7 compare results of analyses performed by Centralia and Ecology on splits of the same samples. Results presented in Table 6 indicated that influent and effluent BOD and fecal coliform were in acceptable agreement. However, influent TSS results revealed a disparity on samplers. Ecology's influent sampler collected a weaker sample than the Centralia sampler (139 versus 162, and 141 versus 177).

Table 7 presents data from the two inspections conducted during July 20-21, 1992 and August 4-5, 1992. Effluent BOD results analyzed by both labs showed good agreement, and did not indicate any obvious problem in sampling or lab techniques. However, it appeared that the Ecology influent sampler collected a weaker sample than the Centralia sampler (260 versus 320, 200 versus 232, and 246 versus 271). A similar sampling problem was also observed during the 1991 inspection (Table 6).

Influent BOD₅ results from the permittee's laboratory were lower than Ecology's lab data (15-28%). On the other hand, the permittee's influent TSS results were 14-19% higher than Ecology's results. Both the BOD₅ and TSS results suggest that the permittee's lab protocols should be examined. On one occasion, the permittee's fecal coliform count (143 #/100 mL) was significantly higher than Ecology's result (41 #/100 mL). However, given the variation in effluent coliform levels, the difference is not considered excessive. The temperature range of all composited samples (7.3-10.6°C) was above the recommended 4°C in 1992 (APHA, 1989).

Chehalis WTP

The Chehalis WTP headworks consists of a grit tank, comminutor, and Parshall flume (Figure 3). A primary clarifier and both trickling filters were on-line. The facility had been

Table 4. Comparison of Results to NPDES Permit Limits, City of Centralia WTP - Chehalis River Basin Class II Inspections, 8/26-28, 1991

Parameter	NPDES Permit Limits		Inspection Data		Loading and Performance			
	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5 (mg/L)			194	---				
(lbs/d)					3600	2500	69	85
Effluent BOD5 (mg/L)	30	45	30;39	---				
(lbs/d)	540	810				450		
(% removal)	85					82		
Influent TSS (mg/L)			139;145	---				
(lbs/d)					3600	1800	50	85
Effluent TSS (mg/L)	30	45	26;28	---				
(lbs/d)	540	810				350		
(% removal)	85					81		
Fecal Coliform (#/100 mL)	200++	400++	---	26++ (34;56;13;19)				
Total Chlorine Residual (mg/L)	Undetectable by amperometric analysis			<= 0.1				
pH (S.U.)	Within the range of 6.0 to 9.0			ND				
Flow (MGD)	4.3				4.3	1.56+	36	85

+ The average of flows on 8/26-27 & 8/27-28.

++ The average for fecal coliform bacteria is based on the geometric mean of the samples taken.

ND - No data; meter malfunction.

Table 5. Comparison of Results to NPDES Permit Limits, City of Centralia WTP - Chehalis River Basin Class II Inspections, 7/20-21 & 8/4-5, 1992

Parameter	NPDES Permit Limits		Inspection Data		Loading and Performance			
	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5 (mg/L) (lbs/d)			260	117;280	3600	2700	75	85
Effluent BOD5 (mg/L) (lbs/d) (% removal)	30 540 85	45 810	26;28	22;22;31;20;28		270 90		
Influent TSS (mg/L) (lbs/d)			200	210;250	3600	2100	58	85
Effluent TSS (mg/L) (lbs/d) (% removal)	30 540 85	45 810	29;30	28;21;21;33;28;31		300 86		
Fecal Coliform (#/100 mL)	200++	400++	---	22++ (<14;32;13;41)				
Total Chlorine Residual (mg/L)	Undetectable by amperometric analysis			< 0.1				
pH (s.u.)	Within the range of 6.0 to 9.0			6.9;7.4;7.4;7.3				
Flow (MGD)	4.3				4.3	1.25+	29	85

+ The average of flows on 7/20-21 & 8/4-5.

++ The average for fecal coliform bacteria is based on the geometric mean of the samples taken.

Table 6. Comparison of Laboratory Results of Sample Splits, City of Centralia WTP - Chehalis River Basin Class II Inspections, 8/91

Station ID:	Inf-E1		Inf-CN1		Eff-E1		Eff-CN1		Eff-1		Eff-ER2	
Lab Number:	358384		358385		358386		358387		358388		358389	
Date:	8/26-27		8/26-27		8/26-27		8/26-27		8/27		8/28	
Sampler:	Ecology		Centralia		Ecology		Centralia		Grab*		Grab*	
Laboratory:	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia
BOD5 (mg/L)	194	198	---	202	30	30	---	29	---	---	---	---
TSS (mg/L)	139	141	162	177	26	28.5	37	27.5	---	---	---	---
F-Coliform (#/100mL)	---	---	---	---	---	---	---	---	34, 56**	23	13, 19**	19

E - Ecology sample, CN - Centralia sample, Inf - Influent, Eff - Effluent

* Centralia and Ecology each sampled for fecal coliform at approximately same time and location.

** The two values shown are the results from analyses of replicate samples.

Table 7. Comparison of Laboratory Results of Sample Splits, City of Centralia WTP - Chehalis River Basin Class II Inspections, 7/92-8/92

Station ID:	Inf-E		Inf-CN		Eff-E		Eff-CN		Eff-1		Eff-E		Eff-CN		Eff-2	
Lab Number:	308280		308281		308285		308286		308283		328232		328233		328234	
Date:	7/20-21		7/20-21		7/20-21		7/20-21		7/20		8/4-5		8/4-5		8/5	
Sampler:	Ecology		Centralia		Ecology		Centralia		Grab*		Ecology		Centralia		Grab*	
Laboratory:	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia	Ecology	Centralia
BOD5 (mg/L)	260	221	320	230	26	27	31	27	22	---	28	28	26	25	28	---
TSS (mg/L)	200	246	232	271	29	27	25	30	28	---	30	25.5	27	27	31	---
F-Coliform (#/100 mL)	---	---	---	---	---	---	---	---	<14	17	---	---	---	---	41	143

E - Ecology sample, CN - Centralia sample

* - Centralia and Ecology each sampled for fecal coliform at approximately same time and location.

Though Ecology sampled for BOD5 and TSS at the same time, Centralia was not requested to analyze those parameters.

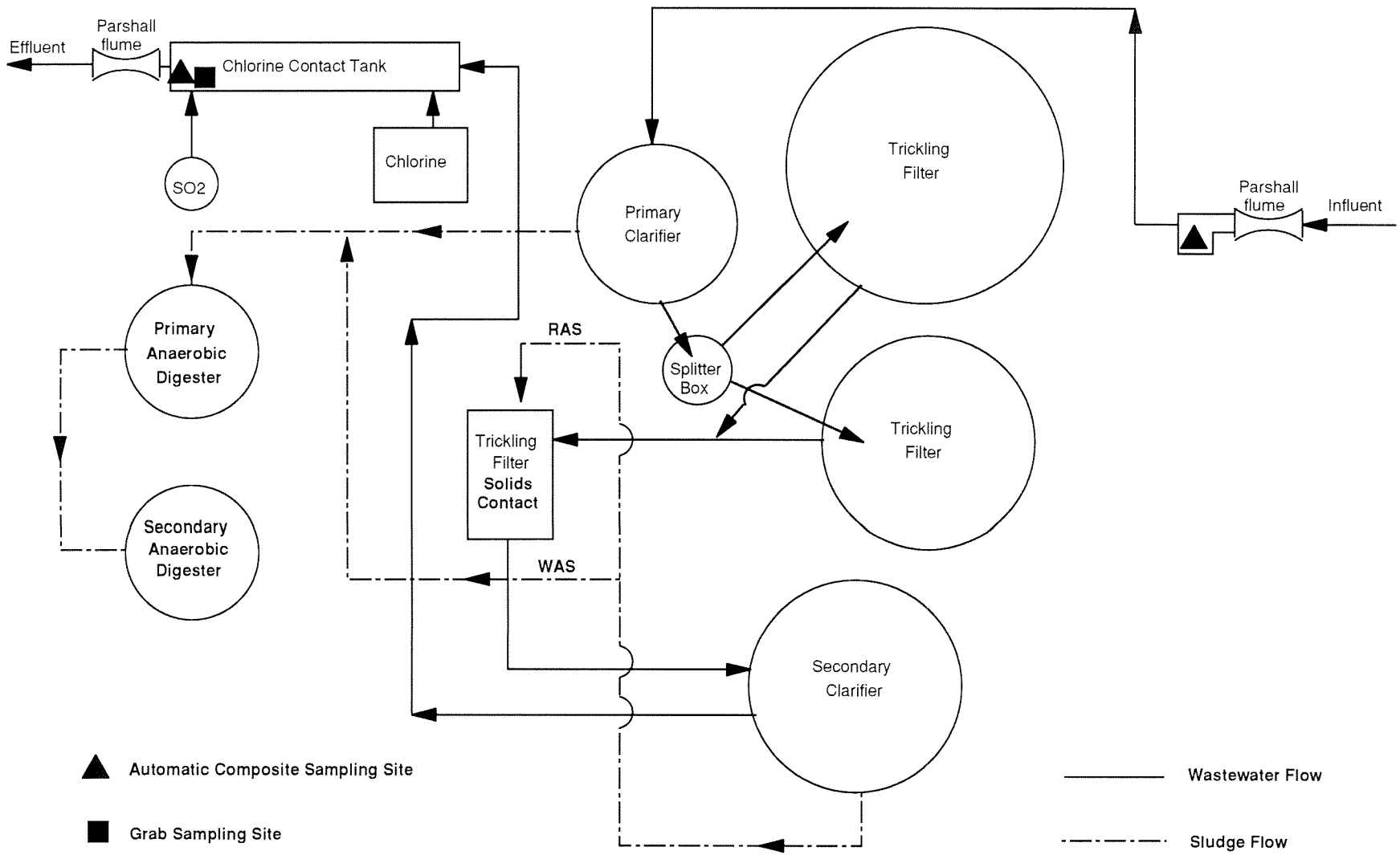


Figure 3. Plant Schematic and Sampling Locations - City of Chehalis WTP, 8/91 - 8/92.

altered in the recent past to provide the capability to operate in solids contact mode. One of the two secondary clarifiers was on-line as part of normal, low flow operation. Another secondary clarifier (not shown in Figure 3) is generally used during the high flow season. Chlorination is flow proportional and dechlorination is paced by flow and chlorine residual.

The influent Parshall flume was used to monitor and report plant flow since the effluent Parshall flume was out of service during the inspections. Measurements taken of the critical dimensions of the effluent 12-inch Parshall flume showed it was properly installed. However, the transducer height sensor was malfunctioning, therefore a verification of effluent flow could not be performed. Influent totalizer readings for the 24-hour time periods during August 26-27, 1991 and August 27-28, 1991 were 1.23 MGD and 1.11 MGD, respectively. An average flow of 1.17 MGD was used to calculate effluent mass loadings for comparison to permit limits. Totalizer readings for the 24-hour time periods of July 20-21, 1992 and August 4-5, 1992 were 0.88 MGD and 0.86 MGD, respectively. Again, the average flow (0.87 MGD) was used to calculate the effluent mass loadings for comparison to permit limits. There was no suitable access to verify correct installation and calibration of the influent Parshall flume.

Conventional pollutant data collected during the 1991 and 1992 visits are tabulated in Tables 8 and 9, respectively. All BOD₅ and TSS results indicated a well-treated effluent. A reduction in ammonia in the treatment process indicated some nitrification was taking place in the plant. However, ammonia levels were sufficiently high to cause concern about toxicity in the receiving water. Acute and chronic water quality criteria (based on salmonids present at pH = 7.0 S.U. and temp. = 20.0°C) were about 19.0 mg-N/L and 1.22 mg-N/L. Concern over chronic toxicity would be minimized by a dilution factor of 12:1 at the edge of the chronic mixing zone. Similar high ammonia concentrations in effluent (25.8-27.3 mg/L) were found during the July 1992 and August 1992 inspections (Table 9). Acute and chronic water quality criteria were about 14.6 and 1.5 mg-N/L (at pH = 7.5, temp. = 20.0°C). Concern over these toxicities would be minimized by a dilution factor of 2:1 at the edge of the acute and 15:1 at the edge of the chronic mixing zones, respectively. A recent review of the city of Chehalis mixing study by Pickett (1993b) also highlighted the potential for ammonia toxicity and recommended how to prevent it in the receiving water. On August 27 and 28, 1991, plant effluent had high residual chlorine levels (1.0 and 0.4 mg/L). However, chlorine levels measured during the 1992 inspections were low (<0.1 mg/L). Fecal coliform counts were well within the NPDES permit limit; the geometric mean was 25 #/100 mL.

Comparisons of effluent parameters to NPDES permit limits are presented in Tables 10 and 11. Effluent met permit limits for BOD₅, TSS, fecal coliform, and pH. Removal efficiencies for BOD₅ and TSS during all three inspections were higher than the 85% requirement. However, effluent total residual chlorine levels observed during the 1991 and 1992 visits did not meet the permit requirement.

Tables 12 and 13 compare results between Chehalis and Ecology samples and labs. In the 1991 sampling, the Chehalis influent sampler collected significantly stronger samples than the Ecology sampler (221 versus 351, 263 versus 789, and 237 versus 412). Table 13 presents split sample

Table 8. General Chemistry Results, City of Chehalis WTP - Chehalis River Basin Class II Inspections, 8/91

Location:	Blank1	Inf-E1	Inf-CH1	Eff-E1	Eff-CH1	Eff-1	Blank2	Inf-E2	Eff-E2	Eff-CH2	Eff-2	Eff-T
Type:	equipment	comp	comp	comp	comp	grab	equipment	comp	comp	comp	grab	grab
Date:	8/27	8/26-27	8/26-27	8/26-27	8/26-27	8/27	8/28	8/27-28	8/27-28	8/27-28	8/28	8/28
Time:	1710	1210-1210	1220-1220	1320-1320	1340-1340	1350	1740	1305-1305	1320-1320	1340-1340	1350	1350
Lab Log#:	358376	358377	358378	358379	358380	358381	358476	358477	358479	358480	358481	358482
LABORATORY RESULTS												
Turbidity (NTU)				12	10				11	12		
Conductivity (µmho/cm)				623	629				496	494		
Chloride (mg/L)				42.1	42.3				34.8	32.9		
Chlorophyll a (µg/L)				4.4	< 1.0				2.8	4.6		
Pheophytin a (µg/L)				26.1	33.4				14.9	21.3		
TS (mg/L)		730	1100	463	455							
TNVS (mg/L)		357	371	261	275							
TSS (mg/L)		263	789	9	9			125	5	18		
TNVSS (mg/L)		83	139	4	7							
BOD5 (mg/L)		219	*	19	*			*	21	*		
TOC (mg/L)				34.9	32.9				29.9	35.0		
NH3-N (mg/L)		25.8	25.2	19.0	18.5			24.8	15.2	15.1		
NO2+NO3-N (mg/L)		0.27	0.04	6.40	8.1			0.12	5.2	5.1		
T-Phosphorus (mg/L)		12.2	13.6	9.3	7.4			5.2	5.8	6.9		
T-Persulfate Nitrogen (mg/L)		37.1	41.6	28.8	31.6			33.9	23.8	24.2		
O-Phosphate (mg/L)	0.02			5.0			0.03		3.1			
F-Coliform MF (#/100 mL)						<1					3	2
FIELD OBSERVATIONS												
Flow (MGD)				1.23					1.11			
Temperature (°C)		ND	ND	ND		ND		ND	ND	ND	ND	ND
pH (S.U.)		ND	ND	ND		ND		ND	ND	ND	ND	ND
Conductivity (µmho/cm)		548	537	590		474		533	555	486	414	
Dissolved Oxygen (ppm)						7.5					6.4	
Chlorine free (ppm)						0.15					<= 1.0	
total (ppm)						1.0					0.4	

Inf - Influent, Eff - Effluent, E - Ecology Sample, CH - Chehalis Sample, T - Ecology replicate sample

* Ecology did not analyze BOD5 on this sample because of laboratory restriction on BOD5 sample load.

ND - No data; meter malfunction.

Table 9. General Chemistry Results, City of Chehalis WTP - Chehalis River Basin Class II Inspections, 7/92-8/92

Location:	Inf-E	Inf-CH	Inf-1	Eff-1	Eff-T	Eff-E	Eff-CH	Eff-2	Inf-2	Eff-1	Eff-T	Eff-E	Eff-CH	Eff-2
Type:	comp	comp	grab	grab	grab	comp	comp	grab	grab	grab	grab	comp	comp	grab
Date:	7/20-21	7/20-21	7/20	7/20	7/20	7/20-21	7/20-21	7/21	7/21	8/4	8/4	8/4-5	8/4-5	8/5
Time:	1100-1100	1100-1100	1200	1115	1120	1130-1130	1130-1130	1110	1120	0950	0950	0945-0945	0945-0945	1000
Lab Log#:	308290	308291	308292	308293	308294	308295	308296	308297	308298	328240	328241	328242	328243	328244
LABORATORY RESULTS														
Turbidity (NTU)	65	50			18	22	20				17	17	22	
Conductivity (µmho/cm)	689	653			584	587	609				645	656	646	
Alkalinity (mg/L)	200	190			168	159	155				120	119	116	
Chloride (mg/L)					39.6	41.2	42.9				53.7	43.8	45.1	
Chlorophyll a (µg/L)					8.26;9.43	7.11	6.52				10.26	19.52	10.79	
TS (mg/L)	626	575			361	392	388				479	371	380	
TNVS (mg/L)	283	256			227	242	247				275	264	272	
TSS (mg/L)	220	120	216	20	18	26	25	20	137	21	17	19	20	13
TNVSS (mg/L)	20	30			4	8	10				9	6	7	
TDS (mg/L)					333	313	335				353	334	343	
BOD5 (mg/L)	265	213	112	15	11	22	19	18	196	16	17	18	19	20
TOC (mg/L)	OHT	OHT			40.9	OHT	OHT				34.8	35.3	35.5	
NH3-N (mg/L)	39.6	39.0			23.8	27.3	29.1				25.4	25.8	24.6	
NO2+NO3-N (mg/L)	0.05	0.04			2.3	2.3	2.2				1.8	1.8	2.0	
T-Phosphorus (mg/L)	6.5	6.0			5.8	5.5	5.0				4.3	3.5	3.9	
T-Persulfate Nitrogen (mg/L)	45.5	42.7			29.1	30.3	29.3				31.3	33.8	32.0	
O-Phosphate (mg/L)					3.9	5.1	4.4				3.2	2.9	2.9	
Oil & Grease (mg/L)				3.4				3.7		<1.0				<1.0
F-Coliform MF (#/100 mL)				<7				<3 BOF		270				69
FIELD OBSERVATIONS														
Flow (MGD)						0.88						0.86		
Temperature (°C)	5.2+	11.5+	19.9	19.6		8.4+	12.0+	20.3	20.5	19.9		8.6+	11.7+	20.1
pH (S.U.)	7.9+	7.4+	7.1	7.0		7.6+	7.6+	7.4	7.6	7.4		7.9+	7.5+	7.1
Conductivity (µmho/cm)	610	550	520	540		510	500	540	610	540		570	570	570
Chlorine free (ppm)				0.05				0.03		<0.1				<0.1
total (ppm)				0.06				0.03		<0.1				<0.1

Inf - Influent, Eff - Effluent, E - Ecology sample, CH - Chehalis WTP sample, T - Ecology replicate sample.

OHT - Over holding time.

BOF - Bottle overfill, can't shake sample.

+ Iced composite sample.

Table 10. Comparison of Inspection Results to NPDES Permit Limits, City of Chehalis WTP - Chehalis River Basin Class II Inspections, 8/26-28, 1991.

Parameter	NPDES Permit Limits		Inspection Data		Loading and Performance			
	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria	Derived Results	Plant Loading (% of DC)	Planning to Begin (% of DC)
Influent BOD5 (mg/L)			219	—				
(lbs/d)					3700	2100	58	85
Effluent BOD5 (mg/L)	30	45	19,21	—				
(lbs/d)	555	833				200		
(% removal)	85					91		
Influent TSS (mg/L)			263,125	—				
(lbs/d)					3100	1900	61	85
Effluent TSS (mg/L)	30	45	9,5	—				
(lbs/d)	455	683				68		
(% removal)	85					96		
Fecal Coliform (#/100 mL)	200*	400*	—	2* (<1,3:2)				
pH (S.U.)	Within the range of 6.0 to 9.0			ND				
Total Residual Chlorine (mg/L)	Undetectable by amperometric analysis for flows up to 7.5 MGD.			1.0;0.4				
Flow (MGD)	4.0	—			4.0	1.17+	29	85

+ The average flow during inspections on 8/26-27 & 8/27-28.

* The average for fecal coliform bacteria is based on the geometric mean of the samples taken.

ND - No data; meter malfunction.

Table 11. Comparison of Inspection Results to NPDES Permit Limits, City of Chehalis WTP - Chehalis River Basin Class II Inspections, 7/20-21 & 8/4-5, 1992

Parameter	NPDES Permit Limits		Inspection Data		Loading and Performance			
	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5 (mg/L) (lbs/d)			265	112	3700	1900	53	85
Effluent BOD5 (mg/L) (lbs/d) (% removal)	30 555 85	45 833	22	15;11		160 92		
Influent TSS (mg/L) (lbs/d)			220	216	3100	1600	52	85
Effluent TSS (mg/L) (lbs/d) (% removal)	30 455 85	45 683	26	20;18		190 91		
Fecal Coliform (#/100 mL)	200*	400*	--	25* (<7,<3 BOF;270,69)				
pH (S.U.)	Within the range of 6.0 to 9.0			7.0;7.4				
Total Residual Chlorine (mg/L)	Undetectable by amperometric analysis for flows up to 7.5 MGD.			0.06;0.03				
Flow (MGD)	4.0	--			4.0	0.87+	22	85

BOF - Bottle overflow; can't shake sample.

+ The average flow during inspections on 7/20-21 & 8/4-5.

* The average for fecal coliform bacteria is based on the geometric mean of the samples taken.

Table 12. Comparison of Laboratory Results of Sample Splits, City of Chehalis WTP - Chehalis River Basin Class II Inspections, 8/26-28, 1991

Station ID:	Inf-E1		Inf-CH1		Eff-E1		Eff-CH1	
Lab Number:	358377		358378		358379		358380	
Date:	8/26-27		8/26-27		8/26-27		8/26-27	
Sampler:	Ecology		Chehalis		Ecology		Chehalis	
Laboratory:	Ecology	Chehalis	Ecology	Chehalis	Ecology	Chehalis	Ecology	Chehalis
BOD5 (mg/L)	219	221	...*	351	19	14	...*	16
TSS (mg/L)	263	237	789	412	9	10	9	17

E - Ecology sample, CH - Chehalis sample, Inf - Influent, Eff - Effluent

* Ecology did not analyze BOD5 on Chehalis composite samples because of laboratory restrictions on BOD5 sample submittal.

Table 13. Comparison of Laboratory Results of Sample Splits, City of Chehalis WTP - Chehalis River Basin Class II Inspections, 7/92 & 8/92

Station ID: Lab Number: Date: Sampler:	Inf-E 308290 7/20-21 Ecology		Inf-CH 308291 7/20-21 Chehalis		Eff-E 308295 7/20-21 Ecology		Eff-CH 308296 7/20-21 Chehalis		Eff-1 308293 7/20 Grab*		Eff-2 308297 7/21 Grab*		Eff-CH 328243 8/4-5 Chehalis		Eff-2 328244 8/5 Grab*	
Laboratory:	Ecology	Chehalis	Ecology	Chehalis	Ecology	Chehalis	Ecology	Chehalis	Ecology	Chehalis	Ecology	Chehalis	Ecology	Chehalis	Ecology	Chehalis
BOD5 (mg/L)	265	307	213	200	22	19	19	20	15	---	18	---	19	18	20	---
TSS (mg/L)	220	247	120	157	26	26.5	25	27.5	20	---	20	---	20	20	13	---
NH3-N (mg/L)	39.6	---	39.0	---	27.3	---	29.1	26.0	---	---	---	---	24.6	25.46	---	---
F-Coliform (#/100 mL)	---	---	---	---	---	---	---	---	<7	14	<3 BOF	1	---	---	69	106

E - Ecology sample, CH - Chehalis sample, Inf - Influent, Eff - Effluent

* - Chehalis and Ecology each sampled for fecal coliform at approximately same time and location.

Though Ecology sampled for BOD5 and TSS at that same time, Chehalis was not requested to analyze those parameters.

BOF - Bottle overfill, can't shake sample.

results from the inspections conducted in 1992. Effluent BOD₅, TSS, and fecal coliform show acceptable agreement. However, the Chehalis influent sampler appeared to collect a weaker sample than the Ecology sampler this year (265 versus 213, 307 versus 200, 220 versus 120, and 247 versus 157). This sampler disparity during both years focuses concern on the discharger's influent sampling procedures. Temperatures of most composited samples (11.5-12.0) were well above the recommended 4°C in 1992.

Pe Ell WTP

The Pe Ell WTP consists of a manually-cleaned bar screen and comminutor, followed by an oxidation ditch (with a single aeration rotor) and a secondary clarifier (Figure 4). The plant's headworks appeared to be poorly maintained. Sludge generated at the plant is wasted directly from the secondary clarifier to the sludge drying beds. The facility has no aerobic or anaerobic sludge digestion process. Dried sludge is spread on city property adjacent to the plant. Chlorinated effluent is discharged to the Chehalis River.

Plant flows are measured with a 90° V-notch weir located at the outfall end of the chlorine contact chamber. Measurements taken of the critical dimensions of the weir showed it was correctly installed and calibrated. Comparison of Ecology's instantaneous flow measurements to permittee's flowmeter readings were reasonably good (within 5%). Totalizer readings for the 24-hour time periods of August 26-27 and August 27-28 were 0.18 MGD and 0.19 MGD, respectively. An average flow of 0.185 MGD was used to calculate effluent mass loadings for comparison to permit limits.

Conventional pollutant data collected during 8/26-28/91 are tabulated in Table 14. Lowered concentrations of ammonia and increased concentrations of nitrite+nitrate nitrogen in effluent indicated considerable nitrification was taking place in the plant. All BOD₅ and TSS results indicated a well-treated effluent. Fecal coliform counts and their geometric mean value were well within NPDES permit limits. Plant effluent had moderately high chlorine residuals (0.5 and 0.4 mg/L). Any excess chlorine in effluent is unnecessary and can be a source of toxicity in the receiving water.

Comparisons of effluent parameters to NPDES permit limits are shown in Table 15. Effluent met permit requirements for BOD₅, TSS, and fecal coliform at the time of inspection. However, removal efficiency for BOD₅ was slightly less than the 85% requirement, and the design flow was exceeded. The plant's weak influent and high flow indicate that the collection system was experiencing excessive infiltration/inflow (I/I). The city of Pe Ell should determine if it is more economical to make repairs to the collection system to correct I/I or to design the treatment facilities for larger flows.

Table 16 compares results between Pe Ell and Ecology samples and labs. The influent BOD₅ and TSS results generally indicated close agreement, however, the difference in results for effluent BOD₅ and TSS between Ecology and Pe Ell labs was consistent. It appears that the

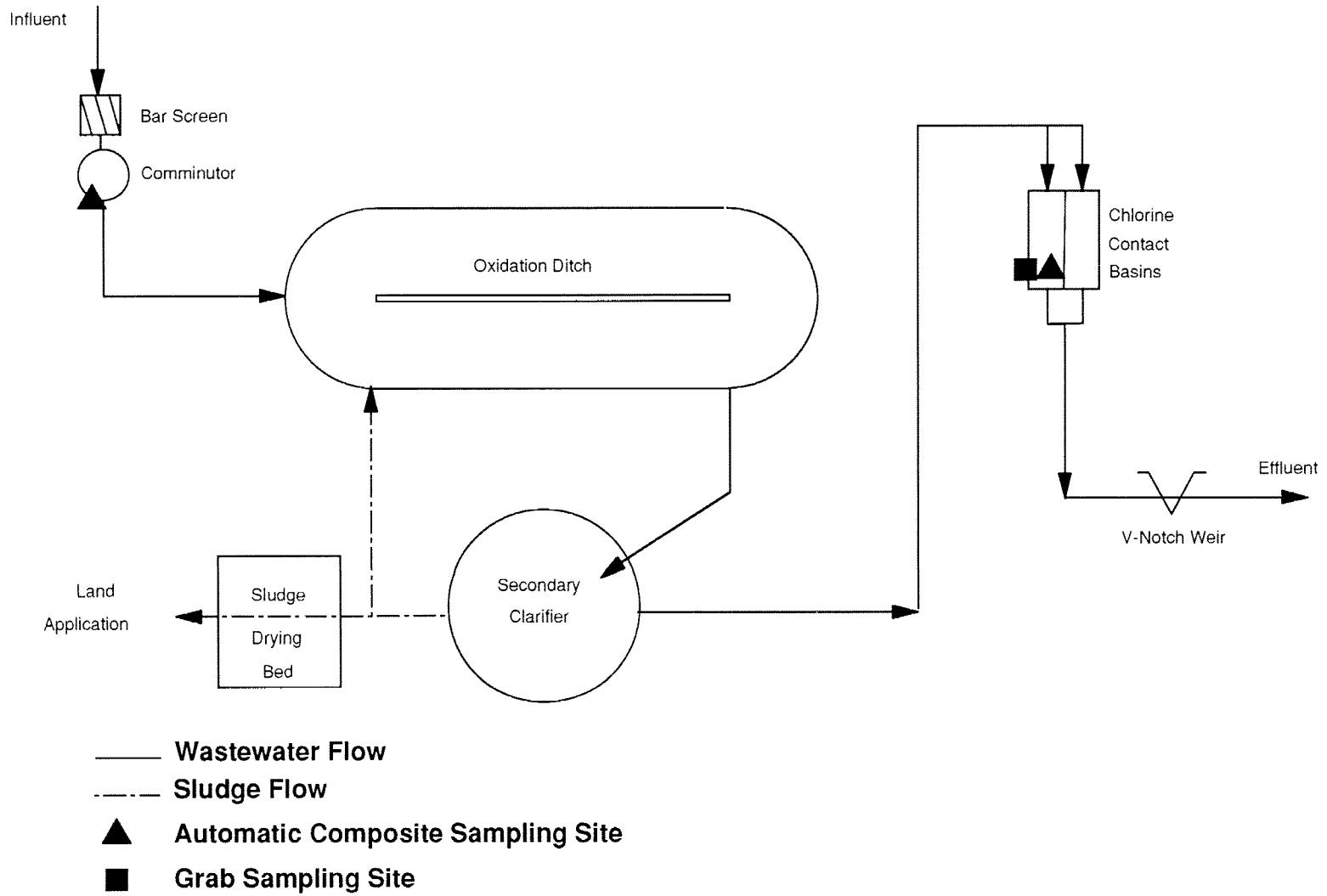


Figure 4. Plant Schematic and Sampling Locations--Pe EII WTP, 8/91.

Table 14. General Chemistry Results, Pe Ell WTP - Chehalis River Basin Class II Inspections, 8/91

Location:	Blank1	Inf-E1	Eff-E1	Eff-PE1	Eff-1	Blank2	Inf-E2	Eff-E2	Eff-PE2	Eff-2	Eff-T
Type:	equipment	comp	comp	grab	grab	equipment	comp	comp	comp	grab	grab
Date:	8/27	8/26-27	8/26-27	8/26	8/27	8/28	8/27-28	8/27-28	8/27-28	8/28	8/28
Time:	1720	1510-1510	1520-1520	1550	1530	1740	1510-1510	1520-1520	1525-1525	1455	1500
Lab Log#:	358370	358371	358372	358373	358374	358470	358471	358472	358473	358474	358475
LABORATORY RESULTS											
Turbidity (NTU)			2.5	2.2				2.6	2.3		
Conductivity (µmho/cm)			243	239				235	238		
Chloride (mg/L)			20.5	18.3				18.9	19.0		
Chlorophyll a (µg/L)			1.5	1.5				< 1.0	1.4		
Pheophytin a (µg/L)			< 1.0	< 1.0				1.0	< 1.0		
TS (mg/L)		263	232	213							
TNVS (mg/L)		135	121	126							
TSS (mg/L)		64	5	5			107	2	1		
TNVSS (mg/L)		11	2	2							
BOD5 (mg/L)		61	11	*			*	11	*		
TOC (mg/L)		34.6	5.5	6.6				6.3	6.7		
NH3-N (mg/L)		9.2	0.03	0.03			10.3	0.02	0.03		
NO2+NO3-N (mg/L)		0.21	11.6	12.4			0.18	11.6	11.8		
T-Phosphorus (mg/L)		2.4	2.0	2.0			2.6	2.1	2.3		
T-Persulfate Nitrogen (mg/L)			13.7	12.7	12.8		15.2	12.8	12.9		
O-Phosphate (mg/L)	0.07		1.9			0.04		1.7			
F-Coliform MF (#/100 mL)					9					3	10
FIELD OBSERVATIONS											
Flow (MGD)			0.18					0.19			
Temperature (°C)		ND	ND		ND		ND	ND		ND	
pH (S.U.)		ND	ND		ND		ND	ND		ND	
Conductivity (µmho/cm)		ND	ND		ND		ND	ND		ND	
Dissolved Oxygen (ppm)					5.4					5.6	
Chlorine free (ppm)					<= 0.1					<= 0.1	
total (ppm)					0.5					0.4	

Inf - Influent, Eff - Effluent, E - Ecology Sample, PE - Pe Ell Sample, T - Ecology replicate sample

* Ecology did not analyze BOD5 on this sample because of laboratory restrictions on BOD sample submittal.

ND - No data; meter malfunction.

Table 15. Comparison of Inspection Results to NPDES Permit Limits, Pe Ell WTP - Chehalis River Basin Class II Inspections, 8/26-28, 1991

Parameter	NPDES Permit Limits		Inspection Data		Loading Performance			
	Monthly Average	Weekly Average	Ecology Composite	Grab Samples	Design Criteria	Inspection Results	Plant Loading (% of DC)	Planning to Begin (% of DC)
Influent BOD5 (mg/L) (lbs/d)			61	---	150	94	63	85
Effluent BOD5 (mg/L) (lbs/d) (% removal)	30 29 85	45 43	11;11	---		17 82		
Influent TSS (mg/L) (lbs/d)			64,107	---		130		85
Effluent TSS (mg/L) (lbs/d) (% removal)	30 29 85	45 43	5,2	5		5 96		
Fecal Coliform (#/100 mL)	200*	400*	---	7* (9;3;10)				
pH (S.U.)	Within the range between 6.0 and 9.0.			ND				
Flow (MGD)	0.115				0.115	0.185+	161	85

+ The average flow during inspections on 8/26-27 & 8/27-28.

* The average for fecal coliform bacteria is based on the geometric mean of the samples taken.

ND - No data; meter malfunction.

Table 16. Comparison of Laboratory Results of Sample Splits, Pe Ell WTP - Chehalis River Basin Class II Inspections, 8/91

Station ID:	Inf-E1		Eff-E1		Eff-PE1	
Lab Number:	358371		358372		348373	
Date:	8/26-27		8/26-27		8/26-27	
Sampler:	Ecology		Ecology		Pe Ell	
Laboratory:	Ecology	Pe Ell	Ecology	Pe Ell	Ecology	Pe Ell
BOD5 (mg/L)	61	64	11	0	---*	0
TSS (mg/L)	64	60	5	1	5	1

E - Ecology sample, PE - Pe Ell sample, Inf - Influent, Eff - Effluent

* Ecology was unable to analyze BOD5 for Pe Ell's composite sample because of laboratory constraints on the number of BOD samples.

Pe Ell lab has difficulty detecting BOD and TSS at the concentrations typically seen in effluent. This finding focuses concern on the discharger's analytical procedures for low-level BOD and TSS, which should be examined further.

Darigold WTP

Darigold is a dairy products processing facility which receives raw milk and processes it into cheese, skim milk, buttermilk, and dry whey. The WTP consists of an equalization tank, a trickling filter, an Orbal aeration tank, a secondary clarifier, and a sludge tank (Figure 5). An anthracite sand filter is used for additional clarification when necessary. Effluent flow is monitored by a Parshall flume installed at the pump house. Effluent is discharged directly to the Chehalis River via a 1.5 mile long outfall, which also serves as a chlorine contact line. Ecology and the permittee both collected effluent grab samples at the end of the contact line. Darigold disposes of its sludge via land application.

Measurements taken of the critical dimensions of the effluent 3-inch Parshall flume showed it was correctly installed and calibrated. Comparison of Ecology's instantaneous flow measurements to discharger flowmeter readings were reasonably good (within 5%). The effluent Parshall flume measures and records plant flow. The totalizer reading for the 24-hour time period of December 3-4, 1991 was 0.42 MGD; this flow was used to calculate effluent mass loadings for comparison to permit limits. Effluent totalizer readings for the 24-hour time periods of July 20-21, 1992 and August 4-5, 1992 were 0.44 and 0.41 MGD, respectively. An average flow of 0.425 MGD was used to calculate effluent mass loadings for the 1992 inspections.

Conventional pollutant data are tabulated in Tables 17 and 18, respectively. Conductivity and chloride levels in both influent and effluent were high, contributed by the dairy food product process. Influent pH levels were also high. High conductivity in effluent is likely due to elevated chlorides. High chloride concentrations in effluent (588-657 mg/L) were found during all of the inspections. The Darigold WTP operator offered no explanation for the elevated chloride levels in effluent (Klobertanz, 1993). However, it was possible that slug loadings of caustic soda/bleach from the cheese plant washing and excessive chlorination might have contributed to high chloride concentrations in the effluent. Acute and chronic freshwater quality criteria for chlorides are 860 mg/L and 230 mg/L, respectively (EPA, 1986). Some studies have reported that higher concentrations of chlorides in water supporting fish fauna can be harmful (e.g., 400 mg/L for trout; McKee and Wolf, 1963). Concern over chronic toxicity would be minimized by a dilution factor of 3:1 at the edge of the chronic mixing zone. A reduction in ammonia and nitrite+nitrate nitrogen ($\text{NO}_2 + \text{NO}_3\text{-N}$) as well as a substantial removal (95%) of total persulfate nitrogen indicated considerable nitrification and denitrification were taking place in the plant. Also, substantial amounts of total phosphorus were removed by the treatment process. Influent soluble BOD_5 results indicated that most of the BOD_5 loading was in the soluble state. Most BOD_5 and TSS results indicated a reasonably well-treated effluent. However, plant effluent had high coliform counts during the July 20-21, 1992 inspection.

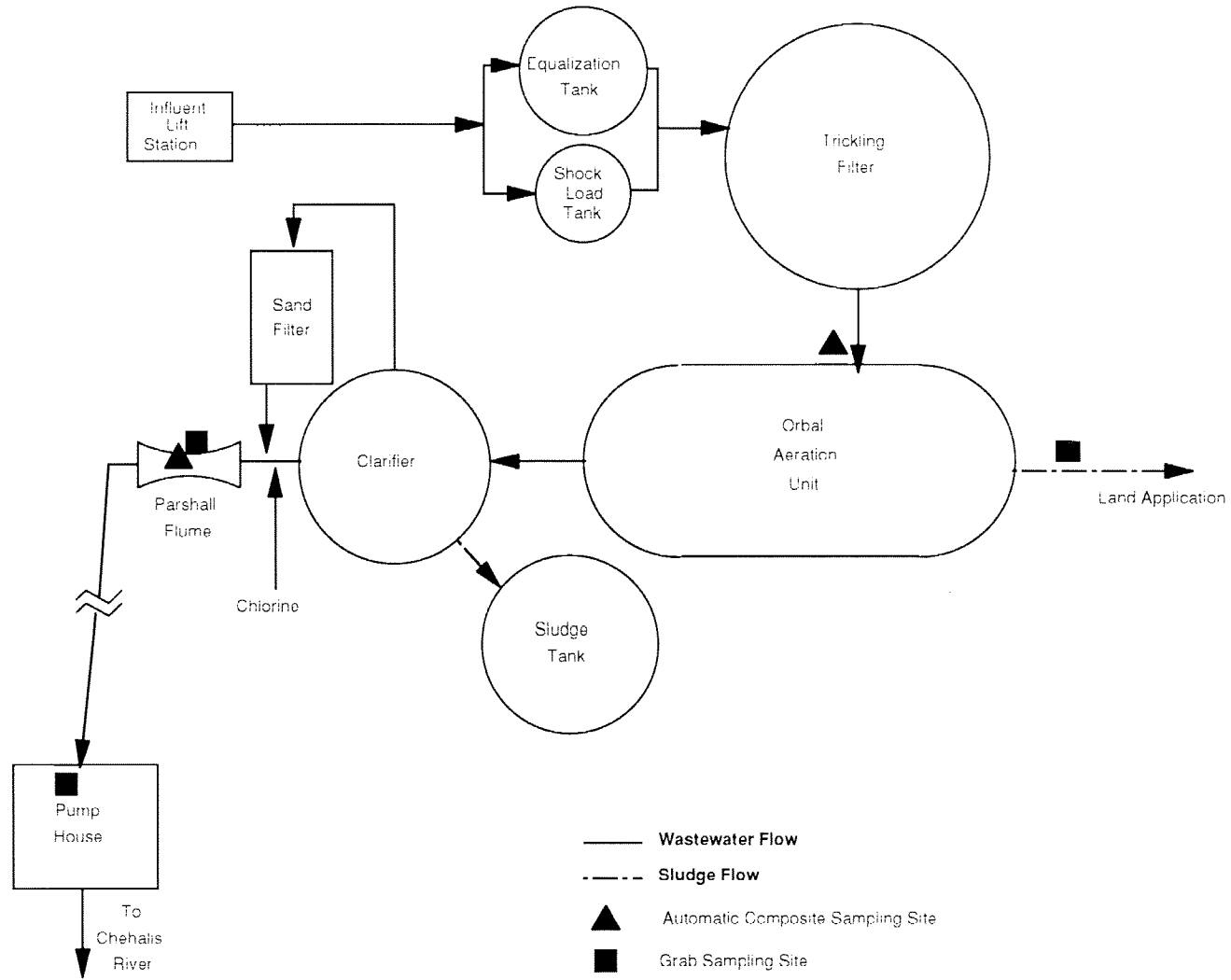


Figure 5. Plant Schematic and Sampling Locations - Darigold WTP, 12/91-8/92.

Table 17. General Chemistry Results, Darigold WTP - Chehalis River Basin Class II Inspections, 12/91

Location:	Inf-E	Inf-DG	Inf-1	Eff-1	Eff-E	Eff-DG	Eff-2	Inf-2	Blank	Sludge
Type:	comp	comp	grab	grab	comp	comp	grab	grab	equipment	grab
Date:	12/3-4	12/3-4	12/3	12/3	12/3-4	12/3-4	12/4	12/4	12/4	12/4
Time:	0830-0830	0830-0830	0900	1040	0800-0800	0800-0800	1040	0845	1450	1020
Lab Log#:	498020	498021	498022	498023	498024	498025	498026	498027	498028	498029
LABORATORY RESULTS										
Turbidity (NTU)	117	120			10	11				
Conductivity (µmho/cm)	2450	2300			3210	3060		2300		
Alkalinity (mg/L)	718	692			649	658				
Chloride (mg/L)	199	191			657	598				
Hardness (mg/L)	145	169			38.4	70.0				
TS (mg/L)	3830	3710			1960	1900				
TNVS (mg/L)	1210	1270			1730	1670				
TSS (mg/L)	370	330			34	36				
TNVSS (mg/L)	90	90			8	3				
Solids (%)										3.01
Volatile Solids (%)										2.36
BOD5 (mg/L)	1860	2010			29+	27				
BOD5 sol (mg/L)	1840				47.8					
TOC (mg/L)	2620 J	2160 J			30.1 J	33.6 J				5600**
NH3-N (mg/L)	5.5	5.1			0.14	0.13				90*
NO2+NO3-N (mg/L)	4.8	4.5			0.33	0.42				<0.2*
T-Phosphorus (mg/L)	75.8 J	70.1 J			43.4	44.3				1100*
T-Persulfate Nitrogen (mg/L)	99.4	88.9			4.9 J	5.8 J				
O-Phosphate (mg/L)					47.6	32.9			0.011	
Oil & Grease (mg/L)			127	2.5			2.7	70.3		150*
F-Coliform MF (#/100 ml.)				35			150			
Klebsiella (%)				65			58			
FIELD OBSERVATIONS										
Flow (MGD)					0.42					
Temperature (°C)	7.4++	15.8++	29.4	16.7	3.8++	6.7++	17.4	28.2		
pH (S.U.)	12.3++	12.0++	11.1	7.8	8.0++	8.0++	7.8	11.1		
Chlorine free (mg/L)				<= 0.2			<= 0.2			
total (mg/L)				<= 0.2			<= 0.2			

Inf - Influent, Eff - Effluent, E - Ecology sampler, DG - Darigold sampler

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

* - mg/kg, ** - mg/L (<3% solid).

+ 5-day BOD result was derived from ultimate BOD (30 days) (Pickett, in prep.), and should be used with caution as the value is less than the 5-day soluble BOD result.

++ Iced composite sample.

Table 18. General Chemistry Results, Darigold WTP - Chehalis River Basin Class II Inspections, 7/92 & 8/92

	Location:	Inf-E	Inf-DG	Inf-1	Eff-1	Eff-T	Eff-E	Eff-DG	Eff-2	Inf-2	Eff-1	Eff-T	Eff-E	Eff-DG	Eff-2
	Type:	comp	comp	grab	grab	grab	comp	comp	grab	grab	grab	grab	comp	comp	grab
	Date:	7/20-21	7/20-21	7/20	7/20	7/20	7/20-21	7/20-21	7/21	7/21	8/4	8/4	8/4-5	8/4-5	8/5
	Time:	1400-1400	1400-1400	1420	1445	1450	1420-1420	1420-1420	1410	1425	1050	1100	1030-1030	1030-1030	1140
	Lab Log#:	308310	308311	308312	308313	308314	308315	308316	308317	308318	328250	328251	328252	328253	328254
LABORATORY RESULTS															
Turbidity (NTU)		190	190			5.5	4.0	5.2				4.8	3.8	5.3	
Conductivity (µmho/cm)		4870	4390			3660	2950	3130				3660	3410	3460	
Alkalinity (mg/L)		975	903			834	693	713				751	790	807	
Chloride (mg/L)						751	588	623				748	650	661	
Chlorophyll a (µg/L)						0.00	1.92	0.00				2.22	0.00	1.38	
TS (mg/L)		3690	3650			2250	1780	1930				2270	2020	2050	
TNVS (mg/L)		2210	2090			2090	1640	1680				2080	1850	1850	
TSS (mg/L)		512	417	417	25	20	12	13	12	335	5	13	9	8	8
TNVS (mg/L)		129	100			2	<1	1				3	4	4	
TDS (mg/L)						2170	1710	1840				2120	1960	2000	
BOD5 (mg/L)		> 770	> 790	> 790	18	17	13	< 2	8	> 780	5	4	6	8	7
TOC (mg/L)		OHT	OHT			32.1	OHT	OHT				15.2	17.4	16.5	
NH3-N (mg/L)		4.5	3.8			0.25	1.2	0.29				0.05	0.51	0.32	
NO2+NO3-N (mg/L)		3.5	2.9			0.04	0.30	0.63				4.0	3.8	3.9	
T-Phosphorus (mg/L)		81.7	80.2			32.7	21.5	21.7				34.2	31.0	35.6	
T-Persulfate Nitrogen (mg/L)		51.7	53.7			2.7	3.1	3.1				6.6	6.3	6.5	
Ortho-Phosphate (mg/L)						27.0	9.44	9.4				32.3	32.2	32.8	
Oil & Grease (mg/L)					1.9				< 1.0		< 1.0				< 1.0
F-Coliform MF (#/100 mL)					2200				220		51 X				48
FIELD OBSERVATIONS															
Flow (MGD)							0.44						0.41		
Temperature (°C)		7.2*	9.1*	16.9	26.5		8.6*	9.5*	25.4		23.9	20.9	9.5*	8.7*	24.4
pH (S.U.)		12.8*	12.6*	11.5	7.8		8.7*	8.6*	8.2	12.3	8.0	8.0	8.6*	8.1*	8.0
Conductivity (µmho/cm)		4510	4180	6120	3080		2620	2790	3020	3870	3010	2850	2800	2970	2700
Chlorine free (pptm)					0.08				0.07		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
total (ppm)					0.1				0.15		< 0.1	0.2	0.25	0.2	0.15

Inf - Influent, Eff - Effluent, E - Ecology sample, DG - Darigold sample, T - Ecology replicate sample

X - High background count of thermal tolerant nonfecal bacteria.

OHT - Over holding time.

* Iced composite sample.

Comparisons of effluent parameters to NPDES permit limits are presented in Tables 19 and 20. Table 19 shows results obtained during the 1991 inspection. Effluent met the BOD₅ limit for daily maximum concentration, however BOD₅ loading exceeded the daily maximum limit. Both TSS concentration and loading in effluent exceeded daily maximum permit limits. Percent removals for BOD₅ and TSS were very high (98%; 91%). The effluent met permit requirements for fecal coliform, total chlorine, ammonia, pH, and flow at the time of the 1991 inspection.

Table 20 shows permit compliance results obtained during the two inspections conducted in 1992. Effluent met permit requirements for BOD₅, TSS, ammonia, pH, and flow, but fecal coliform counts exceeded the daily maximum limit on 7/20/92. Effluent residual chlorine concentrations also exceeded the daily maximum limit on several occasions.

Tables 21 and 22 compare results between Darigold and Ecology samples and labs. Table 21 shows that the operator's results compared acceptably with Ecology results in 1991, except for ammonia (0.1 versus 1.5 and 0.12 versus 1.5). Table 22 presents results of the 1992 inspections. BOD₅ and TSS results show good agreement. As in 1991, the operator's effluent ammonia results were always higher than Ecology's results. Darigold's lab analytical procedure for ammonia should be examined further. Temperatures of all composited samples were above the recommended 4°C.

Fish Farms

Samples of effluents from four privately owned fish farms along the Black River and Scatter Creek were collected and analyzed (Figure 1). Typical fish farm wastes include uneaten food, fecal matter, soluble metabolites (e.g., ammonia), algae, and other chemicals. Fish farm effluents thus may deliver solids, nutrients, and potential toxicants to receiving waters (Kendra, 1991). All four fish farms use ground water from on-site wells which necessitated sampling each permittee's production wells to provide data on influent water quality.

Swecker Salmon Farm

Swecker Salmon Farm uses ground water from four wells to rear salmon and trout in several earthen ponds. Water discharged from the rearing ponds is routed through four different channels, and each channel is fitted with a rectangular weir for flow monitoring as shown in Figure 6. Flow at each channel was measured using a Swoffer® current meter. The average effluent flow rate over the four weirs during the inspection was 2.51 MGD.

Conventional pollutant data collected during the inspection are tabulated in Table 23. Results indicate that levels of turbidity, NH₃, and total phosphorus in effluent increased considerably compared to that of well waters. Conductivity and total dissolved solids (TDS) levels in well and effluent waters remained relatively steady. However, the level of NO₂+NO₃-N in effluent was slightly lower than well water. Fecal coliform bacteria counts were very low (4 and 6 #/100 mL). The average BOD₅ level was 4.31 mg/L (90 lbs/day).

Table 19. Comparison of Inspection Results to NPDES Permit Limits, Darigold WTP - Chehalis River Basin Class II Inspections, 12/91

Parameter	NPDES Permit Limits		Inspection Data		
	Daily Average*	Daily Maximum**	Ecology Composite	Grab Samples	Plant Loading
Effluent BOD5 (mg/L) (lbs/d) (% removal)	75	30 95	29++	---	100 98
Effluent TSS (mg/L) (lbs/d) (% removal)	70	30 92	34	---	120 91
Fecal Coliform (#/100 mL)	200	400	---	93+ (35;150)	
Total Chlorine Residual (mg/L)	1\	<=0.2	---	× 0.2	
Ammonia Nitrogen (mg/L)	3.0	6.0	0.14	---	
pH (S.U.)	Within the range of 6.0 to 9.0		---	7.8;7.8	
Flow (MGD)	0.48	0.60	0.42		

* The daily average is based on the arithmetic mean of the measured values obtained over a calendar month.

** The daily maximum is defined as the greatest allowable value for any calendar day.

+ The arithmetic average of data obtained on 12/4-5.

++ 5-day BOD result was derived from ultimate BOD (30 days)(Pickett, in prep.).

1\ No chlorine residual shall be detected in the effluent as measured by colorimetric analysis.

Table 20. Comparison of Inspection Results to NPDES Permit Limits, Darigold WTP - Chehalis River Basin Class II Inspections, 7/20-21, 1992 and 8/4-5, 1992

Parameter	NPDES Permit Limits		Inspection Data		
	Daily Average*	Daily Maximum**	Ecology Composite	Grab Samples	Plant Loading
Effluent BOD5 (mg/L)		30		18;5	
(lbs/d)	75	95	13;6		47
(% removal)					99
Effluent TSS (mg/L)		30		25;5	
(lbs/d)	70	92	12;9		43
(% removal)					98
Fecal Coliform (#/100 mL)	200	400	---	1200+;50++ (2200;220;51X;48)	
Total Chlorine Residual (mg/L)	1\	×0.2	---	0.1;0.15;<0.1;0.2;0.25;0.2;0.15	
Ammonia Nitrogen (mg/L)	3.0	6.0	1.2;0.51	---	
pH (S.U.)	Within the range of 6.0 to 9.0		---	7.8;8.2;8.0;8.0;8.0	
Flow (MGD)	0.48	0.60	0.425		

* The daily average is defined as the arithmetic average of the measured values obtained over a calendar month.

** The daily maximum is defined as the greatest allowable value for any calendar day.

+ The arithmetic average of data obtained on 7/20-21.

++ The arithmetic average of data obtained on 8/4-5.

1\ No chlorine residual shall be detected in the effluent as measured by colorimetric analysis.

X High background count of thermal tolerant non-fecal bacteria.

Table 21. Comparison of Laboratory Results of Sample Splits, Darigold WTP - Chchalis River Basin Class II Inspections, 12/91

Station ID:	Inf-E		Inf-DG		Eff-E		Eff-DG		Eff-1		Eff-2	
Lab Number:	498020		498021		498024		498025		498023		498026	
Date:	12/3-4		12/3-4		12/3-4		12/3-4		12/3		12/4	
Sampler:	Ecology		Darigold		Ecology		Darigold		Grab		Grab	
Laboratory:	Ecology	Darigold	Ecology	Darigold	Ecology	Darigold	Ecology	Darigold	Ecology	Darigold	Ecology	Darigold
BOD5 (mg/L)	1860	1800	2010	1920	29	34	27	30	---	---	---	---
TSS (mg/L)	370	295	330	354	34	30	36	38	---	---	---	---
Ammonia (mg/L)	5.5	---	5.1	---	0.1	1.5	0.127	1.5	---	---	---	---
F-Coliform (#/100 mL)	---	---	---	---	---	---	---	---	35	40	150	80

E - Ecology sample, DG - Darigold sample, Inf - Influent, Eff - Effluent

Table 22. Comparison of Laboratory Results of Sample Splits, Darigold WTP - Chehalis River Basin Class II Inspections, 7/92 & 8/92

Station ID:	Inf-E		Inf-DG		Eff-E		Eff-DG		Eff-1		Eff-2		Eff-E		Eff-DG	
Lab Number:	308310		308311		308314		308315		308313		308317		328252		328253	
Date:	7/20-21		7/20-21		7/20-21		7/20-21		7/20		7/21		8/4-5		8/4-5	
Sampler:	Ecology		Darigold		Ecology		Darigold		Grab		Grab		Ecology		Darigold	
Laboratory:	Ecology	Darigold	Ecology	Darigold	Ecology	Darigold	Ecology	Dairgold	Ecology	Darigold	Ecology	Darigold	Ecology	Darigold	Ecology	Darigold
BOD5 (mg/L)	> 770	1890	> 770	1950	22	17	< 2	16	18	---	8	---	6	7	8	5
TSS (mg/L)	512	560	417	550	12	13	13	16	25	---	12	---	9	7	8	9
NH3-N (mg/L)	4.5	7.3	3.8	7.1	1.2	2.2	0.29	1.2	---	---	---	---	0.51	1.3	0.32	1.1
F-Coliform (#/100 mL)	---	---	---	---	---	---	---	---	2200	1500	220	580	---	---	---	---

E - Ecology sample, DG - Darigold sample, Inf - Influent, Eff - Effluent

Table 23. General Chemistry Results, Swecker Salmon Farm - Chehalis River Basin Class II Inspections, 9/9

Location:	WELL-1	EFF-1	WELL-2	EFF-2
Type:	hand-comp	comp	hand-comp	comp
Date:	9/10	9/9-10	9/11	9/10-11
Time:	0905	0930-0930	0900	0910-0910
Lab Log#:	378370	378371	378470	378471
LABORATORY RESULTS				
Turbidity (NTU)	0.35	1.5	0.30	1.5
Conductivity (µmho/cm)	130	141	130	145
Chloride (mg/L)	5.1	5.8	5.1	5.8
Chlorophyll a (µg/L)		0.75		1.06
Pheophytin a (µg/L)		0.83		1.72
TSS (mg/L)		3		5
TDS (mg/L)	106	104	122	134
SS (mL/L/hr)		<0.1		<0.1
BOD5 (mg/L)		4		4
TOC (mg/L)	2.58	2.58	1.31	3.81
NH3-N (mg/L)	<0.01	0.94	<0.01	1.23
NO2+NO3-N (mg/L)	2.87	2.58	3.03	2.71
T-Phosphorus (mg/L)	0.02	0.36	0.03	0.49
T-Persulfate Nitrogen (mg/L)	2.87	4.13	3.51	4.67
O-Phosphate (mg/L)	0.02	0.23	0.02	0.35
F-Coliform MF (#/100 mL)		4		6 X
FIELD OBSERVATIONS				
Flow (MGD)		2.51		
Temperature (°C)	11.5	5.1+	11.7	4.0+
pH (S.U.)	7.7	7.4+	7.1	7.2+
Conductivity (µmho/cm)	130	110	135	115
Dissolved Oxygen (mg/L)		9.75*		

Eff - Effluent sample, Well - Hand-composite of 4 different wells

* Grab sample.

+ Iced composite sample.

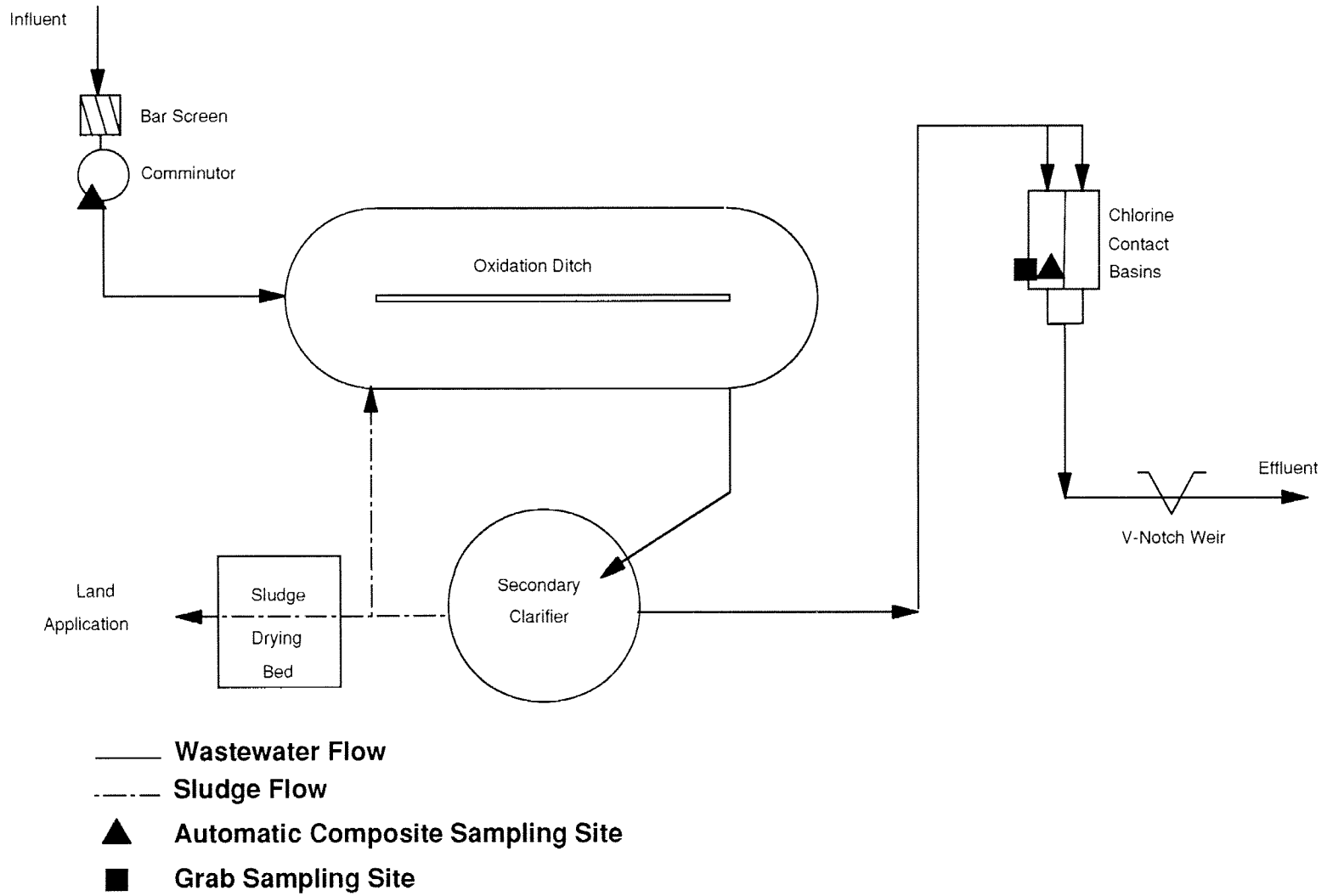


Figure 4. Plant Schematic and Sampling Locations--Pe EII WTP, 8/91.

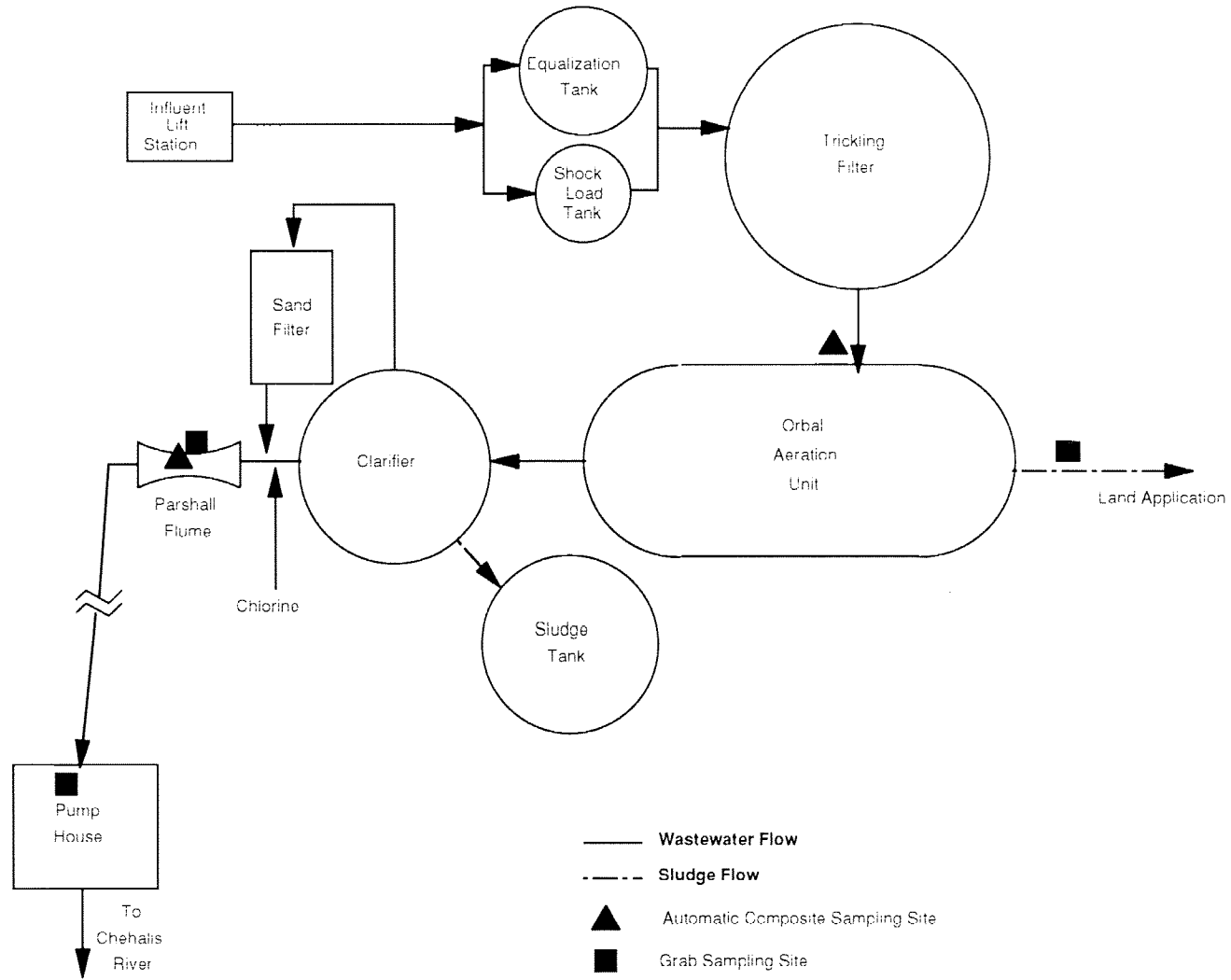


Figure 5. Plant Schematic and Sampling Locations - Darigold WTP, 12/91-8/92.

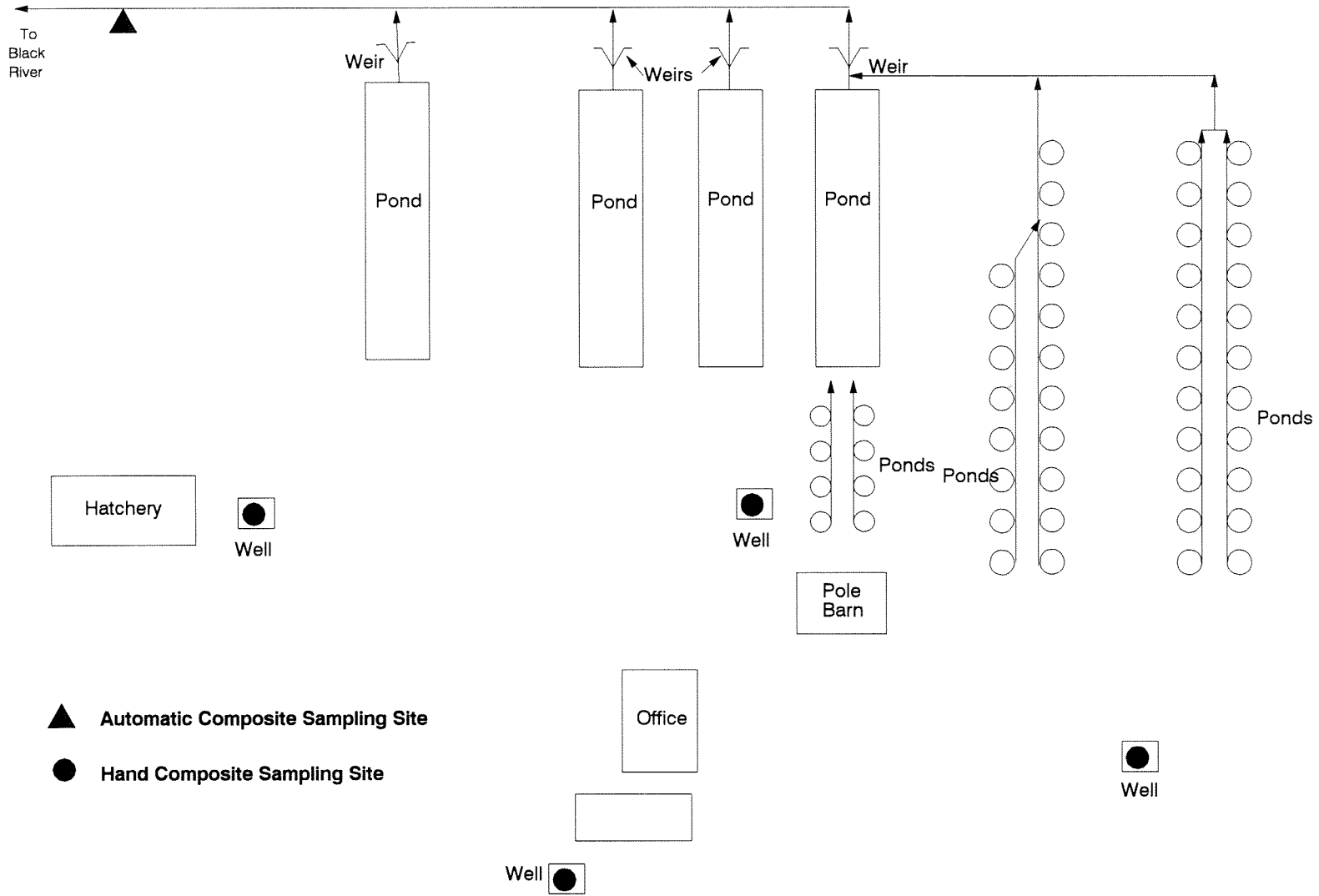


Figure 6. Plant Schematic and Sampling Locations--Swecker Salmon Farm, 9/91.

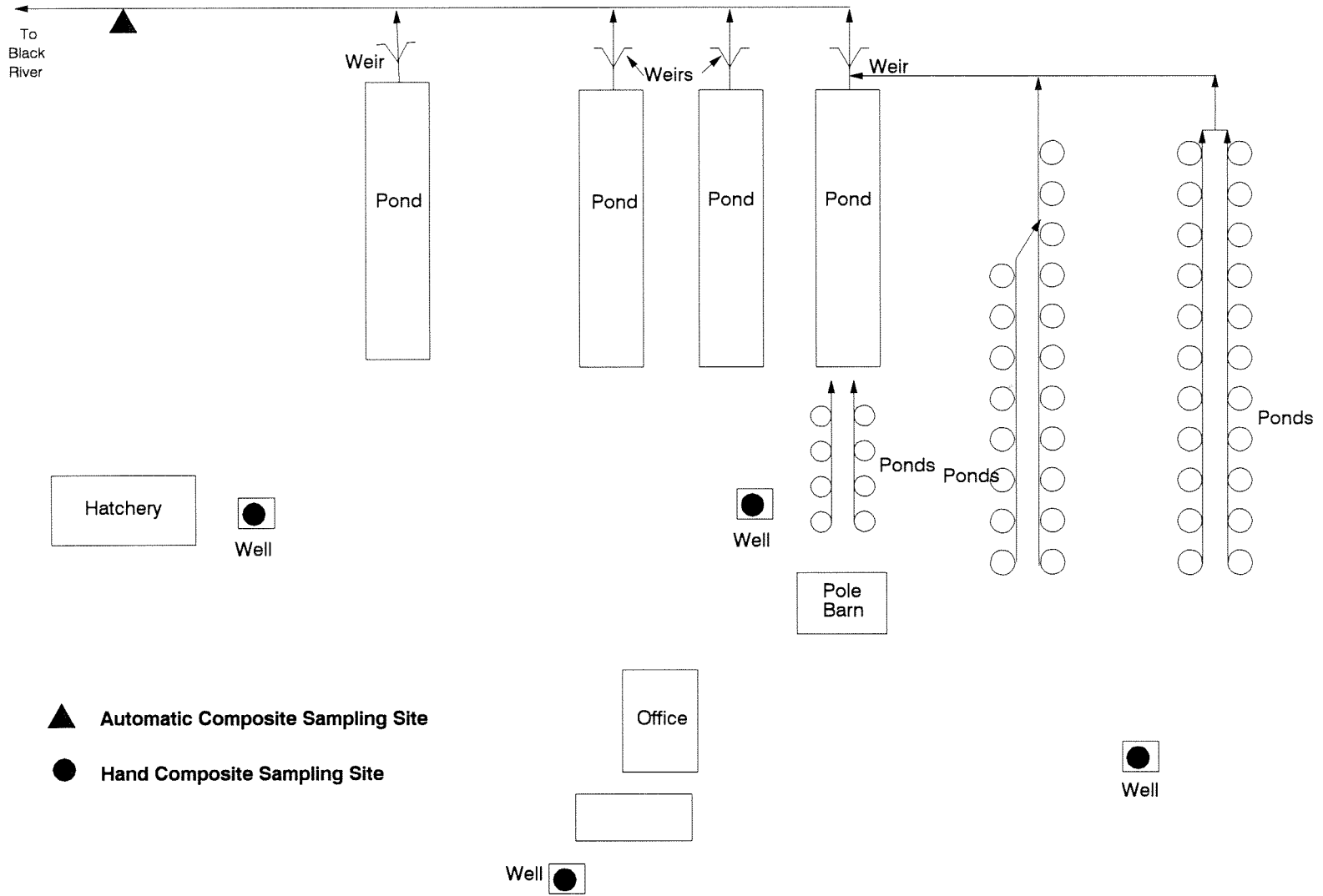


Figure 6. Plant Schematic and Sampling Locations--Swecker Salmon Farm, 9/91.

A comparison of effluent parameters to NPDES permit limits is presented in Table 24. The effluent met permit limits for SS, TSS, temperature, and dissolved oxygen during the inspection.

Global Aqua at Black River (BR)

The treatment system at Global Aqua (BR) consists of a settling basin and large secondary settling pond (Figure 7). All effluent samples were collected across the open channel immediately downstream of the settling basin weir because of convenient location and representativeness of samples. Discharge was measured across the open channel downstream of the weir. The average effluent flow rate during the inspection was 10.12 MGD. Both the settling basin and pond are unlined and percolate to ground water which is believed to be hydraulically interconnected with the Black River. There is no direct surface water discharge from this facility.

Conventional pollutant data collected during the inspection are tabulated in Table 25. Ecology's effluent replicate samples indicated good quality assurance and low variability except for TOC. The general chemistry data showed that turbidity, NH₃, total nitrogen, total phosphorus, ortho phosphorus, and TOC in effluent increased moderately compared to corresponding levels in well waters. The average BOD₅ loading in wastewater was 270 lbs/day. Fecal coliform counts in effluent were below detection.

A comparison of effluent parameters to NPDES permit limits is tabulated in Table 26. Effluent met permit limits for SS, TSS, temperature, and dissolved oxygen at the time of inspection, indicated a well-treated effluent.

Global Aqua at Scatter Creek (SC)

Global Aqua at Scatter Creek (formerly operated by Domsea) was shut down for cleaning during my inspection. The only fish on site were those that had escaped to the settling ponds. Only one well (#2) was operating; all wastewaters (mostly clean ground water running through the rearing tanks) were directed to the unlined settling ponds. Discharge to Scatter Creek was measured at a rectangular weir located downstream of the ponds (Figure 8). The average effluent flow rate at the time of inspection was 1.08 MGD.

Conventional pollutant data collected during the inspection are presented in Table 27. The general chemistry results indicated that turbidity, TOC, and NH₃ in effluent increased slightly relative to well water. On the other hand, levels of NO₂+NO₃-N and TPN in effluent were lower than that of well water. Since no fish farming was in progress during the inspection, it seems likely these changes are due to limnological effects in the settling ponds.

A comparison of effluent parameters to NPDES permit limits is presented in Table 28. As expected, the effluent met permit limits for SS, TSS, temperature, and dissolved oxygen at the time of inspection.

Table 24. Comparison of Inspection Results to NPDES Permit Limits,
 Swecker Salmon Farm - Chehalis River Basin Class II Inspections, 9/91

Parameter	NPDES Permit Limits		Inspection Data
	Monthly Average	Instantaneous Maximum	Ecology Composite
Effluent SS (mL/L/hr)	0.1	---	<0.1
Effluent TSS (mg/L)	5.0	15	3,5
Flow (MGD)	---	---	2.51

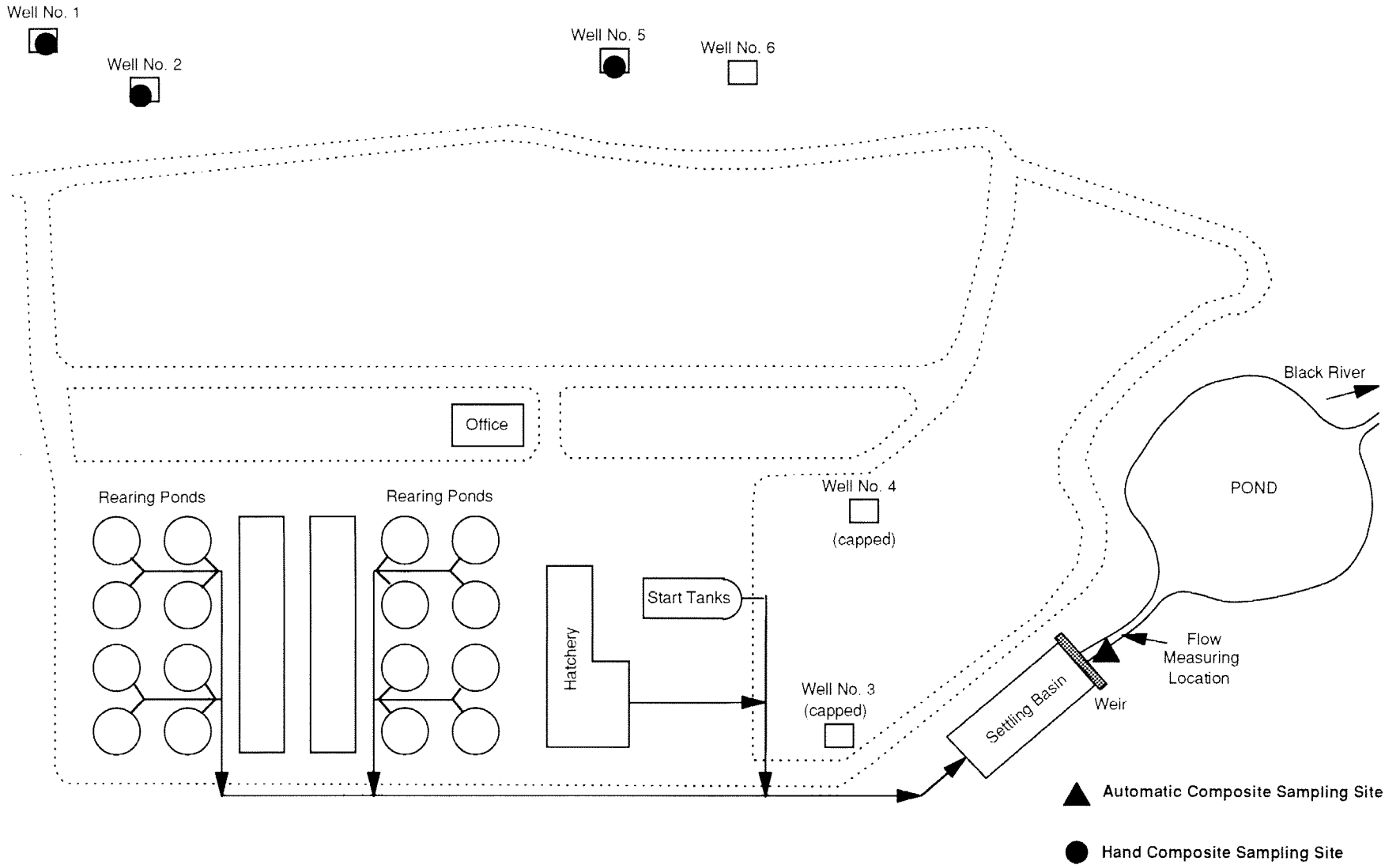


Figure 7. Plant Schematic and Sampling Locations -Global Aqua (Black River), 9/91.

Table 25. General Chemistry Results, Global Aqua, Black River - Chehalis River Basin Class II Inspections, 9/91

	Location:	WELL-1	EFF-1	EFF-T1	WELL-2	EFF-2	EFF-T2
	Type:	hand-comp	comp	comp	hand-comp	comp	comp
	Date:	9/10	9/9-10	9/9-10	9/11	9/10-11	9/10-11
	Time:	1010	1030-1030	1030-1030	1020	1040-1040	1050
	Lab Log#:	378374	378375	378376	378474	378475	378476
LABORATORY RESULTS							
Turbidity (NTU)		0.20	1.0	1.0	0.40	1.1	2.6
Conductivity (µmho/cm)		157	160	160	158	160	160
Chloride (mg/L)		8.4	8.4	8.3	8.2	8.1	8.1
Chlorophyll a (µg/L)			0.05	0.12		0.09	0.09
Pheophytin a (µg/L)			-	0.03		0.12	0.10
TSS (mg/L)			1	3		2	2
TDS (mg/L)		104	113	101	129	130	118
SS (mL/L/hr)			<0.1	<0.1		<0.1	<0.1
BOD5 (mg/L)			4			2.0	
TOC (mg/L)		1.54	3.30	2.57	1.75	2.09	2.96
NH3-N (mg/L)		<0.01	0.21	0.21	<0.01	0.22	0.21
NO2+NO3-N (mg/L)		1.20	1.28	1.26	1.30	1.30	1.33
T-Phosphorus (mg/L)		0.02	0.09	0.09	0.02	0.09	0.13
T-Persulfate Nitrogen (mg/L)		1.33	1.67	1.66	1.29	1.68	1.68
O-Phosphate (mg/L)		0.03	0.06	0.06	0.03	0.06	0.06
F-Coliform MF (#/100 mL)			<1	<1		<1	<1
FIELD OBSERVATIONS							
Flow (MGD)			10.12				
Temperature (°C)		16.3	9.1+	9.1+	13.4	10.9+	10.9+
pH (S.U.)		7.0	7.0+	7.0+	7.1	7.0+	7.0+
Conductivity (µmho/cm)		125	130	130	130	130	130
Dissolved Oxygen (mg/L)				9.40*			9.40*

Eff - Effluent sample, T - Replicate sample, Well - Hand-composite of 3 different wells

+ Iccd composite sample.

* Grab sample.

Table 26. Comparison of Results to NPDES Permit Limits, Global Aqua, Black River - Chehalis River Basin Class II Inspections, 9/91

Parameter	NPDES Permit Limits		Inspection Data
	Monthly Average	Instantaneous Maximum	Ecology Composite
Effluent SS (mL/L/hr)	0.1	---	<0.1
Effluent TSS (mg/L)	5.0	15	1;3;2;2
Flow (MGD)	---	---	10.12

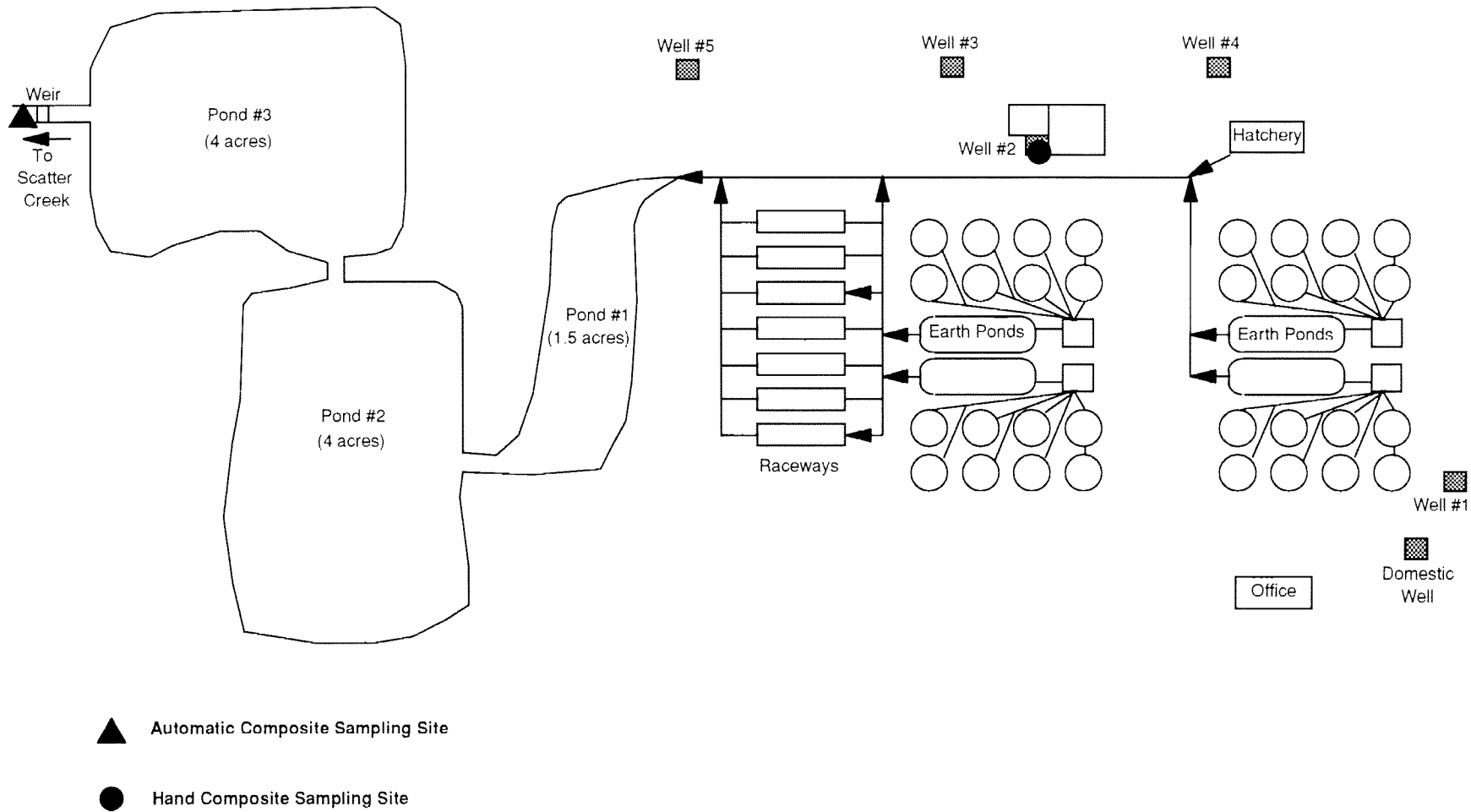


Figure 8. Plant Schematic and Sampling Locations - Global Aqua (Scatter Creek), 9/91.

Table 27. General Chemistry Results, Global Aqua, Scatter Creek - Chehalis River Basin Class II Inspections, 9/91

Location:	WELL-1	EFF-1	BLANK-1	WELL-2	EFF-2	BLANK-2
Type:	hand-comp	comp	equipment	hand-comp	comp	equipment
Date:	9/10	9/9-10	9/10	9/11	9/10-11	9/11
Time:	1230	1300-1300	1730	1200	1215-1215	1710
Lab Log#:	378377	378378	378379	378477	378478	378479
LABORATORY RESULTS						
Turbidity (NTU)	0.40	1.3		0.20	1.0	
Conductivity (µmho/cm)	138	133		138	133	
Chloride (mg/L)	5.2	5.2		4.9	5.0	
Chlorophyll a (µg/L)		3.80			4.43	
Pheophytin a (µg/L)		2.36			3.89	
TSS (mg/L)		1			1	
TDS (mg/L)	88	94		116	119	
SS (mL/L/hr)		<0.1			<0.1	
BOD (mg/L)		2		2		
TOC (mg/L)	1.42	4.12		<1	3.90	
NH3-N (mg/L)	<0.01	0.11		<0.01	0.11	
NO2+NO3-N (mg/L)	4.46	3.00		4.51	3.25	
T-Phosphorus (mg/L)	0.05	0.06		0.09	0.07	
T-Persulfate Nitrogen (mg/L)	4.47	3.49		4.53	3.54	
O-Phosphate (mg/L)	0.02	0.04	0.01	0.02	0.03	0.01
F-Coliform MF (#/100 mL)		3			1	
FIELD OBSERVATIONS						
Flow (MGD)		1.08				
Temperature (°C)	11.1	5.8+		12.8	4.7+	
pH (S.U.)	7.0	7.6+		7.3	8.0+	
Conductivity (µmho/cm)	135	130		135	145	
Dissolved Oxygen (mg/L)		10.35*				

Eff - Effluent sample.

+ Iced composite sample.

* Grab sample.

Table 28. Comparison of Inspection Results to NPDES Permit Limits, Global Aqua, Scatter Creek, Chehalis River Basin Class II Inspections, 9/91

Parameter	NPDES Permit Limits		Inspection Data
	Monthly Average	Instantaneous Maximum	Ecology Composite
Effluent SS (mL/L/hr)	0.1	---	<0.1; <0.1
Effluent TSS (mg/L)	5.0	15	1;1
Flow (MGD)	---	---	1.08

Sea Farm of Washington

Sea Farm of Washington uses ground water from five wells (Figure 9). Water from the rearing ponds flows through concrete collection troughs where settleable solids build up. Effluent then runs through several settling ponds before flowing through a wetland for 1/4 mile prior to discharge to Scatter Creek. Some additional settling and nutrient removal is likely obtained in the wetland.

Conventional pollutant data collected during the inspection are tabulated in Table 29. The effluent flow rate during my inspection was 3.72 MGD. The general chemistry results indicated that concentrations of most parameters remained steady from influent to effluent except for minor increases in NH₃ and phosphorus. The fecal coliform count on September 11 was 20 #/100 mL. BOD₅ loading in the waste stream was about 36 lbs/day.

A comparison of effluent parameters to NPDES permit limits is presented in Table 30. The effluent met permit limits for SS, TSS, temperature, and dissolved oxygen, indicating a well-treated effluent.

CONCLUSIONS AND RECOMMENDATIONS

Centralia WTP

1. The plant was operating well at the time of all three inspections and met applicable effluent limitations except that removal efficiencies for BOD₅ and TSS during August 26-27, 1991, were less than the 85% requirement.
2. The effluent total ammonia concentration exceeded acute and chronic freshwater quality criteria. It is recommended that Pickett's (1993a) review of the city of Centralia effluent mixing study be consulted to address concerns about ammonia toxicity.
3. The overall laboratory performance was acceptable, however, influent TSS results revealed a disparity in sampling. It is recommended that the permittee's influent composite sampling procedures be reviewed.
4. Temperatures of composited samples were often much higher than the recommended 4°C in 1992. The plant's sample cooler should be inspected and repaired as necessary to provide better sample cooling.

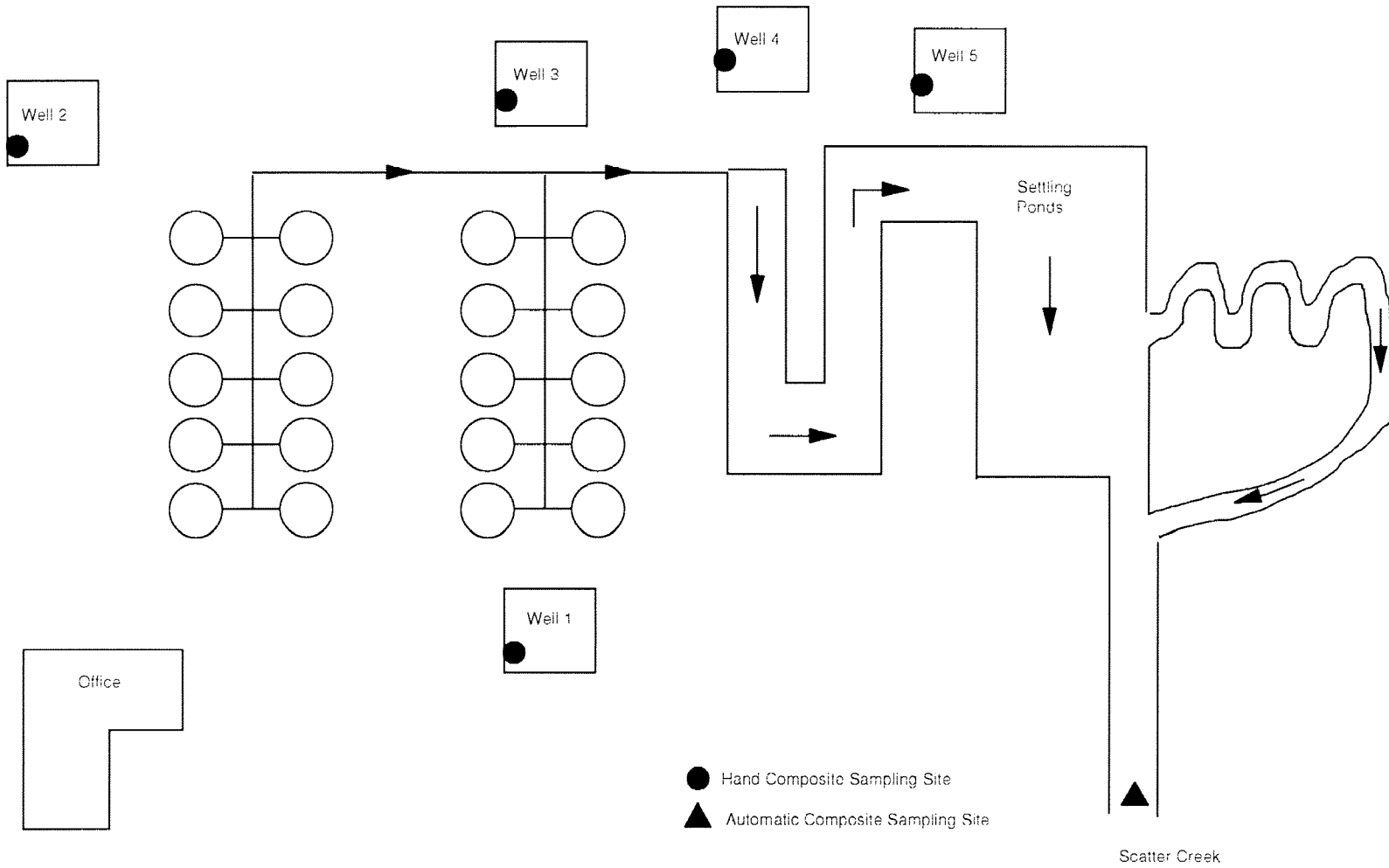


Figure 9. Plant Schematic and Sampling Locations - Sea Farm of Washington, 9/91.

Table 29. General Chemistry Results, Sea Farm of Washington - Chehalis River Basin Class II Inspections, 9/91

Location:	WELL-1	EFF-1	WELL-2	EFF-2
Type:	hand-comp	comp	hand-comp	comp
Date:	9/10	9/9-10	9/11	9/10-11
Time:	1400	1415-1415	1330	1350-1350
Lab Log#:	378372	378373	378472	378473
LABORATORY RESULTS				
Turbidity (NTU)	1.0	0.35	0.35	0.45
Conductivity (µmho/cm)	153	153	151	152
Chloride (mg/L)	5.8	5.5	5.1	5.5
Chlorophyll a (µg/L)		0.03		0.20
Pheophytin a (µg/L)		-		0.23
TSS (mg/L)		1		1
TDS (mg/L)	111	102	132	135
SS (mL/L/hr)		<0.1		<0.1
BOD5 (mg/L)		1.0		
TOC (mg/L)	2.20	3.04	2.16	<1
NH3-N (mg/L)	<0.01	0.12	<0.01	0.12
NO2+NO3-N (mg/L)	4.09	3.76	4.07	3.87
T-Phosphorus (mg/L)	0.03	0.08	0.05	0.12
T-Persulfate Nitrogen (mg/L)	4.11	4.12	4.17	4.01
O-Phosphate (mg/L)	0.03	0.07	0.03	0.06
F-Coliform MF (#/100 mL)		<1		20
FIELD OBSERVATIONS				
Flow (MGD)		3.72		
Temperature (°C)	14.3	8.1+	13.6	4.3+
pH (S.U.)	6.8	7.0+	6.9	7.2+
Conductivity (µmho/cm)	135	135	160	160
Dissolved Oxygen (mg/L)				11.20*

Eff - Effluent sample, Well - Hand-composite of 5 different wells.

+ Iced composite sample.

* Grab sample.

Table 30. Comparison of Inspection Results to NPDES Permit Limits, Sea Farm of Washington - Chehalis River Basin Class II Inspections, 9/91

Parameter	NPDES Permit Limits		Inspection Data
	Monthly Average	Instantaneous Maximum	Ecology Composite
Effluent SS (mL/L/hr)	0.1	---	<0.1;<0.1
Effluent TSS (mg/L)	5.0	15	1;1
Flow (MGD)	---	---	3.72

Chehalis WTP

1. Measurements taken of the critical dimensions of the effluent 12-inch Parshall flume showed it was properly installed. However, the transducer height sensor was malfunctioning, therefore a verification of effluent flow could not be performed. The height sensor should be repaired. The influent Parshall flume was functioning at the time of inspection, however because no suitable access was available, a verification of instantaneous flow could not be carried out. Both effluent and influent flowmeters should be calibrated according to the manufacturer's specifications.
2. The plant was operating well during all three inspections and met applicable effluent limitations except for total residual chlorine. It is recommended that the Chehalis dechlorination system be checked and corrected.
3. The effluent total ammonia concentration exceeded acute and chronic freshwater quality criteria. It is recommended that Pickett's (1993b) review of the city of Chehalis effluent mixing study be consulted to address concerns about ammonia toxicity.
4. Field data indicated that the permittee's influent and effluent composite sample temperatures were often much higher than the recommended 4°C in 1992. The plant's sample coolers should be inspected and repaired as necessary to provide better sample cooling.
5. The permittee's overall laboratory performance was reasonable throughout all three inspections. Both labs' results, however, indicated that Chehalis collected stronger influent samples in 1991 but weaker samples during 1992, which raised a question about the permittee's sample representativeness. It is recommended that the permittee's influent composite sampling methods be checked and corrected.

Pe Ell WTP

1. Comparison of Ecology's instantaneous flow measurements showed that the permittee's flow measuring device was installed and calibrated correctly. However, the permittee should inspect and calibrate the flow monitoring system at least once a year according to manufacturer's specifications.
2. At the time of inspection, the plant met effluent permit limitations for BOD₅, TSS, and fecal coliform. However, removal efficiency for BOD₅ was marginally less than the 85% removal requirement. Also, flow to the plant exceeded the design criterion. The permit manager should consider the option of correcting the I/I problem and follow up with a recommendation.
3. Plant effluent had moderately high residual chlorine (0.5 and 0.4 mg/L). The plant's chlorination system should be examined and corrected as necessary.

4. Split sample evaluations showed a considerable difference in results for effluent BOD₅ and TSS between Pe Ell and Ecology. To help resolve these differences, PE samples should be analyzed in future inspections. Also, the permittee's lab methods for low level BOD₅ and TSS should be examined.
5. The plant's headworks appeared to be poorly maintained and should be cleaned more frequently.

Darigold WTP

1. Ecology's instantaneous flow measurements showed that the permittee's flow measuring device was installed and calibrated correctly. However, the operator should inspect and calibrate the flow monitoring system at least once a year according to the manufacturer's specifications.
2. The plant did not meet daily maximum permit limits for fecal coliform and residual chlorine during the 1992 inspections, nor BOD₅ and TSS load and TSS concentration limits during the 1991 inspection. The permit manager should evaluate whether there is a need to begin planning for an upgrade of the plant to meet present and/or future demands.
3. Plant effluent had a high concentration of chloride, which could be toxic to certain freshwater organisms. It is recommended that the permittee confirm with a mixing zone study that dilution is sufficient to prevent toxicity.
4. The permittee's NH₃ results were consistently higher than Ecology's results. The permittee's lab procedures for NH₃ analysis should be examined and corrected as necessary.

Fish Farms

Effluents from Swecker Salmon Farm, Global Aqua (BR), Global Aqua (SC) and Sea Farm of Washington met general permit limits for SS and TSS. However, another Class II inspection will be needed at Global Aqua (SC) to truly evaluate permit compliance because the facility was not rearing fish at the time of our inspection. It is recommended that temperature and dissolved oxygen levels in the effluent and receiving water be measured during future inspections for verification of compliance with these additional permit limits.

REFERENCES

- APHA-AWWA-WPCF, 1989. Standard Methods for the Examination of Water and Wastewater. 17th ed. American Public Health Association, Washington, D.C.
- EPA, 1983. Methods for Chemical Analyses of Water and Waste. EPA-600/4-79-020 (Rev. March, 1983), Washington, D.C.
- , 1985. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water - Part I. EPA/600/6-85/002a.
- , 1986. Quality Criteria for Water. EPA 440/5-86-001 & May 25, 1988 Addendum for Chloride.
- Huntamer, D. and J. Hyre, 1991. Ecology Laboratory User's Manual. Washington State Department of Ecology, July 1991, Manchester, WA.
- ISCO, 1985. Open Channel Flow Measurement Handbook. Second Edition, ISCO, Inc. Environmental Division, Lincoln, NE.
- Kendra, W., 1991. Quality of Salmonid Hatchery Effluents during a Summer Low-Flow Season. *Transactions of the American Fisheries Society*, vol-120, pp. 43-51.
- Kirchmer, C., 1988. Quality Assurance Manual. Manchester Laboratory, Washington State Department of Ecology, Manchester, WA.
- Klobertanz, F., 1993. Personal Communication, Operator, Darigold WTP, Chehalis, WA. September 15, 1993.
- McKee, J. and H. Wolf, 1963. Water Quality Criteria. Second Edition, US Public Health Service, Department of Health, Education, and Welfare, 3A, pp. 159-161.
- Pickett, P., 1993a. Review of City of Centralia Effluent Mixing Study. Memorandum to D. Harvester, Ecology Southwest Regional Office, Olympia, WA.
- , 1993b. Review of City of Chehalis Effluent Mixing Study. Memorandum to D. Harvester, Ecology Southwest Regional Office, Olympia, WA.
- , in prep. Black River Dry Season Total Maximum Daily Load Study. Washington State Department of Ecology, Environmental Investigations and Laboratory Services Program, Olympia, WA.

REFERENCES (Continued)

Thomson, D., 1993. Personal Communication, Ecology Manchester Laboratory, Manchester, Washington, April 27.

Valderrama, J.C., 1981. The Simultaneous Analysis of Total Nitrogen and Total Phosphorus in Natural Waters. Marine Chemistry 10:109-122.

Whittemore, R., 1991. Ultimate Biochemical Oxygen Demand. Regional Manager, National Council of the Paper Industry for Air and Stream Improvement, Inc., Department of Civil Engineering, Tufts University, Medford, MA.