



STATE OF
WASHINGTON

Dixy Lee Ray
Governor

DEPARTMENT OF ECOLOGY

7272 Cleanwater Lane, Olympia, Washington 98504

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M E M O R A N D U M
September 25, 1980

To: Doug Houck
From: Bili Yake
Subject: Chehalis Wastewater Treatment Plant - Class II Inspection

Introduction

A Class II inspection was conducted at the Chehalis STP on August 5 and 6, 1980. Prior to this inspection, grab samples were obtained during a reconnaissance visit on July 30, 1980. The Class II inspection was conducted simultaneously with a Class II inspection at the Centralia STP and a comprehensive study of the Chehalis River from the Highway 12 Bridge (1/2 mile upstream of the Chehalis STP) to the confluence of the Skookumchuck and Chehalis rivers (below the Centralia STP). A primary objective of these studies was to define the causes of low dissolved oxygen concentrations in the Chehalis River. Depressed dissolved oxygen concentrations have been noted historically at the Chehalis River at Mellen Street Bridge ambient monitoring station (23A120) during summer low flow and severe depletions (as low as 1 mg D.O./l) were recorded during October of 1979.

The Centralia Class II and Chehalis River study results will be issued as separate reports.

Participating in the Chehalis Class II inspection were Will Abercrombie and Bill Yake (DOE Water and Wastewater Monitoring Section, Ambient and Compliance Monitoring Unit). The treatment plant was represented by chief operator Bob Searle and Wayne Balholm. Other operating personnel were on hand and aided in various aspects of the inspection.

General Plant Description

The Chehalis facility is a secondary treatment with a rather unusual design. After grit removal, comminution, and primary clarification, the flow is split. Based on constituent mass balances calculated from data collected during this inspection, about 90% of the flow proceeds to an aeration basin, while the remaining flow is split between two trickling filters. Although the plant has two aeration basins, only one basin was being used. Based on the observed flows (.811 MGD), the detention time in this aeration basin was approximately 17 hours. The activated sludge side of the plant, therefore, approaches extended aeration. During the inspection the F/M ratio was about 0.2 lb BOD₅ removal per lb. aeration basin VSS. The trickling filters are operated during the summer for the sole purpose of retaining some biological growth on the filters when increased flows require substantial use of

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the trickling filters. During the inspection a single pump with 2600 gal/min capacity was providing recirculation to both trickling filters. The recirculation ratio was approximately 50:1 which is extremely high, but may be unavoidable given the current lack of flexibility at the plant.

The effluent from the aeration basin and trickling filter are combined and routed to a secondary clarifier. Chlorine is added and the flow is routed through a contact chamber and discharged to the Chehalis River. The flow scheme and sampling points are illustrated in figure 1.

Specific operational problems at the Chehalis plant are linked primarily to excessive infiltration/inflow (I & I) during high rainfall periods, lack of operational flexibility, and, to a lesser extent, inadequate plant equipment. Specifically, excessive I & I causes hydraulic overload of the secondary clarifier. The aeration basins cannot be drained separately, making use of the second aeration chamber impractical. Aeration capacity is marginal because only three floating aerators are operational. A plant upgrade (approximate cost \$2.5 million) is slated for completion in 1982. This upgrade is primarily aimed at increasing operational flexibility.

Receiving Water

As noted above, the plant discharges to the Chehalis River (waterway segment 10-23-13). The water quality indices (WQI's) of this segment, as reported by Lynn Singleton (1980), are given in table 1. These indices are based on ambient monitoring data from the Chehalis River at Mellon Street Bridge station (23A120).

Table 1. Water Quality Indices* for Receiving Water Segment.

<u>Temp.</u>	<u>Oxygen</u>	<u>pH</u>	<u>Bact.</u>	<u>Trophic</u>	<u>Aesth.</u>	<u>Solids</u>	<u>Ammonia Tox.</u>	<u>Overall Index Rating</u>
32.0	21.0	12.1	25.7	23.3	14.5	(18.0)	0.8	25.7

* < 20 - generally acceptable; 20 to 60 - marginal; > 60 - unacceptable.

The overall WQI (25.7) is the 18th highest in the state with bacterial and trophic problems being attributed to Chehalis and Centralia treatment plants; dissolved oxygen problems to non point sources; and high temperatures to low flows in the river. Based on an initial review of the receiving water data, this assessment may be modified somewhat. If

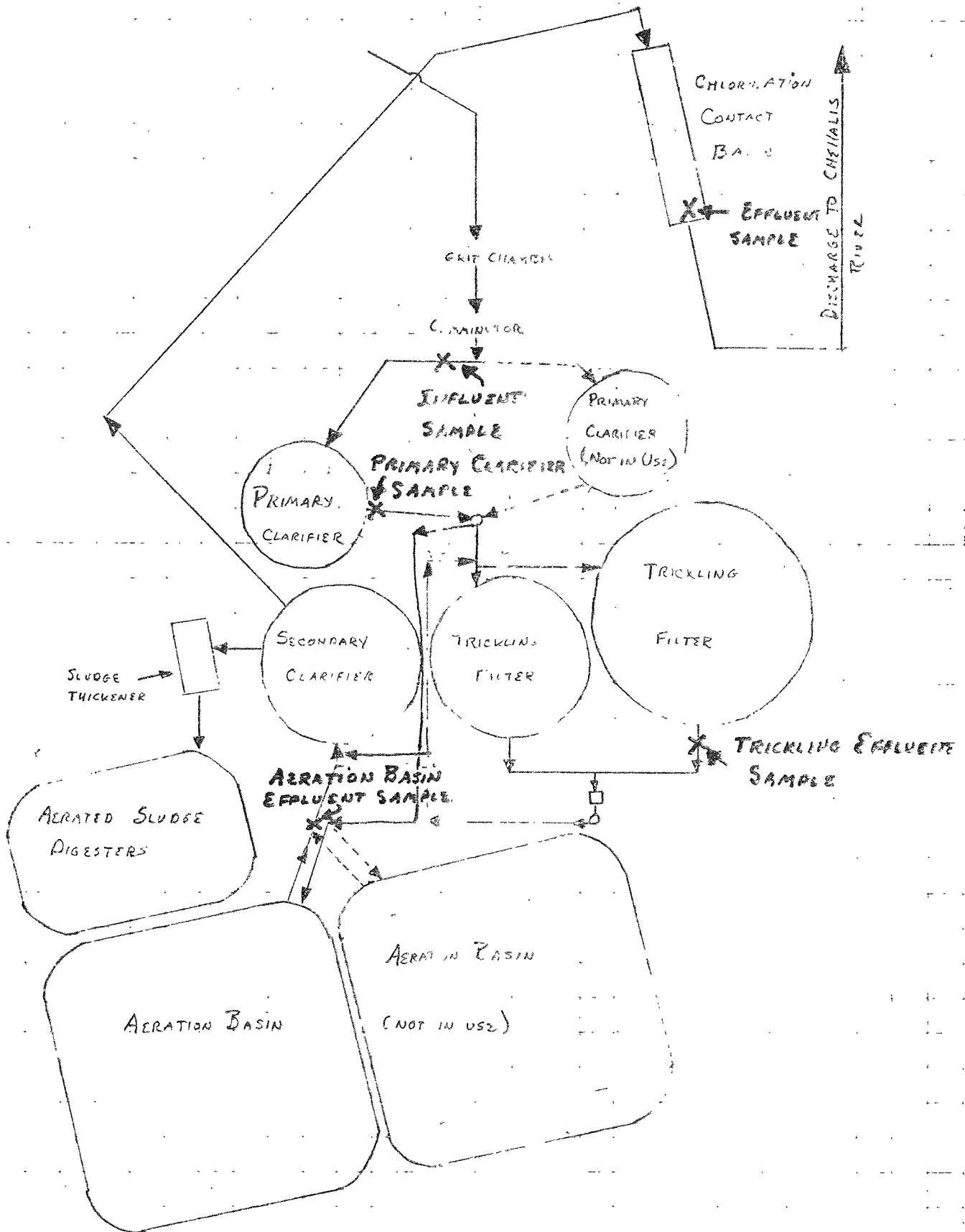


FIGURE 1- CHEILAI'S STP - FLOW SCHEME AND SAMPLE LOCATIONS

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both treatment plants are operating correctly, neither should contribute appreciably to elevated bacterial levels. Trophic conditions (high instream concentrations of nutrients) and low dissolved oxygen concentrations during summer low flows may be linked. The stretch of river between the Chehalis plant and the Centralia plant is very slow, having an estimated travel time of 5 days. Algal growth is substantial, and during the study period appeared to be nitrogen-limited (with inorganic nitrogen concentrations in the euphotic zone below 0.01 mg/l detection limits). A depth profile of temperature and dissolved oxygen was taken from the Mellen Street Bridge on August 13, 1980. These profiles are presented in Figure 2. In addition, three samples were taken at various depths (0.5, 2.0, and 3.5 meters), and the results of these analyses are included in Table 2.

Table 2. Depth Profile Data - Chehalis River at Mellen Street August 13, 1980.

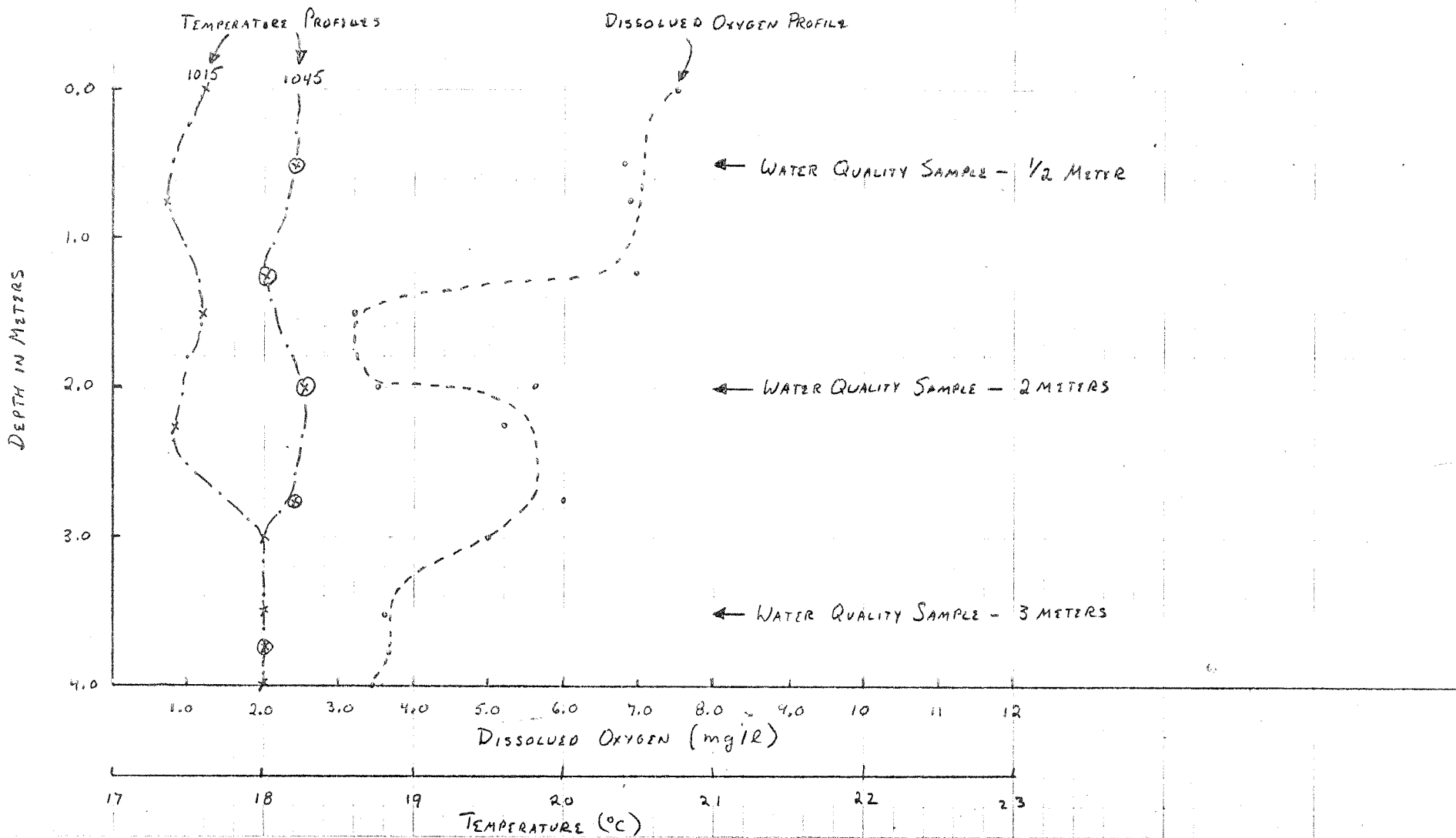
Constituent/Depth	0.5 M	2.0 M	3.5 M
NH ₃ -N (mg/l)	.03	.04	.57
NO ₂ -N (mg/l)	<.01	<.01	.03
NO ₃ -N (mg/l)	.01	.01	.53
Total Inorganic-N (mg/l)	.04	.05	1.13
O-PO ₄ -P	.11	.07	.54
T-PO ₄ -P	.16	.14	.58
COD (mg/l)	16	16	32
TOC (mg/l)	12	9	8
Chlorophyll <u>a</u> (µg/l)	20.2	13	7.9
Pheophytin <u>a</u> (µg/l)	3.0	5.8	9.8

All implications of these data are not yet clear; however, the data do indicate substantial algal activity in the upper 1 meter of the water column with subsequent algal decay in the lower portions of the water column. What is as yet undefined is the extent to which algal respiration and decay are responsible for depressed dissolved oxygen concentrations below the euphotic zone.

To provide the necessary background for placing the results of this sampling inspection in proper perspective, several additional points need to be made:

1. Because the Chehalis River between the Chehalis and Centralia treatment plants is deep, slow, and stratified, physical (or atmospheric) reaeration is minimal. Algal photosynthesis is probably responsible for most of the reaeration in this stretch during low flows. The physical character of the river in this stretch makes it particularly susceptible to oxygen demands exerted here.

FIGURE 2. DISSOLVED OXYGEN & TEMPERATURE PROFILES - CHEHALIS RIVER AT MELLEEN ST. BRIDGE - AUG. 13, 1980



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2. Inorganic nitrogen appeared to be the limiting nutrient for algal production in this stretch of river during the receiving water study. During the August 5-6 receiving water study, total inorganic nitrogen concentrations were below detection limits (<.01 mg/l for NH₃-N, NO₂-N, and NO₃-N) in surface waters in the downstream 2.5 miles of the study area. By comparison, orthophosphate-P concentrations did not fall below .05 mg/l. Because inorganic nitrogen appears to limit algal growth in this stretch of river, it is important to identify its sources. The two primary sources appear to be the Chehalis River upstream of Chehalis and the Chehalis STP. Table 3 compares the loadings from these two sources on two dates.

Table 3. Inorganic Nitrogen Loading to the Chehalis River.

A. 7/30/80

	Chehalis River		Chehalis STP		Total	% of total inorganic nitrogen contributed by Chehalis STP:
Flow (cfs)	116		1.76		118	
	<u>mg/l</u>	<u>lbs/day</u>	<u>mg/l</u>	<u>lbs/day</u>	<u>lbs/day</u>	
NH ₃ -N	<.01	--	11	104	104	
NO ₂ -N	<.01	--	0.3	2.9	2.9	84%
NO ₃ -N	<u>.04</u>	<u>25</u>	<u>2.7</u>	<u>26</u>	<u>51</u>	
Tot.-In-N	.04	25	14	133	158	

B. 8/5-6/80

	Chehalis River		Chehalis STP		Total	% of total inorganic nitrogen contributed by Chehalis STP:
Flow (MGD)	112		1.26		113	
	<u>mg/l</u>	<u>lbs/day</u>	<u>mg/l</u>	<u>lbs/day</u>	<u>lbs/day</u>	
NH ₃ -N	.06	36	2.1	14	50	
NO ₂ -N	<.01	--	0.3	2.0	2.0	44%
NO ₃ -N	<u>.03</u>	<u>18</u>	<u>4.0</u>	<u>27</u>	<u>45</u>	
Tot.-In-N	.09	54	6.4	43	97	

It is clear that a substantial portion of the inorganic nitrogen loading to the Chehalis River is contributed by the Chehalis STP.

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3. Based on the flows given in Table 3, the dilution ratios on 7/30/80 and 8/5-6/80 were 67:1 and 90:1, respectively. It is probably reasonable to assume that a typical low river flow dilution ratio is in the range of 60 to 100:1. This means that an effluent oxygen demand of 60 mg/l would result in a drop of only 1 mg dissolved oxygen/l in the receiving water under worst-case conditions. This oxygen demand would be the sum of carbonaceous BOD₅ and nitrogenous oxygen demand (NOD). During the Class II survey, this value was about 17 mg/l. At this concentration, the direct effect of effluent oxygen demand on the river would be minor. Worst-case conditions at the plant (under current permit limitations) might result in an effluent oxygen demand of about 120 mg/l (45 mg/l of carbonaceous BOD, 20 mg/l of effluent ammonia). This could conceivably result in an oxygen depletion of 2 mg/l in the receiving water.

Additional perspective on algal productivity, nutrients, and related phenomena may be gained by review of ambient monitoring data from the Chehalis River (Mellen Street) station. The appendix provides a listing, Table A-1, of period of record data for flow, dissolved oxygen (concentration and percent of saturation), NH₃-N, NO₂+NO₃-N, orthophosphorus, and total phosphorus. Individual time sequence graphs (Figures A-1 to A-7) are also shown for each of these parameters with the June through October algal growth season denoted. Review of these graphs indicates that both supersaturated and depressed dissolved oxygen concentrations and low flows are associated with this time period. Orthophosphate concentrations are generally elevated and NO₂+NO₃-N concentrations are depressed.

This station is located at the end of the deep, slow reach, and substantial algal production has already occurred. Interpretation of nutrient data must account for station location. Figure 3 illustrates the average monthly total inorganic nitrogen-to-orthophosphate-P ratio. Ratios above 11:1 (Miller, Greene, and Shiroyama, 1978) to 16:1 (Parsons and Takahashi, 1973) ordinarily indicate phosphorus-limited growth, while ratios below these values indicate nitrogen-limited algal growth. This graph suggests that inorganic nitrogen may generally be limiting during the growth period on the Chehalis River.

Figure 4 shows the contribution of Chehalis effluent nutrients to nutrients detected at the Chehalis River (Mellen Street Bridge) station. As can be inferred from this figure, total phosphate loading in the river during the growth season is relatively constant with Chehalis plant effluent accounting for 42 to 72% of the loading at Mellen Street Bridge. Two

FIGURE 3. AVAILABLE NITROGEN:PHOSPHORUS RATIO / CHEHALIS RIVER MELLEN ST. BRIDGE
(AVERAGE VALUES 10/77 to 6/80)

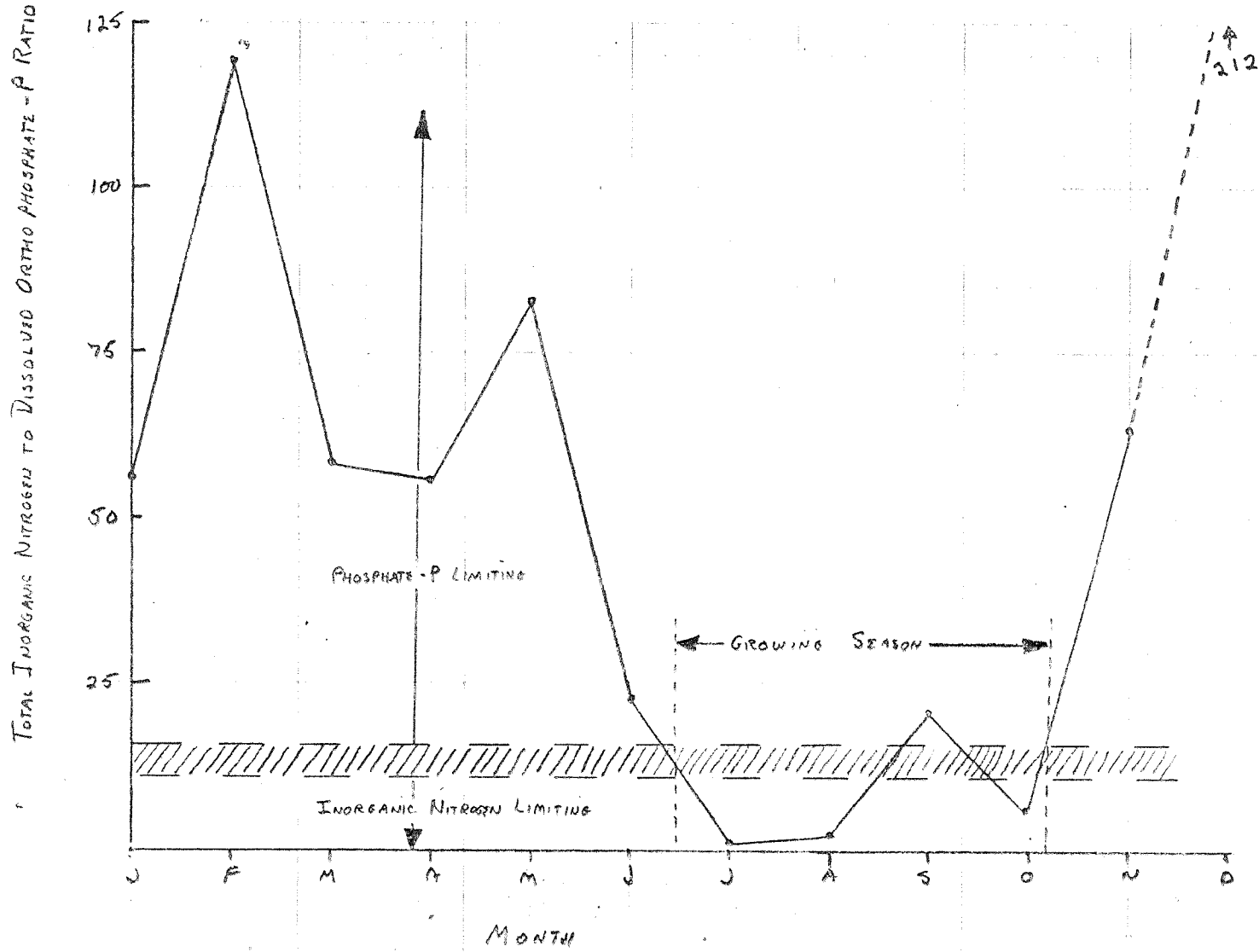
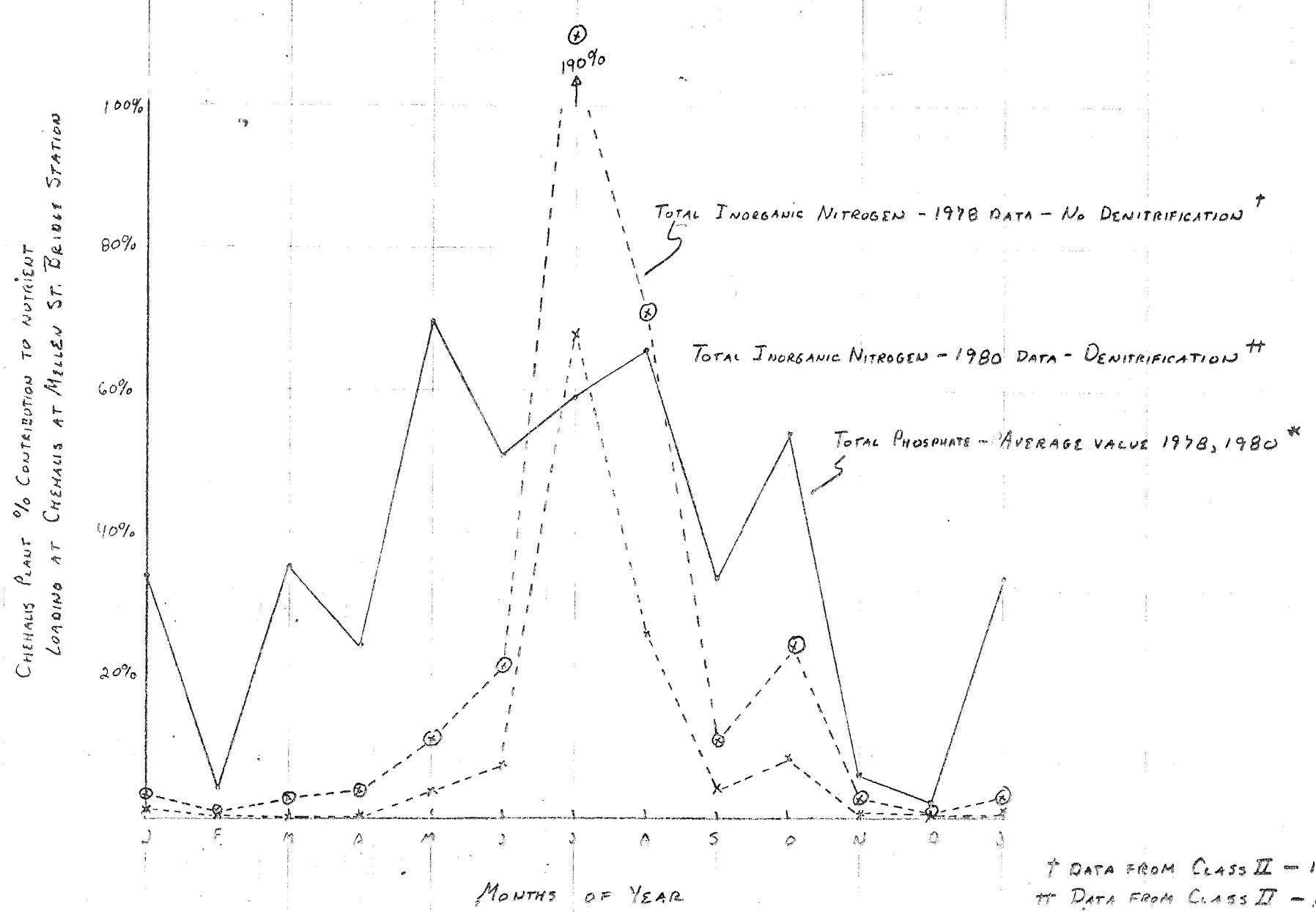


FIGURE 4. CONTRIBUTION OF CHEHALIS PLANT EFFLUENT TO NUTRIENTS IN CHEHALIS RIVER AT MILLEN ST. BRIDGE STATION



† DATA FROM CLASS II - 1/29/79
 †† DATA FROM CLASS II - 8/5-6/80
 * DATA FROM BOTH CLASS II REPTS.

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curves are shown for inorganic nitrogen contribution because two very different effluent concentrations were recorded during the two Class II inspections (January 29, 1979 and August 5, 1980). Percent contributions by the plant are highest in the July-to-August period.

One *caveat* must be considered in all of this analysis. No back data are available on organic nitrogen concentrations in the river (i.e., nitrogen associated with algal cells). Preliminary receiving water data indicate these concentrations may be quite high. If so, internal nitrogen cycling in the slow stretch of river may decrease the importance of inorganic nitrogen loading from the plant.

Based on these considerations, it appears that effluent concentrations of inorganic nitrogen should be given close consideration. Their impact on the receiving water may be more critical than the concentrations of carbonaceous BOD₅ typically discharged.

Findings

The data collected during both the reconnaissance and Class II inspection are presented in Tables 4, 5, and 6. Based on these data, the plant was in compliance with all permit limitations except effluent chlorine residual. The permit requires a total residual chlorine (TRC) of 0 mg/l if Chehalis River flows are less than 150 cfs. During the inspection, TRC's ranged from 0.2 to 2.2 mg/l. The plant has no de-chlorination equipment. Therefore, compliance with this limitation is not presently feasible.

Metals concentrations detected in an anaerobic sludge sample are reported in Table 7. These results indicate no unusual metal concentrations.

Table 7. Metals in Chehalis Plant Sludge
(dry weight basis).

Percent Solids	8.2
Cd (mg/kg d.w.)	9.0
Cr (mg/kg d.w.)	46
Cu (mg/kg d.w.)	451
Fe (mg/kg d.w.)	32,600
Hg (mg/kg d.w.)	7.6
Mn (mg/kg d.w.)	500
Ni (mg/kg d.w.)	30
Pb (mg/kg d.w.)	524
Zn (mg/kg d.w.)	1,790

Table 4. Field Data - Chehalis STP Effluent

Constituent	Date	Time	Concentration
Dissolved Oxygen (mg/l)	7/30/80	1110	5.9*
	8/05/80	1155	7.0*
	8/05/80	1720	6.8*
	8/06/80	0925	6.4*
	8/06/80	1035	6.5*
Conductivity (μ hos/cm)	7/30/80	1110	470*
	8/05/80	1140	440*
	8/06/80	1210	480*
	8/5-6/80	Comp.	400*
Temperature ($^{\circ}$ C)	7/30/80	1110	18.8*
	8/05/80	1140	18.4*
	8/06/80	1210	18.1*
Total Chlorine Resid. (mg/l)	7/30/80	1110	0.7*
	8/05/80	1040	1.6*
	8/05/80	1430	0.3*
	8/05/80	1710	0.2*
	8/06/80	1035	2.2*
Flow (MGD)	7/30/80	1110	1.14 MGD
	8/5-6/80	24-hr. Avg.	.811 MGD
pH (S.U.)	8/05/80	1140	6.9*
	8/06/80	1210	6.8*
	8/5-6/80	Comp.	7.1*

*Field

Table 5. Results from Grab Samples Obtained July 30, 1980.

	Influent	Primary Effluent	Trickling Filter Effluent	Aeration Basin Effluent	Chlorinated Effluent
COD (mg/l)	710	350	170	40	95
TSS (mg/l)	240	85	66	10	26
NH ₃ -N (mg/l)	15	17	30	5.0	11
NO ₂ -N (mg/l)	<0.2	<0.2	1.2	<0.2	0.3
NO ₃ -N (mg/l)	<0.2	<0.2	19	<0.2	2.7
Tot. In-N (mg/l)	15	17	50	5	13
O-PO ₄ -P (mg/l)	6.0	6.2	16	15	11
T-PO ₄ -P (mg/l)	9.6	9.2	18	17	12

Table 6. Analytical Results - Samples Collected August 5-6, 1980.

	Influent	Primary Effluent	Trickling Filter Effluent	Mixed Liquor	Aeration Basin Effluent	Chlorinated Effluent	Monthly Average Permit Limits
Flow (MGD)						.811	1.4
BOD (mg/l)	365	240	-22		14	12	30
lbs/day	2470	1620	--		--	81	350
TSS (mg/l)	237	103	17	1360	20	18	30
lbs/day	1600	697	---		---	122	350
Fecal Coli (#/100 ml)						<1 ¹ 19 ² 110 ³ <1 ⁴	200
T. Chlorine Resid. (mg/l)						1.6 ¹ 0.3 ² 0.2 ³ 2.2 ⁴	0***
pH (S.U.)	6.8 6.8* 7.3* 7.0**	6.2 6.5* 6.3* 6.3**	7.2 6.7* 7.3* 7.0**		7.1 6.9*	7.1 6.9* 6.8* 7.1**	6.0-9.0
Spec. Cond. (µmhos/cm)	969 570* 500* 980**	901 580* 770* 910**	791 495* 1020* 850**		520 490*	486 440* 480* 400**	
NH ₃ -N (mg/l)	17.2	17.2	7.6		1.5	2.1	
NO ₂ -N (mg/l)	<0.2	<0.2	0.2		0.7	0.3	
NO ₃ -N (mg/l)	<0.2	<0.2	15		2.5	4.0	
Tot. In. Org. N (mg/l)	17	17	23		4.7	6.4	
O-PO ₄ -P (mg/l)	16.4	15.4	14.4		12.3	12.1	
T-PO ₄ -P (mg/l)	18.8	18.2	16.2		12.6	12.2	
Total Solids (mg/l)	1116	766	540	1733	348	350	
TNVS (mg/l)	484	434	390	710	271	269	
TSS (mg/l)	237	103	17	1360	20	18	
TNVSS (mg/l)	29	8	2	293	2	2	
Turbidity (NTU)	66	41	11		4	4	
COD (mg/l)	673	463	99		50	55	
BOD ₅ (mg/l)	365	240	22		14	12	
Carbonaceous BOD ₅ (mg/l)	--	--	--		--	7	
Temperature (°C)	20.4* 19.5*	20.0* 19.8*	17.8* 18.6*		18.0*	18.4* 18.1*	
Dissolved Oxygen (mg/l)						7.0* 6.8*	

*Field analysis - grab
 **Field analysis - composite
 ***When Chehalis River flow is less than 150 cfs

¹8/5/80 - 1040
²8/5/80 - 1430
³8/5/80 - 1710
⁴8/6/80 - 1035

< = "less than"

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The venturi flow meter used by the plant to determine plant flows is inaccurate. The accuracy of the meter was checked both by instantaneous comparisons with flows obtained at the rectangular weir at the discharge end of the chlorine contact chamber and over a 24-hour period with a Manning Dipper flow meter installed at the same location. The results are shown in Table 8.

Table 8. Flow Measurement - Chehalis STP.

Measurement Type	Actual Flow	Recorded Flow	Percent Error
Instantaneous	1.14 MGD	1.10 MGD	-3.6%
Instantaneous	0.78 MGD	0.65 MGD	-16.7%
24-hour	0.811 MGD	0.524 MGD	-35.4%

The script chart record of flow is presented as Figure 5.

The plant flow chart indicates that their meter records no flow at all when actual flows drop below 0.5 to 0.6 MGD. In the range of 0.6 to 1.0 MGD, the plant flow meter underestimates actual flows; at higher actual flows, accuracy appears to be good.

BOD removal through both trickling filter and aeration basin was good. Operators had experienced some intermittent solids loss in the secondary clarifier prior to the inspection, but samples indicated compliance. Floating solids were noted during the afternoon of the 7/30/80 reconnaissance visit. These solids had the appearance of flotation-thickened sludge and may have been caused by denitrification and the bouying of solids by nitrogen gas bubbles.

As can be observed in Tables 5 and 6, the plant was experiencing substantial nitrification/denitrification. Nitrification (the oxidation of ammonia to nitrite and nitrate) was occurring in both the trickling filter and aeration basin. Denitrification (reduction of nitrite and nitrate to nitrogen gas) was evident in the aeration basin. Simultaneous nitrification and denitrification are rarely observed in aeration basins. Nitrification requires substantial dissolved oxygen concentrations, while denitrification requires oxygen concentrations which approach zero.

On August 12, 1980 I obtained dissolved oxygen concentrations at various points in the aeration basin to provide an explanation for this phenomenon. One additional aerator had been placed in operation, bringing the total number of aerators to three. The results are shown in Figure 6.

As can be seen in Figure 6, dissolved oxygen concentrations ranged from 1.2 to 0.1 mg/l with concentrations decreasing with increasing distance from the aerators. It is probable that concentrations very near the aerators

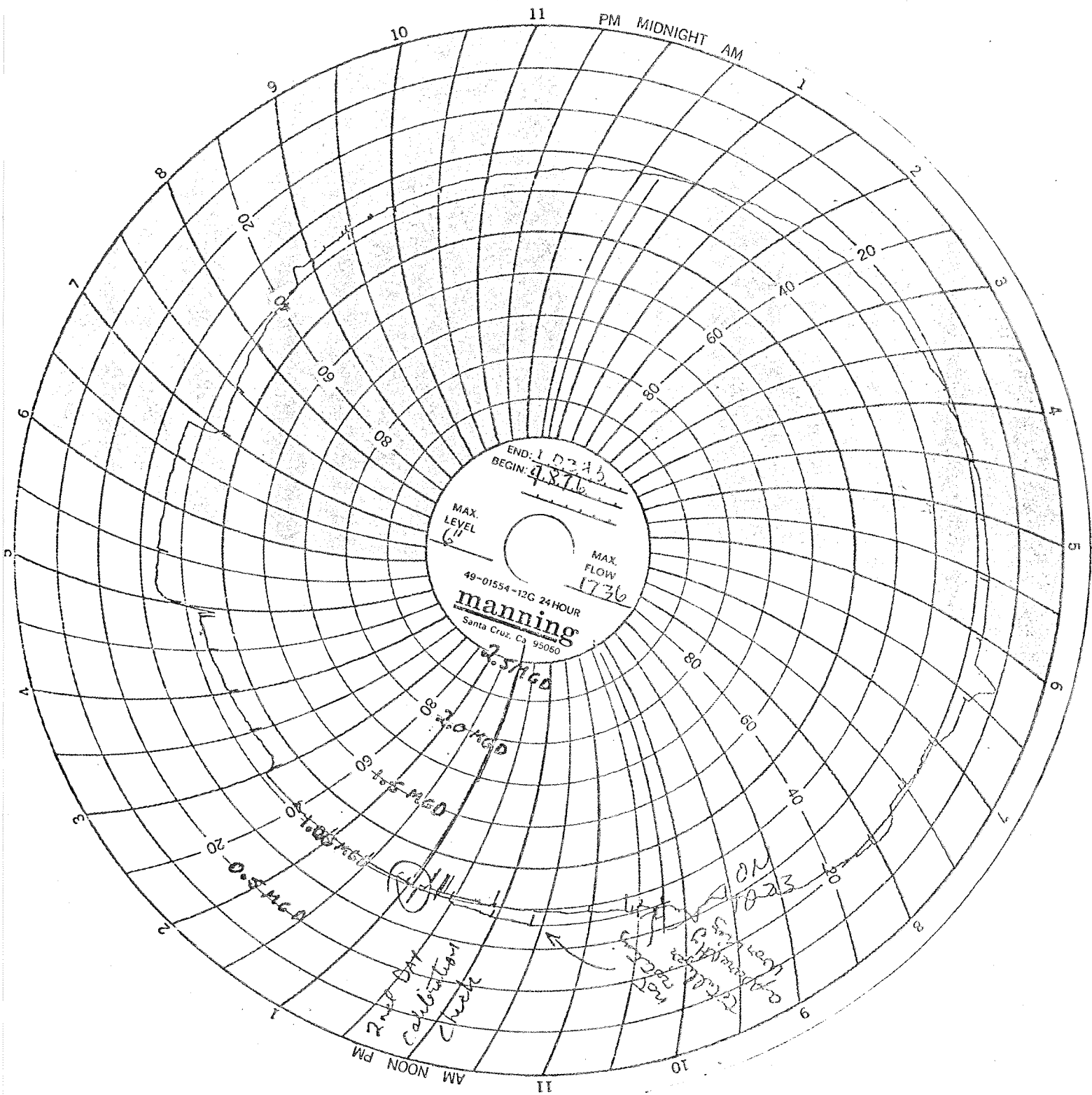


Figure 5. Flow Script Chart - Manning Dipper.

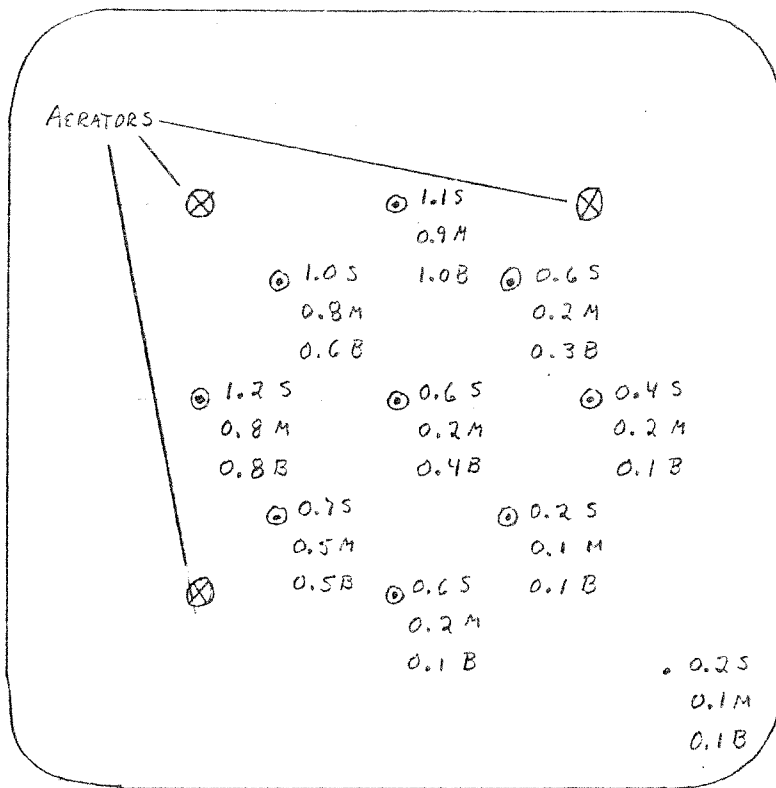


FIGURE 6. DISSOLVED OXYGEN CONCENTRATIONS - AERATION BASIN

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were higher than 1.2 mg/l. A reasonable hypothesis then is that nitrification was proceeding in the portions of the basin with higher oxygen concentrations while denitrification occurred in the areas remote from the aerators.

It is important to note that both nitrification and denitrification are sensitive processes, dependent on a number of parameters including: (1) wastewater temperature; (2) sludge age; (3) dissolved oxygen regime; and (4) pH. There was no intentional attempt on the operator's part to achieve nitrogen oxidation and removal in this manner; it was a matter of chance. At present there is no way of knowing how common this is or to what extent the plant achieves nitrogen removal during the critical period of low river flow. Denitrification minimized effluent nitrogen loading during the study; minimizing, therefore, the impact of the effluent on algal production in the river. Future surveys on the river should pay particular attention to the nitrogen forms and concentrations in the Chehalis plant effluent as these values may be quite transient.

Review of Laboratory Procedures

Composite samples were split with Chehalis plant personnel. The results of the split samples are given in Table 9.

Table 9. Comparison of Split Sample Results.

	DOE Laboratory		Chehalis Laboratory		% Difference	
	BOD	TSS	BOD	TSS	BOD	TSS
Influent (mg/l) lbs/day	365 2470	237 1600	375 2540	292 1975	+3%	+23%
Primary Eff. (mg/l) lbs/day	240 1620	103 697	330 2230	121 818	+37%	+17%
Trickling Filter Effluent (mg/l) lbs/day	22 --	17 --	22 --	12 --	0%	-30%
Aeration Basin Effluent (mg/l) lbs/day	14 --	20 --	-- --	-- --		
Final Eff. (mg/l) lbs/day	12 81	18 122	13 88	8 54	+8%	-56%
Percent Removal	97%	92%	97%	97%	0%	+5%

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Agreement between results is generally good, although the effluent suspended solids results varied substantially.

Laboratory procedures were reviewed in detail with Bob Searle and Wayne Balholm. Procedures were, in general, good. Several recommendations for improvement in procedure were made. A number of these recommendations were acted upon immediately and were in place when I returned one week later to obtain the dissolved oxygen profiles in the aeration basins. All original recommendations are listed here. If corrective measures were noted on the latest visit, this is also noted.

Recommendations

BOD Test

1. Routinely check pH of sample, adjust pH to 6.5 to 8.5 range if necessary.
2. Use zero-day sample dilution dissolved oxygen concentration for beginning point in calculations rather than 5-day blank concentration which was being used at the time of the inspection.
3. Use a thermometer in a water bath in the incubator to monitor incubator temperature. Maintain a continuous log of incubator temperatures and settings. This had been instituted one week after the inspection.

TSS

1. Prior to obtaining filter tare weight, filters should be cooled to room temperature in a dessicator. Tared filters should be stored in a dessicator. After drying in oven, filters and sample solids should be cooled in a dessicator prior to weighing. These recommendations have been addressed.
2. A log of drying oven temperatures and settings should be maintained and posted near the drying oven. This recommendation has been addressed.

Fecal Coliform

1. A log of incubator temperatures and settings should be maintained and posted near the bacterial incubator. This recommendation has been addressed.

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2. Fecal coliform counts (colonies per 100 mls) should be recorded on the DMR's (rather than the logs of these values). The monthly average of coliform counts should be reported as a geometric mean rather than the average of the logs. To obtain the geometric mean, take the antilog (10^x) of the value (x) presently being reported.

Conclusions and Recommendations

1. During this inspection, the Chehalis plant was meeting all permit limitations except chlorine residual. The plant presently has no means of reducing chlorine residual after disinfection.
2. The plant's flow meter is inaccurate at flows of less than 0.7 MGD. Corrective measures should be taken.
3. Substantial nitrification and denitrification was occurring in the plant (primarily in the aeration basin). This has a positive effect on the quality of the effluent as less nutrient nitrogen is discharged. This mode of operation was accidental and is not known how frequently it occurs, or if it could purposely be maintained. It probably results in some excess loss of solids in the effluent, but appears to, in general, improve effluent quality.
4. Several recommendations for changes in laboratory procedure were made. A number of these were addressed immediately by the operating personnel.

BY:cp

Attachments

Class II Field Review and Sample Collection

24-hour Composite Sampler Installations

Sampler	Date and Time Installed	Location
1. Influent sample aliquot: 250 ml/30 min.	8/5/80 - 1045	Effluent end of influent parshall flume.
2. Primary effluent sample aliquot: 250 ml/30 min.	8/5/80 - 1100	At clarifier effluent box.
3. Trickling filter eff. sample aliquot: 250 ml/30 min.	8/5/80 - 1125	Under drain effluent of larger trickling filter. Note this composite sample was settled. Sub-samples were decanted from the composite jug.
4. Chlorinated effluent sample aliquot: 250 ml/30 min.	8/5/80 - 1140	Behind effluent weir on chlorine contact chamber.

Field Data See Table 4. for field data

Parameter(s)	Date and Time	Sample Location
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Grab Samples

Lab Analysis	Date and Time	Sample Location
Nutrients, TSS, COD	7/30/80 - 1500 to 1525	Influent, prim. eff., trickling filter eff., aeration basin eff. & chlorinated eff.
All	8/5/80 - 1110, 1150, 1500, 0600 (grab composite)	Aeration basin effluent, samples settled prior to compositing to remove activated sludge
Fecal coli., T. Cl. resid.	8/5/80 - 1040	Chlorinated effluent
Fecal coli., T. Cl. resid.	8/5/80 - 1430	Chlorinated effluent
Fecal coli., T. Cl. resid.	8/5/80 - 1710	Chlorinated effluent
Fecal coli., T. Cl. resid.	8/6/80 - 1035	Chlorinated effluent

APPENDIX

BIBLIOGRAPHY

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- Parsons, T.R. and M. Takahashi, 1973. "Biological Oceanographic Processes," Pergammon Press, 75 pp.
- Singleton, L., 1980. "Update of the 1980 Analysis of State Waterway Segments," DOE memorandum to John Bernhardt.

Table A-1

DEPARTMENT OF ECOLOGY

RETRIEVAL --- 15 SEPTEMBER 1980

OFFICE OF WATER PROGRAMS
WATER QUALITY MANAGEMENT DIVISION
WATER & WASTEWATER MONITORING SECTION

23A120 CHEHALIS RIVER AT CENTRALIA 12025500

00/00/00 TO 99/99 99

STORET MINOR BASIN: COASTAL STORET SUB BASIN: UPPER CHEHALIS

LATITUDE: 46 42 45.0 ELEVATION (FEET): 170 WATER CLASS: A
LONGITUDE: 122 58 39.0 COUNTY: LEWIS SEGMENT: 10-23-13

AGENCY: 21540000 STATE: WASHINGTON STA TYPE: RMP

TERMINAL 1ST LEV 2ND LEV 3RD LEV 4TH LEV 5TH LEV 6TH LEV
STREAM MILES MILES MILES MILES MILES MILES

1312099 067.50

DATE FROM TO	TIME	DEPTH METERS	00000 STREAM FLOW CFS-AVG	00300 DISSOLVED OXYGEN mg/l	00301 DO PERCENT SATURATN	00610 AMMONIA T NH3-N mg/l	00630 NITROGEN NO2 + NO3 mg/l	00671 DIS-ORTHO PHOSPHURUS mg/l P	00665 TOTAL PHOSPHURUS mg/l P
77/10/04	1345		420.0	9.9	93.0	0.06	0.19	0.02	0.05
77/11/14	1300		5600.0	11.1	96.3	0.09	0.80	0.01	0.08
77/12/05	1240		12000.0	10.5	87.8	0.12	0.98	0.01	0.12
78/01/03	1245		1410.0	13.1	97.3	0.07	0.64	0.02	0.04
78/02/02	1300		5000.0	11.7	101.5	0.16	0.56	0.02	0.13
78/07/13	1230		1400.0	12.0	101.8	0.10	0.54	0.01	0.03
78/04/17	1355		1370.0	10.6	93.7	0.07	0.35	0.02	0.04
78/05/08	1315		710.0	10.4	101.6	0.12	0.29	0.01	0.04
78/05/12	1225		580.0	8.7	80.2	0.10	0.14	0.03	0.05
78/07/24	1310		187.0	10.2	124.0	0.08	0.01	0.07	0.13
78/08/14	1320		235.0	5.7	63.6	0.16	0.10	0.06	0.09
78/09/05	1250		670.0	8.3	80.4	0.14	0.10	0.04	0.06
78/10/09	1440		420.0	8.7	83.4	0.04	0.16	0.04	0.08
78/11/06	1305		1400.0	10.6	87.4	0.02	1.20	0.01	0.05
78/12/04	1335		3900.0	11.2	91.3	0.03	1.20	0.04	0.07
79/01/27	1530		990.0	13.0	94.2	0.06	0.76	0.02	0.03
79/02/20	1350		5700.0	12.8	102.2	0.03	1.20	0.01	0.02
79/03/12	1335		2170.0	11.0	91.5	0.02	0.86	0.01	0.02
79/04/16	1355		2320.0	11.1	95.7	0.03	0.72	0.01	0.03
79/05/21	1325		470.0	9.4	90.6	0.04	0.44	0.00	0.03
79/06/18	1315		310.0	8.5	87.3	0.08	0.10	0.00	
79/07/09	1345		215.0	11.1	123.3	0.01	0.02	0.04	0.12
79/08/06	1340		120.08	10.0	113.6	0.00	0.01	0.05	0.11
79/03/04	1355		660.0	7.1	73.9	0.11	0.26	0.01	0.07
79/10/08	1340			3.0	28.9	0.10	0.02	0.08	0.15
79/11/13	1300			10.8	90.7	0.05	0.63	0.01	0.03
79/12/03	1250			10.9	89.5	0.02	1.30	0.00	0.07
80/01/14	1310			11.6	92.6	0.03	1.20	0.00	0.06
80/02/19	1350			11.6	95.1	0.04	0.84	0.00	0.06
80/03/17	1300			11.9	95.9	0.00	0.21	0.01	0.04
80/04/22	1350			10.4	94.1	0.15	0.59	0.01	0.00
80/05/27	1245			9.6	88.5	0.10	0.22	0.03	0.11
80/06/23	1310			7.7	81.3	0.09	0.18	0.04	0.06
80/07/14	1310			9.6	100.7	0.02	0.11	0.01	0.06

Figure A-1

23A120 -- CHEHALIS R AT CENTRALIA

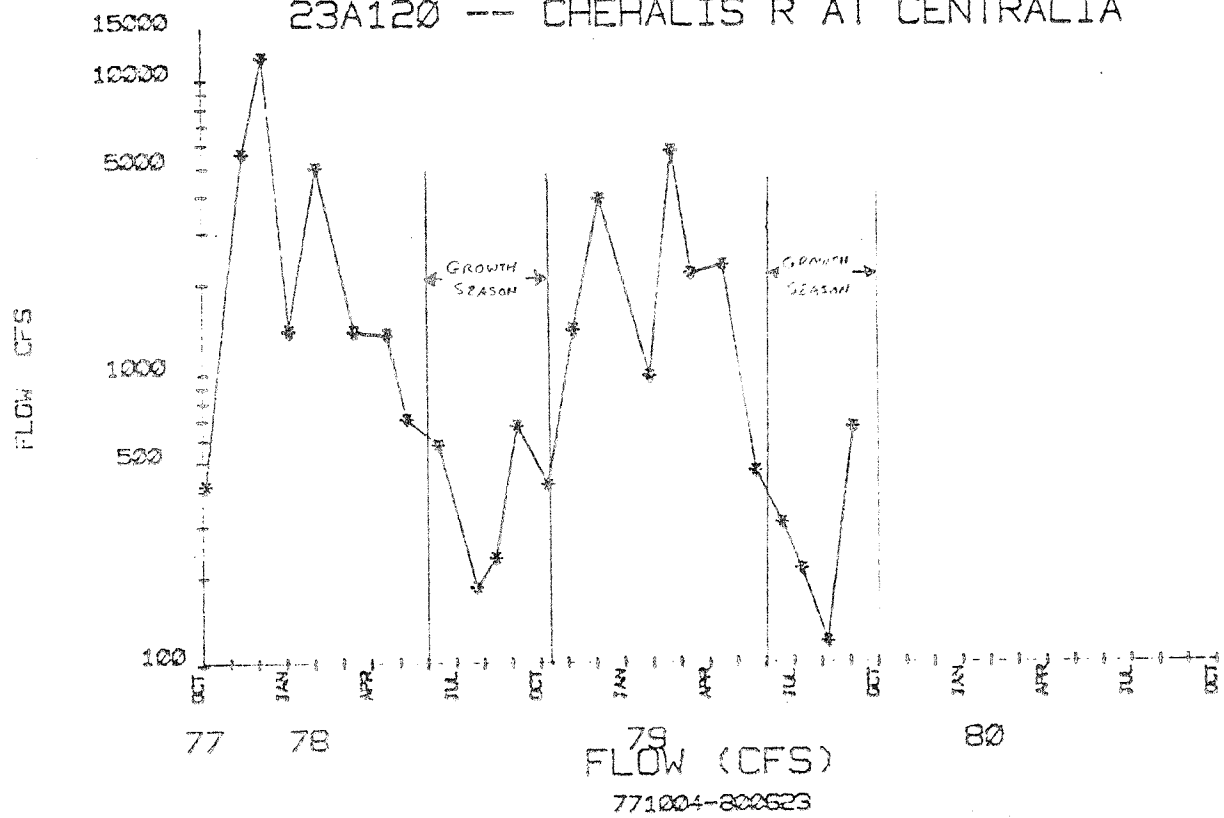


Figure A-2

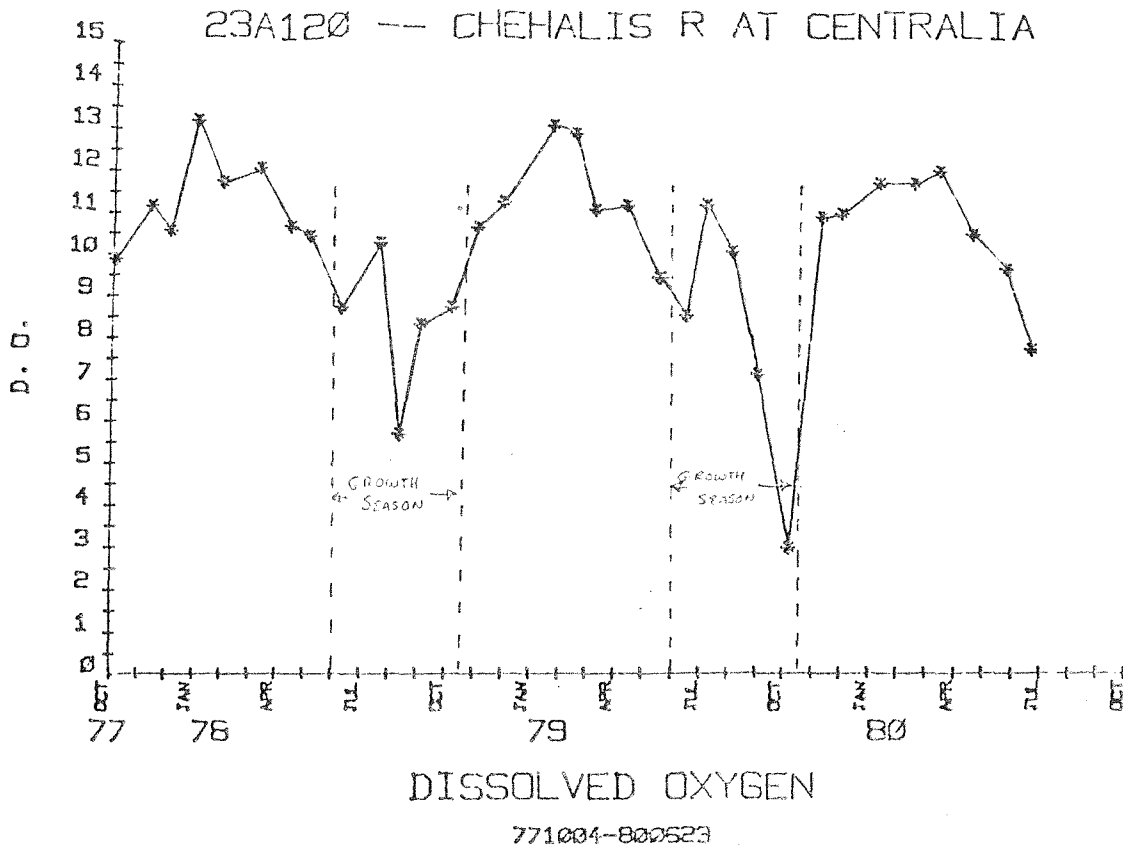
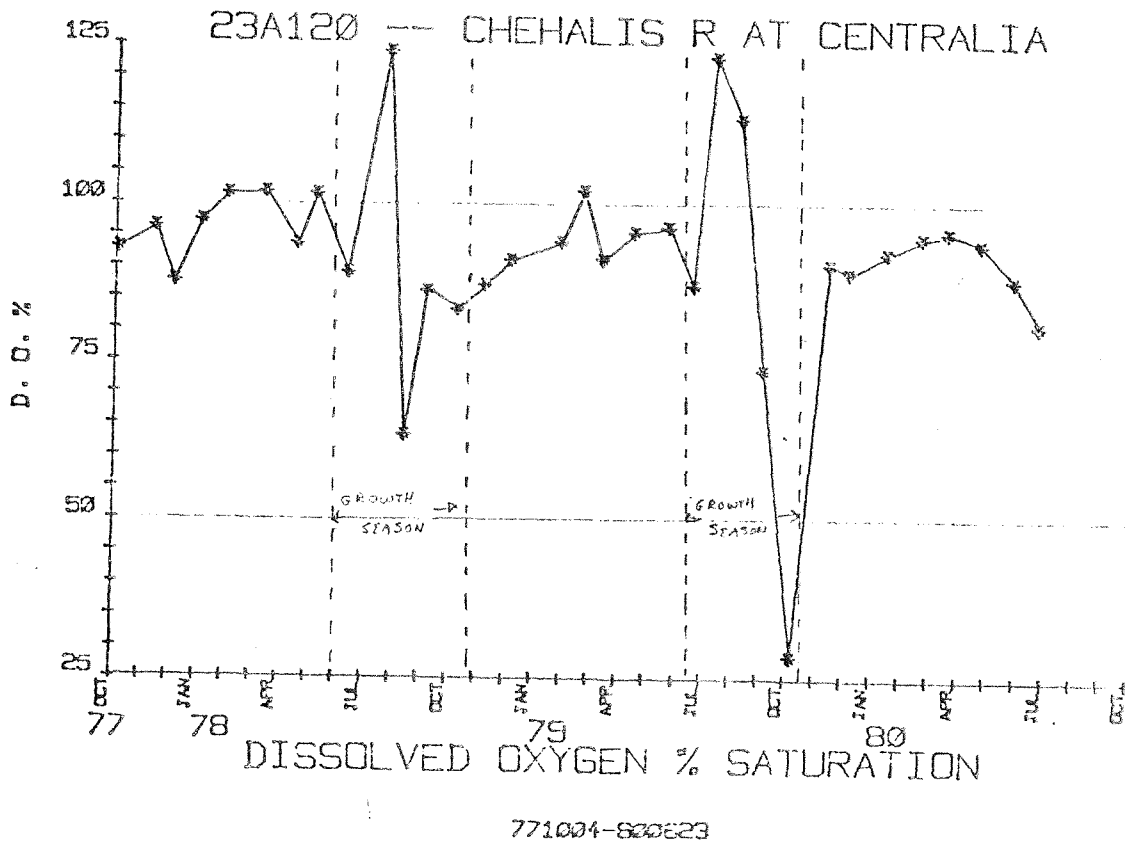
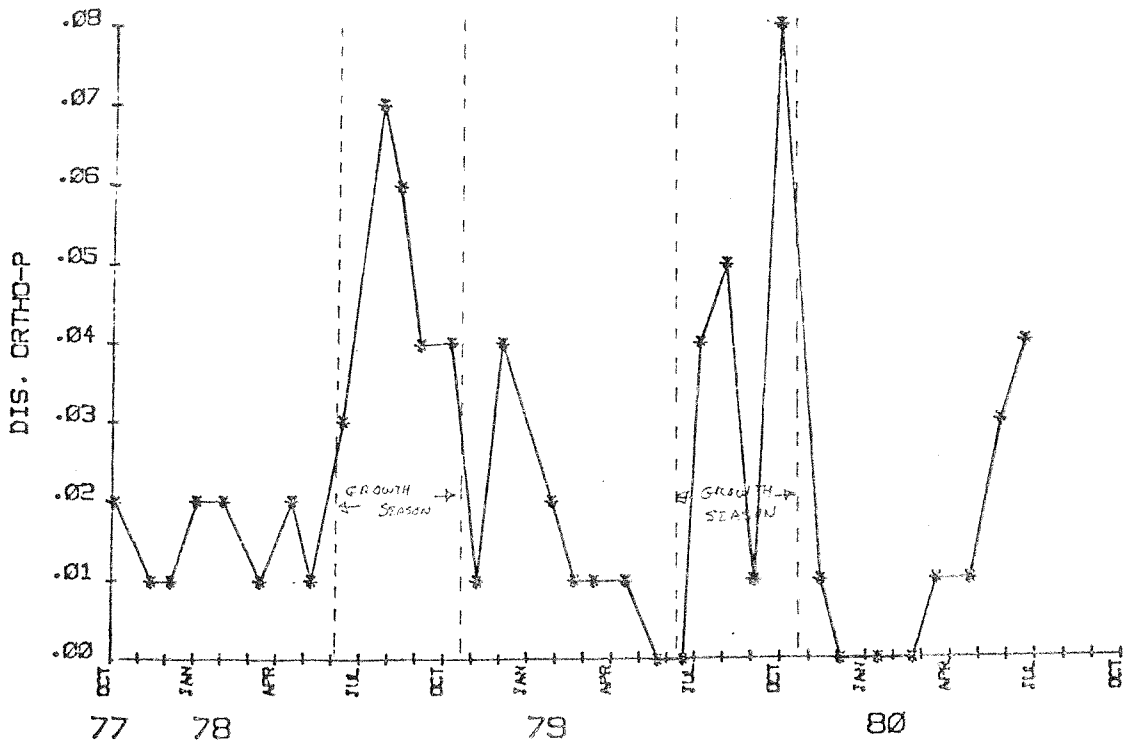


Figure A-3



23A120 -- CHEHALIS R AT CENTRALIA

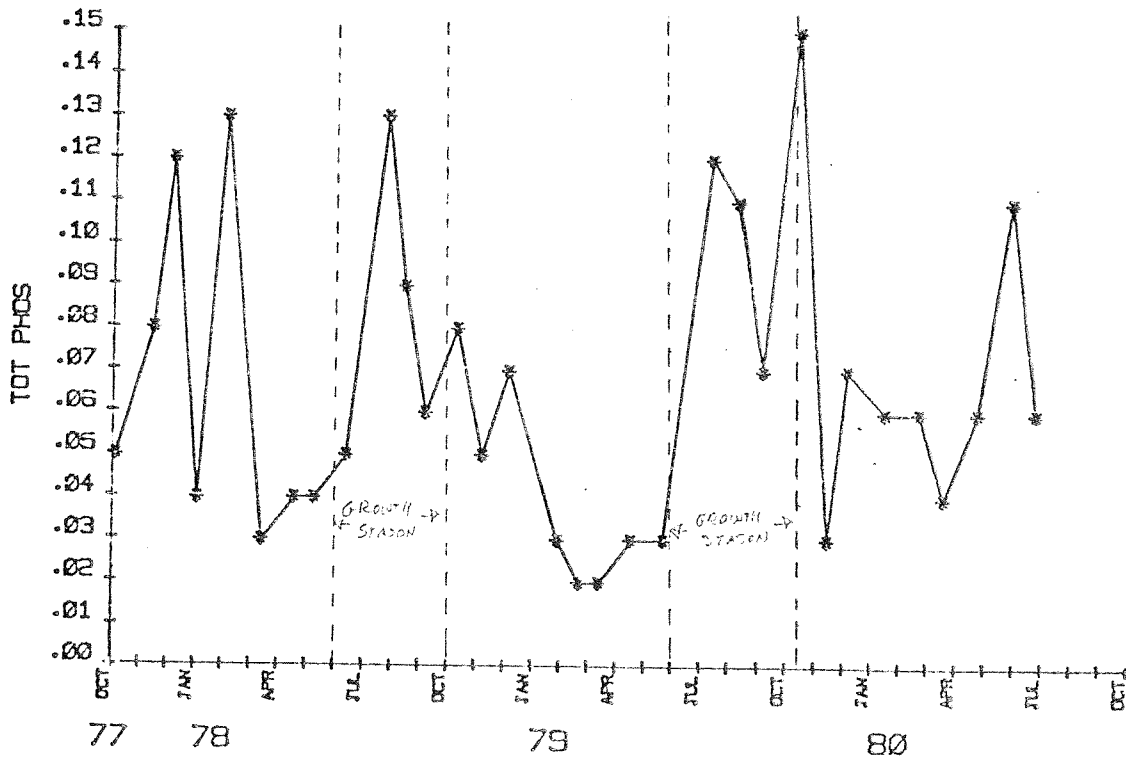


DISSOLVED ORTHO-PHOSPHORUS

771004-800623

Figure A-5

23A120 -- CHEHALIS R AT CENTRALIA



TOTAL PHOSPHORUS

771004-800623

