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MEMORANDUM
October 2, 1986

To: Carl Nuechterlein and Larry Peterson

From: Marc Heffner

Subject: Walla Walla Sewage Treatment Plant Class II Inspection, February 12-13, 1986

ABSTRACT

A Class II inspection was conducted on February 12-13, 1986, at the Walla Walla sewage treatment plant (STP). The inspection was a follow-up to a 1981 pre-upgrade Class II inspection. The Walla Walla STP is a two-stage trickling filter system that also includes mixed-media polishing filters and dechlorination. Problems with the polishing filters and dechlorination measurement system prevented optimal plant performance. Effluent was within most NPDES permit limits with the exception of BOD_5 and TSS percent removals. Reduced chlorine residual and fecal coliform concentrations in the effluent were noted during the 1986 inspection in comparison to the 1981 survey.

INTRODUCTION

At your request, a Class II inspection was conducted at the Walla Walla sewage treatment plant. The inspection was conducted on February 12-13, 1986, concurrently with a receiving water study in Mill Creek. Purposes of the inspection included:

1. Collect samples to estimate plant efficiency and National Pollutant Discharge Elimination System (NPDES) permit compliance.

2. Review laboratory procedures (including sample splits with the STP laboratory) to estimate accuracy of results and conformance with approved analytical techniques.

3. Provide data for consideration as part of the receiving water study.

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The inspection was conducted by Carl Nuechterlein from the Ecology Eastern Regional Office and Marc Heffner from the Ecology Water Quality Investigations Section with the aid of Walla Walla STP personnel Al Prouty (superintendent/operator) and Wayman Sinden (lab technician). The concurrent Ecology receiving water study in Mill Creek will be reported separately (Joy, in prep.).

The 1986 inspection is a follow-up to a pre-upgrade inspection conducted on February 3-4, 1981 (Yake, 1981) and the plant upgrade completed in 1983. The treatment units at the upgraded facility include headworks/grit basin, two primary clarifiers, one first-stage trickling filter, two second-stage trickling filters, two secondary clarifiers, four mixed-media polishing filters, and a chlorination basin with dechlorination (Figure 1). Sludge is anaerobically digested, then applied to farmland. Also included on Figure 1 is the flow scheme during the 1981 inspection. Major changes at the plant include:

1. Improved headworks and larger primaryclarifiers.

2. Removal of the standard rate trickling filter, dosing siphon, and intermediate clarifier allowing the entire flow to pass through a two-stage trickling filter system.

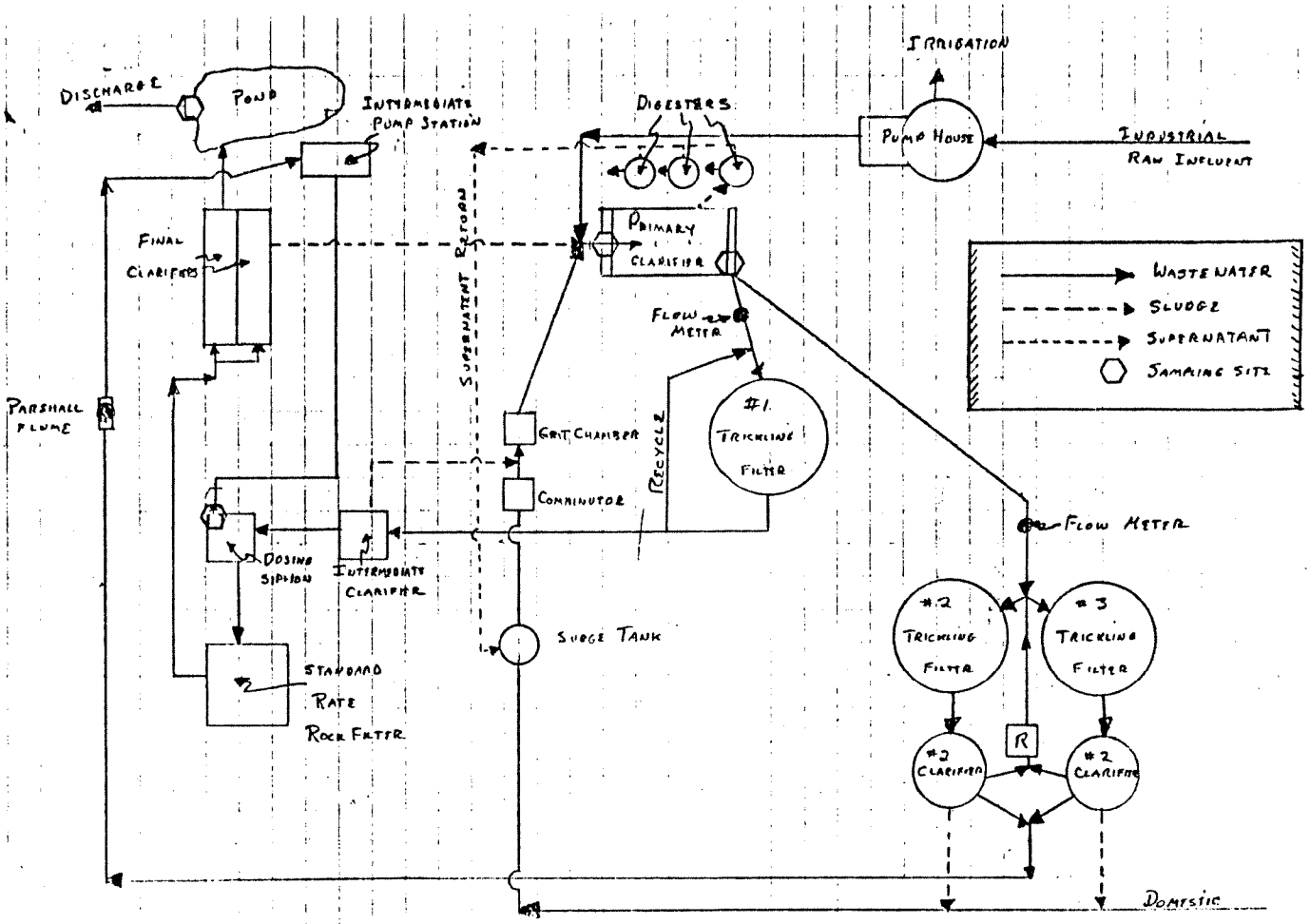
3. Addition of mixed-media polishing filters.

4. An improved chlorine contact chamber including dechlorination.

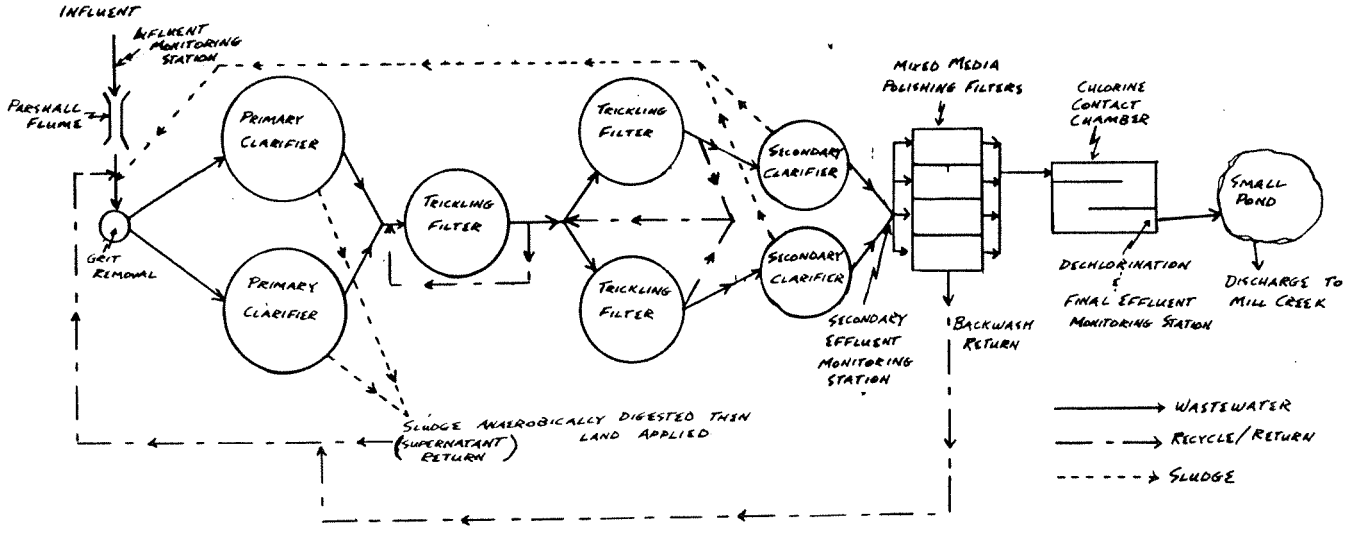
PROCEDURES

Grab and composite samples were collected. Ecology composite samplers set to collect 200 mLs of sample every 30 minutes were positioned to collect influent, secondary effluent (prior to the polishing filter), and final effluent samples (Figure 1). Walla Walla personnel also collected influent and final effluent composite samples. The Walla Walla influent composite was hand-collected, with equal volumes collected every three hours except between 0100 and 0500 hours when no sample is collected--the last aliquot (approximately 0600 hours) was missed during the inspection. The influent sample is routinely hand-composited to avoid the once frequent automatic compositor plugging problem due to rags. The Walla Walla automatic effluent compositor collected equal volumes hourly. Composite samples and selected grab samples were split for analysis by Ecology and Walla Walla laboratories. Samples collected, sampling times, and analytical parameters are summarized on Table 1.

Plant flows are measured at a Parshall flume at the plant headworks. Total flow during the inspection was estimated based on the plant script chart because the plant totalizer was inoperable during the inspection.



1981 FLOW SCHEME (FROM YAKE, 1981)



1986 FLOW SCHEME

FIGURE 1 - FLOW SCHEME - WALLA WALLA, 2/86.

Table 1. Sampling schedule - Walla Walla, February 1986.

					Field Analyses						Laboratory Analyses																		
																		Solids				Nutrients							
Sample	Sampler	Laboratory	Date	Time	Temperature	pH	Conductivity	Chlorine Residual	Fecal Coliform	Oil & Grease	COD	BOD_5	BOD_{20}	Carbonaceous BOD_5	pH	Conductivity	Turbidity	TS	TNVS	TSS	TNVSS	NH_3-N	NO_2-N	NO_3-N	O-PO_4-P	Total-P	Alkalinity	Chloride
Composite Samples																													
Influent	ECO	ECO	2/12-13	0940-0940	X	X	X	.			X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		WW										X								X		X	X	X				
	WW	ECO	2/12-13	0900-0900*							X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		WW										X								X		X	X	X				
Secondary Effluent	ECO	ECO	2/12-13	0920-0920	X	X	X				X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	WW											X								X								
Final Effluent	ECO	ECO	2/12-13	0900-0900	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		WW										X								X		X	X	X				
	WW	ECO	2/12-13	0900-0900							X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		WW										X								X		X	X	X				
Ecology Grab Samples																													
Influent		ECO	2/12	1020	X	X	X			X												X	X	X				
		WW																				X	X	X				
		ECO		1550	X	X	X			X												X	X	X				
		WW																				X	X	X				
		ECO	2/13	0845	X	X	X																						
Secondary Effluent		ECO	2/12	1030	X	X	X																						
				1540	X	X	X																						
			2/13	0900	X	X	X																						
Final Effluent		ECO	2/12	1040	X	X	X	X	X	X	X				X	X	X			X		X	X	X	X	X		X
		WW																				X	X	X				
		ECO		1520	X	X	X	X	X	X	X				X	X	X			X		X	X	X	X	X		X
		WW																				X	X	X				
		ECO	2/13	0930	X	X	X	X	X		X				X	X	X			X		X	X	X	X	X		X

*Hand composite due to large number of rags in influent plugging automatic sampler. Equal volumes collected every three hours except between 0100 and 0500 hours when no sample is collected. NOTE: 0600 hour aliquot was not collected during the inspection.

RESULTS AND DISCUSS10N

Analytical results are summarized on Table 2 and flow measurement data are summarized on Table 3. Instantaneous plant flow meter readings appeared consistent with head heights measured by the flume staff gauge. Table 4 compares inspection data to NPDES permit limits (#WA-002462-7). The permit is set up to allow discharge to two different receiving waters. From December 1 to May 1, discharge to Mill Creek is allowed. Discharge to the Blalock and Gose Irrigation Districts is required from May 1 to December 1 and allowed as needed during the rest of the year. Table 4 includes limits assigned to each discharge mode and the applicable inspection data. During the inspection, discharge was to Mill Creek.

Table 3. Flow measurements - Walla Walla, February 1986.

Date	Time	Instantaneous Flow (MGD)	Totalizer*
2/12	0830	7.5	--
	1315	8.0	--
	1630	7.0	--
2/13	1100	7.0	--
Estimated flow for the day = 6.7 MGD			

*Flow totalizer was included in a computerized monitoring system that malfunctioned just prior to the inspection. Estimated flow for the day is based on script chart record.

Comparison of inspection plant performance with applicable permit limits shows that discharge concentrations and loadings were less than permit limits with the exception of two total chlorine residual measurements. BOD_5 and TSS removals, however, were less than the 85 percent monthly removal minimums. BOD_5 and TSS effluent loads were of some concern in that the BOD_5 effluent load represented 87 percent of the monthly limit, the TSS effluent load represented 93 percent of the monthly limit, but flow was only 62 percent of the monthly limit.

Several problems were occurring at the plant during the inspection. These included:

1. The operator noted that the polishing filter had not been operating well prior to the inspection. During the inspection the polishing filter

Table 2. Ecology analytical results - Walla Walla, February 1986.

Sample	Sampler	Date	Time	Field Analyses: Temperature (°C)	pH (S.U.)	Conductivity (umhos/cm)	Chlorine Residual (free - mg/L)	Chlorine Residual (total - mg/L)	Fecal Coliform (#/100 mL)	Oil & Grease (mg/L)	Laboratory Analyses: COD (mg/L)	BOD_5 (mg/L)	BOD_{20} (mg/L)	Carbonaceous BOD_5 (mg/L)	pH (S.U.)	Conductivity (umhos/cm)	Turbidity (NTU)	Solids (mg/L): TS	TNVS	TSS	TNVSS	Nutrients (mg/L): NH_3-N	NO_2-N	NO_3-N	O-PO_4-P	Total-P	Alkalinity (mg/L as $CaCO_3$)	Chloride (mg/L as Cl^-)
Composite Samples																												
Influent	ECO			2.7	7.2	300					180	76			7.3	268	23	280	150	67	11	6.4	.10	1.5	1.6	2.9	120	18
	WW										210	92			7.5	284	26	290	150	76	11	11	.13	1.2	2.0	3.4	120	17
Secondary Effluent	ECO			2.3	7.2	305					100	19			7.4	265	15	270	150	31	6	4.2	.20	7.7	2.4	3.3	65	25
Final Effluent	ECO			2.1	7.2	300					71	19	55	10	7.4	286	10	340	150	21	5	3.8	.44	9.3	2.4	3.1	69	22
	WW										56	18			7.5	279	9	250	130	22	3	4.5	.46	7.1	2.6	3.2	73	22
Ecology Grab Samples																												
Influent		2/12	1020	12.6	7.2	325				16												8.1	.10	1.6				
			1550	12.0	7.2	300				12												5.0	.09	1.7				
		2/13	0845	12.4	7.1	310																						
Secondary Effluent		2/12	1030	9.0	7.2	290																						
			1540	10.7	7.2	320																						
		2/13	0900	8.4	7.1	280																						
Final Effluent		2/12	1040	9.0	7.2	275	.3*	.6*	1	3	45				7.2	248	6			18		2.9	.42	7.7	2.2	2.4		19
							<.1†	.1†																				
			1520	10.2	7.1	310	.5*	.6*	4	4	71				7.1	279	9			21		5.1	.53	8.8	2.6	3.1		20
							<.1†	<.1†																				
		2/13	0930	8.5	7.2	280	.15*	.7*	1		60				7.0	251	7			21		2.8	.36	8.5	2.1	2.7		22
							<.1†	.15†																				

*Sample taken before dechlorination.
†Sample taken after dechlorination.

Table 4. Comparison of inspection data to NPDES permit limits - Walla Walla, February 1986.

Parameter	Permit Limits when Discharging to Irrigation District Monthly Average	Permit Limits when Discharging to Irrigation District Weekly Average	Permit Limits when Discharging to Mill Creek† Monthly Average	Permit Limits when Discharging to Mill Creek† Weekly Average	Inspection Data* Ecology Composite	Inspection Data* Walla Walla Composite	Inspection Data* Grab
BOD_5							
(mg/L)	12	18	30	45	19	18	
(lbs/day)	1081	1621	1220	1829	1062	1006	
(% removal)	85		85		75	80	
TSS							
(mg/L)	10	15	30	45	21	22	
(lbs/day)	901	1351	1266	1899	1173	1229	
(% removal)	85		85		69	71	
Turbidity (NTU)	10	15					
Fecal Coliform (#/100 mL)			200	400			1; 1; 4
Total Coliform (#/100 mL)	20						
pH (S.U.)	6.5 ≤ pH ≤ 8.5		6.5 ≤ pH ≤ 8.5				7.2; 7.1; 7.0
Total Residual Chlorine (mg/L)			≤0.05				0.1; <0.1; 0.15
Flow (MGD)	10.8		10.8		6.7		

†Discharge to Mill Creek allowed from December 1 - May 1; applicable limits during inspection.
*Ecology laboratory results.

removals were less than anticipated (secondary effluent TSS - 31 mg/L; BOD_5 - 19 mg/L; final effluent TSS - 21 mg/L; BOD_5 - 19 mg/L). Shortly after the inspection the problem became worse and draining the tank revealed that structural problems in one of the filters had resulted in media loss. The operator reported that after extensive repairs were made, the broken filter was again operable. All filters were enzyme-cleaned to remove grease resulting in improved performance.

The operator suspected another problem with the polishing filters. The secondary clarifiers at the plant are designed for a winter average overflow flow rate of 2100 gpd/ft^2 (CH_2M Hill, 1981) and were operating at 1180 gpd/ft^2 during the inspection (based on influent flow only); both well above the 600 gpd/ft^2 recommended in Criteria for Sewage Works Design (Ecology, 1985). The high overflow rate suggests excess solids may be passing through the clarifier to the polishing filter, The higher filter loading increases backwash frequency, thus increasing the load to the headworks and potentially the load on the polishing filter. The backwash flow is not accurately metered, but based on rough measurements by the operator, flow approaches 5 MGD. The additional secondary clarification facilities that the city is considering should be encouraged in an effort to reduce the polishing filter loading rate and thus the backwash flow rate.

2. The chlorination/dechlorination monitoring system was not operating efficiently. Chlorine residual (0.1 and 0.15 mg/L) was detected in two of the three Ecology grab samples at concentrations greater than the 0.05 mg/L limit (Table 2). The operator suspected that a fairly high chlorine residual in the drinking water during the inspection may have upset the detector which uses both drinking water and effluent to make measurements. The operator reported that manual measurements of effluent chlorine residual are currently made every three hours to assure dechlorination is adequate.

3. A portion of the control panel is computer controlled. During the inspection the computer was down, resulting in loss of the flow totalizer. Flows were estimated from the script chart

Table 5 compares the 1986 inspection to data collected during the 1981 inspection (Yake, 1981). Influent concentrations and flows were similar for both studies, with slightly higher BOD_5 and TSS concentrations in 1981. Effluent BOD_5 and TSS concentrations were greater during the 1986 survey. Polishing filter repairs should improve effluent quality in relation to the 1986 survey performance. The primary improvements noted in 1986 were reduced fecal coliform counts and chlorine residual concentrations in the effluent.

Table 5. Comparison of 1981 and 1985 inspection results - Walla Walla, February 1986.

Parameter	Influent		Effluent	
	1981†† Inspection	1985 Inspection	1981†† Inspection	1985 Inspection
BOD_5*				
(mg/L)	88	76	11	19
(lbs/day)	5060	4250	630	1060
(% removal)			88	75
TSS*				
(mg/L)	105	67	11	21
(lbs/day)	6040	3740	630	1170
(% removal)			90	69
Fecal Coliform** (#/100 mL)			545,† 260†	1, 4, 1
Total Chlorine Residual** (mg/L)			0.45,† 0.45†	0.1, <0.1, 0.15
Flow (MGD)	6.9	6.7	6.9	6.7
NO_3-N*				
(mg/L)	0.6	1.5	5.35	9.3
(lbs/day)	35	84	308	520
NO_2-N*				
(mg/L)	<0.1	0.10	<0.05	0.44
(lbs/day)	<6	5.6	<3	25
NH_3-N*				
(mg/L)	7.3	6.4	3.6	3.8
(lbs/day)	420	360	207	212

*Ecology composite sample.
**Grab sample.
†Total chlorine residual reduced from usual 0.8 - 1.5 mg/L range so future limits could better be considered during the inspection.
††Data from Yake, 1981.

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LABORATORY REVIEW

Laboratory analytical results of split samples are presented on Table 6. BOD_5, TSS, and fecal coliform splits compared favorably. Several suggestions were made to keep procedures in conformance with Standard Methods (APHA, 1985) and Ecology approved procedures:

Sample Collection

1. The temperature of composite samples should be checked occasionally (two times per month) to assure that samples are being stored at approximately 4°C during collection.

2. Sampler lines should be cleaned at least monthly with disinfectant, and rinsed thoroughly.

BOD_5

1. Dilution water blank D.O. depletions generally ranged from 0.1 - 0.4 mg/L and were 0.3 and 0.4 mg/L during analysis of the split samples. Depletion appears to run slightly greater than the desired $\leq$ 0.2 mg/L. In an effort to reduce the blank depletion, distilled water should be stored in the dark in cotton-plugged containers for approximately one week prior to use in making dilution water. Dilution water should be made the day the BOD_5 test is started by adding nutrients to the aged distilled water. Nutrient stock solutions should be made fresh every six months or more frequently if they become discolored.

2. Sample dechlorination prior to analysis is done by putting one drop of sodium thiosulfate in the BOD bottle prior to sample addition. Chlorine residual measurement and titration with the proper amount of sodium thiosulfate as described in the Ecology BOD procedures manual is recommended (Ecology, 1983, p. 10, #H3).

3. Walla Walla bench sheet calculations for inspection samples include test dilutions for which D.O. depletions of <2.0 mg/L or final D.O. concentrations of <1.0 mg/L occurred. Calculations should be based on dilutions resulting in a D.O. depletion of >2.0 mg/L and a final D.O. of >1.0 mg/L (Ecology, 1983, p. 20).

4. Monitoring incubator temperatures with a therrnometer placed in a water bath is preferred.

5. Sodium thiosulfate used for calibrating the D.O. meter should be standardized prior to use. The procedure is described in the Ecology BOD procedures manual (Ecology, 1983, p. 20 #7d).

Table 6. Comparison of Ecology and Walla Walla laboratory results - Walla Walla, February 1986.

Sample	Sampler	Date	Time	Laboratory	Total Chlorine Residual† (mg/L)	Fecal Coliforms (#/100 mL)	BOD_5 (mg/L)	TSS (mg/L)	NH_3-N (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)
Influent											
	Ecology	2/12	1020	Ecology					8.1	0.10	1.6
				Walla Walla					14.4	5.5	9.2
	Ecology	2/12	1550	Ecology					5.0	0.09	1.7
				Walla Walla					6.8	4.9	7.2
	Ecology	2/12-13	Comp.	Ecology			76	67	6.4	0.10	1.5
				Walla Walla			107	96	7.2	2.4	7.6
	Walla Walla	2/12-13	Comp.	Ecology			92	76	11	0.13	1.2
				Walla Walla			109	77	10.1	2.4	8.0
Secondary Effluent											
	Ecology	2/12-13	Comp.	Ecology			19	31			
				Walla Walla			29	32			
Final Effluent											
	Ecology	2/12	1040	Ecology					2.9	0.42	7.7
				Walla Walla					4.7	0.96	12.0
	Ecology	2/12	1520	Ecology	0.6				5.1	0.53	8.8
				Walla Walla	0.55*				7.6	2.4	14.0
	Walla Walla	2/13	0930	Walla Walla		1					
	Ecology	2/13	0930	Ecology	0.7	1					
				Walla Walla	0.56*						
	Ecology	2/12-13	Comp.	Ecology			19	21	3.8	0.44	9.3
				Walla Walla			20	20	5.0	1.9	12.5
	Walla Walla	2/12-13	Comp.	Ecology			18	22	4.5	0.46	7.1
				Walla Walla			20	18	4.7	1.9	11.6

†Prior to dechlorination.
*Walla Walla concentration read from continuous flow-through meter measuring at the downstream end of the chlorine contact chamber.

6. Seed correction should be made using results of a seed control (a BOD_5 test on the seed) rather than results of a seeded blank (APHA, 1985, p. 529).

TSS

1. Sample volumes filtered should result in adequate weight changes to minimize the effect of small measurement inaccuracies. Effluent volumes filtered have been increased since the inspection.

2. Extra filters should be prepared (rinsed and dried) so clogged filters (sample not completely filtered in five minutes or less) can be discarded and the test restarted with a smaller sample volume.

3. Redrying and reweighing filters until a constant weight is attained (<0.5 mg weight loss between reweighings) is a suggested quality assurance technique. Quarterly checks of proper solids drying using the redrylreweigh technique are recommended.

The Walla Walla NPDES permit also requires weekly monitoring of NH_3-N, NO_2-N, and NO_3-N in the influent and effluent; although there are no numerical limits. Split sample analysis by Ecology and Walla Walla for the three parameters did not compare closely (Table 6). The Walla Walla laboratory uses an ammonia-selective electrode for NH_3-N analysis and Hach powder pillow methods for NO_2-N and NO_3-N analyses.

Poor correlation of NH3-N analysis may be due to the standards used by Walla Walla. The stock solution used (3.82 gm NH_4Cl in 1 liter of solution) is such that 1 mL = 1 mg N. Thus, the standards used by Walla Walla (1 mL and 10 mLs of stock in 100 mLs of total volume) are 10 mg/L and 100 mg/L. Because concentrations of <10 mg/L are most common, calibration of the instrument with 1 mg/L and 10 mg/L standards is recommended. Dilution of samples with NH_3-N concentrations much greater than 10 mg/L (>20 mg/L) would then be appropriate.

NO_3-N and NO_2-N techniques appeared to follow the procedures included with the Hach chemicals. Alternative test methods may be appropriate.

SUMMARY AND CONCLUSIONS

Performance at the STP during the inspection was generally acceptable. Problems with the polishing filters, flow meter totalizer, and chlorine residual monitor prevented optimal performance. Changes have been made to correct or minimize these three problem areas.

The most significant area of improvement noted during the 1986 post-upgrade survey relative to the 1981 pre-upgrade survey was with disinfection. The improved chlorination facilities, which now include dechlorination facilities, resulted in reduced effluent fecal coliform counts and reduced effluent chlorine residual concentrations.

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During the inspection, BOD_5 and TSS effluent loads approached the NPDES permit limits although plant flow was considerably less than the permit limit. Improved plant efficiency will be necessary to meet BOD_5 and TSS load limits with increased flows. The repair and cleaning done to the polishing filters should improve effluent quality, although the backwash flow rate will probably remain high. The additional secondary clarifier being considered by the city should be encouraged in an effort to reduce the load to the polishing filter and thus reduce the backwash rate.

Walla Walla laboratory analysis of split samples compared well with Ecology results for BOD_5, TSS, and fecal coliforms. Several procedural recommendations are made in the discussion to improve Walla Walla techniques in accordance with approved procedures. Walla Walla laboratory analysis of NH_3-N, NO_2-N, and NO_3-N did not compare well with Ecology results. Different concentrations of standards may improve NH_3-N results.

Checks of the chlorine residual concentration are suggested during regional office visits at the plant. Also, a sample split for NH_3-N analysis by the Ecology and Walla Walla labs should be made after new calibration standards are being used at the Walla Walla lab.

MH:cp

Attachment

REFERENCES

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