JOHN SPELLMAN
Governor

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STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

7272 Cleanwater Lane, LU-11 • Olympia, Washington 98504 • (206) 753-2353

MEMORANDUM
January 24, 1983

To: Gary Brugger

From: Marc Heffner

Subject: West Point Class II Inspection, May 25-26, 1982

INTRODUCTION

On May 25 and 26, 1982, a Class II inspection was conducted at the METRO West Point treatment plant in Seattle. Personnel involved included Bill Yake and Marc Heffner (Department of Ecology [WDOE] Water Quality Investigation Section), Gary Brugger and Barbara Smith (WDOE, Northwest Regional Office), Bob Kievit (Environmental Protection Agency [EPA]), and James Harvey and Dan Grenet (Municipality of Metropolitan Seattle [METRO]).

West Point is a large (125 MGD design average daily flow) primary sewage treatment plant (STP) operated by METRO located on Seattle's west point (Figure 1). Major facilities include course- and fine-grit removal basins, bar screens, primary clarifiers, and chlorination facilities (Figure 2). Effluent is discharged via an outfall line, which also serves as a chlorine contact chamber, and through a diffuser into Puget Sound. Solids are anaerobically digested then centrifuged. Sludge is then sent to one of several land-application or landfill sites.

In addition to wastewater flows from residential and industrial sites in the plant's service area, the West Point STP also processes sludges from the Renton, Richmond Beach, Carkeek Park, and Alki STPs. These sludges are received as part of the influent flow.

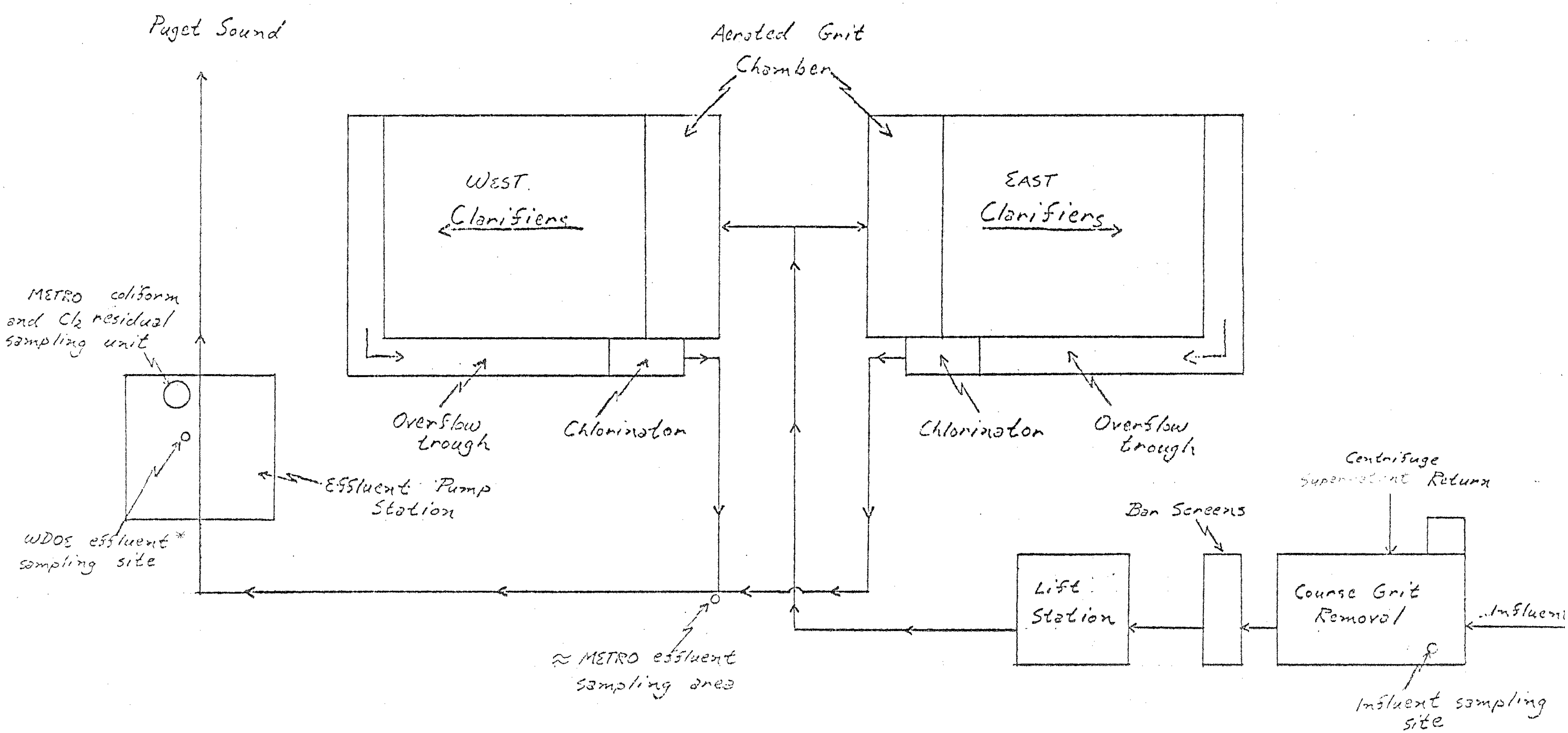
Facility discharge is limited by NPDES permit number WA-002918-1(M).

Procedure

WDOE automatic samplers were set up to collect 24-hour influent and effluent composite samples. The samplers collected 250 mls of sample every 30 minutes for 24 hours. METRO in-plant composite samplers also

Figure 1. Location of West Point STP.

Figure 2. Simplified summary of West Point liquid flow scheme.



*WDOE effluent sanple taken from a bucket that was kept continually mixed by flow through a hose from the effluent line.

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collected 24-hour samples. METRO compositors operate on a flow-time basis for the influent composite sample and a flow basis for the effluent composite sample. The sampling sites are noted in Figure 2. The four composite samples were split for analysis by WDOE and METRO labs (Tables 1 and 2).

In addition to the composite samples, grab samples were taken for field analysis (Table 3) and for fecal coliform and chlorine residual analysis (Table 4). The fecal coliform samples were held for a prescribed time based on plant flow before being dechlorinated to simulate the detention time in the outfall (Table 5).

Time composite samples of solids handled by the plant were collected by METRO. A portion of the digested sludge, centrifuge supernatant, centrifuge cake, and Renton sludge (sludge from METRO's Renton STP is a part of the West Point influent) collected by METRO was provided to WDOE for analysis (Tables 1 and 2).

Plant flows were estimated based on instantaneous and totalizer readings taken from the West Point in-line meter (Table 6).

Table 6. Flow measurements at West Point†.

STP Flows		Instantaneous	Totalizer	Flow Rate	
Date	Time	Flow (MGD)	Reading	(MGD)	
5/25	1110		140438		
5/25	1230	100		104.4	
5/25	1510		140612		106.1*
5/26	1020		141462		
5/26	1115	260			
5/26	1130	250		257.2	
5/26	1245		141721		

*Average flow rate for sampling period.
†Other flow rates provided by METRO:
Digestor feed to centrifuge ∿ 200 gpm.
Renton sludge ∿ 1.3 MGD.

Table 1. Conventional parameter analysis of composite samples.

	BOD_5 (mg/L)		COD (mg/L)		Solids (mg/L) - WDOE Lab				Solids (mg/L) - METRO Lab				WDOE Laboratory			Nutrients (mg/L)				
	WDOE Lab	METRO Lab	WDOE Lab	METRO Lab	TS	TNVS	TSS	TNVSS	TS*	TNVS*	TSS	TNVSS	Turb. (NTU)	pH (S.U.)	Conductivity (umhos/cm)	NO_3-N	NO_2-N	NH_3-N	Dis.-O-P	Total-P
Influent (WDOE Comp.)	240	182	540	500	920	550	310	57	900	604	273	57	130	7.3	1,110	<.10	<.10	17	4.7	6.3
Influent (METRO Comp.)	200	184	440	351	970	630	310	63			324	64	120	7.4	1,010	<.10	<.10	18	5.4	7.0
Effluent (WDOE Comp.)	160	122	300	296	720	530	78	18	700	571	70	15.5	65	7.2	1,150	<.10	<.10	21	4.6	5.6
Effluent (METRO Comp.)	100	94	200	160	780	610	110	23			78.5	15.5	46	7.4	1,190	<.10	<.10	15	4.6	5.4
Centrifuge Supernatant (METRO Comp.)	1,000		11,000		7,600	2,500	6,300	1,900						8.0	6,410	<.50	<.50	660	64	170
Renton Sludge (METRO Comp.)	1,700		3,800		3,200	810	2,900	580						7.1	646	<.25	<.25	21	13	70

*Calculated from percents provided by METRO.

Table 2. Metals analysis of composite samples.

Sample	Compositor	Lab	Cd (mg/L) Total	Cd (mg/L) Diss.	Cr (mg/L) Total	Cr (mg/L) Diss.	Cu (mg/L) Total	Cu (mg/L) Diss.	Pb (mg/L) Total	Pb (mg/L) Diss.	Ni (mg/L) Total	Ni (mg/L) Diss.	Zn (mg/L) Total	Zn (mg/L) Diss.	Hg (mg/L) Total
Liquid Samples															
Influent	WDOE	WDOE	.009	<.002	.06	<.01	.20	.027	.09	<.02	.10	<.02	.28	.035	.00032
	METRO	WDOE	.016	<.002	.05	<.01	.46	.037	.11	<.02	.14	.11	.51	.038	.0008
	METRO	METRO*	.007		.04		.2		.04		.05		.283		.0007
Effluent	WDOE	WDOE	.006	.002	.015	.01	.087	.040	.06	<.02	.03	<.02	.16	.061	.00032
	METRO	WDOE	.008	<.002	.02	<.01	.24	.045	.06	<.02	.11	.09	.23	.089	<.0002
	METRO	METRO	.007		<.03		.22		.06		.06		.215		.0003
Centrifuge Supernat.	METRO	WDOE	.36		2.0		7.4		3.2		.75		11		.0072

Solid Samples (metals results as mg/Kg dry wt.)

	% Solids	Cd (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Ni (mg/Kg)	Zn (mg/Kg)	Hg (mg/Kg)
Renton Sludge†	.32	14	140	1,000	120	83	520	.91
Centrifuge Cake†	13.8	56	320	1,300	580	130	1,900	.02
Digestor Sludge†	3.1	61	340	1,300	590	130	2,000	.24

*Results are for weekly composite samples that included date Class II was conductec.
†Samples composited by METRO with analysis by WDOE.

Table 3. Field measurements.

Sample	Date	Time	Temp. (°C)	pH (SU)	Cond. (umhos/cm)	D.O. (mg/L)	Chlorine Residual Total (mg/L)
Influent	5/25/82	1050	17.0	7.45	>1,000	3.8† 3.5††	
Effluent	5/25/82	1230	17.1	7.00	>1,000		1**
Influent	5/26/82	1040	15.5	7.35	950	2.0† 2.0††	
	5/25-26/82	Composite	3.3*	7.20	>1,000		
Effluent	5/26/82	1115	15.5	6.75	∿1,050		
	5/26/82	1130					<.1***
	5/25-26/82	Composite	3.0*	7.10	>1,000		
Aerated Grit Chamber	5/26/82	1100					2.8
Effluent Channel	5/26/82	1110					2.15

†Influent sample taken prior to mixing with centrifuge supernatant.
††Influent sample with centrifuge supernatant mixed in.
*Composite sample preserved with ice during collection.
**METRO chart reading ∿ .9
***METRO chart reading 0 since 10 a.m., zero readings also noted 10/25 p.m.

Table 4. Fecal coliform - chlorine residual data.

			Fecal Coliforms (#/100 mls)		Chlorine Resid. (mg/L)	
Site	Date	Time	WDOE	METRO†	WDOE DPD Kit Total	METRO Meter Total
METRO Sampling Site	5/25	1230	670			.9
96-in. line	5/25	1230	1,100			
96-in. line*	5/25	1230	330		1	
96-in. line**	5/26	1130	560,000	790,000	<.1	0

*Sample dechlorinated 20 minutes after collection per METRO outfall line DT chart (Table 5).

**Sample dechlorinated 8 minutes after collection per METRO outfall line DT chart (Table 5); WDOE and METRO sample containers were placed side by side and filled with a hose from the effluent line in alternate intervals to simulate a split sample.

†MPN test used by METRO.

Table 5. Detention time in West Point outfall* (table provided by METRO).

Travel time through 96-inch diameter submarine outfall
(Effluent pump bldg. to diffuser) (3650 ft.)

MGD	Minutes
50	39
55	35
60	32
65	30
70	28
75	26
80	25
85	23
90	22
100	20
105	19
110	18
115	17
120	16
125 & 130	15
135 & 140	14
145 - 155	13
160 - 170	12
175 & 180	11
185 - 205	10
210 - 225	9
250 - 270	8
275 - 295	7
300 +	6

*For use in determining holding time necessary before dechlorinating coliform samples.

Memo to Gary Brugger
Weat Point Class II Inspection, May 25-26, 1982

DISCUSSION

Conventional Parameters

Results of the conventional parameter analysis are presented in Table 1. Some differences existed in composite sample collection by WDOE and METRO that probably had an influence on the analytical results. These differences included:

1. The time of day the 24-hour composites were started. METRO compositors ran from approximately 0700 to 0700 while the WDOE influent compositor ran from 1040 to 1040 and the effluent compositor ran from 1220-1115. During the morning of May 26, it began raining, so any runoff impacts would have affected WDOE samplers for a longer period of time. Table 6 shows the flow measurements taken by WDOE from the West Point meter.

2. METRO compositors accounted for flow variations during the sampling period whereas WDOE composites were collected on a time basis. Variations in influent or effluent quality associated with flow would probably be more accurately composited by the METRO samplers.

3. Different effluent collection sites were utilized by WDOE and METRO (see Figure 2). METRO reported that their sample site favored flow from the east set of clarifiers and they were making plans to move the sampling site. The WDOE compositor was set up at the METRO proposed site. METRO is presently sampling the effluent at the site used by WDOE with a modified version of the WDOE setup.

Table 7 provides a comparison of the data collected from the two sets of compositors. Percent removals (BOD, COD, TSS) found by both the WDOE and METRO labs were quite similar for a given set of compositors with the exception of METRO compositor TSS values. Plant efficiency for BOD and COD removal was noticeably better for the METRO set of compositors. The factors mentioned previously could have contributed to this situation. Also, checks to make sure that samples are adequately cooled during compositing might be made to assure minimal BOD and COD reduction during compositing.

Table 7. Comparison of compositor and laboratory results.*

	BOD			COD			BOD:COD (%)		TSS		
	Influent	Effluent	Percent Removal	Influent	Effluent	Percent Removal	Influent	Effluent	Influent	Effluent	Percent Removal
WDOE Compositor											
METRO Lab	182	122	33	500	296	41	36	41	273	70	74
WDOE Lab	240	160	33	540	300	44	44	53	310	78	75
% Difference	24	24		7	1				12	10	
METRO Compositor											
METRO Lab	184	94	49	351	160	54	52	59	324	78.5	76
WDOE Lab	200	100	50	440	200	54	45	50	310	110	64
% Difference	8	6		20	20				4	29	

*Units are mg/L unless noted as percent.

Table 7 also provides a comparison of the laboratory results reported by the WDOE and METRO laboratories. The correspondence between TSS results is generally good with only analysis of the METRO effluent composite sample showing a large variation. BOD results for the METRO composite samples and COD results for the WDOE composite samples correspond well, with METRO laboratory results generally slightly lower than WDOE laboratory results. METRO laboratory results for the WDOE composite sample (BOD test) and METRO composite sample (COD test) were notably less than the WDOE laboratory results. Although the differences did not appear excessive, it is unusual that for the respective tests the difference in lab results was the same percentage for both influent and effluent samples. The BOD:COD ratio column in Table 7 also suggests a possible analytical problem. The variance in the ratio is much greater for METRO laboratory results than for WDOE laboratory results for the different compositors. Differences of this nature suggest a possible problem with a dilution factor multiplier and stress the need to carefully monitor dilution procedures.

Table 8 compares the Class II inspection data to the May through October NPDES permit limits. The NPDES permit includes both a May-through-October, as well as a November-through-April set of limits. BOD, TSS, and pH Class II results were within permit limits for all cases except the WDOE compositor-WDOE laboratory BOD result. For this result, the weekly and monthly concentration limits and monthly loading limit were exceeded.

Table 8. Comparison of NPDES permit limits of conventional pollutants to Class II results.

	NPDES Permit Limits (May through October)		Class II Results (Effluent)										
			WDOE Compositor				METRO Compositor				Grab		
	Monthly	Weekly	WDOE Laboratory		METRO Laboratory		WDOE Laboratory		METRO Laboratory			WDOE	METRO
Parameter	Average	Average	(mg/L)	(lbs/D)	(mg/L)	(lbs/D)	(mg/L)	(lbs/D)	(mg/L)	(lbs/D)	Date	Laboratory	Laboratory
BOD_5	135 mg/L 112,000 lbs/D	150 mg/L 123,000 lbs/D	160	142,000	122	108,000	100	88,500	94	83,200			
TSS	125 mg/L 110,000 lbs/D	140 mg/L 140,000 lbs/D	78	69,000	70	61,900	110	97,300	78.5	69,500			
Fecal Coliform	700/100 mL	1500/100 mL									5/25 5/26	330 560,000	 790,000
pH	6.5 to 9.0										5/25 5/26	7.0 6.75	

The fecal coliform samples taken on May 26 far exceeded NPDES permit limits but because permit fecal coliform averages are based on a geometric mean, permit compliance would still be readily achievable. (May, 1982, discharge monitoring report (DMR) values were: monthly average - 226/100 mL; weekly average - 697/100 mL.) When the samples were taken, the chlorine residual in the effluent was read as zero on the plant meter and <.1 using a DPD kit. The plant chart showed zero chlorine residual concentrations in the effluent on the afternoon of May 25 and on May 26 from 1000 until last checked at 1130. METRO attributed the problem to flash mixing problems with the west chlorine injection system as well as the high chlorine demand associated with the flushing effect of the rainfall that occurred.

METRO reports improvements have been made in coliform testing and chlorination since the inspection. Prior to and during the inspection, the METRO coliform sampling site was a tap on a tank fed by the effluent stream at a site near the WDOE effluent sampling site (Figure 2). Although the detention time in the tank was unknown, it appeared as if it could have been sufficient to significantly affect the fecal coliform test results. WDOE took grab samples from the METRO sampling tank (result: 670/100 mL) and the effluent line (result: 1100/100 mL) on May 25 (Table 4) with those results also suggesting that the METRO sampling tank system may not be representative. METRO reports that coliform samples are now taken from the effluent line at the relocated METRO effluent sampling site previously noted. They also report that chlorination capacity has been increased by one-third to help meet the chlorine demand and an effort to correlate chlorine residual and fecal coliform counts is being made. Data and results of the chlorine-coliform correlation should be made available to WDOE, and a monitoring system to assure lapses in chlorination are not occurring should be installed.

BOD, COD, and solids tests were also run on the Renton sludge sample. Table 9 was set up to evaluate the contribution of the Renton sludge to the influent load at West Point. The Renton sludge contribution to the West Point influent load for those three parameters was in the 8 to 14 percent range during the Class II inspection. The "fact sheet" released by EPA concerning the proposed issuance of a 301(h) waiver for West Point reports that METRO has estimated late 1986 as the time when Renton sludge will no longer be transferred to West Point. This action is estimated to reduce the influent load to West Point for BOD by 45 percent and for TSS by 38 percent (EPA, 1982, p. 7). This magnitude of impact due to Renton sludge was not noted during the Class II inspection.

Table 9. BOD, COD, and TSS load on West Point by Renton sludge.

		WDOE compositor-WDOE Laboratory Data		METRO compositor-METRO Laboratory Data	
	Renton* Sludge (lbs/D)	West Point Influent Load (lbs/D)	% of Influent load due to Renton	West Point Influent Load (lbs/D)	% of Influent load due to Renton
BOD	18,400	212,000	8.7	163,000	11.3
COD	41,200	478,000	8.6	311,000	13.2
TSS	31,400	274,000	11.5	274,000	11.5

*Load calculations based on WDOE laboratory analysis of the composite sample provided by METRO and a flow of 1.3 MGD.

Metals

Metals data collected during the Class II are presented in Table 2. The data collected generally fall into two groups: (1) the liquid stream including the influent and the effluent; and (2) the solids stream including the digested sludge, the centrifuge cake, and the centrifuge supernatant. Because the Renton sludge enters the plant as part of the influent, the Renton sludge input is included in the influent data.

Liquid stream data include results from dissolved and total metals analysis. Concentrations of dissolved Cd, Cr, and Zn were at or below detection limits. Table 10 shows the percent of the total Cu, Ni, and Zn in the sample that was present in the dissolved form. For Cu and Zn, the percentage of the metal present in the dissolved form was greater in the effluent sample than in the influent sample. The variation in dissolved Ni present in METRO versus WDOE compositor data seems to indicate that the compositors or sample handling might have influenced solubility of the metal.

Table 10. Percent of influent and effluent total metals in dissolved form.

Sample	Compositor	Lab	Cu (%)	Ni (%)	Zn (%)
Influent	WDOE	WDOE	14	<20	12
	METRO	WDOE	8	79	7
Effluent	WDOE	WDOE	46	<67	38
	METRO	WDOE	19	82	39

The total metals data include analysis of the METRO effluent composite sample by both WDOE and METRO laboratories. Results of the split sample compare well except for some discrepancy in Ni concentration (WDOE laboratory result: .11 mg/L; METRO laboratory result: .06 mg/L). The discrepancy in Ni concentrations reported might be expected as Ni is more prone to interferences than the other metals being tested (Robb, 1982). A comparison of the metals concentrations found in the WDOE and METRO composite samples shows that metals concentrations were generally higher in the METRO composite samples. This is most noticeable for the Zn and Cu influent concentrations and the Cu effluent concentration. Reasons for the differences in WDOE and METRO composite sample results might include those factors noted in the beginning of the conventional parameter discussion. Another possibility could be sample contamination by the METRO samplers and/or adsorption of the metals by the WDOE samplers. Comparison of a set of grab samples taken with a properly cleaned sampler (EPA, 1976) and a set of grab samples taken using the compositor and composite jug with corresponding members of each set sampled at the same time may prove useful in determining if a compositor contamination problem exists.

Liquid stream metals removals at West Point are noted in Table 11. The percent removal range defined by the removals found using the METRO compositor and WDOE compositor data vary less than 20 percent for all metals except Ni and Hg. As mentioned previously, analytical interferences with Ni analysis occur more frequently than with other metals. The cause of the Hg disagreement is unknown.

Table 11. Liquid stream metals removal at West Point*.

	Cd	Cr	Cu	Pb	Ni	Zn	Hg
METRO Composite							
In	.016	.05	.46	.11	.14	.51	.0008
Out	.008	.02	.24	.06	.11	.23	<.0002
% Removal	50	60	48	45	21	55	>75
WDOE Composite							
In	.009	.06	.20	.09	.10	.28	.00032
Out	.006	.015	.087	.06	.03	.16	.00032
% Removal	33	75	56	33	70	43	0
% Removal Range	33-50	60-75	48-56	33-45	21-70	43-55	0->75

*All laboratory analysis by WDOE.

Table 12 presents a comparison of the effluent metal concentrations and loadings found during the Class II inspection to the NPDES permit limits. Concentrations and loadings for all the metals tested fell below the daily maximum permit limitations. Results of the WDOE analysis of the METRO composite sample for Cd concentration and Ni concentration and loading were the only metals results in excess of monthly average limits.

Table 12. Comparison of NPDES permit limits for metals to Class II data.

	NPDES Permit Limits (May-October)				Class II Results (Effluent)					
					WDOE Compositor		METRO Compositor			
	Monthly Average		Daily Maximum		WDOE Laboratory		WDOE Laboratory		METRO Laboratory	
Parameters	(mg/L)	(lbs/D)	(mg/L)	(lbs/D)	(mg/L)	(lbs/D)	(mg/L)	(lbs/D)	(mg/L)	(lbs/D)
Cd	.007	7.5	.02	17	.006	5.3	.008	7.1	.007	6.2
Cr	.07	65	.16	140	.015	13.3	.02	17.7	<.03	<26.5
Cu	.25	215	.40	550	.087	77.0	.24	212.4	.22	194.7
Pb	.09	110	.25	360	.06	53.1	.06	53.1	.06	53.1
Ni	.06	80	.165	210	.03	26.5	.11	97.3	.06	53.1
Zn	.55	450	.78	850	.16	141.6	.23	203.5	.215	190.2
Hg	.0007		.0033		.00032	.2832	<.0002	<.1770	.0003	0.2655

Comparison of effluent metals concentrations found during the Class II inspection to EPA toxicity criteria for receiving waters is provided in Table 13. Effluent dilution required to meet criteria concentrations were calculated (calculations assume dilution water contains no metals). A maximum dilution requirement of 60:1 for the METRO compositor-WDOE laboratory Cu concentration was found. This requirement is less than the 78:1 minimum dilution factor predicted for the West Point discharge in the West Point 301(h) waiver application (METRO, 1979).

Table 13. Comparison of West Point effluent metals concentrations to EPA toxic criteria for receiving waters (EPA, 1980).

	Cd	Cr*	Cu	Pb	Ni	Zn	Hg
EPA Saltwater Toxicity Criteria							
Acute (μg/L)	59	1260	23	668	140	170	3.7
Chronic (μg/L)**	4.5	18	4	25	7.1	58	.10
WDOE Compositor - WDOE Laboratory							
Results (μg/L)	6	15	87	60	30	160	.32
Dilution Required†							
Acute	--	--	3.8:1	--	--	--	--
Chronic**	1.3:1	--	22:1	2.4:1	4.2:1	2.8:1	3.2:1
METRO Compositor - WDOE Laboratory							
Results (μg/L)	8	20	240	60	110	230	<.2
Dilution Required†							
Acute	--	--	10:1	--	--	1.3:1	--
Chronic**	1.8:1	1.1:1	60:1	2.4:1	15:1	4.0:1	<2:1

*Total recoverable hexavalent chromium.
**24-hour average concentration.
†Dilution required to meet EPA toxicity criterion; ratio assumes no metals in dilution water.

Solids stream data included the results of digested sludge metals analysis. Table 14 compares metals concentrations in West Point digestor sludge to concentrations found in sludges sampled during Class II inspections at other plants in the state. West Point sludge metals concentrations are well above average concentrations with Cd, Cu, and Ni concentrations being higher than found in previously collected data. The data suggest that, from a metals standpoint, West Point is one of the more heavily loaded primary treatment plants in the state.

Table 14. Comparison of West Point digested sludge to previously collected data.*

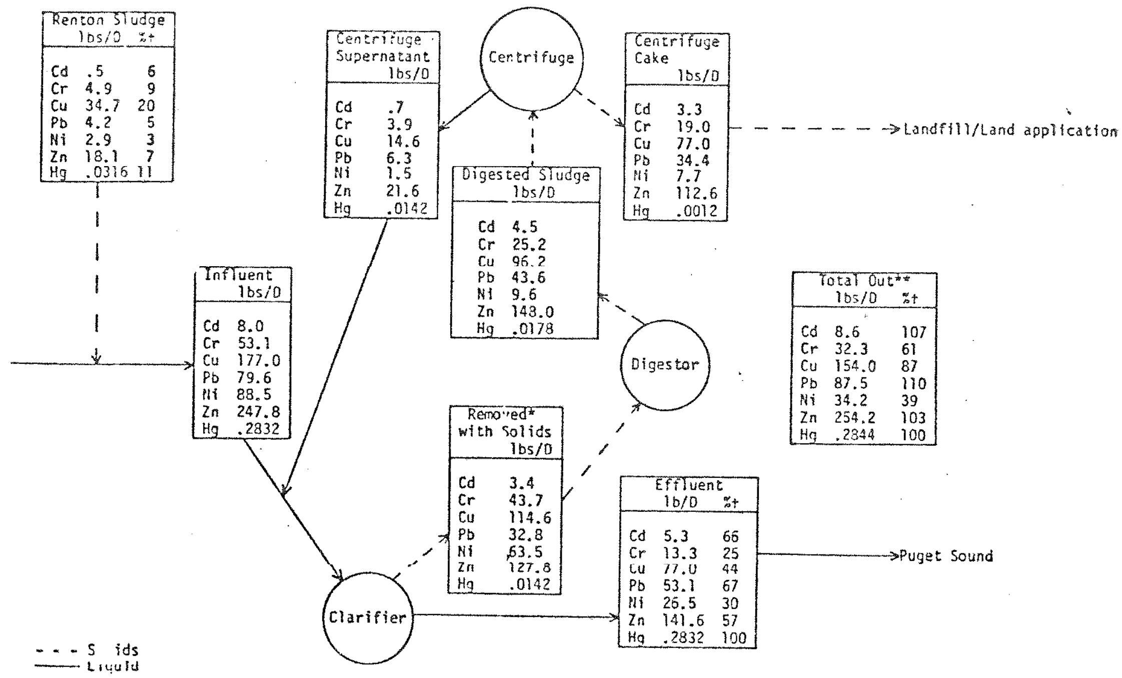
	West Point Data	Previously Collected Data*		
Parameters	(mg/Kg)†	Geometric Mean (mg/Kg)†	Range (mg/Kg)†	Number of Samples
Cd	61	6.93	1.8 - 17	19
Cr	340	56.8	11 - 540	19
Cu	1300	434.3	137 - 1190	19
Pb	590	324.7	73 - 1090	19
Ni	130	49.1	18 - 120	13
Zn	2000	1283.8	180 - 2680	19

*Summary of data collected prior to 4/82 during WDOE Class II inspections of primary plants.
†Dry weight basis.

An effort to provide a metals balance for the treatment plant using the Class II data was made. Certain problems associated with such an effort have to be recognized. The major problem associated with the balance is the inability to follow a given input through the plant. Using a composite sample to get a daily average value helps somewhat, but because the liquid and solid handling components of the plant have different detention times, the problem is not entirely avoided.

Metals flow charts were set up using WDOE analysis of WDOE composite samples (Figure 3) and METRO composite samples (Figure 4) for the liquid stream data. Renton sludge and solids stream data came from WDOE analysis of composite samples provided by METRO.

Metals loadings for the solid stream were calculated based upon the concentrations of solids and metals in the component and a flow rate calculated on the basis of the METRO estimate of 200 gallons of digestor sludge fed into the centrifuge per minute (see appendix A for calculations). Results of the calculations appear on Figures 3 and 4.



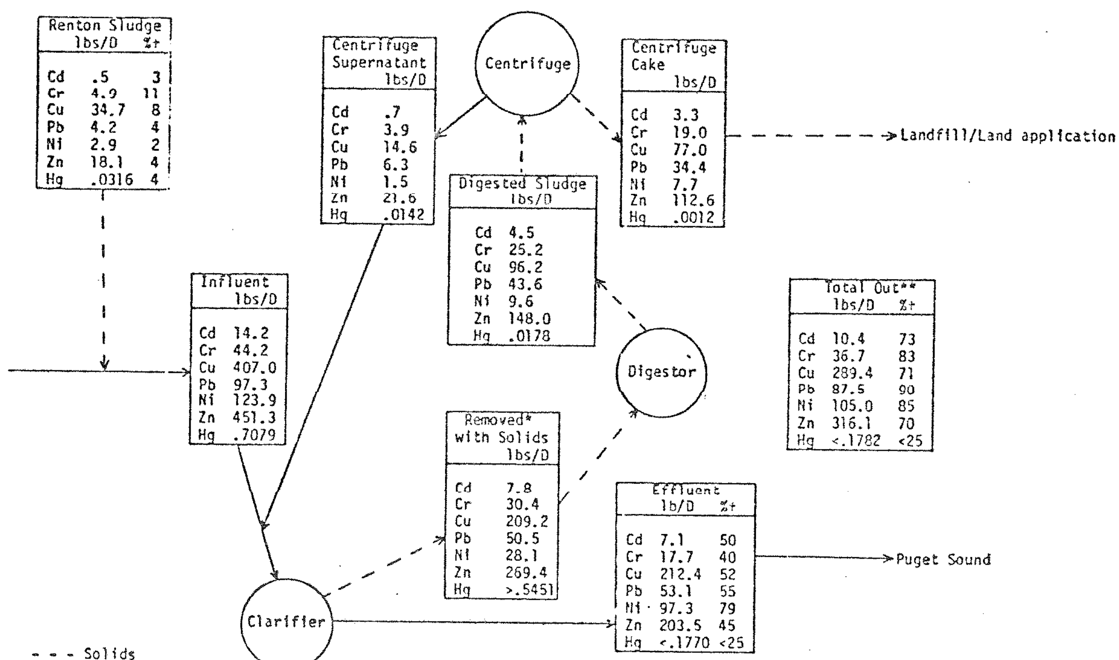
- - - Solids
——— Liquid

*Calculated value:
Influent + supernatant - effluent = removed with solids

**Calculated value:
Effluent + centrifuge cake = total out

+ % = % of influent.

Figure 3. Metals balance at West Point using WDOE analysis of WDOE influent and effluent compositor data.



- - - Solids
——— Liquid

*Calculated value:
Influent + supernatant - effluent = removed with solids

**Calculated value:
Effluent + centrifuge cake = total out

+ % = % of influent.

Figure 4. Metals balance at West Point using WDOE analysis of METRO influent and effluent compositor data.

Table 15 compares digested sludge metals load with the respective loads of its two components (the centrifuge supernatant and the centrifuge cake). The agreement is good, with roughly 86 to 96 percent of the digested sludge metals load accounted for by the sum of the centrifuge cake plus supernatant metals loads. It is interesting to note that for all metals except Hg, the vast majority of the metals were associated with the centrifuge cake rather than the supernatant. Most of the Hg seemed to be associated with the supernatant.

Table 15. Percent of digested sludge metals load found in centrifuge streams.

Parameters	Supernatant (%)	Cake (%)	Supernatant + Cake (%)
Cd	15.6	73.3	88.9
Cr	15.5	75.4	90.9
Cu	15.2	80.0	95.2
Pb	14.4	78.9	93.3
Ni	15.6	80.2	95.8
Zn	14.6	76.1	90.7
Hg	79.8	6.7	86.5

The metals balances look slightly different depending on whether the METRO or WDOE compositor data are used. The WDOE composite sample data indicate a balance in which the metals (Cd, Cu, Pb, Zn, and Hg) load sent to the digestors approximately equals the metals load being taken out of the digestors. Thus the total metals being removed from the plant approximate 100 percent of the metals coming into the plant. The Renton sludge contribution to the influent represents 2 to 11 percent of the input except for Cu. Approximately 20 percent of the Cu load to the West Point plant was attributed to Renton.

The METRO composite sample data depict a situation in which the digestor is being loaded with more metals than are being taken out. For all metals except Hg, the total percentage of metals being removed from the plant is 70 to 90 of that coming in. Using these data, Renton sludge composes 2 to 11 percent of the metals loading to West Point.

The two sets of influent and effluent data suggest that the metals load removed from the liquid stream was approximately equal to or slightly less than the metals removed during the period when the digestor was loaded. Based on the solids data, it appears that the METRO compositor Ni results and WDOE compositor Hg results are probably more accurate than the WDOE compositor Ni results and METRO compositor Hg results. As noted earlier, an effort to find any sampling problems associated with Cu and/or Zn would be useful for determining the loading to Puget Sound.

LABORATORY PROCEDURES

Laboratory procedures were reviewed with James Harvey of METRO. At the time of the inspection, METRO was reviewing and upgrading laboratory procedures and equipment used at West Point. Comments relative to the procedures being used include:

Composite Sampling Comments

1. It was noted in the conventional parameter discussion that the effluent compositor sampling site could have been more representative. METRO reported that improvements have been made.

2. A program for compositor and composite bottle cleaning should be set up and followed. As noted in the metals discussion, a check to see if any metals contamination is occurring in the compositors may be worthwhile.

BOD Analysis Comments

METRO equipment upgrades and procedural reviews for the BOD test were almost complete and BOD procedures looked good. As discussed earlier, there were some differences between WDOE and METRO laboratory results. Although the differences did not seem excessive, the pattern of variation suggests the need for continuous review of dilution procedures.

TSS Analysis Comments

1. It was recommended that one of the approved filters listed in *Standard Methods* be used for the test (APHA, 1980).

2. The temperature of the drying oven should be calibrated and monitored daily. During the inspection the temperature was noted to be 112°C rather than within the prescribed range of 103 to 105°C.

3. It was recommended that duplicate samples be run when <50 mls of sample can be filtered.

Fecal Coliform Analysis Comments

1. The Most Probable Number (MPN) technique was used for this analysis. Procedures looked appropriate.

2. As noted in the conventional parameter analysis, improvements in the fecal coliform sampling site were thought necessary to provide representative samples. METRO reported that changes have been made.

RECOMMENDATIONS AND CONCLUSIONS

1. Results obtained from samples collected during the Class II inspection were compatible with meeting NPDES permit limits when used in calculating weekly and monthly averages needed to evaluate permit compliance. A high coliform count (560,000/100 mL) from the May 26 sample was of concern; although because a geometric mean is used in coliform averages, a permit violation due to a single count is unlikely. The high count resulted from a lack of chlorine residual in the effluent. METRO reported that additional chlorine capacity has been provided since the inspection. Monitoring should assure that high coliform counts due to insufficient chlorine residual are an infrequent occurrence.

2. Laboratory procedures were generally good. Use of an approved filter paper, keeping a log of drying oven temperatures, and filtering at least 50 mls of sample unless duplicates are run were suggested as means of improving the METRO TSS analysis. Also, because of the nature of the differences between some METRO and WDOE compositor and laboratory BOD and COD results run on split samples, careful monitoring of both dilution procedures and composite sample refrigeration is suggested.

3. The METRO effluent composite and fecal coliform grab sampling stations being used during the inspection were not in preferred sites. METRO reported that a better sampling site is now used and a more representative sample is collected.

4. Metals data collected during the Class II led to the construction of fairly well-balanced metals flow charts. Results indicated that metals loading of the digestor was approximately equal to or slightly greater than the load being withdrawn. The effluent metals load to the Sound varied depending upon whether WDOE or METRO compositor data were used in the calculations. METRO composite samples generally showed higher metals concentations. Differences in sampling times and/or techniques may account for differences in results, but a check for sample contamination by the compositors would be desirable. Results of analysis of samples from both compositors were below NPDES permit limits and, when dilution with metal-free water was considered, were below EPA saltwater toxicity criteria.

MH:cp

Attachments

REFERENCES

APHA, AWWA, WPCF, 1980. *Standard Methods for the Examination of Water and Wastewater*. 15th Edition.

EPA, 1976. Methods for Chemical Analysis of Water and Wastes, "Metals" Section 4.1, p. 80. EPA 625/6-74-003a, pp. 298.

EPA, 1980. Water quality criteria documents; availability. *Federal Register*, Part V, Vol. 45, No. 281., November 28, 1980.

EPA, 1982. Fact Sheet - Proposed Issuance of National Pollutant Discharge Elimination (NPDES) Permit Incorporating a Clean Water Act Section 301(h) Variance. Application No: WA-002918-1 (West Point), April 5, 1982, pp. 12.

METRO, 1979. West Point Treatment Plant Section 301(h) Application. Part B, Section 1. Subsection A.1-4, August 30, 1979.

Robb, S., 1982. WDOE chemist, personal communication.

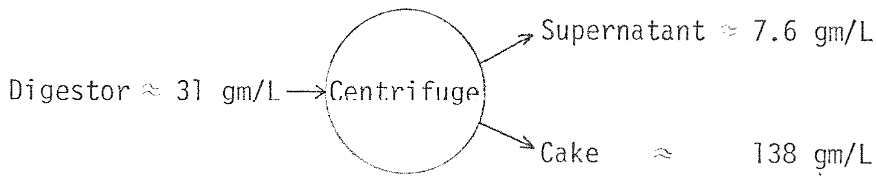
Appendix A: Calculation for Metals Load in Solids

Given:

Digestor sludge 3.1% solids = 31 gm/L

flow rate to centrifuge ∿ 200 gpm

Centrifuge sludge 13.8% solids = 138 gm/L
Centrifuge supernatant 7600 mg/L solids = 7.6 gm/L



Assume that 1 L of digested sludge is fed into the centrifuge

$$\underset{\text{sludge}}{1000\ \text{mL}\ (31)} = \underset{\text{supernatant}}{(100 - x)\ 7.6} + \underset{\text{cake}}{(x)\ 138}$$

$$31000 - 7600 - 7.6x + 138x$$
$$23400 = 130.4x$$
$$179.4 = x \sim 180$$

Thus: Cake amount = 180 mL
Supernatant amount = 820 mL

Since digested sludge flows at 200 gpm (.288 MGD)

$\frac{200\ \text{gpm}}{1\ \text{L}} = \frac{x}{.82\ \text{L}}$; x = 164 gpm (.236 MGD) supernatant

$\frac{200\ \text{gpm}}{1\ \text{L}} = \frac{y}{.18\ \text{L}}$; y = 36 gpm (.052 MGD) cake

The pounds of solids associated with each stream can then be calculated:

Digested sludge:

200 gal/min (60 min/hr x 24 hr/D x 3.76 L/gal) x 31 gm/L $\left(\frac{1}{454\ \text{gm/lb}}\right)$ ∿ 73900 lbs/D

Supernatant:

164 gal/min (60 min/hr x 24 hr/D x 3.76 L/gal) x 7.6 gm/L $\left(\frac{1}{454\ \text{gm/lb}}\right)$ ∿ 14900 lbs/D

Cake:

36 gal/min (60 min/hr x 24 hr/D x 3.76 L/gal) x 138 gm/L $\left(\frac{1}{454\ \text{gm/lb}}\right)$ ∿ 59200 lbs/D

(Supernatant + Cake) 74100

The pounds of metals associated with each stream could then be calculated:

For digested sludge and centrifuge cake:

$$\frac{\text{lbs/D of solids x mg/Kg of metal in solids}}{\text{2.2 lbs/Kg x 454000 mg/lb}} = \text{lbs/D of metal}$$

For centrifuge supernatant:

mg/L metals in flow x 8.34 x MGD of flow = lbs/D of metal

	Digested Sludge		Cake + Super.	Centrifuge Cake		Centrifuge Supernatant	
	mg/Kg	lbs/D (73900)	(lbs/D)	mg/Kg	lbs/D (59200)	mg/L	.236 MGD lbs/D
Cd	61	4.5	4.0	56	3.3	0.36	.7
Cr	340	25.2	22.9	320	19.0	2.0	3.9
Cu	1300	96.2	91.6	1300	77.0	7.4	14.6
Pb	590	43.6	40.7	580	34.4	3.2	6.3
Ni	130	9.6	9.2	130	7.7	0.75	1.5
Zn	2000	148.0	134.2	1900	112.6	11	21.6
Hg	.24	.0178	.0154	.02	.0012	.0072	.0142
% Solids	3.1			13.8		7600 mg/L = .76%	