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STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

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MEMORANDUM

May 10, 1983

To: Al Newman

From: Marc Heffner

Subject: Prosser Class II Inspection - October 5-6, 1982

INTRODUCTION

On October 5-6, 1982, a Class II inspection was conducted at the Prosser Sewage Treatment Plant (STP). Personnel involved included Dale Clark and Marc Heffner (Washington State Department of Ecology [WDOE] Water Quality Investigations Section [WQIS]), Al Newman (WDOE Central Regional Office), and Perry Harris and Gil Valdez (Operators, Prosser STP).

While the Class II inspection was being conducted, a receiving water study was being conducted by Art Johnson and Joe Joy (WDOE, WQIS). Results of the receiving water study will be presented in a separate report (Johnson, 1983).

The Prosser STP is operated as two sewage treatment plants; an industrial plant and a domestic plant (Figures 1 and 2). The industrial plant receives most of its flow from a potato processor and consists of a barminutor, a primary clarifier, and a trickling filter. Sludge from the primary clarifier is hauled for use as animal feed. There is also provision for pumping settled sewage from the primary clarifier to be sprayed on nearby fields. The domestic plant includes aerated grit removal, primary clarification, trickling filter, secondary clarification, and chlorine contact facilities. Sludge is digested, then dried on drying beds before final disposal. Effluent from both facilities is routed to a ditch in which it is combined, then flows approximately 100 feet into the Yakima River.

The Prosser STP is presently limited by Docket No. DE 81-485 which modifies National Pollution Discharge Elimination System (NPDES) permit number WA-002080-0. The docket provides both industrial and domestic interim limits. A new permit has been issued and the limits will be in effect after the facility has been upgraded. The new permit provides one set of limits for the combined discharge.

Figure 1. Location of Prosser STP - Prosser STP Class II inspection, October 1982.

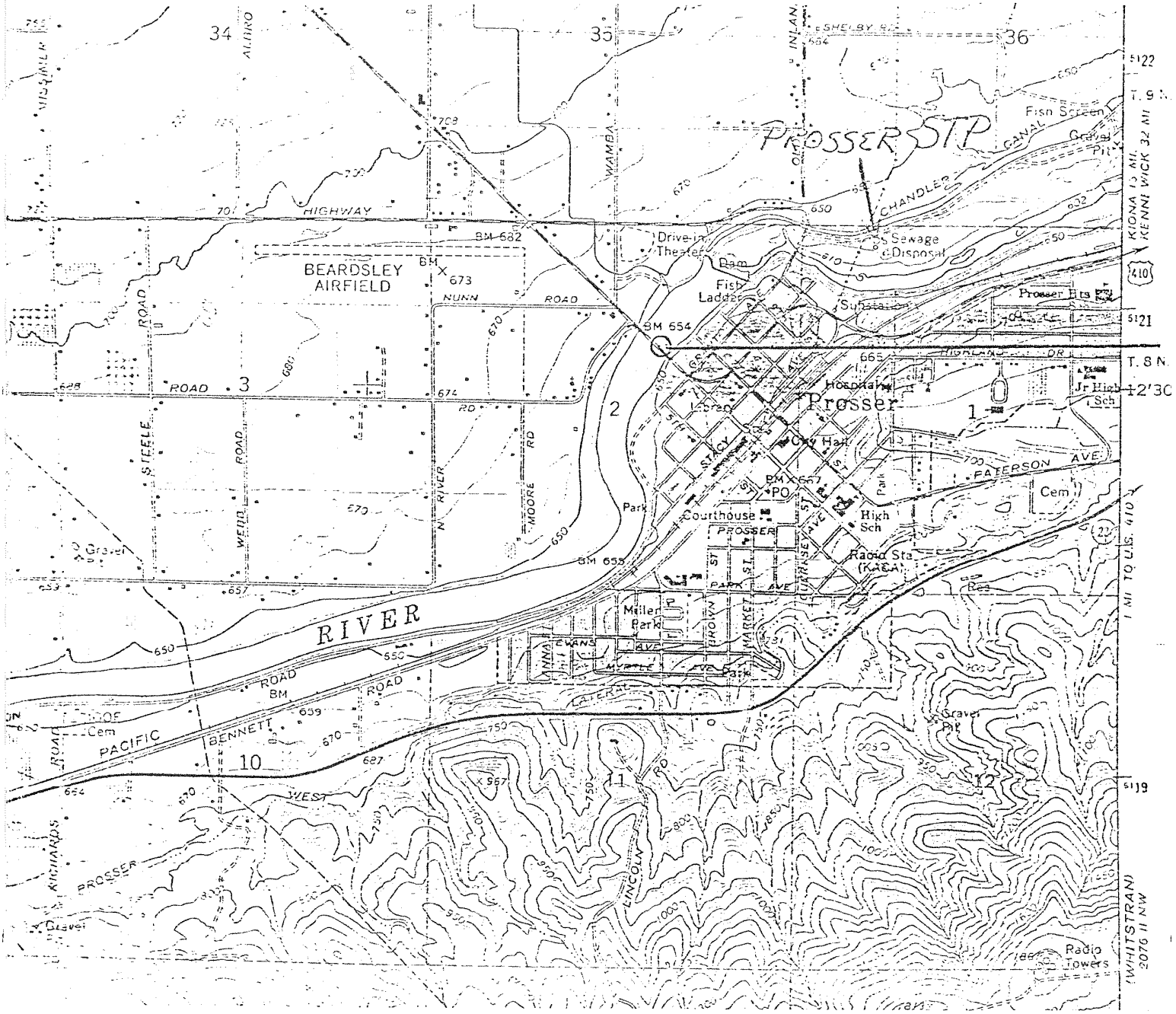
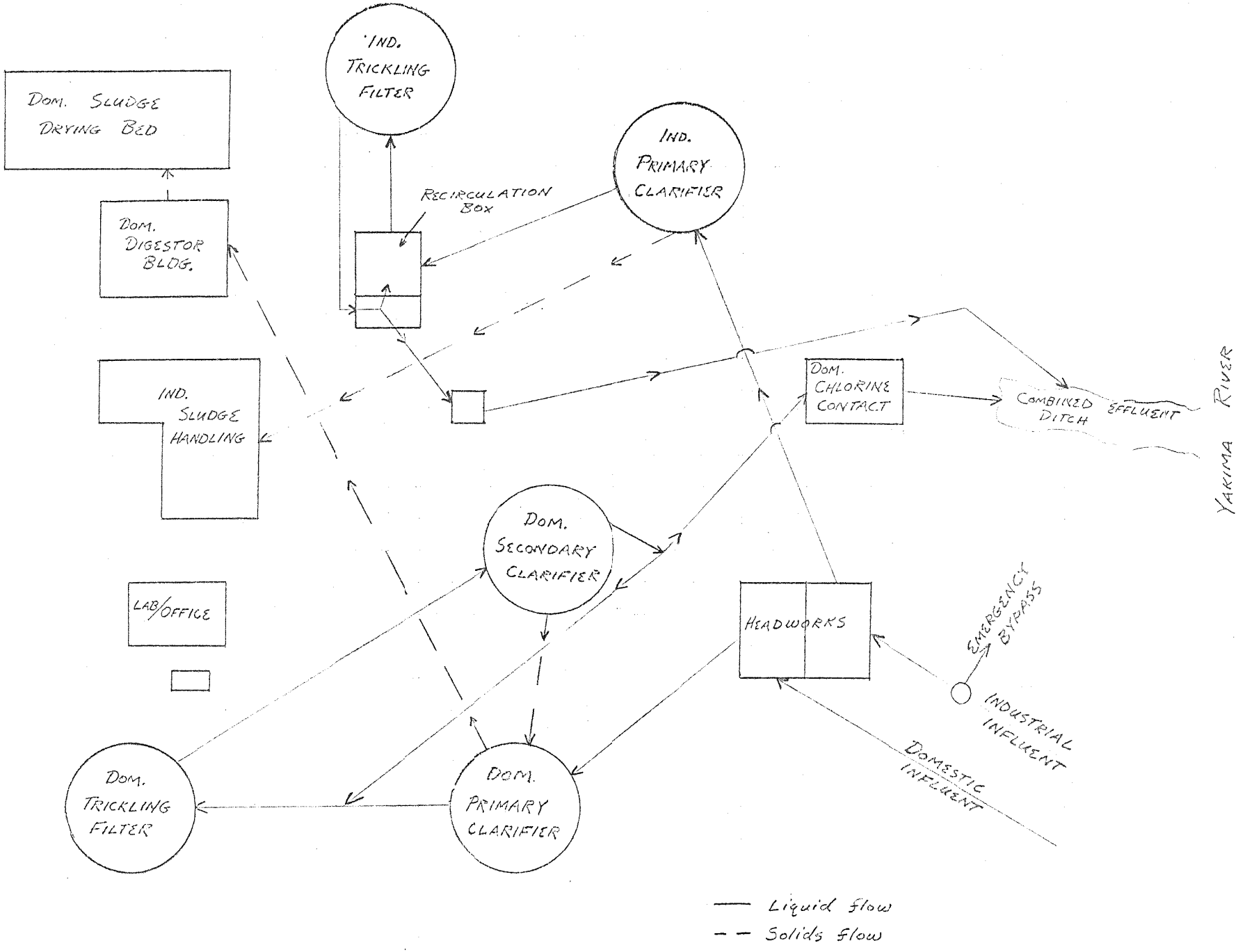


Figure 2. Prosser STP flow scheme - Prosser STP Class II inspection, October 1982.



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PROCEDURES

Upon arrival at the STP on Monday, October 4, it was found that the industrial portion of the STP was not operating. The industrial portion had not been operating correctly over the weekend due to an excessive solids load resulting in heavy solids deposits in the clarifier and a plugged influent line to the clarifier. Solving the problem necessitated draining and cleaning the clarifier and allowing the industrial influent to flow into the effluent channel, bypassing the plant. A grab sample of the bypassing discharge was taken with results shown in Table 1. While the problem was being corrected, the trickling filter was being continually wetted with the same recycle water. The plant was back on line, with clarifier filled and effluent being discharged at approximately 1700 hours on October 5.

October 5-6 Sampling

WDOE composite samplers were set up to collect 250 mls of sample every 30 minutes for 24 hours at the domestic plant. Both domestic influent and domestic effluent samples were collected. Industrial influent, industrial effluent, and a combined effluent composite sample were also taken. These compositors were set to collect 250 mls of sample every 15-20 minutes for approximately 14 hours. Sampling times are noted in Table 2. Prosser collected hand composite samples on October 6 with equal volumes of sample collected every 2 hours for 6 hours. The domestic and industrial effluent samples were split for WDOE and Prosser laboratory analysis. Results of composite sample analysis by WDOE are presented in Table 1.

Grab samples were collected for field and coliform analysis (Tables 3 and 4). Also, a grab sample of the domestic sludge was taken for sludge metals analysis. Flow measurements using a WDOE Marsh-McBernie magnetic flow meter in the effluent ditches and the Prosser in-line meters are noted in Table 5.

October 20-21 Sampling

Because of difficulties experienced during the first sampling period, industrial influent and effluent and combined effluent flows were subsequently re-sampled on October 20-21. WDOE compositors were set up to sample those three flows for 24 hours taking 250 mls of sample every 30 minutes. Problems occurred with the industrial effluent composite (a power failure resulted in the plant not operating for approximately five hours during the night) and the combined effluent composite (a compositor malfunction resulted in inadequate sample collection). WDOE hand composites of the industrial and combined effluents were taken by collecting equal volumes of the flows every 15 minutes for one hour to provide samples for analysis.

Also, grab samples were taken for field analysis, coliform analysis, and oils and grease analysis. Data collected during the October 20-21 sampling is included on the tables with the October 5-6 data.

Table 1. WDOE laboratory results - Prosser STP Class II inspection, October 1982.

							Solids (mg/L)							Nutrients (mg/L)						
Date	Sample	Composite Duration (hours)	Sampler	BOD_5 (mg/L)	Inh. BOD_5 (mg/L)	COD (mg/L)	T. Solids	T. Non-Vol. Solids	T. Susp. Solids	T. Non-Vol. Susp. Solids	pH (S.U.)	Turbitidy (NTU)	Spec. Cond. (umhos/cm)	NO_3-N	NO_2-N	NH_3-N	T-Kjd-N	Diss. O-P	Tot.-P	Chloride as Cl (mg/L)
10/4	Industrial Eff.	Grab	WDOE			3,500			1,800		5.4	470	937	1.2	<.05	2.7		5.8	13	
10/5-6	Dom. In.	24	WDOE	160		370	640	370	120	26	7.7	84	720	<.10	<.10	16		5.0	6.4	
10/5-6	Dom. Eff.	24	WDOE	20	16*	83	520	340	17	5	8.0	19	660	6.3	1.1	5.8		6.0	6.6	43
10/6	Dom. Eff.	6	Prosser	20					16		8.2									
10/5-6	Industrial Inf.	14	WDOE	2,900		4,600	4,000	1,400	1,800	550	5.0	980	1,350	<.10	.10	15		9.5	22	
10/5-6	Industrial Eff.	14	WDOE	340	160	1,200	1,600	840	540	120	8.0	240	1,370	<.10	<.10	53		5.3	16	46
10/6	Industrial Eff.	6	Prosser	310					340		8.1									
10/5-6	Combined Eff.	15	WDOE	570	520	1,100	1,400	720	380	80	7.1	200	1,200	.70	.25	26		5.7	16	47
10/20-21	Industrial Inf.	24	WDOE	3,000		4,800			3,200		5.1		1,580	<.25	<.25	18	160	11	32	
10/20-21	Industrial Eff.	19**	WDOE	670	500	1,500			820		7.7		1,330	<.25	<.25	8.8	82	6.5	25	
10/21	Industrial Eff.	1	WDOE	1,200		2,300			1,200		7.4		1,260	<.25	<.25	7.0	130	8.5	29	
10/21	Combined Eff.	1	WDOE	580		1,400			780		7.4		1,000	1.8	.25	9.0	90	7.0	21	

* = Estimated value.
** = Compositor operated for 24 hours, but due to power outage, plant operated for 19 hours.

Table 2. Composite sampling times - Prosser STP Class II inspection, October 1982.

Date	Sample	Sampler	Composite Type	Time	Duration (hours)	Sampling Frequency (minutes)
10/5-6	Domestic Inf.	WDOE	Automatic	0910-0915	24	30
10/5-6	Domestic Eff.	WDOE	Automatic	0930-0930	24	30
10/5-6	Industrial Inf. Industrial Eff. Combined Eff.	WDOE	Automatic	2100-1100	14	15-20
10/5-6	Domestic Eff. Industrial Eff.	Prosser	Hand	0800-1400	6	120
10/20-21	Industrial Inf.	WDOE	Automatic	1000-1000	24	30
10/20-21	Industrial Eff.	WDOE	Automatic	1000-1000	19†	30
10/20-21	Combined Eff.	WDOE	Automatic	1000-	*	--
10/21	Industrial Eff. Combined Eff.	WDOE	Hand	1100-1200	1	15

* = Sampler malfunctioned
† = Plant bypassed for 5 hours during sampling due to power outage

Table 3. Field measurements - Prosser STP Class II inspection, October 1982.

Station	Date	Time	pH	Conductivity	Temperature	Dissolved Oxygen*
Domestic Influent						
	10/5	0910	8.1	785	21.5	
	10/6	0915	8.0	740	22.0	0
	10/6 (Comp.)	0915	7.8	840	5.6	
	10/6	1305	7.5	745	22.5	0
Domestic Effluent						
	10/5	0930	7.8	690	17.8	
	10/6	0925	7.7	695	18.0	5.5
	10/6 (Comp.)	0930	7.8	725	5.2	
	10/6	1315	7.6	710	18.8	5.9
	10/21	1015	7.7	700	16.0	5.0
Industrial Influent						
	10/6	0900	6.4	>1,000	33.9	0
	10/6	1245	6.0	>1,000	34.3	0
	10/6 (Comp.)	1255	5.4	>1,000	8.5	
	10/21	1000	11.2†	>1,000	38.2	0
Industrial Effluent						
	10/6	0850	8.2	>1,000	21.7	0
	10/6	1335	8.4	>1,000	23.0	0
	10/6 (Comp.)	1315	8.2	>1,000	5.3	
	10/21	1000	8.4	>1,000	20.4	0
Combined Effluent						
	10/6	0910	6.8	≈1,010	22.4	0
	10/6	1000	6.8	>1,000	22.8	
	10/6	1400	6.8	>1,000	22.3	1.9
	10/6 (Comp.)	1345	7.2	>1,000	8.7	
	10/21	0930	7.3	1,000	19.7	0
Trickling Filter Recirculation Box						
	10/5	1510				**

*Winkler analysis
**Interference with test (>90 mls titrant used)
†Value questionable

Table 4. Fecal coliform - chlorine residual results - Prosser STP Class II inspection, October 1982.

		Domestic Effluent			Industrial Effluent		Combined Effluent			
		Fecal Coli.	Chlorine Residual (mg/L)		Fecal Coliform		Fecal Coliform		Chlorine Residual (mg/L)	
Date	Time	(Cts/100 ml)	Free	Total	(Cts/100 ml)	(% KES)	(Cts/100 ml)	(% KES)	Free	Total
10/5	1430	6 Est.	.45	3.6						
	1430				1.4×10^6 Est.					
10/6	0945	31	.55	2.6*						
	1000						2.0×10^6		N.D.	N.D.
	1315	31	.2	3.7						
	1335				2.4×10^6					
	1400						1.9×10^6 Est.			
10/20	0930	88 Est.								
	0930				<33,000					
	0930						930,000	36		
10/21	1015	180								
	1000				3.2×10^6	6				
	0930						2.8×10^6	7	N.D.	N.D.
	1130	100								
	1130				3.6×10^6	3				
	1130						1.2×10^6	8		

*Prosser value = 1 mg/L
Est. = Estimate
N.D. = None detected

Table 5. Flow measurements - Prosser STP Class II inspection, October 1982.

	Marsh-McBernie Meter				Plant Meter				
			Flow				Instantaneous Flow		
	Date	Time	(gpm)	(MGD)	Date	Time	(gpm)	(MGD)	Totalizer
WDOE MEASUREMENTS									
Domestic									
	10/4	1510	562	.81	10/4	1510	350	.50	
					10/5	0942	400	.58	31577
	10/6	1025	444	.64	10/5	1147	375	.54	31621 } 290 gpm (.42 MGD)
					10/6	1015	390	.56	32001
Industrial									
	10/4	1520	479	.69					
	10/4	1530	368	.53					
	10/6	≈1015*	619	.90					
Combined									
	10/4	1450	1097	1.58					
	10/4	1500	965	1.39					
	10/4		(range for Domestic + Industrial) 930 - 1041 gpm						
	10/6	1000	1060	1.53					
PROSSER MEASUREMENTS									
Domestic									.4 MGD
Industrial									.7 MGD†

* = Value calculated by subtraction of 10/6 domestic flow from 10/6 combined flow
† = Value used by Prosser for loading calculations. Plant industrial meters did not seem to be functioning properly (thought to be associated with the plant upset).

RESULTS AND DISCUSSION

Domestic Plant

Data collected from the domestic plant (Table 1) were characteristic of good effluent from a trickling filter plant. Table 6 compares domestic effluent quality to NPDES limits. As noted, BOD and TSS loadings and concentrations were both well within present permit limits and were under the respective allowances used in calculating the domestic BOD and TSS contributions to the future combined effluent limits. Fecal coliform and pH measurements were also in compliance with the permit limits. Flow measurements using the Prosser in-line meter (.42 MGD) were slightly greater than the docket monthly average limit (.40 MGD).

Table 6. Comparison of domestic effluent to permit limits - Prosser STP Class II inspection, October 1982.

Parameter	Present Limits*		Future Allotment**		Class II Inspection
	Monthly	Weekly	Monthly	Weekly	(WDOE Data)
BOD (mg/L)	65	90	30	45	20
(lbs/day)	217	300	113	169†*	70
TSS (mg/L)	90	144	30	45	17
(lbs/day)	300	480	113	169†*	59
F. Coliform	200/100 ml	400/100 ml			6† - 180/100 ml
pH	6.5 ≤ pH ≤ 8.5				7.6 - 7.8*†
Flow	.4 MGD		.45 MGD		.42 MGD††
NH_3-N			always ≤ 16 mg/L***		6.8 mg/L

* = Limits in Docket No. DE 81-485
** = Domestic allotment used on fact sheet to figures, combined effluent limits
*** = Allotment applies to combined effluent flow
† = Estimated value
†† = Flow using Prosser meter
†* = Note: permit says 45 lbs/day, (169 mg/L)
*† = Field measurements

Flow measurements using a WDOE Marsh-McBernie magnetic flow meter were noticeably higher than the Prosser meter readings (as noted in Table 7).

Table 7. Comparison of domestic plant flow measurements - Prosser STP Class II inspection, October 1982.

Marsh-McBernie			Plant Meter		
Date	Time*	Flow (MGD)	Date	Time	Flow (MGD)
10/4	1510	.81	10/4	1510	.50
10/6	1025	.64	10/6	1015	.56

*Time when measurement began.

Because of the poor characteristics of the effluent channel for flow measurements (channel was muddy with grass growing along edges), conclusions regarding flow meter accuracy cannot be made. Tom Coleman of Davis and Sheible Engineering, a consultant for Prosser, indicated that measurements they took showed flows of .4 to .5 MGD at the domestic plant; a figure more closely approximating the Prosser flow meter measurements.

In addition to BOD and TSS removal, it appears that some nitrification may be taking place at the plant:

Table 8. Nitrogen concentrations in domestic flows* - Prosser STP Class II inspection, October 1982.

	NO_3-N	NO_2-N	NH_3-N
Influent	<.10	<.10	16
Effluent	6.3	1.1	6.8

*October 5-6 WDOE composite data - units = mg/L.

This may be partially attributable to the high recirculation at the plant. Tom Coleman reported a recycle flow of 2200 to 2400 gpm. Based on an influent flow of 375 gpm, a recycle ratio of approximately 6:1 can be calculated. This is somewhat higher than the 1:1 to 4:1 range in which plants are usually operated (Medcalf and Eddy, 1972).

Results of the sludge metals analysis of Prosser domestic sludge are noted on Table 9. Concentrations generally fall within the ranges found at other Washington state STPs, with the exception of zinc. The

Prosser sludge zinc concentration (2500 mg/Kg dry weight) was slightly greater than the highest concentration (2220 mg/Kg dry weight) reported in previous source surveys of Washington State trickling filter and RBC treatment plants.

Table 9. Prosser domestic sludge metals data - Prosser STP Class II inspection, October 1982.

Metal	Prosser Results* (mg/Kg dry weight)	Previous Survey Results† Geometric Mean (mg/Kg dry weight)	Range (mg/Kg dry weight)	No. of Samples
Cd	10	5.1	.01 - 16	12
Cr	120	37	.4 - 313	12
Cu	490	491	28 - 3100	12
Pb	180	337	100 - 1140	12
Ni	25	32	17 - <100	10
Zn	2500	1580	680 - 2220	12

* = Digested secondary sludge - 6.48 percent solids
† = Results from previous Class II inspections at municipal RBC and trickling filter plants

Industrial Plant and Combined Flow

The October 5-6 sampling at the industrial plant began within four hours after the clarifier was refilled after being cleaned. During the cleaning process, trickling filter recycle was continually recirculated over the filter. The trickling filter is continually fed at the pumping maximum value of 9000 gpm (≈ 13 MGD). The operators suggested that filter performance was better after such a resting period and they attributed this to higher dissolved oxygen (D.O.) concentrations associated with the filter after rest. WDOE took several D.O. samples for Winkler analysis, including one from the trickling filter recycle box during the recirculation period (Table 3).

The D.O. concentrations measured in the industrial influent and effluent were zero for all measurements. The D.O. concentration in the trickling filter recirculation box was not determined as the sample behaved unusually when titrated with sodium thiosulfate. A final titration endpoint had not been reached even after over 90 mls of titrant had been added. It appears that an oxidant or interference was present in the recycle water.

Several other measurements associated with the October 5-6 industrial samples are also unusual. The pH data collected in the field showed that running the industrial flow through the treatment plant increased the pH of the wastewater (influent pH ranged from 5.4 to 6.5; effluent pH ranged from 8.0 to 8.4). When the industrial effluent (pH range 8.0 to 8.4) and the domestic effluent (pH range 7.6 to 8.0) were combined, the pH of the combined effluent ranged from 6.8 to 7.2. It is unclear as to why the pH of the combined effluent was lower than the pH of the domestic or the industrial effluent. Sediment deposits in the effluent ditch were not examined during the Class II to see if they had any influence on combined effluent pH.

BOD_5 test results for the combined effluent sample (570 mg/L) were outside the range of concentrations bounded by the domestic (20 mg/L) and industrial (340 mg/L) effluent. This same situation occurred for the inhibited BOD_5 test results. COD results were higher as would be expected with the combined result (1100 mg/L) bounded by the domestic (83 mg/L) and industrial (1200 mg/L) results.

It is suspected that a problem was associated with a BOD test for the industrial effluent.

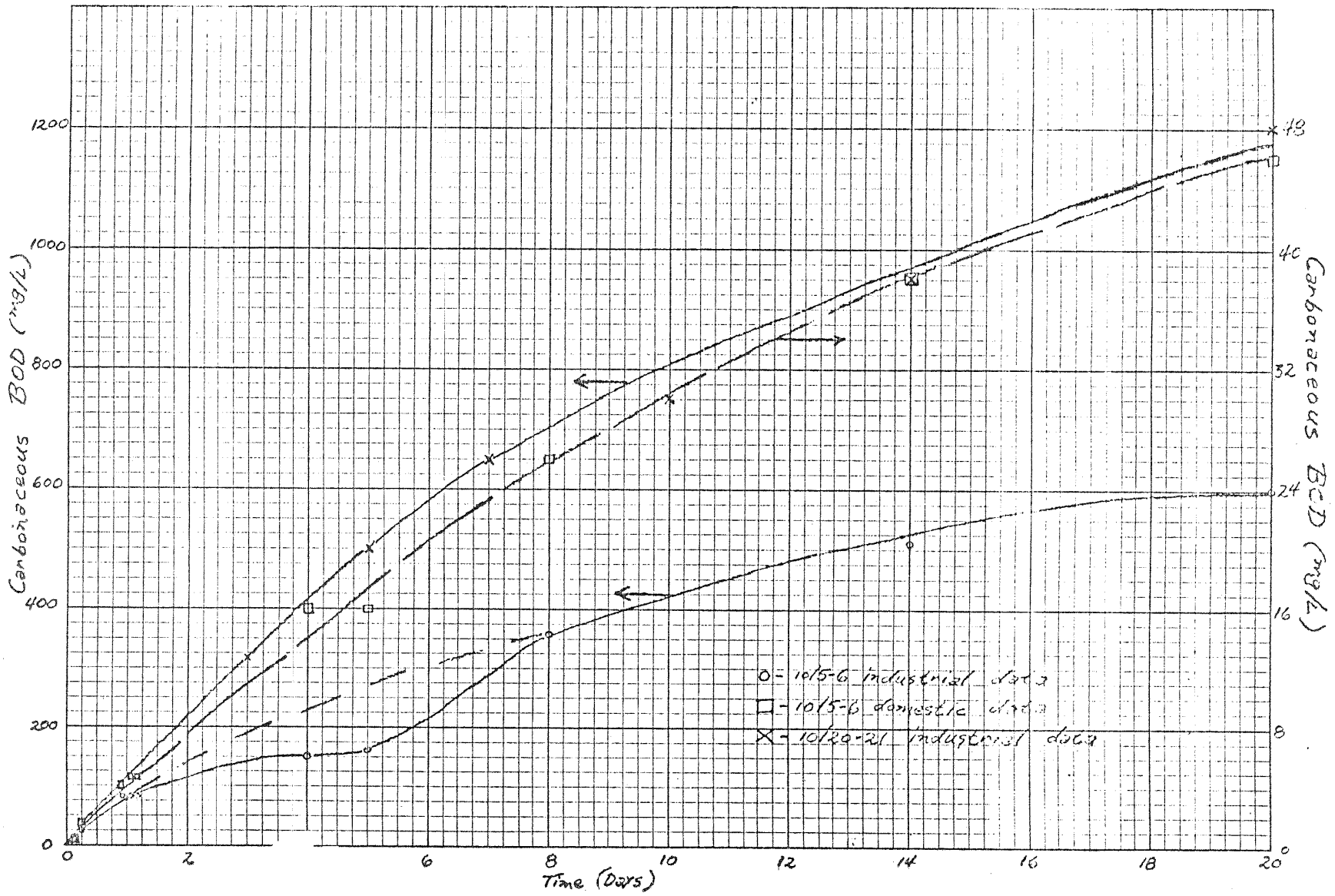
The long-term inhibited BOD test also suggests possible problems (Table 10, Figure 3). The data collected during the longterm study resulted in a growth curve describing a situation of limited activity during days 1 through 5 of the study with fairly high activity during days 0-1 and days 5-8. Since an artificially high D.O. in the BOD test would result in a lower BOD calculated, a possible relationship between the unusual trickling filter recirculation D.O. result and the industrial BOD results is suggested. This is, however, unconfirmed.

Table 10. Long-term inhibited BOD data - Prosser STP Class II inspection, October 1982.

	10/5-6 Samples		10/20-21 Sample
	Domestic Effluent	Industrial Effluent	Industrial Effluent
Time (days)	BOD (mg/L)	BOD (mg/L)	BOD (mg/L)
.08	.4†	8†	
.25	1.4†	25	
.92	4.0	80†	
1.08	4.8	80†	
1.25	4.8	80†	
3			320
4	16†	150	
5	16†	160	500
7			650
8	26	360	
10			750
14	38	510	950
20	46	600	1,200

† = Estimated value

Figure 3. Long-term carbonaceous BOD graphs.- Prosser STP Class II inspection, October 1982.



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Ammonia concentrations in the industrial influent (15 mg/L) and effluent (53 mg/L) did not show an expected relationship. It was suspected that during cleanup some ammonia may have been used resulting in a slug load to the clarifier prior to starting the compositors. A source of the ammonia could not be found by checking with individuals at the STP and Twin City Foods. Another possibility was that organic nitrogen had broken down into ammonia during the extended recycle period.

Fecal coliform data for the industrial effluent were also quite high. Counts approximated 2 x 10^6 organisms/100 mL in both the industrial and combined effluent.

Because of the amount of unusual data collected during the October 5-6 sampling, it was decided to do additional sampling of the industrial influent and effluent and the combined effluent. Objectives of the follow-up sampling conducted on October 20-21 included:

1. Collect more data to help interpret BOD and ammonia results found during the October 5-6 sampling;

2. Take additional coliform samples to determine if high coliform counts are continuing to occur. Also, it was desired to identify the organisms responsible for the high counts; and

3. Collect oil and grease samples to obtain more information regarding the greasy skum blanket observed in the industrial clarifier.

The October 20-21 sampling represented different operating conditions than the October 4 sampling. The major difference was the absence of a resting period for the filter prior to sampling.

A comparison of the industrial influent measurements for most constituents look similar with major differences in the TSS and total phosphorus concentrations (Table 1). In both cases the October 20-21 concentrations were higher.

Because of the incomplete sample sets collected during the October 20-21 sampling, direct comparisons are difficult. The value of the October 20-21 industrial effluent composite is questionable because of the power outage that occurred during this period. The samples taken during the power outage would most likely not be representative of "typical" treated effluent as the samples collected during the outage were probably of pooled effluent at the sampling site. The hour grab-composite samples are not considered to be representative of average discharge concentrations, but are useful in noting a relationship between industrial and combined effluent.

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The October 21 grab-composites express the relationship between the industrial and combined effluents that was expected. Table 11 was set up to attempt to analyze the domestic and industrial contributions to the combined effluent flow. It was assumed that for the parameters used to calculate the relative contributions, the domestic effluent characteristics should remain fairly constant. For this reason, the domestic data collected October 5-6 were used in calculations with both the October 5-6 and October 21 industrial and combined data.

Table 11. Industrial:domestic calculated flow ratios - Prosser STP Class II inspection, October 1982.

Date Industrial and Combined Data Collected	Ratio Calculated Based On:*					Ratio Based on Prosser Flows	Ratio Based on WDOE Flows
	BOD	COD	TSS	Cond.	Tot.-P		
10/5-6	†	10.2:1	2.3:1	3.2:1	†	1.8	1.4**
10/21	.9:1	1.5:1	1.8:1	1.3:1	1.8:1		

*Ratios calculated assume parameter is conserved when industrial and domestic flows are mixed. The 10/5-6 domestic concentrations are used for both calculations. Calculation used:

$$C(x + 1) = D(1) + I(x)$$

C = Concentration (mg/L) of parameter in combined effluent.
D = Concentration (mg/L) of parameter in domestic effluent.
I = Concentration (mg/L) of parameter in industrial effluent.
x = Industrial flow.

†Combined effluent concentration ≥ industrial and domestic effluent concentrations.
**October 6 flow measurements used.

The flow ratios calculated using different parameters for the October 21 data are much more uniform than the October 5-6 ratios. The October 5-6 ratios, for ratios calculated for parameters other than flow, indicate a higher contribution to the combined flow from the industrial flow than the ratio calculated with flow indicates. This indication along with the variability of the ratios suggests that contributions in addition to the domestic and industrial effluent may have been influencing the combined effluent. Because portions of the clarifier contents had been emptied in the field adjoining the ditch during clarifier cleanup, drainage from the field into the effluent ditch is considered likely. The degree of ratio variance seems too great for this to be the only explanation. Although some discrepancies might result from drainage into the ditch, the degree of variation suggests the possibility of test interference(s) as a source of error.

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The nitrogen data collected during the October 20-21 sampling are compared to the October 5-6 data in Table 12:

Table 12. Comparison of industrial and combined nitrogen data* - Prosser STP Class II inspection, October 1982.

Sample	Date	NO_3-N	NO_2-N	NH_3-N	T-Kjd-N
Industrial Inf.	10/5-6	<.10	.10	15	
Industrial Eff.	10/5-6	<.10	<.10	53	
Combined Eff.	10/5-6	.70	.25	26	
Industrial Inf.	10/20-21	<.25	<.25	18	160
Industrial Eff.	10/20-21	<.25	<.25	8.8	82
Industrial Eff.	10/21	<.25	<.25	7.0	130
Combined Eff.	10/21	1.8	.25	9.0	90

*Concentrations in mg/L.

The industrial influent data were similar for both sampling dates whereas the effluent data varied considerably. October 20-21 samples were also analyzed for Kjeldahl-N (Kjd-N) to estimate the nitrogen available in the sample for breakdown to ammonia. It appears that in the October 20-21 sample there was sufficient Kjd-N available for breakdown to NH_3-N to result in the NH_3-N concentrations found in the October 5-6 samples. Therefore, it appears theoretically possible that the ammonia levels found in the October 5-6 samples could have resulted from breakdown of organic nitrogen in the trickling filter recycle during the plant resting period.

Fecal coliform counts during the October 20-21 sampling were in the same range as those found during the October 5-6 sampling. Results of the speciation using the API 20E system are shown in Table 13. Results indicate that only a small percentage of the organisms found fell into the KES (Klebsiella, Enterobacter, and Serratia) group. Thus most organisms remained unidentified. Because both the organic content and temperature of potato wastewater are relatively high (industrial influent temperatures ranged from 33.9 to 38.2°C), it has a good potential for support of fecal coliform organisms. Twin City Foods indicated that some of their process water (referred to as "gutter water") is fairly warm and is recycled within the plant. Recycling could offer the organisms an opportunity to build up high concentrations as were seen in WDOE samples.

Table 13. Speciation of fecal coliform organisms - Prosser STP Class II inspection, October 1982.

Sample	Date	Time	F. Coliform cts/100 ml	Number of Colonies Selected For % KES Study**	Number of KES Colonies	% KES	*Enterobacter aerogenes* Number of Colonies	*Enterobacter Sakazakii* Number of Colonies	*Enterobacter cloacae* Number of Colonies	*Klebsiella pneumoniae* Number of Colonies	*Klebsiella oxytoca* Number of Colonies
Industrial Effluent	10/20	0930	<33,000	*							
Combined Effluent	10/20	0930	930,000	28	10	36		7	2		1
Industrial Effluent	10/21	1000	3.2×10^6	32	2	6	1	1			
Combined Effluent	10/21	0930	2.8×10^6	28	2	7	1	1			
Industrial Effluent	10/21	1130	3.6×10^6	36	1	3		1			
Combined Effluent	10/21	1130	1.2×10^6	37	3	8		1		2	

* = Low count did not allow further study
** = This is the number of colonies on the fecal coliform plate from which the fecal coliform count came

Memo to Al Newman
Prosser Class II Inspection - October 5-6, 1982

Receiving water study fecal coliform counts in the Yakima River ranged from 20-61/100 ml upstream of the Prosser STP to 21,000-39,000/100 ml downstream from the plant at the Highway 82 bridge. Class B median value fecal coliform criterion of 200/100 ml was exceeded for approximately 10 miles downstream of the plant (Johnson, 1983). The high coliform counts suggest the probability that water quality standards for fecal coliforms are being violated in the Yakima River below Prosser. Additionally, receiving water counts were sufficient to mask any other high fecal coliform inputs that were not of extreme magnitude, thus restricting the ability of the fecal coliform test to detect potential sanitation problems. The source of the high fecal coliform counts should be isolated and provisions made for solution of the problem.

Allowable ammonia limits to the Yakima River from the Prosser STP (River Mile [R.M.] 46.6) were calcualted using the system suggested by Yake and James (1983). Limits were calculated so that an in-stream un-ionized ammonia concentration of .0165 mg/L (as N) would be exceeded only during conditions more severe than when the 1-in-10-year low flow occurred simultaneously with conditions in which percent un-ionized NH_3 concentrations are exceeded only 10 percent of the time. United States Geological Survey (USGS) flow data from the Mabton flow gage (R.M. 59.3) were used along with water quality data from Mabton, Parker (R.M. 104.6), and Kiona (R.M. 29.8) for limit calculations. It was assumed that 15 percent of the flow was allowable for effluent dilution. Results of the calculations are shown in Table 14.

Although the Mabton station is closest to Prosser, because samples were last collected there in 1975, it was thought desirable to also consider more recent data from the Parker and Kiona station. Based on the results shown in Table 14, the NPDES permit limit of 16 mg/L NH_3-N from May 1 through October 1 looks reasonable, although the Parker and Kiona results indicate that October might also need a limit.

Long-term inhibited BOD tests were run on the domestic and industrial effluents (Table 10, Figure 3) in order to find constants so that the BOD exerted at various times after discharge could be estimated. Values for L and K were calculated for substitution into the equation:

$$Y = L\ (1-10^{-kt})$$

where:

Y = BOD exerted (mg/L)
L = Ultimate BOD (mg/L)
k = Rate constant ($days^{-1}$)
t = Time (days)

Table 14. NH_3 permit concentrations based on dilution in 15% of the river flow. Prosser STP Class II Inspection, October 1982.

Permit concentrations based on Mabton NH_3 data.

MONTH	RIVER FLOW (CFS) RECURRANCE INTERVAL 10 YEARS	BACKGROUND T-NH3-N mg/l	% UNIONIZED AMMONIA AT 10% PROB.	SOURCE FLOW (MGD)	EFFLUENT CONC. mg/l	AMMONIA-N LOADING lbs/day
JAN	1580.5	0.220	0.971	0.9	253.3	1901
FEB	1593.0	0.090	1.451	0.9	180.7	1356
MAR	1323.5	0.110	1.409	0.9	152.3	1143
APR	920.3	0.070	1.482	0.9	104.4	784
MAY	1234.6	0.080	2.001	0.9	99.8	749
JUN	1099.2	0.050	3.239	0.9	54.8	411
JUL	793.5	0.120	5.139	0.4	34.6	130
AUG	890.2	0.100	6.340	0.9	15.6	117
SEP	1077.7	0.060	5.188	0.9	30.2	227
OCT	1137.4	0.090	2.871	1.1	47.0	451
NOV	1569.4	0.160	1.449	0.9	166.5	1250
DEC	1684.9	0.170	1.321	0.9	196.9	1478

Permit concentrations based on Parker NH_3 data.

MONTH	RIVER FLOW (CFS) RECURRANCE INTERVAL 10 YEARS	BACKGROUND T-NH3-N mg/l	% UNIONIZED AMMONIA AT 10% PROB.	SOURCE FLOW (MGD)	EFFLUENT CONC. mg/l	AMMONIA-N LOADING lbs/day
JAN	1580.5	0.110	1.263	0.9	204.9	1538
FEB	1593.0	0.120	1.792	0.9	133.2	1038
MAR	1323.5	0.080	2.452	0.9	85.1	639
APR	920.3	0.050	3.244	0.9	45.9	344
MAY	1234.6	0.030	4.163	0.9	42.4	318
JUN	1099.2	0.100	5.175	0.9	26.2	196
JUL	793.5	0.040	6.165	0.4	39.1	146
AUG	890.2	0.040	6.842	0.9	19.5	146
SEP	1077.7	0.060	6.731	0.9	21.7	163
OCT	1137.4	0.090	5.428	1.1	20.8	199
NOV	1569.4	0.110	3.205	0.9	68.9	517
DEC	1684.9	0.100	1.190	0.9	234.7	1762

Permit concentrations based on Kiona NH_3 data.

MONTH	RIVER FLOW (CFS) RECURRANCE INTERVAL 10 YEARS	BACKGROUND T-NH3-N mg/l	% UNIONIZED AMMONIA AT 10% PROB.	SOURCE FLOW (MGD)	EFFLUENT CONC. mg/l	AMMONIA-N LOADING lbs/day
JAN	1580.5	0.060	1.019	0.9	266.8	2003
FEB	1593.0	0.080	2.636	0.9	94.2	707
MAR	1323.5	0.030	3.625	0.9	61.0	458
APR	920.3	0.020	4.700	0.9	33.1	248
MAY	1234.6	0.070	7.092	0.9	21.8	164
JUN	1099.2	0.020	11.917	0.9	14.1	106
JUL	793.5	0.010	18.439	0.4	13.6	51
AUG	890.2	0.020	20.930	0.9	5.7	42
SEP	1077.7	0.020	14.915	0.9	10.6	79
OCT	1137.4	0.030	6.837	1.1	20.4	195
NOV	1569.4	0.030	2.757	0.9	96.6	725
DEC	1684.9	0.020	1.991	0.9	147.5	1107

Values were calculated using the Thomas and Least Squares methods (Metcalf and Eddy). Results are noted in Table 15. Because of the unusual October 5-6 industrial data, two estimates of the October 5-6 industrial K and L values are provided. Results of the comparison presented in Table 16 suggest that use of the K and L values calculated using the Thomas method for the domestic and October 20-21 industrial flows are probably of most value for any future calculations.

Table 15. K & L values calculated using long-term inhibited BOD data - Prosser STP Class II inspection, October 1982.

	Date	Least Squares K	Least Squares L	Thomas Method K	Thomas Method L
Domestic	10/5-6	.124	42	.035	58
Industrial	10/5-6	.106	208	.247*	187
				.040*	721
Industrial	10/20-21	.024	1853	.033	1543

*The Thomas method involves fitting a line through a series of points derived from the data. This data group was unusual and required two lines of quite different slopes to fit the data. Two estimates of K and L were then made: one based on each of the lines. The K = .247, L = 187 values would apply from 0 day to appromately 5 days and the K = .040, L = 721 values would apply after approximately 5 days (see Figure 3).

Table 16. Accuracy of BOD predictions generated using Thomas Method and Least Squares Method K & L values - Prosser STP Class II inspection, October 1982.

T (Time in Days)	BOD_T (mg/L) Measured	Thomas Method Calculated BOD_T (mg/L)	Thomas Method BOD_T Measured-BOD_T Calculated	Least Squares Method Calculated BOD_T (mg/L)	Least Squares Method BOD_T Measured-BOD_T Calculated
10/5-6 Domestic Sample					
.08	.4	.4	0	.9	.5
.25	1.4	1.2	.2	2.9	1.5
.92	4.0	4.1	.1	9.7	5.7
1.08	4.8	4.8	0	11.1	6.3
1.25	4.8	5.6	.8	12.6	7.8
4	16	16.0	0	28.6	12.6
5	16	19.2	3.2	31.9	15.9
8	26	27.6	1.6	37.7	11.7
14	38	39.2	1.2	41.2	3.2
20	46	46.4	.4	41.9	4.1
			7.5		69.3
10/20-21 Industrial Sample					
3	320	315	5	283	37
5	500	488	12	447	53
7	650	637	13	594	56
10	750	821	71	787	37
14	950	1010	60	998	48
20	1200	1205	5	1239	39
			166		270

Results of the oil and grease samples are shown in Table 17. Although oil and grease is not limited in the Prosser discharge, limits of 15 mg/L weekly average and 10 mg/L monthly average are generally used when limits are set. Industrial influent and effluent concentrations at Prosser suggest a possible need for pretreatment and/or permit limits for oil and grease.

Table 17. Oil and grease results - Prosser STP Class II inspection, October 1982.

Sample	Date	Recoverable Oil & Grease (mg/L)
Industrial Influent	10/21	210
		56
Industrial Effluent	10/21	70
		9

Table 18 compares Class II industrial data to NPDES permit limits. Prosser flow data were used in calculating loading because, as with the domestic flow data, correlation was poor between WDOE Marsh-McBernie meter and Prosser plant flow meter measurements (Table 5). The October 5-6 and 20-21 data are less than present docket limits. The October 21 data exceed monthly and weekly BOD concentrations and loading limits and the monthly TSS concentration limit. The future allotment values were frequently exceeded. It will be necessary for the plant upgrade to provide improved treatment and flow reduction in order for permit limits to be met.

Table 18. Comparison of industrial effluent to permit limits - Prosser STP Class II inspection, October 1982.

Parameter	Present Limits*		Future Allotment**		Class II Inspection (WDOE Data)		
	Monthly	Weekly	Monthly	Weekly	10/5-6†	10/20-21††	10/21†††
BOD_5 (mg/L)	480†*	720†*	485†*	728†*	340	670	1,200
(lbs/day)	4,003	6,004	1,820	2,731	1,985	3,911	7,006
TSS (mg/L)	854†*	1,280†*	485†*	728†*	540	820	1,200
(lbs/day)	7,119	10,679	1,820	2,731	3,513	4,787	7,006
pH	6.5 ≤ pH ≤ 8.5		6.0 ≤ pH ≤ 9.0		8.2 - 8.4†**	8.4†*	8.4†*
Flow	1.0 MGD		.45 MGD		.7*†		
NH_3-N			always < 16 mg/L***		53	8.8	7.0

* = Limits in Docket No. DE 81-485
** = Industrial allotment for potato waste used on fact sheet to figure combined effluent limits (no allowance made for fruit processor as STP plant operators determined that they were not discharging on basis of the color of flow during the Class II)
† = 14-hour composite
†† = 19-hour composite; flow of .7 MGD used for loading calculations
††† = 1-hour composite; flow of .7 MGD used for loading calculations
†* = Calculated value based on flow of 1 MGD
†** = Field measurements
*† = Prosser flow estimate
*** = Allotment applies to combined effluent flow

Memo to Al Newman
Prosser Class II Inspection - October 5-6, 1982

LABORATORY PROCEDURES

Laboratory procedures were discussed with the two operators at Prosser. Numerous shortcomings are noted on the attached Laboratory Procedural Survey sheet. These shortcomings generally result from two basic problems.

1. Operator training for laboratory procedures was generally inadequate. The training received consisted primarily of an explanation of how tests were done by the previous operator. References were not used and no formal laboratory training was provided. The WDOE roving operator has been scheduled to provide some training. It is hoped that this will help bring Prosser STP laboratory procedures in compliance with more generally accepted methods. After training, comparison of Laboratory Procedural Survey comments to Prosser laboratory procedures might be used as a measure of progress.

2. Laboratory equipment was inadequate. Two examples of this include the plant pH meter which could not be standardized to pH 10 using WDOE pH 10 buffer (Prosser only had pH 7 buffer) and a shortage of thermometers resulting in an unmonitored solids drying oven because a thermometer was not available.

Results of the WDOE and Prosser analysis of the Prosser effluent composite samples is presented in Table 19.

Table 19. Comparison of WDOE and Prosser analysis of Prosser samples - Prosser STP Class II inspection, October 1982.

	WDOE Analysis	Prosser Analysis
Domestic Effluent		
BOD_5 (mg/L)	20	47
TSS (mg/L)	16	50
Industrial Effluent		
BOD_5 (mg/L)	310	550
TSS (mg/L)	340	420
Total Chlorine Residual (mg/L)*	2.6	1.0

* = Split grab sample

Results of the WDOE and Prosser analysis do not correlate well. Possible explanations include:

1. BOD analysis - Prosser D.O. depletions in the blank generally ranged from 1 to 2 mg/L. Drops of this magnitude make BOD analyses questionable. It is suspected that unclean glassware may contribute to this problem.

2. TSS analysis - unmonitored drying oven temperatures may have resulted in insufficiently dried samples.

3. Cl_2 residual - Prosser used the Orthotolidine method which is not accepted by Standard Methods (APHA, 1980).

Fecal coliform testing techniques were briefly reviewed during the laboratory discussion. One important point noted was that chlorinated effluent samples collected for coliform analysis should be dechlorinated immediately upon sampling to help assure accurate counts.

Laboratory procedures and facilities should be upgraded. After this occurs, it would be desirable to split Prosser samples for duplicate analysis by WDOE and Prosser to re-evaluate laboratory accuracy.

CONCLUSIONS AND RECOMMENDATIONS

Data collected during the Class II generated several questions and concerns. The most important items include:

1. Plant flexibility was fairly minimal at Prosser. One of the few controllable variables was trickling filter recirculation. Both the domestic and industrial filters were operated at maximum recycle. Some experimentation with the recycle rate may result in acceptable treatment with reduced power consumption.

2. Laboratory results and operator comments regarding BOD testing of industrial (potato) wastes suggest a need for additional sampling. Two major questions were raised regarding BOD testing of these waters: (1) is there substantial variability in waste strength throughout the week? (operators reported that they suspect better effluent quality early in the week after the filter has received minimal loading over the weekend); and (2) are there toxics or interferences affecting BOD test results? (industrial BOD tests are seeded even though the flow is not chlorinated). The WDOE laboratory results for the October 5-6 industrial effluent sample are also unusual.

   BOD testing of the industrial effluent two times per week may be warranted. A sample early in the week and later in the week could be tested each week for a time period sufficient to establish if more than one sample per week is needed. Testing of the combined effluent and domestic effluent might also be done as a check to

help estimate industrial test accuracy using ratios as was done in Table 11. COD testing in addition to the BOD test might be useful in determining BOD test accuracy.

3. Ammonia concentrations found in the October 5-6 industrial and combined effluent samples were greater than the NPDES permit limit applicable after the plant upgrade. Testing for ammonia after a plant resting period in the industrial clarifier and the trickling filter recycle may be useful in helping to predict compliance with future permit limits. Testing during warm weather may show greater ammonia concentrations than in cold weather if organic nitrogen is breaking down to ammonia in the plant. Also, testing for dissolved oxygen at the same time using the Winkler method may be helpful in determining if BOD test interferences may be present.

4. As discussed in the text, provision should be made for elimination or treatment of the high fecal coliform counts found in the industrial flow.

5. A permit limit and/or pretreatment for oil and grease in the industrial flow should be considered.

6. Adequate laboratory equipment, training, and references should be provided at the Prosser STP. Specific problems are noted on the laboratory procedural survey and in the laboratory discussion.

7. Data from the Class II were compared to allotments used in calculating the NPDES permit limits to be applied after the upgrade. The domestic plant data fell within the permit allotment although the flow approached the monthly average flow allotment. The industrial plant data generally exceeded the permit allotments for both loading and flow.

MH:cp

Attachments

REFERENCES

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

Johnson, A., 1983. Prosser STP Receiving Water Survey, WDOE intra-agency memorandum (draft)

Metcalf and Eddy, Inc., 1972. *Wastewater Engineering*, McGraw-Hill Book Co., 1972. pp. 782

Yake, W.E. and R.K. James, 1983. Setting effluent ammonia limits to meet in-stream toxicity criteria, *Journal, WPCF*, March 1983. pp 303-309.

LABORATORY PROCEDURAL SURVEY

Discharger: Prosser

NPDES Permit Number: WA-002080-0 (Docket DE 81-485)

Date: 10/5/82

Industrial/Municipal Representatives Present: Gil Valdez, Perry Harris

Agency Representatives Present: Marc Heffner, Dale Clark

I. COMPOSITE SAMPLES

A. Collection and Handling

1. Are samples collected via automatic or manual compositing method? Hand, Model? _____

   a. If automatic, are samples portable _____ or permanently installed _____?

   Comments/problems _____

2. What is the frequency of collecting composite samples? _____

   Weekly

3. Are composites collected at a location where homogeneous conditions exist?

   a. Influent? Influent line

   b. Final Effluent? Open box on effluent line

   c. Other (specify)? _____

4. What is the time span for compositing period? 8 Hours

   Sample aliquot? 200 mls per 2 Hours ~~minutes~~

5. Is composite sample flow or time proportional? Time

6. Is final effluent composite collected from a chlorinated or non-chlorinated source? UN-CHLORINATED

7. Are composites refrigerated during collection? YES

8. How long are samples held prior to analyses? HELD TO FOLLOWING DAY

9. Under what condition are samples held prior to analyses?

   a. Refrigeration? YES

   b. Frozen? _____

   c. Other (specify)? _____

10. What is the approximate sample temperature at the time of analysis? REFRIGERATOR TEMPERATURE

11. Are compositor bottles and sampling lines cleaned periodically? YES

   a. Frequency? _____

   b. Method? _____

12. Does compositor have a flushing cycle? N/A

   a. Before drawing sample? _____

   b. After drawing sample? _____

13. Is composite sample thoroughly mixed immediately prior to withdrawing sample? _____

Recommendations:

① TAKE SAMPLES TO BE COMPOSITED HOURLY

② ALLOW SAMPLES TO WARM TO ROOM TEMPERATURE BEFORE SETTING UP BOD's

II. BIOCHEMICAL OXYGEN DEMAND CHECKLIST

A. Technique

1. What analysis technique is utilized in determining BOD_5?

a. Standard Methods? _____ Edition? _____

b. EPA? _____

c. A.S.T.M.? _____

d. Other (specify)? METHOD DEVELOPED FOR PLANT USE YEARS AGO

B. Seed Material

1. Is seed material used in determining BOD? FOR INDUSTRIAL SAMPLES

2. Where is seed material obtained? FROM DOMESTIC EFFLUENT THE DAY OF THE TEST

3. How long is a batch of seed kept? LESS THAN ONE DAY and under what conditions? (temperature, dark) _____

4. How is seed material prepared for use in the BOD test? _____ AERATED FOR 15 MINUTES

Recommendations:

③ USE A STANDARD REFERENCE FOR BOD TESTING.

④ SEED WITH CLEAR PORTION OF EFFLUENT THAT HAS BEEN SETTLED FOR 24 HOURS AT 20° ± 1° C

C. Reagent Water

1. Reagent water utilized in preparing diultion water is:

   a. Distilled? Yes

   b. Deionized? _____

   c. Tap _____, chlorinated _____ non-chlorinated _____

   d. Other (specify)? _____

2. Is reagent water aged prior to use? _____

   How long? _____, under what conditions? _ _

   WATER IS KEPT IN THE DARK IN SEALED CONTAINERS

Recommendations:

⑤ SEAL AGING REAGENT WITH COTTON PLUGS

D. Dilution Water

1. Are the four (4) nutrient buffers added to the reagent water? Yes

   a. 1 mls of each nutrient buffer per 1000 mls of reagent water

2. When is phosphate buffer added (in relation to setting up BOD test)? _____

3. How often is dilution water prepared? WEEKLY
   Maximum age of dilution water at the time test is set up.

4. Under what conditions is dilution water kept? SEALED

5. What is temperature of dilution water at time of setup? Room Temp.

Recommendations:

⑥ ADD BUFFERS TO REAGENT WATER APPROXIMATELY 10 MINUTES BEFORE USING

E. Test Procedure

1. How often are BOD's being set up? WEEKLY

   What is maximum holding time of sample subsequent to end of composite period? 24 HOURS

2. If sample to be tested has been previously frozen, is it reseeded? _____ How? _____

   SAMPLES NOT FROZEN

3. Does sample to be tested contain residual chlorine? No
   If yes, is sample

   a. Dechlorinated? _____

      How? _____

   b. Reseeded? _____

      How? _____

4. Is pH of sample between 6.5 and 8.0? INDUSTRIAL SAMPLE SOMETIMES NOT

   If no, is sample pH adjusted and sample reseeded? _____
   No Yes

5. How is pH measured? pH METER

   a. Frequency of calibration? DAILY

   b. Buffers used? 7 (METER WOULD NOT STANDARDIZE TO USING WDOE 10 BUFFER)

6. Is final effluent sample toxic? No? (INDUSTRIAL WASTE ROUTINELY SEEDED)

7. Is the five (5) day DO depletion of the dilution water (blank) determined? Yes, normal range? 1.0 - 2.0 mg/L
DIRTY GLASSWARE?

8. What is the range of initial (zero day) DO in dilution water blank? ≈7.0 mg/L

9. How much seed is used in preparing the seeded dilution water?
1.6 ML SEED / 5½ L DILUTION WATER

10. Is five (5) day DO depletion of seeded blank determined? Yes
If yes, is five (5) day DO depletion of seeded blank approximately 0.5 mg/l greater than that of the dilution water blank?

11. Is BOD of seed determined? No

12. Does BOD calculation account for five (5) day DO depletion of

a. Seeded dilution water? Yes

How? FINAL DO OF SEEDED BLANK USED AS INITIAL DO OF SEEDED SAMPLES

b. Dilution water blank? Yes

How? FINAL DO OF BLANK USED AS INITIAL DO OF UNSEEDED SAMPLES

13. In calculating the five (5) day DO depletion of the sample dilution, is the initial (zero day) DO obtained from

a. Sample dilution?

b. Dilution water blank? AS NOTED ABOVE

14. How is the BOD_5 calculated for a given sample dilution which has resulted in a five (5) day DO depletion of less than 2.0 ppm or has a residual (final) DO of less than 1.0 ppm?

CALCULATED PROPERLY, BUT FACE VALUE OF <OR> VALUES USED IN AVERAGING

15. Is liter dilution method or bottle dilution method utilized in preparation of

a. Seeded dilution water? Yes

b. Sample dilutions? No

16. Are samples and controls incubated for five (5) days at 20°C ± 1°C and in the dark? TEMPERATURE WAS 22-24°

17. How is incubator temperature regulated? THERMOSTAT

18. Is the incubator temperature gage checked for accuracy? _____

    a. If yes, how? THERMOMETER INSIDE

    b. Frequency? _____

19. Is a log of recorded incubator temperatures maintained? _____

    a. If yes, how often is the incubator temperature monitored/ checked? _____

20. By what method are dissolved oxygen concentrations determined?

    Probe _____ Winkler X Other _____

    a. If by probe:

        1. What method of calibration is in use? _____

        2. What is the frequency of calibration? _____

    b. If by Winkler:

        1. Is sodium thiosulfate or PAO used as titrant? THIO

        2. How is standardization of titrant accomplished? CAREFUL WEIGHING OF THIOSULFATE

        3. What is the frequency of standardization? _____

Recommendations:

⑦ pH OF SAMPLES SHOULD BE ADJUSTED IF NOT BETWEEN 6.5 & 8.0. THE PLANT SHOULD HAVE AN ACCURATE pH METER.

⑧ STEPS TO GET A HIGHER INITIAL DO AND A SMALL DO DEPLETION IN THE BLANK SHOULD BE TAKEN.

⑨ THE WDOE OR STND MTHDS SYSTEM OF BOD CALCULATION SHOULD BE USED.

⑩ BOD INCUBATOR TEMPERATURE CONTROL SHOULD BE BETTER.

⑪ THE SODIUM THIOSULFATE SOLUTION SHOULD BE STANDARDIZED USING POTASSIUM BIIODATE.

F. Calculating Final Biochemical Oxygen Demand Values Washington State Department of Ecology

1. Correction Factors

a. Dilution factor:

$$= \frac{\text{total dilution volume (ml)}}{\text{volume of sample diluted (ml)}}$$

b. Seed correction:

$$= \frac{(\text{BOD of Seed})(\text{ml of seed in 1 liter dilution water})}{1000}$$

c. F factor ∿ a minor correction for the amount of seed in the seeded reagent versus the amount of seed in the sample dilution:

$$F = \frac{[\text{total dilution volume (ml)}] - [\text{volume of sample diluted ml}]}{\text{Total dilution volume, ml}}$$

2. Final BOD Calculations

a. For seed reagent:

(seed reagent depletion-dilution water blank depletion) x D.F.

b. For seeded sample:

(sample dilution depletion-dilution water blank depletion-scf) x D.F.

c. For unseeded sample:

(sample dilution depletion-dilution water blank depletion) x D.F.

3. Industry/Municipality Final Calculations

Recommendations:

_____

_____

_____

_____

_____

_____ _____

III. TOTAL SUSPENDED SOLIDS CHECKLIST

A. Technique

1. What analysis technique is utilized in determining total suspended solids?

a. Standard Methods? _____ Edition _____

b. EPA? _____

c. A.S.T.M.? _____

d. Other (specify)? METHOD DEVELOPED FOR PLANT USE YEARS AGO

B. Test Procedure

1. What type of filter paper is utilized:

a. Reeve Angel 934 AH? _____

b. Gelman A/E? _____

c. Other (specify)? WHATMAN GFC

d. Size? _____

2. What type of filtering apparatus is used? MILLIPORE TYPE APPARATUS

3. Are filter papers prewashed prior to analysis? No

a. If yes, are filters then dried for a minimum of one hour _____ at 103°C-105°C OVEN TEMP. NOT MONITORED

b. Are filters allowed to cool in a dessicator prior to weighing? YES

4. How are filters stored prior to use? HEATED, THEN IN DESSICATOR

5. What is the average and minimum volume filtered? 10 ML

6. How is sample volume selected?

   a. Ease of filtration? YES

   b. Ease of calculation? _____

   c. Grams per unit surface area? _____

   d. Other (specify)? _____

7. What is the average filtering time (assume sample is from final effluent)? LESS THAN 5 MINUTES

8. How does analyst proceed with the test when the filter clogs at partial filtration? DOESN'T HAPPEN

9. If less than 50 milliliters can be filtered at a time, are duplicate or triplicate sampe volumes filtered? NO

10. Is sample measuring container; i.e., graduated cylinder, rinsed following sample filtration and the resulting washwater filtered with the sample? _____

11. Is filter funnel washed down following sample filtration? _____

12. Following filtration, is filter dryed for one (1) hour, cooled in a desscator, and then reweighed? _____

13. Subsequent to initial reweighing of the filter, is the drying cycle repeated until a constant filter weight is obtained or until weight loss is less than 0.5 mg? NO

14. Is a filter aid such as cellite use ? NO

a. If yes, explain: _____

Recommendations:

(12) USE A STANDARD REFERENCE FOR TSS ANALYSIS.

(13) USE A STND METHODS APPROVED FILTER PAPER.

(14) PREWASH AND DRY FILTERS PRIOR TO USE.

(15) MONITOR OVEN TEMPERATURE.

(16) RUN DUPLICATE SAMPLES WHEN <50MLS OF SAMPLE CAN BE FILTERED.

(17) RINSE ALL SOLIDS FROM THE MEASURING CONTAINER AND FILTER FUNNEL WALLS ONTO THE FILTER.

(18) FOLLOW PROCEDURES TO ASSURE THAT THE FILTER HAS BEEN ADEQUATELY DRIED.

C. Calculating Total Suspended Solids Values Washington State Department of Ecology

A. $mg/l\ TSS = \frac{A-B}{C} \times 10^6$

1. Where: A = final weight of filter and residue (grams)

B = initial weight of filter (grams)

C = Milliliters of sample filtered

2. Industry/Municipality Calculations

Recommendations:

(19) FECAL COLIFORM SAMPLES SHOULD BE DECHLORINATED WHEN THE SAMPLE IS TAKEN.

SPLIT SAMPLE RESULTS:

Origin of Sample _____

Collection Date _____

BOD		TSS		EPA BOD Standard	
DOE	IND./MUN.	DOE	IND./MUN.	DOE	IND./MUN