88-e10
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WA-59-1010

COLVILLE WASTEWATER TREATMENT PLANT
CLASS II INSPECTION
September 22-23, 1987

by
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ABSTRACT

A Class II inspection was conducted at the Colville Wastewater Treatment Plant on September 22 and 23, 1987. The WTP is a three-cell lagoon system discharging into the Colville River. The plant was meeting the BOD_5 and TSS limits set forth in Docket No. DE-77-281 which relaxes the NPDES permit limits (#WA-002261-6). Metals concentrations in the plant discharge were below toxicity concentration criteria. Plans to remove sludge from the first lagoon cell should be developed and executed in the near future. Improved flow measurement is also recommended.

INTRODUCTION

A Class II inspection was conducted at the Colville Wastewater Treatment Plant (WTP) on September 22 and 23, 1987 (Figure 1). The inspection was conducted by Marc Heffner of the Ecology Water Quality Investigations Section (WQIS) with help from Jim Prudente and Jeff Dill of the Ecology Eastern Regional Office. Otis Hampton, Ecology roving operator, conducted a lab review with the WTP operator. The WTP operator, George Ryan, represented the city during the inspection. A receiving water study in the Colville River was conducted by Tim Determan and Joy Michaud (Ecology, WQIS) concurrently with the Class II and will be reported separately.

The Colville WTP is a three-cell lagoon system that was built in 1967 (Figure 2). The first two cells are unaerated while the third cell has a 5-hp propeller aerator. Flow is chlorinated then held in a contact pond prior to discharge. The effluent flows through a pipe into a short ditch (10 to 20 yards) which discharges into the Colville River. The discharge is limited by Docket No. DE-77-281 which relaxes NPDES Permit No. WA-002261-6.

Objectives of the survey were to:

1. Collect influent and effluent samples to determine plant loading and performance. Compare results with Docket limits to estimate compliance.

2. Review laboratory and sampling procedures for conformance with approved techniques. Sample splits for analysis by the Ecology and WTP labs were made.

3. Estimate the accuracy of plant flow measurements.

4. Collect influent, effluent, and sludge samples to determine metals concentrations at the plant.

5. Make measurements to determine the sludge deposition in the lagoons.

6. Provide data to support the concurrent receiving water study.

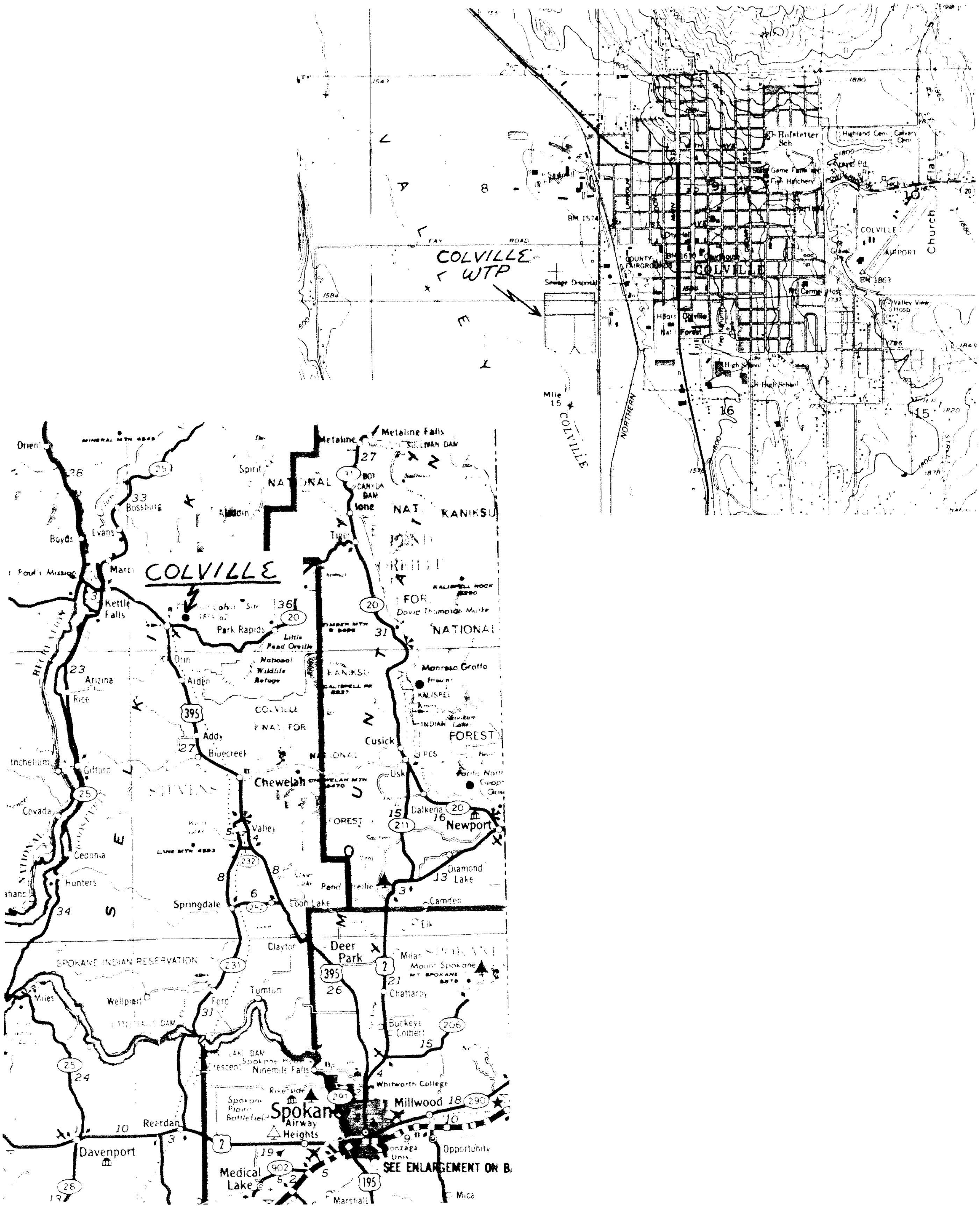

Figure 1. Location Map, Colville, 9/87.

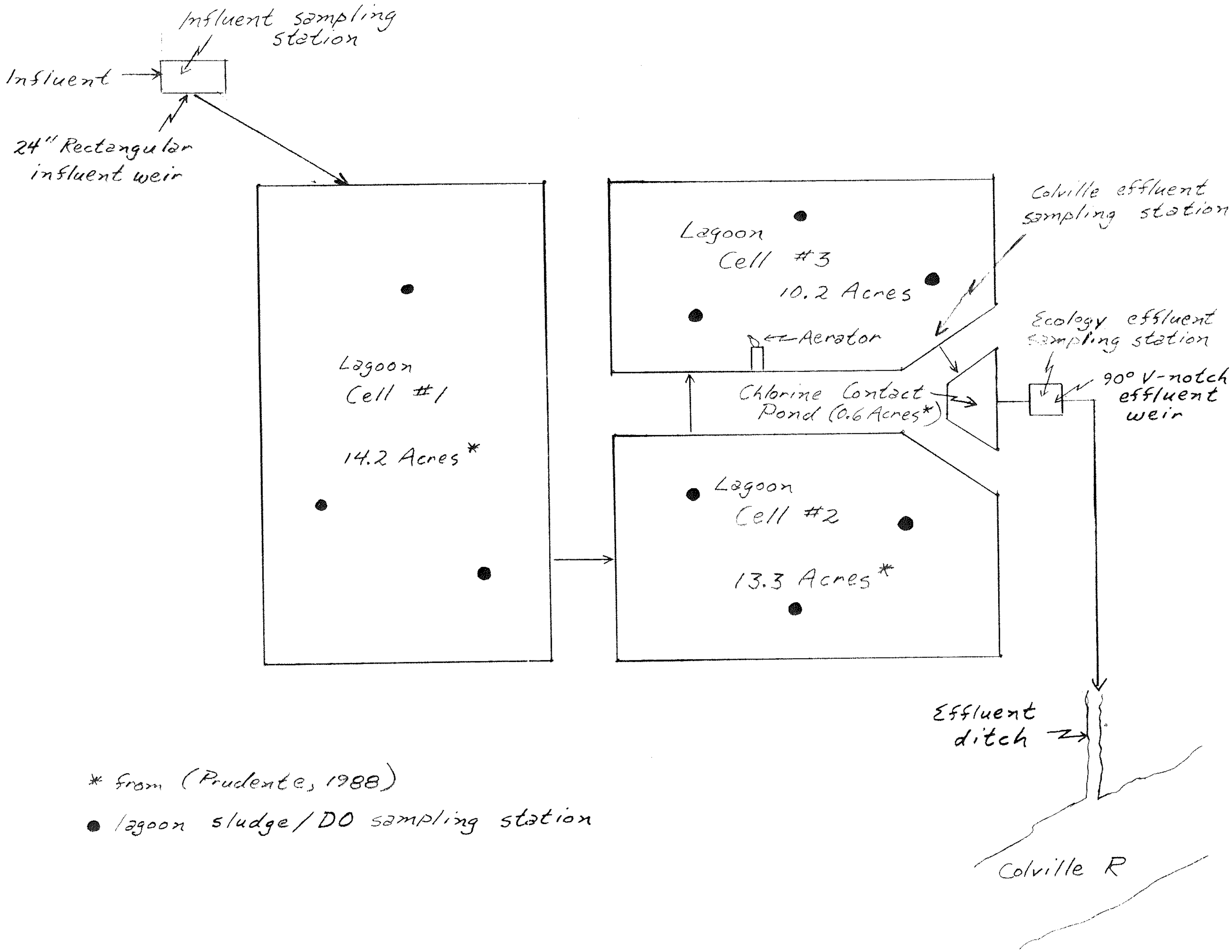

Figure 2. Flow Scheme, Colville, 9/87.

PROCEDURES

Influent and effluent composite samples were collected by Ecology (Figure 2). Isco composite samplers collected approximately 200 mLs of sample every 30 minutes for 24 hours. Samples were cooled with ice during collection. The Colville operator collected influent and effluent hand composite samples. Equal volumes of sample were collected hourly during his 0700 to 1600 hours work day. His samples were refrigerated between collection times. All composite samples were split for analysis by the Ecology and WTP laboratories. Sampling times and parameters analyzed are included in Table 1. Table 1 also summarizes grab samples that were collected for field and laboratory analysis. All samples for Ecology laboratory analysis were kept on ice after collection and transported to the Ecology Manchester Laboratory. Analytical methods conformed with EPA or Standard Methods approved techniques (APHA, 1985).

Operator flow measurements at the plant include daily influent and effluent instantaneous measurements. An Ecology Manning Dipper flow meter was set up at the influent 24-inch rectangular weir, and an Ecology American Sigma 8100 Bubble Meter was set up at the 90-degree V-notch effluent weir to measure flows during the inspection (Figure 2).

A composite sludge sample was collected from each lagoon for metals analysis. Approximately equal volumes of sludge were collected from a boat using a "Sludge Judge" core sampler at three sites in each lagoon (Figure 2). The volumes were composited to form one sample from each lagoon. Sampling times and parameters analyzed are included in Table 1. Sludge depth, water depth, and dissolved oxygen (D.O.) concentrations were also measured.

RESULTS AND DISCUSSION

The results from the Ecology flow meters are summarized in Table 2. The accuracy of the influent measurements are questionable because flow approaching the weir is fairly rapid. The operator was taking instantaneous measurements on the weir, rather than in the partially quiescent zone upstream of the weir. Installing a continuous flow meter and either replacing the weir with a flume that is less sensitive to the approach velocity, or modifying the inlet box to reduce flow velocity upstream of the weir would be necessary to accurately measure the influent flow.

The effluent flow rate appeared to decrease during the inspection from 0.70 to 0.40 MGD. It is unclear whether this is meter error or a real change. The operator makes an instantaneous flow measurement using a float to measure head height. The float height underestimated the flow rate (Table 2). Installation of a staff gauge in the upstream end of the effluent box is recommended to more accurately measure the flow rate.

Table 1. Sample collection - Colville, September 1987.

Station	Date	Time	Sampler**	Laboratory**	Field Analyses: Temp.	pH	Cond	Chlorine Residual Free	Chlorine Residual Tot.	Laboratory Analyses: Fecal Coli.	Total Entero-Cocci.	BOD_5	Inhib. BOD_5	COD	Solids: TS	TNVS	TSS	TNVSS	Turb.	Nutrients: NH_3-N	NO_2 + NO_3-N	Tot. -P	Cond.	Alk.	Chlorides	Total Hard.	Total Metals*	Sludge Metals + % Solids*	D.O.
Influent	22	1135			X	X	X							X			X												
		1520			X	X	X							X			X												
	23	1040			X		X							X			X												
	22-23	Comp.	Ecology++	Ecology+								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
		1130-		Ecology+								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
		1130		Colville								X					X												
			Colville++	Ecology								X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		
				Colville								X					X												
Effluent	22	1120			X	X	X	X	X					X			X												
		1530			X	X	X							X			X												
	23	0750								X	X																		
		1055		Ecology	X		X			X	X			X			X												
				Colville						X																			
	22-23	Comp.	Ecology++	Ecology								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
		1130-		Colville								X					X												
		1130	Colville++	Ecology								X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		
				Colville								X					X												
Lagoon #1	22	1445																										X	X
Lagoon #2	22	1345																										X	X
Lagoon #3	22	1415																										X	X

*metals analyzed were: Cd, Cr, Cr VI, Cu, Pb, Ni, Zn.
**grab samples collected and analyzed by Ecology unless otherwise specified
+duplicate samples submitted to Ecology lab for analysis.
++Ecology samples automatically collected. Colville composite hand collected approximately hourly during working hours (0700-1600).

Table 2. Ecology flow measurements - Colville, September 1987.

Date					
Month	Day	Time	Instantaneous Flow (MGD)	Totalizer Reading	Flow Rate for Time Increment (MGD)
Influent measurements using Manning dipper flowmeter					
9	22	1135	0.72	106936	
					0.82
9	22	1520	0.65	107080	
					0.54
9	23	0745	0.95	107499	
					0.80
9	23	1115	0.79	107631	
		Average flow during inspection =		0.63 MGD	
Effluent measurements using American Sigma model 8100 flowmeter					
9	22	1050	0.64	11360	
					0.70
9	22	1530	0.68*	11496	
					0.44
9	23	0750	0.41	11798	
					0.40
9	23	1110	0.41	11854	
		Average flow during inspection =		0.49 MGD	

*instantaneous measurement using operator's float was 0.45 MGD

Ecology analytical results are summarized in Table 3. The plant was providing good BOD_5 removal and also removing most of the influent nitrogen. Table 4 compares inspection data to limits in the Docket. Plant performance during the inspection was within the limits for BOD_5 and TSS. One of the pH measurements exceeded the 8.5 maximum. High effluent pH in lagoon systems due to algal activity is not uncommon. Variations outside the pH limits are generally acceptable when not due to inorganic chemical addition or industrial sources (EPA, 1986a). The chlorine residual was less than the 0.1 mg/L minimum limit in the Docket. The low effluent fecal coliform concentrations suggest the low chlorine residual concentration is of no concern. A fecal coliform limit and maximum chlorine residual concentration (with no minimum) are recommended for the permit/docket.

Influent and effluent metals data are summarized in Table 5. The data show in-plant removal for most metals except hexavalent chromium. All effluent metals concentrations were less than EPA receiving water toxicity criteria at the effluent hardness, with only lead and hexavalant chromium approaching criteria concentrations (EPA, 1986b).

Sludge depths were measured during the inspection. In Cell 1, the sludge blanket was within six inches of the water surface for approximately one-fifth of the lagoon at the inlet end. Nuisance odors resulting from this deep sludge blanket and shallow water depth are likely. The sludge in the rest of the lagoon was approximately 1.5 feet deep, with the total lagoon depth 3.5 to 4.0 feet. The operator reported that sludge has never been removed from the lagoons. The sludge volume in the first cell is likely reducing treatment capacity, and solids removal options should be studied. Sludge in Lagoons 2 and 3 was approximately 0.5 to 1.0 foot deep in the four-feet-deep lagoons, and did not appear to be a problem.

Dissolved oxygen concentrations in the lagoons were in excess of 20 mg/L at the surface at 1400 hours on September 22. In Lagoons 2 and 3, the D.O. concentrations were 8 mg/L at the two- and three-feet depths. In Lagoon 1, the concentration was 0 mg/L at the 2.5-feet depth. The sludge deposition is assumed to cause the 0 mg/L D.O. in Cell 1.

Sludge metals concentrations are summarized in Table 6. The data show metals concentrations are less in the sludges of the sequential lagoons. Cadmium, chromium, and nickel concentrations in the first lagoon cell are high in comparison to digester sludges from activated sludge plants (Hallinan, 1988). The nickel concentration remained elevated even in the third cell. The Cell 1 concentrations generally compare well with the Lagoon 1 sample collected in 1985 by the Ecology ERO (Goldstein, 1985). The metals concentrations should be considered when developing the sludge removal plan for Cell 1.

Table 7 compares inspection loadings to state design criteria (Ecology, 1985). The lagoons were being loaded at approximately design criteria, emphasizing the need for sludge removal from Cell 1 to provide optimum treatment conditions. Capacity should

Table 3. Ecology conventional parameter analytical results - Colville, September 1987.

Station	Date	Time	Sampler	Field Analyses: Temp. (°C)	pH (S.U.)	Cond. (umhos/cm)	Chlorine Residual (mg/L): Free	Total	Laboratory Analyses: Fecal Coliform (#/100mL)	Total Enteroco. (#/100mL)	BOD_5 (mg/L)	Inhib. BOD_5 (mg/L)	COD (mg/L)	Solids (mg/L): TS	TNVS	TSS	TNVSS	Turb. (NTU)	NH_3-N	Nutrients (mg/L): NO_2+NO_3-N	Total-P	Cond. (umhos/cm)	Alkalinity (mg/L as $CaCO_3$)	Chlorides (mg/L as Cl-)	Hardness (mg/L as $CaCO_3$)
Influent	22	1135		19.9	8.1	860							350			130									
		1520		20.1	8.0	930							230			82									
	23	1040		20.2		950							300			160									
	22-23	Comp.	Ecology*								140	110	300	870	510	120	15	32	12	0.30	5.3	1170	370	120	310
			Ecology*								130	110	300	820	510	130	10	32	13	0.31	7.8	1170	360	120	340
			Colville								180		410	790	470	190	33	36	13	0.08	8.3	1010	380	57	360
Effluent	22	1120		17.5	8.3	990	<0.1	<0.1					120			18									
		1530		18.5	8.9	1050							100			26									
	23	0750							4	120															
		1055		16.5		1000			3	110			97			24									
	22-23	Comp.	Ecology								20	15	100	690	460	33	5	9	1.0	0.05	2.1	1010	290	110	310
			Colville								38		160	720	490	70	20	10	0.02	0.01	2.7	984	290	110	300

*sample split in field for duplicate analysis by the Ecology lab

Table 4. NPDES Permit Comparison - Colville, September 1987.

Parameter	Permit Limits*		Inspection Data**		
	Monthly Average	Weekly Average	Ecology Composite	WTP Composite	Grab Samples
BOD_5					
(mg/L)	60	100	20	38	
(lbs/D)	600	1000	82	155	
TSS					
(mg/L)	60	100	33	70	
(lbs/D)	600	1000	135	286	
Chlorine residual (mg/L)	0.1 - 0.5				<0.1
pH (S.U.)	6.5-8.5				8.3, 8.9
Fecal coliform (#/100 mL)	200+	400+			4, 3
Flow (MGD)	1.20+		0.49	0.49	

*limits as modified by Docket #DE 77-281
**calculated using Ecology analytical results
+parameter included in NPDES permit (#WA-002261-6), but not in Docket.

Table 5. Ecology influent and effluent metals results - Colville, September 1987.

Station	Date	Time	Sampler	Hardness (mg/L as $CaCO_3$)	Total Metals (ug/L)+ Cadmium	Hexa-Chromium	Chromium	Copper	Lead	Nickel	Zinc
Influent	9/22-23	Comp.	Ecology*	310	<0.2	2	8	71	120	18	125
			Ecology*	340	<0.2	5	9	69	99	20	126
			Colville	360	<0.2	1	17	90	71	20	197
Effluent	9/22-23	Comp.	Ecology	310	<0.2	9	10	7	<5	27	<1
			Colville	300	<0.2	7	<5	13	12	33	3
Toxicity criteria**											
(4 day)				310	2.8	11	523	31	13	411	276
(1 hour)				310	14	16	4386	51	345	3694	305

*Sample split in field for duplicate analysis by the Ecology lab
**From (EPA, 1986b)
+Total recoverable metals analysis are recommended for comparison to toxicity criteria. Due to laboratory error, total rather than total recoverable analysis were run. Total metals concentrations should be greater than or equal to total recoverable metals concentrations.

Table 6. Lagoon sludge metals data - Colville, September 1987.

Metal	Lagoon 1 Sample (mg/Kg dry wt)			Lagoon 2 Sample (mg/Kg dry wt)	Lagoon 3 Sample (mg/Kg dry wt)	Data from previous inspections+		
	10/85*	9/87**	9/87**			Range (mg/Kg dry wt)	Geometric Mean (mg/Kg dry wt)	Number of Samples
Cd	118	116	111	45.0	13.8	<0.1-25	7.6	34
Cu	517	473	464	130	57.7	75-1700	398	34
Cr	370	475	469	218	102	15-300	62	34
Pb	227	365	342	74.9	28.7	34-600	207	34
Ni	843	1008	984	523	138	<0.1-62	26	29
Zn	1244	1380	1419	413	184	165-3370	1200	33
Cr VI		2.89	2.19	0.44	0.85			
% Solids	4.84	4.43	4.24	6.16	8.32			

*sample from Class II inspection conducted on 10/29-30/85 (Goldstein, 1986)
**Ecology sample split in field for duplicate analysis
+data from digested sludge collected during previous Class II inspections at activated sludge plants (Hallinan, 1988)

Table 7. Inspection loading/design criteria comparison - Colville, September 1987.

Unit	Size	Inspection Data	State Design Criteria+	Inspection Loading
Lagoon Cell 1	14.2 acres* 4 feet deep	Q = 0.63 MGD BOD_5 = 140 mg/L = 740 lbs/D	50 lbs BOD_5/acre-D	52 lbs BOD_5/acre-D
Lagoon Cells 1+2+3	37.7 acres* 4 feet deep	Q = 0.63 MGD BOD_5 = 140 mg/L = 740 lbs/D	20 lbs BOD_5/acre-D	20 lbs BOD_5/acre-D
Chlorine Contact Pond	0.6 acres 6 feet deep** 1.2 MG	Q = 0.63 MGD	DT = 20 min. @ peak flow 1 hr. @ avg. flow 2 hrs maximum	46 hours

*From (Prudente, 1988)
**Per operator
+From (Ecology, 1985)

be closely reviewed before any significant loading increases are made. The chlorine contact chamber is oversized, but the low fecal coliform counts suggest this is of minimal concern.

Laboratory Review

Colville laboratory procedures were reviewed by Otis Hampton, the Ecology east side roving operator. His review is included in Appendix A. Important comments included:

BOD_5:

Dilutions should be selected so that D.O. depletion is at least 2.0 mg/L and at least 1.0 mg/L D.O. remains after incubation.

TSS:

1. A Standard Methods approved filter paper should be used for the test (APHA, 1985).
2. Filters should be cooled in the desiccator prior to weighing.
3. The drying cycle should be repeated once every two months to assure that a constant filter weight has been reached.

Table 8 compares laboratory results for the split samples. The Colville influent and effluent samples had higher BOD_5 and TSS concentrations than the corresponding Ecology samples. This was probably due to lower concentrations at night when the Ecology compositors were sampling but the Colville hand composites were not collected.

The analytical results do not compare well in most cases. The Colville lab TSS results were considerably lower than the Ecology results. The operator reported that TSS concentrations increased noticeably after the inspection when the lab switched to an approved filter paper as recommended. The BOD_5 results compared well for the Ecology samples, but poorly for the Colville samples. The cause is unclear. Fecal coliform results compared closely. An additional sample split with Colville by the roving operator is suggested for BOD_5 and TSS analyses.

RESULTS AND CONCLUSIONS

The Colville WTP discharge was within the relaxed BOD_5 and TSS limits of the Docket during the inspection. Although meeting limits, sludge deposits in the first cell of the lagoon were within six inches of the water surface at the inlet end, and D.O. concentrations dropped quickly below the surface. Sludge depths and D.O. concentrations were acceptable in the other lagoon cells. A sludge removal plan for the first cell should be developed and executed in the near future. Part of the study

Table 8. Laboratory comparison - Colville, September 1987.

Sample	Sampler	Laboratory	BOD_5 (mg/L)	TSS (mg/L)	F. Coli. (#/100 mL)
Influent	Ecology	Ecology	140	120	
		Colville	140	70	
	Colville	Ecology	180	190	
		Colville	60	53	
Effluent	Ecology	Ecology	20	33	
		Colville	27	11	
	Colville	Ecology	38	70	
		Colville	13	10	
	Grab	Ecology			3
		Colville			0

should involve consideration of the metals concentrations in the sludge. The concentrations in the first cell were higher than is generally expected in municipal sludges. Metals concentrations in the effluent were below toxicity criteria at the discharge hardness.

One measurement exceeded the effluent pH limit. This variance appears acceptable because algal activity in the lagoon, rather than inorganic chemical or industrial inputs, is the suspected cause. Also, the chlorine residual concentration was less than the 0.1 mg/L minimum limit. The fecal coliform counts were low, indicating this was not a problem. Replacing the minimum chlorine residual limit in the Docket with fecal coliform limits is recommended.

The plant flow measurement techniques did not appear accurate. Installation of a staff gauge at the upstream end of the effluent flow box is recommended. Installation of a continuous flow meter and either replacing the weir with a flume, or modification of the influent flow box to reduce flow velocity upstream of the weir, are recommended to accurately measure the influent flow.

Recommendations to bring laboratory procedures in compliance with accepted techniques are included in the discussion and Appendix A. Comparisons of split samples were marginal and a recheck is suggested. The Colville influent composite sample had higher BOD_5 and TSS concentrations than the Ecology sample, likely because only daytime flows were included in the Colville sample.

REFERENCES

APHA-AWWA-WPCF, 1985. Standard Methods for the Examination of Water and Wastewater, 16th Ed.

Ecology, 1985. Criteria for Sewage Works Design, DOE 78-5. Revised October 1985.

EPA, 1986a, 40 CFR Part 132.102, July 1, 1986.

EPA, 1986b. Quality Criteria for Water, EPA 440/5-86-001, May 1, 1986.

Goldstein, F., 1986. Ecology Eastern Regional Office, City of Colville/Class II Inspection Report, Memo to Files, March 25, 1986.

Hallinan, Pat, 1988. Ecology Water Quality Investigations Section, Metals Concentrations Found During Ecology Inspections of Municipal Wastewater Treatment Plants, Memo to John Bernhardt, April 11, 1988.

Prudente, J., 1988. Ecology Eastern Regional Office, personal communication.

APPENDIX

LABORATORY PROCEDURAL SURVEY

Discharger: Colville

NPDES Permit Number: WA00226-6

Date: 9-22-87

Industrial/Municipal Representatives Present: George Ryan

Agency Representatives Present: Jim Deudente, Jeff Dill, Mark H. Otis H., Jim DeTurman, Jay Michaud

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? yes

b. Final Effluent? yes

c. Other (specify)? ____

4. What is the time span for compositing period? 60 minutes

Sample aliquot? 500 mls per 60 minutes

5. Is composite sample flow or time proportional? Time

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

7. Are composites refrigerated during collection? yes

8. How long are samples held prior to analyses? 2 hour's

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

   a. Refrigeration? ✓

   b. Frozen? ______

   c. Other (specify)? ______

10. What is the approximate sample temperature at the time of analysis? 68°F

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

    a. Frequency? weekly

    b. Method? ammonium chloride base soap.

12. Does compositor have a flushing cycle? nA

    a. Before drawing sample? nA

    b. After drawing sample? nA

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

Recommendations:

need to use a chlorine solution to rinse sample bottles for sampling. also alconox detergent for washing lab glassware

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)? ______

B. Seed Material

1. Is seed material used in determining BOD? no

2. Where is seed material obtained? ______

3. How long is a batch of seed kept? NA

   and under what conditions? (temperature, dark) ______

4. How is seed material prepared for use in the BOD test? ______

   NA

Recommendations:

Need to order The 16th Edition of Standard Methods.

C. Reagent Water

1. Reagent water utilized in preparing diultion water is:

   a. Distilled? ✓

   b. Deionized? __________

   c. Tap __________, chlorinated __________ non-chlorinated __________

   d. Other (specify)? __________

2. Is reagent water aged prior to use? yes

   How long? 7 days, under what conditions? under The counter in the dark.

Recommendations:

Store BOD5 Reagent Water in the Incubator.

D. Dilution Water

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

   a. 1.0 mls of each nutrient buffer per Liter mls of reagent water

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

3. How often is dilution water prepared? Weekly
   Maximum age of dilution water at the time test is set up. 30 minutes

4. Under what conditions is dilution water kept? discarded

5. What is temperature of dilution water at time of setup? ______ unknown

Recommendations:

Store Reagent water in the incubator to stabalize at 20°C

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? 12 hour's

2. If sample to be tested has been previously frozen, is it reseeded? no How? ______

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 ~~8.5?~~ 7.5 no

   If no, is sample pH adjusted and sample reseeded? no

5. How is pH measured? meter Hach cat. no. 16415

   a. Frequency of calibration? monthly

   b. Buffers used? 4.0, 9.0

6. Is final effluent sample toxic? no

7. Is the five (5) day DO depletion of the dilution water (blank) determined? yes, normal range? .1 — 0.3

8. What is the range of initial (zero day) DO in dilution water blank? 7.4 – 7.8 mg/l

9. How much seed is used in preparing the seeded dilution water? NA

10. Is five (5) day DO depletion of seeded blank determined? NA 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? NA

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

   a. Seeded dilution water? NA

      How? ______

   b. Dilution water blank? no

      How? subtract from sample dilution

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? ______

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? subtracting actual number's

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

   a. Seeded dilution water? NA

   b. Sample dilutions? graduated cylinder - Liter

16. Are samples and controls incubated for five (5) days at 20°C ± 1°C and in the dark? yes

17. How is incubator temperature regulated? thermostat

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

a. If yes, how? Thermometer in a beaker

b. Frequency? daily

19. Is a log of recorded incubator temperatures maintained? no

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

20. By what method are dissolved oxygen concentrations determined?

Probe ✓ Winkler ______ Other ______

a. If by probe:

1. What method of calibration is in use? air

2. What is the frequency of calibration? 2/week

b. If by Winkler:

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

2. How is standardization of titrant accomplished? not standardized

3. What is the frequency of standardization? NA

Recommendations:

Calibrate pH meter with buffer 7.0 before each use. 3 point calibration weekly with buffer 4, 7, 10

Need to adjust BOD5 sample volumes to maintain a final D.O. of 2.0 mg/L

Maintain a log on the BOD incubator

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:

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

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

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

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:

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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)? ____

B. Test Procedure

1. What type of filter paper is utilized:

   a. Reeve Angel 934 AH? ____

   b. Gelman A/E? ____

   c. Other (specify)? Whatman 540

   d. Size? ____

2. What type of filtering apparatus is used? Gooch crucible apparatus

3. Are filter papers prewashed prior to analysis? yes

   a. If yes, are filters then dried for a minimum of one hour yes at 103°C-105°C yes ?

   b. Are filters allowed to cool in a dessicator prior to weighing? yes 5-10 minutes

4. How are filters stored prior to use? in the dessicator

5. What is the average and minimum volume filtered?

Inf. - 15 ml EFF. [illegible]

6. How is sample volume selected?

a. Ease of filtration? ✓

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)?

3-5 minutes

8. How does analyst proceed with the test when the filter clogs at partial filtration? Stir with a Stirring Rod.

9. If less than 50 milliliters can be filtered at a time, are duplicate or triplicate sampe volumes filtered? yes

10. Is sample measuring container; i.e., graduated cylinder, rinsed following sample filtration and the resulting washwater filtered with the sample? no

11. Is filter funnel washed down following sample filtration?

no - use Gooch Crucible

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

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 used? no

a. If yes, explain:

Recommendations:

need to use 934 AH Filter paper.
Cool Filters For 1.0 hour in the dessicator before weighing.
Do not use a stirring Rod to ease sample Filtration.
Reweigh Filter's every 2 months to check the weight loss or gain.

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:

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SPLIT SAMPLE RESULTS:

Origin of Sample ___

Collection Date ___

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