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Segment No.: 02-03-06

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90-e24

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October 25, 1990

TO: Dave Wright

FROM: Marc Heffner

SUBJECT: Burlington Class II Inspection Report - March 28-29, 1989

INTRODUCTION

A Class II Inspection was conducted at the Burlington Wastewater Treatment Plant (STP) on March 28-29, 1989. The Burlington STP is an activated sludge plant limited by NPDES Permit # WA-002015-0. Discharge is into a swiftly moving reach of the Skagit River. The plant treats domestic wastewater as well as septage, leachate from the Inman Landfill (a county landfill), and wastewater (not to include flyash) from the Skagit County Waste Incinerator.

Treatment units include primary clarifiers, activated sludge basins, secondary clarifiers, and chlorine contact basins (Figure 1). The activated sludge system was operated as a modified anoxic-aerobic system. The first half of the activated sludge basins were mixed, but not aerated. Both aeration and mixing were supplied in the second half of the basins. This system of operation was recommended to the operator by Mike Myers, Ecology Roving Operator. Primary clarifier sludge and waste activated sludge are thickened in a gravity thickener, then aerobically digested. The digested sludge is gravity thickened before it is land applied or dried on drying beds, then land applied.

Landfill leachate and septage are hauled to the plant by tank truck. Both are dumped through a moving screen into an aerated equalization tank. The equalization tank contents are bled into the influent as a fixed percentage of the influent pump station pumping rate (1-3%). Ten thousand gallons of leachate and up to 6000 gallons of septage are received daily. The leachate is pre-treated in an aerated lagoon at the landfill before being hauled to the STP.

Incinerator wastewater is primarily washwater and boiler blowdown. The wastewater is sent to a 30,000 gallon holding tank where the pH is lowered to approximately neutral. When the tank is 70-80% full and the pH is properly adjusted, the tank is pumped to the sewer. Tank pumping takes approximately 1-1.5 hours and occurs every one to five days.

The inspection was conducted by Keith Seiders and Marc Heffner of the Ecology Compliance Monitoring Inspection. Bud Brink, the STP Operator, provided assistance at the plant. Objectives of the inspection included:

1. Assess plant compliance with NPDES permit limits.

2. Characterize toxicity with priority pollutant scans and effluent bioassays.

3. Review lab procedures to determine conformance with standard techniques. Samples were split with the permittee for permit parameter analysis.

4. Characterize the landfill leachate and incinerator wastewater being sent to the treatment plant.

Little deposition was expected near the outfall, so receiving water sediments were not collected.

The City of Anacortes drinking water intake is in the Skagit River downstream of the STP discharge. Two river samples were collected to aid the Ecology Surface Water Investigation Section (SWIS) in addressing concerns of possible STP discharge impacts on the drinking water supply. A data summary from the two stations and a copy of the SWIS memo are included in Appendix A (Carey, 1990).

PROCEDURES

Grab and composite samples were collected by Ecology. Ecology influent and effluent composite samples were collected with priority pollutant cleaned Isco composite samplers (Figure 1). The samplers collected approximately 350 mLs of sample every 30 minutes for 24 hours. The collection jugs were iced to provide cooling during the composite period. Ecology sampling quality assurance/quality control (QA/QC) steps included priority pollutant cleaning sampling equipment and collection of a field transfer blank sample (Table 1).

Plant influent and effluent composite samples were collected by the operator during the same 24-hour period. STP composite samplers collected equal volumes of samples hourly. The Ecology and operator influent and effluent composite samples and selected grab samples were split for analysis by the Ecology and STP laboratories. Samples collected, sampling times, and parameters analyzed are summarized in Table 2.

Samples of landfill leachate were collected as the tank truck discharged leachate at the STP. One grab sample was collected from each of the two loads brought to the plant on March 28, and a composite sample was formed with equal volumes of the two grab samples. The incinerator wastewater sample was a grab sample of the mixed wastewater taken prior to discharge into the sewer. Samples collected, sampling times, and parameters analyzed are summarized in Table 2.

Samples for Ecology analysis were placed on ice and shipped to the Ecology Manchester Laboratory. Analytical procedures used by the Ecology Laboratory are summarized in Table 3.

RESULTS AND DISCUSSION

Flow Measurement

The in-line plant meter measured flow (Table 4). The operator indicated that the flow meter is calibrated yearly. Ecology measurements could not be made to verify accuracy.

Conventional Parameters/NPDES Permit Limits Comparison

STP operation during the inspection was not optimal. During the morning on March 28, the plant began to lose solids in the effluent. The operator increased the sludge recycle rate in an effort to minimize the problem. The problem appeared to be due to hydraulic overloading. The flow rate for the sampling period was 2.0 MGD which was greater than the average monthly design capacity (1.6 MGD). The plant rain gauge indicated that 0.75 inches of rain had fallen the previous night. Summertime flows are generally in the 0.6-0.7 range, indicating a significant I/I problem. The operator suggested part of the problem may be due to the Lake Sammish STP, a lagoon system that pumps effluent to the Burlington STP for additional treatment and discharge.

The influent BOD_5 (120 mg/L) and NH_3-N (10 mg/L) concentrations were fairly weak (Table 5). The effluent NH_3-N concentration (7.3 mg/L) was slightly less than the influent concentration, but the difference was too small to make definitive comments about the occurrence of nitrification.

Data comparison with the NPDES permit found several parameters in excess of limits (Table 6). The Ecology composite sample exceeded the monthly BOD_5 loading limit, the weekly and monthly TSS loading limits, and the monthly TSS concentration limit. The STP composite sample exceeded BOD_5 and TSS monthly and weekly loading and concentration limits. Neither the Ecology nor the STP composite sample percent removals met the 85% minimum monthly limit. Also, one fecal coliform sample exceeded the monthly limit. The plant design criteria were being approached for TSS loading and the inspection flow exceeded the maximum monthly average design flow. The plant's ability to adequately treat wet weather flows should be thoroughly evaluated.

The landfill leachate BOD_5 (1700 mg/L) and NH_3-N (120 mg/L) concentrations were much stronger than the STP influent while the TSS concentration (340 mg/L) was only slightly stronger than the influent (Table 5). At the inspection hauling rate (10,000 gpd) and STP loading rate, the leachate represented six to ten percent of the BOD_5 and NH_3-N loads at the STP.

The incinerator flow had slightly higher BOD_5, TSS, and NH_3-N concentrations than the plant influent (Table 5). Several observations made at the incinerator needed further investigation:

1. Acid for wastewater neutralization was being stored outside on an unbermed flat pad. A small ditch beside the storage area ran through two grass catch basins on the property and then discharged into a roadside ditch off the property.

2. The cooling water filter backwash was being discharged into the ditch near the acid storage area. The unit continuously drips and flushes for eight seconds every five minutes. A grab sample was checked for pH (7.9) and conductivity (174 umhos/cm), but a more complete analysis of the discharge is suggested.

3. Drainage from the materials recycling area was routed through one of the grass catch basins, then discharged into the roadside ditch.

Priority Pollutants - Water

Organics detected in the STP samples were found in fairly low concentrations (Table 7). The methylene chloride and acetone data are not reliable because methylene chloride was found in the method and transfer blanks and a high concentration of acetone was found in the transfer blank. Most organics detected in the influent were below detection limits in the effluent. Metals concentrations were reduced through the facility, although most were still found in measurable concentrations in the effluent. Iron, lead, mercury, and silver concentrations exceeded chronic freshwater toxicity criteria in one or both of the effluent samples analyzed, while copper exceeded both the acute and chronic criteria (Table 8; EPA 1986b).

Landfill leachate organic concentrations were considerably higher than STP influent concentrations for several analytes (Table 7). Again, methylene chloride and acetone data must be used with caution, but the acetone concentration (1400 ug/L) was high enough to warrant a recheck if the parameter is of concern. 2-Butanone (1800 ug/L) and 4-Methylphenol (1600 ug/L) were also found in fairly high concentrations. Several priority pollutant metals concentrations were somewhat higher than STP influent concentrations.

Incinerator organics concentrations fell between the landfill and STP concentrations (Table 7). Several metals concentrations were somewhat higher than the landfill leachate concentrations.

A summary of analytes and detection limits is included in Appendix B.

Priority Pollutants - Sludge

A few organics were found in the sludge (Table 7). 4-Methylphenol was found in the highest concentration (1700 ug/Kg dry wt). 4-Methylphenol was also found in the landfill leachate (1600 ug/L).

Metals were also found in the sludge (Table 7). Burlington sludge metals concentrations were greater than the geometric mean, but within the range of sludge metals data collected during previous class II inspections statewide (Table 9).

A summary of analytes and detection limits is included in Appendix B.

Bioassays - Water

Effluent toxicity was low in the bioassays (Table 10). Acute mortality was not observed in the rainbow trout or *Daphnia magna* tests. Chronic effects were not observed in the *Daphnia magna* test. In fact, *Daphnia magna* reproduction increased with increased effluent concentrations, suggesting nutrient enrichment effects of the effluent exceeded any toxic effects. Toxicity to Microtox was also low.

Laboratory Review/Sample Splits

Laboratory procedures were generally acceptable. A copy of the "Laboratory Procedure Review Sheet" with recommendations circled is included in Appendix C. A copy was left with the operator at the time of the inspection. The major problem noted was incubator/oven temperatures. Temperatures were too high in the BOD incubator (20°C required: 26°C at Burlington) and TSS oven (103-105°C required, 114°C at Burlington), and the fecal coliform incubator thermometer was broken. Temperatures should be properly adjusted and the broken thermometer replaced.

Results of the split samples are inconclusive (Table 11). Total chlorine residual splits compared closely as did two of the three TSS splits. Burlington BOD_5 analysis of the influent samples yielded higher concentrations than Ecology analysis, whereas effluent results were similar. The Burlington fecal coliform result was ten times greater than the Ecology result. The Burlington fecal coliform plate counts were quite high (568 estimated and 640 estimated), possibly contributing to the problem. Greater dilutions should be run so plate counts range from 20-60.

The STP effluent sample appeared to have higher concentrations of BOD_5 and TSS than the Ecology sample (Table 11). The effluent sampler and sampling point should be inspected to assure it is representative.

RECOMMENDATIONS AND CONCLUSIONS

Conventional Parameters/NPDES Permit Limits Comparison

A high flow rate occurred during the inspection suggesting significant I/I. Plant performance appeared to be suffering. Effluent BOD_5, TSS, and fecal coliform loads and/or concentrations during the inspection were greater than monthly and/or weekly NPDES permit limits. The plant's ability to adequately treat wet weather flows should be thoroughly evaluated.

Landfill leachate had considerably higher BOD and NH_3-N concentrations than the STP influent. Six to ten percent of the STP influent load for these two parameters came from the landfill leachate.

The incinerator wastewater was only slightly stronger than the STP influent. General housekeeping observations noted in the discussion may need further investigation.

Priority Pollutants - Water

Few organics were found in the STP effluent; those found were in low concentrations. Copper, iron, lead, mercury, and silver concentrations exceeded chronic and/or acute freshwater toxicity in one or both of the effluent samples analyzed.

Concentrations of organics found in the landfill leachate sample were considerably higher than concentrations found in the STP influent. Acetone, 2-Butanone, and 4-Methylphenol were found in concentrations greater than 1000 ug/L. The acetone concentration was also high in the transfer blank sample; therefore, the acetone concentration should be rechecked if it is a parameter of concern.

Concentrations of organics found in the incinerator wastewater fell between landfill leachate and STP influent concentrations.

Priority Pollutants - Sludge

Few organics were detected in the sludge. Metals concentrations fell within the range of sludges collected during previous class II inspections statewide.

Bioassays - Water

Toxicity of the STP effluent was low.

Laboratory Review/Sample Splits

Laboratory procedures were generally acceptable. Specific recommendations included:

1. Temperatures of the BOD incubator and TSS oven should be properly adjusted. An accurate thermometer should be used to monitor the fecal coliform incubator.

2. Effluent sampler positioning and operation should be checked to assure a representative sample is being collected.

3. Fecal coliform samples should be diluted so between 20 and 60 coliform organisms grow per plate when more than 20 organisms/100 mL are present.

Additional comments are included on the "Laboratory Procedure Review Sheet" included in Appendix C.

REFERENCES

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FIGURES

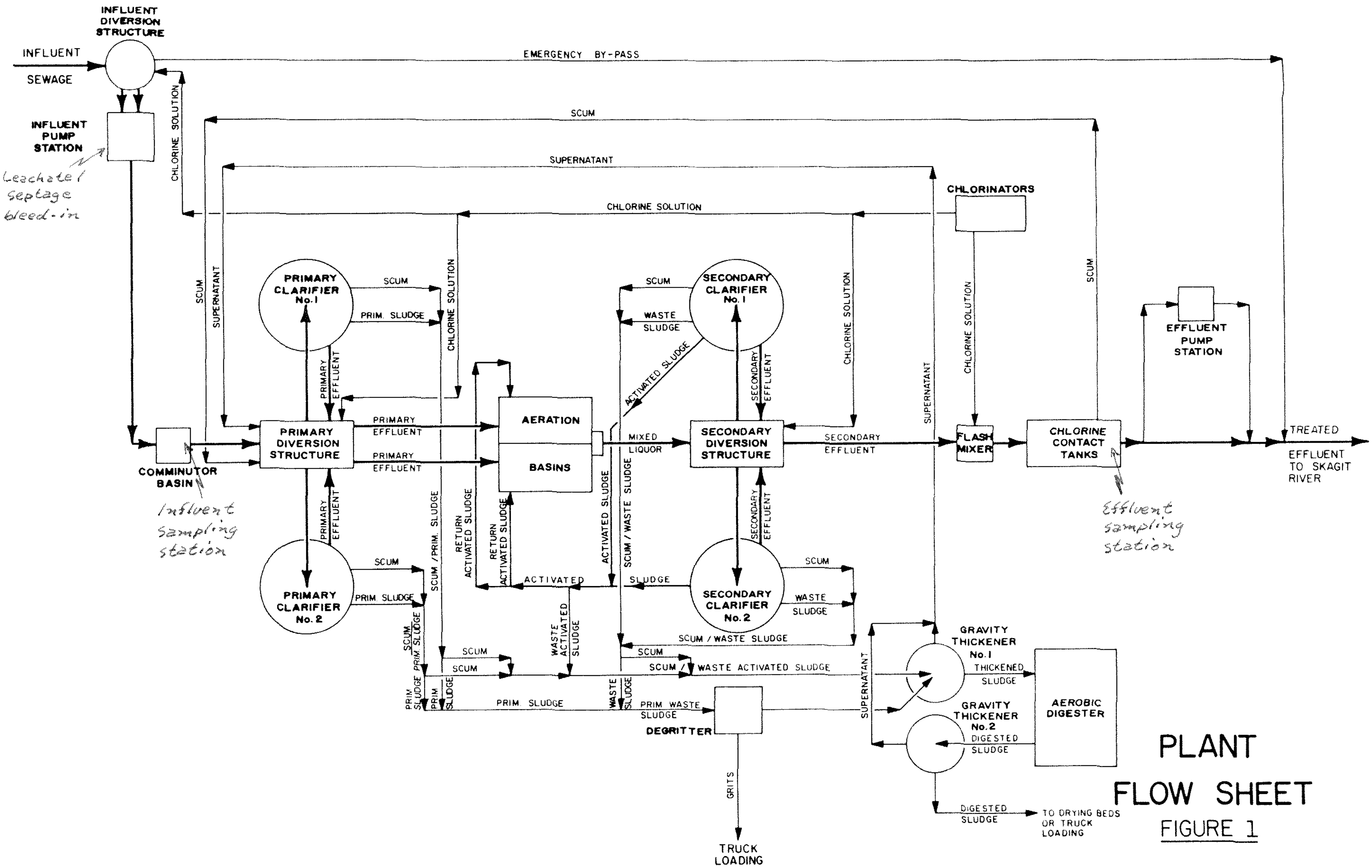

Figure 1. Flow Scheme - Burlington, March 1989 (from Stevens *et al.*, 1976)

TABLES

Table 1 - Priority Pollutant Cleaning and Field Transfer Blank Procedures - Burlington, March 1989.

PRIORITY POLLUTANT SAMPLING EQUIPMENT CLEANING PROCEDURES

1. Wash with laboratory detergent
2. Rinse several times with tap water
3. Rinse with 10% HNO_3 solution
4. Rinse three (3) times with distilled/deionized water
5. Rinse with high purity methylene chloride
6. Rinse with high purity acetone
7. Allow to dry and seal with aluminum foil

FIELD TRANSFER BLANK PROCEDURE

1. Pour organic free water directly into appropriate bottles for parameters to be analyzed from grab samples (VOA).

2. Run approximately 1L of organic free water through a compositor and discard.

3. Run approximately 6L of organic free water through the same compositor and put the water into appropriate bottles for parameters to be analyzed from composite samples (BNA, Pesticide/PCB, and metals).

Table 2 - Samples Collected and Parameters Analyzed - Burlington, March 1989.

Sample:	Influent	Influent	Influent	Influent	Effluent	Effluent	Effluent	Effluent	Upstrm
Date:	3/28	3/28	3/28-29	3/28-29	3/28	3/28	3/28-29	3/28-29	3/28
Time:	0755	1435	0700-0700	0700-0700	0835	1500	0700-0700	0700-0700	1610
Type:	Grab	Grab	ECO-Comp	STP-Comp	Grab	Grab	ECO-Comp	STP-Comp	Grab
Lab Log #:	138230	138231	138232	138233	138234	138235&8	138236	138237	138238
Field Analyses									
pH	E	E			E	E			E
Conductivity	E	E	E		E	E	E		E
Temperature	E	E			E	E			E
Chlorine Residual									
Total					E B	E B			
Free					E	E			
Laboratory Analyses									
Turbidity			E				E		E
Conductivity	E	E	E	E	E	E	E	E	E
Alkalinity			E	E			E	E	
Hardness			E	E			E	E	
Chloride			E	E			E	E	E
Sulfate			E	E			E	E	E
Cyanide			E				E		
TS			E				E		
TNVS			E				E		
TSS	E	E	E B	E B	E	E	E B	E	E
TNVSS			E				E		
BOD_5			E B	E B			E B	E B	
Inhib. BOD_5			E	E			E	E	
COD	E	E	E	E	E	E	E	E	E
TOC									
NH_3-N			E	E			E	E	E
NO_3+NO_2-N			E	E			E	E	E
Total-P			E	E			E	E	E
Fecal Coliform					E B	E			E
pp metals			E	E			E	E	E
Fe			E	E			E	E	E
Mn			E	E			E	E	E
Ba			E	E			E	E	E
BNA			E				E		
VOA	E	E			E	E			
Pest/PCB			E				E		
% Solids									
% Volatile Solids									
Trout							E *		
Microtox							E *		
Daphnia Magna							E *		
TOX						E			

* - collected as a grab composite. Equal volumes collected on 2/28 at 0835, 1150, and 1500.
** - equal volumes collected during 0815 and 0920 grab samples
E - Ecology Laboratory Analysis
B - Burlington Laboratory Analysis

Table 2 - Continued - Burlington

Sample:	Intake	Landfill	Landfill	Landfill	Incnrtr	Fltr Bkwsh	Trns Blk	Aer Basin	Sludge
Date:	3/28	3/28	3/28	3/28	3/28	3/28	3/27	3/29	3/29
Time:	1650	0815	0920	**	0925	0940	1545	0910	0920
Type:	Grab	Grab	Grab	Grab-Comp	Grab	Grab		Grab	Grab
Lab Log #:	138239	138240	138241	138242	138243&5		138246	138249	138247
<u>Field Analyses</u>									
pH	E	E	E		E	E			
Conductivity	E	E	E		E	E			
Temperature		E	E						
Chlorine Residual									
Total									
Free									
<u>Laboratory Analyses</u>									
Turbidity	E								
Conductivity	E	E	E	E	E				
Alkalinity				E	E				
Hardness				E	E				
Chloride	E			E	E				
Sulfate				E	E				
Cyanide									
TS									
TNVS									
TSS	E	E	E	E	E			E	
TNVSS								E	
BOD_5				E	E				
Inhib. BOD_5									
COD	E	E	E	E	E				
TOC									E
NH_3-N	E			E	E				
NO_3+NO_2-N	E			E	E				
Total-P	E			E	E				
Fecal Coliform	E								
pp metals	E			E	E		E		E
Fe	E			E	E				E
Mn	E			E	E				E
Ba	E			E	E				E
BNA				E	E		E		E
VOA		E	E		E		E		E
Pest/PCB				E	E		E		E
% Solids									E
% Volatile Solids									E
Trout									
Microtox									
Daphnia Magna									
TOX									

Table 3 - Ecology Analytical Methods - Burlington, March 1989.

	Method Used for Ecology Analysis (Ecology, 1988 & 1989)	Laboratory Performing Analysis
Laboratory Analyses		
Turbidity	EPA #180.1	Ecology
Conductivity	EPA #120.1	Ecology
Alkalinity	EPA #310.1	Ecology
Hardness	EPA #130.2	Ecology
Chloride	EPA #300.0	Ecology
Sulfate	EPA #300.0	Ecology
NH_3-N	EPA #350.1	Ecology
NO_3+NO_2-N	EPA #353.2	Ecology
Total-P	EPA #365.1	Ecology
TS	EPA #160.3	Ecology
TNVS	EPA #160.4	Ecology
TSS	EPA #160.2	Ecology
TNVSS	EPA #160.4	Ecology
COD	EPA #410.1	Ecology
BOD_5	EPA #405.1	Ecology
Inhib. BOD_5	EPA #405	Ecology
Fecal Coliform (MF)	APHA, 1985: #909C	Ecology
TOC (sed/sludge)	Tetra Tech, 1986	ARI
% Solids	EPA #160.3	ARI
% Volatile Solids	EPA #160.4	ARI
Cyanide	EPA #335.3	Ecology
VOA (water)	EPA #624	ARI
VOA (sed/sludge)	EPA #8240	ARI
BNA (water)	EPA #625	ARI
BNA (sed/sludge)	EPA #8270	ARI
Pest/PCB (water)	EPA #608	ARI
Pest/PCB (sed/sludge)	EPA #8080	ARI
TOX	EPA #9020	Ecology
Metals	EPA #200	ARI
Trout	Ecology, 1981	Ecology
Daphnia Magna	EPA, 1987	Ecology
Microtox (water)	Beckman, 1982	Ecology
Field Analyses		
pH	APHA, 1985: #423	Ecology
Conductivity	APHA, 1985: #205	Ecology
Temperature	APHA, 1985: #212	Ecology
Chlorine Residual	APHA, 1985: #408E	Ecology

ARI - Analytical Resources Inc.

Table 4 - Flow Measurements - Burlington, March 1989.

Date					
Month	Day	Time	Instantaneous flow (MGD)	Totalizer reading	Flow for time increment (MGD)
3	28	745	2.6	20814	
					2.0
3	28	1045	2.0	21061	
					2.0
3	28	1300	1.7	21245	
					1.9
3	28	1430	2.3	21362	
					2.0
3	29	755	2.3	22832	
Average flow during inspection =					2.0

Table 5 - Ecology Laboratory Conventional Parameter Results - Burlington, March 1989.

Sample:	Influent	Influent	Influent	Influent	Effluent	Effluent	Effluent	Effluent
Date:	3/28	3/28	3/28-29	3/28-29	3/28	3/28	3/28-29	3/28-29
Time:	0755	1435	0700-0700	0700-0700	0835	1500	0700-0700	0700-0700
Type:	Grab	Grab	ECO-Comp	STP-Comp	Grab	Grab	ECO-Comp	STP-Comp
Lab Log #:	138230	138231	138232	138233	138234	138235&8	138236	138237
Field Analyses								
pH (S.U.)	7.0	6.9			7.0	6.7		
Conductivity (umhos/cm)	310	490	390		370	384	385	
Temperature (^{o}C)	10.2	12.8			10.4	10.6		
Chlorine Residual (mg/L)								
Total					0.3	0.2		
Free					<0.1	<0.1		
Laboratory Analyses								
Turbidity (NTU)			42				13	
Conductivity (umhos/cm)	325	461	430	390	371	361	420	420
Alkalinity (mg/L as $CaCO_3$)			120	100			110	110
Hardness (mg/L as $CaCO_3$)			88	87			88	89
Chloride (mg/L)			33.2	30.2			35.8	35.7
Sulfate (mg/L)			23.0	21.3			22.8	140
Cyanide (ug/L)			6				2	
TS (mg/L)			411				283	
TNVS (mg/L)			234				180	
TSS (mg/L)	96	410	160	190	26	30	37	60
TNVSS (mg/L)			105				13	
BOD_5 (mg/L)			120	76			25	56
Inhib. BOD_5 (mg/L)			74	32			11	10
COD (mg/L)	130	730	300	206	46	53	72	77
TOC (mg/gm - dry wt)								
NH_3-N (mg/L)			10	5.9			7.3	7.2
NO_3+NO_2-N (mg/L)			1.0	2.8			0.53	0.65
Total-P (mg/L)			2.1	2.0			1.9	1.9
Fecal Coliform (#/100 mL)					260	14		
% Solids								
% Volatile Solids								
TOX (ug/L)						134		

U analyzed for but not found at the given detection limit
LAC laboratory accident
NAI not analyzed due to interference
** equal volumes collected during 0815 and 0920 grab samples

Table 5 - Continued - Burlington

Sample: Date: Time: Type: Lab Log #:	Upstrm 3/28 1610 Grab 138238	Intake 3/28 1650 Grab 138239	Landfill 3/28 0815 Grab 138240	Landfill 3/28 0920 Grab 138241	Landfill 3/28 ** Grab-Comp 138242	Incnrtr 3/28 0925 Grab 138243&5	Fltr Bkwsh 3/28 0940 Grab	Aer Basin 3/29 0910 Grab 138249	Sludge 3/29 0920 Grab 138247
Field Analyses									
pH (S.U.)	7.2	7.6	7.3	7.3		7.6	7.9		
Conductivity (umhos/cm)	60	60	8250	8560		1080	174		
Temperature (°C)	6.6		9.1	9.4					
Chlorine Residual (mg/L)									
Total									
Free									
Laboratory Analyses									
Turbidity (NTU)	3	5							
Conductivity (umhos/cm)	74	75	7400	7700	8350	1150			
Alkalinity (mg/L as $CaCO_3$)					1400	290			
Hardness (mg/L as $CaCO_3$)					2500	320			
Chloride (mg/L)	1.34	1.05			1850	159			
Sulfate (mg/L)	3.56				NAI	44.2			
Cyanide (ug/L)									
TS (mg/L)									
TNVS (mg/L)									
TSS (mg/L)	12	14	370	370	340	180		2000	
TNVSS (mg/L)								LAC	
BOD_5 (mg/L)					1700	340			
Inhib. BOD_5 (mg/L)									
COD (mg/L)	4	4 U	2700	2700	2660	513			
TOC (mg/gm - dry wt)								300	
NH_3-N (mg/L)	0.01	0.01			120	13			
NO_3+NO_2-N (mg/L)	0.17	0.19			0.01	0.02			
Total-P (mg/L)	0.03	0.03			0.59	1.1			
Fecal Coliform (#/100 mL)	3 U	26							
% Solids									5.6
% Volatile Solids									54.5
TOX (ug/L)									

Table 6 - Comparison of Inspection Results with Permit Limits - Burlington, March 1989.

	NPDES Permit Limits		Inspection Data **		
Parameter	Monthly Average	Weekly Average	Ecology Composite	STP Composite	Grab Samples
Influent BOD_5					
(mg/L)			120	76	
(lbs/D)	3181 *		2002	1268	
BOD_5					
(mg/L)	30	45	25	56	
(lbs/D)	400	600	417	934	
(% removal)	85		79	26	
Influent TSS					
(mg/L)			160	190	
(lbs/D)	3181 *		2669	3169	
TSS					
(mg/L)	30	45	37	60	
(lbs/D)	400	600	617	1001	
(% removal)	85		77	68	
Fecal coliform					
(#/100 mL)	200	400			260; 14
pH (S.U.)	shall not be outside the range 6.0 - 9.0				7.0; 6.7
Flow (MGD)	1.61 *		2.0	2.0	

* Design criteria specified in the permit. The flow criteria is the average daily flow of the maximum month. The BOD_5 and TSS loads are the maximum 24-hour load.

** Ecology laboratory results

Table 7 - Priority Pollutants Detected - Burlington, March 1989.

Station:	Influent	Influent	Effluent	Effluent	Landfill	Landfill	Incinerator	Trns Blk	Sludge
Lab Log #:	138230	138231	138234	138235	138240	138241	138243	138246	138247
Date:	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/27	3/29
Time:	0755	1435	0835	1500	0815	0920	0925	1545	0920
---- VOA Compounds ----	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg-dry wt)
Methylene Chloride	3.7 B	3.1 JB	3.8 B	2.8 JB	43 B	110 B	17 B	3.6 B	37 B
Acetone	18	63	7.4	5.0 J	1400	1400	180	970 K	71 M
Carbon Disulfide	-	-	-	-	0.9 J	-	-	-	-
1,2-Dichloroethene (total)	-	-	-	-	7.1	-	-	-	-
Chloroform	9.1	15	8.7	7.9	-	-	16	-	-
2-Butanone	-	29	-	-	1800	2100	460	-	18
1,1,1-Trichloroethane	-	1.2 M	-	-	-	-	-	-	-
Bromodichloromethane	-	0.7 M	-	-	-	-	-	-	-
Benzene	-	1.3	-	-	-	-	-	-	-
4-Methyl-2-Pentanone	-	4.3	-	-	180	210	8.5	-	-
2-Hexanone	-	-	-	-	85	81	2.2	-	-
Toluene	2.5	12	-	-	93	130	1.5	-	320
Ethylbenzene	-	1.1	-	-	10	-	1.3	-	-
Total Xylenes	4.6	5.4	-	-	20	-	11	-	-

Station:	Influent	Effluent	Landfill	Incinerator	Trns Blk	Sludge
Type:	ECO-Comp	ECO-Comp	ECO-Comp	Grab		Grab
Lab Log #:	138232	138236	138242	138245	138246	138247
Date:	3/28-29	3/28-29	3/28	3/28	3/27	3/29
Cyanide (ug/L)	6	2				
---- BNA Compounds ----	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg-dry wt)
Phenol	2 M	-	360	14	-	65 M
1,4-Dichlorobenzene	1 M	-	-	-	-	-
Benzyl Alcohol	5	-	-	4 M	-	-
2-Methylphenol	-	-	36	1 M	-	-
4-Methylphenol	12	-	1600	110	-	1700
Naphthalene	1 J	-	-	-	-	-
2-Methylnaphthalene	1 J	-	-	-	-	-
Dimethyl Phthalate	-	-	-	1	-	-
Diethyl Phthalate	2	-	44	5	-	-
Pentachlorophenol	-	-	4 M	-	-	-
Phenanthrene	-	-	-	1 M	-	-
Bis(2-Ethylhexyl)phthalate	9	2	2	-	3	610
---- Pest/PCB Compounds ----						(mg/Kg-dry wt)
gamma-BHC (Lindane)	-	-	-	-	-	0.03 J
gamma-Chlordane	-	-	-	-	-	0.03 J

Table 7 - Continued

Station:	Influent	Influent	Effluent	Effluent	Landfill	Incinerator	Trns Blk	Sludge
Type:	ECO-Comp	STP-Comp	ECO-Comp	STP-Comp	ECO-Comp	Grab		Grab
Lab Log #:	138232	138233	138236	128237	138242	138245	138246	138247
Date:	3/28-29	3/28-29	3/28-29	3/28-29	3/28	3/28	3/27	3/29
---- Metals** ----	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/Kg-dry)
Antimony	-	-	1.1	1.1	4.0	14.0	-	5.44
Arsenic	3.0	1.4	-	-	13.0	3.2	-	11.0
Barium+	60	45	20	25	720	57		443
Cadmium	0.68	0.56	0.27	1.04	1.35	6	0.28	8.6
Chromium	16	13	8	10	27	8	-	190
Copper	121	123	36	53	77	129	-	994
Iron+	4460	3100	1260	1660	35500	8940		30200
Lead	30	36.0	14.0	18.4	35.6	140	1.9	579
Manganese+	259	203	200	211	6920	363		977
Mercury	0.7	0.6	-	0.2	0.1	1.9	-	4.12
Nickel	10	-	-	-	60	-	-	47
Silver	4	1.60	0.85	1.38	0.75	0.62	-	45.1
Zinc	178	197	62	1500	422	692	30	1090

J indicates an estimated value when result is less than specified detection limit

B This flag is used when the analyte is found in the blank as well as the sample. Indicates possible/probable blank contamination

M indicates an estimated value of analyte found and confirmed by analyst but with low spectral match parameters

K the quantified value falls above the limit of calibration and a dilution should be run

+ non-priority pollutant metals collected as background for SWIS metals review

** total recoverable except - total metal for mercury at all stations and total metals for all sludge sample metals (lab log #138247).

Table 8 - Comparison of Effluent Data to Toxicity Criteria - Burlington, March 1989.

Station:	Effluent	Effluent	Freshwater Toxicity Criteria (EPA, 1986b)	
Lab Log #:	138234	138235		
Date:	3/28	3/28		
Time:	0835	1500	Acute	Chronic
---- VOA Compounds ----	(ug/L)	(ug/L)		
Methylene Chloride	3.8 B	2.8 JB		
Acetone	7.4	5.0 J		
Chloroform	8.7	7.9	28900 *	1240 *

Station:	Effluent	Effluent	Acute	Chronic
Type:	ECO-Comp	STP-Comp		
Lab Log #:	138236	128237		
Date:	3/28-29	3/28-29		
	(ug/L)	(ug/L)		
Cyanide	2		22	5.2
---- BNA Compounds ----				
Bis(2-Ethylhexyl)phthalate	2		940 **	3 **
---- Metals*+ ----				
Antimony	1.1	1.1	9000 *	1600 *
Barium++	20	25		
Cadmium	0.27	1.04	3.4 +	1.0+
Chromium	8	10		
(Hex)			16	11
(Tri)			1564 +	186 +
Copper	36	53	16 +	11 +
Iron++	1260	1660		1000
Lead	14.0	18.4	69 +	2.7+
Manganese++	200	211		
Mercury	-	0.2	2.4	0.012
Silver	0.85	1.38	3.3 +	0.12
Zinc	62	1500	105 +	95 +

J indicates an estimated value when result is less than specified detection limit
B This flag is used when the analyte is found in the blank as well as the sample. Indicates possible/probable blank contamination
* insufficient data to develop criteria - Lowest Observed Effect Level (LOEL) presented
** LOEL for Total Phthalate Esters
\+ calculation based on hardness (88 mg/L)
++ non-pp metals
*+ total recoverable except Hg which is total

Table 9 - Sludge Metals Comparison - Burlington, March 1989.

Sample:	Sludge	Statewide Class II Sludge Data ***		
Lab Log #:	138247	Geometric		
Date:	3/29	Mean	Range	# Sampled
	(mg/Kg dry wt)			
Cadmium	8.6	7.6	<0.1-25	34
Chromium	190	62	15-300	34
Copper	994	400	75-1700	34
Lead	579	210	34-600	34
Nickel	47	26	<0.1-62	29
Zinc	1090	1200	165-3370	33

*** summary of data collected during previous class II inspections statewide at activated sludge plants (Hallinan, 1988)

Table 10 - Effluent Bioassay Results - Burlington, March 1989.

Rainbow Trout (*Oncorhynchus mykiss*) - 96 hour survival test

Sample	# Tested	# Survived	Percent Mortality	Percent Survival
Control	30	30	0	100
100 % Effluent	30	30	0	100

Daphnia magna - 7 day survival and reproduction test

		after 7 days			
Sample	# Tested	# Survived	Percent Mortality	Percent Survival	Mean # Young per Original Female
Control	10	10	0	100	6.2
1% Effluent	10	10	0	100	7.8
3% Effluent	10	10	0	100	8.9
10% Effluent	10	10	0	100	10.9
30% Effluent	10	10	0	100	16.7
100% Effluent	10	10	0	100	25.4

Acute
LC_{50} > 100% effluent
NOEC = 100 % effluent

Chronic
NOEC = 100% effluent

Microtox

	EC_{50} (% effluent)	Ranking *
5 minutes	84	low
15 minutes	84	low
30 minutes	66	moderate

NOEC - no observable effects concent.
LOEC - lowest observable effects concent.
LC_{50} - lethal concent. for 50% of the organ.
EC_{50} - effect concent. for 50% of the organ.

* - priority ranking for further toxicity evaluation based on the EC_{50} (EPA, 1980)

Table 11 - Comparison of Ecology and Burlington Lab Results - Burlington, March 1989.

	Sample:	Influent	Influent	Effluent	Effluent	Effluent	Effluent
	Date:	3/28-29	3/28-29	3/28	3/28	3/28-29	3/28-29
	Time:	0700-0700	0700-0700	0835	1500	0700-0700	0700-0700
	Type:	ECO-Comp	STP-Comp	Grab	Grab	ECO-Comp	STP-Comp
	Lab Log #:	138232	138233	138234	138235&8	138236	138237
Parameter	Laboratory						
Total Chlorine	Ecology			0.3	0.2		
Residual (mg/L)	Burlington			0.4	0.3		
TSS (mg/L)	Ecology	160	190			37	60
	Burlington	160	119			30	
BOD_5 (mg/L)	Ecology	120	76			25	56
	Burlington	182	140			25	39
Fecal Coliform	Ecology			260			
(#/100 mL)	Burlington			2684			

APPENDIX

Appendix A - River Sample Results - Burlington, March 1989.

Sample:	Upstream		Intake	
Date:	3/28		3/28	
Time:	1610		1650	
Type:	Grab		Grab	
Lab Log #:	138238		138239	
<u>Field Analyses</u>				
pH (S.U.)	7.2		7.6	
Conductivity (umhos/cm)	60		60	
Temperature (°C)	6.6			
<u>Laboratory Analyses</u>				
Turbidity (NTU)	3		5	
Conductivity (umhos/cm)	74		75	
Chloride (mg/L)	1.34		1.05	
Sulfate (mg/L)	3.56			
TSS (mg/L)	12		14	
COD (mg/L)	4		4	U
NH_3-N (mg/L)	0.01		0.01	
NO_3+NO_2-N (mg/L)	0.17		0.19	
Total-P (mg/L)	0.03		0.03	
Fecal Coliform (#/100 mL)	3	U	26	
---- Metals * ----	(ug/L)		(ug/L)	
Antimony	1.1		1.0	U
Arsenic	1.0	U	1.0	U
Barium	10		10	
Beryllium	1	U	1	U
Cadmium	0.20	U	0.20	U
Chromium	1.0		1.6	
Copper	3		6	
Iron	324		476	
Lead	1.0	U	1.7	
Manganese	11		15	
Mercury	0.1	U	0.1	U
Nickel	10	U	10	U
Selenium	1.0	U	1.0	U
Silver	0.20	U	0.20	U
Thallium	1.0	U	1.0	U
Zinc	9		7	

* total recoverable metals except for mercury which is total
U analyzed for but not found at the given detection limit

APPENDIX A

CHRISTINE O. GREGOIRE
Director

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
7171 Cleanwater Lane, Building 8, LH-14 • Olympia, Washington

March 7, 1990

TO: Dave Nunnallee

THROUGH: Lynn Singleton

FROM: Barbara Carey

SUBJECT: Survey of Metals and Organics in the Skagit River Below the Burlington Wastewater Treatment Plant

In response to your concern about human health effects from the Burlington Wastewater Treatment Plant (WTP) effluent on the downstream City of Anacortes Water Treatment Plant, Environmental Investigations Surface Water Investigations and Compliance Monitoring Sections cooperated in a survey of the effluent and receiving water on March 28 - 29, 1989.

Grab samples were collected upstream of the WTP at the Highway 1A bridge just below Sedro Wooley and at the City of Anacortes Water Treatment Plant intake. Two 24-hour WTP effluent composites and two grab samples were analyzed. Priority pollutant metals were analyzed at all three sites as well as other parameters for which drinking water standards exist. The effluent was also analyzed for pesticides and PCB's; volatile organics; and acid extractables/base neutrals. Field blanks were likewise submitted to the laboratory for priority pollutant metals and all organic analyses. Samples were iced and shipped to Ecology's Manchester laboratory. From there, samples were transported to a contract laboratory for analysis.

The mean river flow during the survey was 12,100 cubic feet/second (cfs) at the USGS gaging station near Mount Vernon (Gage No. 12200500). Despite the fact that WTP flow during the survey (3.1 cfs) exceeded the 2.5 cfs design capacity for the plant, dilution was 4,000. Dilution at design capacity and the 7-day, 10-year (7Q10) low river flow is still quite good at 1900.

Concentrations for all primary drinking water parameters were below the maximum Contaminant Levels (MCL's) (Health, 1989) even prior to mixing (Table 1). After mixing at the observed ratio of 4,000 or the 7Q10 design ratio of 1,900, loading of these constituents to the river is insignificant.

The secondary drinking water parameters, iron and manganese, exceeded standards in the effluent. However, total loading to the river was insufficient to cause a significant increase in downstream concentrations. Indeed iron exceeded the drinking water standard at both the upstream site and the downstream drinking water intake, while manganese was well below the standard at both upstream and downstream sites.

Chloroform was detected in both the morning and evening effluent grab samples collected on March 28 (Appendix). The observed concentrations of 7.9 and 8.7 ug/L are below the $10^{(-6)}$ health risk criteria even before a worst case dilution of 1,900 (Nash, 1989). Since chloroform is a volatile compound, a portion of that discharged to the river would be lost before reaching the Anacortes Water Treatment plant. Nevertheless, as a known carcinogen, chloroform at any level is undesirable.

A suspected carcinogen, bis(2-ethylhexyl)phthalate, was also detected at low levels in the effluent composite sample (2 ug/L). However, both cancer and non-cancer health risks were below $10^{(-6)}$ risk at this concentration even before any dilution (Nash, 1989). All other organic compounds analyses were unremarkable.

Although results of this study do not indicate health problems for the Anacortes Water Treatment Plant due to the Burlington WTP in March 1988, seasonal and day-to-day variation in effluent composition likely occurs. Additional sampling requirements could be imposed to further characterize effluent quality. Any sampling should target primary drinking water parameters and organics, attention should be given to quality assurance/quality control, including collection of field blanks and duplicates. If analyses identified any compounds of concern, the Anacortes Water Treatment Plant should be notified immediately.

References

Health, Washington Department of. 1989. Public Water Systems Rules and Regulations. Chapter 248-54.

Nash, D. 1989. Washington Department of Health. Environmental Health Program. Personal communication.

LS:krc

Table 1. Burlington Metals Data (mg/L).

Primary & Secondary Drinking Water Parameters	Upstream	Effluent (Ecology)	Effluent (WTP)	DW Intake	Blank	Primary Drinking Water Standard	Secondary Drinking Water Standards
Antimony	0.0011	0.0011	0.0011	0.0010 L	0.0010 L		
Arsenic	0.0010 L	0.0010 L	0.0010 L	0.0010 L	0.0010 L	0.050	
Barium	0.010	0.020	0.025	0.010	---	1.000	
Beryllium	0.001 L	0.001 L	0.001 L	0.001 L	0.001 L		
Cadmium	0.00020 L	0.00027	0.00104	0.00020 L	0.00028	0.010	
Chromium	0.001	0.008	0.010	0.002	0.001 L	0.050	
Copper	0.003	0.036	0.053	0.006	0.001 L		1.0
Iron	0.324	1.26	1.660	0.476	---		0.30
Lead	0.001 L	0.014	0.0184	0.002	0.002	0.050	
Manganese	0.011	0.200	0.211	0.015	---		0.050
Mercury	0.0001 L	0.0001	0.0002	0.0001 L	0.0001 L	0.002	
Nickel	0.01 L	0.01 L	0.010 L	0.01 L	0.01 L		
Selenium	0.0010 L	0.0010 L	0.001 L	0.0010 L	0.0010 L	0.010	
Silver	0.00020 L	0.00085	0.00138	0.00020 L	0.00020 L	0.050	
Thallium	0.0010 L	0.0010 L	0.0010 L	0.0010 L	0.0010 L		
Zinc	0.009	0.062	1.50	0.007	0.030		5.0

* L = Analyte detected at the reported concentration level.

--- Not Analyzed

Appendix B - VOA, BNA, Pest/PCB and Metal Scan Results - Burlington, March 1989.

Station:	Influent	Influent	Effluent	Effluent	Landfill	Landfill	Incinerator	Trns Blk	Sludge
Lab Log #:	138230	138231	138234	138235	138240	138241	138243	138246	138247
Date:	3/28	3/28	3/28	3/28	3/28	3/28	3/28	3/27	3/29
Time:	0755	1435	0835	1500	0815	0920	0925	1545	0920
---- VOA Compounds ----	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg-dry wt)
Chloromethane	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	76 U	3.8 U	3.8 U	7.6 U
Bromomethane	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	62 U	3.1 U	3.1 U	6.2 U
Vinyl Chloride	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	40 U	2.0 U	2.0 U	4.0 U
Chloroethane	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	66 U	3.3 U	3.3 U	6.6 U
Methylene Chloride	3.7 B	3.1 JB	3.8 B	2.8 JB	43 B	110 B	17 B	3.6 B	37 B
Acetone	18	63	7.4	5.0 J	1400	1400	180	970 K	71 M
Carbon Disulfide	1.2 U	1.2 U	1.2 U	1.2 U	0.9 J	24 U	1.2 U	1.2 U	2.4 U
1,1-Dichloroethene	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	14 U	0.7 U	0.7 U	1.4 U
1,1-Dichloroethane	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	12 U	0.6 U	0.6 U	1.2 U
1,2-Dichloroethene (total)	0.8 U	0.8 U	0.8 U	0.8 U	7.1	16 U	0.8 U	0.8 U	1.6 U
Chloroform	9.1	15	8.7	7.9	1.1 U	22 U	16	1.1 U	2.2 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	1.0 U
2-Butanone	6.2 U	29	6.2 U	6.2 U	1800	2100	460	6.2 U	18
1,1,1-Trichloroethane	0.6 U	1.2 M	0.6 U	0.6 U	0.6 U	12 U	0.6 U	0.6 U	1.2 U
Carbon Tetrachloride	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	18 U	0.9 U	0.9 U	1.8 U
Vinyl Acetate	3.1 U	3.1 U	3.1 U	3.1 U	3.1 U	62 U	3.1 U	3.1 U	6.2 U
Bromodichloromethane	0.3 U	0.7 M	0.3 U	0.3 U	0.3 U	6.0 U	0.3 U	0.3 U	0.6 U
1,2-Dichloropropane	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	14 U	0.7 U	0.7 U	1.4 U
trans-1,3-Dichloropropene	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	36 U	1.8 U	1.8 U	3.6 U
Trichloroethene	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	12 U	0.6 U	0.6 U	1.2 U
Dibromochloromethane	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	14 U	0.7 U	0.7 U	1.4 U
1,1,2-Trichloroethane	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	14 U	0.7 U	0.7 U	1.4 U
Benzene	1.0 U	1.3	1.0 U	1.0 U	2.0 UJ	20 U	1.0 U	1.0 U	2.0 U
cis-1,3-Dichloropropene	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	38 U	1.9 U	1.9 U	3.8 U
2-Chloroethylvinylether	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	54 U	2.7 U	2.7 U	5.4 U
Bromoform	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	50 U	2.5 U	2.5 U	5.0 U
4-Methyl-2-Pentanone	3.5 U	4.3	3.5 U	3.5 U	180	210	8.5	3.5 U	7.0 U
2-Hexanone	3.2 U	3.2 U	3.2 U	3.2 U	85	81	2.2	3.2 U	6.4 U
Tetrachloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10 U	0.5 U	0.5 U	1.0 U
1,1,2,2-Tetrachloroethane	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	54 U	2.7 U	2.7 U	5.4 U
Toluene	2.5	12	0.8 U	0.8 U	93	130	1.5	0.8 U	320
Chlorobenzene	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	18 U	0.9 U	0.9 U	1.8 U
Ethylbenzene	0.8 U	1.1	0.8 U	0.8 U	10	16 U	1.3	0.8 U	1.6 U
Styrene	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	22 U	1.1 U	1.1 U	2.2 U
Total Xylenes	4.6	5.4	1.8 U	1.8 U	20	36 U	11	1.8 U	3.6 U

Appendix B - Continued - Burlington

Station:	Influent	Effluent	Landfill	Incinerator	Trns Blk	Sludge
Type:	ECO-Comp	ECO-Comp	Grab-Comp	Grab		Grab
Lab Log #:	138232	138236	138242	138245	138246	138247
Date:	3/28-29	3/28-29	3/28	3/28	3/27	3/29
Cyanide (ug/L)	6	2				
---- BNA Compounds ----	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg-dry wt)
Phenol	2 M	1 U	360	14	1 U	65 M
Bis(2-Chloroethyl)Ether	1 U	1 U	1 U	1 U	1 U	63 U
2-Chlorophenol	1 U	1 U	1 U	1 U	1 U	63 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	63 U
1,4-Dichlorobenzene	1 M	1 U	1 U	1 U	1 U	63 U
Benzyl Alcohol	5	5 U	10 U	4 M	5 U	310 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	63 U
2-Methylphenol	1 U	1 U	36	1 M	1 U	63 U
Bis(2-chloroisopropyl)ether	1 U	1 U	1 U	1 U	1 U	63 U
4-Methylphenol	12	1 U	1600	110	1 U	1700
N-Nitroso-Di-n-Propylamine	1 U	1 U	1 U	1 U	1 U	63 U
Hexachloroethane	2 U	2 U	2 U	2 U	2 U	130 U
Nitrobenzene	1 U	1 U	1 U	1 U	1 U	63 U
Isophorone	1 U	1 U	1 U	1 U	1 U	63 U
2-Nitrophenol	5 U	5 U	5 U	5 U	5 U	310 U
2,4-Dimethylphenol	2 U	2 U	2 U	2 U	2 U	130 U
Benzoic Acid	10 U	10 U	10 U	10 U	10 U	630 U
Bis(2-Chloroethoxy)Methane	1 U	1 U	1 U	1 U	1 U	63 U
2,4-Dichlorophenol	3 U	3 U	3 U	3 U	3 U	190 U
1,2,4-Trichlorobenzene	1 U	1 U	1 U	1 U	1 U	63 U
Naphthalene	1 J	1 U	1 U	1 U	1 U	63 U
4-Chloroaniline	3 U	3 U	3 U	3 U	3 U	190 U
Hexachlorobutadiene	2 U	2 U	2 U	2 U	2 U	130 U
4-Chloro-3-Methylphenol	2 U	2 U	2 U	2 U	2 U	130 U
2-Methylnaphthalene	1 J	1 U	1 U	1 U	1 U	63 U
Hexachlorocyclopentadiene	5 U	5 U	5 U	5 U	5 U	310 U
2,4,6-Trichlorophenol	5 U	5 U	5 U	5 U	5 U	310 U
2,4,5-Trichlorophenol	5 U	5 U	5 U	5 U	5 U	310 U
2-Chloronaphthalene	1 U	1 U	1 U	1 U	1 U	63 U
2-Nitroaniline	5 U	5 U	5 U	5 U	5 U	310 U
Dimethyl Phthalate	1 U	1 U	1 U	1	1 U	63 U
Acenaphthylene	1 U	1 U	1 U	1 U	1 U	63 U
3-Nitroaniline	5 U	5 U	5 U	5 U	5 U	310 U
Acenaphthene	1 U	1 U	1 U	1 U	1 U	63 U
2,4-Dinitrophenol	10 U	10 U	10 U	10 U	10 U	630 U
4-Nitrophenol	5 U	5 U	5 U	5 U	5 U	310 U
Dibenzofuran	1 U	1 U	1 U	1 U	1 U	63 U
2,4-Dinitrotoluene	5 U	5 U	5 U	5 U	5 U	310 U
2,6-Dinitrotoluene	5 U	5 U	5 U	5 U	5 U	310 U
Diethyl Phthalate	2	1 U	44	5	1 U	63 U
4-Chlorophenyl-Phenylether	1 U	1 U	1 U	1 U	1 U	63 U
Fluorene	1 U	1 U	1 U	1 U	1 U	63 U
4-Nitroaniline	5 U	5 U	5 U	5 U	5 U	310 U
4,6-Dinitro-2-Methylphenol	10 U	10 U	10 U	10 U	10 U	630 U
N-Nitrosodiphenylamine	1 U	1 U	1 U	1 U	1 U	63 U
4-Bromophenyl-Phenylether	1 U	1 U	1 U	1 U	1 U	63 U
Hexachlorobenzene	1 U	1 U	1 U	1 U	1 U	63 U
Pentachlorophenol	5 U	5 U	4 M	5 U	5 U	310 U
Phenanthrene	1 U	1 U	1 U	1 M	1 U	63 U
Anthracene	1 U	1 U	1 U	1 U	1 U	63 U
Di-n-Butyl Phthalate	1 U	1 U	1 U	1 U	1 U	63 U
Fluoranthene	1 U	1 U	1 U	1 U	1 U	31 J

Station:	Influent	Effluent	Landfill	Incinerator	Trns Blk	Sludge
Type:	ECO-Comp	ECO-Comp	Grab-Comp	Grab		Grab
Lab Log #:	138232	138236	138242	138245	138246	138247
Date:	3/28-29	3/28-29	3/28	3/28	3/27	3/29
---- BNA Compounds ----	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg-dry wt)
Pyrene	1 U	1 U	1 U	1 U	1 U	22 J
Butylbenxylphthalate	1 U	1 U	1 U	1 U	1 U	63 U
3,3'-Dichlorobenzidine	5 U	5 U	5 U	5 U	5 U	310 U
Benzo(a)Anthracene	1 U	1 U	1 U	1 U	1 U	22 M
Bis(2-Ethylhexyl)phthalate	9	2	2	1 U	3	610
Chrysene	1 U	1 U	1 U	1 U	1 U	32 J
Di-n-Octyl Phthalate	1 U	1 U	1 U	1 U	1 U	63 U
Benzo(b)Fluoranthene	1 U	1 U	1 U	1 U	1 U	53 M*
Benzo(k)Fluoranthene	1 U	1 U	1 U	1 U	1 U	*
Benzo(a)Pyrene	1 U	1 U	1 U	1 U	1 U	63 U
Indeno(1,2,3-cd)Pyrene	1 U	1 U	1 U	1 U	1 U	63 U
Dibenzo(a,h)Anthracene	1 U	1 U	1 U	1 U	1 U	63 U
Benzo(g,h,i)Perylene	1 U	1 U	1 U	1 U	1 U	63 U

---- Pest/PCB Compounds ----						(mg/Kg-dry wt)
alpha-BHC	0.04 U	0.04 U	0.16 U	0.04 U	0.04 U	0.04 U
beta-BHC	0.04 U	0.04 U	0.16 U	0.04 U	0.04 U	0.04 U
delta-BHC	0.04 U	0.04 U	0.16 U	0.04 U	0.04 U	0.04 U
gamma-BHC (Lindane)	0.04 U	0.04 U	0.16 U	0.04 U	0.04 U	0.03 J
Heptachlor	0.04 U	0.04 U	0.16 U	0.04 U	0.04 U	0.04 U
Aldrin	0.04 U	0.04 U	0.16 U	0.05 U	0.04 U	0.12 U
Heptachlor Epoxide	0.04 U	0.04 U	0.16 U	0.04 U	0.04 U	0.04 U
Endosulfan I	0.04 U	0.04 U	0.16 U	0.04 U	0.04 U	0.04 U
Dieldrin	0.06 U	0.06 U	0.24 U	0.06 U	0.06 U	0.06 U
4,4'-DDE	0.06 U	0.06 U	0.24 U	0.06 U	0.06 U	0.06 U
Endrin	0.06 U	0.06 U	0.24 U	0.06 U	0.06 U	0.06 U
Endosulfan II	0.06 U	0.06 U	0.24 U	0.06 U	0.06 U	0.06 U
4,4'-DDD	0.12 U	0.12 U	0.48 U	0.12 U	0.12 U	0.12 U
Endosulfan Sulfate	0.12 U	0.12 U	0.48 U	0.12 U	0.12 U	0.12 U
4,4'-DDT	0.08 U	0.08 U	0.32 U	0.08 U	0.08 U	0.08 U
Methoxychlor	0.16 U	0.16 U	0.64 U	0.16 U	0.16 U	0.16 U
Endrin Ketone	0.06 U	0.06 U	0.24 U	0.06 U	0.06 U	0.06 U
alpha-Chlordane	0.04 U	0.04 U	0.16 U	0.04 U	0.04 U	0.04 U
gamma-Chlordane	0.04 U	0.04 U	0.16 U	0.04 U	0.04 U	0.03 J
Toxaphene	60 U	60 U	240 U	60 U	60 U	60 U
Aroclor-1242/1016	0.8 U	0.8 U	3.2 U	0.8 U	0.8 U	0.8 U
Aroclor-1248	0.8 U	0.8 U	3.2 U	0.8 U	0.8 U	0.8 U
Aroclor-1254	0.8 U	0.8 U	3.2 U	0.8 U	0.8 U	0.8 U
Aroclor-1260	0.8 U	0.8 U	3.2 U	0.8 U	0.8 U	0.8 U

Appendix B - Continued - Burlington

Station:	Influent	Influent	Effluent	Effluent	Landfill	Incinerator	Trns Blk	Sludge	Upstream	Intake
Type:	ECO-Comp	STP-Comp	ECO-Comp	STP-Comp	ECO-Comp	Grab		Grab	Grab	Grab
Lab Log #:	138232	138233	138236	138237	138242	138245	138246	138247	138238	138239
Date:	3/28-29	3/28-29	3/28-29	3/28-29	3/28	3/28	3/27	3/29	3/28	3/28
---- Metals** ----	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/Kg-dry)	(ug/L)	(ug/L)
Antimony	1.0 U	1.0 U	1.1	1.1	4.0	14.0	1.0 U	5.44	1.1	1.0 U
Arsenic	3.0	1.4	1.0 U	1.0 U	13.0	3.2	1.0 U	11.0	1.0 U	1.0 U
Barium+	60	45	20	25	720	57		443	10	10
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.7 U	1 U	1 U
Cadmium	0.68	0.56	0.27	1.04	1.35	6	0.28	8.6	0.20 U	0.20 U
Chromium	16	13	8	10	27	8	1.0 U	190	1.0	1.6
Copper	121	123	36	53	77	129	1.0 U	994	3	6
Iron+	4460	3100	1260	1660	35500	8940		30200	324	476
Lead	30	36.0	14.0	18.4	35.6	140	1.9	579	1.0 U	1.7
Manganese+	259	203	200	211	6920	363		977	11	15
Mercury	0.7	0.6	0.1 U	0.2	0.1	1.9	0.1 U	4.12	0.1 U	0.1 U
Nickel	10	10 U	10 U	10 U	60	10 U	10 U	47	10 U	10 U
Selenium	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	3.45 U	1.0 U	1.0 U
Silver	4	1.60	0.85	1.38	0.75	0.62	0.20 U	45.1	0.20 U	0.20 U
Thallium	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.73 U	1.0 U	1.0 U
Zinc	178	197	62	1500	422	692	30	1090	9	7

U indicates compound was analyzed for but not detected at the given detection limit

J indicates an estimated value when result is less than specified detection limit

B This flag is used when the analyte is found in the blank as well as the sample. Indicates possible/probable blank contamination

M indicates an estimated value of analyte found and confirmed by analyst but with low spectral match parameters

K The quantified value falls above the limit of calibration and a dilution should be run

* Benzo (B+K) Fluoranthene

** Total recoverable except - Total metals for mercury at all stations and total metals for sludge sample metals (lab log #138247).

\+ non-priority pollutant metal collected as background for SWIS metals review (Carey, 1990)

APPENDIX C

Laboratory Procedure Review Sheet

Discharger: Burlington

Date: 3/28/89

Discharger representative: Bud Brink

Ecology reviewer: Marc Heffner

Instructions

Questionnaire for use reviewing laboratory procedures. Circled numbers indicate work is needed in that area to bring procedures into compliance with approved techniques. References are sited to help give guidance for making improvements. References sited include:

Ecology = Department of Ecology Laboratory User's Manual, December 8, 1986.

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

SSM = WPCF, Simplified Laboratory Procedures for Wastewater Examination, 3rd ed., 1985.

Sample Collection Review

1. Are grab, hand composite, or automatic composite samples collected for influent and effluent BOD and TSS analysis?

2. If automatic compositor, what type of compositor is used? Sirco
   The compositor should have pre and post purge cycles unless it is a flow through type. Check if you are unfamiliar with the type being used.

3. Are composite samples collected based on time or flow?

4. What is the usual day(s) of sample collection? daily - BOD set-up Wed

5. What time does sample collection usually begin? 0700

6. How long does sample collection last? 24 hrs

7. How often are subsamples that make up the composite collected? hourly

8. What volume is each subsample? ≈ 375 ml

9. What is the final volume of sample collected? ≈ 2½ gal

10. Is the composite cooled during collection? yes

11. To what temperature?
The sample should be maintained at approximately 4 degrees C (SM p41, #5b: SSM p2).

12. How is the sample cooled?
Mechanical refrigeration or ice are acceptable. Blue ice or similar products are often inadequate.

13. How often is the temperature measured? seldom
The temperature should be checked at least monthly to assure adequate cooling.

14. Are the sampling locations representative? check inf. - may be in solids

15. Are any return lines located upstream of the influent sampling location? no
This should be avoided whenever possible.

16. How is the sample mixed prior to withdrawal of a subsample for analysis? yes
The sample should be thoroughly mixed.

17. How is the subsample stored prior to analysis? set up same day
The sample should be refrigerated (4 degrees C) until about 1 hour before analysis, at which time it is allowed to warm to room temperature.

18. What is the cleaning frequency of the collection jugs? daily rinse
The jugs should be thoroughly rinsed after each sample is complete and occasionally be washed with a non-phospate detergent. scrub weekly

19. How often are the sampler lines cleaned? never
Rinsing lines with a chlorine solution every three months or more often where necessary is suggested.

pH Test Review

1. How is the pH measured? Beckmen
A meter should be used. Use of paper or a colorimetric test is inadequate and those procedures are not listed in Standard Methods (SM p429).

2. How often is the meter calibrated? 1X - 2wks
The meter should be calibrated every day it is used.

3. What buffers are used for calibration? 4 & 10 - 7 check
Two buffers bracketing the pH of the sample being tested should be used.

If the meter can only be calibrated with one buffer, the buffer closest in pH to the sample should be used. A second buffer, which brackets the pH of the sample should be used as a check. If the meter cannot accurately determine the pH of the second buffer, the meter should be repaired.

BOD Test Review

1. What reference is used for the BOD test?
   Standard Methods or the Ecology handout should be used.

2. How often are BODs run? weekly
   The minimum frequency is specified in the permit.

3. How long after sample collection is the test begun? same day
   The test should begin within 24 hours of composite sample completion (Ecology Lab Users Manual p42). Starting the test as soon after samples are complete is desirable.

4. Is distilled or deionized water used for preparing dilution water?
   – Store in dark

5. Is the distilled water made with a copper free still?
   Copper stills can leave a copper residual in the water which can be toxic to the test (SSM p36). Barnstead still – tin lined ?

6. Are any nitrification inhibitors used in the test? no What?
   2-chloro-6(trichloro methyl) pyridine or Hach Nitrification Inhibitor 2533 may be used only if carbonaceous BODs are being determined (SM p 527, #4g: SSM p 37).

7. Are the 4 nutrient buffers of powder pillows used to make dilution water?
   If the nutrients are used, how much buffer per liter of dilution water are added? ok
   1 mL per liter should be added (SM p527, #5a: SSM p37).

8. How often is the dilution water prepared? when used
   Dilution water should be made for each set of BODs run.

9. Is the dilution water aged prior to use? none
   Dilution water with nitrification inhibitor can be aged for a week before use (SM p528, #5b).
   Dilution water without inhibitor should not be aged.

10. Have any of the samples been frozen? no
    If yes, are they seeded?
    Samples that have been frozen should be seeded (SSM p38).

11. Is the pH of all samples between 6.5 and 7.5? ok
    If no, is the sample pH adjusted?
    The sample pH should be adjusted to between 6.5 and 7.5 with 1N NaOH or 1N H2SO4 if 6.5 > pH >7.5 if caustic alkalinity or acidity is present (SM p529, #5e1: SSM p37).
    High pH from lagoons is usually not caustic. Place the sample in the dark to warm up, then check the pH to see if adjustment is necessary.

    If the sample pH is adjusted, is the sample seeded?
    The sample should be seeded to assure adequate microbial activity if the pH is adjusted (SM p528, #5d).

12. Have any of the samples been chlorinated or ozonated?
If chlorinated are they checked for chlorine residual and dechlorinated as necessessary? yes
How are they dechlorinated? thiosulfate
Samples should be dechlorinated with sodium sulfite (SM p529, #5e2: SSM p38), but dechlorination with sodium thiosulfate is common practice. Sodium thiosufate dechlorination is probably acceptable if the chlorine residual is < 1-2 mg/L.
If chlorinated or ozonated, is the sample seeded? yes
The sample should be seeded if it was disinfected (SM p528, #5d&5e2: SSM p38).

13. Do any samples have a toxic effect on the BOD test? doesn't think so
Specific modifications are probably necessary (SM p528, #5d: SSM p37).

14. How are DO concentrations measured? YSI
If with a meter, how is the meter calibrated? air calbrate — winkler check
Air calibration is adequate. Use of a barometer to determine saturation is desirable, although not manditory. Checks using the Winkler method of samples found to have a low DO are desirable to assure that the meter is accurate over the range of measurements being made.

How frequently is the meter calibrated? daily air 1x /wk - winkler
The meter should be calibrated before use.

15. Is a dilution water blank run? yes
A dilution water blank should always be run for quality assurance (SM p527, #5b: SSM p40, #3).

What is the usual initial DO of the blank? ≈8
The DO should be near saturation; 7.8 mg/L @ 4000 ft, 9.0 mg/L @ sea level (SM p528, #5b). The distilled or deionized water used to make the dilution water may be aged in the dark at ~20 degrees C for a week with a cotton plug in the opening prior to use if low DO or excess blank depletion is a problem .

What is the usual 5 day blank depletion? ≈0.2 some outlier
The depletion should be 0.2 mg/L or less. If the depletion is greater, the cause should be found (SM p527-8, #5b: SSM p41, #6).

16. How many dilutions are made for each sample? one
At least two dilutions are recommended. The dilutions should be far enough apart to provide a good extended range (SM p530, #5f: SSM p41).

17. Are dilutions made by the liter method or in the bottle?
Either method is acceptable (SM p530, #5f).

18. How many bottles are made at each dilution? 3
How many bottles are incubated at each dilution? 2
When determining the DO using a meter only one bottle is necessary. The DO is measured, then the bottle is sealed and incubated (SM p530, #5f2).
When determining the DO using the Winkler method two bottles are necessary. The initial DO is found of one bottle and the other bottle is sealed and incubated (Ibid.).

19. Is the initial DO of each dilution measured? yes
What is the typical initial DO? ≈ 8
The initial DO of each dilution should be measured. It should approximate saturation (see #14).

20. What is considered the minimum acceptable DO depletion after 5 days?
What is the minimum DO that should be remaining after 5 days?
The depletion should be at least 2.0 mg/L and at least 1.0 mg/L should be left after 5 days (SM p531, #6: SSM p41).

21. Are any samples seeded? Sinal
Which?
What is the seed source? settle 2°
Primary effluent or settled raw wastewater is the preferred seed. Secondary treated sources can be used for inhibited tests (SM p528, #5d: SSM p41).

How much seed is added to each sample? 25mL/L
Adequate seed should be used to cause a BOD uptake of 0.6 to 1.0 mg/L due to seed in the sample (SM p529, #5d).

How is the BOD of the seed determined? yes
Dilutions should be set up to allow the BOD of the seed to be determined just as the BOD of a sample is determined. This is called the seed control (SM p529, #5d: SSM p41). (referred to as seed dilution - get depletion ≥2.0 & use for correction)

22. What is the incubator temperature? was too warm ≈ 26°C
The incubator should be kept at 20 +/- 1 degree C (SM p531, #5i: SSM p40, #3).

→ How is incubator temperature monitored? suggest log
A thermometer in a water bath should be kept in the incubator on the same shelf as the BODs are incubated.

How frequently is the temperature checked? weekly
The temperature should be checked daily during the test. A temperature log on the incubator door is recommended.

How often must the incubator temperature be adjusted?
Adjustment should be infrequent. If frequent adjustments (every 2 weeks or more often) are required the incubator should be repaired.

Is the incubator dark during the test period?
Assure the switch that turns off the interior light is functioning.

23. Are water seals maintained on the bottles during incubation? yes
Water seals should be maintained to prevent leakage of air during the incubation period (SM p531, #5i: SSM p40, #4).

24. Is the method of calculation correct? use seed dil for seed correction
Check to assure that no correction is made for any DO depletion in the blank and that the seed correction is made using seed control data.

Standard Method calculations are (SM p531, #6):

for unseeded samples;

$$\text{BOD (mg/L)} = \frac{D1 - D2}{P}$$

for seeded samples;

$$\text{BOD (mg/L)} = \frac{(D1 - D2) - (B1 - B2)f}{P}$$

Where: D1 = DO of the diluted sample before incubation (mg/L)
D2 = DO of diluted sample after incubation period (mg/L)
P = decimal volumetric fraction of sample used
B1 = DO of seed control before incubation (mg/L)
B2 = DO of seed control after incubation (mg/L)

$$f = \frac{\text{amount of seed in bottle D1 (mL)}}{\text{amount of seed in bottle B1 (mL)}}$$

Total Suspended Solids Test Review

Preparation

1. What reference is used for the TSS test? → taught → should use Std Mthds (already have)

2. What type of filter paper is used? use ED - suggest approved
Std. Mthds. approved papers are: Whatman 934AH (Reeve Angel), Gelman A/E, and Millipore AP-40 (SM p95,footnote: SSM p23)

3. What is the drying oven temperature? 114°C
The temperature should be 103-105 degrees C (SM p96, #3a: SSM p23).

4. Are any volatile suspended solids tests run? OK
If yes--What is the muffle furnance temperature?
The temperature should be 550+/- 50 degrees C (SM p98, #3: SSM p23).

5. What type of filtering apparatus is used?
Gooch crucibles or a membrane filter apparatus should be used (SM p95, #2b: SSM p23).

6. How are the filters pre-washed prior to use? yes
The filters should be rinsed 3 times with distilled water (SM p23, #2: SSM p23, #2).

Are the rough or smooth sides of the filters up?
The rough side should be up (SM p96, #3a: SSM p23, #1)

How long are the filters dried? day plus
The filters should be dried for at least one hour in the oven. An additional 20 minutes of drying in the furnance is required if volatile solids are to be tested (Ibid).

How are the filters stored prior to use? to dessicator
The filters should be stored in a dessicator (Ibid).

7. How is the effectiveness of the dessicant checked? OK
All or a portion of the dessicant should have an indicator to assure effectiveness.

Test Procedure

8. In what is the test volume of sample measured?
The sample should be measured with a wide tipped pipette or a graduated cylinder.

9. Is the filter seated with distilled water? OK
The filter should be seated with distilled water prior to the test to avoid leakage along the filter sides (SM p97, #3c).

10. Is the entire measured volume always filtered? OK
The entire volume should always be filtered to allow the measuring vessel to be properly rinsed (SM p97, #3c: SSM p24, #4).

11. What are the average and minimum volumes filtered?

	Volume Minimum	Volume Average
Influent	40-60	
Effluent	80-100	

12. How long does it take to filter the samples?

	Time
Influent	30 sec – 3 min
Effluent	

13. How long is filtering attempted before deciding that a filter is clogged? shouldn't do too long, not usually problem
Prolonged filtering can cause high results due to dissolved solids being caught in the filter (SM p96, #1b). We usually advise a five minute filtering maximum.

14. What do you do when a filter becomes clogged? should pitch (don't stir)
The filter should be discarded and a smaller volume of sample should be used with a new filter.

15. How are the filter funnel and measuring device rinsed onto the filter following sample addition? OK
Rinse 3x's with approximately 10 mLs of distilled water each time (? ?).

16. How long is the sample dried? hour - two
The sample should be dried at least one hour for the TSS test and 20 minutes for the volatile test (SM p97, #3c; p98, #3: SSM p24, #4). Excessive drying times (such as overnight) should be avoided.

17. Is the filter thoroughly cooled in a dessicator prior to weighing?
The filter must be cooled to avoid drafts due to thermal differences when weighing (SM p97, #3c: SSM p97 #3c). 10 min

18. How frequently is the drying cycle repeated to assure constant filter weight has ben reached (weight loss <0.5 mg or 4%, whichever is less: SM p97, #3c)?
We recommend that this be done at least once every 2 months.

19. Do calculations appear reasonable? yes
Standard Methods calculation (SM p97, #3c).

$$\text{mg/L TSS} = \frac{(A - B) \times 1000}{\text{sample volume (mL)}}$$

where: A= weight of filter + dried residue (mg)
B= weight of filter (mg)

Fecal Coliform Test Review

1. Is the Membrane Filtration (MF) or Most Probable Number (MPN) technique used?
This review is for the MF technique.

2. Are sterile techniques used? yes

3. How is equipment sterilizated? autoclave
Items should be either purchased sterilized or be sterilized. Steam sterilization, 121 degrees C for 15 to 30 minutes (15 psi); dry heat, 1-2 hours at 170 degrees C; or ultraviolet light for 2-3 minutes can be used. See Standard Methods for instruclions for specific items (SSM p67-68).

4. How is sterilization preserved prior to item use?
Wrapping the items in kraft paper or foil before they are sterilized protects them from contamination (Ibid.).

5. How are the following items sterilized?

	Purchased Sterile	Sterilized at Plant
Collection bottles		
Phosphate buffer		
Media		
Media pads		
Petri dishes		
Filter apparatus		
Filters		
Pipettes		
Measuring cylinder		
Used petri dishes		

6. How are samples dechlorinated at the time of collection? OK
Sodium thiosulfate (1 mL of 1% solution per 120 mLs (4 ounces) of sample to be collected) should be added to the collection bottle prior to sterilization (SM p856, #2: SSM p68, sampling).

7. Is phosphate buffer made specifically for this test? yes
Use phosphate buffer made specifically for this test. The phosphate buffer for the BOD test should not be used for the coliform test (SM p855, #12: SSM p66).

8. What kind of media is used? OK
M-FC media should be used (SM p896, SSM p66).

9. Is the media mixed or purchased in ampoules?
Ampoules are less expensive and more convient for under 50 tests per day (SSM p65, bottom).

10. How is the media stored?
The media should be refrigerated (SM p897, #1a: SSM p66, #5).

11. How long is the media stored? ≈ 6 mths
Mixed media ahould be stored no longer than 96 hours (SM p897, #1a: SSM p66, #5). Ampoules will usually keep from 3-6 months -- read ampoule directions for specific instructions.

12. Is the work bench disinfected before and after testing? OK
This is a necessary sanitazation procedure (SM p831, #1f).

13. Are forceps dipped in alcohol and flamed prior to use? yes
Dipping in alcohol and flaming are necessary to sterilize the forceps (SM p889, #1: SSM p73, #4).

14. Is sample bottle thoroughly shaken before the test volume is removed? The sample should be mixed thoroughly (SSM p73, #5). OK

15. Are special procedures followed when less than 20 mLs of sample is to be filtered? OK
10-30 mLs of sterile phosphate buffer should be put on the filter. The sample should be put into the buffer water and swirled, then the vacuum should be turned on. More even organism distribution is attained using this technique (SM p890, #5a: SSM P73, #5).

16. Are special procedures followed when less than 1 mL of sample is to be filtered? N/A 17 & 28 mLs when wet - use closer 100 when low colis
Sample dilution is necessary prior to filtration when <1 mL is to be tested (SM p864, #2c: SSM p69).

17. Is the filter apparatus rinsed with phosphate buffer after sample filtration? yes
Three 20-30 mL rinses of the filter apparatus are recommended (SM p891, #5b: SSM p75, #7).

18. How soon after sample filtration is incubation begun? OK
Incubation should begin within 20-30 minutes (SM p897, #2d: SSM p77, #10 note).

19. What is the incubation temperature? get thermometer
44.5 +/- 0.2 degrees C (SM p897, #2d: SSM p75, #9).

20. How long are the filters incubated? OK
24 +/- 2 hours (Ibid.).

21. How soon after incubation is complete are the plate counts made? OK
The counts should be made within 20 minutes after incubation is complete to avoid colony color fading (SSM p77, FC).

22. What color colonies are counted? OK
The fecal coliform colonies vary from light to dark blue (SM p897, #2e: SSM p78).

23. What magnification is used for counting? eyeball
10-15 power magnification is recommended (SM p898, #2e: SSM p78).

24. How many colonies blue colonies are usually counted on a plate? <20
Valid plate counts are between 20 and 60 colonies (SM p897, #2a: SSM p78).

25. How many total colonies are usually on a plate? ok
The plate should have <200 total colonies to avoid inhabition due to crowding (SM p893, #6a: SSM p63, top).

26. When calculating results, how are plates with <20 or >60 colonies considered when plates exist with between 20 and 60 colonies?
In this case the plates with <20 or >60 colonies should not be used for calculations (SM p898, #3: SSM p78, C&R).

27. When calculating results how are results expressed if all plates have < 20 or > 60 colonies?
Results should be identified as estimated.
The exception is when water quality is good and <20 colonies grow. In this case the lower limit can be ignored (SM p893, #6a: SSM p78, C&R).

28. How are results calculated?
Standard Methods procedure is (SM p893, #6a: SSM p79):

$$\text{Fecal coliforms/100 mL} = \frac{\text{\# of fecal coliform colonies counted}}{\text{sample size (mL)}} \times 100$$

report real #'s
use geometric mean for calculating monthly average only