Water Body No. WA-39- 1110
(Segment No. 18-37-02)

SELAH WASTEWATER TREATMENT PLANT
RECEIVING WATER SURVEY
OCTOBER 1988

by
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ABSTRACT

A low flow receiving water survey was conducted in the vicinity of the Selah wastewater treatment plant (WWTP) during the height of the fruit processing season. The WWTP was performing exceptionally well and had minimal impact on Selah ditch. However, the ditch had very poor water quality because the upstream receiving water was contaminated with fruit reclamation water from one of the fruit processors. A total maximum daily load analysis indicated that once the reclamation water problem was solved, the ditch would continue to violate Class A standards unless exceptionally high treatment quality of WWTP effluent continued. A habitat assessment was also performed. Several recommendations were made.

INTRODUCTION

The Selah wastewater treatment plant (WWTP) treats municipal and pretreated fruit processing wastewaters. WWTP effluent is discharged to the Yakima River at river mile (rm) 117.1 via a mile long ditch southeast of the city (Figure 1). Chronic upsets of the WWTP during fruit processing season have led to violations of its NPDES permit limits. Prior to this investigation, little was known of the background water quality characteristics of the ditch, and the impacts of the wastewater upon the ditch had never been completely investigated and documented. The Central Regional Office (CRO) requested a survey to address the following questions:

1. What is the background water quality of the ditch?

2. What are the impacts of the fruit processing plant cooling waters on the water quality of the ditch?

3. What are the impacts of the Selah WWTP effluent on the water quality of the ditch and Yakima River?

4. What are the current and potential uses of the ditch as a fish habitat or passage?

The CRO will take the survey results into account while reviewing the permit for Selah and finding solutions for the chronic problems plaguing the plant.

On October 25 and 26, 1988, Will Kendra and I of the Environmental Investigations and Laboratory Services (EILS) program of the Department of Ecology (Ecology) conducted a receiving water survey at the Selah WWTP ditch. Carlos Ruiz and Marc Heffner of the same program concurrently performed a Class II inspection of the WWTP and pretreatment facility. The Class II inspection results will be discussed in a separate report (Heffner, 1989).

SITE DESCRIPTION

The City of Selah (population 4,980) lies one mile north of Yakima along the Yakima River just before its confluence with the Naches River. The city is a major fruit storage and processing center for the region.

The Selah WWTP serves the municipal needs and treats pretreated fruit processing wastewater with an activated sludge system. The pretreatment facility consists of an aerated lagoon. During the processing season the effluent from the lagoon contributes a large portion of the Selah WWTP influent flow, biochemical oxygen demand (BOD), and solids loads (Heffner, 1989). Effluent from the WWTP is discharged into an open ditch. Until September 1, 1990, effluent must meet the interim limits set in the NPDES permit as listed in Table 1.

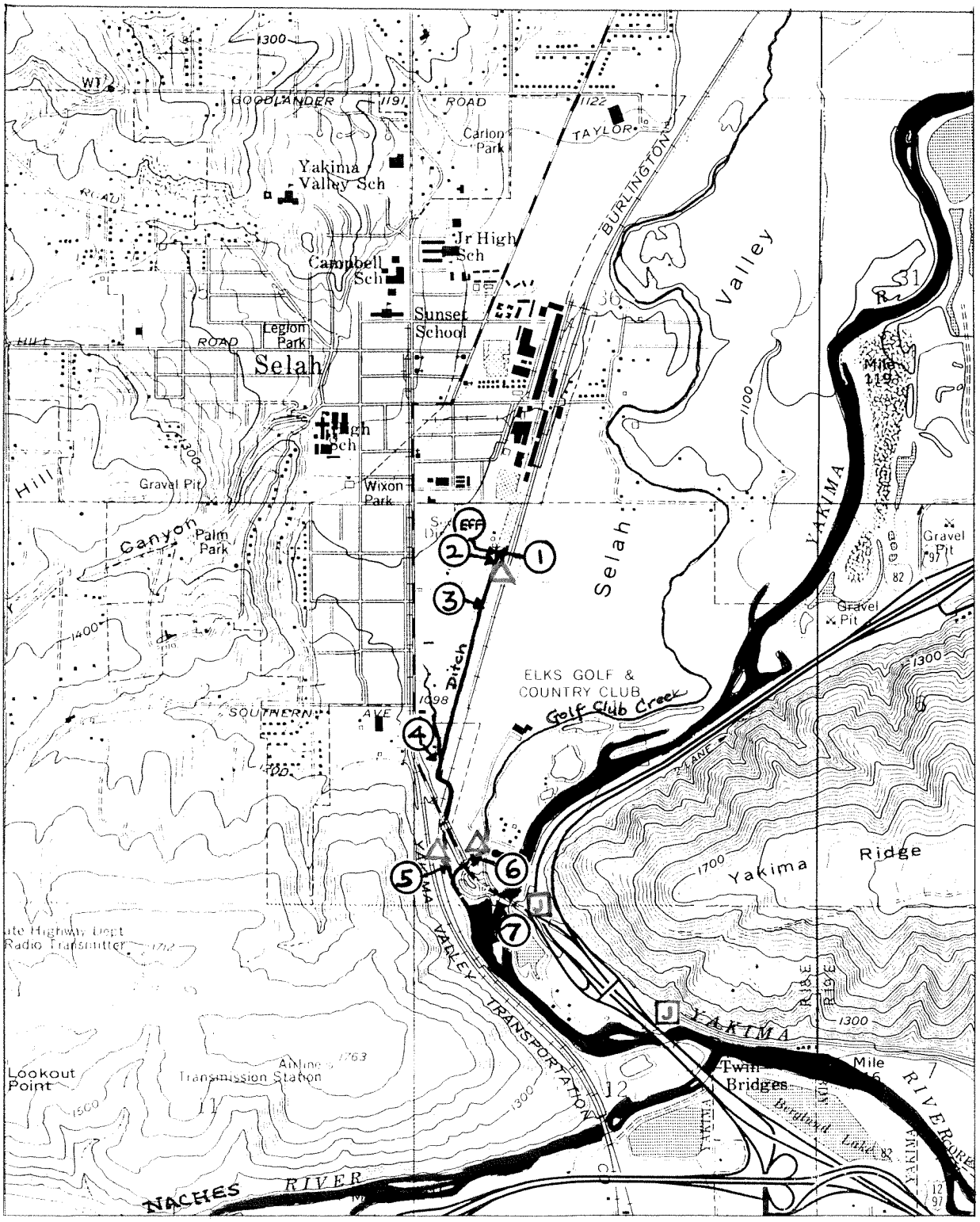


Figure 1. Water quality monitoring sites◯, and habitat assessment areas△, for the Selah wastewater treatment plant (WWTP) receiving water survey: October 25-26, 1988. Two stations,□, from the 1982 survey are shown (Johnson & Newman, 1983).

Table 1. Expired and interim NPDES permit effluent limitations for the Selah wastewater treatment plant (WWTP): Permit No. WA-002103-2.

	Expired Permit	Interim Permit
Discharge (MGD)		
Monthly Average	2.1	2.1
Design Criteria	2.1	2.1
85% Loading	1.8	1.8
Influent BOD5 (lbs./day)		
Design Criteria	6000	
85% Loading	5100	
Effluent BOD_5		
Monthly mg/L	30	60
Monthly lbs./day	525	1050
Weekly mg/L	45	
Weekly lbs./day	788	
Influent TSS		
Design Criteria	6130	
85% Loading	5210	
Effluent TSS		
Monthly mg/L	30	100
Monthly lbs./day	525	1750
Weekly mg/L	45	
Weekly lbs./day	788	
Effluent Fecal Coliform (#/100mL)		
Monthly	200	
Weekly	400	
Effluent Total Ammonia (mg/L) as Nitrogen Between May 1 and October 30 not to exceed	15	

Water in the ditch originates from an 18-inch culvert approximately 200 feet upstream of the WWTP outfall (Figure 1). This is the terminus of a municipal stormwater collection system along the east side of the city.

Non-contact cooling waters from several fruit packing warehouses are discharged to the collection system and are the major sources of water to the ditch. Stormwater and subsurface water may contribute to the collection system and ditch during wet weather. Cooling water from other fruit packing warehouses in the same area of the city are discharged to another branch of the stormwater system. These flow from a 24-inch culvert into the ditch ten feet downstream of the outfall. There are no requirements for the fruit packers to maintain a minimum discharge volume to the storm drain system.

Effluent in the ditch travels about 0.98 mile before discharging to the Yakima River. One small right bank tributary to the ditch enters 0.65 mile downstream of the outfall. It appears to be little more than a natural seep collecting subsurface drainage off the hillside residential area in the southwest area of the city. Golf Club Creek joins the ditch from the left bank just prior to its confluence with the Yakima River. It drains the Elks Golf Course and low-lying northeastern areas between Selah and the Yakima River.

As a tributary to the Yakima River, the ditch is considered a Class A water body: WAC 173-201-070(6). Class A water quality standards are listed in Table 2.

METHODS

Descriptions and field/laboratory activities for individual stations are listed in Table 3. Station locations are shown in Figure 1.

Field analyses included: temperature by mercury thermometer, dissolved oxygen (D.O.) by Winkler-azide modified titration, pH and conductivity by field meters, and total residual chlorine by DPD colorometry (APHA, AWWA, WPCF, 1985). Stream discharges were calculated for selected sites using data obtained from cross-sectional stream and velocity measurements by propeller flow meter. Flow measurements in the Selah WWTP were calculated using the inplant flow meter and totalizer.

Grab samples collected for laboratory analysis were stored in the dark on ice and received via air freight by the Ecology/USEPA Manchester Environmental Laboratory within 24 hours. WWTP samples were collected by Ruiz and Heffner (Heffner, 1989) using composite samplers set to collect 250 mL aliquots of unchlorinated effluent at 30 minute intervals for 24 hours. The compositor jugs were adequately iced over that period, and samples taken from them were analyzed within 24 hours at the Manchester Laboratory. All analyses were performed using approved procedures (Huntamer, 1986). Total kjeldahl nitrogen analyses were performed by a contract laboratory.

Three sites were evaluated using protocol level II (Plafkin, et al., 1988) of the USEPA Rapid Bioassessment Method (Table 4; Figure 1). Benthic invertebrate samples were collected by kicking substrate in front of a 600 um mesh framed net while traveling across the width of

Table 2. Class A (excellent) freshwater quality standards (WAC 173-201-045) and characteristic uses.

Class A	
Characteristics shall meet or exceed requirements for all or substantially all uses:	Domestic, industrial, and agricultural water supply; wildlife habitat; livestock watering; general recreation and aesthetic enjoyment; commerce and navigation; and salmonid and other fish reproduction, migration, rearing, and harvesting.
Water Quality Criteria	
Fecal coliform:	Geometric mean not to exceed 100 organisms/ 100 mLs with not more than 10 percent of samples exceeding 200 organisms/100 mLs.
Dissolved oxygen:	Shall exceed 8 mg/L.
Total dissolved gas:	Shall not exceed 110 percent saturation.
Temperature:	Shall not exceed 18°C due to human activity. Increases shall not, at any time, exceed $t = 28(T+7)$; or where temperature exceeds 18°C naturally, no increase greater than 0.3°C. t = allowable temperature increase across dilution zone, and T = highest temperature outside the dilution zone. Increases from non-point sources shall not exceed 2.8°C.
pH:	Shall be within the range of 6.5 to 8.5, with man-caused variation within a range of less than 0.5 unit.
Turbidity:	Shall not exceed 5 NTU over background when background is 50 NTU or less, or cause 10 percent increase in turbidity over background when background is greater than 50 NTU.
Toxic, radioactive, or deleterious materials:	Shall be below concentrations of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect any water use.
Aesthetic values:	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

Table 3. Station descriptions and activities performed during the Selah WWTP receiving water survey, October 25-26, 1988

Station	River Mile	Station Description	Field/Laboratory Activities	Benthic Invertebrate/Habitat Assessment
1	0.98	Selah Ditch at 18" culvert, approximately 100′ above the WWTP outfall, mid-pipe	Temperature, pH, conductivity, TRC, D.O., discharge NH_3, NO_2+NO_3, COD, total phosphorous, fecal coliform, BOD, total nitrogen, solids, turbidity, chloride, alkalinity.	Yes
EFF	0.96	Effluent grab sample taken at right bank Selah WWTP outfall, mid-pipe	Temperature, pH, conductivity, D.O., total residual chlorine/TOC, total nitrogen, chloride, BOD	--
2	0.95	24" culvert from right bank, approximately 10′ below the WWTP outfall, mid-pipe	Same as Station 1/Same as Station 1 except no turbidity and alkalinity, add TOX	No
3	0.85	Selah Ditch behind truck trailer fabrication plant at wood bridge, mid-channel	Same as Station 1/Same as Station 1 except no BOD, TOC, COD, total nitrogen	No
4	--	Right bank tributary, 15′ upstream of confluence with ditch, mid-channel	Same as Station 1 except no TRC/ Fecal coliform, NH_3, NO_2+NO_3, total phosphorus, TSS, chloride	No
4a	0.42	Selah Ditch 75′ below confluence with right bank tributary, mid-channel	Early morning D.O., temperature, pH, and conductivity/None	No
5	0.15	Selah Ditch approximately 100′ upstream of confluence with Golf Club Cr., mid-channel	Same as Station 4/Same as Station 1 except TSS for solids(4), and no turbidity	Yes
6	--	Golf Club Creek 500′ above Selah Ditch confluence, off start of Hwy. ramp, mid-channel	Same as Station 4/Same as Station 5 except no BOD or COD	Yes
7	117.1	Yakima River under the Selah Rd. bridge, right bank	Same as Station 4 but no discharge/ Fecal coliform, TOC, TSS, ammonia, NO_2+NO_3, total P, chloride, alkalinity	No

Table 4. Description of USEPA Rapid Bioassessment Techniques for Protocol Level II (Plaflin et al, 1989).

COMPONENT	DESCRIPTION
Objectives	o Assess biological impairment o Provide information for ranking sites o Screen for future assessment or testing
Level of Effort per Station and Experience Required	o Field: 2 people at 1.5-2.5 hrs./person o Lab : 1 person at 1-1.5 hrs. o Data : 1 person at 2-4 hrs. o Professional impact assessment experience o Knowledge of benthic ecology and taxonomy
Habitat Assessment Areas	o Characterize and rate: substrate, instream cover, channel morphology, riparian and bank structure and impacts.
Water Quality, Physical and Chemical Areas	o Measure conventional water quality parameters o Examine discharge components and physical characteristics
Biosurvey	o Examination focusing on the riffle/run community supplemented with a CPOM* sample o 100 organisms taken from a single kick-net sample across the width of the stream** IDed in field to family o Functional feeding group analysis of riffle/run and CPOM sample in field*
Analysis	o Integrated assessment of metrics measuring various components of family community structure
Conclusion	o Characterize conditions as: no impairment, moderate impairment, or severe impairment o Indicate generic cause of impairment, e.g. habitat, organic enrichment, toxicity.

* Not performed during Selah WWTP receiving water survey

** Ecology Surface Water Investigations collection technique; not defined in USEPA protocols.

the stream. Fish populations were surveyed with a single pass of a back-pack electroshocking unit on a 90 - 100 feet reach of blocked stream. Aquatic habitats were evaluated using the USEPA protocol II assessment form. Specific collection sites were chosen because of similarities in water velocity and depth, and ambient lighting.

RESULTS AND DISCUSSION

Field and laboratory results from samples taken during the receiving water survey are shown in Table 5.

Background Receiving Water Quality/Cooling Water Impacts

As described earlier, receiving water in the ditch is provided from the 18-inch and 24-inch culverts (Stations 1 and 2) that collect cooling water from several fruit packing plants in the industrial section of the city. These non-contact cooling waters are NPDES permitted discharges (K. Sherwood, personal communication, 1988). Therefore, the receiving water for the Selah WWTP effluent under low flow conditions is essentially "wastewater" from upstream sources.

In general, the "upstream" receiving water quality was very poor. It had a relatively low volume (less than 5 cfs), and high temperature (greater than 18 degrees C.). Fecal coliform levels (1100 to 15,000 organisms/100 mL) in samples taken from both sites greatly exceeded Class A criteria (Table 5). Although Station 1 dissolved oxygen (D.O.) concentrations were usually in compliance with the 8 mg/L Class A water quality standard, Station 2 concentrations were often less than 5 mg/L (Figure 2).

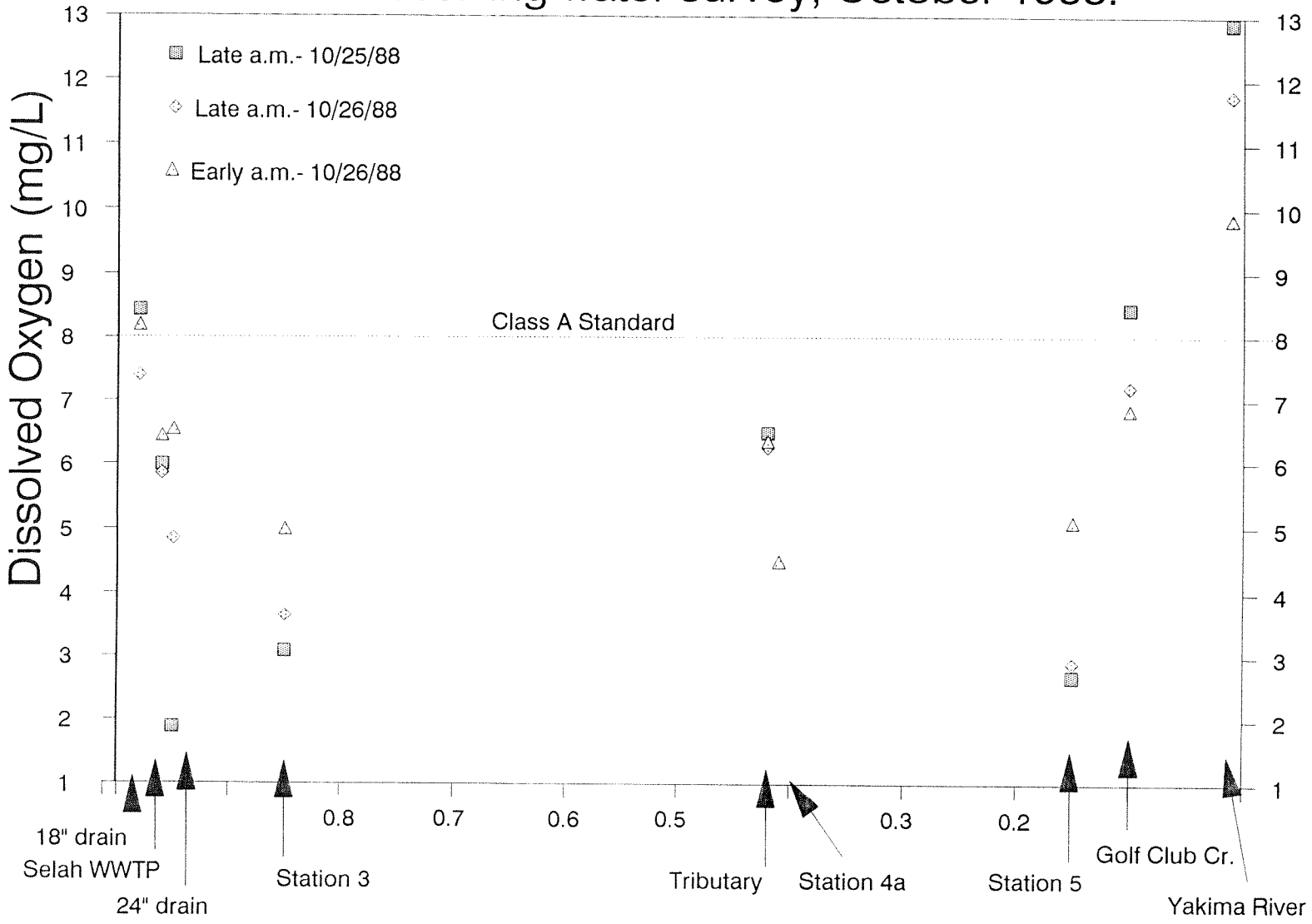
Most of the benthic surface of the ditch from Station 2 downstream to the mouth was thickly carpeted with *Sphaerotilus*, the dominant member of a white filamentous growth of fungal and bacterial heterotrophic organisms.

Sphaerotilus communities prefer simple carbohydrates and organic acids (indicated by high carbonaceous BOD concentrations), pH above 7, instream D.O. above 3 mg/L, and an optimum temperature of 22°C. (Schwoerbel, 1987). All riffle areas of the ditch were nearly ideal environments for optimum growth of this community. The metabolic activity of the heterotrophic organisms kept the D.O. below 5 mg/L at all sites in the ditch to its confluence with the Yakima River (Figure 2).

The source of the carbohydrates appeared to be the water contained in the 24-inch culvert (Station 2) 10 feet downstream of the WWTP outfall. The BOD concentrations from the Station 2 culvert on the two sampling days were 120 mg/L and 63 mg/L (Table 5). The *Sphaerotilus* growth began at the mouth of culvert; none was evident in the ditch above Station 2. The culvert also had a slight acetic acid smell.

We investigated the route of the 24-inch and 18-inch storm drains and reported our findings to the CRO (APPENDIX I - Joy, 1988). At the request of Kim Sherwood, the CRO inspector, the environmental managers at Tree Top later inspected their waste and process

Figure 2. Dissolved oxygen concentrations at sites during Selah WWTP receiving water survey, October 1988.



water systems and subsequently detected a cross-connection between a juice plant reclamation water line and the storm drain (K. Sherwood, personal conversation, 1989). Removal of the cross-connection was expected to be completed soon after its detection.

The source of fecal coliform is puzzling because no other parameter indicated the presence of fecal wastes, e.g. ammonia concentrations were low and Station 1 BOD was low. Reclamation water at Station 2 was not considered a source of fecal coliform loading. Some storm drain samples should be taken to trace the source of the fecal coliform loading within the system after the reclamation water cross-connection is fixed.

The coliform concentrations at all downstream ditch stations (Table 5 - Stations 3 and 5) violated Class A water quality standards. The small right bank tributary, Station 4, fecal coliform level met Class A standards. Golf Club Creek (Station 6) fecal coliform results violated the Class A standards. Livestock observed in a pasture upstream of the golf course may be the source of elevated Golf Club Creek values.

The presence of the *Sphaerotilus* and low D.O. concentrations at all ditch stations (Stations 3, 4a, and 5) to the Yakima River indicate the carbonaceous decomposition of the Station 2 wastewater was not completed before the ditch's confluence with the Yakima River. This was also verified by the Station 5 BOD of 17 mg/L. The resulting critically low D.O. concentrations prohibited support of most aquatic life, and seriously impaired all potential beneficial uses of the ditch. The ditch was basically an extension of waste treatment and conveyance of wastewater.

Station 4, the right bank tributary, had D.O. concentrations less than 8 mg/L, but ground water seeps like these are often naturally low in dissolved oxygen. Dissolved oxygen in Golf Club Creek did not always meet the Class A criterion of 8 mg/L, but the concentrations did not eliminate some sensitive aquatic (see Habitat Potential of Selah Ditch). The non-point sources upstream could be affecting the lower reach of the creek. Golf Club Creek D.O. concentrations theoretically could have raised oxygen concentrations in the ditch approximately 1.5 mg/L.

Yakima River fecal coliform and D.O. concentrations above the confluence with the ditch were within Class A criteria (Table 5). Generally, the 60:1 dilution ratio of river to ditch and creek water adequately protected water quality of the river. Downstream concentrations of fecal coliform and D.O. probably violated criteria along the right bank until mixing of the ditch and river were complete. No water quality standard violations would be evident after complete mixing, e.g. an estimated increase of fecal coliform from 27 to 40 organisms/100 mL, and a 0.1 mg/L D.O. loss. However, the poor water quality in the ditch probably poses a serious blockage to fish passage into Golf Club Creek.

These results are in general agreement to those found during a set of surveys in June through October 1982 (Johnson and Newman, 1983). Johnson and Newman (1983) found both increases and decreases in fecal coliform concentrations in the reach between the Selah Bridge (same as this survey Station 7) and Highway 97 Bridge, 0.7 r.m. downstream. They reported an average 0.3 mg/L (3% saturation) D.O. loss in October in this reach. Johnson

Table 5. Field and laboratory results from the October 25-26, 1988, Selah wastewater treatment plant (WWTP) receiving water survey. All values mg/L unless otherwise indicated.

Station Number	1		EFF		2		3	
Location	Head of Ditch at Culvert		Selah WWTP effluent at Outfall*		24" Drain Outfall		Selah Ditch Behind Fabrication Plant	
River Mile	0.98		0.96		0.95		0.85	
Date	25-Oct-88	26-Oct-88	25-Oct-88	26-Oct-88	25-Oct-88	26-Oct-88	25-Oct-88	26-Oct-88
Time	845	923	920	933	940	940	1040	1010
Discharge (CFS)	0.7	0.8	2.83	2.30	2.9	3.5	6.4	6.6
Temperature (deg.C)	18.7	19.4	15.4	17.7	23.8	21.2	20.1	18.6
pH (s.u.)	7.13	7.75	7.83	7.62	7.95	7.70	7.83	7.58
Sp.Cond. (umhos/cm)	535	530	970	945	480	455	640	610
Diss. O2	8.45	7.40	6.00	5.85	1.90	4.85	3.10	3.65
% Diss. O2 sat.	89.8	79.7	59.6	60.9	22.2	54.1	33.9	38.7
T.Residual Chlorine	<0.1	<0.1	1.5	1.5	<0.1	<0.1	<0.1	<0.1
F. coli. (#/100mL)	15000	1100	3	3	8000	1300	6600	970
(Lab Qualifier)**	JL				JL	XL	JL	XL
BOD_5	<3	<3	<3	<3	120	63		
TOC	5		20		79	53		
COD	6			35	160			
NH_3-N	0.03	0.02		0.05	0.04	0.02	0.08	0.04
NO_3+NO_2	3.1	3.0		0.70	2.1	2.2	1.5	1.4
Kjeldahl Nitrogen	<0.1		1.16	1.01	0.434	0.213		
Total Nitrogen	3.13	3.02		1.66	2.49	2.39		
Total P	0.20	0.19		0.49	0.30	0.30	0.31	0.28
Total Solids	400	320		710	460		480	370
T. Non-Vol Solids	380	280		510	330		310	250
T.Susp. Solids	4	4		4	6	4	6	10
T. Non-VolSusp.Solid	2	2		<1	2		2	5
Turbid. (NTU)	1			1			1	
Alkal. as $CaCo_3$	250	240		260			240	
Chloride	13	12	95	88	12	12	39	35
Total Org Halogens					0.016			

* Field parameters at outfall, others taken at contact chamber and reported by Heffner (1989). Discharge calculated by difference. Daily average discharge 1.8 cfs (Heffner, 1989).

** Laboratory analyses remark codes: JL = estimated value, plate count over 200.
XL = many background organisms, plate count over 200

*** Yakima River discharge estimate obtained from Yakima office of the U.S. Bureau of Reclamation.

Table 5. (continued)

Station Number	4		5		6		7	
Location	Right Bank Tributary to Selah Ditch		Selah Ditch above Golf Club Creek		Golf Club Creek at Hwy. Ramp		Yakima River above Selah Ditch at Hwy.***	
River Mile	- -		0.15		- -		- -	
Date	25-Oct-88	26-Oct-88	25-Oct-88	26-Oct-88	25-Oct-88	26-Oct-88	25-Oct-88	26-Oct-88
Time	1125	1020	1345	1053	1250	1043	1417	1105
Discharge (CFS)	0.6	0.6	7.8	7.6	3.5	2.5	640	640
Temperature (deg.C)	13.7	13.5	19.1	17.2	12.4	11.7	11.9	10.5
pH (s.u.)	7.57	7.54	7.58	7.52	7.84	7.63	8.76	8.20
Sp.Cond. (umhos/cm)	490	490	600	580	520	525	180	187
Diss. O2	6.50	6.25	2.70	2.90	8.45	7.20	12.90	11.75
% Diss. O2 (sat)	62.3	59.6	28.9	29.9	78.7	66.1	118.8	104.8
T.Residual Chlorine								
F. coli. (#/100mL)	21	28	930	740	450	730	32	22
(Lab Qualifier)**				XL				
BOD_5			17					
TOC			40		33		21	
COD			42					
NH_3-N	0.02	0.02	0.03	0.03	0.05	0.06	0.02	0.02
NO_3+NO_2	1.7	1.7	0.9	1.0	0.8	0.8	0.3	0.3
Kjeldahl Nitrogen			0.408	0.258	0.496			
Total Nitrogen			1.29	1.23	1.25			
Total P	0.17	0.16	0.19	0.21	0.21	0.22	0.13	0.13
Total Solids								
T. Non-Vol Solids								
T. Susp. Solids		2	25	9	1	7	13	18
T.Non-VolSusp. Solid								
Turbid. (NTU)								
Alkal. as $CaCo_3$				230	250	250		87
Chloride	12	12	31	28	12	13	3	3
Total Org Halogens								

* Field parameters at outfall, others taken at contact chamber and reported by Heffner (1989). Discharge calculated by difference. Daily average discharge 1.8 cfs (Heffner, 1989).

** Laboratory analyses remark codes: JL = estimated value, plate count over 200.
XL = many background organisms, plate count over 200

*** Yakima River discharge estimate obtained from Yakima office of the U.S. Bureau of Reclamation.

and Newman (1983) attributed the loss to BOD loads from WWTP while the Selah WWTP was experiencing an upset.

Selah WWTP Effluent Impacts

In contrast to the 24-inch drain, the WWTP effluent had BOD concentrations less than 3 mg/L (Table 5), with D.O. concentrations from 5.8 mg/L to 6.45 mg/L (Figure 2). Since the average initial dilution ratio of effluent in the ditch was 1.4:1, and 3.2:1 after Station 2, the low D.O. WWTP effluent would have had a local impact on the ditch under more favorable receiving water quality conditions. For example, at 3.2:1 dilution of background cooling water with D.O. at 8.0 mg/L, a loss of 0.5 mg/L could be expected after complete mixing.

The 1.5 mg/L total residual chlorine in the WWTP effluent resulted in no detectable fecal coliforms in the effluent samples. A 0.4 mg/L total chlorine residual was detected 40 feet (12.2 m.) below the outfall, and .1 mg/L at Station 3, 580 feet (177 m.) below the outfall. The chlorine residual appeared to have no impact on the *Sphaerotilus* community, and very little impact on the excessive fecal coliform concentrations in the ditch at Station 3 (Table 5).

The effluent appeared to be in compliance with all other aspects of the NPDES permit (Heffner, 1989). In addition, phosphorus and other nutrient concentrations not regulated by the current permit were lower than generally found in municipal effluents. This may be a result of the high contribution of fruit processing wastewater to the plant. Toxic un-ionized ammonia conditions were not present according to calculations made using the effluent and receiving water ammonia concentrations, pH and temperatures present during the survey (USEPA, 1986).

As stated earlier, the performance of the WWTP during the survey appeared to be quite different from the upset situations commonly experienced during fruit processing season. The impact of the WWTP effluent on the ditch and Yakima River under upset conditions has been investigated by Johnson and Newman (1983) (see above). The BOD and coliform loads at the confluence with the Yakima River were very similar in 1982 to loads in 1988. In both cases, the additional treatment of the wastewater provided by the ditch helped buffer the river, so that no water quality standard violations in the river were observed. However, the ditch is a large point source contributor of BOD and coliform loading in this area of the Yakima River relative to other sources (Johnson and Newman, 1983).

Total Maximum Daily Load Analysis

The total maximum daily load (TMDL) analysis is applied to conditions of critical plant loading and receiving water sensitivity. It is used to evaluate the limits on a permitted discharge, i.e. are they sufficient to protect receiving water quality.

Selah ditch was heavily overloaded with wastes during the time of the survey. These wastes were contained in the "upstream" receiving water rather than in the WWTP effluent. Ideally, wastewater from the WWTP would not be allowed into the ditch until the problem of the reclamation water was solved. However, there was no alternative route for the WWTP

effluent. Also, the plant was operating at such a high level of treatment during the survey, the effluent could have been thought of as receiving water for the contaminated cooling water.

Assuming the reclamation water problem is soon corrected, a general TMDL analysis can be constructed for the Selah WWTP system. However, assumptions for receiving water quality, reaction rates in the ditch, and resultant water quality in the ditch are tenuous since very few of the data collected during the receiving water study can be applied to the analysis. So, the TMDL results may contain a large margin of error.

A set of water quality simulations were run using a simple Streeter-Phelps model with nitrogenous oxygen demand (NOD), BOD, and reaeration functions operating with temperature compensations (Hammer and MacKichan, 1981). Ammonia uptake other than NOD conversion was not incorporated into the model. Dissolved oxygen and ammonia toxicity in the ditch appear to be the most critical parameters to assess under maximum effluent loading conditions. Chlorine toxicity with 300 feet of the outfall is another problem to be addressed, but was not modeled. Assumptions for receiving water quality and physical characteristics are listed in Table 6. Effluent design conditions taken from the interim NPDES permit, in Simulation 1 can be compared to various permit modifications in Simulations 2 and 3. The head of the ditch to Golf Club Creek was characterized as a single reach.

Simulation results are also shown in Table 6. Simulation 1 results indicate that water quality in the ditch would be seriously impaired under the interim permitted effluent discharge conditions. The lack of adequate volumes of receiving water for dilution seriously compromises the ability of the ditch to handle the permitted waste load before reaching Golf Club Creek. After mixing with Golf Club Creek, the results suggest fish passage between the Yakima River and Golf Club Creek would probably be blocked. Ammonia concentrations would violate the chronic criterion for salmonids and D.O. would be below 6.0 mg/L. Mixing calculations further indicated chronic ammonia toxicity could continue in the Yakima River for 300 feet downstream of the confluence along the right bank.

Permitted effluent ammonia and BOD concentrations would have to be sharply reduced for the ditch to meet Class A water quality standards at the confluence with Golf Club Creek. Simulations 2 and 3 demonstrate that permit conditions would have to require effluent quality nearly as good as the effluent quality encountered during the survey, e.g. BOD_5 < 10 mg/L, NH_3-N < 5 mg/L.

Chlorine toxicity will be a problem downstream of the Selah WWTP outfall unless receiving water volumes are increased or effluent total residual chlorine (TRC) is greatly reduced. A reduced effluent TRC of 0.03 mg/L would be required to meet the 4-day average, or chronic, freshwater criterion after complete mixing under design conditions stated earlier. A 0.1 mg/L TRC effluent limit may be more practical, both for proper disinfection of the effluent, and for monitoring (0.1 mg/L is the most common detection limit for most TRC monitoring devices). If efforts are made to rehabilitate the ditch for fish habitat, or major revisions to the WWTP operation and outfall location are made, dechlorination should be considered.

Table 6. Model assumptions and simulation results for a total maximum daily load (TMDL) analysis at Selah WWTP into Selah ditch.

SIMULATION #1 - INTERIM PERMIT AT ESTIMATED LOW FLOW		
Assumptions	Receiving Water	Selah WWTP
Discharge (cfs)	4.3	3.1
Temperature (^{O}C)	20.0	20.0
D.O. (mg/L)	8.6	6.0
Ammonia-N (mg/L)	0.02	15.0
BOD (mg/L)	2.0	60.0

Reaction coefficients (log base e): k1 = 2.44, k2 = 50.0, k3 = 3.0, C_s = 8.87 mg/L
Channel characteristics: velocity = 1.9 fps, depth = 0.8 ft., width = 4.9 ft.
travel time: 0.8 mi.= 0.024 days

Results at confluence with Golf Club Cr. @ 7.75 pH, 20^{O}C:
Initial D.O. Deficit : 0.42 mg/L
BOD caused Deficit : 0.86 mg/L
NOD caused Deficit : 1.10 mg/L
Total D.O Deficit : 2.39 mg/L (6.5 mg/L D.O. instream)
Ammonia -N : 5.8 mg/L (un-ionized = 0.12 mg/L)
BOD Concentration :18.8 mg/L

Results after Golf Club Cr. @ 7.75 pH, 17.8^{O}C, C_s = 9.26 mg/L
Initial D.O. Deficit : 2.51 mg/L
BOD caused Deficit : 0.25 mg/L
NOD caused Deficit : 0.68 mg/L
Total D.O. Deficit : 3.44 mg/L (5.8 mg/L D.O. instream)
Ammonia -N : 3.97 mg/L
BOD Concentration :17.8 mg/L

SIMULATION #2 - STANDARD BOD AND DECREASED NH_3 CONCENTRATIONS		
Assumptions	Receiving Water	Selah WWTP
Discharge (cfs)	4.3	3.1
Temperature (^{O}C)	20.0	20.0
D.O. (mg/L)	8.6	6.0
Ammonia-N (mg/L)	0.02	10.0
BOD (mg/L)	2.0	30.0

Reaction coefficients (log base e): k1 = 2.44, k2 = 50.0, k3 = 3.0
Channel characteristics: velocity = 1.9 fps, depth = 0.8 ft., width = 4.9 ft.
travel time: 0.8 mi. = 0.024 days

Table 6. (continued)

Results at confluence with Golf Club Cr. @ 7.75 pH, 20°C:

Initial D.O. Deficit	: 0.42 mg/L	
BOD caused Deficit	: 0.43 mg/L	
NOD caused Deficit	: 0.73 mg/L	
Total D.O Deficit	: 1.58 mg/L	(7.3 mg/L D.O. instream)
Ammonia -N	: 3.8 mg/L	(un-ionized = 0.08 mg/L)
BOD Concentration	:12.8 mg/L	

SIMULATION #3 - SURVEY EFFLUENT BOD AND NOD CONCENTRATIONS

Assumptions	Receiving Water	Selah WWTP
Discharge (cfs)	4.3	3.1
Temperature (°C)	20.0	20.0
D.O. (mg/L)	8.6	6.0
Ammonia-N (mg/L)	0.02	0.05
BOD (mg/L)	2.0	3.0

Reaction coefficients (log base e): k1 = 2.44, k2 = 50.0, k3 = 3.0
Channel characteristics: velocity = 1.9 fps, depth = 0.8 ft.,
width = 4.9 ft.
travel time: 0.8 mi. = 0.024 days

Results at confluence with Golf Club Cr. @ 7.75 pH, 20°C:

Initial D.O. Deficit	: 0.42 mg/L	
BOD caused Deficit	: 0.08 mg/L	
NOD caused Deficit	: 0.01 mg/L	
Total D.O Deficit	: 0.51 mg/L	(8.4 mg/L D.O. instream)
Ammonia -N	: 0.03 mg/L	(un-ionized = 0.0006 mg/L)
BOD Concentration	: 2.25 mg/L	

If the ditch is to be rehabilitated alternatives to consider include:

- Increasing receiving water volumes by routing additional non- wastewater sources to it
- Land application of WWTP effluent, seasonally or year-around
- Direct discharge of effluent to the Yakima River

Habitat Potential of Selah Ditch

Habitat at three sites in the study area were assessed (Figure 1). The Golf Club Creek site was considered a control; the area between Stations 1 and 2 was considered impacted by cooling and/or wastewater; and Station 5 was considered a potential recovery area.

Table 7 summarizes the results of the habitat assessment. The Golf Club Creek control site rated as a fairly good fish and benthic macroinvertebrate environment. Macroinvertebrate and fish communities here were generally healthy. Data from the two impacted sites on the ditch indicated that both the aquatic habitat and biotic communities were impaired. This finding matches the obviously poor water quality found during the survey.

Some of the physical characteristic and habitat assessment data of the two ditch sites indicate they could be partially supporting of the type of biotic community found at the control site if water quality conditions were improved. A fairly large effort would be necessary to establish and preserve a healthy biotic community in the ditch for the following reasons:

- There is an inadequate volume of water in the upper end of the ditch.
- The water from the storm drain system would be difficult to monitor and treat, e.g. cooling water temperature and contaminated street run-off.
- The treatment effectiveness of the WWTP is not reliable, and the effluent is not adequately diluted in the ditch to protect downstream beneficial uses.
- The ditch's straight north-south orientation leaves it vulnerable to solar heating, especially with its current lack of cover.
- The streambed would require rehabilitating from years of organic accumulations and siltation.

CONCLUSIONS

The following summarized the findings of the receiving water survey performed at the Selah WWTP:

1. The cooling water used to dilute the WWTP effluent in the ditch was contaminated with juice reclamation water (with a high BOD) and an unknown source of fecal

contamination. This seriously impaired water quality of the ditch and probably blocked fish passage into Golf Club Creek. It also impaired water quality along the right bank of the Yakima River for a short distance downstream of the ditch.

2. The volume of cooling water and other water sources in the Selah storm drain system are inadequate to serve as a receiving water for the WWTP effluent in the ditch under current permitted conditions. A very general TMDL analysis indicated effluent BOD_5 and NH_3-N would have to be below 10 mg/L and 5 mg/L, respectively at design flow with improved receiving water quality conditions but current volumes.

3. The WWTP effluent quality was exceptional and met all NPDES permit requirements during the survey. It contained relatively low BOD, ammonia and nutrient concentrations. The only impacts on receiving water quality were a high residual chlorine, and lowered instream D.O. from initial mixing of low D.O. effluent.

4. The habitat of the ditch is seriously impaired from a history of poor water quality and current reclamation water release. Under better water quality conditions, several impairments to establishing a healthy biotic community would remain, e.g. solar heating potential, low discharge volume, and poor streambed quality. The habitat provided by Golf Club Creek needs protection against non-point source contamination.

Considering the findings of the survey, I would recommend the following steps:

- Investigate the source of fecal contamination in the Selah storm drain system after the reclamation water cross-connection is repaired.

- Reduce total residual chlorine in the effluent to 0.1 mg/L, or as low as practical. Consider dechlorination in future plant upgrade plans.

- Explore alternative wastewater discharge methods to eventually remove the Selah outfall from the ditch, e.g. land application, direct discharge to the Yakima River with improved treatment reliability.

- Ensure access of migratory game fish to Golf Club Creek. Direct any habitat restoration efforts to the creek by assessing and managing non-point sources. Habitat in the lowest reaches of the ditch can be improved over time by increasing treatment reliability of the WWTP and alleviating major problems in the storm drain system.

Table 7. Habitat Assessment Information for Selah Receiving Water Study: 10/25/88.

PHYSICAL CHARACTERISTICS	Control- Golf Club Creek	Station 1-2 - Head of Ditch : Impacted	Station 5 - End of Ditch : Impacted
Predominant Land Use	Golf course, road	Commercial/Industrial	Railroad, Wetland
Local Watershed Erosion	None	Moderate	Moderate
Local NPS Pollution	Some evidence	Obvious Sources	Obvious
Est. Width, Depth, Velocity			
-Riffle	4', 0.3-0.6', 1.6 fps	5', 0.3', 2.6 fps	10', 0.6', 1.3 fps
-Pool	5', 2-3', 0.25 fps	None	7', 1.5', 0.7 fps
-Run	4', 1-1.2', 0.7 fps	5'. 0.6', 1.3 fps	5', 0.8', 1.9 fps
High Water Mark	2.5'	2'	2.5'
Channelization, Dam	None	Yes - channelized	None
Canopy Cover	Partly open	Partly Open	Partly Open
Percent Open Sky	70%	85%	70%
Sediment Odors	Normal	Anaerobic, Chlorine	Anaerobic
Sediment Oils	None	Slight	Absent
Sediment Deposits	None	Moderate - silt	Sand & Silt
Underside rock color	No blackening	20% blackened	Blackened
Inorganic Substrate Composit.			
-Bedrock	0%	0%	0%
-Boulder	0%	1%	0%
-Cobble	25%	14%	40%
-Gravel	15%	15%	5%
-Sand	0%	0%	35%
-Silt	60%	70%	20%
-Clay	0%	0%	0%
Organic Substrate Composition			
-Detritus	0%	2%	55%
-Muck-mud	0%	0%	
-Marl	0%	0%	

Table 7. (continued)

HABITAT ASSESSMENT	Control- Golf Club Creek	Station 1-2 - Head of Ditch : Impacted	Station 5 - End of Ditch : Impacted
Bottom Substrate Cover (score)	Good (13)	Fair (8)	Good (13)
Embeddedness	Excellent (18)	Fair - Good (10)	Fair - Good (10)
Flow Regimes	Excellent (18)	Fair (8)	Good (13)
Channel Alteration	Excellent (13)	Fair (6)	Poor (2)
Bottom Scour/Deposition	Good (10)	Good (10)	Fair (6)
Pool/Riffle Run/Bend Ratio	Good (10)	Poor (2)	Good (10)
Bank Stability	Good (7)	Good (7)	Good to Fair (6)
Bank Vegetation Stability	Excellent (10)	Excellent (9)	Good (8)
Streamside Cover	Excellent (10)	Excellent (10)	Excellent (10)
Total Score	109	70	78
Comparison to control	--	Partially supporting	Partially supporting
Stream Orientation	North-South	North - South	North - South
Clinometer data			
-Left Bank Near	11%	10%	30%
-Left Bank Far	15%	27%	25%
-Right Bank Near	30%	5%	18%
-Right Bank Far	17%	15%	21%

Table 7. (continued)

BIOTIC COMMUNITY	Control- Golf Club Creek	Station 1-2 - Head of Ditch : Impacted	Station 5 - End of Ditch : Impacted
Percentage Bottom Coverage			
-Periphyton	25%		10%
-Filamentous Algae			
-Macrophytes	20%	10%	5%
-Slimes		5%	
-Fungal Communities		20%	85%
-Grasses	10%		
-Sterile		10%	
Benthic Macroinvertebrates	100 organisms	100 organisms	Only 50 organisms found
-Ephemeroptera		Rare	
-Trichoptera	Abundant		
-Simulidae	Abundant		
-Chironomidae	Abundant		
-Amphipod	Common		
-Turbellaria	Abundant		
-Hydracarnia	Rare		
-Gastropoda		Abundant	
-Oligiocheate	Abundant	Abundant	Abundant
Fish	1 pass/100 ft.	None observed	No fish/1 pass/90'
-Salmon	3		
-Trout	1		
-Dace	8		
-Shiner	12		
CONCLUSIONS ON LEVEL OF IMPAIRMENT	SLIGHT IMPAIRMENT	MODERATE IMPAIRMENT	SEVERE IMPAIRMENT

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APPENDIX

State of Washington
Department of Ecology

TELECOPY TRANSMITTAL

DATE: Nov. 1, 1988
TIME: 11:08
NO. OF PAGES: 2 +

TO (NAME / AGENCY)
Kim Sherwood
Central Regional Office
Dept. of Ecology

FROM (NAME / DIVISION)
Joe Joy
Surface Water Investigations
Dept. of Ecology

REMARKS
Selah storm drain information

THIS MACHINE IS A HARRIS/3M 2110 FACSIMILE. THIS MACHINE RECEIVES GROUP I (SIX-MINUTE MACHINES), GROUP II (THREE-MINUTE MACHINES) AND GROUP III (SUB-MINUTE MACHINES).

LOCATION: DEPT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE
7272 CLEANWATER LANE - MS LU-11
OLYMPIA, WA 98504-6811

MACHINE TELEPHONE: (206)753-8531
OPERATOR TELEPHONE: (206)753-2353
(SCAN PREFIX 234)

ECY-010-52(c)

MESSAGE CONFIRMATION

DATE:11/01/88 TIME:12:39

ID:206 753 8531

DATE	TIME	TX-TIME	DISTANT STATION ID	MODE	PAGES	RESULT
11/01	12:36	02'26"	509 575 2809	G3-S	003	OK

CHRISTINE O. GREGOIRE
Director

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
7272 Cleanwater Lane, LU-11 • Olympia, Washington 98504-6811 • (206) 753-2353

To: Kim Sherwood, Central Regional Office
From: Joe Joy, Surface Water Quality Investigations
Subject: Selah Storm Drain Investigations
Date: November 1, 1988

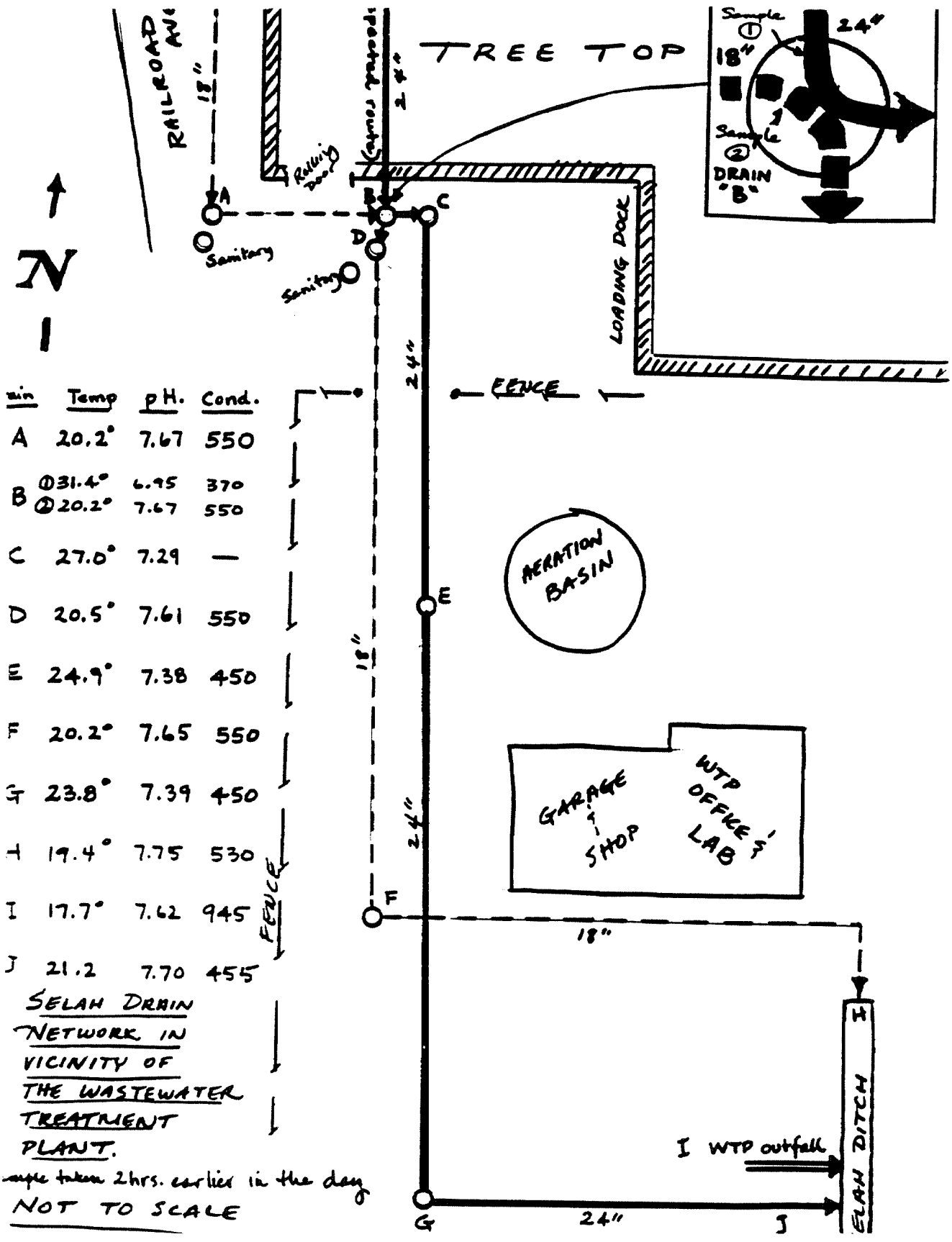
Here is a rough diagram of the Selah storm drain network in the vicinity of the Selah wastewater treatment plant that you requested yesterday. I've also listed the pH, temperature and conductivity data we recorded from the various manholes on October 26 th. I'm fairly certain of the direction and interconnections indicated in the diagram. We dyed, or sent messengers, from "B" to "D", "B" to "C", and "C" to "E". The pH, temperature and conductivity measurements are also very indicative of the interconnections.

The flow pattern discovered in manhole "B" is especially interesting and has been detailed as an enlargement in the diagram. Cooling water from the 18 inch drain system and 24 inch drain system described in city plans as two completely separate networks appear to both join there. However, water from the 18 inch drain approaches the manhole from the west and leaves to the south. Water from the 24 inch drain approaches from the north and leaves to the east. The water from the north is extremely warm (34 ° C.) compared to the water from the west (20 ° C.). Downstream samples of both lines suggest there is little mixing in Drain "B".

We failed to locate any manholes for the 24 inch storm drain system between 2nd Avenue and Drain "B". The drain line probably travels under Tree Top since the building was built on the old road after the city sold Tree Top an easement. Joe Ford, the wastewater treatment operator, thought there may be a manhole on the north side of the Tree Top building. Unfortunately, while we were there this area was under hundreds of apple boxes. From 2nd Avenue north along Railroad Avenue to Naches Avenue, there was no flowing water in the 24 inch drain line.

Manholes "B","C", "E", "G", and outfall "J", all had a fruit odor which suggests a misconnection with a condensate or other product line. Tentative laboratory analyses of total organic carbon indicate the water from outfall "J" will have a BOD greater than 100 mg/L, while water from outfall "H" will be less than 20 mg/L (personal conversation with F. Crawford, Manchester Laboratory). As you stated yesterday, engineers from Tree Top and the City of Selah should be notified of the problem, the drain under the building should be traced, and the errant discharge to the 24 inch line should be eliminated.

Good luck. Let me know if I can be of any more assistance.



	Temp	pH.	Cond.
A	20.2°	7.67	550
B	①31.4°	6.95	370
	②20.2°	7.67	550
C	27.0°	7.29	—
D	20.5°	7.61	550
E	24.9°	7.38	450
F	20.2°	7.65	550
G	23.8°	7.39	450
H	19.4°	7.75	530
I	17.7°	7.62	945
J	21.2	7.70	455

SELAH DRAIN NETWORK IN VICINITY OF THE WASTEWATER TREATMENT PLANT.

sample taken 2hrs. earlier in the day

NOT TO SCALE