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LONGVIEW DRAINAGE SYSTEM:

PART 1
WATER QUALITY ASSESSMENT

by
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PART 2
CHEMICAL SCREENING OF SEDIMENT SAMPLES

by
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Waterbody No. WA-25-5010

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ABSTRACT

On September 14 and November 16, 1992, surveys were conducted to assess the water quality of a portion of the Longview Ditches. Overall, the ditches' aesthetic values were found to be impaired by materials which offend the senses. The water in the ditches was found to violate water quality standards for fecal coliform, dissolved oxygen, and turbidity throughout the study area. Levels of iron, total suspended solids (TSS), and *Escherichia coli* (*E. coli*) were also high. In addition, metals such as copper, lead, mercury, zinc, and possibly cadmium exceeded water quality criteria, at least at one sampling station. These findings, which are consistent with historical water quality assessments, support reducing or eliminating point and nonpoint pollutants which contribute to the degraded water quality conditions in the ditches.

ACKNOWLEDGEMENTS

I would like to thank Rob Plotnikoff for his willingness to wade in the ditches, albeit hermetically sealed. Will Kendra and Art Johnson contributed review comments that improved the document and Barbara Tovrea did her usual good work in preparing it.

INTRODUCTION

The cities of Longview and Kelso are located at the confluence of the Cowlitz, Coweeman, and Columbia Rivers. The area is surrounded by dikes and a stormwater ditch drainage system. The ditch system receives stormwater from Longview and Kelso, and other areas in Cowlitz County, plus a number of industrial discharges. When necessary, water is pumped from the ditch system into the Coal Creek slough, or to the Coweeman, Cowlitz, or Columbia Rivers. Consequently, as tributaries of the Columbia, the Longview Ditches are classified as Class A waters of the state (WAC 173-201A-120). Figure 1 is a map of the study area.

Characteristic uses for Class A (excellent) waters include: water supply (domestic, industrial, and agriculture), fish and wildlife habitat, and recreation (primary contact, sport fishing, and aesthetic enjoyment). Aesthetic values of Class A waters 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 (WAC Chapter 173-201A (2)).

Ecology conducted water quality surveys of the ditches on January 25 and 26, 1983 and August 16, 1984 (Singleton and Bailey, 1983; Singleton, 1984). The major findings of the surveys were: 1) dissolved oxygen was low in all ditches; and 2) in some areas zinc, copper, lead, fecal coliform, solids, turbidity, and color exceeded acceptable levels, and all were significantly loaded by the discharges to the ditches. In addition, cyanide was found at discharge points and ditch stations in the area of Reynolds Metals Company. Oil was found in all areas sampled. High concentrations of organic compounds were found in sediments and some organic compounds were measured in water samples.

Since the studies cited above were completed, two of the major discharges to the ditches, Reynolds Metals Company and Longview Fiber (IP log pond), have been eliminated or greatly reduced. Weyerhaeuser and American Cyanamid still discharge to the ditches.

Weyerhaeuser collected water quality data from ditch No. 3 and 5 to assess the impact of their two major outfalls (ES&T, 1990). They conducted two surveys for five days each, one during the week of September 11, 1989, and the other during the week of February 26, 1990. They found that Class A water quality standards were violated above and below the discharge points for pH, dissolved oxygen, fecal coliform, temperature, and lead during the summer survey; and for pH, dissolved oxygen, and lead during the winter survey.

The Cowlitz Wahkiakum Governmental Conference received a Centennial Clean Water Fund grant (#TAX 91042) in 1990 to prepare an action plan which would document the elements necessary to develop a water quality management plan for the Longview-Kelso drainage network. The action plan was completed in September, 1991 (Cowlitz-Wahkiakum Governmental Conference, 1991). The Action Plan outlines a water quality assessment project to collect and evaluate ground water, surface water, and sediment quality data. Ecology's Southwest Regional Office (SWRO) requested that Environmental Investigations and Laboratory

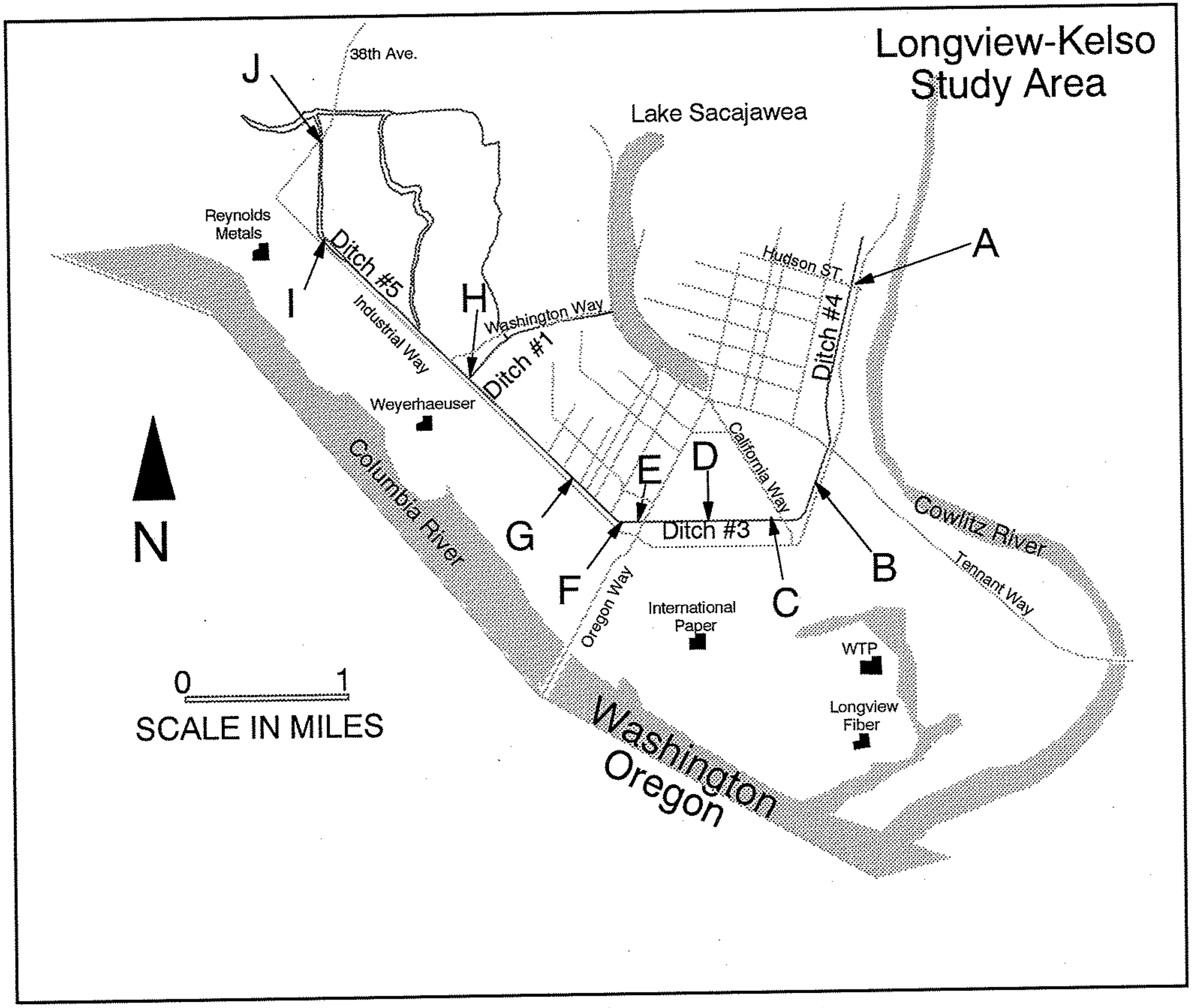

Figure 1. Map of the study area with sampling site locations.

Services (EILS) Program conduct a water and sediment sampling project along selected segments of the ditch drainage system in order to assess current water and sediment quality. The Watershed Assessments Section (WAS) conducted a water quality survey on selected segments of the ditches, and the Toxics, Compliance, and Ground Water Investigations Section sampled the sediments. The following report describes the results of the water quality assessment. The Johnson and Davis report (Part 2) describes the sediment assessment. The objectives of the Longview-Kelso drainage system water quality assessment are listed below:

- provide baseline water quality data for ditch segments 3, 4, and 5;
- determine water quality of the major discharge points to these ditches; and
- provide current information for use in 304(l) individual control strategy determinations.

METHODS

Two water quality surveys were conducted: one during dry weather on September 14, 1992, and one during wet weather on November 16, 1992. Sampling stations are listed below and annotated on the study area map (Figure 1):

Sample Locations:

A. Ditch #4 North of Hudson Street
B. Ditch #4 North of California Way
C. IP log pond discharge at California Way
D. Ditch 3 midway between California Way and Oregon Way
E. Lake Sacajawea drainage and tributary to Ditch #3 by Oregon Way
F. Weyerhaeuser East pond discharge point near Oregon Way
G. Ditch #3 midway between Oregon Way and Ditch #1 outlet
H. Ditch #1 (tributary to Ditch 5) near Washington Way
I. Ditch #5 between 38th Ave and Washington Way
J. Ditch #5 near 38th Avenue

Sampling parameters and frequency are listed in Table 1. These parameters were selected because SWRO requested that WAS test for the parameters identified in the Longview-Kelso urban area drainage system action plan. The MPN method was chosen to determine fecal coliform concentrations because of high turbidity found in earlier Ecology and Weyerhaeuser studies (range = 33-150 NTU).

All samples for laboratory analysis were stored on ice and shipped to arrive at the Ecology Laboratory in Manchester, Washington, within 24 hours. Laboratory analyses were performed in accordance with APHA *et al.* (1989), EPA (1983), and Huntamer and Hyre (1991). Field measurements included temperature (mercury thermometer), pH (Orion Model 250A meter and

Table 1. Sampling design for Longview-Kelso drainage system water quality assessment conducted on September 14 and November 16, 1992.

PARAMETER	SITE A	B	C	D	E	F	G	H[a]	I	J
Field Measurements										
Temperature	X	X	X	X	X	X	X	X	X	X
pH	X	X	X	X	X	X	X	X	X	X
Conductivity	X	X	X	X	X	X	X	X	X	X
Flow	X	X	X	X	X	X	X			
Dissolved oxygen	X	X	X	X+	X	X	X	X	X	X
Laboratory Measurements										
Total phosphorus	X	X	X	X+	X	X	X	X	X	X
Ortho-phosphorus	X	X	X	X+	X	X	X	X	X	X
Total persulfate nitrogen	X	X	X	X+	X	X	X	X	X	X
Nitrate + nitrite nitrogen	X	X	X	X+	X	X	X	X	X	X
Ammonia nitrogen	X	X	X	X+	X	X	X	X	X	X
Fluoride	X	X	X	X+	X	X	X	X	X	X
Chlorophyll *a*	X			X+	X			X	X	X
Biochemical Oxygen Demand$_5$	X	X	X	X+	X	X	X			
Ultimate Biochem. Oxygen Demand[b]				X+			X			
Hardness	X	X	X	X+	X	X	X	X	X	X
Turbidity	X	X	X	X+	X	X	X	X	X	X
Total Dissolved Solids	X	X	X	X+	X	X	X	X	X	X
Total Suspended Solids	X	X	X	X+	X	X	X	X	X	X
Total Organic Carbon	X	X	X	X+	X	X	X	X	X	X
Fecal Coliform (MPN)	X	X	X	X+	X	X	X	X	X	X
Oil & Grease	X	X	X	X+	X	X	X	X	X	X
Chloride	X	X	X	X+	X	X	X	X	X	X
Total Cyanide[b]									X+	
ICP Metals(Cr, Cu, Ni, Zn, Fe)	X	X	X	X+	X	X	X	X	X	X
CVAA Metals (Hg)	X	X	X	X+	X	X	X	X	X	X
GFAA Metals (Cd, Pb, Ag)	X	X	X	X+	X	X	X	X	X	X
Base-Neutral Extractables	X	X			X			X	X	
Pesticides/PCBs	X	X		X	X			X	X	X
Resin-Fatty Acids (water)	X	X		X			X		X	
Resin-Fatty Acids (effluent)			X			X				

[a] No flow was visible in Ditch #1 during either survey.
[b] Measured only on September 8.
+ Replicate sample collected.

Triode™ pH electrode), conductivity (Beckman Model RB-5), and dissolved oxygen (azide-modified Winkler titration). Streamflow was measured by taking cross-channel and/or culvert cross-section velocity measurements with a Marsh-McBirney Model 201 current meter.

QUALITY ASSURANCE/QUALITY CONTROL

All analyses were performed within specified holding times for general chemistry and priority pollutants. All data were reported as usable noting the data qualifiers (Appendix A). The laboratory reported some contamination of metals in procedural blank samples. Those metal results which showed possible blank contamination are marked with a "B" qualifier, denoting possible lab contribution to the sample result. These metal results should be considered estimates. There was also some blank contamination of semivolatile organics compounds in the November sample results. However, only two semivolatile compounds, 4-bromophenyl-phenyl ether and hexachlorobenzene, should be discounted because of the contamination.

Replicate precision, calculated as coefficient of variation (% CV), for conventional variables and metals are listed in Appendices B and E. The average of the replicate samples are used in data presentations in this report. Because of the high cost per sample and the stated goal of the surveys to only characterize water quality in the ditches, other priority pollutant samples were not replicated. The poor replicate precision for fecal coliform and *E. coli* suggests that sampling and analytical variation for these variables within the study area is high. It is also likely that for all variables the spacial variation in the ditches is such that results of the surveys reported here should only be used to assess the overall water quality of the ditches, and not used to define specific site conditions for load and wasteload allocations.

RESULTS AND DISCUSSION

Analytical results of the water quality surveys are compiled in Appendices B-F. The following is a summary of the data:

Ditch Flow

The direction of flow during both surveys was from station A to J. Under high flow conditions when pumping occurs, the direction of flow is altered by active pumps. Consequently, predicting flow direction under different ditch flows would be difficult.

As with the direction of flow, the amount of flow in the ditches and sources of water are not easily determined. There appear to be intermittent discharges to the ditch even during dry weather. For example, two pipe discharges of unknown origin were flowing during the September survey, one just below site A (about 0.04 cubic feet per second [cfs]) and the other just above site C (about 0.06 cfs). Neither of these were flowing during the November survey, even though rainfall had been occurring during the preceding few days. Ditch No. 1, site H was not flowing during either survey, but contained standing water.

The channel characteristics (e.g., depth, width, bottom type) of the ditches are relatively homogeneous from site A to just above site I (velocities between about 0.10 to 0.31 cfs). Downstream from site I, the ditch begins to resemble a shallow lake (velocity <0.05).

Figure 2 shows the amount of flow measured at selected ditch sampling locations during both surveys. Approximately 35% and 25% of the flow at station G is composed of discharge from Weyerhaeuser East pond (site F) for the two surveys, respectively. Only about 0.3 to 0.5 cfs or 4-5% of the flow at this point is from other known sources to the system. The rest of the ditch flow is assumed to be from ground water. Using the flow at site G, minus the Weyerhaeuser East pond discharge, the receiving water to effluent dilution ratio is about 3:1 for September and 4:1 for November. These ratios are extremely low, given that Ecology recommends a dilution of 100:1 for new facilities (Ecology, 1985).

Aesthetic Quality

Overall, the ditches are impaired with material which offend the senses of sight, smell, and touch. The water color in places is dark brown with spots or streaks of black and the smell is comparable to that of wastewater treatment plant effluent. Unlike a typical Class A waterbody, the water in the ditches have an oily surface sheen, and high amounts of suspended materials make it undesirable to touch. (I would suspect that the ditch water also offends the sense of taste, however, I was not willing to confirm this hypothesis.) The discharges sampled during the surveys, IP log pond (site C), Lake Sacajawea drainage (site H), and Weyerhaeuser East pond discharge (site F), were also offensive to the senses and likely contribute to the degradation of Class A water aesthetic values. The IP log pond and Weyerhaeuser East pond discharge waters were black and had a strong odor. Although the IP log pond discharge was scant, its consistency was syrupy. The Lake Sacajawea drainage pipe had a considerable amount of what appeared to be iron-colored *Sphaerotilus* growth, a sulphur bacterium associated with reducing conditions.

Conventional Parameters

Appendix B contains the water quality data for conventional variables. Oxygen levels at all ditch sampling sites were well below the Class A standard of 8.0 mg/L (Figure 3). The data presented in Figure 3 do not represent the true minima, because it is likely the early morning dissolved oxygen levels were lower than those found during the surveys. The biochemical oxygen demand (BOD_5) within the study area appeared to increase below both point source discharges (site C and F). Although the discharge from site C was small (0.002 and 0.006 cfs), the BOD_5 was high at 43.5 and 660 mg/L for September and November, respectively. Since it is unlikely the composition of the discharge at site C significantly changed between surveys, these BOD values represent field sampling and laboratory variation, or an error in one value. In either case, the concentration of oxygen-consuming material being discharged was high. As

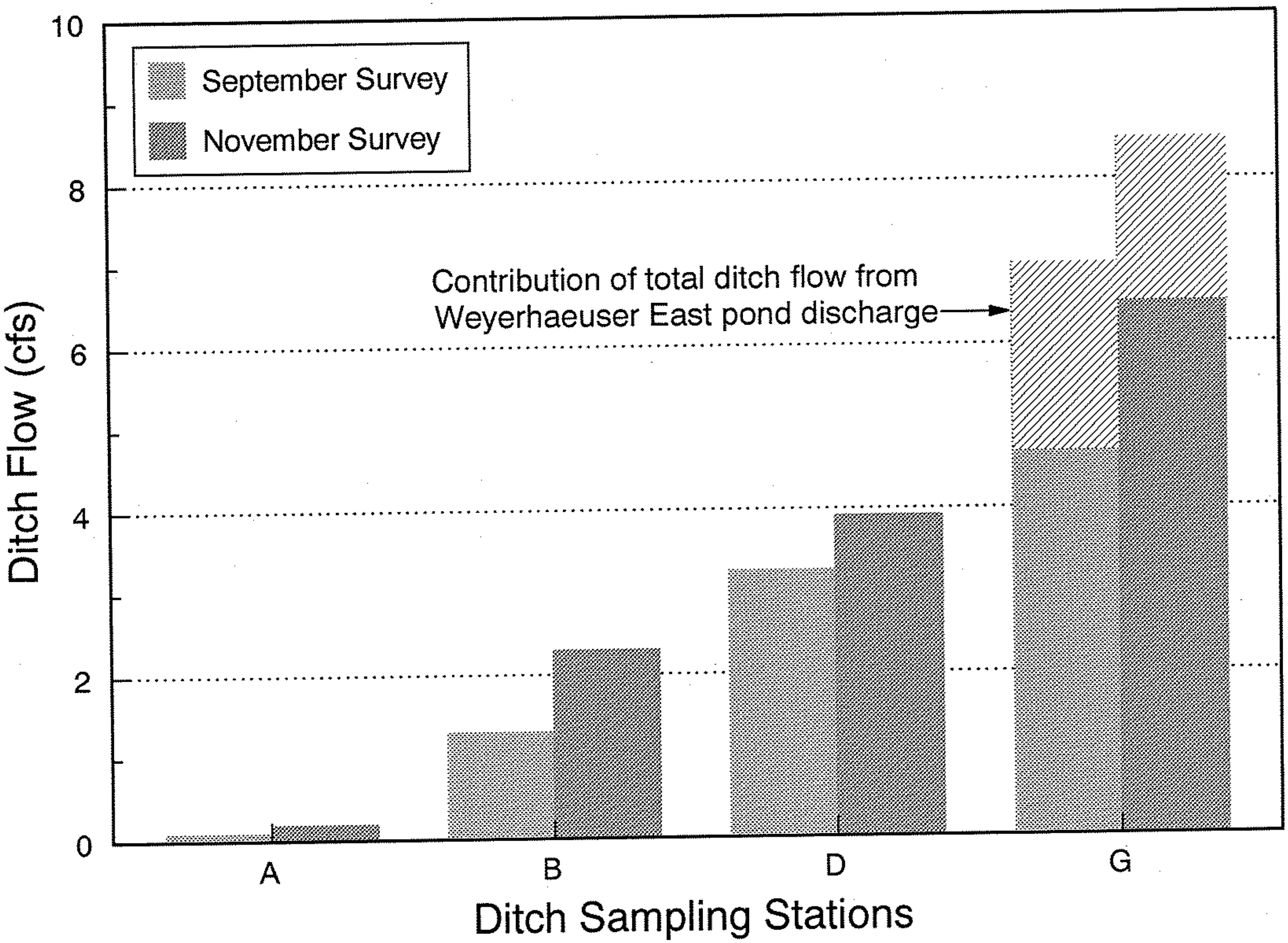

Figure 2. Flow measured at selected ditch sampling locations.

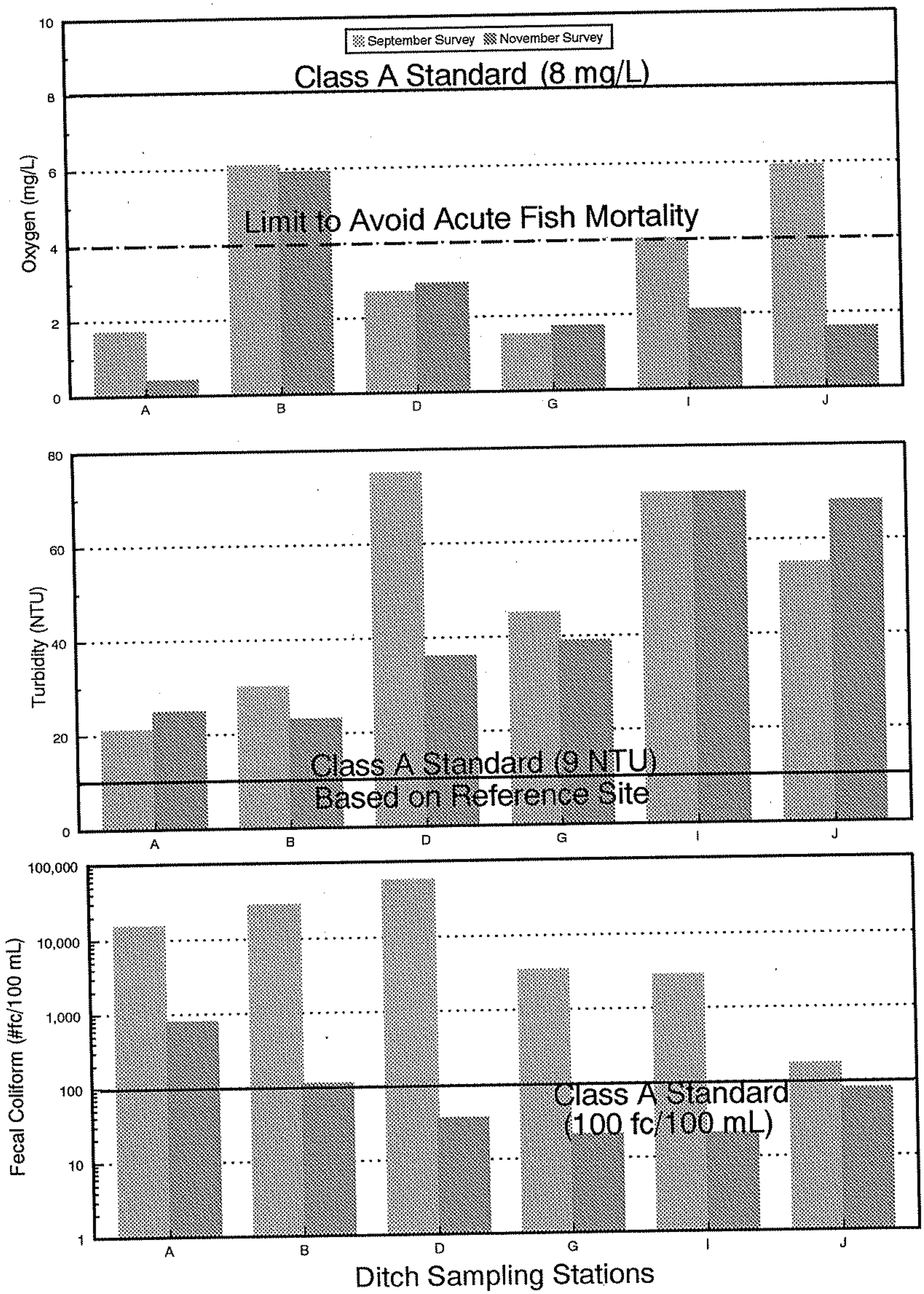

Figure 3. Oxygen, turbidity, and fecal coliform concentrations.

mentioned in the flow section, the discharge at site F was a significant portion of the flow in the ditches, and at a BOD_5 concentration of approximately 14-17 mg/L, the discharge probably had a considerable impact on dissolved oxygen in the ditches. The 35-day ultimate biochemical oxygen demand ($UBOD_{35}$) to BOD_5 ratio established from ditch samples at site D was 1.42 and for site G was 1.60. These are close to the ratio of 1.46 often used in modeling the impacts of BOD loading on streams. These ratios can be used to estimate the UBOD of the discharges from the IP log pond and Weyerhaeuser East pond.

The ditches' total organic carbon (TOC) and total suspended solids (TSS) concentrations were also high. The values of these constituents were outside the range that would be expected in a Class A water and indicate the extensive impacts of anthropogenic inputs to the ditch system. For example, the mean September through November (data from 1982-1991) TSS concentration at Ecology's ambient monitoring station (26C070) on the nearby Class A Coweeman River is approximately 8 mg/L (n=25), while the average ditch TSS level for both surveys was about 33 mg/L. This level of TSS probably reduces the viable habitat in the ditches for phytoplankton, zooplankton, benthic invertebrates, and fish. An aquatic entomologist from Ecology who assisted in the field sampling did a visual assessment of the invertebrate species in the ditches; he only found one invertebrate (a mosquito larva) in the study area. A non-polluted waterbody would be expected to support a much more diverse invertebrate population.

The WAC (173-201A-030 2,c,vi) defines the turbidity water quality criteria for Class A waters as follows "Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, . . ." If the mean September through November turbidity value (4 NTU, n=23) for the Coweeman River station is used as a reference condition, turbidity in the ditches would violate Class A water quality standards at all sampling sites (Figure 3). In defining "background" conditions, the Washington Administrative Code (WAC 173-201A-020) states that ". . .When assessing background conditions in the headwaters of a disturbed watershed it may be necessary to use the background conditions of a neighboring or similar watershed as the reference condition." The ditch system must be considered disturbed so using the Coweeman River station to establish reference conditions for variables such as turbidity in the area is appropriate.

Fecal coliform concentrations at all stations during the September survey also exceeded the Class A water quality criterion of 100 fc/100 mL (Figure 3). The replicate precision for fecal coliform at site D is low, which indicates a high amount of sampling and analytical variation in the values. In addition, Klebsiella bacteria, a bacterium not specific to mammalian fecal pollution and common in pulp mill effluents, may account for a considerable amount of the fecal coliform bacteria found. However, *E. coli* levels are also high, which indicates a large portion of the coliform are probably from digestive tract waste. The fecal coliform and *E. coli* data imply that there may be some sewage discharging to the ditches, especially in ditch 4. The November data are lower, which suggests that direct inputs of fecal coliform may be more of a problem than bacteria loading from nonpoint runoff.

Nutrients in the ditches appear to be relatively low, however the nitrate-nitrite to ammonia ratio indicates the system is either contaminated with sewage and/or that decomposition, nitrification, and denitrification are occurring simultaneously. It is possible that nitrification/denitrification is occurring rapidly in the deep, flocculated sediments, and is removing nitrate-nitrite out of the shallow waters in the ditches as it is formed. The oxygen consuming nitrification process in the sediments are probably contributing to the low levels of oxygen in the overlying water.

The September chlorophyll *a* data suggest that primary productivity in most of the ditch system is relatively low, except at site J where the system seems to be more eutrophic (higher chlorophyll and considerable macrophyte growth). This is consistent with the water quality and hydrology of the system observed during the survey. High turbidity and TSS probably inhibit primary productivity through most of the flowing part of the system until it begins to exhibit the characteristics of a lake. In addition, much of the organic material carried in the flowing portion of the ditches is probably deposited in the section around site J, providing nutrients for primary productivity.

Oil and grease were only identified above detection limits at site I during the September survey, but were present at all sites in November. Johnson and Davis reported (Part 2) high concentrations of oil and grease in the sediments at all ditch sampling sites. High concentrations of oil and grease or other toxic substances and low dissolved oxygen in the sediments may also account for the lack of invertebrates in the ditches.

Base-Neutral Extractable Compounds

Samples were analyzed for Base-Neutral Extractable Compounds (organic compounds) at sites A, B, E, and I (Appendix C). There were some organic compounds found at all four sites, which indicates some level of anthropogenic contamination. However, most substances were within the quantification limit and none were at toxic levels.

The major class of organic compounds identified in the ditches are polynuclear aromatic hydrocarbons (PAHs) (e.g., acenaphthene, naphthalene, pyrene, fluoranthene). These compounds are associated with gasoline, oil, fluid additives, and constituents (Atkinson, 1992).

Pesticide/PCB Compounds

Samples were analyzed for Pesticide/PCB compounds at sites A, B, D, E, I, and J (Appendix D). None of the Pesticide/PCB analytes were found during either survey.

Total Recoverable Metals

Total recoverable metals measurements were made for cadmium, chromium, copper, lead, mercury, iron, nickel, silver, and zinc at all sampling sites (Appendix E). A number of these metals were identified at the different sites during both surveys, but they were mainly found during the November survey. Only site A had metals which consistently exceeded chronic or acute water quality criteria. Lead and mercury violated chronic criteria levels at some of the other sites. Cadmium also may exceed criteria, but blank contamination for this metal was substantial. Iron exceeded the EPA recommended limit of 1000 μg/L at all sites for both surveys (EPA, 1987).

It should be noted that Ecology adopted formal revisions to the surface water quality standards on November 25, 1992--effective December 26, 1992. The final WAC (173-201A-040) contains new metals water quality criteria based on the dissolved fraction of metals, except for effluent, which remains as total recoverable. The data and criteria calculations in Appendix E are based on total recoverable metals and reflect the criteria that existed during the time of the surveys.

Resin Acid/Fatty Acid Compounds

Samples were analyzed for resin acid/fatty acid compounds at sites A, B, C, D, F, G, and I (Appendix F). Some analytes were identified at each of the sites. As expected, the highest concentrations of these compounds were found in the log pond effluent (site F). Resin Acids/Fatty Acids are associated with paper mill effluent and can be toxic to aquatic life. The concentrations found in the ditches are low with respect to reported whole mill effluent toxicity (McLeay and Associates, 1986).

Qualitative Total Maximum Daily Load (TMDL) Analysis

As mentioned in the QA/QC section, the spacial variation in the ditches is such that the survey data reported here should only be used to assess the overall water quality of the ditches, but not used to define specific site conditions for load or wasteload allocations. However, the surveys and historical results do raise expectations about determining appropriate loading limits in the study area in order to improve water quality. Before a TMDL study for the area is initiated, the usefulness of a specific TMDL should be determined. For example, the ditches do not presently possess assimilative capacity for oxygen-consuming substances such as ammonia or BOD. Pursuing a labyrinth of technical issues, such as quantifying sediment oxygen demand, ground water inputs, and design conditions, only to return to the obvious conclusion that the ditches have no assimilative capacity would seem to be, at best, a misguided effort. In addition, if the technical problems are overcome, the impacts of periodic ditch dredging would render even the most sophisticated modeling effort useless for predicting water quality conditions.

Using both historical and survey data, WLAs and LAs for the study area would have to be 0 lbs./day for BOD and ammonia, and 0 fc/100 mL for fecal coliform. In addition, for some metals (such as lead, copper, and possibly cadmium), the allocations would also be 0 lbs./day. Even if the "natural conditions" in the ditches are found to be lower than the standards for these parameters, the WLAs and LAs would still need to be zero because the WAC (173-201A-070) anti-degradation section states that natural conditions shall become the new water quality standard. Therefore, no additional materials could be discharged to the system which may degrade the waterbody.

SUMMARY AND CONCLUSIONS

A water quality survey of about five of the greater than 60 miles of the Longview Ditches was conducted on September 14 and November 16, 1992. Historically, there have been concerns about the water quality classification of the Longview Ditches because of their design and function as a stormwater conveyance system. However, because they are a tributary to the Columbia River, the ditches are designated as a Class A waterbody. Consequently, the water quality assessment presented here is based on the criteria established to protect Class A beneficial uses.

Flow in the ditch system during both surveys was low. Although the flow direction was consistent during both surveys, it is generally not predictable due to pumping practices. Consequently, it is not possible to establish a design flow for the ditch system. However, during dry periods, flow direction and channel characteristics are probably the same as those found during the present surveys. The flow in the ditches during the September survey provides approximately a 3:1 dilution ratio for the Weyerhaeuser East pond discharge, which is, under current standards of effluent dilution ratios, extremely low.

One of the major objectives of this study was to provide baseline water quality data. Because the ditches are periodically dredged, it is not possible to "characterize" in total the water quality of the ditch system. However, it is reasonable to assume that due to anthropogenic loadings, the system after dredging returns quickly to the water quality conditions found during these surveys.

Water quality throughout the ditch system is poor. Dissolved oxygen, fecal coliform, turbidity, and some metals violate water quality criteria. In addition to these violations, the ditch system violates the aesthetic values of Class A waters. Also, iron, TSS, and *E. coli* levels exceed acceptable levels.

Generally, the findings of the September and November surveys are consistent with the historical water quality assessments of the ditches. It is very unlikely that the ditches in the study area can attain the water quality or aesthetic values of Class A waters without severely curbing point and nonpoint pollutant loadings to the system.

Finally, it may not be cost-effective to pursue a TMDL for the ditches since the result would be the same as presented in this report (no allocations).

RECOMMENDATIONS

Based on the water quality standards for Class A waters and the "natural conditions" clause in the anti-degradation section of the WAC, the Longview-Kelso ditches in the area of the study can not assimilate oxygen consuming material, either from point or nonpoint sources. Possible BOD (and COD) sources should be identified and reduced or, if possible, eliminated. In addition, turbidity, TSS, fecal coliform, and metals concentrations in the ditches also should be reduced.

In order to help improve water quality in the ditches, the diking, drainage, and improvement districts should consider alternatives to the current methods of maintaining the ditches (*i.e.* piling dredged material on the ditch banks). In addition, the diking districts and local governmental departments, such as Public Works and the Health Department, must cooperate in identifying and providing mitigation strategies for sources of contamination in the drainage, such as stormwater runoff.

The water quality monitoring portion of the Longview-Kelso urban area drainage system action plan should be modified to greatly reduce the number of variables measured. Both historical and present survey results identified a number of conventional and priority pollutants in the ditches. Continuing to monitor for the same set of pollutants in the ditches would be of no value. The plan should instead focus its analytical efforts on assessing parameters which are associated with chronic problems in the water (e.g., dissolved oxygen, bacteria, turbidity, TSS, and some metals) and sediments (see Part 2) of the ditches, specifically by monitoring to evaluate the effectiveness of control strategies. Monthly or bimonthly sampling of expensive analytes such as pesticides and PCBs should be eliminated since they were not found. Other analytes such as base-neutral extractables should be reduced to only periodic samplings that are designed to assess the effectiveness of control strategies on eliminating their presence.

TABLE 9. TENTATIVELY INDENTIFIED COMPOUNDS (ug/Kg, dry weight)						
Ditch:	No. 4	No. 4	No. 3	No. 3	No.5	No.5
Site I.D.:	A	B	D	G	I	J
Description:	@ Hudson Street	Between California Way & Tennant Way	Between California Way & Oregon Way	@ 23rd Avenue	@ 3500 Industrial Way	@ 38th Avenue
Sample Number:	47-8050	47-8051	47-8052	47-8053	47-8055	47-8056
Volatiles						
Thiobismethane		3.6 NJ		3.6 NJ		
2-Butene		3.4 NJ		5.8 NJ		
2,3-Dimethylbutane			31 NJ			
Pentane				4.3 NJ		
Hexane				3.7 NJ		
3-Methylhexane			46 NJ			
1,2-Dimethylhexane			35 NJ			
1,1,3-Trimethylhexane			44 NJ			
1-Methylcyclohexane			260 NJ	87 NJ		
3-Ethyl-5-methylheptane			280 NJ			
3,6-Dimethyloctane		22 NJ				
2,4,6-Trimethyloctane		380 NJ	1400 NJ			
4-Methyldecane		370 NJ				
Decane		210 NJ	840 NJ			
Dodecane			640 NJ			
6,6-Dimethylundecane				18 NJ		
Semivolatiles						
4-Hydroxy-4-methylpentane	480000 NJ					
Pentacosane	38000 NJ					
17-Pentatriacontene	14000 NJ					
3-Octadecene	75000 NJ					
1,2-Dibromododecane	31000 NJ					

NJ = evidence analyte is present, value is an estimate

Tentatively Identified Compounds (Table 9) - An additional 21 non-target compounds were tentatively identified during analysis for volatiles and semivolatiles. With the exception of 1,2-dibromododecane, previously mentioned in connection with EOX, all appear to be biogenic in origin, in many cases (e.g., butene, pentane, hexane, decane) probably related to petroleum or its combustion.

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APPENDICES

Appendix A. Data Qualifier Codes:

B - Analyte was also found in the analytical method blank indicating the sample may have been contaminated.

U - The analyte was not detected at or above the reported value.

J - The analyte was positively identified. The associated numerical value is an estimate.

UJ - The analyte was not detected at or above the reported estimated result.

P - The analyte was detected above the instrument detection limit but below the established minimum quantification limit.

REJ - The data are unusable for all purposes.

NAF - Not analyzed for.

LAC - Lab accident, sample was ruined.

NJ - There is evidence that the analyte is present. The associated numerical result is an estimate.

Appendix B. Results of water quality surveys conducted on Longview ditches on September 14 and November 16, 1992

Sample Site	Miles(a)	Date	Time	Flow (cfs)	Temp (C)	pH (S.U.)	Cond (umhos/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat)	CN (mg/L)	O&G (mg/L)	Hard. (mg/L)	Cl (mg/L)	F (mg/L)	Turb. (NTU)	TSS (mg/L)	TDS (mg/L)
A	0	14-Sep-92	0850	0.10	11.0	7.7	150	1.7	15		<1	45	9.1	0.3	21	28	139
B	1.1	14-Sep-92	0945	1.30	11.5	7.0	130	6.1	56		<1	50	6.4	<0.2	30	12	117
C	1.5	14-Sep-92	1015	0.002	12.0	6.5	460	<0.5	<4		<1	197 J	10.4	0.2	50 J	105	335
D	1.6	14-Sep-92	1045	3.24	12.5	6.7	210	2.6	24		<1	86	6.9	<0.2	75	37	159
Replicate at D		14-Sep-92	1050					2.9	27		<1	81	7.1	<0.2	75	37	173
E	2.2	14-Sep-92	1140	0.26	15.5	6.7	220	3.5	35		<1	85	12.6	<0.2	38	11	171
F	2.4	14-Sep-92	1155	2.39	16.0	7.0	185	4.8	49		<1	69	9.5	<0.2	20 J	19	152
G	2.7	14-Sep-92	1220	6.97	14.0	6.6	250	1.5	15		<1	93	8.7	<0.2	45	35	173
H	3.6	14-Sep-92	NO FLOW IN DITCH														
I	4.6	14-Sep-92	1310		14.0	6.7	260	4.0	39	<0.01(b)	3.3	104	10.9	<0.2	70	28	204
J	5.2	14-Sep-92	1340		15.5	6.9	240	5.9	59		<1	102	10.6	<0.2	55	21	208
CVs for Replicate Pairs (%)								**8**	**8**			**5**	**2**		**0**	**0**	**6**
A	0	16-Nov-92	0855	0.19	9.3	6.9	147	<0.4	<3		3	52	8.5	0.23	25	54	216
B	1.1	16-Nov-92	0940	2.29	11.7	7.2	135	5.9	54		1	48	6.2	0.15	23	15	141
C	1.5	16-Nov-92	1000	0.006	12.1	6.0	600	3.5	33		3	NAF	14.7	2.14	160	211	946
D	1.6	16-Nov-92	1025	3.90	10.5	7.2	225	2.9	26		2	74	9.5	0.17	35	52	300
Replicate at D		16-Nov-92	1030					2.9	26		1	68	9.1	0.18	37	56	173
E	2.2	16-Nov-92	1110	0.41	12.4	7.1	275	3.7	35		2	87	12.2	0.23	52	9	204
F	2.4	16-Nov-92	1130	2.02	10.6	7.3	210	4.9	44		2	69	8.6	0.19	100	118	202
G	2.7	16-Nov-92	1150	8.48	10.9	6.7	290	1.7	15		1 u	86	8.1	0.19	39	60	219
H	3.6	16-Nov-92	NO FLOW IN DITCH														
I	4.6	16-Nov-92	1225		10.9	6.9	320	2.1	19		1	106	10.5	0.23	70	25	222
J	5.2	16-Nov-92	1245		10.9	6.9	305	1.6	14		LAC	102	10.7	0.22	68	30	205
CVs for Replicate Pairs (%)								**0**	**0**		**47**	**6**	**3**	**4**	**4**	**5**	**38**

(a) Miles = Distance from site A
(b) Replicate also <0.01 mg/L

Cont- Appendix B.

Sample Site	Miles(a)	Date	Time	Fecal Coliform (#/100 mL)	E. Coli (#/100 mL)	TOC (mg/L)	BOD-5 (mg/L)	Chloro a (ug/L)	Pheo a (ug/L)	NH3 (mg/L)	NO2+NO3 (mg/L)	TKN (mg/L)	TP (mg/L)	SRP (mg/L)
A	0	14-Sep-92	0850	15000	8400	24.7	3.8	2.4	8.2	0.536	0.010 U	4.3	0.094	0.214
B	1.1	14-Sep-92	0945	28000	230	23.5	<3			0.068	0.012	3.1	0.023	0.021
C	1.5	14-Sep-92	1015	350000	83	213	43.5			0.381	0.010 U	4.2	0.010	0.020
D	1.6	14-Sep-92	1045	110000	560	42.2	4.4	2.2	3.2	0.333	0.022	1.3	0.037	0.010 U
Replicate at D		14-Sep-92	1050	3500	110	56.3	3.9	1.9	1.5	0.334	0.021	1.2	0.018	0.010 U
E	2.2	14-Sep-92	1140	120	20	44.5	3	4.2	0.05 U	0.247	0.124	1.1	0.027	0.018
F	2.4	14-Sep-92	1155	7600	18	56.1	14.7			0.035	0.010 U	<1	0.053	0.046
G	2.7	14-Sep-92	1220	3500	20	54.3	6.1			0.340	0.010 U	1.6	0.024	0.010 U
H	3.6	14-Sep-92	NO FLOW IN DITCH											
I	4.6	14-Sep-92	1310	2800	40	76		1.0	0.43	0.460	0.010 U	<1	0.013	0.010 U
J	5.2	14-Sep-92	1340	170	45	43.1		21.7	0.05 UJ	0.233	0.010 U	4.5	0.015	0.010 U
CVs for Replicate Pairs (%)				**133**	**95**	**20**	**9**	**10**	**51**	**0**	**3**	**6**	**49**	**0**
A	0	16-Nov-92	0855	790		5.2	<4	3.6	9.3	0.297	0.056 U	0.78	0.392	0.020
B	1.1	16-Nov-92	0940	110		3	<4			0.149	0.035	0.37	0.187	0.023
C	1.5	16-Nov-92	1000	20 U		456	660			0.125	0.046	4.8	0.414	0.213
D	1.6	16-Nov-92	1025	20 U		4.8	5	1.0	1.6	0.244	0.033	0.91	0.13	0.010 U
Replicate at D		16-Nov-92	1030	45		4.8	5	1.6	2.7	0.272	0.031	0.65	0.117	0.010 U
E	2.2	16-Nov-92	1110	17		2.9	<4	1.7	0.05 U	0.273	0.099	0.52	0.016	0.097
F	2.4	16-Nov-92	1130	450		33.8	17	0.0	0	0.013	0.010 U	1.1	0.103	0.042
G	2.7	16-Nov-92	1150	20		11.5	6	0.0	0	0.361	0.021	0.79	0.097	0.010 U
H	3.6	16-Nov-92	NO FLOW IN DITCH											
I	4.6	16-Nov-92	1225	20 U		4.2		0.6	0.51	0.569	0.015 U	0.80	0.057	0.010 U
J	5.2	16-Nov-92	1245	78		4.4		1.3	0.14	0.538	0.015	0.72	0.067	0.010 U
CVs for Replicate Pairs (%)				**54**		**0**	**0**	**33**	**36**	**8**	**4**	**24**	**7**	**0**

(a) Miles = Distance from site A

Appendix C. Base-Neutral Extractable organics for Longview ditch sites sampled on September 14, 1992

BNA Compounds	SITE A (ug/L)	SITE B (ug/L)	SITE E (ug/L)	SITE I (ug/L)	BLANK 1 (ug/L)	BLANK 2 (ug/L)	SPIKE 1 % Recov	SPIKE 2 % Recov
Benzo(a)Pyrene	1 U	2 U	1 U	3 U	4 U	4 U	97	100 U
2,4-Dinitrophenol	19 UJ	19 UJ	19 UJ	32 UJ	50 UJ	50 UJ	121 J	127 J
Dibenzo(a,h)Anthracene	4 U	4 U	4 U	6 U	10 U	10 U	115	117
Benzo(a)Anthracene	1 U	2 U	1 U	3 U	4 U	4 U	85	87
4-Chloro-3-Methylphenol	7 U	8 U	7 U	13 UJ	20 U	20 U	101	105
Benzoic Acid	19 UJ	19 UJ	19 UJ	32 UJ	50 UJ	50 UJ	91 J	87 J
Hexachloroethane	1 U	2 U	1 U	3 UJ	4 U	4 U	48	56
Hexachlorocyclopentadiene	7 U	8 U	7 U	13 UJ	20 U	20 U	21	21
Isophorone	1 U	2 U	1 U	3 U	4 U	4 U	93	99
Acenaphthene	1 U	0.08 J	1 U	0.1 J	4 U	4 U	79	79
Diethyl Phthalate	1 J	2 U	1 U	3 U	4 U	4 U	89	94
Di-n-Butyl Phthalate	1 U	2 U	1 U	3 U	4 U	4 U	88	92
Phenanthrene	0.2 J	0.09 J	1 U	0.1 J	4 U	4 U	84	87
Butylbenzyl Phthalate	1 U	2 U	1 U	3 U	10 U	10 U	100	95
N-Nitrosodiphenylamine	19 UJ	19 U	1 UJ	3 UJ	50 UJ	50 UJ	122 J	130 J
Fluorene	0.1 J	2 U	1 U	3 U	4 U	4 U	82	84
Carbazole	7 UJ	8 UJ	7 UJ	13 UJ	20 UJ	20 UJ	NAF	NAF
Hexachlorobutadiene	4 U	4 U	4 U	6 UJ	10 U	10 U	45	49
Pentachlorophenol	7 U	8 U	7 U	13 U	20 U	20 U	88	88
2,4,6-Trichlorophenol	4 U	4 U	4 U	6 U	10 U	10 U	74	76
2-Nitroaniline	4 U	4 U	4 U	6 U	10 U	10 U	130	137
2-Nitrophenol	4 U	4 U	4 U	6 U	10 U	10 U	102	108
1-Methylnaphthalene	0.2 J	2 U	1 U	3 U	4 U	4 U	NAF	NAF
Naphthalene	1 U	2 U	1 U	3 U	4 U	4 U	70	72
2-Methylnaphthalene	0.1 J	2 U	1 U	3 U	4 U	4 U	53	53
2-Chloronaphthalene	1 U	2 U	1 U	3 U	4 U	4 U	70	69
3,3'-Dichlorobenzidine	37 U	39 U	37 U	64 U	100 U	100 U	NAF	NAF
2-Methylphenol	1 U	2 U	1 U	3 U	4 U	4 U	93	95
1,2-Dichlorobenzene	1 U	2 U	1 U	3 U	4 U	4 U	58	61
o-Chlorophenol	1 U	2 U	1 U	3 U	4 U	4 U	91	92
2,4,5-Trichlorophenol	7 U	8 U	7 U	13 U	20 U	20 U	104	104
Nitrobenzene	1 U	2 U	1 U	3 U	4 U	4 U	94	99
3-Nitroaniline	REJ	REJ	REJ	REJ	REJ	REJ	564 J	464 J
4-Nitroaniline	19 U	19 UJ	19 U	32 UJ	50 U	50 U	163	155
4-Nitrophenol	9 U	10 U	9 U	16 UJ	25 U	25 U	125	134
Benzyl Alcohol	30 UJ	31 UJ	30 UJ	51 UJ	80 UJ	80 UJ	166 J	181 J
4-Bromophenyl Phenylether	1 U	2 U	1 U	3 U	4 U	4 U	75	76
2,4-Dimethylphenol	1 U	2 U	1 U	3 U	4 U	4 U	126	126
4-Methylphenol	1 U	2 U	1 U	3 U	4 U	4 U	97	96
1,4-Dichlorobenzene	1 U	2 U	1 U	3 U	4 U	4 U	55	60
4-Chloroaniline	19 U	19 U	19 U	32 UJ	50 U	50 U	187	212
Phenol	1 U	2 U	1 U	3 U	4 U	4 U	96	98
Bis(2-Chloroethyl)Ether	1 U	2 U	1 U	3 U	4 U	4 U	81	84
Bis(2-Chloroethoxy)Methane	1 U	2 U	1 U	3 U	4 U	4 U	83	88
Bis(2-Ethylhexyl)Phthalate	2 U	2 U	1 U	3 U	4 U	4 U	99	95
Di-n-Octyl Phthalate	1 UJ	2 UJ	1 UJ	3 UJ	4 UJ	4 UJ	100 J	104 J
Hexachlorobenzene	1 U	2 U	1 U	3 U	4 U	4 U	76	79
Anthracene	1 U	2 U	1 U	3 U	4 U	4 U	82	87
1,2,4-Trichlorobenzene	1 U	2 U	1 U	3 U	4 U	4 U	56	58
2,4-Dichlorophenol	1 U	2 U	1 U	3 U	4 U	4 U	79	81
2,4-Dinitrotoluene	4 UJ	4 UJ	4 UJ	6 UJ	10 UJ	10 UJ	87 J	93 J
Pyrene	0.2 J	0.10 J	1 U	3 U	4 U	4 U	90	84
Dimethyl Phthalate	1 U	2 U	1 U	3 U	4 U	4 U	85	89
Dibenzofuran	1 U	2 U	1 U	3 U	4 U	4 U	77	78
Benzo(g,h,i)Perylene	1 U	2 U	1 U	3 U	4 U	4 U	102	106
Indeno(1,2,3-cd)Pyrene	1 U	2 U	1 U	3 U	4 U	4 U	112	118
Benzo(b)Fluoranthene	1 U	2 U	1 U	3 U	4 U	4 U	86	92
Fluoranthene	0.2 J	0.08 J	1 U	3 U	4 U	4 U	84	88
Benzo(k)Fluoranthene	1 U	2 U	1 U	3 U	4 U	4 U	80	81
Acenaphthylene	1 U	2 U	1 U	3 U	4 U	4 U	98	97
Chrysene	1 U	2 U	1 U	3 U	4 U	4 U	83	77
Retene	1 U	2 U	1 U	3 U	4 U	4 U	NAF	NAF

CONT - Appendix C.

BNA Compounds	SITE A (ug/L)	SITE B (ug/L)	SITE E (ug/L)	SITE I (ug/L)	BLANK 1 (ug/L)	BLANK 2 (ug/L)	SPIKE 1 % Recov	SPIKE 2 % Recov
4,6-Dinitro-2-Methylphenol	19 UJ	19 UJ	19 UJ	32 UJ	50 UJ	50 UJ	105 J	112 J
1,3-Dichlorobenzene	1 U	2 U	1 U	3 U	4 U	4 U	55	61
2,6-Dinitrotoluene	4 U	4 U	4 U	6 U	10 U	10 U	78	81
N-Nitroso-di-n-Propylamine	1 U	2 U	1 U	3 U	4 U	4 U	97	100
4-Chlorophenyl Phenylether	1 U	2 U	1 U	3 U	4 U	4 U	74	75
Bis(2-Chloroisopropyl)Ether	1 UJ	2 UJ	1 UJ	3 UJ	4 UJ	4 UJ	95 J	100 J
Surrog: 2-Fluorobiphenol (%)	64	61	67	64	65	58	70	73
Surrog: 2-Fluorophenol (%)	62	71	76	84	88	85	92	94
D4-1,2-Dichlorobenzene (%)	51	48	52	48	42	37	52	57
Surrog: D14-Terphenyl (%)	66	71	74	76	80	74	80	74
PYRENE-D10 (SS) (%)	80	77	83	81	82	79	83	79
Surrog: D5-Nitrobenzene (%)	83	87	96	88	91	88	100	102
Surrog: D5-Phenol (%)	42	52	54	71	83	84	98	98
Tentatively Identified BNA Compounds								
Decanoic Acid, Hexa-	1.5 NJ	0.66 NJ	0.30 NJ					
Ethanol, 2-Butoxy-, Phosphate	2.7 NJ	8.80 NJ						
2-Pyrrolidinone, 1-Methyl-	2.6 NJ							
Triphenyl Phosphate			0.27 NJ					
Unknown Hydrocarbons	31 NJ							
Unknown Compound	0.84 NJ		1.3 NJ	1.7 NJ				

CONT-Appendix C. Base-Neutral Extractable Organics for Longview ditch sites sampled on November 16, 1992

	SITE							
BNA Compounds	A (ug/L)	B (ug/L)	E (ug/L)	I (ug/L)	BLANK 1 (ug/L)	BLANK 2 (ug/L)	SPIKE 1 % Recov	SPIKE 2 % Recov
Benzo(a)Pyrene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	98	99
2,4-Dinitrophenol	32 U	32 U	32 U	32 U	32 U	32 U	128	131
Dibenzo(a,h)Anthracene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U		
Benzo(a)Anthracene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	85	85
4-Chloro-3-Methylphenol	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	94	97
Aniline	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U		
Benzoic Acid	8 U	8 U	8 U	8 U	8 U	8 U	70	60
Hexachloroethane	1.6 U	1.6 UJ	1.6 U	1.6 U	1.6 U	1.6 U	34	8
Hexachlorocyclopentadiene	16 U	16 UJ	16 U	16 U	16 U	16 U	30	7
Isophorone	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	91	92
Acenaphthene	0.066 J	0.035 J	1.6 U	0.12 J	1.6 U	1.6 U	78	80
Diethyl Phthalate	1.6 U	1.6 U	1.6 U	1.6 U	0.24 J	0.36 J	97	101
Di-n-Butyl Phthalate	1.6 U	1.6 U	1.6 U	1.6 U	0.27 J	0.35 J	98	97
Phenanthrene	1.6 U	1.6 U	1.6 U	0.086 J	1.6 U	1.6 U	92	91
Butylbenzyl Phthalate	1.6 U	0.1 J	1.6 U	1.6 U	1.6 U	1.6 U	92	94
N-Nitrosodiphenylamine	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	88	90
Fluorene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	85	87
Carbazole	1.6 U	1.6 U	1.6 U	0.032 J	1.6 U	1.6 U	90	87
Hexachlorobutadiene	1.6 U	1.6 UJ	1.6 U	1.6 U	1.6 U	1.6 U	43	11
Pentachlorophenol	16 U	16 U	16 U	16 U	16 U	16 U	92	92
2,4,6-Trichlorophenol	4 U	4 U	4 U	4 U	4 U	4 U	99	101
2-Nitroaniline	4 U	4 U	4 U	4 U	4 U	4 U	97	102
2-Nitrophenol	4 U	4 U	4 U	4 U	4 U	4 U	96	100
1-Methylnaphthalene	0.49 J	0.038 J	1.6 U	0.074 J	1.6 U	1.6 U	NAF	NAF
Naphthalene	0.38 J	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	67	60
2-Methylnaphthalene	0.26 J	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	46	42
2-Chloronaphthalene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	67	64
3,3'-Dichlorobenzidine	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	85	85
Benzidine	3.2 UJ	3.2 UJ	3.2 UJ	3.2 UJ	3.2 UJ	3.2 UJ	93	95
2-Methylphenol	1.6 U	0.13 J	1.6 U	1.6 U	1.6 U	1.6 U	90	93
1,2-Dichlorobenzene	1.6 U	1.6 UJ	1.6 U	1.6 U	1.6 U	1.6 U	43	24
o-Chlorophenol	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	87	91
2,4,5-Trichlorophenol	4 U	4 U	4 U	4 U	4 U	4 U	101	103
Nitrobenzene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	88	90
3-Nitroaniline	4 U	4 U	4 U	4 U	4 U	4 U	90	98
4-Nitroaniline	4 U	4 U	4 U	4 U	4 U	4 U	91	96
4-Nitrophenol	8 U	8 U	8 U	8 U	8 U	4 U	89	92
Benzyl Alcohol	4 UJ	4 UJ	4 UJ	4 UJ	4 UJ	8 U	92 J	93 J
4-Bromophenyl Phenylether	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	91	90
2,4-Dimethylphenol	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	87	88
4-Methylphenol	0.62 J	0.18 J	1.6 U	1.6 U	1.6 U	1.6 U	88	90
1,4-Dichlorobenzene	1.6 U	0.14 J	1.6 U	1.6 U	1.6 U	1.6 U	41	NAF
4-Chloroaniline	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	87	92
Phenol	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	81	82
Bis(2-Chloroethyl)Ether	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	80	83
Bis(2-Chloroethoxy)Methane	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	88	91
Bis(2-Ethylhexyl)Phthalate	5.2 U	1.6 U	1.6 U	1.6 U	0.31 J	1.6 U	95	95
Di-n-Octyl Phthalate	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	95	97
Hexachlorobenzene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	103	103
Anthracene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	NAF	NAF
1,2,4-Trichlorobenzene	1.6 U	1.6 UJ	1.6 U	1.6 U	1.6 U	1.6 U	47	NAF
2,4-Dichlorophenol	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	121	127
2,4-Dinitrotoluene	4 U	4 U	4 U	4 U	4 U	4 U	101	106
Pyrene	0.5 J	0.08 J	1.6 U	0.051 J	1.6 U	1.6 U	92	90
Dimethyl Phthalate	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	94	97
Dibenzofuran	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	85	86
Benzo(g,h,i)Perylene	0.21 J	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U		
Indeno(1,2,3-cd)Pyrene	0.18 J	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U		
Benzo(b)Fluoranthene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	103	103
Fluoranthene	0.57 J	0.078 J	1.6 U	0.061 J	1.6 U	1.6 U	NAF	NAF
Benzo(k)Fluoranthene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	97	99
Acenaphthylene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	81	83
Chrysene	0.36 J	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	96	98
Retene	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	95	97

CONT-Appendix C. Base-Neutral Extractable Organics for Longview ditch sites sampled on November 16, 1992

BNA Compounds	SITE A (ug/L)	B (ug/L)	E (ug/L)	I (ug/L)	BLANK 1 (ug/L)	BLANK 2 (ug/L)	SPIKE 1 % Recov	SPIKE 2 % Recov
4,6-Dinitro-2-Methylphenol	16 U	16 U	16 U	16 U	16 U	16 U	117	116
1,3-Dichlorobenzene	1.6 U	1.6 UJ	1.6 U	1.6 U	1.6 U	1.6 U	38	16
2,6-Dinitrotoluene	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	107	111
N-Nitroso-di-n-Propylamine	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	84	88
4-Chlorophenyl Phenylether	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	77	79
1,2-Diphenylhydrazine	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	85	82
Bis(2-Chloroisopropyl)Ether	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	81	84
Surrog: 2,4,6-Tribromo+	NAF	NAF	NAF	NAF	NAF	NAF	NAF	NAF
Surrog: 2-Fluorobiphenol (%)	81	82	81	72	66	68	67	56
Surrog: 2-Fluorophenol (%)	71	77	74	66	88	91	85	86
D4-1,2-Dichlorobenzene (%)	75	77	74	46	36	37	48	20
Surrog: D14-Terphenyl (%)	75	82	77	74	80	83	82	81
PYRENE-D10 (SS) (%)	88	93	89	83	70	92	93	93
Surrog: D5-Nitrobenzene (%)	94	103	103	96	99	105	98	98
Surrog: D5-Phenol (%)	52	60	54	49	83	86	84	84
d4-2-Cchlorophenol	85	90	90	85	90	93	86	88
Tentatively Identified BNA Compounds								
2-Propanol, 1-(2-methoxy-1-	3.8 NJ			2.7 NJ				
Undecane, 3,6-dimethyl-	1.5 NJ							
Heptadecane, 2, 6-dimethyl-	2.1 NJ							
Tetradecane	7.6 NJ							
Naphthalene, 2, 6-dimethyl-	2.3 NJ							
Nonane, 3-methyl-5 propyl-	2.4 NJ							
Dodecane	2.4 NJ							
Decane, 2, 3, 5- trimethyl-	9.0 NJ							
Heptadecane	6.7 NJ							
Dodecane, 2-methyl-propyl-	4.6 NJ							
Dodecane, 1-iodo-	1.7 NJ							
Pentadecane	2.7 NJ							

Appendix D. Pesticide/PCB compounds for Longview ditch sites sampled on September 14, 1992

Pesticide/PCB Compounds	SITE A (ug/L)	SITE B (ug/L)	SITE D (ug/L)	SITE E (ug/L)	SITE I (ug/L)	SITE J (ug/L)	BLANK 1 (ug/L)	BLANK 2 (ug/L)	SPIKE 1 % Recov	SPIKE 2 % Recov
4,4'-DDT	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U	86	79
Chlordane	0.100 U	0.100 U	0.100 U	0.100 U	0.130 U	0.110 U	0.200 U	0.200 U	93	86
gamma-BHC (Lindane)	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U	99	98
Dieldrin	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
Endrin	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U	110	101
Methoxychlor	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U	92	83
4,4'-DDD	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
4,4'-DDE	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
Heptachlor	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U	63	68
Aldrin	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U	59	66
alpha-BHC	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
beta-BHC	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
delta-BHC	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
Endosulfan I	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U	103	103
Heptachlor Epoxide	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
Endosulfan Sulfate	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
Endrin Aldehyde	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
Toxaphene	0.450 U	0.460 U	0.450 U	0.450 U	0.760 U	0.670 U	1.2 U	1.2 U		
Endosulfan II	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
Endrin Ketone	0.010 U	0.010 U	0.010 U	0.010 U	0.013 U	0.011 U	0.020 U	0.020 U		
Aroclor-1016	0.15 U	0.15 U	0.15 U	0.15 U	0.25 U	0.22 U	0.40 U	0.40 U		
Aroclor-1221	0.15 U	0.15 U	0.15 U	0.15 U	0.25 U	0.22 U	0.40 U	0.40 U		
Aroclor-1232	0.37 U	0.39 U	0.37 U	0.37 U	0.64 U	0.56 U	1.0 U	1.0 U		
Aroclor-1242	0.15 U	0.15 U	0.15 U	0.15 U	0.25 U	0.22 U	0.40 U	0.40 U		
Aroclor-1248	0.15 U	0.15 U	0.15 U	0.15 U	0.25 U	0.22 U	0.40 U	0.40 U		
Aroclor-1254	0.15 U	0.15 U	0.15 U	0.15 U	0.25 U	0.22 U	0.40 U	0.40 U		
Aroclor-1260	0.15 U	0.15 U	0.15 U	0.15 U	0.25 U	0.22 U	0.40 U	0.40 U		
DIBUTYLCHLORENDATE (SS) (%)	71	74	86	118	130	120	111	116	120	102
DECACHLOROBIPHENYL (%)	74	74	89	104	127	120	122	117	120	107
4,4-Dibromooctaflurob- (%)	47	35	44	57	58	70	57	63	70	65

CONT-Appendix D. Pesticide/PCB compounds for Longview ditch sites sampled on November 16, 1992

Pesticide/PCB Compounds	SITE A (ug/L)	B (ug/L)	D (ug/L)	E (ug/L)	I (ug/L)	J (ug/L)	BLANK 1 (ug/L)	BLANK 2 (ug/L)	SPIKE 1 % Recov	SPIKE 2 % Recov
4,4'-DDT	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U	105	101
Chlordane	0.15 U	0.20 U	0.40 U	0.08 U	0.08 U	0.13 U	0.4 U	0.2 U	93	88
gamma-BHC (Lindane)	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U	111	102
Dieldrin	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
Endrin	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U	112	101
Methoxychlor	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U	112	106
4,4'-DDD	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
4,4'-DDE	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
Heptachlor	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U	80	74
Aldrin	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U	64	60
alpha-BHC	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
beta-BHC	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
delta-BHC	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
Endosulfan I	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U	98	93
Heptachlor Epoxide	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
Endosulfan Sulfate	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
Endrin Aldehyde	0.03 U	0.40 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
Toxaphene	1.5 U	2.0 U	0.4 U	0.8 U	0.8 U	2.0 U	4.0 U	2.0 U		
Endosulfan II	0.03 U	0.08 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
Endrin Ketone	0.03 U	0.08 U	0.02 U	0.02 U	0.02 U	0.03 U	0.08 U	0.04 U		
Aroclor-1016	0.15 U	0.2 U	0.08 U	0.08 U	0.08 U	0.2 U	0.4 U	0.2 U		
Aroclor-1221	0.15 U	0.2 U	0.08 U	0.08 U	0.08 U	0.2 U	0.4 U	0.2 U		
Aroclor-1232	0.15 U	0.2 U	0.08 U	0.08 U	0.08 U	0.2 U	0.4 U	0.2 U		
Aroclor-1242	0.15 U	0.2 U	0.08 U	0.08 U	0.08 U	0.2 U	0.4 U	0.2 U		
Aroclor-1248	0.15 U	0.2 U	0.08 U	0.08 U	0.08 U	0.2 U	0.4 U	0.2 U		
Aroclor-1254	0.15 U	0.2 U	0.08 U	0.08 U	0.08 U	0.2 U	0.4 U	0.2 U		
Aroclor-1260	0.15 U	0.2 U	0.08 U	0.08 U	0.08 U	0.2 U	0.4 U	0.2 U		
DIBUTYLCHLORENDATE (SS) (%)	70	74	66	41	36	86	68	51	74	70
DECACHLOROBIPHENYL (%)	96	74	80	52	50	92	78	71	93	99

Appendix E. Total recoverable metals concentrations for Longview ditch sites sampled on September 14, 1992

Metals	SITE A (ug/L)	B (ug/L)	C (ug/L)	D (ug/L)	Replicate (ug/L)	E (ug/L)	F (ug/L)	G (ug/L)	I (ug/L)	J (ug/L)	Blank (ug/L)	SPIKE 1 (ug/L)	SPIKE 2 (ug/L)	CV for Replicate (%)
Cadmium	0.51 B	0.18 PB	0.25 PB	0.24 PB	0.36 PB	14 PB	0.37 PB	1.04 B	0.43 PB	0.35 PB	0.51 P			**28**
Chromium	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	77	85	**0**
Copper	13	3 U	3 U	3 U	3 U	3 U	5.1 P	3 U	3 U	3 U	3 U	100	100	**0**
Lead	42	2.7 P	1.5 P	3.9 P	4.6 P	1 U	1.3 P	1.2 P	1 U	1 U	1 U	100	95	**12**
Mercury	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	U	102	98	**0**
Iron	5420	5530	35900	14500	14500	10100	2430	14700	14500	6950	5 U	NA	NA	**0**
Nickel	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	101	102	**0**
Silver	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	113	114	**0**
Zinc	70.6	12 P	20 P	15 P	15 P	10 P	26	14 P	12 P	9.4 P	4 U	103	104	**0**
Criteria														
Hardness	45	50		86	81	85		93	104	102				
Cadmium	0.6 (a)	0.7		1.0	1.0	1.0		1.1	1.2	1.2				
	1.6 (b)	1.8		3.3	3.1	3.3		3.6	4.1	4.0				
Chromium														
Copper	6	7		10	10	10		11	12	12				
	8	9		15	15	15		17	18	18				
Lead	1.2	1.3		2.6	2.4	2.6		2.9	3.3	3.3				
	29.5	33.8		67.4	62.4	66.4		74.4	85.8	83.7				
Mercury	0.012	0.012		0.012	0.012	0.012		0.012	0.012	0.012				
	2.4	2.4		2.4	2.4	2.4		2.4	2.4	2.4				
Iron	1000	1000		1000	1000	1000		1000	1000	1000				
Nickel	80	88		139	132	137		148	163	160				
	722	789		1,248	1,187	1,236		1,334	1,466	1,442				
Silver	0.12	0.12		0.12	0.12	0.12		0.12	0.12	0.12				
Zinc	54	59		93	89	92		100	110	108				
	59	65		103	98	102		110	121	119				

(shaded) = Criteria exceedence (after metal concentration measured in blank sample subtracted)
(a) Top value = Chronic Criteria
(b) Bottom value = Acute Criteria

CONT-Appendix E. Total recoverable metals concentrations for Longview ditch sites sampled on November 16, 1992
Chronic and acute criteria for metals at specified sites listed below.

	SITE													
Metals	A (ug/L)	B (ug/L)	C (ug/L)	D (ug/L)	Replicate (ug/L)	E (ug/L)	F (ug/L)	G (ug/L)	I (ug/L)	J (ug/L)	Blank 1 (ug/L)	SPIKE 1 % recov	SPIKE 2 % recov	**CV for Replicate (%)**
Cadmium	**2.13 J**	**1.29 J**	1.18 J	**2.83 J**	0.64 J	0.62 J	2.94 J	1.33 J	1.58 J	0.66 J	0.65 P	75	129	**150**
Chromium	5.0 U	5.0 U	5.0 U	20	17	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	98	99	**12**
Copper	**20**	4.5 P	52.2	4.9 P	8.0 P	3.0 U	21	6.2 P	3.0 U	3.5 P	3.0 U	106	107	**34**
Lead	**44.2 B**	**12.6 B**	17.3 B	**9.0 B**	**11.4 B**	1.4 J	3.6 J	3.2 G	5.0 B	1.7 J	4.9 P	93	96	**17**
Mercury	**0.055 J**	**0.087 J**	0.050 UJ	0.05 UJ	0.05 UJ	**0.07 J**	0.08 J	0.05 UJ	**0.055 J**	**0.097 J**	0.0 U	112	104	**0**
Iron	**5910**	**5900**	**24700**	**9850**	**11100**	**9710**	**5860**	**16300**	**17100**	**14500**	5.0 U	92	83	**8**
Nickel	10 U	10 U	17 P	22 P	21 P	10 U	10 U	10 U	10 U	10 U	10 U	101	103	**3**
Silver	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	89	90	**0**
Zinc	**101**	23 B	447	23 B	33 B	12 BP	50.8	41.7	16 PB	19 PB	4.0 U	105	105	**25**
Criteria														
Hardness	52	48		74	68	87		86	106	102				
Cadmium	0.7 (a)	0.6		0.9	0.8	1.0		1.0	1.2	1.2				
	1.9 (b)	1.7		2.8	2.5	3.4		3.3	4.2	4.0				
Chromium														
Copper	7	6		9	9	10		10	12	12				
	10	9		13	12	16		15	19	18				
Lead	1.4	1.2		2.2	1.9	2.7		2.6	3.4	3.3				
	35.5	32.1		55.6	50.0	68.4		67.4	87.9	83.7				
Mercury	0.012	0.012		0.012	0.012	0.012		0.012	0.012	0.012				
	2.4	2.4		2.4	2.4	2.4		2.4	2.4	2.4				
Iron	1000	1000		1000	1000	1000		1000	1000	1000				
Nickel	91	85		122	114	140		139	166	160				
	816	762		1,099	1,023	1,261		1,248	1,490	1,442				
Silver	0.12	0.12		0.12	0.12	0.12		0.12	0.12	0.12				
Zinc	61	57		82	76	94		93	111	108				
	67	63		91	84	104		103	123	119				

(shaded) = Criteria exceedence (after metal concentration measured in blank sample subtracted)
(a) Top value = Chronic Criteria
(b) Bottom value = Acute Criteria

CONT-Appendix F. Resin Acid/Fatty Acid compounds for Longview ditch samples on November 16, 1992

	SITE										
Resins Acids Fatty Acids	A (ug/L)	B (ug/L)	C (ug/L)	D (ug/L)	F (ug/L)	G (ug/L)	I (ug/L)	BLANK 1 (ug/L)	BLANK 2 (ug/L)	SPIKE 1 (% recov)	SPIKE 2 (% recov)
Palmitoleic acid (EE)	7.6	3.6 U	14.5	1.9 J	30.2 J	15	3.5	10 U	10 U	68	82
Decanoic Acid, Hexa-	14.2	1.7 J	27.7 J	4.1 J	33.2 J	13	2.2 J	10 J	10 U	157	181
Linoleic acid	1.9 J	3.6 U	14.6 J	5.4 U	3.8 J	2 U	0.45 J	10 U	10 U	26 J	32
Oleic acid	4.2	3.6 U	7.1 U	1.1 J	7.3	4.6	0.76 J	10 U	10 U	65	80
Octadecanoic acid	5.2	3.6 U	3.6 J	1.8 J	8.2	3.8	0.58 J	0.78 J	0.62 J	141	157
Retene	3.7 U	3.6 U	3.7 U	5.4 UJ	1.2 J	3.6 U	3.5 U	10 U	10 U	171	165
Pimaric acid	3.7 U	3.6 U	3.7 U	5.4 U	3.8 U	3.6 U	3.5 U	10 U	10 U	46	53
Sandaracopimaric acid	3.7 U	3.6 U	3.7 U	5.4 U	2.2 J	0.9 J	3.5 U	10 U	10 U	8 J	8 J
Isopimaric acid	3.7 U	3.6 U	0.83 J	5.4 U	5.9	2.3 J	3.5 U	10 U	10 U	32	34
Palustric acid	3.7 U	3.6 U	3.7 U	5.4 UJ	3.8 U	3.6 U	3.5 U	10 U	10 U	42	NAF
Dehydroabietic acid	0.6 J	0.14 J	4.2	3.3 J	23 J	5.7	1.2 J	10 U	10 U	151	166
Abietic acid	3.7 U	3.6 U	3.7 U	5.4 UJ	3.8 U	3.6 U	3.5 U	10 U	10 U	NAF	NAF
Neoabietic Acid	3.7 U	3.6 U	3.7 U	5.4 UJ	3.8 U	3.6 U	3.5 U	10 U	10 U	NAF	NAF
Dichlorostearic Acid	3.7 U	3.6 U	3.7 U	5.4 U	3.8 U	3.6 U	3.5 U	10 U	10 U	132	140
14-Cl Dehydroabietic Acid	3.7 U	3.6 U	3.7 U	5.4 U	3.8 U	3.6 U	3.5 U	10 U	10 U	125	135
12-Cl Dehydroabietic Acid	3.7 U	3.6 U	3.7 U	5.4 UJ	3.8 U	3.6 U	3.5 U	10 U	10 U	147	152
Dichlorodehydroabietic Acid	3.7 U	3.6 U	3.7 U	5.4 U	3.8 U	3.6 U	3.5 U	10 U	10 U	159	160
d31-Hexadecanoic Acid (EE) (%)	50	55	10	82	43	66	56	214	114	190	204
Surrog: o-Methylpodocarpic acid (%)	45	82	18	70	51	61	49	98	100	98	104

Appendix F. Resin Acid/Fatty Acid compounds for Longview ditch samples on September 14, 1992

Resin Acids/Fatty Acids	SITE A (ug/L)	B (ug/L)	C (ug/L)	D (ug/L)	F (ug/L)	G (ug/L)	I (ug/L)	BLANK 1 (ug/L)	BLANK 2 (ug/L)	SPIKE 1 (% recov)	SPIKE 2 (% recov)
Palmitoleic acid (EE)	13.4	3	4.3	3.4	60.2 J	10.5	4	2 U	2 U	390	490
Decanoic Acid, Hexa-	11.8	4.8	3.3	3.8	28.1 J	6.4	2.7	1.3 J	2 U	244	284
Linoleic acid	2 U	2 U	1.8 J	2 U	3.9 J	2 U	2 U	2 U	2 U	158	180
Oleic acid	6.7	2 U	2 U	2 U	5.8 J	3.5	2 U	2 U	2 U	164	192
Octadecanoic acid	5.4	2.3	1.1 J	0.91 J	3.7 J	0.97 J	0.44 J	0.7 J	0.9 J	144	166
Retene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	138	165
Pimaric acid	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	140	164
Sandaracopimaric acid	2 U	2 U	1.4 J	2 U	6.9	0.92 J	2 U	2 U	2 U	54	62
Isopimaric acid	2 U	2 U	5.1	2 U	19.2 J	2.4	2 U	2 U	2 U	228	256
Palustric acid	2 U	2 U	6.4	2 U	2 U	2 U	2 U	2 U	2 U	61	28
Dehydroabietic acid	2 U	2 U	19.2	0.93 J	124 J	21.3	1.5 J	2 U	2 U	620	750
Abietic acid	2 U	2 U	2 U	2 U	4.8 J	2 U	2 U	2 U	2 U	196	182
Neoabietic Acid	2 U	2 U	2 U	2 U	2 UJ	2 U	2 U	2 U	2 U	34	8.8
Dichlorostearic Acid	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	138	164
14-Cl Dehydroabietic Acid	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	134	165
12-Cl Dehydroabietic Acid	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	138	165
Dichlorodehydroabietic Acid	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	NAF	NAF
d31-Hexadecanoic Acid (EE) (%)	112	55	23	52	69	31	59	99.2	114	129	147
Surrog: o-Methylpodocarpic acid (%)	116	82	73	90	80	56	61	96.5	100	127	168

LONGVIEW DRAINAGE SYSTEM: CHEMICAL SCREENING OF SEDIMENT SAMPLES November 16, 1992

PART 2

by
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ABSTRACT

Chemical analyses were conducted on sediment samples collected in November 1992 from ditches in the Longview Drainage System. The results were compared to similar surveys of other urban areas, freshwater sediment criteria, soil clean-up levels in the Model Toxics Control Act, and the Dangerous Waste Regulations. Based on these comparisons and results of a companion water quality survey, the following chemicals were identified as contaminants of primary concern in the drainage system: oil & grease, total petroleum hydrocarbons (TPH), polyaromatic hydrocarbons (PAH), iron, cyanide, lead, chromium, and cadmium.

ACKNOWLEDGEMENTS

Bob Cusimano's research and field experience in the study area were extremely helpful in planning, conducting, and reporting the sediment survey. Dave Serdar gave helpful advice on evaluating the data. Kelly Carruth prepared the final copy of the report.

INTRODUCTION

At the request of the Department of Ecology, Southwest Regional Office (SWRO), sediment samples were collected from six sites in the Longview Drainage System on November 16, 1992, and submitted to the Ecology Manchester Environmental Laboratory for chemical analysis. The sampling sites were a subset of ten water quality stations monitored in September and November 1992 by Bob Cusimano, Watershed Assessments Section, as part of a related Ecology study (see Part 1). Station locations for both surveys are shown in Figure 1. The results of the sediment survey are described here.

The objective of the survey was to evaluate sediment quality in terms of general physical/chemical characteristics and selected potentially toxic chemicals. The data were obtained to assist SWRO in implementing the action plan developed by the Cowlitz-Wahkiakum Governmental Conference (1991) and to be used for 304(l) individual control strategies. At the direction of SWRO, sample collection was done after the onset of the rainy season.

METHODS

Each sediment sample was a composite of the top 2-cm layer from four separate grabs taken with a .05 m^2, stainless steel Ponar sampler. The composites were homogenized by stirring with stainless steel spoons in stainless steel bowls before being split into subsamples for analysis. Samples to be analyzed for volatile organic compounds were taken from the first grab prior to homogenizing. The samples were placed on ice and transported to the Manchester Laboratory the following day. All sampling equipment was cleaned with hot water and Liquinox detergent, followed by sequential rinses with deionized water, dilute nitric acid, deionized water, methylene chloride, and acetone.

Table 1 shows how the samples were analyzed. Chemical analyses included those specified in the action plan, less pH and nutrients. Analyses added to those in the plan were grain size, total petroleum hydrocarbons (TPH), cyanide, fluoride, nickel, antimony, silver, thallium, selenium, herbicides, and resin & fatty acids. The TPH analysis was suggested by Manchester Laboratory's Bob Carrell.

DATA QUALITY

Staff at the Manchester Laboratory prepared written quality assurance reviews of all the Longview sediment analyses. The data contained in the present report are considered acceptable for their intended use as qualified.

The reviewers identified several noteworthy problems encountered during analysis of these samples:

- The fluoride analysis suffered from significant blank contamination and the data were rejected.

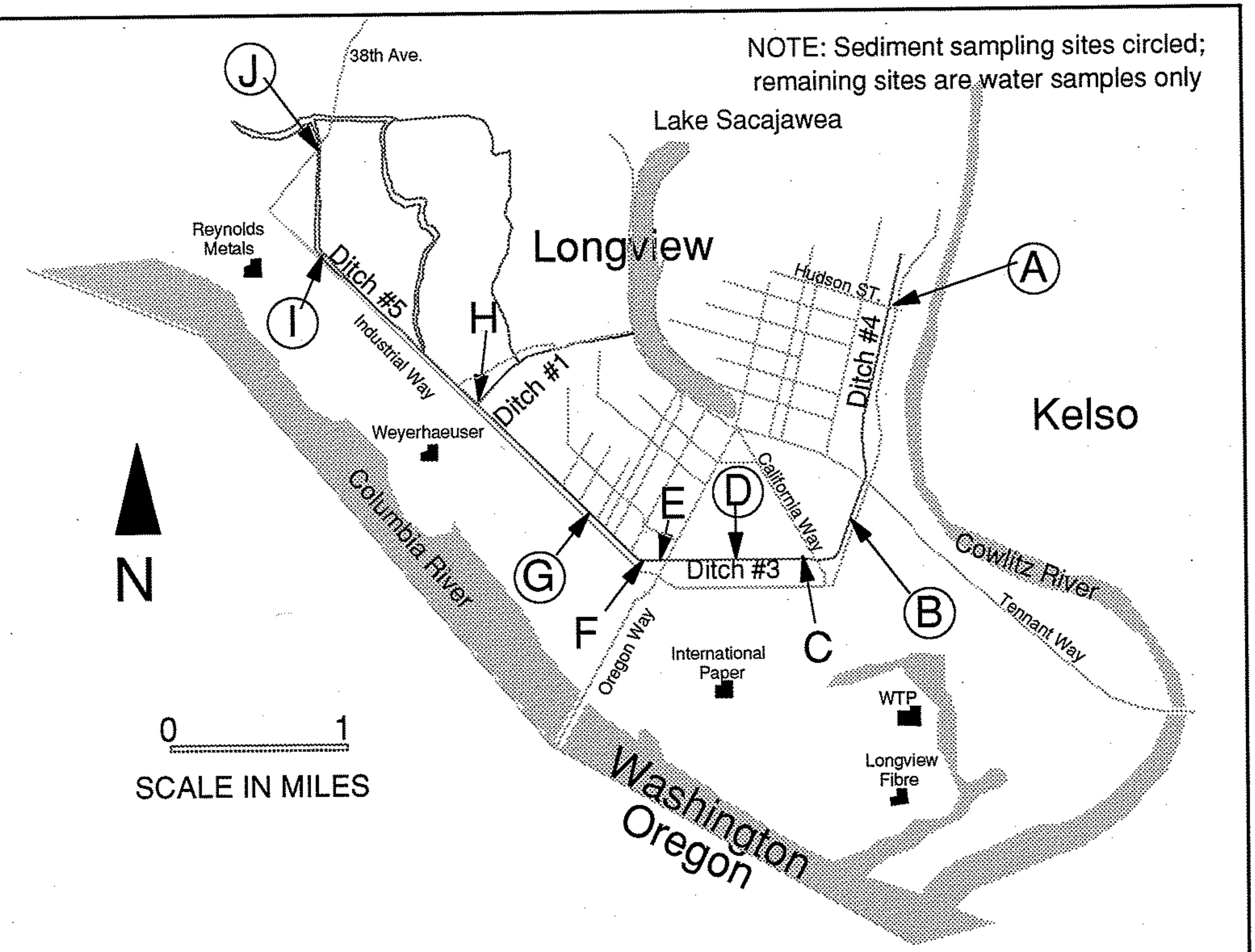

Figure 1. Ecology Sampling Sites for Water (Part 1) and Sediment (Part 2) in the Longview Ditch System (prep. by B. Cusimano)

TABLE 1. ANALYTICAL METHODS			
ANALYSIS	METHOD	REFERENCE	LABORATORY
General Physical/Chemical			
Grain Size	PSEP	Tetra Tech (1986)	Soil Technology Inc.
Total Solids	SM 2540G	APHA (1989)	Weyerhaeuser Technology Center
Total Non-volatile Solids	SM 2540G	APHA (1989)	Weyerhaeuser Technology Center
Total Organic Carbon	PSEP	Tetra Tech (1986)	Weyerhaeuser Technology Center
Oil & Grease	SM 5520E	APHA (1989)	Weyerhaeuser Technology Center
Total Petroleum Hydrocarbons	WTPH-418.	Ecology (1991)	Ecology Manchester Laboratory
Extractable Organic Halogens	Dohrmann	-	Weyerhaeuser Technology Center
Toxics			
Cyanide	4500CN-C	APHA (1989)	Ecology Manchester Laboratory
Fluoride	4500F-E	APHA (1989)	Ecology Manchester Laboratory
As, Se, Tl	GFAA	EPA (1979, 1986)	Ecology Manchester Laboratory
Hg	CVAA	EPA (1979, 1986)	Ecology Manchester Laboratory
Be, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn, Sb, Fe	ICP	EPA (1979, 1986)	Ecology Manchester Laboratory
Volatiles	8240	EPA (1986)	Ecology Manchester Laboratory
Semivolatiles	8270	EPA (1986)	Ecology Manchester Laboratory
Organochlorine Pesticides & PCBs	8080	EPA (1986)	Ecology Manchester Laboratory
Chlorinated Herbicides	8150	EPA (1986)	Ecology Manchester Laboratory
Resin & Fatty Acids	85.01	NCASI (1986a)	Ecology Manchester Laboratory
Phenolics*	86.01	NCASI (1986b)	Ecology Manchester Laboratory

*guaiacols, catechols, and phenols

- High iron levels in the samples interfered with analysis of arsenic, thallium, silver, antimony, and mercury. The affected results are either qualified as estimates or as having matrix spike recoveries outside control limits.

- Due to an autosampler malfunction, sample numbers 47-8055 and 56 were analyzed for volatiles after the holding time had elapsed.

- Heavy contamination of the samples with petroleum caused significant interferences in analysis for semivolatiles, chlorinated pesticides, polychlorinated biphenyls (PCBs), resin & fatty acids, and phenolics. The interferences resulted in higher than normal quantitation limits.

- The laboratory forgot to add surrogate compounds to five of the six samples analyzed for resin & fatty acids. If one assumes similar matrix effects for all the sediments, the surrogate results for the one sample spiked (47-8053) suggest recovery of native compounds was probably adequate.

TABLE 2. PRECISION OF SELECTED DUPLICATE ANALYSES			
CONSTITUENT	ANALYSIS #1	ANALYSIS #2	RELATIVE % DIFFERENCE
General Physical/Chemical			
Total Organic Carbon (%)	5.6	5.7	2%
Oil & Grease (mg/Kg)	4700	3200	38%
Total Petroleum Hydrocarbons (mg/Kg)	2020	3420	51%
Extractable Organic Halogens (mg/Kg)	<1	<1	not detected
Toxics			
Cyanide (mg/Kg)	0.18	0.18 U	not detected
Iron (mg/Kg)	86700	86900	<1%
Lead (mg/Kg)	78	78	0%
Chromium (mg/Kg)	19.9	21.4	7%
Cadmium (mg/Kg)	1.9	1.6	17%
Pentachlorophenol (ug/Kg)	34	32	6%
Dehydroabietic Acid (ug/Kg)	4840 J	5720 J	17%
Oleic Acid (ug/Kg)	4320 J	4170 J	4%
4-Methylphenol (ug/Kg)	2600 J	2600 J	0%

U = not detected at or above reported value
J = estimated value

Sample number 47-8053 was analyzed in duplicate to provide an estimate of precision. Results for selected constituents of interest are summarized in Table 2. A duplicate analysis was not done for semivolatiles, organochlorine pesticides, or PCBs. Volatiles were analyzed in duplicate but not detected.

Duplicate analyses for oil & grease and TPH were in poor agreement. However, since all field samples had extremely high levels of petroleum, imprecision of the data does not weaken conclusions regarding these contaminants.

RESULTS AND DISCUSSION

Results of sample analysis are summarized in Tables 3 through 9. For organics, only detected compounds were included in the tables; the complete results showing all compounds analyzed are in Appendix A.

Screening Approach

Four methods were used to identify chemicals of potential concern in the drainage basin:

- The results were first compared to contaminant concentrations typical of urban street dust and storm drain sediments. Galvin and Moore (1982) report data from Metro's analysis of 14 street dust samples collected in Bellevue. Ecology has analyzed 20 samples of catch basin sediments collected during 1991 and 1992 from the Duwamish area in Seattle and from southwest Snohomish County (Serdar, 1993). Both studies included urban, commercial, and industrial land use. Some comparisons were also made to results of the EPA Nationwide Urban Runoff Program (water samples) to better gauge expected frequency of occurrence for certain compounds (EPA, 1983).

- Secondly, the findings were evaluated against sediment quality guidelines for protecting freshwater aquatic life, as summarized in Bennett and Cubbage (1991). The Ontario Ministry of Environment guidelines (Persaud *et al.*, 1991) were used primarily.

  The Ontario guidelines give three concentration levels for long-term adverse effects of contaminants on freshwater bottom-dwelling organisms: no effect, lowest effect, and severe effect. Because the lowest effect level is considered to be tolerated by most benthic organisms, the severe effect level was used to flag potential problem chemicals in the ditches.

- Results were then examined for exceedance of soil cleanup levels in the Model Toxics Control Act (WAC Ch. 173-340; Tables 2 and 3). Two sets of cleanup levels are provided, one for generic soil and another generally less restrictive level for industrial soils. As stated in MTCA, exceedance of these levels does "not necessarily trigger requirements for cleanup action."

- The data were finally reviewed against the Toxicity Characteristics List and Persistent Dangerous Waste tables in the Dangerous Waste Regulations (WAC Ch. 173-303; pages 27 and 29). The former table uses the Toxicity Characteristics Leaching Procedure (TCLP) analysis to determine if chemical concentrations are at or above Dangerous Waste (DW) or Extremely Hazardous Waste (EHW) thresholds.

  The dry weight sediment concentrations obtained during the survey were divided by 20 to determine if any of the Longview samples had potential to designate as dangerous or hazardous if TCLP were analyzed (samples are diluted by a factor of 20 during TCLP). The Manchester Laboratory uses this calculation to decide if a sample warrants TCLP analysis (Dave Thompson, personal communication). Because extraction efficiencies for the Longview samples are unknown for a TCLP analysis, results of this calculation provide only an indication, rather than demonstration, that a sample may designate.

TABLE 3. GENERAL PHYSICAL/CHEMICAL CHARACTERISTICS						
Ditch:	No. 4	No. 4	No. 3	No. 3	No. 5	No. 5
Site I.D.:	A	B	D	G	I	J
Description:	@ Hudson Street	Between California Way & Tennant Way	Between California Way & Oregon Way	@ 23rd Avenue	@ 3500 Industrial Way	@ 38th Avenue
Sample Number:	47-8050	47-8051	47-8052	47-8053	47-8055	47-8056
Gravel (%)	3	0	0	0	5	1
Sand (%)	10	28	17	22	33	10
Silt (%)	73	66	74	70	56	79
Clay (%)	14	6	9	8	6	10
Total Solids (%)	40.8	37.8	29.1	32.2	35.2	12.2
Total Volatile Solids (%)	11.4	10.1	18.3	12.1	13.6	23.4
Total Organic Carbon (%)	6.5	4.9	10.2	5.6	6.6	9.2
Oil & Grease (mg/Kg, wet)	9400	3700	4900	4700	2800	1700
TPH* (mg/Kg, dry)	3510	1570	2850	2020	2530	1230
EOX** (mg/Kg, wet)	19	3	2	<1	1	2

*Total Petroleum Hydrocarbons
**Extractable Organic Halogens

Each of the four approaches described above covers a limited and different suite of chemicals. A number of the chemicals analyzed for the Longview survey are not addressed in any of the documents cited. For these reasons, the discussion that follows does not consistently draw on all four areas of comparison and sometimes uses additional sources of information to help put results in perspective.

Chemical Evaluation

General Physical/Chemical Characteristics (Table 3) - The sediment samples obtained from the Longview Ditches were relatively fine (56 - 79% silt) with high organic content (4.9 - 10.2 % TOC). All grabs examined during the survey were black, foul smelling, and oily.

The highest concentrations of oil & grease, TPH, and extractable organic halogens (EOX) were found in Ditch 4 @ Hudson Street, the most upstream of the six sampling sites. The TPH levels in the ditches were 1,230 to 3,510 mg/Kg (parts per million), similar to those found by Ecology (Serdar, 1993) in sediment samples from storm drains in the Duwamish area and Snohomish County (median of 2,800 mg/Kg). TPH concentrations at all Longview locations were well in excess of the MTCA cleanup level of 200 mg/Kg (both generic and industrial soils).

Oil & grease and TPH concentrations did not differ widely between sampling sites suggesting multiple and widespread sources of contamination. The much higher EOX concentration at Hudson Street (19 mg/Kg vs. <1 - 3 mg/Kg), however, may indicate the presence of a nearby source of halogenated material.

Compounds detected in an EOX analysis "include but are not limited to: trihalomethanes, organic solvents..., chlorinated and brominated pesticides and herbicides, polychlorinated biphenyls, chlorinated aromatics such as hexachlorobenzene and 2,4-dichlorophenol; and high-molecular weight, partially chlorinated aquatic humic substances." (APHA, 1989). None of the target compounds analyzed for the survey were detected at concentrations that may have contributed significantly to high EOX. This may be partly due to poor detection limits. However, one halogenated compound, 1,2-dibromododecane (Table 9), was tentatively identified in the Hudson Street sample at an estimated concentration of 31 mg/Kg, sufficient to account for the EOX result. No information was found on potential sources of this compound.

Cyanide (Table 4) - Cyanide was detected at one site each in Ditches 3, 4, and 5 at concentrations from 0.18 to 0.65 mg/Kg. Cyanide was also detected in 8 of 12 street dust samples analyzed by Metro (Galvin and Moore, 1982). Mean and maximum concentrations in the Metro study were 0.2 and 0.7 mg/Kg, respectively.

EPA Region V has classed Great Lakes harbor sediments as "moderately polluted" when cyanide concentrations range from 0.10 to 0.25 mg/Kg and "heavily polluted" when over 0.25 mg/Kg (EPA, 1977). The Ditch 5 site along Industrial Way would be judged heavily polluted with cyanide, based on these guidelines. The Ontario sediment guidelines do not have a severe effect level for cyanide. The guidelines give a concentration of 0.1 mg/Kg as being tolerable to most freshwater sediment-dwelling organisms.

Metals (Table 4) - Three of the 15 metals analyzed - silver, thallium, and selenium - were rarely or never detected in the sediments. Antimony was quantified at only half the sampling locations, with only Ditch 5 having a concentration substantially above detection limits. The remaining 13 metals were detected at all sampling sites.

Except for two sites with high lead and chromium, described below, metals concentrations in the ditch sediments compare extremely closely to concentrations reported for urban street dust (Galvin and Moore, 1982) and storm drain sediments (Serdar, 1993). These studies, however, did not analyze iron or manganese.

Iron concentrations at all sites except Ditch 4 @ Hudson Street exceeded 40,000 mg/Kg, the level considered detrimental to most benthic organisms according to the Ontario sediment guidelines. Lead in sediments from Ditch 4 @ Hudson Street (451 mg/Kg) and chromium in Ditch 3 between California and Oregon Way (186 mg/Kg) also exceeded the Ontario severe effect levels of 250 and 110 mg/Kg, respectively. The chromium concentration was an order

TABLE 4. CONCENTRATIONS OF CYANIDE AND METALS (mg/Kg, dry weight)						
Ditch:	No. 4	No. 4	No. 3	No. 3	No. 5	No. 5
Site I.D.:	A	B	D	G	I	J
Description:	@ Hudson Street	Between California Way & Tennant Way	Between California Way & Oregon Way	@ 23rd Avenue	@ 3500 Industrial Way	@ 38th Avenue
Sample Number:	47-8050	47-8051	47-8052	47-8053	47-8055	47-8056
Cyanide	0.19	0.12 U	0.20 U	0.18	0.65	0.48 U
Iron	26900	53900	60400	86700	87500	177000
Zinc	420	196	343	213	191	308
Lead	451	123	141	78	71	57
Manganese	290	302	372	441	620	843
Copper	104	54.7	81.6	57.7	50.5	81.9
Chromium	39.7	15.7	186	19.9	16.9	17.0
Nickel	23.2	14.6	44.2	15.4	17.1	21.0 P
Arsenic	5.5 N	5.8 N	4.9 N	9.8 N	10.8 N	13.1 N
Cadmium	2.9	1.8	2.3	1.9	2.0	3.6 P
Antimony	3.0 J	3.0 UN	4.3 J	3.0 UN	3.0 UN	15 J
Beryllium	0.37 P	0.35 P	0.37 P	0.41 P	0.38 P	0.61 P
Silver	0.30 J	0.30 UN	0.30 UN	0.30 UN	0.30 UN	1.5 UN
Thallium	0.25 UN	0.25 UN	0.25 UN	0.25 UN	0.25 UN	0.25 UN
Mercury	0.10 J	0.05 J	0.04 J	0.05 J	0.09 J	0.03 J
Selenium	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U

N = spike recovery outside control limits
U = not detected at or above reported value
J = estimated value
P = above detection limit but below quantitation limit

of magnitude higher than at other locations, pointing to a possible chromium source along Ditch 3. Concentrations of other metals were not sufficiently different among the sampling sites to suggest significant localized inputs.

MTCA has cleanup levels for lead, chromium, cadmium, and arsenic. The above-mentioned lead and chromium concentrations in Ditch 4 and Ditch 3 were above generic soil cleanup levels (250 and 100 mg/Kg, respectively), but did not exceed industrial soil cleanup levels (1,000 and 500 mg/Kg, respectively). Cadmium concentrations at these two sites and at Ditch 5 @ 38th Avenue were 2.3 to 3.6 mg/Kg, slightly above the 2.0 mg/Kg generic soil cleanup level in MTCA; the industrial cleanup level is 10.0 mg/Kg. Arsenic concentrations were low and did not exceed cleanup levels.

A Dangerous Waste threshold of 5.0 mg/L (by TCLP) has been established for lead and for chromium. If the Ditch 4 and Ditch 3 concentrations of 451 mg/Kg lead and 186 mg/Kg chromium are divided by 20, as previously described, the results suggest the sediment samples from these sites could exceed DW thresholds in a TCLP analysis.

Volatiles (Table 5) - Trace amounts (0.5 - 12 ug/Kg; parts per billion) of 12 volatile compounds were detected in samples collected from Ditches 3 and 4. The higher detection limits encountered in Ditch 5 samples may have masked similar low-level contamination by volatile organics.

Detected compounds included benzenes, chlorinated benzenes, and chlorinated ethenes. These chemicals are routinely identified in urban runoff and related samples (EPA, 1983; Galvin and Moore, 1982; Serdar, 1993), being constituents of gasoline, asphalt, paints, solvents, and degreasers, among other materials (Verschueren, 1983). The trace concentrations found in the ditch sediments would not be considered a significant environmental hazard.

TABLE 5. VOLATILES DETECTED (ug/Kg, dry weight)

Ditch:	No. 4	No. 4	No. 3	No. 3	No. 5	No. 5
Site I.D.:	A	B	D	G	I	J
Description:	@ Hudson Street	Between California Way & Tennant Way	Between California Way & Oregon Way	@ 23rd Avenue	@ 3500 Industrial Way	@ 38th Avenue
Sample Number:	47-8050	47-8051	47-8052	47-8053	47-8055	47-8056
Benzene	0.5 J	2.0 J	3 U	3 U	7 UJ	24 UJ
Ethylbenzene	3 U	6	3 U	3 U	7 UJ	24 UJ
Propylbenzene	5 J	2 UJ	4 J	3 U	7 UJ	24 UJ
Butylbenzene	2 UJ	2 UJ	12	3 U	7 UJ	24 UJ
1,2,4-Trimethylbenzene	2 UJ	10 J	3 UJ	3 U	7 UJ	24 UJ
1,3,5-Trimethylbenzene	2 UJ	7 J	3 UJ	3 U	7 UJ	24 UJ
Chlorobenzene	2 U	2	3 U	3 U	7 UJ	24 UJ
1,2-Dichlorobenzene	2 UJ	11 J	2 J	3 U	7 UJ	24 UJ
1,2,3-Trichlorobenzene	2 UJ	1 J	3 UJ	3 U	7 UJ	24 UJ
Trichloroethene	0.6 J	2 U	3 U	3 U	7 UJ	24 UJ
Tetrachloroethene	2 U	0.9 J	3 U	3 U	7 UJ	24 UJ
Total Xylenes	11 J	6 UJ	3 UJ	3 U	7 UJ	24 UJ

U = not detected at or above reported value
J = estimate value

Semivolatiles (Table 6) - Semivolatile compounds detected in the Longview sediments included polyaromatic hydrocarbons (PAH), phenols, bis-(2-ethylhexyl)phthalate, and dibenzofuran. These are also common urban contaminants. Because detection limits for semivolatiles varied widely between sampling sites, no strong conclusions can be drawn about which areas were most contaminated. The occurrence of phenolics is discussed later in this report using data from the NCASI analysis (Table 1) which is more specific for methylphenols.

Among the semivolatiles detected, PAH concentrations stand out as being high relative to the street dust and storm drain sediments analyzed by Metro and Ecology. PAH originate primarily as trace constituents of petroleum (low molecular weight PAH) or as products of fossil fuel combustion (high molecular weight PAH). Mean concentrations of individual PAH compounds ranged from 210 to 1,700 ug/Kg in street dust (Galvin and Moore, 1982), whereas concentrations in the ditch sediments typically exceeded 1,000 ug/Kg and were greater than 10,000 ug/Kg for some compounds. The highest PAH concentrations in Ecology's storm drain survey (Serdar, 1993) were found in commercial and industrial areas where median total PAH concentrations were 16,600 and 14,900 ug/Kg, respectively, a level exceeded at four of the six Longview sites.

The Ontario severe effect level for total PAH in freshwater sediments is 11,000 mg/Kg, on a TOC normalized basis. TOC normalized concentrations of total PAH in the ditches were between 140 and 1,200 mg/Kg TOC, one-to-two orders of magnitude below the level causing severe effects to benthic organisms.

MTCA cleanup levels for PAH were exceeded in the ditch sediments. The MTCA levels apply only to carcinogenic PAH [*i.e.*, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and dibenzo(a,h)anthracene]. Except for dibenzo(a,h)anthracene, one or more of these compounds at each site exceeded the 1.0 mg/Kg cleanup level for generic soil. The concentration of total carcinogenic PAH at one site, Ditch 3 @ 23rd Avenue, also exceeded the industrial soil cleanup level of 20.0 mg/Kg.

PAH concentrations must be greater than 1.0% to designate as EHW (there is no DW level for PAH). None of the Longview samples approached the EHW threshold.

Pesticides/Herbicides (Table 7) - Pentachlorophenol (PCP) was the only compound detected in these analyses and was present at all sites; concentrations ranged from 25 to 154 ug/Kg. The sample from Ditch 4 between California and Tennant Way had a two-to-six times higher PCP concentration than other locations. These results suggest sources occur throughout the drainage basin, perhaps especially along Ditch 4.

PCP was routinely detected in EPA urban runoff samples (EPA, 1983) and Galvin and Moore (1982) report relatively high concentrations in some of Metro's street dust samples (120 - 3,400 ug/Kg). These studies, however, were both done prior to restrictions on use of PCP. PCP was not detected in the more current Ecology survey of storm drain sediments, but detection limits exceeded 1,000 ug/Kg (Serdar, 1993).

TABLE 6. SEMIVOLATILES DETECTED (ug/Kg, dry weight)												
Ditch:	No. 4		No. 4		No. 3		No. 3		No.5		No. 5	
Site I.D.:	A		B		D		G		I		J	
Description:	@ Hudson Street		Between California Way & Tennant Way		Between California Way & Oregon Way		@ 23rd Avenue		@ 3500 Industrial Way		@ 38th Avenue	
Sample Number:	47-8050		47-8051		47-8052		47-8053		47-8055		47-8056	
<u>Low Mol. Wt. PAH</u>												
Naphthalene	840	J	450	J	11000	U	1700	J	16000	J	3200	J
1-Methylnaphthalene	280	J	4000	U	11000	U	270	J	920	J	360	J
2-Methylnaphthalene	320	J	4000	U	11000	U	300	J	770	J	310	J
Acenaphthene	8000	U	4000	U	11000	U	280	J	650	J	5200	U
Phenanthrene	4800	J	1000	J	1900	J	2500	J	13000		3500	J
Fluorene	8000	U	4000	U	11000	U	430	J	1100	J	410	J
Anthracene	350	J	4000	U	11000	U	310	J	1700	J	340	J
Acenaphthylene	8000	U	4000	U	11000	U	5300	U	3900		5200	U
<u>High Mol. Wt. PAH</u>												
Fluoranthene	7000	J	1900	J	3900	J	6200	J	13000		5900	
Pyrene	9500		2500	J	4800	J	8400		16000		7600	
Benzo(a)anthracene	8000	U	880	J	11000	U	5200	J	2000	J	5200	U
Chrysene	8000	U	4000	U	11000	U	4700	J	2700	J	4600	J
Benzo(b)fluoranthene	5600	J	1600	J	4000	J	5900		2500	J	4000	J
Benzo(k)fluoranthene	1500	J	4000	U	11000	U	2200	J	3100	U	5200	U
Benzo(a)pyrene	3000	J	4000	U	11000	U	3200	J	1100	J	5200	U
Indeno(1,2,3-cd)pyrene	8000	U	4000	U	11000	U	2900	J	3100	U	5200	U
Benzo(ghi)perylene	8000	U	4000	U	11000	U	2200	J	3100	U	5200	U
Total PAH* =	33200		8330		14600		46700		79800		30200	
<u>Phenolics**</u>												
Phenol	8000	U	4000	U	11000	U	5300	U	7000	J	5200	U
2-Methylphenol	8000	U	4000	U	11000	U	5300	U	550	J	5200	U
4-Methylphenol	8000	U	4000	U	11000	U	1900	J	6500	J	1300	J
<u>Misc. Compounds</u>												
bis(2-Ethlyhexyl)phthalate	5900		19000	U	17000	J	11000		3000	UJ	6800	J
Dibenzofuran	8000	U	4000	U	11000	U	5300	U	2600	J	570	J

U = not detected at or above reported value
J = estimated value
*detected compounds only
**see also Table 8

TABLE 7. PESTICIDES/HERBICIDES DETECTED (ug/Kg, dry weight)						
Ditch:	No. 4	No. 4	No. 3	No. 3	No.5	No. 5
Site I.D.:	A	B	D	G	I	J
Description:	@ Hudson Street	Between California Way & Tennant Way	Between California Way & Oregon Way	@ 23rd Avenue	@ 3500 Industrial Way	@ 38th Avenue
Sample Number:	47-8050	47-8051	47-8052	47-8053	47-8055	47-8056
Pentachlorophenol	71	25	154	34	43	52

Recent results from the Puget Sound basin suggest PCP concentrations in the range found at Longview are not unusual. PCP was detected in all 17 freshwater sediment samples collected by PTI Environmental Services (1991) and Crecelius *et al.*, (1989) from five separate drainages to the Sound. Concentrations ranged from 2 to 56 ug/Kg.

There are no freshwater sediment guidelines or MTCA cleanup levels for PCP. For sediments in the marine environment, Ecology has established a standard of 360 ug/Kg as a PCP concentration "having no adverse effect on biological resources, and not possessing a significant health threat to humans" (WAC Ch. 173-204).

PCBs - None of the sites had detectable concentrations of PCBs. Although detection limits were high (2,400 - 6,000 ug/Kg) the data allow some comparison to freshwater sediment guidelines and to MTCA cleanup levels. Severe effect levels for PCBs in freshwater sediments range from 24 to 530 mg/Kg TOC. Based on detection limits and TOC concentrations in the ditch samples, maximum concentrations of the most common PCB mixtures (Aroclor-1254 and -1260) could potentially have been in the range of 30 to 60 mg/Kg TOC and not been detected.

MTCA cleanup levels for PCBs are 1.0 mg/Kg for generic soil and 10.0 mg/Kg for industrial soils (dry weight based). Assuming worst case concentrations, PCB levels in the Longview Ditch samples could have exceeded the generic cleanup level, but should have been detected if concentrations approached the industrial cleanup level.

Resin & Fatty Acids (Table 8) - Resin acids and fatty acids, and at most sites the related compound retene, were common to all sampling locations. Although these are produced naturally by plants and animals, concentrations in the range found in the ditch sediments (558 - 20,100 ug/Kg) are usually associated with pulp mill discharges. Sediment concentrations much above 100 to 200 ug/Kg would generally not be expected in areas away from pulp mills or wood waste (Tetra Tech, 1988; Johnson and Coots, 1989). At present, there are no environmental criteria for these compounds in sediments or soils.

Phenolics (Table 8) - 4-Methylphenol was present at all sampling locations, ranging from 400

TABLE 8. RESIN ACIDS, FATTY ACIDS, AND PHENOLICS DETECTED (ug/Kg, dry weight)						
Ditch:	No. 4	No. 4	No. 3	No. 3	No.5	No. 5
Site I.D.:	A	B	D	G	I	J
Description:	@ Hudson Street	Between California Way & Tennant Way	Between California Way & Oregon Way	@ 23rd Avenue	@ 3500 Industrial Way	@ 38th Avenue
Sample Number:	47-8050	47-8051	47-8052	47-8053	47-8055	47-8056
Resin Acids						
Abietic Acid	8340 U	6950 U	4630 J	4320 UJ	4040 U	2000 U
Dehydroabietic Acid	4910 J	4210 J	23100	4840 J	7600	2000
Isopimaric Acid	8340 U	692 J	6250 J	778 J	2020 J	4400 J
Sandaracopimaric Acid	8340 U	1460 J	2050 J	REJ	4040 U	2000 U
Fatty Acids						
Oleic Acid	20100	6560 J	27800	4320 J	2140 J	12100 J
Linoleic Acid	7970 J	3060 J	50900	2710 J	1020 J	9440 J
Palmitoleic Acid	3580 J	5050 J	14400	4510	994 J	15300 J
Hexadecanoic Acid	23600 U	11600 U	34600	7000 UJ	4040 U	29500 U
Octadecanoic Acid	8340 U	6950 U	12200	4320 U	4040 U	20000 U
Misc. Compounds						
Retene	8340 U	558 J	1630 J	320 J	1700 J	1900 J
Phenolics						
2-Methylphenol	420 UJ	430 UJ	570 UJ	530 UJ	1200 J	1200 UJ
4-Methylphenol	400 J	490 J	2300 J	2600 J	7600 J	1800 J
2,4-Dimethylphenol	420 UJ	430 UJ	1100 UJ	530 UJ	240 J	1200 UJ
Guaiacol	55 J	430 UJ	570 UJ	530 UJ	380 J	120 J

U = not detected at or above reported value
J = estimated value
REJ = data rejected

to 7,600 ug/Kg. The Ditch 5 site along Industrial Way stands out as having several additional phenolics detected. These included 2-methylphenol, 2,4-dimethylphenol, guaiacol (methoxyphenol), and phenol (Table 6).

The above phenolics have numerous commercial uses as well as a variety of natural sources including coal, petroleum, and wood (NOAA, 1979; Verschueren, 1983). As with resin & fatty acids, concentrations found in the ditches are elevated compared to natural sediments but criteria to evaluate their significance are lacking.

TABLE 9. TENTATIVELY INDENTIFIED COMPOUNDS (ug/Kg, dry weight)						
Ditch:	No. 4	No. 4	No. 3	No. 3	No.5	No.5
Site I.D.:	A	B	D	G	I	J
Description:	@ Hudson Street	Between California Way & Tennant Way	Between California Way & Oregon Way	@ 23rd Avenue	@ 3500 Industrial Way	@ 38th Avenue
Sample Number:	47-8050	47-8051	47-8052	47-8053	47-8055	47-8056
Volatiles						
Thiobismethane		3.6 NJ		3.6 NJ		
2-Butene		3.4 NJ		5.8 NJ		
2,3-Dimethylbutane			31 NJ			
Pentane				4.3 NJ		
Hexane				3.7 NJ		
3-Methylhexane			46 NJ			
1,2-Dimethylhexane			35 NJ			
1,1,3-Trimethylhexane			44 NJ			
1-Methylcyclohexane			260 NJ	87 NJ		
3-Ethyl-5-methylheptane			280 NJ			
3,6-Dimethyloctane		22 NJ				
2,4,6-Trimethyloctane		380 NJ	1400 NJ			
4-Methyldecane		370 NJ				
Decane		210 NJ	840 NJ			
Dodecane			640 NJ			
6,6-Dimethylundecane				18 NJ		
Semivolatiles						
4-Hydroxy-4-methylpentane	480000 NJ					
Pentacosane	38000 NJ					
17-Pentatriacontene	14000 NJ					
3-Octadecene	75000 NJ					
1,2-Dibromododecane	31000 NJ					

NJ = evidence analyte is present, value is an estimate

Tentatively Identified Compounds (Table 9) - An additional 21 non-target compounds were tentatively identified during analysis for volatiles and semivolatiles. With the exception of 1,2-dibromododecane, previously mentioned in connection with EOX, all appear to be biogenic in origin, in many cases (e.g., butene, pentane, hexane, decane) probably related to petroleum or its combustion.

Correlations with Water Quality

The survey of water quality conditions in the Longview Ditch system found high concentrations of suspended solids, TOC, and oil & grease (see Part 1). Aesthetically, water quality was severely degraded.

The following chemical contaminants were analyzed in both the sediment and water quality surveys: cyanide (one sample only), iron, zinc, copper, lead, nickel, chromium, silver, cadmium, mercury, semivolatiles, pesticides, PCBs, and resin & fatty acids. Chemicals found to be substantially elevated in both media were iron, lead, cadmium, PAH, and resin & fatty acids.

SUMMARY AND RECOMMENDATIONS

Table 10 summarizes major findings of Ecology's survey of sediment quality in the Longview Ditch system and identifies chemical contaminants that may be of particular concern. Mercury, copper, and zinc were found at elevated levels in the companion water quality survey (see Part 1), but were not substantially elevated in the sediments. These metals are included in Table 10 for sake of completeness. There are additional water quality issues not addressed in this table (e.g., fecal coliform, dissolved oxygen, and turbidity) which are described in the water quality report.

The principal problem contaminants are oil & grease, total petroleum hydrocarbons (TPH), polyaromatic hydrocarbons (PAH), iron, cyanide, lead, chromium, and cadmium. These contaminants are significant contributors to poor environmental conditions in the Longview Ditch system and may currently be having an adverse effect on water quality in the Cowlitz and Columbia River to which it discharges. Dredging projects in the ditches should control resuspension so as not to worsen impacts to these waters. Fluoride levels in the sediments are a remaining data gap.

Source identification/control efforts or related follow-up studies in the Longview Ditches should focus on the priority contaminants. Any further chemical analysis on the ditch sediments should take into account the significant interferences encountered in the present survey and only be undertaken after consultation with the laboratories doing the analyses.

TABLE 10. CONTAMINANTS OF POTENTIAL CONCERN IN LONGVIEW DITCHES						
Contaminant	Sites w/ Elevated Concentrations*	Concentrations Relative to Other Urban Areas	Freshwater Sediment Guidelines**	MTCA Cleanup Levels	Potential Dangerous Waste	Water Quality Concern***
<u>Primary Concern</u>						
Oil & Grease	all	no data	no guideline	na	na	yes
TPH	all	**high**	no guideline	exceeded	na	yes
PAH	all	**high**	less than	exceeded	no	yes
Iron	all	no data	exceeded	na	na	yes
Cyanide	A,G,I	**moderately high**	exceeded	na	na	no
Lead	A	**moderately high**	exceeded	exceeded	yes	yes
Chromium	D	**moderately high**	exceeded	exceeded	yes	no
Cadmium	A,D,J	comparable	less than	exceeded	no	yes
<u>Secondary Concern</u>						
PCP	all	comparable	no guideline	na	na	no
Resin & Fatty Acids	all	**high**	no guideline	na	na	yes
Phenolics	all	**high**	no guideline	na	na	no data
Volatiles	A,B,D	comparable	no guideline	na	na	no data
EOX	A	no data	no guideline	na	na	no data
Mercury	none	comparable	less than	less than	na	yes
Copper	none	comparable	less than	na	na	yes
Zinc	none	comparable	less than	na	na	yes

*sediment sites only, see Figure 1

**severe effect level for benthic organisms

***as identified by Cusimano, see Part 1

na = not applicable

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APPENDIX A

Complete Results for Organic Compounds

APPENDIX A.1 COMPLETE VOLATILES RESULTS (ug/Kg, dry weight)

Ditch:	No. 4		No. 4		No. 3		No. 3		No. 5		No. 5	
Site I.D.:	A		B		D		G		I		J	
Description:	@ Hudson Street		Between California Way & Tennant Way		Between California Way & Oregon Way		@ 23rd Avenue		@ 3500 Industrial Way		@ 38th Avenue	
Sample Number:	47-8050		47-8051		47-8052		47-8053		47-8055		47-8056	
Carbon Tetrachloride	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Acetone	11	UJ	19	UJ	23	UJ	26	UJ	96	UJ	580	UJ
Chloroform	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Benzene	0.5	J	2.0	J	3	U	3	U	7	UJ	24	UJ
1,1,1-Trichloroethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Bromomethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Chloromethane	2	UJ	2	UJ	3	UJ	3	UJ	7	UJ	24	UJ
Dibromomethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Bromochloromethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Chloroethane	2	UJ	2	UJ	3	UJ	3	UJ	7	UJ	24	UJ
Vinyl Chloride	2	U	2	U	1	U	3	U	7	UJ	24	UJ
Methylene Chloride	2	U	2	U	4	U	3	U	8	UJ	25	UJ
Carbon Disulfide	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Bromoform	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
Bromodichloromethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
1,1-Dichloroethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
1,1-Dichloroethene	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Trichlorofluoromethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Dichlorodifluoromethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
1,2-Dichloropropane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
2-Butanone	3	U	6	U	8	U	9	U	7	UJ	24	UJ
1,1,2-Tirchloroethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Trichloroethene	0.6	J	2	U	3	U	3	U	7	UJ	24	UJ
1,1,2,2-Tetrachloroethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
1,2,3-Trichlorobenzene	2	UJ	1	J	3	UJ	3	U	7	UJ	24	UJ
Hexachlorobutadiene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
Naphthalene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
2-Chlorotoluene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
1,2-Dichlorobenzene	2	UJ	11	J	2	J	3	U	7	UJ	24	UJ
1,2,4-Trimethylbenzene	2	UJ	10	J	3	UJ	3	U	7	UJ	24	UJ
1,2-Dibromo-3-chloropropane	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
1,2,3-Trichloropropane	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ

U = not detected at or above reported value

J = estimate value

APPENDIX A.1 (continued)

Ditch:	No. 4		No. 4		No. 3		No. 3		No. 5		No. 5	
Site I.D.:	A		B		D		G		I		J	
Description:	@ Hudson Street		Between California Way & Tennant Way		Between California Way & Oregon Way		@ 23rd Avenue		@ 3500 Industrial Way		@ 38th Avenue	
Sample Number:	47-8050		47-8051		47-8052		47-8053		47-8055		47-8056	
tert-Butylbenzene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
Isopropylbenzene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
p-Isopropyltoluene	2	UJ	2	UJ	20	UJ	3	U	7	UJ	24	UJ
Ethylbenzene	3	U	6		3	U	3	U	7	UJ	24	UJ
Styrene	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Propylbenzene	5	J	2	UJ	4	J	3	U	7	UJ	24	UJ
Butylbenzene	2	UJ	2	UJ	12		3	U	7	UJ	24	UJ
4-Chlorotoluene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
1,4-Dichlorobenzene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
1,2-Dibromomethane	2	UJ	2	UJ	3	U	3	U	7	UJ	24	UJ
1,2-Dichloroethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
4-Methyl-2-pentanone	2	U	2	U	3	U	3	U	7	UJ	24	UJ
1,3,5-Trimethylbenzene	2	UJ	7	J	3	UJ	3	U	7	UJ	24	UJ
Bromobenzene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
Toluene	2	U	5	U	12	U	4	U	7	UJ	24	UJ
Chlorobenzene	2	U	2		3	U	3	U	7	UJ	24	UJ
1,2,4-Trichlorobenzene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
Dibromochloromethane	2	U	2	U	3	UJ	3	U	7	UJ	24	UJ
Tetrachloroethene	2	U	0.9	J	3	U	3	U	7	UJ	24	UJ
sec-Butylbenzene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
1,3-Dichloropropane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
cis-1,2-Dichloroethene	2	U	2	U	3	U	3	U	7	UJ	24	UJ
trans-1,2-Dichloroethene	2	U	2	U	3	U	3	U	7	UJ	24	UJ
1,3-Dichlorobenzene	2	UJ	2	UJ	3	UJ	3	U	7	UJ	24	UJ
1,1-Dichloropropene	2	U	2	U	3	U	3	U	7	UJ	24	UJ
2-Hexanone	2	UJ	2	UJ	3	UJ	3	UJ	7	UJ	24	UJ
2,2-Dichloropropane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
1,1,1,2-Tetrachloroethane	2	U	2	U	3	U	3	U	7	UJ	24	UJ
Total Xylenes	11	J	6	UJ	3	UJ	3	U	7	UJ	24	UJ
cis-1,3-Dichloropropene	2	U	2	U	3	U	3	U	7	UJ	24	UJ
trans-1,3-Dichloropropene	2	U	2	U	3	U	3	U	7	UJ	24	UJ

U = not detected at or above reported value

J = estimate value

APPENDIX A.2 COMPLETE SEMIVOLATILES RESULTS (ug/Kg, dry weight)

Ditch:	No. 4	No. 4	No. 3	No. 3	No.5	No. 5
Site I.D.:	A	B	D	G	I	J
Description:	@ Hudson Street	Between California Way & Tennant Way	Between California Way & Oregon Way	@ 23rd Avenue	@ 3500 Industrial Way	@ 38th Avenue
Sample Number:	47-8050	47-8051	47-8052	47-8053	47-8055	47-8056
Benzo(a)pyrene	**3000** J	4000 U	11000 U	**3200** J	**1100** J	5200 U
2,4-Dinitrophenol	100000 UJ	53000 UJ	150000 UJ	69000 UJ	410000 UJ	68000 UJ
Dibenzo(a,h)anthracene	20000 U	10000 U	29000 U	13000 U	7900 U	13000 U
Benzo(a)anthracene	8000 U	**880** J	11000 U	**5200** J	**2000** J	5200 U
4-Chloro-3-methylphenol	41000 U	21000 U	58000 U	27000 U	16000 U	27000 U
Benzoic Acid	100000 UJ	53000 UJ	150000 UJ	69000 UJ	41000 UJ	68000 UJ
Hexachloroethane	8000 U	4000 U	11000 U	5300 U	3100 U	5200 U
Hexachlorocyclopentadiene	41000 UJ	21000 UJ	58000 UJ	27000 UJ	16000 UJ	27000 UJ
Isophorone	8000 U	4000 U	11000 U	5300 U	3100 U	5200 U
Acenaphthene	8000 U	4000 U	11000 U	**280** J	**650** J	5200 U
Diethylphthalate	8000 UJ	4000 UJ	11000 UJ	5300 UJ	3100 UJ	5200 UJ
Di-n-Butylphthalate	8000 U	4000 U	11000 U	5300 U	3100 U	5200 U
Phenanthrene	**4800** J	**1000** J	**1900** J	**2500** J	**13000**	**3500** J
Butylbenzyphthalate	20000 U	10000 U	29000 U	13000 U	7900 U	13000 U
N-Nitrosodiphenylamine	100000 UJ	53000 UJ	150000 UJ	69000 UJ	41000 UJ	68000 UJ
Fluorene	8000 U	4000 U	11000 U	**430** J	**1100** J	**410** J
Carbazole	41000 UJ	21000 UJ	58000 UJ	27000 UJ	16000 UJ	27000 UJ
Hexachlorobutadiene	20000 UJ	10000 UJ	29000 UJ	13000 UJ	7900 UJ	13000 UJ
Pentachlorophenol	41000 UJ	21000 UJ	58000 UJ	27000 UJ	16000 UJ	27000 UJ
2,4,6-Trichlorophenol	20000 UJ	10000 UJ	29000 UJ	13000 UJ	7900 UJ	13000 UJ
2-Nitroaniline	20000 UJ	10000 UJ	29000 UJ	13000 UJ	7900 UJ	13000 UJ
2-Nitrophenol	20000 U	10000 U	29000 U	13000 U	7900 U	13000 U
1-Methylnaphthalene	**280** J	4000 U	11000 U	**270** J	**920** J	**360** J
Naphthalene	**840** J	**450** J	11000 U	**1700** J	**16000** J	**3200** J
2-Methylnaphthalene	**320** J	4000 U	11000 U	**300** J	**770** J	**310** J
2-Chloronaphthalene	8000 U	4000 U	11000 U	5300 U	3100 U	5200 U
3,3'-Dichlorobenzidine	200000 UJ	100000 UJ	290000 UJ	130000 UJ	79000 UJ	130000 UJ
2-Methylphenol	8000 U	4000 U	11000 U	5300 U	**550** J	5200 U
1,2-Dichlorobenzene	8000 U	4000 U	11000 U	5300 U	3100 U	5200 U
2-Chlorophenol	8000 U	4000 U	11000 U	5300 U	3100 U	5200 U
2,4,5-Trichlorophenol	40000 U	20000 U	57000 U	27000 U	16000 U	26000 U
Nitrobenzene	8000 U	4000 U	11000 U	5300 U	3100 U	5200 U
4-Nitroaniline	100000 UJ	53000 UJ	150000 UJ	69000 UJ	41000 UJ	68000 UJ
4-Nitrophenol	100000 U	53000 U	150000 U	69000 U	41000 U	68000 U

U = not detected at or above reported value

J = estimated value

APPENDIX A.2 (continued)

Ditch:	No. 4		No. 4		No. 3		No. 3		No.5		No. 5	
Site I.D.:	A		B		D		G		I		J	
Description:	@ Hudson Street		Between California Way & Tennant Way		Between California Way & Oregon Way		@ 23rd Avenue Avenue		@ 3500 Industrial Way		@ 38th Avenue	
Sample Number:	47-8050		47-8051		47-8052		47-8053		47-8055		47-8056	
Benzyl Alcohol	41000	U	21000	U	58000	U	27000	U	16000	U	27000	U
4-Bromophenylphenylether	8000	UJ	4000	UJ	11000	UJ	5300	UJ	3100	UJ	5200	UJ
2,4-Dimethylphenol	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
4-Methylphenol	8000	U	4000	U	11000	U	1900	J	6500	J	1300	J
1,4-Dichlorobenzene	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
Phenol	8000	U	4000	U	11000	U	5300	U	7000	J	5200	U
bis(2-Chloroethyl)ether	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
bis(2-Chloroethoxy)methane	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
bis(2-Ethylhexyl)phthalate	59000		19000	UJ	17000	J	11000		3000	UJ	6800	U
Di-n-Octylphthalate	8000	UJ	4000	UJ	11000	UJ	5300	UJ	3100	UJ	5200	UJ
Hexachlorobenzene	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
Anthracene	350	J	4000	U	11000	U	310	J	1700	J	340	J
1,2,4-Trichlorobenzene	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
2,4-Dichlorophenol	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
2,4-Dinitrotoluene	20000	U	10000	U	29000	U	13000	U	7900	U	13000	U
Pyrene	9500		2500	J	4800	J	8400		16000		7600	
Dimethylphthalate	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
Dibenzofuran	8000	U	4000	U	11000	U	5300	U	2600	J	570	J
Benzo(ghi)perylene	8000	U	4000	U	11000	U	2200	J	3100	U	5200	U
Indeno(1,2,3-cd)pyrene	8000	U	4000	U	11000	U	2900	J	3100	U	5200	U
Benzo(b)fluoranthene	5600	J	1600	J	4000	J	5900		2500	J	4000	J
Fluoranthene	7000	J	1900	J	3900	J	6200	J	13000		5900	
Benzo(k)fluoranthene	1500	J	4000	U	11000	U	2200	J	3100	U	5200	U
Acenaphthylene	8000	U	4000	U	11000	U	5300	U	3900		5200	U
Chrysene	8000	U	4000	U	11000	U	4700	J	2700	J	4600	J
Retene	8000	U	4000	U	11000	U	5300	U	3600		5200	U
4,6-Dinitro-2-methylphenol	100000	UJ	53000	UJ	150000	UJ	69000	UJ	41000	UJ	68000	UJ
1,3-Dichlorobenzene	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
2,6-Dinitrotoluene	20000	U	10000	U	29000	U	13000	U	7900	U	13000	U
N-Nitroso-di-propylamine	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U
4-Chlorophenylphenylether	8000	UJ	4000	UJ	11000	UJ	5300	UJ	3100	UJ	5200	UJ
bis(2-Chloroisopropyl)ether	8000	U	4000	U	11000	U	5300	U	3100	U	5200	U

U = not detected at or above reported value

J = estimated value

APPENDIX A.3 COMPLETE ORGANOCHLORINE PESTICIDE & PCB RESULTS (ug/Kg, dry weight)

Ditch:	No. 4		No. 4		No. 3		No. 3		No. 5		No. 5	
Site I.D.:	A		B		D		G		I		J	
Description:	@ Hudson Street		Between California Way & Tennant Way		Between California Way & Oregon Way		@ 23rd Avenue		@ 3500 Industrial Way		@ 38th Avenue	
Sample Number:	47-8050		47-8051		47-8052		47-8053		47-8055		47-8056	
4,4'-DDT	390	U	410	U	580	U	540	U	510	U	990	U
Chlordane	1600	U	1700	U	2300	U	2200	U	2000	U	4000	U
gamma-BHC	390	U	410	U	580	U	540	U	510	U	990	U
Dieldrin	390	U	410	U	580	U	540	U	510	U	990	U
Endrin	390	U	410	U	580	U	540	U	510	U	990	U
Methoxychlor	390	U	410	U	580	U	540	U	510	U	990	U
4,4'-DDD	390	U	410	U	580	U	540	U	510	U	990	U
4,4'-DDE	390	U	410	U	580	U	540	U	510	U	990	U
Heptachlor	390	U	410	U	580	U	540	U	510	U	990	U
Aldrin	390	U	410	U	580	U	540	U	510	U	990	U
alpha-BHC	390	U	410	U	580	U	540	U	510	U	990	U
beta-BHC	390	U	410	U	580	U	540	U	510	U	990	U
delta-BHC	390	U	410	U	580	U	540	U	510	U	990	U
Endosulfan I	390	U	410	U	580	U	540	U	510	U	990	U
Heptachlor Epoxide	390	U	410	U	580	U	540	U	510	U	990	U
Endosulfan Sulfate	390	U	410	U	580	U	540	U	510	U	990	U
Endrin Aldehyde	390	U	410	U	580	U	540	U	510	U	990	U
Toxaphene	4700	U	5000	U	6900	U	6500	U	6100	U	12000	U
PCB-1260	2400	U	2500	U	3500	U	3200	U	3000	U	6000	U
PCB-1254	2400	U	2500	U	3500	U	3200	U	3000	U	6000	U
PCB-1221	2400	U	2500	U	3500	U	3200	U	3000	U	6000	U
PCB-1232	3500	U	4100	U	5800	U	5400	U	5100	U	9900	U
PCB-1248	2400	U	2500	U	3500	U	3200	U	3000	U	6000	U
PCB-1016	2400	U	2500	U	3500	U	3200	U	3000	U	6000	U
Endosulfan II	390	U	410	U	580	U	540	U	510	U	990	U
PCB-1242	2400	U	2500	U	3500	U	3200	U	3000	U	6000	U
Endrin Ketone	390	U	410	U	580	U	540	U	510	U	990	U

U = not detected at or above reported value

APPENDIX A.4 COMPLETE HERBICIDE RESULTS (ug/Kg, dry weight)												
Ditch:	No. 4		No. 4		No. 3		No. 3		No. 5		No. 5	
Site I.D.:	A		B		D		G		I		J	
Description:	@ Hudson Street		Between California Way & Tennant Way		Between California Way & Oregon Way		@ 23rd Avenue		@ 3500 Industrial Way		@ 38th Avenue	
Sample Number:	47-8050		47-8051		47-8052		47-8053		47-8055		47-8056	
Dalapon	551	U	1050	U	1040	U	1210	U	1080	U	2160	U
Pentachlorophenol	71		25		154		34		43		52	
2,4,6-Trichlorophenol	44	U	84	U	83	U	97	U	86	U	172	U
Dinoseb	55	U	105	U	104	U	121	U	108	U	216	U
MCPP	5510	U	10500	U	41700	UJ	19300	U	60300	UJ	146600	UJ
2,4,5-TP (Silvex)	44	U	84	U	83	U	97	U	86	U	172	U
2,4,5-T	44	U	84	U	83	U	97	U	86	U	172	U
2,4,5-TB	44	U	84	U	83	U	97	U	86	U	172	U
MCPA	5510	U	10500	U	29200	U	14500	U	10800	U	21600	U
2,4-D	88	U	168	U	167	U	193	U	172	U	345	U
2,4-DB	187	U	357	U	354	U	411	U	366	U	733	U
2,4,5-Trichlorophenol	44	U	84	U	83	U	97	U	86	U	172	U
Dichloroprop	88	U	168	U	167	U	193	U	172	U	345	U
Ioxynil	44	U	84	U	83	U	97	U	86	U	172	U
Bromoxynil	44	U	84	U	83	U	97	U	86	U	172	U
Dachthal	44	U	84	U	83	U	97	U	86	U	172	U
Dicamba	44	U	84	U	83	U	97	U	86	U	172	U
Picloram	66	U	126	U	125	U	145	U	129	U	259	U
2,3,4,5-Tetrachlorophenol	44	U	84	U	83	U	97	U	86	U	172	U

U = not detected at or above reported value
J = estimated value

APPENDIX A.5 COMPLETE RESIN & FATTY ACIDS RESULTS (ug/Kg, dry weight)

Ditch:	No. 4		No. 4		No. 3		No. 3		No. 5		No. 5	
Site I.D.:	A		B		D		G		I		J	
Description:	@ Hudson Street		Between California Way & Tennant Way		Between California Way & Oregon Way		@ 23rd Avenue		@ 3500 Industrial Way		@ 38th Avenue	
Sample Number:	47-8050		47-8051		47-8052		47-8053		47-8055		47-8056	
Palmitoleic Acid	3580	J	5050	J	14400		4510		994	J	15300	J
Hexadecanoic Acid	23600	U	11600	U	34600		7000	UJ	4040	U	29500	U
Linoleic Acid	7970	J	3060	J	50900		2710	J	1020	J	9440	J
Oleic Acid	20100		6560	J	27800		4320	J	2140	J	12100	J
Octadecanoic Acid	8340	U	6950	U	12200		4320	U	4040	U	20000	U
Retene	8340	U	558	J	1630	J	320	J	1700	J	1900	J
Pimaric Acid	8340	U	6950	U	11500	U	4320	U	4040	U	2000	U
Sandaracopimaric Acid	8340	U	1460	J	2050	J	REJ		4040	U	2000	U
Isopimaric Acid	8340	U	692	J	6250	J	778	J	2020	J	4400	J
Palustric Acid	8340	U	6950	U	11500	U	REJ		4040	U	2000	U
Dehydroabietic Acid	4910	J	4210	J	23100		4840	J	7600		2000	
Abietic Acid	8340	U	6950	U	4630	J	4320	UJ	4040	U	2000	U
Neoabietic Acid	8340	U	6950	U	11500	U	4320	U	4040	U	2000	U
Dichlorostearic Acid	8340	U	6950	U	11500	U	4320	U	4040	U	2000	U
14-Chlorodehydroabietic Acid	8340	U	6950	U	11500	U	4320	U	4040	U	2000	U
12-Chlorodehydroabietic Acid	8340	U	6950	U	11500	U	4320	U	4040	U	2000	U
Dichlorodehydroabietic Acid	8340	U	6950	U	11500	U	4320	U	4040	U	2000	U

U = not detected at or above reported value
J = estimated value
REJ = data were rejected

APPENDIX A.6 COMPLETE PHENOLICS RESULTS (ug/Kg, dry weight)

Ditch:	No. 4		No. 4		No. 3		No. 3		No. 5		No. 5	
Site I.D.:	A		B		D		G		I		J	
Description:	@ Hudson Street		Between California Way & Tennant Way		Between California Way & Oregon Way		@ 23rd Avenue		@ 3500 Industrial Way		@ 38th Avenue	
Sample Number:	47-8050		47-8051		47-8052		47-8053		47-8055		47-8056	
2-Methylphenol	420	UJ	430	UJ	570	UJ	530	UJ	1200	J	1200	UJ
4-Methylphenol	400	J	490	J	2300	J	2600	J	7600	J	1800	J
a-Terpeneol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
2-Chlorophenol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
2,4-Dimethylphenol	420	UJ	430	UJ	1100	UJ	530	UJ	240	J	1200	UJ
Guaiacol	55	J	430	UJ	570	UJ	530	UJ	380	J	120	J
4-Chloro-3-methylphenol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
2,4-Dichloroguaiacol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
2,4-Dichlorophenol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
2,3,4-Trichlorophenol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
2,4,6-Trichlorophenol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
2,4,5-Trichlorophenol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
2,3,5-Trichlorophenol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
4-Allylguaiacol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
4,5-Dichloroguaiacol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
4-Chlorocatechol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
4-Propenylguaiacol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
6-Chlorovanillin	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
4,5-Dichlorocatechol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	NAR	
4,5,6-Trichloroguaiacol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
3,4,5-Trichloroguaiacol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
Pentachlorophenol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ
Tetrachloroguaiacol	420	UJ	430	UJ	570	UJ	530	UJ	510	UJ	1200	UJ

U = not detected at or above reported value

J = estimated value

NAR = no analytical result

APPENDIX B

State Plane Coordinates for Ecology 1992 Sediment Sampling Sites
in Longview Drainage System

APPENDIX B. STATE PLANE COORDINATES						
Ditch:	No. 4	No. 4	No. 3	No. 3	No. 5	No. 5
Site I.D.:	A	B	D	G	I	J
Description:	@ Hudson Street	Between California Way & Tennant Way	Between California Way & Oregon Way	@ 23rd Avenue	@ 3500 Industrial Way	@ 38th Avenue
Sample Number:	47-8050	47-8051	47-8052	47-8053	47-8055	47-8056
X-coordinate	1,375,800	1,379,300	1,380,900	1,374,900	1,371,000	1,369,600
Y-coordinate	301,800	296,100	295,600	297,900	302,800	306,800