



Fraser
River
Estuary
Management
Program

**WATER QUALITY
IN THE FRASER RIVER ESTUARY
JANUARY, 1993 TO MARCH, 1994**

**TECHNICAL REPORT SERIES
FREMP - WQM 94-01
DOE - FRAP 1994-18**

Fraser River Estuary Management Program
Suite 501 - 5945 Kathleen Avenue
Burnaby, B.C.
V5H 4J7

March, 1997

WATER QUALITY IN THE FRASER RIVER ESTUARY
JANUARY, 1993 TO MARCH, 1994

TECHNICAL REPORT SERIES
FREMP - WQWM 94-01
DOE - FRAP 1994-18

Prepared by

R.W. Drinnan¹ and B. Humphrey²

¹Aquatic Science Consultants Ltd., Victoria, B.C.

²EnviroEd Consultants Ltd., Victoria, B.C.

for

FREMP Water Quality Waste Management Committee

Fraser River Estuary Management Program
Suite 501 - 5945 Kathleen Avenue
Burnaby, B.C.
V5H 4J7

March, 1997

Canadian Cataloguing in Publication Data

Drinnan, R. W. (Robert Warren), 1946-

Water quality in the Fraser River Estuary,
January 1993 to March 1994

(Technical report series ; WQM 94-01)

(Technical report series ; DOE FRAP 1994-18)

Co-published by Environment Canada.

Includes bibliographical references: p.

ISBN 0-7726-2318-X

1. Water quality - British Columbia - Fraser River Estuary. I. Humphrey, B. II. Fraser River Estuary Management Program (Canada). Water Quality Management Committee. III. Canada. Environment Canada. IV. Fraser River Action Plan (Canada) V. Title. VI. Series: Technical report (Fraser River Estuary Management Program (Canada). Water Quality Management Committee) ; WQM 94-01. VII. Series: Technical report (Fraser River Action Plan (Canada)) ; DOE FRAP 1994-18.

TD227.F7D74 1997 363.73'942'0971133 C94-960394-5

EXECUTIVE SUMMARY

Physical, inorganic and organic parameters were measured between January, 1993 and March, 1994 at three stations in the lower Fraser River - in the Main Stem at Mission, in the Main Arm at Tilbury Island and in the North Arm at Oak Street Bridge. Cross-section profiles were conducted on a quarterly basis at the three sites to investigate the suitability of taking a single water sample. In addition, six sloughs within the Main and North Arms of the river were sampled twice during the study.

At the main river sites, physical and inorganic parameters, including metals, were measured approximately every two weeks. Chlorophenolic compounds, nonylphenol and absorbable organic halides (AOX) were measured monthly while resin and fatty acids, pesticides, polychlorinated biphenyls (PCBs) and 2(Thiocyanomethylthio)Benzothiazole (TCMTB) were measured on four occasions.

Sampling in the six sloughs was conducted on two dates during low flow conditions. Parameters included the same physical, inorganic and organic parameters as were measured at the main river sites, plus polycyclic aromatic hydrocarbons (PAHs).

Both the parametric analysis on selected variables and the non-parametric analysis on all variables indicate that while cross-sectional differences were apparent on some sampling dates, this wasn't the case during other periods. Overall, there were no significant differences between the cross-section stations at any of the main river sites. It was concluded that samples collected at the mid-channel station could be considered representative of the river.

Most of the physical and inorganic parameters were not significantly different among the three main river sites or when compared to federal/provincial data collected at Hope. For some parameters, primarily those associated with dissolved ions, values were higher at the Oak Street Bridge and Tilbury Island sites than the upstream sites at Mission and Hope. This was attributed to the effects of marine water intrusion. These differences generally did not exist, or were considerably less, during periods of high river flow. Many of the parameters associated with particulate material (e.g., total nitrogen and phosphorus and several metals) showed seasonal differences attributable to higher levels of particulate material, with an increase in concentration during higher flows.

Many of the metals were below the method detection limit (MDL) with most measurable values within guidelines and criteria set by federal and provincial agencies for the protection of aquatic life. Copper and iron were frequently higher than the guidelines but were within the provincial water quality objectives set for the lower Fraser River. Most measurements which exceeded the guidelines or criteria were generally associated with higher levels of suspended solids.

Fecal coliform levels were within provincial criteria and the Fraser River objectives set for the period between April and September (the objective doesn't apply during the remainder of the year). Lower concentrations during the summer period were associated with the chlorination of sewage discharged to the river, lower rainfall and stormwater discharges, and increased dilution during river freshet. Individual high levels were associated with high rainfall events.

Most of the measurements for chlorophenolic compounds, resin and fatty acids, organochlorine pesticides, PCBs, TCMTB and AOX were below or near the detection limit. A few individual compounds were slightly higher than federal or provincial water quality guidelines/criteria but there was no evidence of differences between the upstream sites at Hope and Mission and those at Tilbury Island and Oak Street Bridge. A decrease during the summer for some groups of organics (AOX, total chlorophenols) is likely a dilution effect from increased river flow.

Total chlorophenol concentrations appeared to have decreased by nearly an order of magnitude based on a comparison of the data collected in this study with a compilation of water quality data collected prior to 1988. The trend reflects the decrease in use by the forest industry of chlorophenates as an anti-sapstain agent.

The water quality in the six sloughs sampled was generally good. Some parameters reflected the presence of marine waters (all samples were collected in February when the salt wedge penetrates the furthest upstream). There were few differences between the sloughs except those furthest upstream, Tree Island Slough and Gundersen Slough, which showed the least effects from seawater intrusions.

Measurements for most metals in the sloughs were similar to those measured at the main river sites and below the maximum concentrations set for the protection of aquatic life. There was also no evidence of consistently higher organic compounds (chlorophenolics, resin and fatty acids and PCBs) in the sloughs when compared to the main river sites. Most measurements were below the detection limit and, except for a few individual compounds, all were within water quality guidelines or criteria.

The concentration of LPAH, HPAH and total PAH compounds was similar in most of the sloughs. There were a few elevated levels of specific PAH compounds which exceeded water quality guidelines but these represented less than 1% of the analyses.

It was concluded that the overall quality of the Fraser River for water-borne contaminants was good. There was no evidence of consistently elevated concentrations of nutrients, metal or organic contaminants that would pose a threat to aquatic life and no evidence of an increase in levels that could be attributable to specific municipal or industrial discharges within the study area. Because there is a strong association of both metal and organic contaminants with particulate material it was recommended that these parameters be monitored in sediments rather than in the water.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
1.0 INTRODUCTION	1
2.0 METHODS	3
2.1 Field Program Design	3
2.1.1 Phase I - Main River Sites.....	3
2.1.2 Federal/Provincial Water Quality Monitoring at Hope	6
2.1.3 Phase II - Cross-Sectional Sampling at Main River Sites.....	7
2.1.4 Phase III - Sloughs	7
2.2 Laboratory Program Design.....	8
2.2.1 Phase I: Main River Sites.....	8
2.2.2 Phase II - Cross-Sectional Sampling at Main River Sites.....	16
2.2.3 Phase III - Water Quality in Sloughs.....	16
2.3 Quality Assurance	16
2.3.1 Field Replicates and Inter-laboratory Comparisons.....	16
2.3.2 Field Blanks	17
2.3.3 Method Blanks.....	18
2.3.4 Bottle Blanks.....	18
2.3.5 Spiked Samples.....	18
2.3.6 Standard Reference Materials	18
2.3.7 Continuity of Analytical Procedures for Inorganic Variables.....	19
2.3.8 Continuity of Sampling Procedures for Slough Sampling.....	19
2.3.9 Overall Data Quality	20
2.4 Statistical Treatment of the Data.....	20
2.4.1 Phase I - Main River Sites	20
2.4.2 Phase II -Cross Sectional Sampling at Main River Sites	21
2.4.3 Phase III - Water Quality in Sloughs.....	22
2.5 Water Quality Guidelines, Criteria and Objectives.....	22
3.0 RESULTS AND DISCUSSION - MAIN RIVER SITES.....	25
3.1 Cross-Sectional Profiles.....	25
3.2 Factors Influencing Water Quality	30
3.2.1 Flow.....	30
3.2.2 Tides and Seawater Intrusion	30
3.2.3 Seasonal Factors.....	32
3.2.4 Tributaries and Runoff.....	32
3.2.5 Municipal and Industrial Discharges.....	32
3.3 Physical Properties.....	35
3.3.1 Water Temperature	35

3.3.2	Dissolved Oxygen.....	35
3.3.3	pH and alkalinity	35
3.4	Non-filterable Residue	39
3.5	Dissolved Ions	39
3.6	Nutrients	48
3.6.1	Nitrogen	48
3.6.2	Phosphorus.....	49
3.7	Metals	55
3.7.1	Silver (Ag)	55
3.7.2	Aluminum (Al)	55
3.7.3	Arsenic (As)	58
3.7.4	Barium (Ba).....	58
3.7.5	Cadmium (Cd)	58
3.7.6	Cobalt (Co)	58
3.7.7	Chromium (Cr)	61
3.7.8	Copper (Cu).....	61
3.7.9	Iron (Fe)	61
3.7.10	Mercury (Hg).....	62
3.7.11	Manganese (Mn)	62
3.7.12	Molybdenum (Mo).....	66
3.7.13	Nickel (Ni)	66
3.7.14	Lead (Pb).....	66
3.7.15	Selenium (Se).....	66
3.7.16	Tin (Sn)	69
3.7.17	Zinc (Zn)	69
3.8	Total Organic Carbon.....	69
3.9	Fecal Coliforms.....	69
3.10	Organic Compounds	73
3.10.1	Adsorbable Organic Halides (AOX).....	73
3.10.2	Chlorophenolics.....	73
3.10.3	Nonylphenol.....	74
3.10.4	TCMTB.....	74
3.10.5	Resins and Fatty Acids	80
3.10.6	Organochlorine Pesticides and Polychlorinated Biphenols (PCBs)	80
4.0	RESULTS AND DISCUSSION - SLOUGHS.....	81
4.1	Water Temperature and Dissolved Oxygen.....	81
4.2	pH and Alkalinity.....	82
4.3	Non-filterable Residue	82
4.4	Dissolved Ions	84
4.5	Nutrients	84
4.5.1	Nitrogen	84
4.5.2	Phosphorus.....	84

4.6 Metals	90
4.7 Fecal Coliform Bacteria.....	94
4.8 Total Organic Carbon.....	94
4.9 Adsorbable Organic Halides (AOX).....	94
4.10 Chlorophenolics	94
4.11 Nonylphenol	94
4.12 Resin and Fatty Acids	96
4.13 TCMTB	96
4.14 Organochlorine Pesticides and PCBs	96
4.15 Polycyclic Aromatic Hydrocarbons (PAHs)	97
5.0 CONCLUSIONS.....	99
5.1 Water Quality - Main River Sites	99
5.1.1 Cross-sectional Profiles	99
5.1.2 Physical Parameters and Inorganic Ions	99
5.1.3 Nutrients.....	99
5.1.4 Metals.....	100
5.1.5 Fecal Coliforms.....	100
5.1.6 Organic Compounds	101
5.2 Water Quality - Sloughs.....	101
6.0 RECOMMENDATIONS	103
7.0 REFERENCES.....	104

LIST OF APPENDICES

APPENDIX I. DETAILED FIELD PROCEDURES AND STATION LOCATIONS
APPENDIX II. DETAILED LABORATORY PROCEDURES
APPENDIX III. QUALITY ASSURANCE PROGRAM
APPENDIX IV. ANALYTICAL RESULTS FOR QC REPLICATE DATA
APPENDIX V. RIVER CROSS SECTION DATA
APPENDIX VI. WATER QUALITY DATA FOR FEDERAL/PROVINCIAL SITE AT HOPE
APPENDIX VII. WATER QUALITY DATA FOR MISSION SITE
APPENDIX VIII. WATER QUALITY DATA FOR TILBURY ISLAND SITE
APPENDIX IX. WATER QUALITY DATA FOR OAK STREET BRIDGE SITE
APPENDIX X. WATER QUALITY DATA FOR MAIN ARM AND NORTH ARM SLOUGHS
APPENDIX XI. FIELD PROFILE DATA FOR MAIN ARM AND NORTH ARM SLOUGHS

LIST OF FIGURES

Figure 1. General Location of FREMP Water Quality Monitoring Sites, Lower Fraser River	4
Figure 2. Comparison of Cross-Sectional Data for Specific Conductivity	28
Figure 3. Comparison of Cross-Sectional Data for Calcium.....	28
Figure 4. Comparison of Cross-Sectional Data for Nitrite/Nitrate	29
Figure 5. Comparison of Cross-Sectional Data for Iron.....	29
Figure 6. Fraser River Flow at Hope	31
Figure 7. Comparison of Fraser River Flow at Hope, Mission and Port Mann	31
Figure 8. Ratio of Fraser River Flows: Mission/Hope; Port Mann Hope; Port Mann/Mission.	33
Figure 9. Daily Precipitation, Vancouver Airport	33
Figure 10. Summary of Water Temperature Data, Main River Sites	36
Figure 11. Seasonal Changes in Water Temperature, Main River Sites.....	36
Figure 12. Summary of Dissolved Oxygen Data, Main River Sites.....	37
Figure 13. Seasonal Changes in Dissolved Oxygen, Main River Sites	37
Figure 14. Summary of pH Data, Main River Sites	38
Figure 15. Summary of Alkalinity Data, Main River Sites	38
Figure 16. Summary of Non-filterable Residue Data, Main River Sites	40
Figure 17. Seasonal Changes in Non-Filterable Residue, Main River Sites	40
Figure 18. Summary of Specific Conductivity Data, Main River Sites.....	41
Figure 19. Seasonal Changes in Specific Conductivity, Main River Sites.....	41
Figure 20. Summary of Hardness Data, Main River Sites	43
Figure 21. Summary of Filterable Residue Data, Main River Sites.....	43
Figure 22. Summary of Sodium Data, Main River Sites	44
Figure 23. Summary of Potassium Data, Main River Sites.....	44
Figure 24. Summary of Total Magnesium Data, Main River Sites	45
Figure 25. Summary of Chloride Data, Main River Sites	45
Figure 26. Summary of Sulphate Data, Main River Sites	46
Figure 27. Summary of Fluoride Data, Main River Sites	46
Figure 28. Summary of Calcium Data, Main River Sites	47
Figure 29. Summary of Total Ammonia Data, Main River Sites	50
Figure 30. Summary of Nitrite/Nitrate Data, Main River Sites	50
Figure 31. Summary of Total Nitrogen Data, Main River Sites	51
Figure 32. Seasonal Changes in Total Ammonia, Main River Sites	51
Figure 33. Seasonal Changes in Nitrite/Nitrate, Main River Sites	52
Figure 34. Seasonal Changes in Total Nitrogen, Main River Sites.....	52
Figure 35. Summary of Dissolved Phosphorus Data, Main River Sites.....	53
Figure 36. Summary of Total Phosphorus Data, Main River Sites.....	53
Figure 37. Seasonal Changes in Total Phosphorus, Main River Sites.....	54
Figure 38. Summary of Total Silver Data, Main River Sites	57
Figure 39. Summary of Total Aluminum Data, Main River Sites	57

Figure 40. Summary of Total Arsenic Data, Main River Sites	59
Figure 41. Summary of Barium Data, Main River Sites	59
Figure 42. Summary of Total Cadmium Data, Main River Sites.....	60
Figure 43. Summary of Total Cobalt Data, Main River Sites.....	60
Figure 44. Summary of Total Chromium Data, Main River Sites.....	63
Figure 45. Summary of Total Copper Data, Main River Sites	63
Figure 46. Seasonal Changes in Total Copper, Main River Sites.....	64
Figure 47. Summary of Total Iron Data, Main River Sites	64
Figure 48. Seasonal Changes in Total Iron, Main River Sites	65
Figure 49. Summary of Total Manganese Data, Main River Sites	65
Figure 50. Summary of Total Molybdenum Data, Main River Sites	67
Figure 51. Summary of Total Nickel Data, Main River Sites	67
Figure 52. Summary of Total Lead Data, Main River Sites	68
Figure 53. Summary of Total Zinc Data, Main River Sites	68
Figure 54. Summary of Total Organic Carbon Data, Main River Sites	71
Figure 55. Summary of Fecal Coliform Data, Main River Sites.....	71
Figure 56. Seasonal Changes in Fecal Coliforms, Main River Sites	72
Figure 57. Summary of Absorbable Organic Halide (AOX) Data, Main River Sites	75
Figure 58. Summary of Total Chlorophenolic Data (Calculated), Main River Sites.....	75
Figure 59. Seasonal Changes in Total Chlorophenolics, Main River Sites	76
Figure 60. Summary of Individual Chlorophenolic Compounds, Mission	77
Figure 61. Summary of Individual Chlorophenolic Compounds, Tilbury Island.....	78
Figure 62. Summary of Individual Chlorophenolic Compounds, Oak Street Bridge.....	79
Figure 63. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates) a) Water Temperature; b) Dissolved Oxygen; c) pH; d) Total Alkalinity	83
Figure 64. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates): a) Non Filterable Residue; b) Conductivity; c) Filterable Residue; d) Hardness	85
Figure 65. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates): a) Calcium; b) Magnesium; c) Potassium; d) Sodium.....	86
Figure 66. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates): a) Chloride; b) Fluoride; c) Sulphate	87
Figure 67. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates): a) Ammonia; b) Nitrite/Nitrate; c) Total Nitrogen.....	88
Figure 68. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates): a) Total Phosphorus; b) Dissolved Phosphorus	89
Figure 69. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates): a) Total Aluminum; b) Total Arsenic; c) Barium; d) Total Copper	91
Figure 70. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates): a) Total Iron; b) Total Manganese; c) Total Molybdenum; d) Total Nickel	92
Figure 71. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates): a) Total Tin; b) Total Zinc	93
Figure 72. Mean and Range of All Data for Sloughs (Surface and Bottom on Two	

Dates): a) Fecal Coliforms; b) Total Organic Carbon; c) AOX; d) Total Chlorophenolics.....	95
Figure 73 Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates):	
a) Total Resin Acids; b) LPAH; c) HPAH; d) Total PAH	98

LIST OF TABLES

Table 1. Sampling Schedule for the 1993-1994 FREMP Water Quality Monitoring Program.	5
Table 2. Phase I Part 1 Physical and Inorganic Variables	10
Table 3. Organic Compounds Sampled on a Monthly Basis, Main River Sites.....	11
Table 4. Resin and Fatty Acid Compounds Sampled on an Event Basis.	13
Table 5. Organochlorine Pesticides and Total PCBs Sampled on an Event Basis.....	14
Table 6. Polycyclic Aromatic Hydrocarbons Analysed in Slough Samples.....	15
Table 7. Summary of Replicate Analyses for Organic Parameters.....	17
Table 8. Summary of Water Quality Guidelines, Criteria and Objectives For the Protection of Aquatic Life, Applicable to the Fraser River	23
Table 9. Summary Data for FREMP Main River Monitoring Sites and Federal-Provincial Site at Hope.....	26
Table 10. Comparison of Total Ammonia with Water Quality Guidelines.....	49
Table 11. Comparison of Metal Data with Water Quality Objectives and Guidelines	56
Table 12. Summary of Measurable Resin and Fatty Acid Compounds	80
Table 13. Number of Measurable Resin and Fatty Acid Compounds in Fraser River Sloughs	96
Table 14. PAH Values in Fraser River Sloughs Exceeding Water Quality Criteria.....	97

ACKNOWLEDGEMENTS

This project was commissioned by the Fraser River Estuary Management Program (FREMP). Funding for this study was provided by Environment Canada, under the Fraser River Action Plan. Sharon Peters, Water Quality Coordinator at FREMP and Taina Tuominen, Environment Canada, acted as Scientific Authorities and provided valuable advice throughout this project. Anne Wilson, FREMP, coordinated the final review and edit of the report.

Field sampling was carried out by Beak Consultants (now IRC Inc) who also prepared field reports. Analytical services were provided by Zenon Environmental Laboratories and ASL Analytical Services Laboratories. Bacteriological analysis for fecal coliform bacteria was performed at the Greater Vancouver Regional District laboratory. A preliminary report of the data was prepared by Don Morse of FREMP, who also supervised and reviewed the quality assurance components of the project.

The authors also wish to thank D. Hull, Aquatic Science Consultants Ltd., for her considerable assistance in the final preparation of this report.

1.0 INTRODUCTION

In 1991, the Fraser River Estuary Management Program (FREMP) Standing Committee on the Fraser River Estuary Water Quality Plan, including representatives from Environment Canada, Fisheries and Oceans Canada, B.C. Ministry of Environment (now Environment, Lands and Parks) and the Greater Vancouver Regional District (GVRD), published a Water Quality Plan for the estuary, (FREMP, 1991). The purpose of the Water Quality Plan was to establish agreed upon Water Quality Objectives and a coordinated environmental monitoring program.

The results of the coordinated monitoring program are being used to assess the health of the estuary and determine the adequacy of water quality objectives and current waste treatment and disposal practices for protecting aquatic resources. These activities advance the overall goal of the Fraser River Estuary Management Program which is to maintain and, where possible, improve the water quality of the estuary.

The water quality monitoring project described in this report is one component of the coordinated environmental monitoring program. The coordinated program calls for monitoring of physical, chemical and bacteriological variables within the water column and sediments and biota. This first of a three year cycle of studies took place from 1992 to 1994. An overall assessment of water quality in the Fraser River estuary is documented in FREMP, 1996.

In support of the Water Quality Plan, a number of studies have been completed and published in a FREMP Technical Report Series from 1992 to 1994. Related studies of sediment quality, effluent characteristics and contaminant levels in resident biota were carried out before this period by Swain and Walton (1990, 1991, 1993) through a partnership between the BC Ministry of Environment, Lands and Parks and the Fraser River Harbour Commission. Examination of contaminant concentrations in tissues and health characteristics of resident fish within various reaches of the Fraser River Estuary, carried out in 1994, is the final study of the three year monitoring cycle.

The goals of the FREMP coordinated environmental monitoring program are presented in detail in the "Water Quality Plan - Monitoring and Objectives" (FREMP, 1991). Briefly, these are:

- to determine the current water quality status of the Fraser River Estuary;
- to assess trends in water quality;
- to investigate the water quality in sloughs where environmental extremes may be expected to occur, and;
- to compare the results obtained with Provisional Water Quality Objectives established for the lower Fraser River by B.C. Ministry of Environment (Swain and Holms, 1985) and provide information for the revision of objectives.

In order to achieve these goals as they relate to the water column, a three phase monitoring program was carried out. Under Phase I, three sites within the estuary were monitored for physical, chemical and bacteriological variables every two weeks for 15 months from January, 1993 to March, 1994.

Phase II of the study investigated the spatial variability of measurements at each of three sites through cross-section profiles of water quality in order to assess how well a single mid-stream sample represented conditions in the river.

Under Phase III, water quality conditions were investigated at six Main and North Arm sloughs to determine the water quality in areas where extremes may occur. Sloughs were targeted because, as areas of low flow velocity, contaminants may concentrate there.

This report presents the data collected within the estuary during the fifteen month monitoring program. The estuary data are evaluated relative to data collected upstream at a water quality monitoring site operated jointly by the federal and provincial governments at the head of the Fraser Valley at Hope, as well as to established objectives, guidelines and criteria developed by federal and provincial agencies. Results of the first three months of monitoring were previously published as a joint FREMP and Fraser River Action Plan (FRAP) document (Morse, 1994). The entire data set for this study is available in electronic spreadsheet format from the FREMP office at the address given on the title page of this report.

2.0 METHODS

2.1 Field Program Design

The field program was organized in three distinct phases. Each phase was designed to characterize specific aspects of water quality in the Fraser River estuary. Detailed field procedures are described in Appendix 1. The field activities were conducted by IRC Integrated Resource Consultants Inc. (formerly Beak Consultants Ltd.). The general location of sampling sites is shown in Figure 1. Detailed locations are presented in the tables and figures of Appendix 1.

2.1.1 Phase I - Main River Sites

Water samples from three stations located at Mission, Tilbury Island and Oak Street Bridge, were sampled approximately every two weeks over a 15-month interval, between January, 1993 and March, 1994 (Figure 1). At each site, samples were collected at mid-stream from one metre below the surface. Samples from the Tilbury Island and Oak Street Bridge sites were collected during low slack tide conditions which necessitated sampling the three sites over two consecutive days. Samples were collected on a biweekly basis on the dates listed in Table 1. Table 1 also lists the groups of variables sampled on each date. Single samples were collected for each variable or group of variables. A total of 30 samples were collected from each site during the monitoring period.

Samples for inorganic and physical parameters were collected using a multiple sampler, provided by Environment Canada. The sampler, of stainless steel, acrylic and PVC construction, was specifically designed to hold a series of sample containers required for the analysis of the specific inorganic variables measured during this program. The sampler was suspended from the vessel by a rope and immersed into the water to rinse it prior to sample collection. After rinsing, the appropriate bottles were inserted into the sampler and the caps removed before lowering the sampler to a depth of one metre below the water surface. The sampler was retrieved after all bubbling had ceased. The individual sample bottles were then capped and removed from the device.

Samples for organic analyses were collected in four-litre glass Winchester type bottles. The bottles were secured in a second stainless steel sampling device attached to a stainless steel pole that was held one metre below the surface during filling. Samples for AOX analysis were collected in one litre amber glass bottles that were placed in a separate multiple sampler and lowered to a depth of one metre using the procedure described above for sampling inorganic parameters.

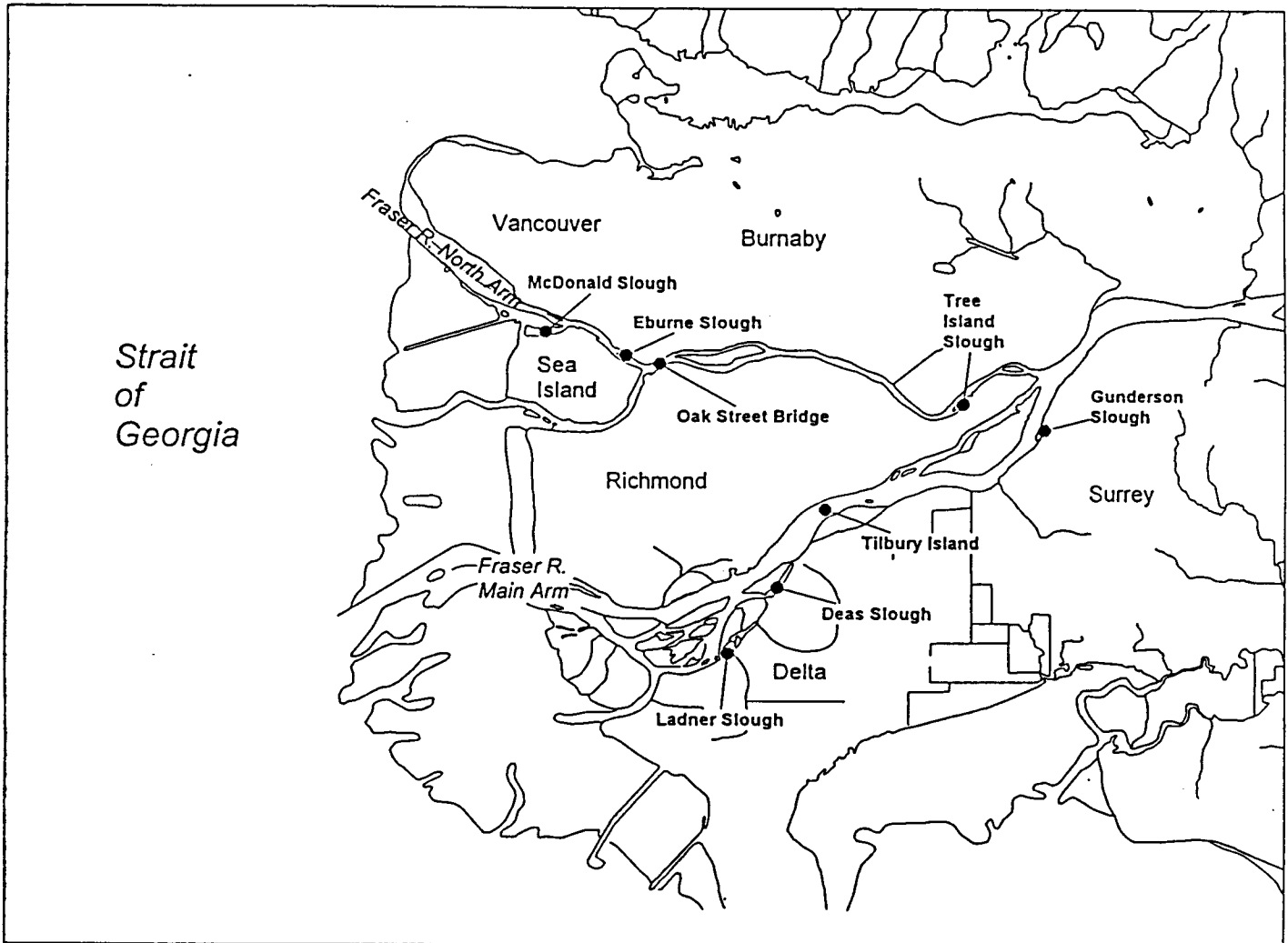
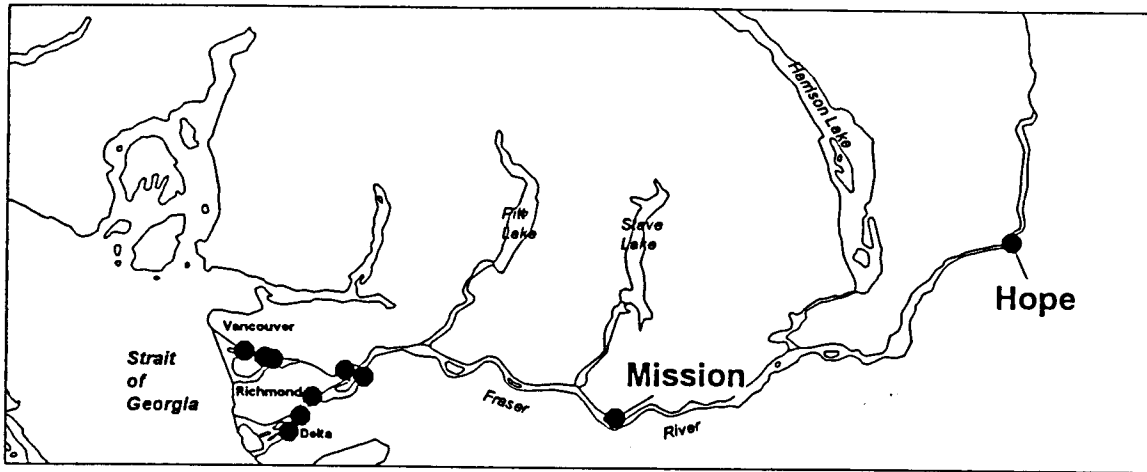


Figure 1. General Location of FREMP Water Quality Monitoring Sites, Lower Fraser River. Upper Figure: Upstream Sites at Mission and Hope.

**Table 1. Sampling Schedule for the 1993-1994 FREMP
Water Quality Monitoring Program.**

Sampling Dates	Phase I, Part 1 Inorganics	Phase I, Part 2 Chlorophenolics, Nonylphenol, AOX	Phase I, Part 3 Resin/Fatty Acids Pesticides/PCBs, TCMTB	Phase II Cross- Sections	Phase III Sloughs
Jan. 25-26, 1993	✓	✓			
Feb. 8-11, 1993	✓				✓
Feb. 22-23, 1993	✓	✓	✓		
Mar. 8-9, 1993	✓			✓	
Mar. 22-23, 1993	✓	✓			
Missed Sampling					
April 19-20, 1993	✓	✓			
May 3-4, 1993	✓				
May 17-18, 1993	✓	✓	✓		
May 31-Jun.1, 1993	✓			✓	
Jun. 14-15, 1993	✓	✓			
Jun. 28-29, 1993	✓				
Jul. 12-13, 1993	✓	✓			
Jul. 26-27, 1993	✓				
Aug. 9-10, 1993	✓	✓			
Aug. 23-24, 1993	✓				
Sep. 6-7, 1993	✓	✓			
Sep. 20-21, 1993	✓				
Oct. 4-5, 1993	✓	✓		✓	
Oct. 18-19, 1993	✓	✓	✓		
Nov. 1-2, 1993	✓	✓			
Nov. 15-16, 1993	✓				
Nov. 29-30, 1993	✓	✓			
Dec. 13-14, 1993	✓				
Dec. 27-28, 1993	✓	✓			
Jan. 10-11, 1994	✓				
Jan. 24-25, 1994	✓	✓			
Feb. 7-8, 1994	✓			✓	
Feb. 20-22, 1994	✓	✓	✓		✓
Mar. 7-8, 1994	✓				
Mar. 21-22, 1994	✓	✓			

Bacteriological samples were collected at each sampling location from approximately a 0.3 m depth below the surface. Sterile polyethylene containers were used with the mouth of the bottle facing into the current. The sample containers were drained to provide 1 cm airspace according to the method described in GVRD (1992).

Upon retrieval aboard the vessel, the sample containers were examined to determine that good representative water samples had been obtained and that no leakage of the contents had occurred, according to methods recommended in Tetra Tech Inc. (1986). Specific details regarding the monitoring station designation, date, time, and water depth at each site were recorded in the vessel log.

It should be noted that none of these sampling methods prevent surface waters from entering the sample bottles. The technique relies on lowering the bottle to the desired sampling depth as quickly as possible to ensure that the majority of the sample is collected from the designated depth.

Temperature, conductivity, dissolved oxygen and pH were measured in the field at the time of sample collection. One bottle of sample water from the multiple sampler was used on board the vessel to make the measurements. Dissolved oxygen and temperature were determined with a YSI Model 54 meter. Dissolved oxygen values were adjusted for salinity where appropriate. Conductivity was determined with a YSI Model 33 meter. A Canlab Model 607 pH meter was used to determine pH. All field equipment was pre-calibrated and adjusted in IRC's laboratory prior to each sampling date. The bottles used for field testing were returned to the IRC laboratory for verification of conductivity and salinity values. The field measurements were reported to FREMP and Environment Canada in regular progress reports.

2.1.2 Federal/Provincial Water Quality Monitoring at Hope

Water samples were collected at Hope (approximately 50 kilometers upstream of the Mission site) at two week intervals during the January, 1993 to March, 1994 monitoring period, similar to the present study, although samples were not collected on the same dates. This site (Fraser River at Hope, Environment Canada Water Quality Site BC08MF0001; BC Ministry of Environment, Lands and Parks Site E206581) is part of a joint federal and provincial program to monitor long term trends in water quality at various locations within British Columbia.

Most of the inorganic water quality parameters examined in this study were common to both programs. To facilitate the interpretation of the data collected from the main river sites, data from the Hope site were obtained from the Environment Canada database, ENVIRODAT. (The data from the Hope site are tabulated in Appendix VI for comparison with FREMP water quality data collected at Mission). AOX results at the Hope site were obtained directly from BC Ministry of Environment, Lands and Parks (Pommen, 1994).

2.1.3 Phase II - Cross-Sectional Sampling at Main River Sites

On March 8 and 9, 1993, cross-sectional profiles were collected at the Oak Street Bridge and Tilbury Island sites. The Mission site was also sampled during the remaining three cross-section profile series, which occurred on May 31/June 1, 1993, October 5/6, 1993 and February 7/8, 1994.

At each site, samples were collected from a depth of one metre at five stations across the river, as shown in the figures in Appendix I. The Phase I samples were collected from the same location as the mid channel samples, designated as location 3 on each profile. The first station of each cross-section was resampled at the end of the traverse as a check on temporal variability during sample collection.

2.1.4 Phase III - Sloughs

Water samples were collected from two depths (one metre below the water surface and one metre above the bottom) in six sloughs - Ladner, Deas and Gundersen Sloughs in the Main Arm; and, McDonald, Eburne and Tree Island Sloughs in the North Arm, as shown in the figures in Appendix I. Slough samples were collected during the February 8-11, 1993 and February 21-23, 1994 sampling periods (Table 1).

Unlike the main river sites, water samples in the sloughs were collected at high slack tide. Physical parameters (temperature, conductivity, salinity, dissolved oxygen and pH) were measured immediately from a two litre sample collected at each one metre interval through the water column. Additional water samples were collected one metre below the surface and approximately one metre from the bottom of the slough for inorganic and organic chemical analyses.

The first samples were collected between February 9 and 11, 1993 by lowering sample bottles to the desired depth in a weighted multiple sampler. This procedure was satisfactory for the near surface sample but not for the sample from one metre above the bottom, primarily because the bottles were not sealed on descent. In addition, it was difficult to locate and hold the required depth over the short duration that the bottle was filling.

A different approach was taken for the second series of slough samples which were collected between February 20 and 22, 1994. These samples were collected using a submersible pump (March, Model 5C-MD) attached to a Teflon coated woven stainless steel hose. The hose and pump filter-head were pre-rinsed with de-ionised water then rinsed with acetone and hexane. High temperature, oven-heated aluminium foil was used to cover hose ends and pump head to prevent contamination during transport.

The sample depth was determined using a weighted measuring rope and a depth sounder. A 2.5 kg weight was placed on the end of the nylon rope marked at 0.5 metre intervals. The vessel was anchored in position and the rope was lowered over the bow to determine the length of line required to reach the bottom. The reading given by the ship's depth sounder was compared to the depth indicated by the rope to ensure currents were not preventing the sampling apparatus from descending on a straight course perpendicular to the bottom. The measuring rope was fastened to the pump which was then lowered to each sampling depth. Water was pumped through the hose for two minutes to rinse the hose before sampling at each depth. Individuals handling the sample bottles and lids wore polyethylene gloves during water sample collection.

As with the main river sites, temperature, conductivity, dissolved oxygen and pH were measured in the field at the time of collection. In addition, salinity was measured with a YSI Model 33 SCT meter. Dissolved oxygen values were adjusted for salinity where appropriate.

2.2 Laboratory Program Design

Between January and March of 1993, Zenon Environmental Laboratories analysed the samples for all physical and chemical variables. After March 1993, Zenon conducted the analyses for organic contaminants and ASL (Analytical Services Laboratories) provided analytical services for the physical and inorganic variables. Bacteriological analysis for fecal coliform bacteria was performed at the GVRD laboratory.

The following sections summarize the variables analysed in Phases I, II, and III of the water quality monitoring program. Detailed analytical procedures are presented in Appendix II. The method detection limit (MDL) for each parameter is presented in Tables 2-6.

2.2.1 Phase I: Main River Sites

Inorganic parameters and metals were analyzed from samples collected during each sampling event at the three main river sites. A suite of organic compounds, including chlorinated phenolics, nonylphenol and adsorbable organic halides (AOX) were analyzed in water samples collected during every second sampling event. On four occasions during the 15-month sampling program a broader suite of organic compounds were analyzed which included resin and fatty acids, organochlorine pesticides and total polychlorinated biphenyls (PCBs) (refer to Table 1 for the sampling schedule).

Inorganics and Metals

Biweekly samples collected from the three main river sites (Mission, Tilbury Island and Oak Street Bridge) were analyzed for those variables listed in Table 2.

In addition to the metals listed in Table 2, a number of other metals were supplied by the analytical laboratory at no additional charge to the contract as a result of the multi-element nature of the analytical methodology. These metals were:

aluminum	barium	calcium
cobalt	iron	magnesium
manganese	molybdenum	potassium
selenium	silver	sodium
tin		

The method detection limits for these additional metals are found on page 1 of Appendix V, and the method detection limits for the metals analyzed at the Environment Canada lab (i.e. replicate samples) are found on page 1 of Appendix IV.

Organic Compounds

During every second sampling event, samples collected from the main river sites were also analyzed for the suite of variables listed in Table 3 (chlorinated phenolics, nonylphenol and AOX). Chlorinated phenolics and AOX are classes of chemicals known to be associated with effluent from wood preservation plants, pulp mills using the chlorine bleaching process, and other sources where chlorine disinfection may be used. Nonylphenols are chemicals used in surfactants and possible sources include sewage treatment plants and pulp mills.

On four occasions, water samples collected at the three main river sites at Mission, Tilbury Island and Oak Street Bridge were also analyzed for the following organic constituents: resin and fatty acids; organochlorine pesticides; total polychlorinated biphenyls (PCBs); and, TCMTB (2 [thiocyanomethylthio]benzothiazole) (Tables 4 and 5). These compounds are associated with forest industry processing and agricultural runoff. Sample dates were chosen to represent different hydrological events: February 22-23, 1993 (low flow conditions), May 17-18, 1993 (freshet), October 18-19, 1993 (first flush after a rainstorm) and February 21-23, 1994 (low flow).

Table 2. Physical and Inorganic Variables¹

Field Analyses	Laboratory Analyses	
	Conventional/Inorganics	Metals
Water Temperature	pH	Total Arsenic (0.001 mg/L; 0.0001 mg/L)
pH	Conductivity (1 µS/cm)	Total Cadmium (0.0001 mg/L; 0.0002 mg/L)
Conductivity (1 µS/cm; 0.2 µS/cm)	Residue, Filterable (4 mg/L; 1 mg/L)	Total Chromium (0.005 mg/L; 0.001 mg/L)
Dissolved Oxygen	Residue, Non-filterable (4 mg/L; 1 mg/L)	Total Copper (0.001 mg/L)
Salinity	Hardness (Calculated)	Total Lead (0.003 mg/L; 0.001 mg/L)
		Total Mercury (0.00005 mg/L)
	Major Anions	Total Nickel (0.005 mg/L; 0.001 mg/L)
	Alkalinity (0.5 mg/L)	Total Zinc (0.01 mg/L; 0.001 mg/L)
	Sulphate (1.0 mg/L; 0.5 mg/L)	
	Chloride (0.5 mg/L; 0.2 mg/L)	Bacteriological
	Fluoride (0.1 mg/L; 0.02 mg/L)	Fecal Coliforms (<2 MPN/100 mL)
	Nutrients	
	Total Kjeldahl Nitrogen (0.04 mg/L; 0.05 mg/L)	Organic Parameters
	Nitrite/Nitrate Nitrogen (0.02 mg/L; 0.005 mg/L)	Total Organic Carbon (3 mg/L; 0.5 mg/L)
	Ammonia Nitrogen (0.005 mg/L)	
	Total Phosphorus (0.003 mg/L; 0.001 mg/L)	
	Total Dissolved Phosphorus (0.003 mg/L; 0.001 mg/L)	

¹Numbers in parenthesis represent the Method Detection Limit (MDL); the two values, if present, represent the two analytical labs used during the period 01/93-03/93 and 04/93-03/94, respectively.

Table 3. Organic Compounds Sampled on a Monthly Basis, Main River Sites.¹

Chlorinated Phenolics, Adsorbable Organic Halides (AOX), Nonylphenol			
Parameter	MDL (mg/L)	Parameter	MDL (mg/L)
4-chlorophenol [4CP]	0.000001	5-chloroguaiacol [5CG]	0.000002
2,6-dichlorophenol [26DCP]	0.000001	6-chloroguaiacol [6CG]	0.000002
2,4 and 2,5-dichlorophenol [24DCP] and [25DCP]	0.000001	4-chloroguaiacol [4CG]	0.000002
3,4-dichlorophenol [34DCP]	0.000001	4,6-dichloroguaiacol [46CG]	0.000002
2,3-dichlorophenol [23DCP]	0.000001	4,5-dichloroguaiacol [45CG]	0.000002
3,5-dichlorophenol [35DCP]	0.000001	3,4,5-trichloroguaiacol [345TCG]	0.000002
2,3,4-trichlorophenol [234TCP]	0.000001	3,4,6-trichloroguaiacol [346TCG]	0.000002
2,3,5-trichlorophenol [235TCP]	0.000001	4,5,6-trichloroguaiacol [456TCG]	0.000002
2,3,6-trichlorophenol [236TCP]	0.000001	3,4,5,6-tetrachloroguaiacol [TETCG]	0.000002
2,4,5-trichlorophenol [245TCP]	0.000001	3-chlorocatechol [3CC]	0.000002
2,4,6-trichlorophenol [246TCP]	0.000001	4-chlorocatechol [4CC]	0.000002
3,4,5-trichlorophenol [345TCP]	0.000001	3,4-dichlorocatechol [34DCC]	0.000002
2,3,4,5-tetrachlorophenol [2345TCP]	0.000001	3,5-dichlorocatechol [35DCC]	0.000002
2,3,4,6-tetrachlorophenol [2346TCP]	0.000001	4,5-dichlorocatechol [45DCC]	0.000002
2,3,5,6-tetrachlorophenol [2356TCP]	0.000001	3,4,5-trichlorocatechol [345TCC]	0.000002
pentachlorophenol [PCP]	0.000001	3,4,5,6-tetrachlorocatechol [TETCC]	0.000002
3,4,5-trichlorosyringol [345TCS]	0.000002	4,5-Dichloroveratrole [45DCV]	0.000002
6-chlorovanillin [6CVAN]	0.000002	3,4,5-Trichloroveratrole [345TCV]	0.000002

Table 3 continued.

Chlorinated Phenolics, Adsorbable Organic Halides (AOX), Nonylphenol			
Parameter	MDL (mg/L)	Parameter	MDL (mg/L)
5,6-dichlorovanillin [56CVAN]	0.000002	Tetrachloroveratrole [TETCV]	0.000001
Adsorbable Organic Halides [AOX]	0.01	2-Chlorosyringaldehyde [2CSA]	0.000002
		2,6-Dichlorosyringaldehyde [26DCSA]	0.000002
Nonylphenol [NONPHE]	0.000005		

¹ The codes in parentheses refer to the abbreviations used in Figures 60-62 and the database.

Table 4. Resin and Fatty Acid Compounds Sampled on an Event Basis.¹

Resin Acids	MDL (mg/L)	Fatty Acids	MDL (mg/L)
Pimaric [PIM]	0.0005	Myristic [MYRIST]	0.0005
Sandaracopimaric [SANDPIM]	0.0005	Palmitic [PALM]	0.0005
Isopimaric [IPIM]	0.0005	Linolenic [LINOLENIC]	0.0005
Dehydroabietic [DHABIE]	0.0005	Linoleic [LINOLEIC]	0.0005
Abietic [ABIE]	0.0005	Stearic [STEARIC]	0.0005
Neoaabietic [NABIE]	0.0005	Oleic [OLEIC]	0.0005
12/14-Monochlorodehydroabietic [CDHABID]	0.0005	Arachidic [ARAACA]	0.0005
12/14-Dichlorodehydroabietic [DCHABIE]	0.0005	Behenic [BEHE]	0.0005
Palustric [PAUL]	0.0005	Lignoceric [LIGNO]	0.0005
Lauric [LAUR]	0.0005		

¹ The codes in parentheses refer to the abbreviations used in the database.

Table 5. Organochlorine Pesticides and Total PCBs Sampled on an Event Basis¹

COMPOUND	MDL (mg/L)	COMPOUND	MDL (mg/L)
Aldrin [ALDRIN]	0.000001	Endosulfan sulphate [ENDOSSULF]	0.000001
BHC alpha- [BHCa]	0.000001	Endrin [ENDRIN]	0.000005
BHC beta- [BHCb]	0.000001	Hexachlorobenzene [HCB]	0.000005
BHC delta- [BHCd]	0.000001	Heptachlor [HCHLOR]	0.000001
Chlordane alpha- [CHLORDa]	0.000005	Heptachlor epoxide [HCHLOREPOX]	0.000002
Chlordane gamma- [CHLORDg]	0.000005	Lindane BHC gamma- [LINDBHCg]	0.000001
DDE pp' [DDEpp]	0.000005	Methoxychlor [METHOXYCHLOR]	0.000001
DDD pp' [DDDpp]	0.000005	Mirex [MIREX]	0.000001
DDT pp' [DDTpp]	0.000005	Nonachlor trans- [NONACHLOR]	0.000005
DDT op' [DDTop]	0.000005	Oxychlordane [OXYCHLORDANE]	0.000005
Dieldrin [DIELD]	0.000005	Toxaphene [TOXAPHENE]	0.000005
Endosulfan I [ENDOS1]	0.000005		
Endosulfan II [ENDOS2]	0.000005	Total Polychlorinated Biphenyls [TOTPCB]	0.00002
2(Thiocyanomethylthio)Benzothiazole [TCMTB]: 0.005 mg/L			

¹ The codes in parentheses refer to the abbreviations used in the database.

Table 6. Polycyclic Aromatic Hydrocarbons Analysed in Slough Samples¹

PAH Compound	MDL (mg/L)	PAH Compound	MDL (mg/L)
Naphthalene [NAPHTH]	0.00001	Benzo(b+k)fluoranthene [BbkFLUOR]	0.00001
Acenaphthylene [ACENAPHTYLENE]	0.00001	Benzo(j)fluoranthene [BjFLUOR]	0.00001
Acenaphthene [ACENAPHTHENE]	0.00001	7,12-dimethylbenz (a)anthracene [DMaANTH]	0.00005
Fluorene [FLUOR]	0.00001	Benzo(a)pyrene [BaP]	0.00001
Phenanthrene [PHEN]	0.00001	3-methylcholanthrene [MCHOLANTH]	0.00002
Anthracene [ANTH]	0.00001	Indeno(1,2,3-c,d)pyrene [INDPYR]	0.00001
Total Low Molecular Weight PAHs [LPAH]	0.00001	Dibenz(a,h)anthracene [DBENZANTH]	0.00001
		Benzo(g,h,i)perylene [BghiPERY]	0.00002
Fluoranthene [FLUORANTH]	0.00001	Dibenzo(a,l)pyrene [DBaIIP]	0.00005
Pyrene [PYR]	0.00001	Dibenzo(a,i)pyrene [DBaiIP]	0.00005
Benzo(c)phenanthrene [BcPHEN]	0.00001	Dibenzo(a,h)pyrene [DBahP]	0.00005
Benz(a)anthracene [BaANTH]	0.00001	Total High Molecular Weight PAHs [HPAH]	0.00005
Chrysene [CHRY]	0.00001	Total PAH [TPAH]	0.00005

¹ The codes in parentheses refer to the abbreviations used in the database.

2.2.2 Phase II - Cross-Sectional Sampling at Main River Sites

Water samples collected at five cross-sectional stations at Oak Street Bridge in the North Arm, Tilbury Island in the Main Arm and Mission were analyzed for the same inorganic and metal parameters as those analysed during the Phase I program listed in Table 2.

2.2.3 Phase III - Water Quality in Sloughs

Slough samples collected during pre-freshet (low flow) were analyzed for physical and inorganic variables, including metals (Table 2), chlorophenolics, nonylphenol and AOX (Table 3) and resin and fatty acids, organochlorines, PCBs, and TCMTB (Tables 4 and 5).

In addition, samples were analyzed for individual polycyclic aromatic hydrocarbons compounds (PAHs), as listed in Table 6.

2.3 Quality Assurance

The quality assurance (QA) component of the monitoring program consisted of the following:

- collection of field replicates;
- preparation and analysis of method, bottle and field blanks;
- analysis of matrix spikes and standard reference materials; and,
- inter-laboratory analysis of field replicates.

The results of the replicate samples (inorganic and organic parameters) collected as part of the QA component are presented in Appendix IV. The complete database of all of the QA results are in a separate computer file, in spreadsheet format (Excel), at the FREMP office.

2.3.1 Field Replicates and Inter-laboratory Comparisons

Five field replicate samples for inorganic and metal parameters were collected from Oak Steet Bridge on January 25, 1993. On February 2, 1993 ten replicate samples were collected from Tilbury Island. Five of these samples were analyzed at the Environment Canada laboratories (North Vancouver, B.C. and Burlington, Ontario) for Inter-laboratory comparisons. In August 1993, six replicate samples were collected from all three river sites.

A limited number of field duplicate samples were also measured for selected organic parameters, as shown below in Table 7.

Table 7. Summary of Replicate Analyses for Organic Parameters

Date Sampled	Sample ID	Location	Parameters
January 25, 1993	FR0012	Mission	AOX
February 22, 1993	FR0045	Tilbury Island	Chlorinated phenolics
February 22, 1993	FR0050	Oak Street	Resin & Fatty Acids, Pesticides, PCBs
April 4, 1993	FR0072	Mission	AOX
May 17, 1993	FR0086	Oak Street	AOX, Resin & Fatty Acids, Pesticides, PCBs
October 19, 1993	FR0179	Oak Street	Chlorinated Phenolics

All replicates were submitted as blind samples (without identifying them as replicates) to the analytical laboratories. The field replicate inter-laboratory comparison data are presented in Appendix IV.

In general, there was good agreement between the replicate results for both the inorganic and organic variables (values of replicates were within the acceptable precision limits - 75%-125% at concentrations at or above 10 times the detection limit).

Overall agreement between laboratories was also acceptable, within 20% of the mean value. The inter-laboratory comparison did point out the need for lower detection limits for some metals. As a result, lower detection limits for arsenic, nickel, zinc and chromium were required for the remaining sampling periods (April, 1993 - March, 1994).

2.3.2 Field Blanks

Field blanks were incorporated into each sampling period. Sample bottles were filled with laboratory reagent water in the field, under conditions as close as possible to the real sampling conditions. The blanks were submitted as "blind" samples to the analytical laboratory.

No significant contamination problems were found through the field blank data. Some isolated instances of positive values for field blank variables were noted but these were close to the method detection limit.

2.3.3 Method Blanks

At least one method blank was analyzed with each batch of samples processed during the 15 month sampling period. A method or procedural blank is a control sample, in this case reagent water, that is carried through all procedural steps required for a specific analysis within the laboratory. The main value of a method blank is to identify the presence of contamination within the laboratory that may be introduced into the sample through contact with glassware, reagents or instrumentation.

In most cases, method blanks were below detection for inorganics and organics; exceptions were at or near the detection limit (MDL).

2.3.4 Bottle Blanks

Regular sample bottles destined for field use were selected at random and filled with reagent water in the laboratory. These bottle blanks were then set aside until the remainder of the batch of sample bottles returned from the field sampling program. The bottle blanks were then included in the analytical batch as routine samples. Bottle blanks were included periodically throughout the study for all bottle types, to verify the integrity of the sample containers.

The results for bottle blanks for this study were below the detection limit except for a few that were at or near the detection limit.

2.3.5 Spiked Samples

Samples were spiked for all variables of interest as part of the laboratory quality assurance program. Recoveries were determined as the known concentration of the spike minus the concentration found in the sample.

For most samples and compounds the recoveries were good, mainly between 80% and 120% for inorganics and between 60% and 140% for organics.

2.3.6 Standard Reference Materials

Standard Reference Materials (SRM) were provided by the U.S. National Institute of Standards and Technology (NIST) for metals (#1643c); by the Canada Centre for Inland Waters (CCIW) for major ions (CM ION 91); and by CCIW for trace metals (TM-21). The SRMs were analyzed three times during the monitoring program, and were included with

samples collected on January 29, 1993; August 10, 1993; and March 22, 1994. The August, 1993 and March, 1994 samples were submitted blind as samples FR0130 and FR0271 as part of the regular field samples. The sample analyzed in January, 1993 was part of the regular laboratory quality control program.

Results for the standard reference materials (SRMs) are presented in Table III-1 of Appendix III, along with the range of acceptable values at the 95% confidence level. The reporting laboratory provided results that, with few exceptions, were within the tolerances of the SRM. The analytical results for some parameters were slightly (<10%) outside the SRM. These included dissolved fluoride and chloride, arsenic, barium, chromium, iron, lead, magnesium, molybdenum and zinc.

2.3.7 Continuity of Analytical Procedures for Inorganic Variables

Beginning with the April 19, 1993 sampling period, inorganic parameters, including metals, were analyzed at Analytical Services Laboratory (ASL) rather than at Zenon Environmental Laboratories (Zenon). Care was taken to ensure that differences in analytical methodologies were minimal. Both laboratories maintain an extensive quality control program and participate in external quality assurance testing round-robins.

The data for inorganic variables collected before and after April, 1993 appeared to be consistent. Replicate samples (Appendix IV) and Standard Reference Materials (Table III-1, Appendix III) were analysed by both laboratories with similar results.

2.3.8 Continuity of Sampling Procedures for Slough Sampling

The procedure for collecting slough samples at depth was changed between the February, 1993 and the February, 1994 collection periods. In February, 1993, samples were collected by lowering sample bottles to within one metre of the bottom of the slough as quickly as possible while in February, 1994 samples were collected by lowering a submersible pump to a depth of one metre above slough bottom, pumping for several minutes to flush the lines and then filling sample bottles as required. Thus, the slough samples collected from one metre from the bottom in 1994 should be considered as representative of slough bottom conditions and those from the 1993 sampling period should be evaluated as composites over the entire water column.

2.3.9 Overall Data Quality

The quality of the data set is considered to be good. Method, bottle and field blanks were either below detection or at trace levels and no corrections were required. Results from the analyses of replicate data, spiked samples and standard reference materials were within acceptable values.

In some cases relatively high detection limits for some metals (a result of less than optimum analytical conditions) restricts the utility of the results since most of the values are below the MDL. For example, the detection limits for sodium and potassium (2 mg/L), cobalt (0.015 mg/L), and tin (0.3 mg/L) were not low enough, in many cases, to provide quantitative values of the variables for the entire study period.

2.4 Statistical Treatment of the Data

The data were incorporated into a single spreadsheet (Quattro Pro) by station and by date. Replicates sampled for quality assurance were not included in this analysis. Many of the parameters measured were below the method detection limit (MDL). In order to evaluate the data, in most cases the MDL was converted to an actual number; for example an MDL of <0.03 mg/L was incorporated into the database as a real value of 0.03 mg/L. The calculation of total PAHs in sloughs marked the exception whereby a non detected compound was given a value of zero. In the case of contaminants (which constituted most of the MDLs) this assumes a "worst case" scenario. As many parameters were not detected, the varying detection limits for inorganic parameters complicated the interpretation of results. The MDLs changed with the switch in analytical laboratories from Zenon to ASL after three months of data collection for the main channel and slough sites. The Hope data have different MDLs relative to the estuary sites, as do the replicate data analyzed at the Environment Canada laboratory in Burlington.

2.4.1 Phase I - Main River Sites

Differences Between Sites

To facilitate easy visual comparison of data among sites for this large dataset, an exploratory statistics approach was selected. The 95% confidence limit of the mean (C.L.) and the range (minimum and maximum value) are displayed graphically for each parameter and station. Sub-sets of the data (summer values only; see next page) were also treated in this manner.

This statistical presentation is similar to stem-leaf diagrams. The software calculates the 95% confidence interval (CI) of the mean which is plotted as a box, along with the range. The plot is similar to a t-test comparison of means. The t-test comparison of means uses a pooled standard deviation to determine the confidence intervals; the graphical method uses the

standard deviation for each set of data. In interpreting the graphs, the mean for each set of data is considered to be within the box and, if the boxes overlap, then the means can be considered not statistically different (at $p < 0.05$). If the two boxes do not overlap, the two means may be statistically different, and a multiple comparisons test would have to be employed to confirm the difference. Multiple comparisons were not employed in this analysis.

Summer Comparisons

There were significant differences for a number of variables between Mission and the downstream sites at Oak Street Bridge and Tilbury Island. This was believed to be largely attributable to the influence of seawater during low flows. While the sampling strategy was specifically designed to minimize this effect (by collecting samples only at the end of the larger of the two ebb tides on the sampling day), the influence of marine waters was still apparent.

To avoid the influence of seawater in testing for differences between the three sites, only those samples in which the specific conductivity was less than or equal to 200 $\mu\text{S}/\text{cm}$ were compared. This value was chosen since virtually all conductivity data from Hope fell between 100 $\mu\text{S}/\text{cm}$ and 200 $\mu\text{S}/\text{cm}$. The 200 $\mu\text{S}/\text{cm}$ cutoff corresponded to the sampling dates April 4 and September 21, 1993 and the results are referred to as "summer" values. This period also corresponds to higher river flows.

2.4.2 Phase II - Cross-Sectional Sampling at Main River Sites

As only one sample was collected at each station in the cross channel transect, an assessment of cross channel variability was made by examining the data for all sample dates (three days for Mission and four for Oak Street and Tilbury Island) together. Two methods of analysis were used: a parametric analysis for specific conductivity, calcium, nitrate/nitrite, and total iron; and, a non-parametric method for all parameters.

For the parametric analysis, data for each site (Mission, Oak Street, Tilbury Island) and date combination were normalized by determining the relative deviations from the mean value for the site on that day, in order to avoid the large differences in daily values due to the greater or lesser influence of sea water intrusion during different river flows. In this way, the mean concentration of each parameter at a site was set to 1, and the relative concentrations at each station were then determined. For each site/station combination, the 95% confidence interval of the mean was calculated and plotted. Overlap of the 95% confidence intervals implies no difference in mean values.

A non-parametric Kruskal-Wallis one way Analysis of Variance (ANOVA) was conducted for all parameters, by site. This analysis ranks the actual value of each parameter by station, then compares the rank sums at each site. The null hypothesis for this analysis is that there are no differences between stations in the cross-section.

2.4.3 Phase III - Water Quality in Sloughs

The low number of values (two from each depth), plus the different collection method for the bottom samples between the two dates (see Section 2.3.8), makes comparisons between surface and bottom waters, or between sloughs, difficult. Thus, the results from the four samples are plotted as the mean and range for each parameter, by slough, and then compared to water quality criteria and guidelines.

2.5 Water Quality Guidelines, Criteria and Objectives

Water quality guidelines and criteria for fresh and marine waters have been recommended by federal agencies (CCREM, 1987) and the provincial Ministry of Environment, Lands and Parks (BCMOELP, 1994), respectively, for the protection of aquatic biota. Generally, the two jurisdictions are in close agreement with each other, and with criteria from other countries (e.g., U.S. EPA, 1986a). In addition, the BC Ministry of Environment, Lands and Parks has set specific provisional objectives for the lower Fraser River (below Kanaka Creek) for a number of selected parameters (Swain and Holms, 1985). These latter objectives are currently under review by provincial and federal agencies (Swain, *et al.*, 1995). Table 8 summarizes the guidelines, criteria and objectives from these three sources for the parameters measured in this study.

**Table 8. Summary of Water Quality Guidelines, Criteria and Objectives
For the Protection of Aquatic Life, Applicable to the Fraser River**

PARAMETER	BCMOELP CRITERIA	CCREM GUIDELINES	FRASER R. OBJECTIVES
Dissolved Oxygen	6.5-9.0 mg/L	6.5-9.5 mg/L	7.75 mg/L (min)
pH	6.5-9.0	6.5 - 9.0	6.5 - 8.5
Temperature	1 °C change from natural levels 22-24 °C max for salmonids	maximum weekly average temperature cannot be exceeded (page 3-40)	na
Suspended Solids (Non-filterable Residue, NFR)	na	increase of 10.0 mg/L or 10% above background (sus. solids >100.0 mg/L)	10 mg/L or 10% (max. increase)
Hardness (mg/L as Alkalinity)	na	na	na
Ammonia-Nitrogen (NH ₄ -N) (pH and temperature dependent)	1.13 mg/L (ave) 5.86 mg/L (max) pH=8.0, T=10°C (page 22-23)	1.37 mg/L (pH 8.0, temp. 10 °C)	0.03 mg/L (max) 0.007 mg/L (ave) (unionized)
Total Phosphorus (Tot.-P)	5 -15 µg/L (lakes only)	na	na
Aluminum (Al)	0.1 mg/L (max) 0.05 mg/L (30 d ave) Dissolved; at pH ≥ 6.5	0.005-0.1 mg/L (Total)	na
Arsenic (As)	50 µg/L	50 µg/L	na
Barium (Ba)	1 mg/L (30 day ave) 5 mg/L (max)	na	na
Cadmium (Cd) (Total)	0.2 µg/L (hardness <60 mg/L) 0.8 µg/L (hardness >60 mg/L)	0.2 µg/L (hardness <60 mg/L) 0.8 µg/L (hardness >60 mg/L)	na
Chromium (Cr) (Total)	20 µg/L (max for fish)	2 - 20 µg/L (for fish)	na
Cobalt (Co) (Total)	50 µg/L	na	na
Copper (Cu) (Total)	≤ 2 µg/L (30 d ave) hardness is ≤ 50 mg/L CaCO ₃ [0.094(hardness)+2] (max) (Hardness as mg/L CaCO ₃)	2 µg/L (hardness 0-120)	<4 µg/L (ave) 6 µg/L (max)
Fluoride	0.2 mg/L (max) (hardness <50 mg/L) 0.3 mg/L (max) (hardness >50 mg/L)	na	na
Iron (Fe) (Total)	0.3 mg/L (max)	0.3 mg/L	na
Lead (Pb) (Total)	5 µg/L (30 d ave) 34 µg/L (max) (Hardness <50 mg/L CaCO ₃)	1 µg/L	<3 µg/L (ave) 10 µg/L (max)
Manganese (Mn) (Total)	100-1000 µg/L	na	na

Table 8 continued.

PARAMETER	BCMOELP CRITERIA	CCREM GUIDELINES	FRASER R. OBJECTIVES
Mercury (Hg) (Total)	0.02 µg/L (30 d ave) 0.1 µg/L (max)	0.1 µg/L	na
Molybdenum (Mo) (Total)	≤ 1 mg/L (30 d ave) 2 mg/L (max)	na	na
Nickel (Ni) (Total)	25 µg/L (max) (hardness 0-60 mg/L CaCO ₃)	25 µg/L	na
Selenium (Se) (Total)	1 µg/L (max)	1 µg/L	na
Silver (Ag) (Total)	0.1 µg/L (max)	0.1 µg/L	na
Sulphate	100 mg/L	na	na
Tin (Sn)	na	na	na
Zinc (Zn) (Total)	30 µg/L (max)	30 µg/L	<50 µg/L (ave) 100 µg/L (max)
Fecal Coliforms	na	na	<1000 FC/100 mL (geo. mean) 4000 FC/100 mL (max)
Total Organic Carbon (TOC)	na	na	na
Total Residual Chlorine	2 µg/L (ave) 100 µg/L (max)	2.0 µg/L	2.0 µg/L (max)
Chlorophenols	mono: 0.5-0.9 µg/L di: 0.12-0.9 µg/L tri: 0.06 - 0.32 µg/L tetra: 0.02 - 0.30 µg/L penta: 0.10 - 0.30 µg/L	mono - 7 µg/L di - 0.2 µg/L tri - 18 µg/L tetra - 1 µg/L penta - 0.5 µg/L	0.2 µg/L (max) (sum of tri, tetra and penta)
Resin and Fatty Acids	52 µg/L (max) (pH 8.0) (total resin acids)	na	na
Polycyclic Aromatic Hydrocarbons (PAH)	naphthalene 1 µg/L (marine) acenaphthene 6 µg/L (marine) fluorene 12 µg/L (marine) chrysene 0.1 µg/L (marine) benzo(a)pyrene 0.01 µg/L (marine) pyrene 0.02 µg/L (freshwater) phenanthrene 0.3 µg/L (freshwater)	na	na (being proposed)
Total Polychlorinated Biphenyls (PCBs)	0.00001 mg/L (marine) 0.000001 mg/L (freshwater)	1 ng/L	na
Organochlorine Pesticides	na	hexachlorobenzene 0.0065 µg/L	na
Adsorbable Organic Halides (AOX)	na	na	na

3.0 RESULTS AND DISCUSSION - MAIN RIVER SITES

Analytical results for the three main river sites over the fifteen month sampling period are presented in chronological order, by site, in Appendix VII (Mission), VIII (Tilbury Island) and IX (Oak Street Bridge). Table 9 summarizes all of the data for the three study sites as well as the data from the federal/provincial water quality monitoring program site at Hope. On four occasions when samples were collected across a cross-section only the one measurement from mid-channel at each site was used to determine these statistics. The 10th, 50th and 90th percentile and the range (minimum and maximum values) are presented.

3.1 Cross-Sectional Profiles

The data for the cross-sectional profiles are tabulated in Appendix V.

For the parametric analysis (i.e. for specific conductivity, calcium, nitrate/nitrite, and total iron) the 95% confidence interval of the mean for each site/station combination was calculated and plotted in Figures 2 to 5. This analysis shows that for the four parameters selected, there was no consistent statistical difference between stations across the river at any of the three main sites.

The non-parametric Kruskal-Wallis one way ANOVA indicated that for all parameters and sites, there was no significant difference among stations in the cross section. The results of this analysis are shown at the end of Appendix V. The probability that stations in a cross-section are the same at one site generally ranged from 80 to 100%; the lowest probability was 31% at Tilbury, for zinc.

Both the parametric analysis on selected parameters and the non-parametric analysis on all parameters indicate that there were no significant differences between stations at any site for the three or four times the profiles were sampled. One conclusion that may be made is that samples collected at the mid-channel station can be considered representative of the river.

These results are largely due to the fact that the variation in station differences across the river can be large and may result in apparent cross-channel differences at any particular time.

The data from this project indicate that apparent cross-channel differences should be treated with caution, and should be supported with replication of samples at all stations. In the present data set, for some parameters, there was an appearance of higher (or lower) concentrations near the shores on some sampling dates; these apparent differences were not present on other dates.

**Table 9. Summary Data for FREMP Main River Monitoring Sites
and Federal-Provincial Site at Hope**

Parameter	Code	Units	Hope					Mission				
			Minimum	10th %ile	50th %ile	90th %ile	Maximum	Minimum	10th %ile	50th %ile	90th %ile	Maximum
Dissolved oxygen	DO	mg/L						8.8	9.2	11.0	12.9	13.8
pH	PH							7.2	7.4	7.6	7.7	7.9
Water temperature	WT	degrees C						1.0	2.4	7.0	17.6	18.9
Filterable residue	FR	mg/L						45	54	71	87	91
Non-filterable residue	NFR	mg/L						1	4	15	59	377
Specific conductivity	SC	us/cm	100	109	136	164	172	93	102	120	139	146
Alkalinity	ALK	mg CaCO3/L	41	44	55	65	66	38	42	48	54	58
Hardness	HARD	mg CaCO3/L	46	51	62	73	77	40	48	56	62	82
Calcium	CA	mg/L	1.4	16	18	22	22	12	14	16	18	19
Potassium	K	mg/L	0.60	0.69	0.80	0.93	1.03	0.75	0.98	<2.00	<2.00	<2.00
Magnesium	MG	mg/L	2.6	3.0	4.2	5.2	5.3	2.7	3.0	3.8	4.2	5.1
Sodium	NA	mg/L	1.6	2.0	3.2	5.0	5.7	<2.0	2.2	3.3	4.1	4.3
Chloride, dissolved	DCL	mg/L	0.6	0.7	1.4	2.2	2.4	0.7	1.0	1.7	2.3	2.6
Fluoride, dissolved	DF	mg/L	0.03	0.04	0.05	0.06	0.07	0.03	0.04	0.04	<1	<1
Sulphate	SO4	mg/L	5.8	6.8	9.1	12.9	15.0	5.8	7.0	9.9	12.7	14.4
Ammonia, dissolved	DNH4	mg N/L						<0.005	<0.005	0.018	0.032	0.043
Nitrate/nitrite, dissolved	DNO3NO2	mg N/L	0.01	0.03	0.10	0.15	0.18	0.02	0.03	0.13	0.18	0.32
Nitrogen, total	TOTN	mg N/L	0.06	0.10	0.18	0.28	0.73	<0.04	0.12	0.18	0.27	0.75
Phosphorous, dissolved	DP	mg P/L						0.002	0.004	0.010	0.029	0.066
Phosphorous, total	TP	mg P/L	0.01	0.02	0.03	0.18	0.30	0.01	0.02	0.03	0.11	0.48
Silver	AG	mg/L						<0.0001	<0.0001	<0.0001	<0.03	<0.03
Aluminum	AL	mg/L	0.05	0.2	0.4	3.3	5.8	0.1	<0.2	0.3	0.8	5.6
Arsenic	AS	mg/L	0.0002	0.0004	0.0005	0.0015	0.0026	0.0003	0.0003	0.0005	<0.001	0.0017
Barium	BA	mg/L	0.015	0.016	0.019	0.048	0.083	0.013	0.015	0.018	0.026	0.085
Cadmium	CD	mg/L	<0.0001	<0.0001	0.0002	0.0007	0.0012	<0.0001	<0.0001	<0.0002	<0.0002	0.0011
Cobalt	CO	mg/L	0.0001	0.0001	0.0004	0.003	0.005	<0.0004	<0.004	<0.015	<0.015	<0.015
Chromium	CR	mg/L	0.0003	0.0005	0.001	0.005	0.012	<0.001	<0.001	<0.001	0.011	0.011
Copper	CU	mg/L	0.0004	0.001	0.002	0.006	0.011	<0.001	<0.001	0.001	0.008	0.012
Iron	FE	mg/L	0.08	0.21	0.58	4.96	9.53	0.05	0.14	0.30	0.94	9.22
Mercury	HG	mg/L	<0.000005	<0.000005	<0.000005	7.E-06	1.E-05	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Manganese	MN	mg/L	0.008	0.01	0.02	0.11	0.21	0.01	0.01	0.02	0.05	0.29
Molybdenum	MO	mg/L	0.0004	0.0004	0.0006	0.0008	0.0009	<0.001	<0.001	<0.001	<0.004	<0.004
Nickel	NI	mg/L	0.0004	0.0007	0.0014	0.0076	0.0151	<0.001	<0.001	<0.001	<0.005	0.015
Lead	PB	mg/L	<0.0002	<0.0002	0.0011	0.0028	0.0050	<0.0001	<0.0001	<0.0001	<0.003	0.003
Selenium	SE	mg/L	<0.0001	<0.0001	0.0001	0.0002	0.0012	<0.0005	<0.0005	<0.0005	<0.03	<0.03
Tin	SN	mg/L						<0.02	<0.02	<0.3	<0.3	<0.3
Zinc	ZN	mg/L	0.0009	0.002	0.003	0.013	0.024	<0.001	<0.001	0.005	0.011	0.070
Absorbable organic halides	AOX	mg/L	0.01	0.01	0.03	0.05	0.07	<0.01	<0.01	0.02	0.0355	0.04
Fecal coliform	FC	MPN/100 mL						<2	11	50	340	800
Total organic carbon	TOC	mg C/L						1.0	2.0	2.5	3.5	5.1

Table 9 continued.

Parameter	Code	Units	Oak Street					Tilbury				
			Minimum	10th %ile	50th %ile	90th %ile	Maximum	Minimum	10th %ile	50th %ile	90th %ile	Maximum
Dissolved oxygen	DO	mg/L	8.4	9.1	10.8	12.1	12.4	8.8	9.1	10.8	12.3	12.8
pH	PH		6.9	7.1	7.4	7.6	7.7	7.0	7.3	7.5	7.8	7.9
Water temperature	WT	degrees C	2.2	4.2	9.3	18.2	19.0	2.0	3.0	8.1	17.3	19.0
Filterable residue	FR	mg/L	43	50	85	2598	3830	44	54	99	1818	2400
Non-filterable residue	NFR	mg/L	6	10	28	63	224	6	9	35	83	685
Specific conductivity	SC	uS/cm	71	98	155	4679	6360	89	104	150	2954	4090
Alkalinity	ALK	mg CaCO3/L	33	35	43	50	59	37	38	45	50	56
Hardness	HARD	mg CaCO3/L	40	44	55	510	634	44	48	59	304	394
Calcium	CA	mg/L	11	12	15	44	54	12	13	16	28	39
Potassium	K	mg/L	<2.00	<2.00	<2.00	27.26	33.00	1.10	<2.00	<2.00	16.65	21.40
Magnesium	MG	mg/L	2.4	2.7	4.3	96.7	121.0	2.8	3.0	4.5	57.2	75.3
Sodium	NA	mg/L	2.1	2.5	12.1	734.5	909.0	<2.0	2.5	7.7	441.0	577.0
Chloride, dissolved	DCL	mg/L	1.1	1.5	16.5	1380.0	1920.0	0.6	1.3	9.3	846.0	1170.0
Fluoride, dissolved	DF	mg/L	0.03	0.03	0.04	0.12	0.16	0.03	0.03	0.04	0.10	0.21
Sulphate	SO4	mg/L	5.8	6.8	10.8	195.3	315.0	5.7	6.7	11.2	120.3	166.0
Ammonia, dissolved	DNH4	mg N/L	<0.005	<0.005	0.036	0.059	0.089	<0.005	0.007	0.029	0.069	0.096
Nitrate/nitrite, dissolved	DNO3NO2	mg N/L	0.03	0.04	0.13	0.24	0.36	0.03	0.03	0.16	0.26	0.34
Nitrogen, total	TOTN	mg N/L	0.10	0.15	0.21	0.40	0.40	<0.05	0.15	0.23	0.42	0.73
Phosphorous, dissolved	DP	mg P/L	0.001	0.007	0.017	0.033	0.040	0.002	0.007	0.016	0.028	0.122
Phosphorous, total	TP	mg P/L	0.02	0.03	0.05	0.12	0.23	0.02	0.03	0.05	0.10	0.77
Silver	AG	mg/L	<0.0001	<0.0001	<0.0001	<0.03	<0.03	<0.0001	<0.0001	<0.0001	<0.03	<0.03
Aluminum	AL	mg/L	0.1	<0.2	0.3	0.6	3.4	<0.2	<0.2	0.4	1.0	8.4
Arsenic	AS	mg/L	0.0003	0.0004	0.0005	0.0010	0.0013	0.0003	0.0003	0.0005	0.0010	0.0035
Barium	BA	mg/L	0.013	0.014	0.017	0.022	0.051	0.011	0.013	0.018	0.028	0.200
Cadmium	CD	mg/L	<0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0001	<0.0001	<0.0002	<0.0002	0.0002
Cobalt	CO	mg/L	<0.004	<0.004	<0.015	<0.015	<0.015	<0.004	<0.004	<0.015	<0.015	<0.015
Chromium	CR	mg/L	<0.001	<0.001	<0.001	<0.005	0.007	<0.001	<0.001	<0.001	0.002	0.018
Copper	CU	mg/L	<0.001	<0.001	0.002	0.004	0.008	<0.001	<0.001	0.002	0.005	0.016
Iron	FE	mg/L	0.14	0.18	0.47	0.86	5.48	0.11	0.18	0.51	1.42	13.70
Mercury	HG	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Manganese	MN	mg/L	0.02	0.02	0.03	0.05	0.17	0.01	0.01	0.03	0.05	0.12
Molybdenum	MO	mg/L	<0.001	<0.001	<0.001	<0.004	<0.004	<0.001	<0.001	<0.001	<0.004	0.005
Nickel	NI	mg/L	<0.001	<0.001	0.001	0.005	0.017	<0.001	<0.001	0.002	<0.005	0.023
Lead	PB	mg/L	<0.001	<0.001	<0.001	<0.003	<0.003	<0.001	<0.001	<0.001	<0.003	<0.005
Selenium	SE	mg/L	<0.0005	<0.0005	<0.0005	<0.03	<0.03	<0.0005	<0.0005	<0.0005	<0.03	<0.03
Tin	SN	mg/L	<0.02	<0.02	<0.3	<0.3	<0.3	<0.02	<0.02	<0.3	<0.3	<0.3
Zinc	ZN	mg/L	<0.001	<0.001	0.005	0.014	0.090	<0.001	<0.001	0.005	0.021	0.070
Absorbable organic halides	AOX	mg/L	<0.01	0.01	0.02	0.03	0.04	<0.01	<0.01	0.02	0.03	0.04
Fecal coliform	FC	MPN/100 mL	14	30	800	8000	17000	<2	29	500	8300	11000
Total organic carbon	TOC	mg C/L	1.0	1.9	2.4	3.5	4.9	1.0	1.8	2.5	3.9	5.0

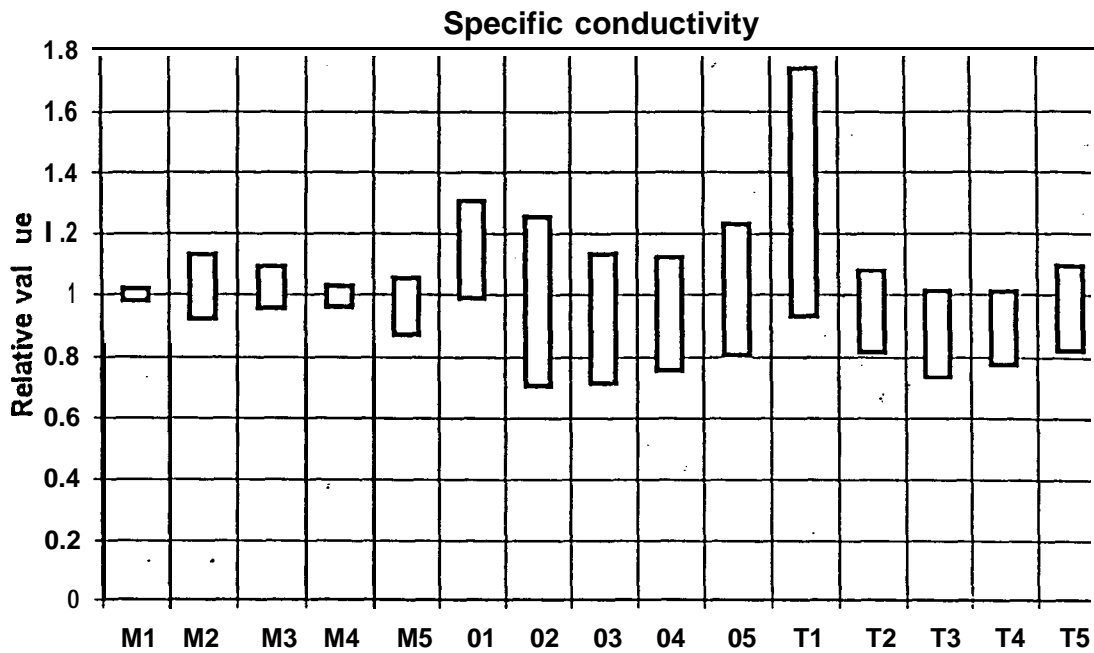


Figure 2. Comparison of Cross-Sectional Data for Specific Conductivity. The box is the 95% confidence limit of the mean, normalized to 1; M=Mission, O=Oak Street Bridge, T=Tilbury Island

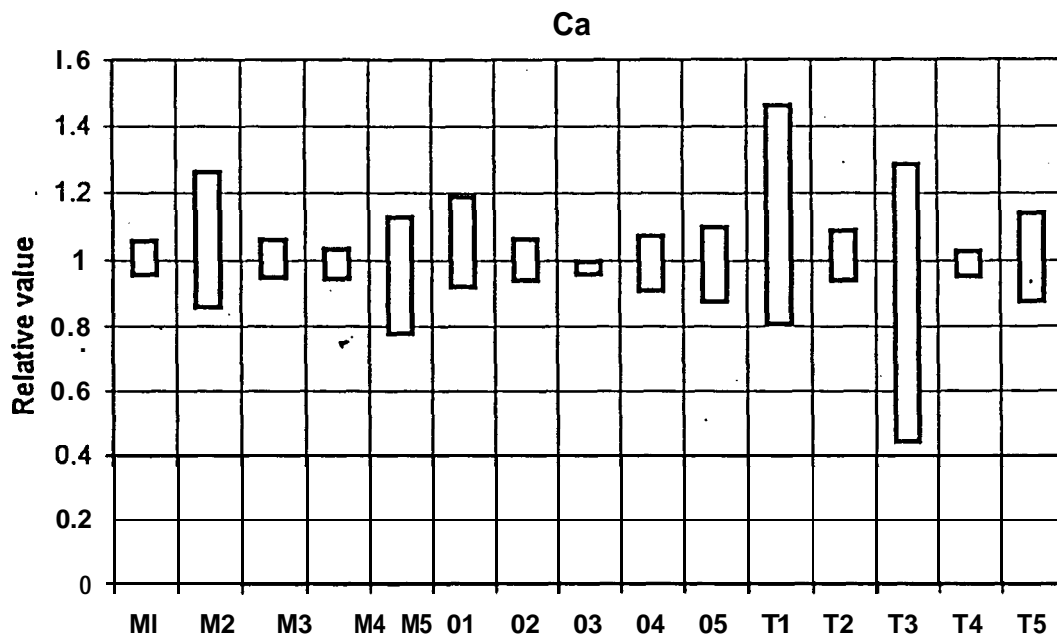


Figure 3. Comparison of Cross-Sectional Data for Calcium. The box is the 95% confidence limit of the mean, normalized to 1; M=Mission, O=Oak Street Bridge, T=Tilbury Island

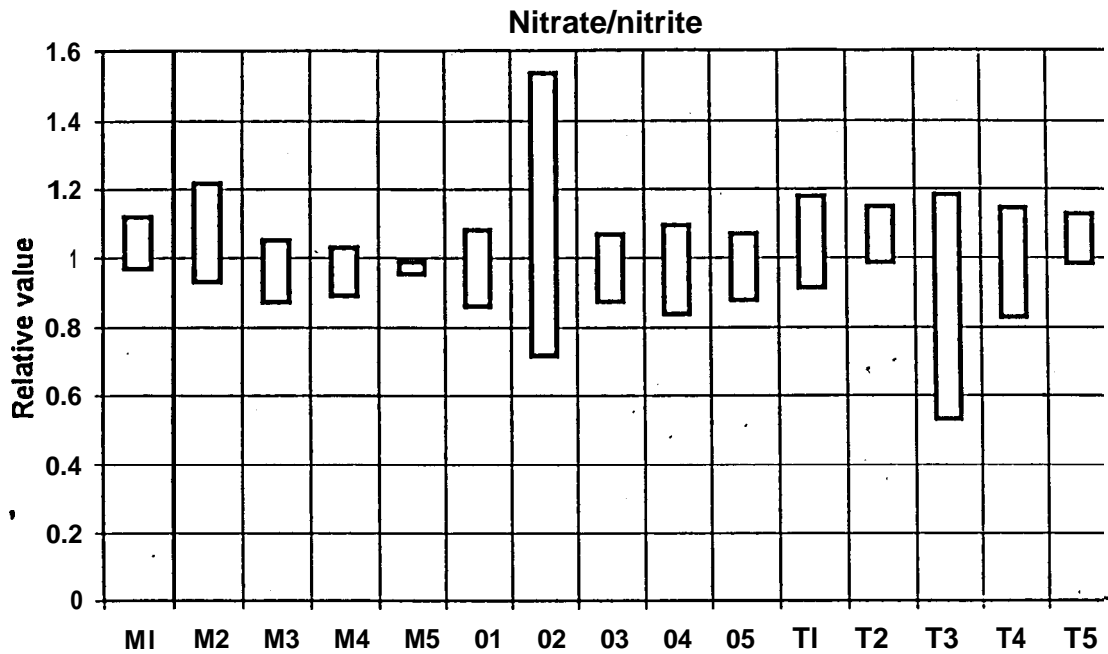


Figure 4. Comparison of Cross-Sectional Data for Nitrite/Nitrate
 The box is the 95% confidence limit of the mean, normalized to 1;
 M=Mission, O=Oak Street Bridge, T=Tilbury Island

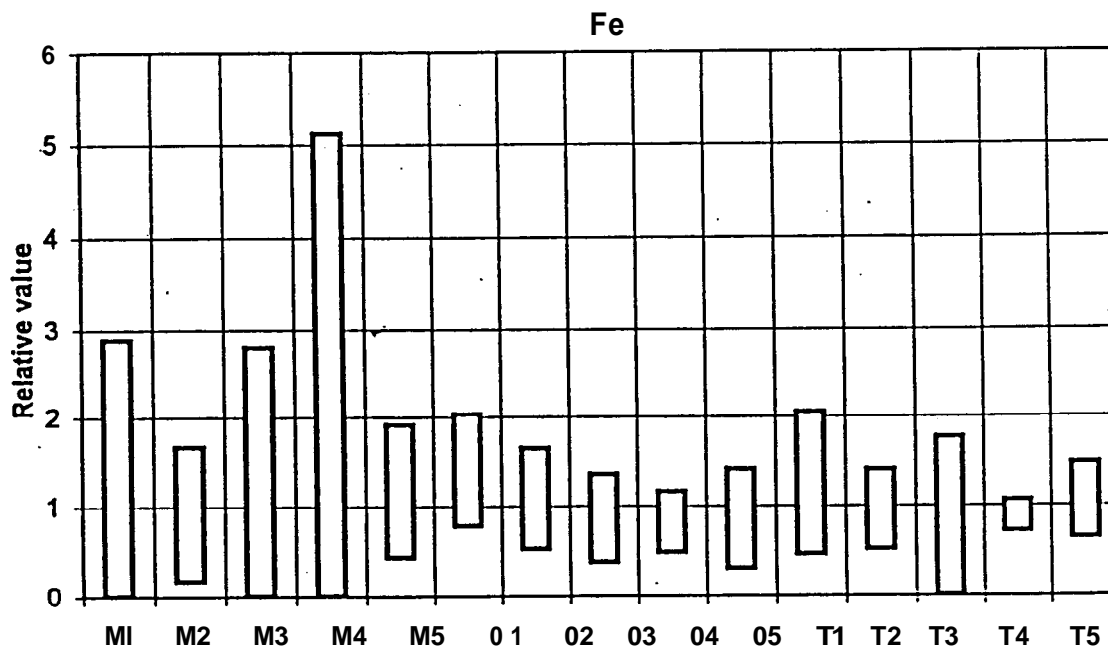


Figure 5. Comparison of Cross-Sectional Data for Iron
 The box is the 95% confidence limit of the mean, normalized to 1;
 M=Mission, O=Oak Street Bridge, T=Tilbury Island

3.2 Factors Influencing Water Quality

3.2.1 Flow

The flow (discharge) of the Fraser River varies significantly throughout the year. It begins to increase in April and peaks generally in May to June as the snow pack in the watershed melts. The flow then gradually decreases to winter minimum rates between December and March.

Figure 6 shows the historical mean flow of the Fraser River, as well as the measured flow on the study sampling dates, as measured at Hope. A comparison of the historical flow data at Mission with flows at Hope showed that the former is much greater, particularly during low flow periods, because of the contribution from tributaries entering the Fraser River below Hope (Environment Canada, 1991a). For example, during low flow (January to March) the discharge at Mission is 1.5 to 1.7 times the discharge at Hope; during high flow (May and June) the discharge at Mission is only 1.1 times the discharge at Hope (Figures 7 and 8).

The increase in flow during spring peak periods tends to dilute dissolved constituents in the river because the snow melt is typically much lower in dissolved ions than water from groundwater sources. The increase in flow also coincides with an increase in particulate material as the river bottom and banks are eroded. Constituents associated with particulates, such as total iron or total phosphorus, tend to increase with increasing flow.

3.2.2 Tides and Seawater Intrusion

During the rising (flood) tide, seawater from the Strait of Georgia moves up the river channels. Since seawater is significantly denser than freshwater, it forms a wedge along the bottom as it moves up the channels. This wedge is flushed out during the falling (ebb) tide, the degree of which depends on both flow and tidal conditions. At low flow and high tide, saline water may penetrate the Main Arm of the river as far as New Westminster. During freshet, however, the salt wedge does not move much further upstream than Steveston. The much shallower depths in the North Arm prevents the salt wedge from moving as far upstream as it does in the Main Arm. Marine waters do not reach as far upstream as Mission although during low flow periods the tides can affect both the water level and river velocity.

The mixing of marine and river water in the estuarine environment causes unique conditions that are reflected in water quality monitoring results, especially in the dissolved ion concentration. This effect is most pronounced during low flow periods.

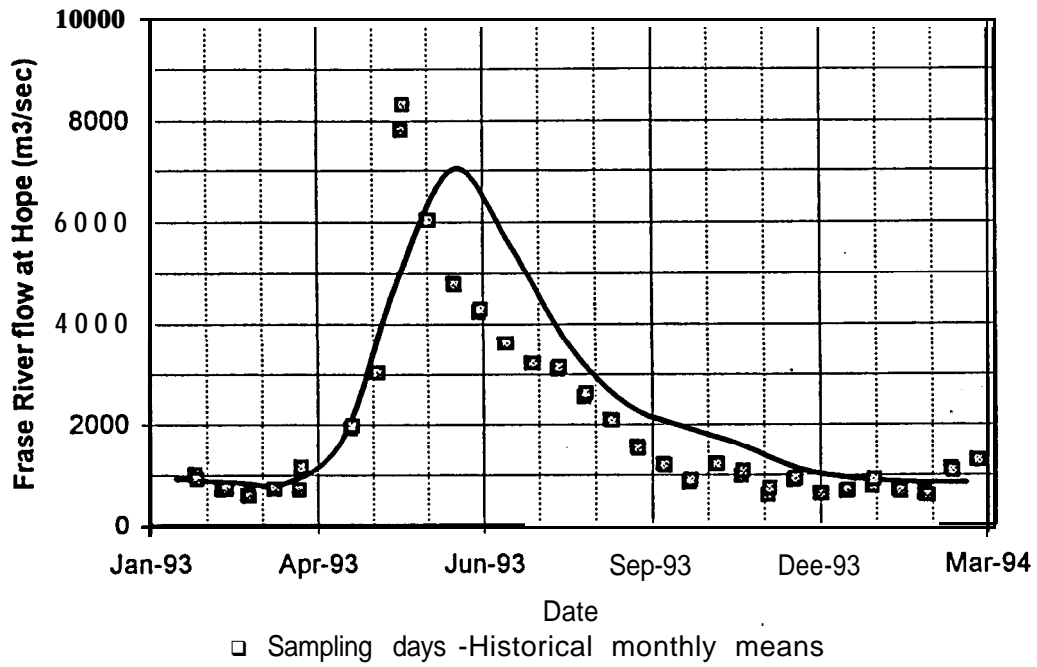


Figure 6. Fraser River Flow at Hope

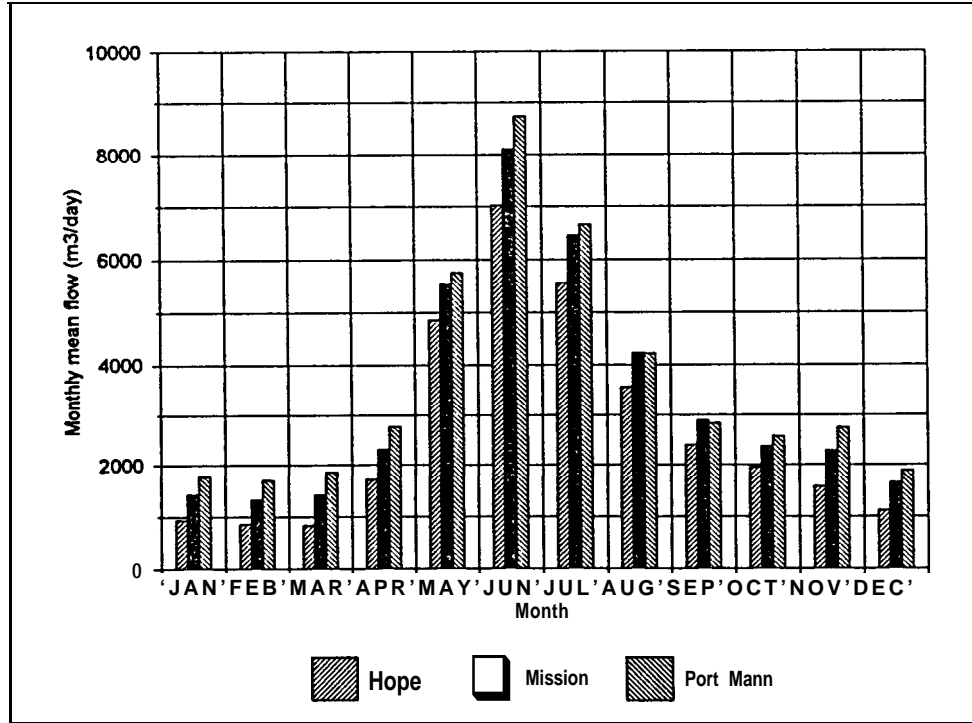


Figure 7. Comparison of Fraser River Flow at Hope, Mission and Port Mann

3.2.3 Seasonal Factors

While the most significant influence on water quality in the Fraser River estuary appears to be the interaction between river flow and seawater intrusion, the time of year can also affect some parameters. For example, as water temperature increases during the summer the dissolved oxygen concentration decreases; the proportion of unionized ammonia also increases with higher temperatures. The uptake by plants of nutrients such as nitrogen and phosphorus is also greater during the summer period.

3.2.4 Tributaries and Runoff

Tributaries and storm water runoff can add significant amounts of contaminants to the Fraser River. Some of the storm water outlets are combined storm water/sewage overflows, which discharge a mixture of sewage and runoff water during extreme rainfall events. Receiving water data on tributaries have been summarized by Swain *et al.* (1995). Potential contaminants from storm water runoff were also discussed in this report.

Daily rainfall data from Vancouver International Airport for the period January, 1993 to March, 1994 are presented in Figure 9. There is no strong seasonal pattern to the data; high rainfall events (>10 mm/day) occurred at least once for most months of the study period. It is known that there are considerable differences in precipitation within the study area and total runoff volume to the Fraser River will vary accordingly.

Swain *et al.*, (1995) estimated potential increases in the main river of 13.5 mg/L suspended solids, 1300 fecal coliforms/100 mL, 4 µg/L copper, 16 µg/L lead and 16 µg/L zinc from stormwater runoff, a calculation based on typical concentrations in storm water, mean monthly runoff discharges to the river ($3 \times 10^8 \text{ m}^3$) and low river flows ($1200 \text{ m}^3/\text{s}$).

3.2.5 Municipal and Industrial Discharges

There are a number of discharges to the Fraser River authorized under the Waste Management Act. A summary of effluent and adjacent receiving water data is presented in Moore (1993) and in Swain *et al.* (1995). A detailed effluent characterization study of eleven Lower Fraser River industrial discharges was conducted by McDevitt *et al.*, (1994).

Generally, the effluents are within compliance with their permitted discharge limits. Outside the initial dilution zone, the concentration of most parameters was comparable to "control" station levels or background concentrations. Higher values for some parameters, most often fecal coliforms and suspended solids, were reported downstream from wastewater treatment plants (WWTPs).

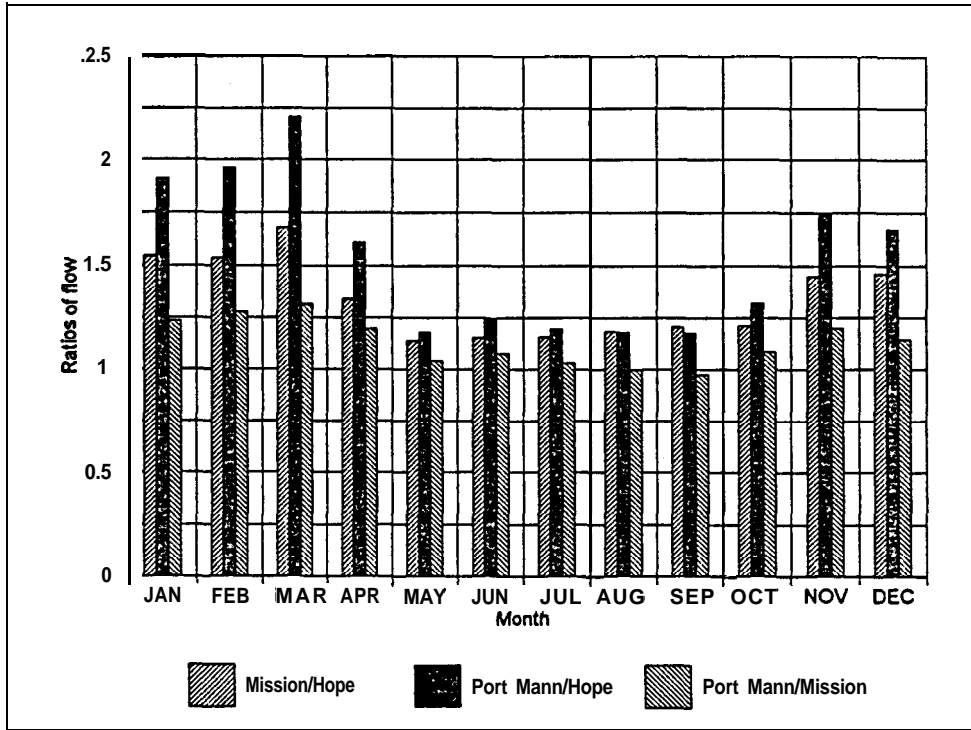


Figure 8. Ratio of Fraser River Flows: Mission/Hope; Port Mann Hope; Port Mann/Mission.

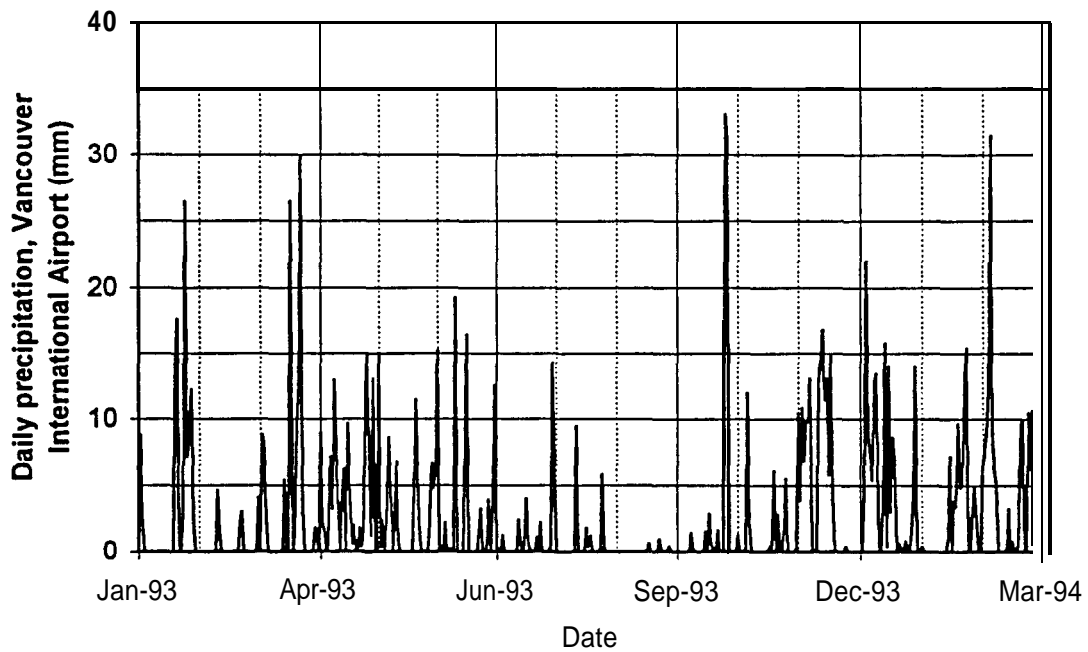


Figure 9. Daily Precipitation, Vancouver Airport

Wastewater treatment plants discharge to the Fraser River approximately 91% (990,000 m³/day) of the total effluent that is discharged under a BCMOELP permit; the remainder is from industrial discharges. In the Main Stem of the Fraser River there are WWTPs located at Mission (45,000 m³/d), Langley near Abbotsford (7,500 m³/d) and Langley near Barnston Island (4,215 m³/d). The Annacis Island WWTP and Lulu Island WWTP discharge 370,000 m³/d and 52,000 m³/d respectively, to the Main Arm of the river. Flow rates from all WWTPs have increased about 20% between 1985 and 1992 (Moore, 1993).

Industrial discharges were estimated to be about 9% of the total effluent (94,000 m³/d) and loadings for most chemical contaminants were less than is contributed by WWTPs. Loadings from some parameters (suspended solids, volatile suspended solids, dissolved manganese, BOD and oil & grease) were higher in industrial effluents compared to individual WWTPs such as Lulu Island. Overall, the total volume of industrial discharges has decreased by about 36% between 1997 and 1992 and the total loading of many of the individual parameters has also decreased (Moore, 1993). However, oil & grease, BOD, suspended solids, phenols, aluminium, chromium and vanadium loadings have increased during this period.

In a survey of eleven industrial effluents (McDevitt, *et al.*, 1994) PAHs, dioxins, furans, resin and fatty acids and chlorinated phenolics were at very low or undetectable concentrations. Some metals, particularly copper, iron, lead and zinc were found in effluent samples at concentrations that might have an adverse effect on bioassay organisms. A concurrent study (Norecol, Dames & Moore, Inc., 1994) looked at the impact within the initial dilution zone of ten of these industries. The study reported elevated levels of pentachlorophenol in the sediments downstream of three wood-processing industries although the concentrations were lower than those measured at many other sites in the estuary over the past decade. Some PAH compounds were present in the sediments downstream of three discharges but the levels were similar to other sites in the estuary. Except for acenaphthene in a single sample, PAH levels were below MOELP sediment objectives set for Burrard Inlet (although these objectives are not officially applicable to the Fraser River estuary).

3.3 Physical Properties

3.3.1 Water Temperature

There were no significant differences in water temperature between the three main sites at Mission (Main Stem), Tilbury Island (Main Arm) or Oak Street Bridge (North Arm) when all of the data, or the "summer only" data, were compared (Figure 10). Water temperature showed the expected seasonal changes with maxima (18-19 °C) during July-August and minima (0.9-2.2 °C) in January-February (Figure 11).

3.3.2 Dissolved Oxygen

There was also no significant difference in dissolved oxygen levels between the three sites (Figure 12), either for the entire database or for the "summer only" values. All measurements were above the minimum criterion of 6.5 mg/L.

The seasonal pattern for dissolved oxygen was the "mirror-image" to that of water temperature reflecting the fact that the solubility of oxygen in water decreases with increasing temperature (Figure 13). However, the percent saturation for dissolved oxygen was greater than 90% for all samples indicating that there are few oxygen-reducing substances present.

Drinnan and Clark (1980) reported lower overall oxygen values for the North Arm compared to the Main Arm of the Fraser River and both areas in turn were lower when compared to upstream measurements, although all measurements were still well above minimum objectives (median concentration >9.5 mg/L). Similar results were reported in a review of ambient receiving water data for the Fraser River between Hope and the estuary (Swain *et al.*, 1995).

3.3.3 pH and alkalinity

The pH at the Oak Street Bridge site was significantly lower than the other two sites, for all data, but not with the "summer only" data (Figure 14). A lower pH reflects an increase in average hydrogen ion concentration possibly due to more acidic discharges from industry or storm drains in the North Arm. However, all measurements were within the objective of 6.5-8.5 pH units (Fraser River objective, Swain and Holms, 1985) or the water quality guidelines of 6.5-9.0 pH units (CCREM,1987; BC MOELP,1994). A median pH of 7.0 to 8.0 was reported for the period 1970-1978 (Drinnan and Clark, 1980) and similar results were reported in Swain *et al.*, (1995).

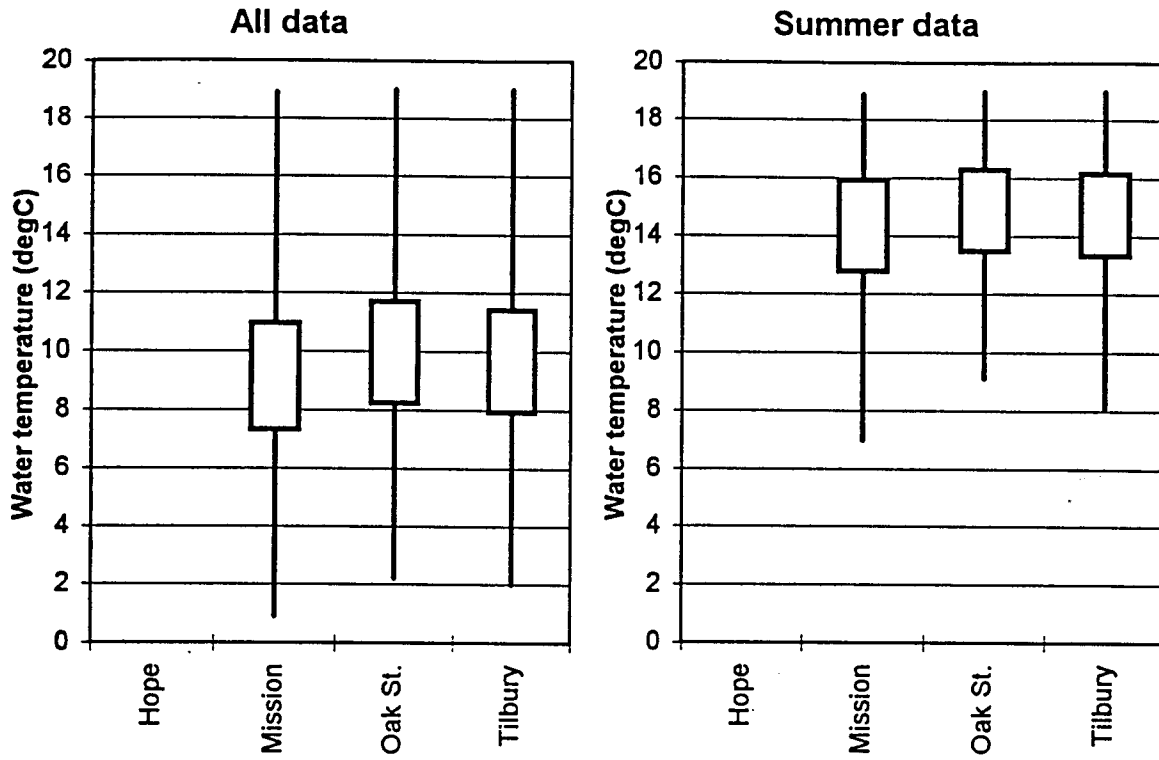


Figure 10. Summary of Water Temperature Data, Main River Sites

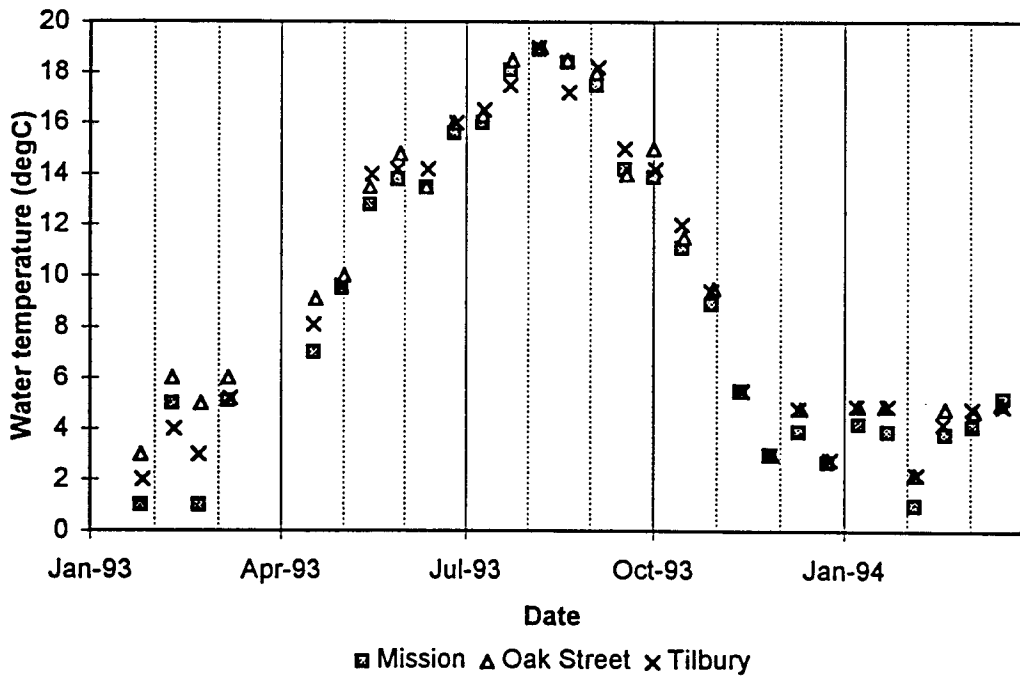


Figure 11. Seasonal Changes in Water Temperature, Main River Sites

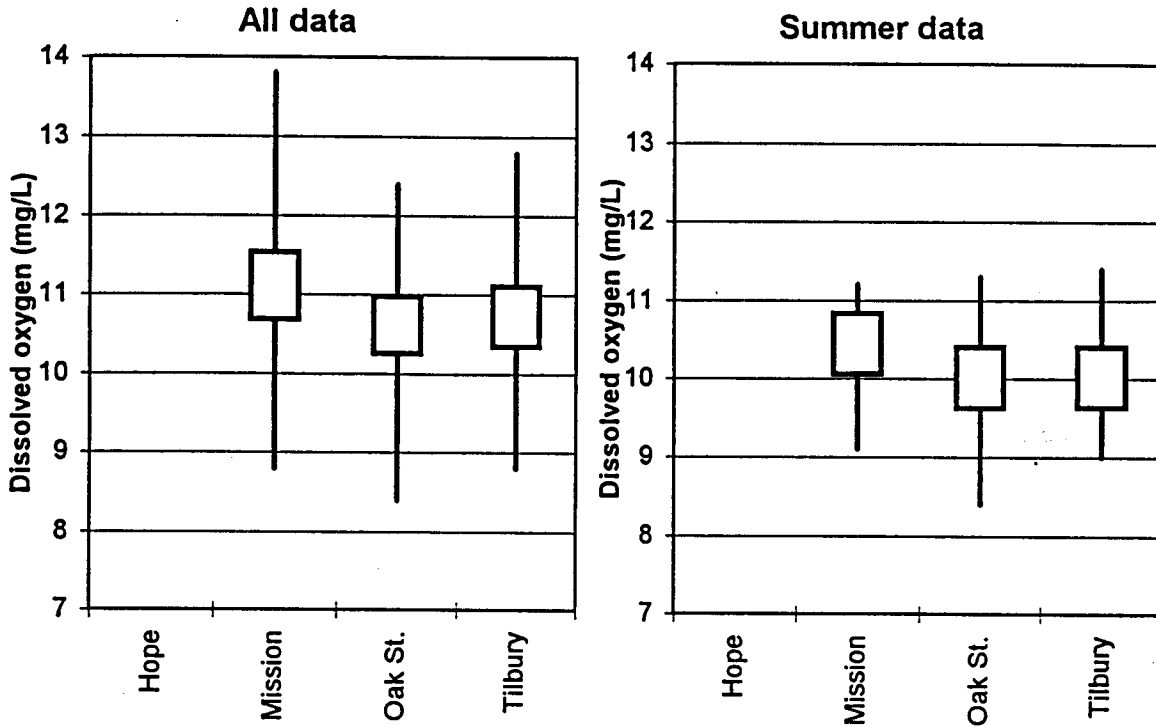


Figure 12. Summary of Dissolved Oxygen Data, Main River Sites

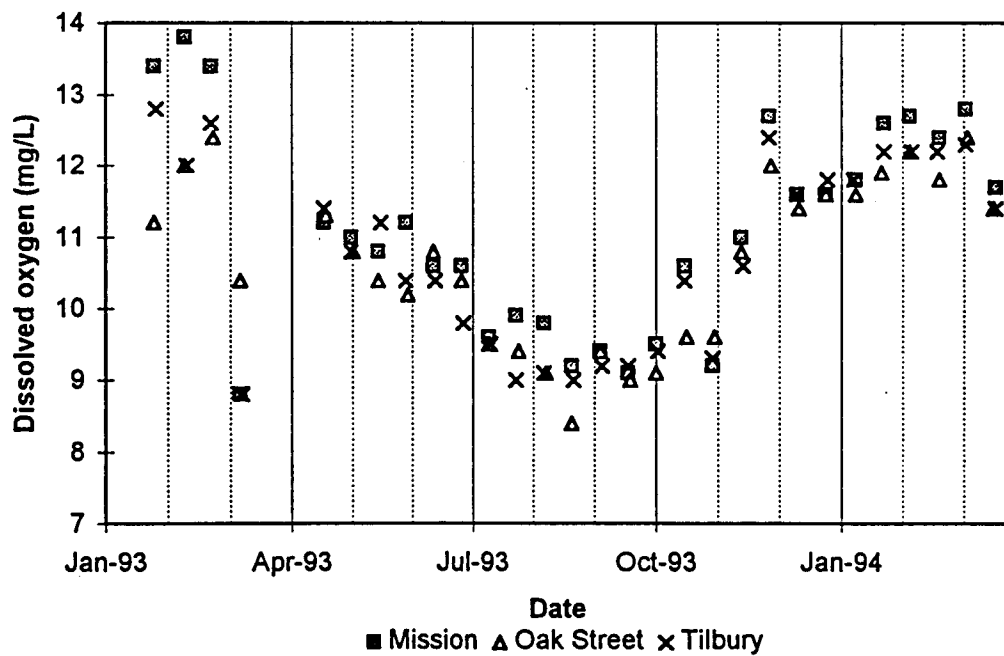


Figure 13. Seasonal Changes in Dissolved Oxygen, Main River Sites

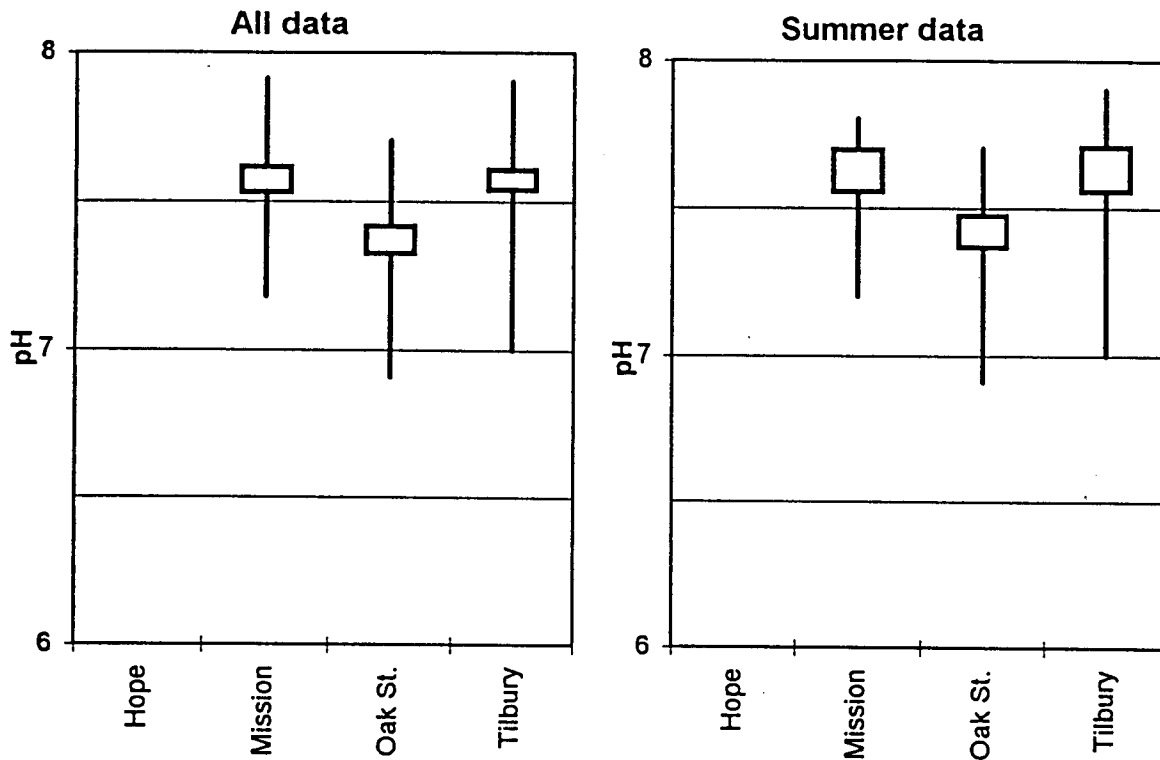


Figure 14. Summary of pH Data, Main River Sites

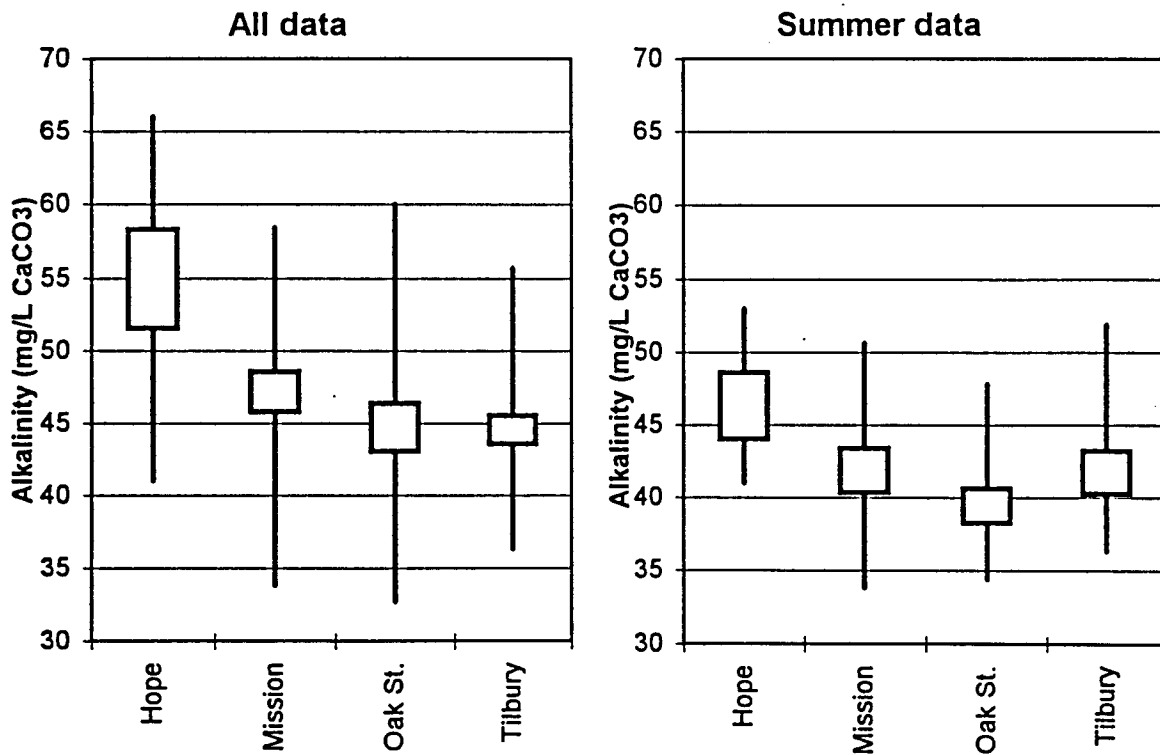


Figure 15. Summary of Alkalinity Data, Main River Sites

There was a significant difference in alkalinity measurements between Mission and the two downstream sites with the entire data set but not when the summer only data were compared (Figure 15). Data collected at Hope were significantly higher compared to downstream sites, with the differences less when the summer only data are compared. The higher values at Hope and Mission may reflect the influence of downstream tributaries particularly during the winter period when their contributions to the total flow are greater (see Section 3.1.1).

3.4 Non-filterable Residue

Non-filterable residue (NFR=suspended solids) was similar at all three sites both for the entire data set and for the "summer only" values (Figure 16). NFR closely parallels Fraser River flow, with much higher concentrations (60 to 200-700 mg/L) during high flow compared to low flow times. However, even during low flow, elevated concentrations of NFR were frequently measured at Oak Street Bridge and Tilbury Island but less so at Mission (Figure 17). Possible explanations include stormwater discharges, seawater intrusions (some of the high winter NFR data corresponded with higher specific conductance) and municipal discharges. Non-filterable residue concentrations measured during this study are comparable with those for the time period 1970-1978: 50-150 mg/L during freshet and 10-30 mg/L during low flow (Drinnan and Clark, 1980).

3.5 Dissolved Ions

A comparison of field and laboratory specific conductance measurements showed the field values to be generally lower, particularly in more estuarine water, as well as more variable. This may be due to the use of a less precise instrument in the field compared to the lab. As a result only laboratory data were used for interpretative purposes.

Specific conductivity was much higher at Oak Street Bridge and Tilbury Island compared with the upstream sites at Mission and Hope, when all data were considered but there were no differences for the "summer only" data (Figure 18). The pattern illustrates the influence of marine water intrusions into the river during periods of lower river flow even though considerable care was taken to sample at the end of the outgoing tide. A seasonal pattern (all sites combined) is not readily apparent although much higher values are encountered during the "winter months" (Figure 19).

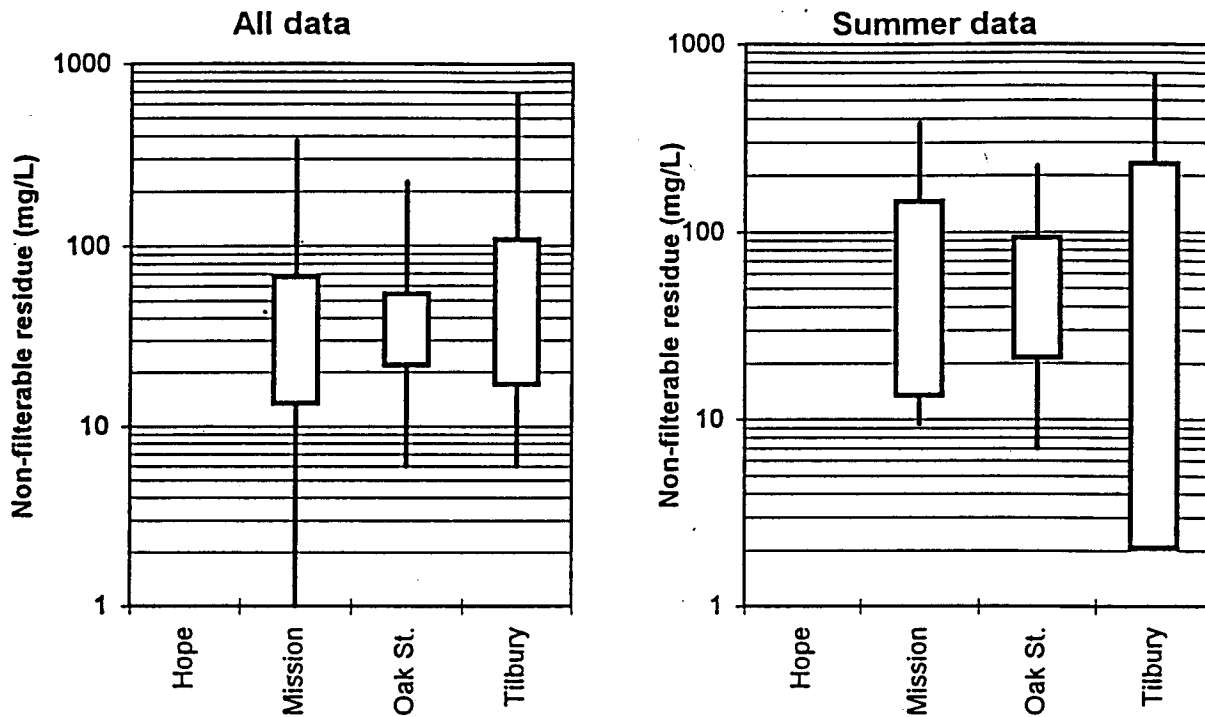


Figure 16. Summary of Non-filterable Residue Data, Main River Sites

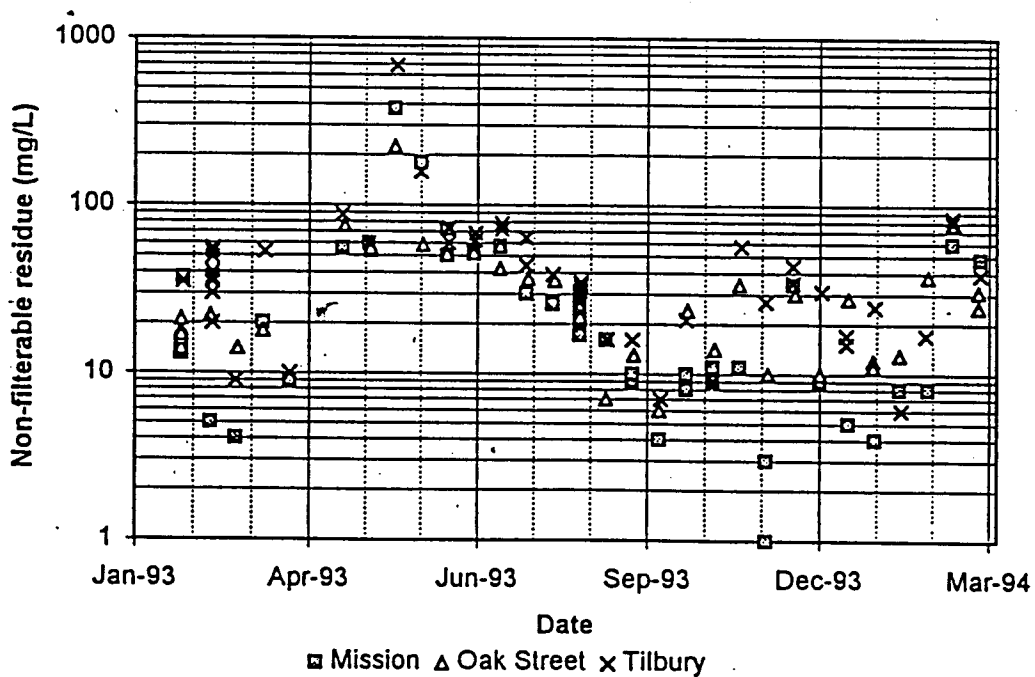


Figure 17. Seasonal Changes in Non-Filterable Residue, Main River Sites

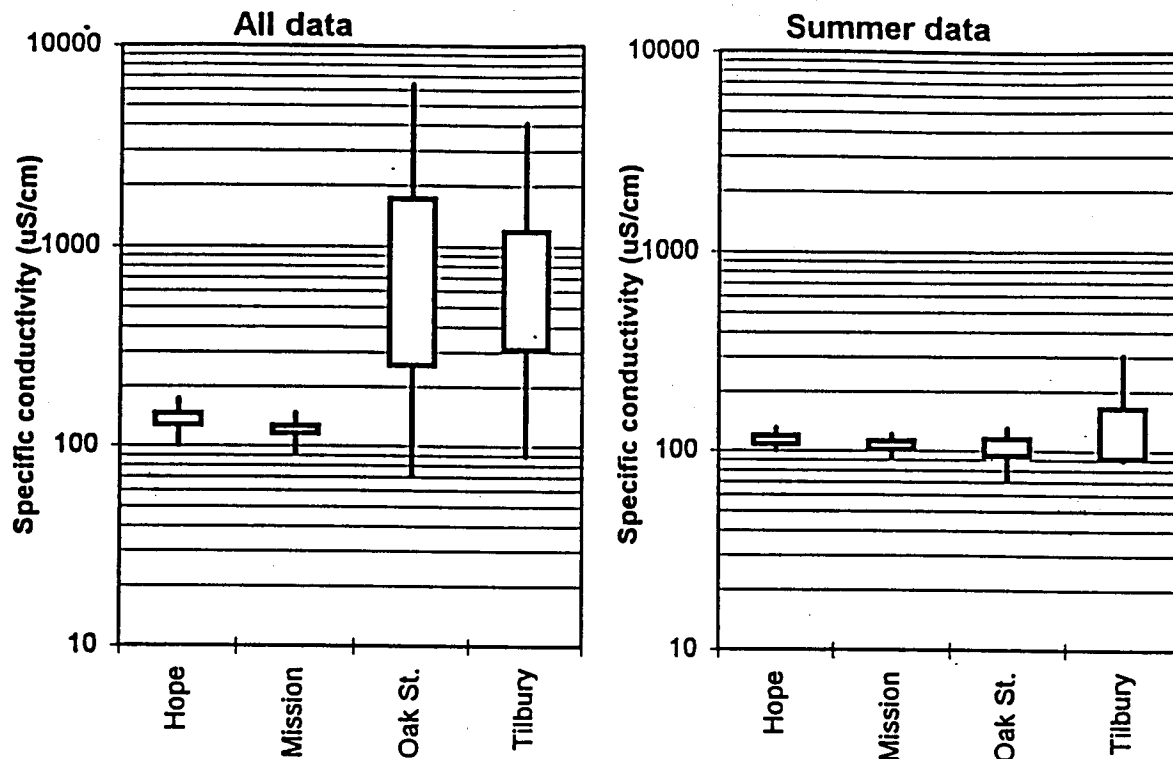


Figure 18. Summary of Specific Conductivity Data, Main River Sites

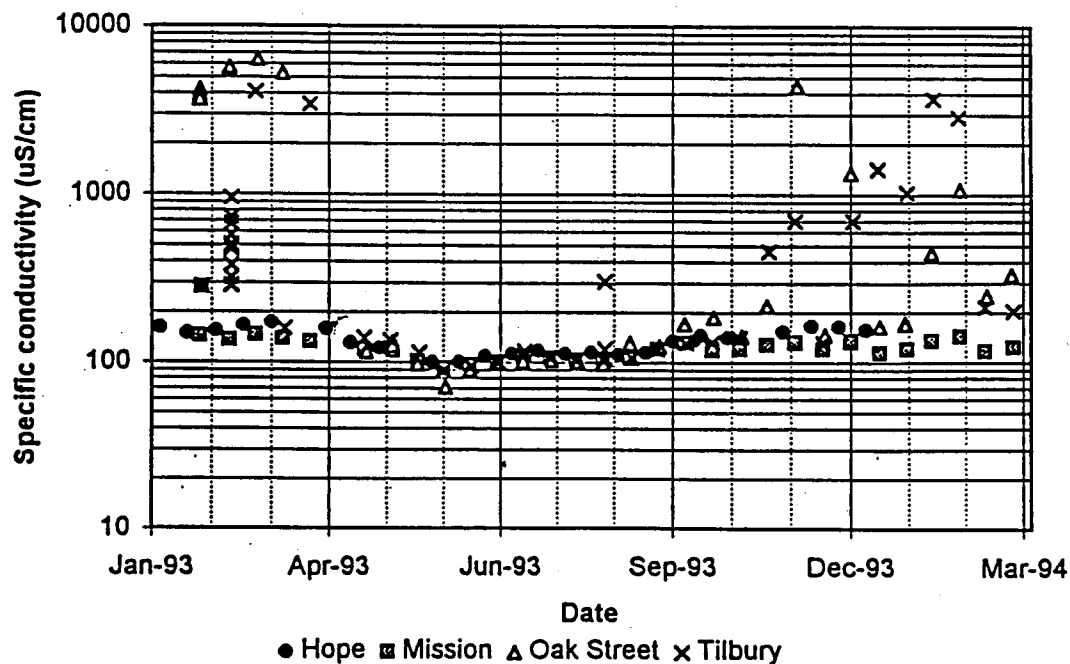


Figure 19. Seasonal Changes in Specific Conductivity, Main River Sites

Hardness, filterable residue and the dissolved ions sodium, potassium, magnesium, chloride and sulphate, all showed a similar pattern to specific conductivity (Figures 20-26). Higher concentrations were measured at Oak Street Bridge and Tilbury Island compared to Mission and Hope, when the entire data set is included, but there were no significant differences when "summer only" data are considered. The data illustrate the effects of seawater intrusions during low flow periods.

Comparisons among sites showed the upstream site at Mission to be significantly lower for these parameters than either of the Tilbury Island or Oak Street Bridge sites but there was no significant difference between the latter two sites. Where there were data for comparison (specific conductivity, sodium, magnesium, chloride and sulphate), there were no significant differences between Hope and Mission.

Fluoride concentrations were not significantly different among all four sites when all data were considered. Concentrations at Mission, Oak Street and Tilbury were lower than Hope for the summer only data. Mission had lower calcium concentrations than Hope when all data were considered, but Oak Street had lower concentrations than Hope when summer only data were considered. In both cases, the differences are small.

A summary of all water quality data collected up to 1978 (Drinnan and Clark, 1980) showed a similar range in values for most parameters measured in this study.

A maximum concentration for dissolved fluoride of 0.2 mg/L (hardness <50 mg/L) or 0.3 mg/L (hardness >50 mg/L) is recommended for the protection of aquatic life. None of the measurements exceeded these guidelines (Table 8).

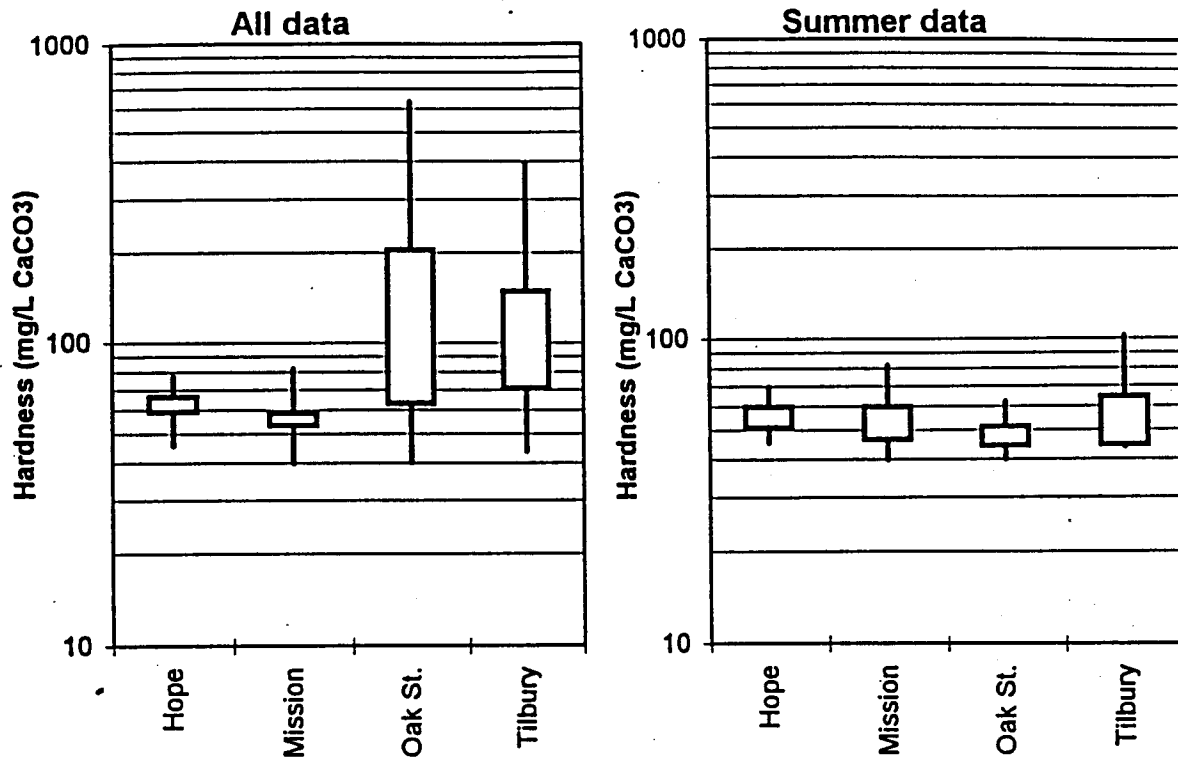


Figure 20. Summary of Hardness Data, Main River Sites

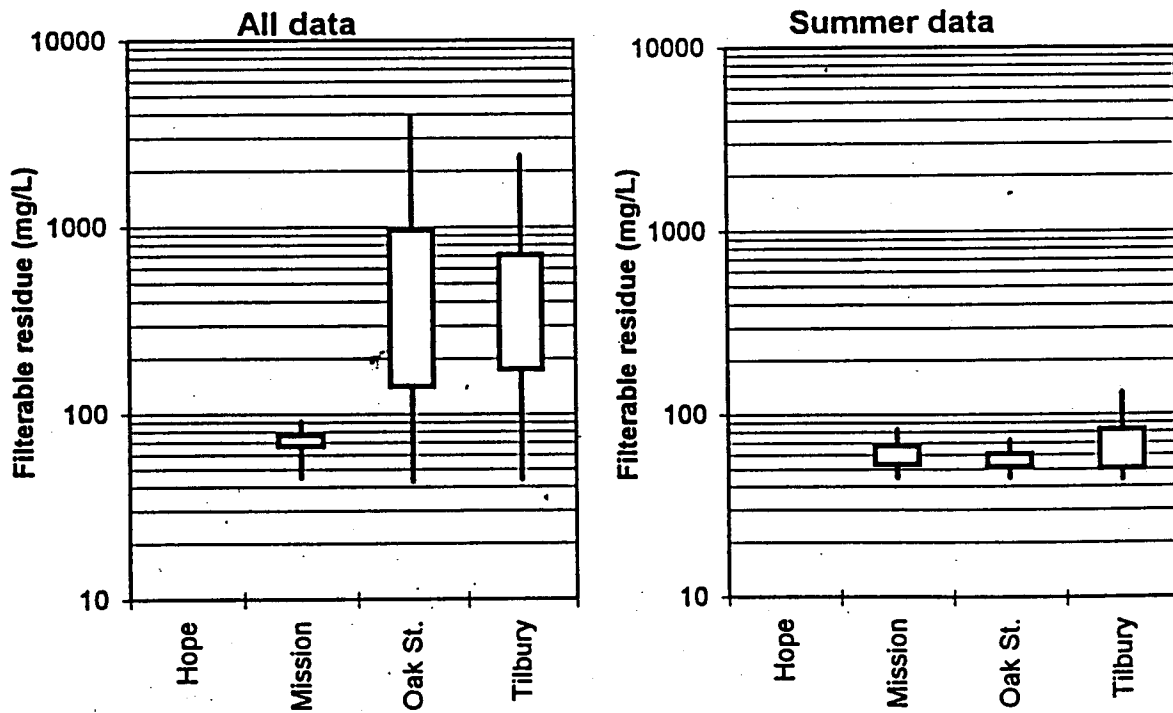


Figure 21. Summary of Filterable Residue Data, Main River Sites

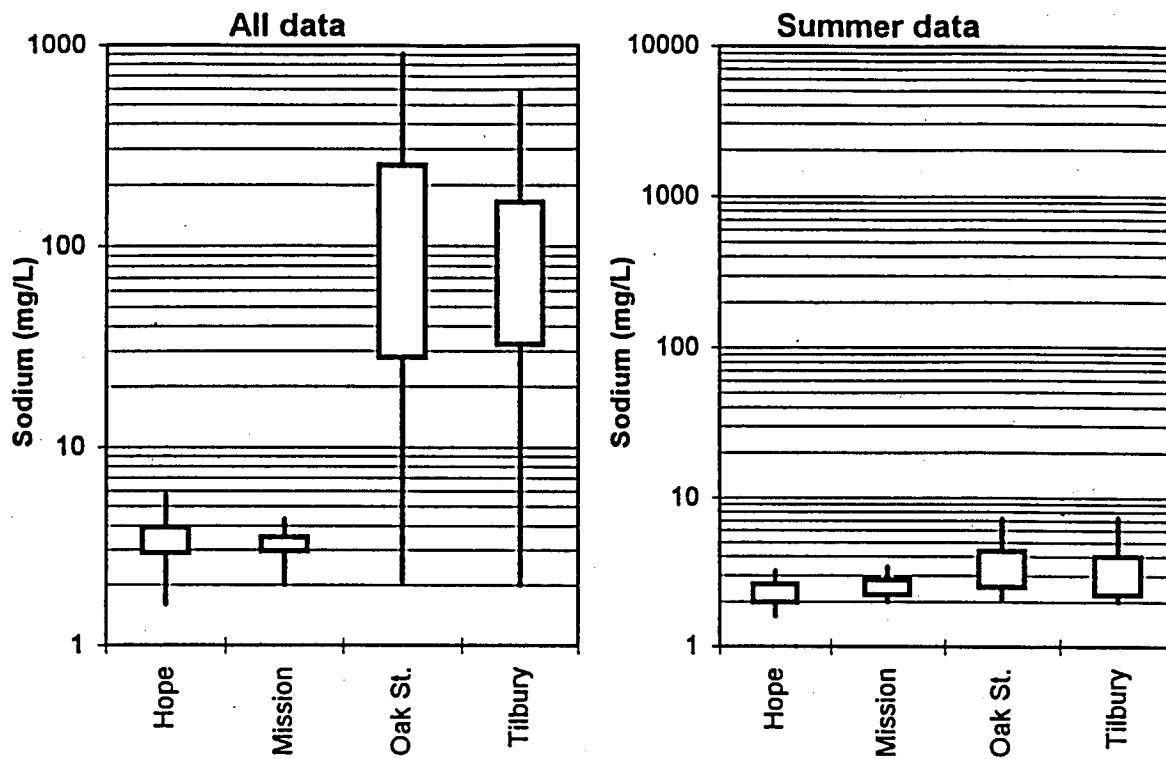


Figure 22. Summary of Sodium Data, Main River Sites

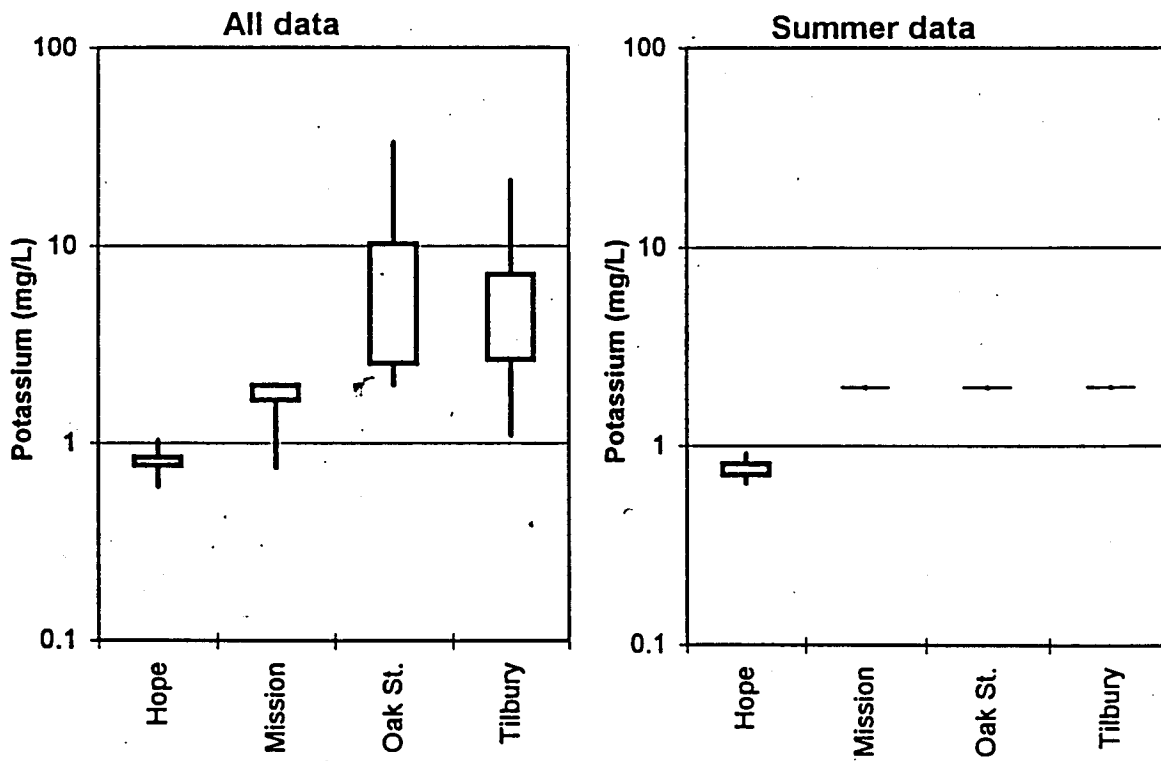


Figure 23. Summary of Potassium Data, Main River Sites

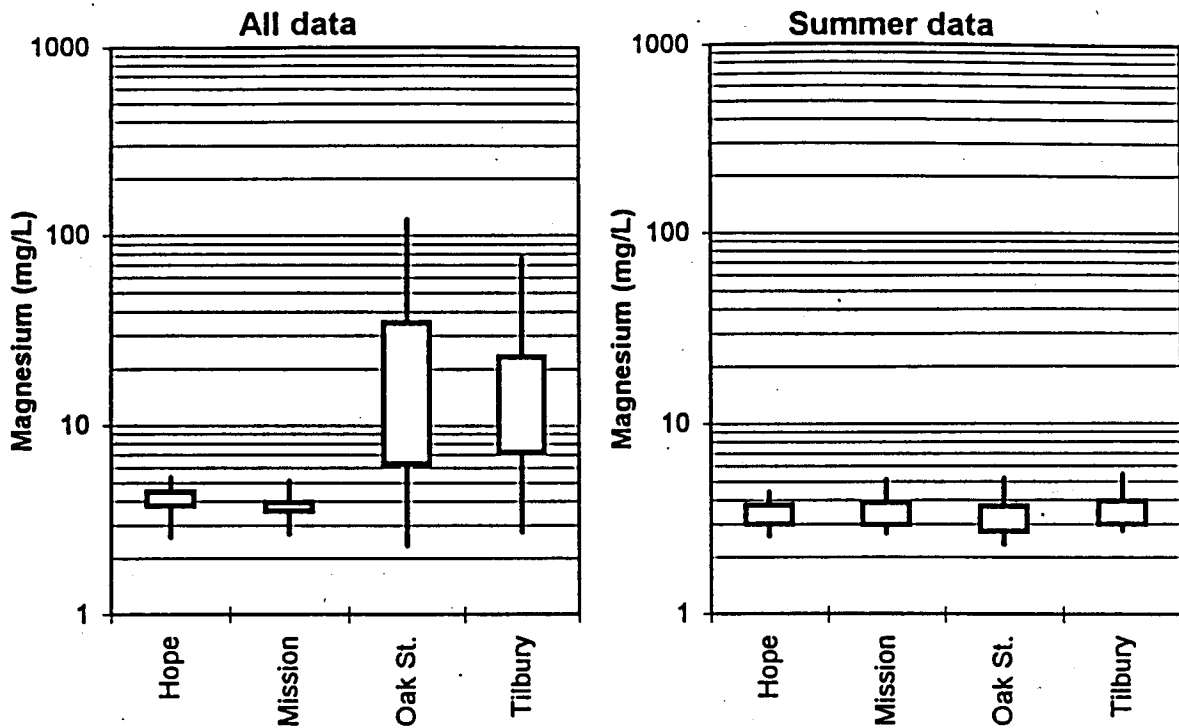


Figure 24. Summary of Total Magnesium Data, Main River Sites

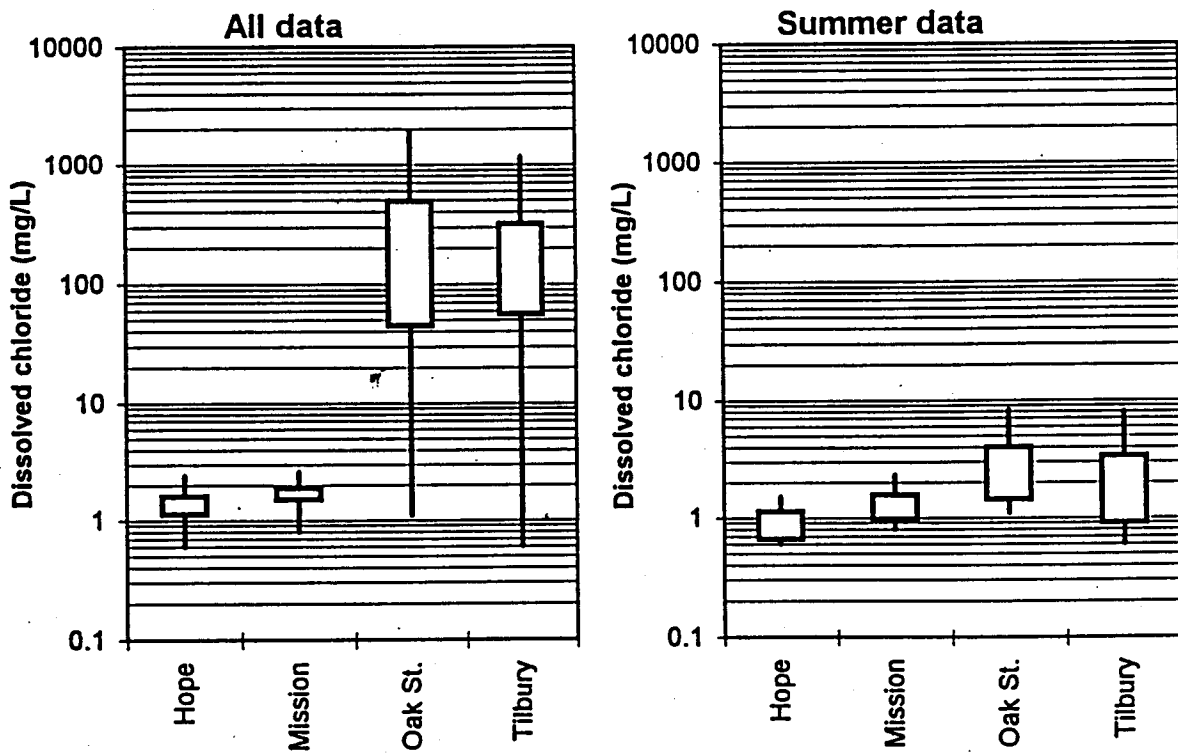


Figure 25. Summary of Chloride Data, Main River Sites

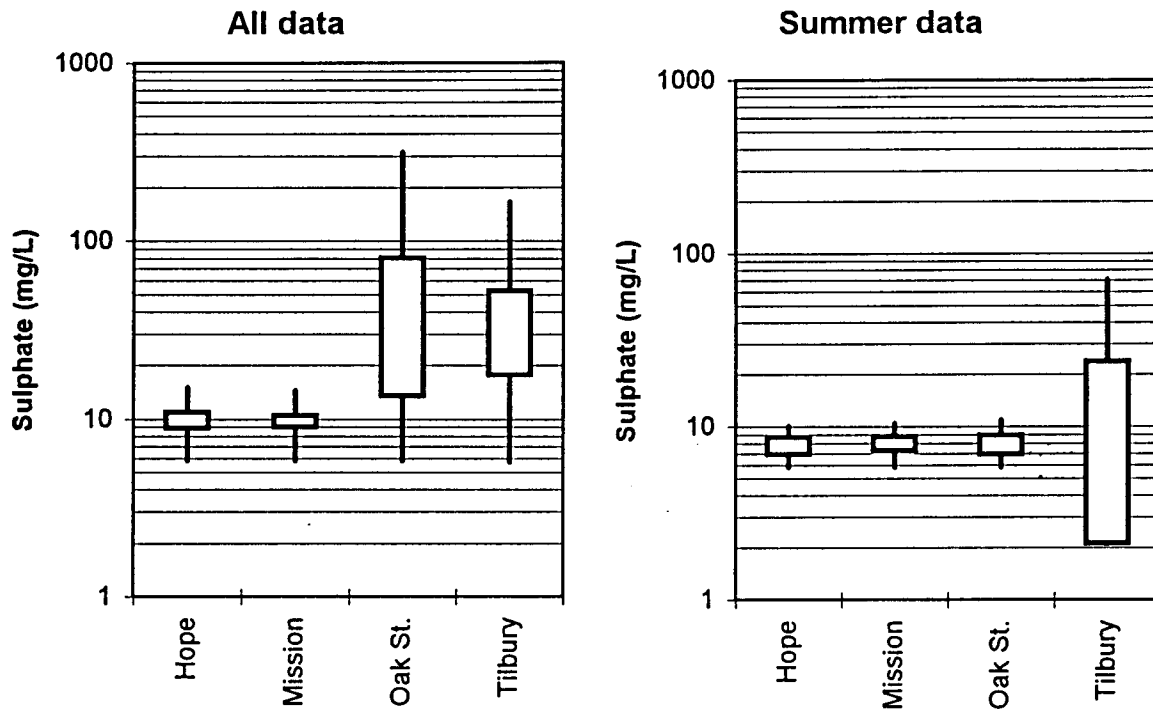


Figure 26. Summary of Sulphate Data, Main River Sites

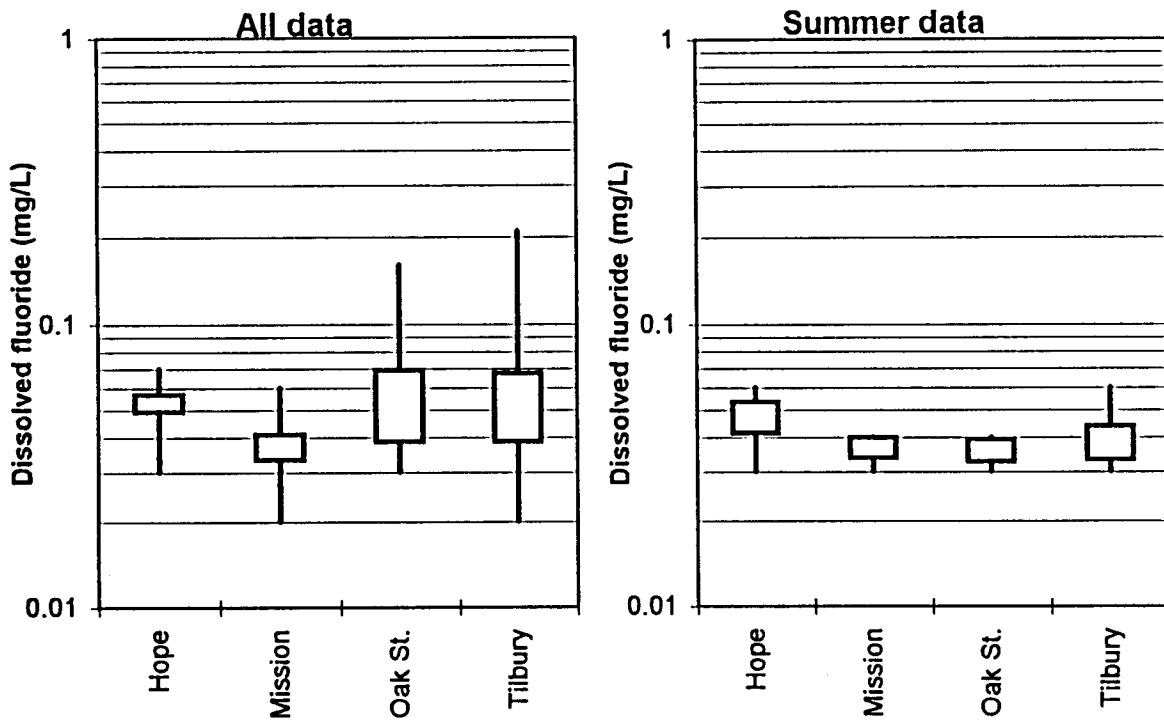


Figure 27. Summary of Fluoride Data, Main River Sites

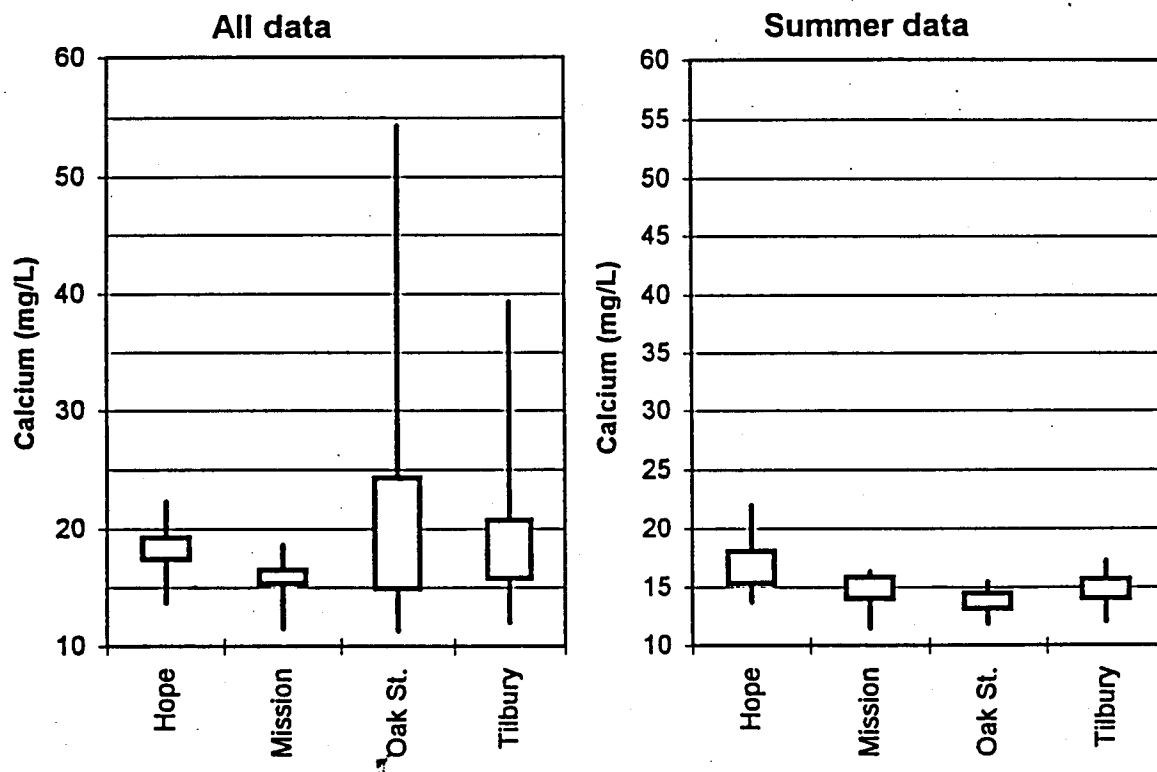


Figure 28. Summary of Calcium Data, Main River Sites

3.6 Nutrients

3.6.1 Nitrogen

Ammonia concentrations were lower at Mission when compared to Oak Street and Tilbury when all data were considered, but there were no differences between stations in the summer. Seasonal changes are most clearly shown by the nitrite/nitrate data (Figure 33). The lowest concentrations were measured between July and September (0.03 mg/L-N) while maxima occur during February/March (ca. 0.15 mg/L-N). These values are similar to levels measured between 1970 and 1978 (0.05 mg/L-N minima; 0.15-0.20 mg/L-N maxima) reported by Drinnan and Clark (1980).

Dissolved nitrate/nitrite and total nitrogen concentrations were not different between stations for all data and for summer only data. The trend towards higher concentration of nitrite/nitrate at Tilbury Island and Oak Street Bridge during low flow (0.24 mg/L-N and 0.25 mg/L-N, respectively) may be evidence of some mixing with marine waters, which are typically higher in winter (ca. 0.35 mg/L for Georgia Strait surface waters; Harrison *et al.*, 1994), from the discharge from sewage treatment plants (STPs), or a combination of the two. However, since there was no significant differences between the Oak Street Bridge in the North Arm and Tilbury Island in the Main Arm (where most of the sewage, apart from combined sewage/stormwater overflows, is discharged), the contribution from the STPs may be masked by marine water intrusion.

Harrison *et al.* (1994) compared anthropogenic contributions of nitrogen from tributary sources, sewage treatment plants and atmospheric deposition and found that the entrained nitrate (which constitutes about 90% of the total nitrogen present) from nitrate-rich marine waters in the salt wedge was generally 2 to 12 times the river-borne nitrate. Even during the summer period of July and August, when nitrogen in marine surface waters can periodically decrease to less than 0.03 mg/L, the contributions from the Fraser River would have only a minor effect on primary production.

The seasonal pattern more closely reflects that of water temperature than Fraser River discharge (Figures 11 and 6, respectively) suggesting that processes other than dilution during freshet, such as biological uptake, are responsible for the lower summer concentrations. However, because of the generally high turbidity in the Fraser River at this time, the biological uptake of nitrogen may occur more in the tributaries to the Fraser.

The measurement of ammonia includes both the undissociated (NH_3) and dissociated (NH_4^+) forms. Undissociated ammonia can be toxic to aquatic organisms and the concentration increases with increasing water temperature and pH. Table 10 compares the maximum total ammonia with the maximum temperature and pH at each site. The results show that total ammonia were well below the guidelines set by CCREM (1987) and BC MOELP (1994)

criteria (Table 8). A review of all receiving water data from the Fraser River (Swain *et al.*, 1995) also found that ammonia never exceeded established criteria.

Table 10. Comparison of Ammonia with Water Quality Guidelines and Criteria for the Protection of Aquatic Life

Site	Maximum pH	Maximum T (°C)	Total Ammonia Guidelines (mg/L) ¹	Maximum Concentration in River (mg/L)
Mission	7.9	18.9	0.93/0.97	0.043
Tilbury Island	7.9	19.0	0.93/0.97	0.096
Oak Street Bridge	7.7	19.0	1.50/1.34	0.089

¹The first number represents the CCREM (1987) water quality guideline; the second values is the BCMOELP (1995) criterion for protection of aquatic life.

3.6.2 Phosphorus

There were no significant differences between the main river stations (including Hope) for total or dissolved phosphorus, either for the total database or for the "summer only" values (Figures 35-36).

The seasonal pattern for total phosphorus (Figure 37) was similar to that of non-filterable residue, which in turn was similar to the river flow pattern (compare with Figures 16 and 6, respectively). Total phosphorus was highly correlated to non-filterable residue ($r^2 = 0.92$). Total phosphorus ranged between minimum values of about 0.015-0.02 mg/L and maximum concentrations of 0.2 to 0.7 mg/L. These values are similar to those reported for the Fraser River for the period 1970-1978 (Drinnan and Clark, 1980).

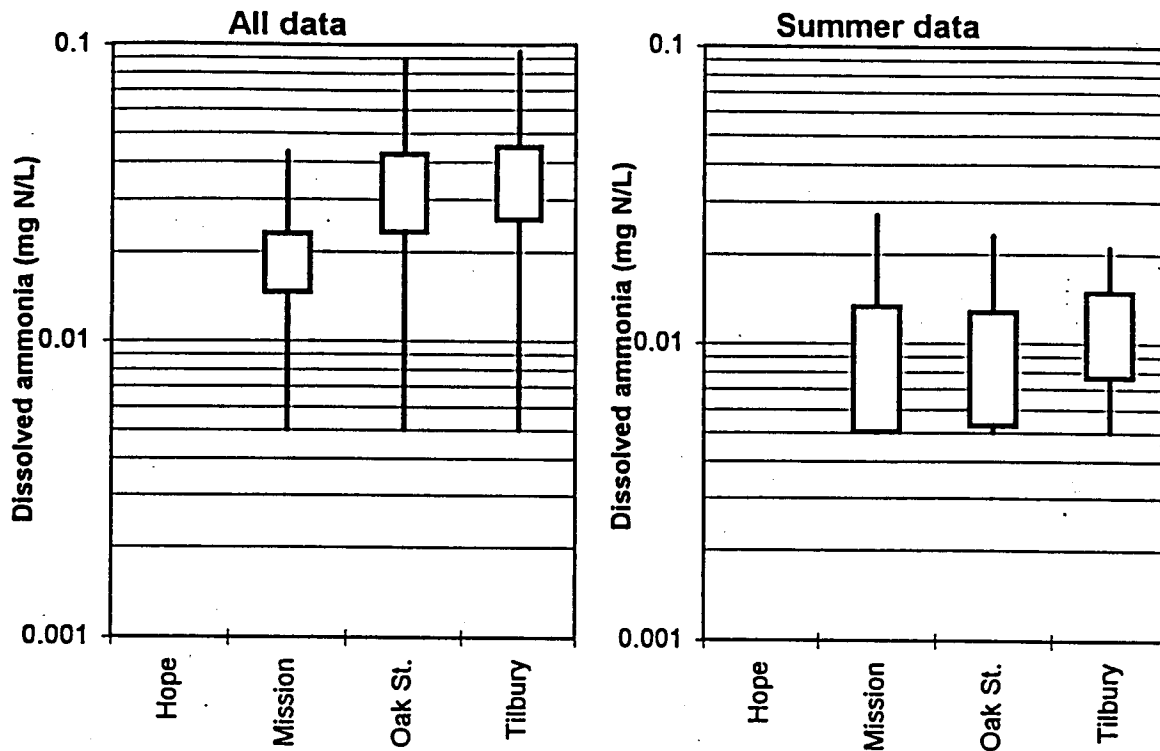


Figure 29. Summary of Total Ammonia Data, Main River Sites

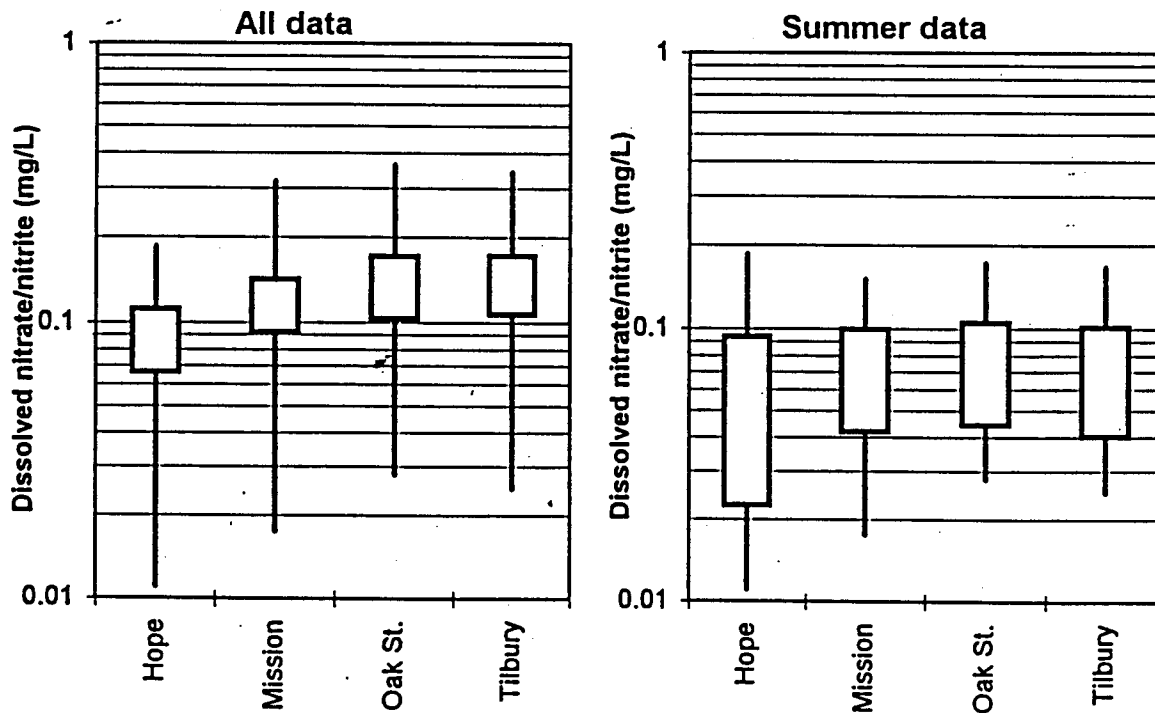


Figure 30. Summary of Nitrite/Nitrate Data, Main River Sites

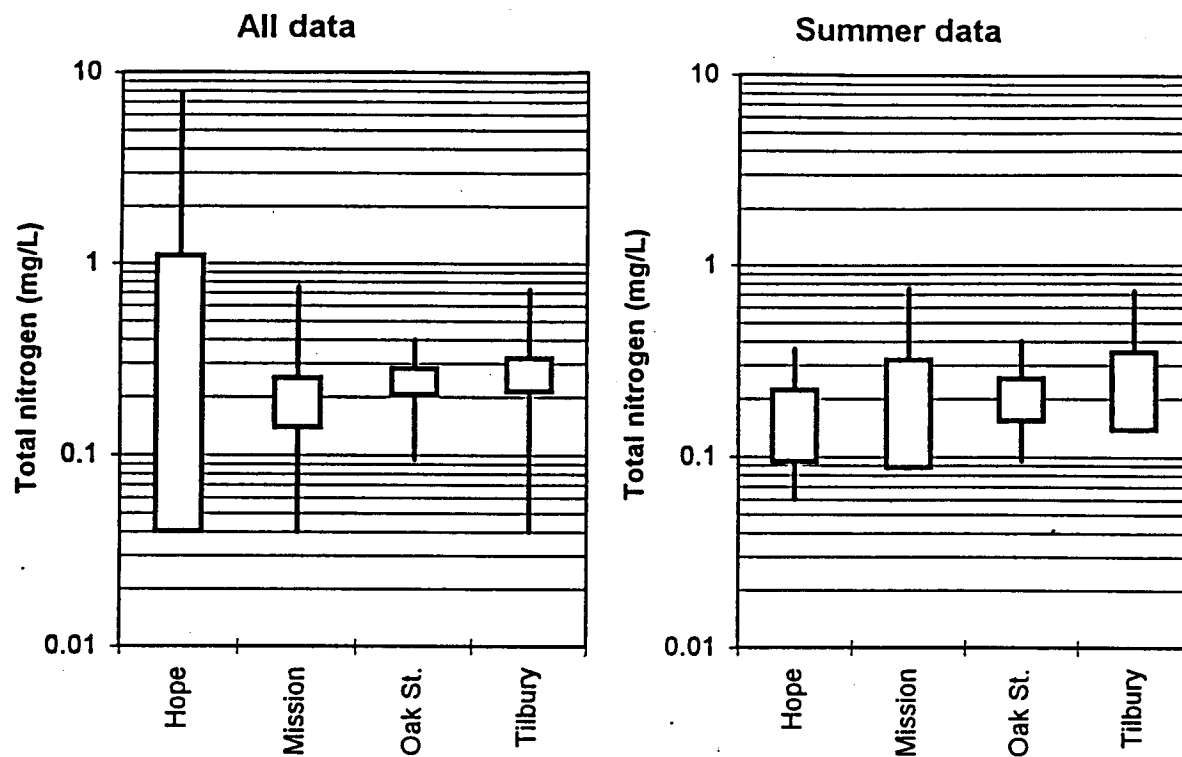


Figure 31. Summary of Total Nitrogen Data, Main River Sites

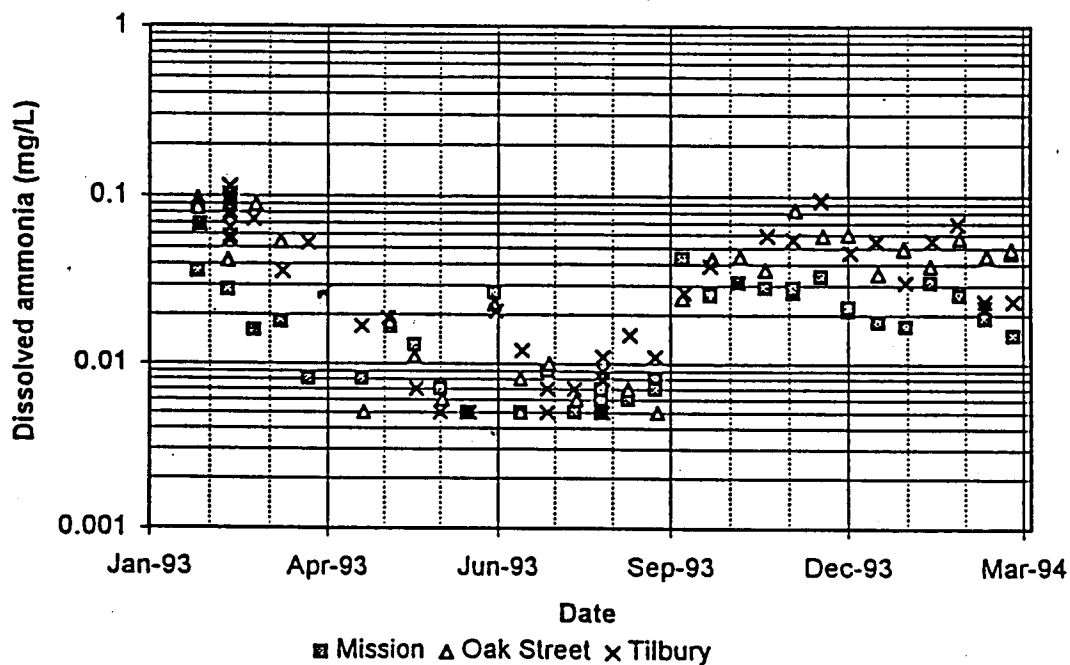


Figure 32. Seasonal Changes in Total Ammonia, Main River Sites

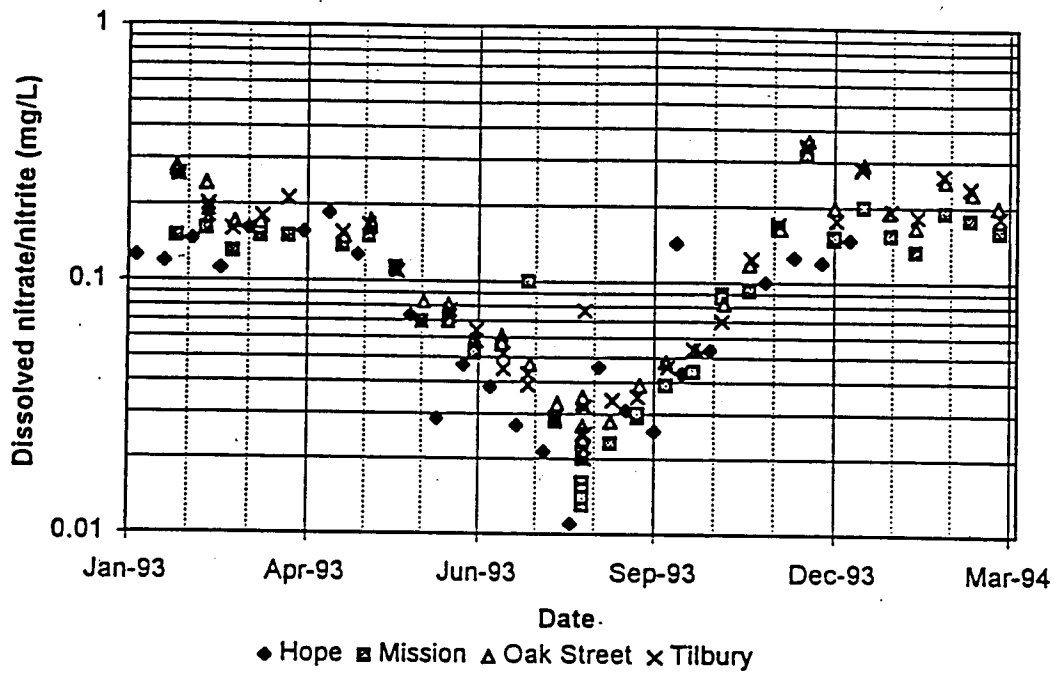


Figure 33. Seasonal Changes in Nitrite/Nitrate, Main River Sites

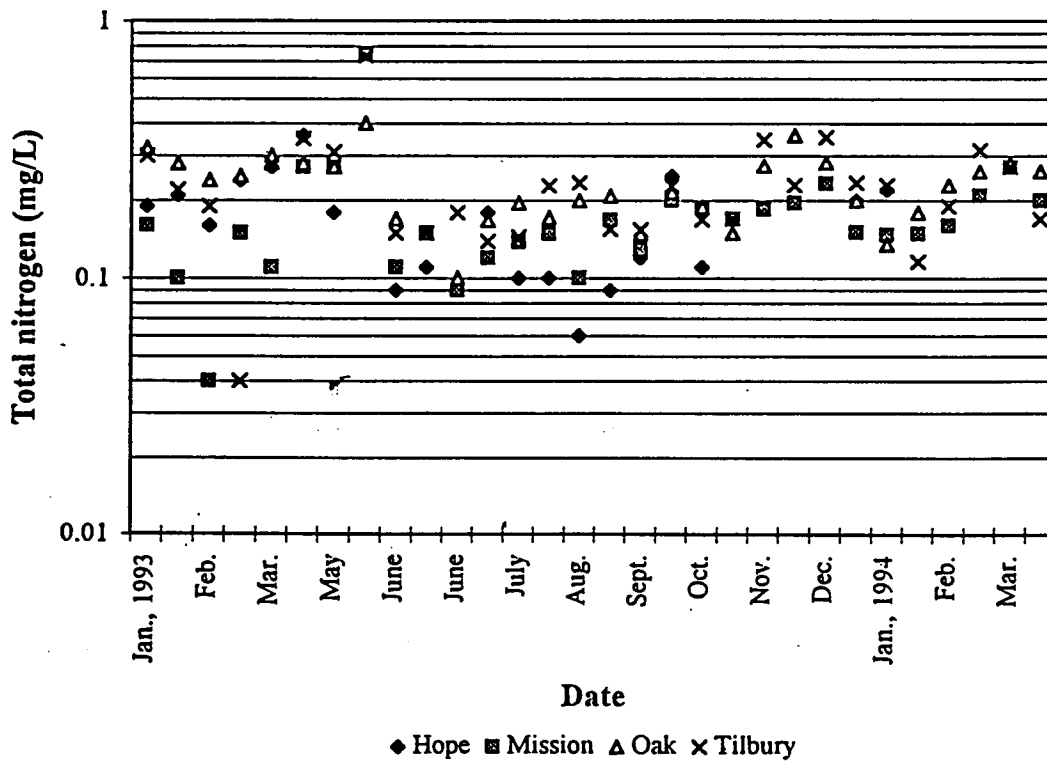


Figure 34. Seasonal Changes in Total Nitrogen, Main River Sites

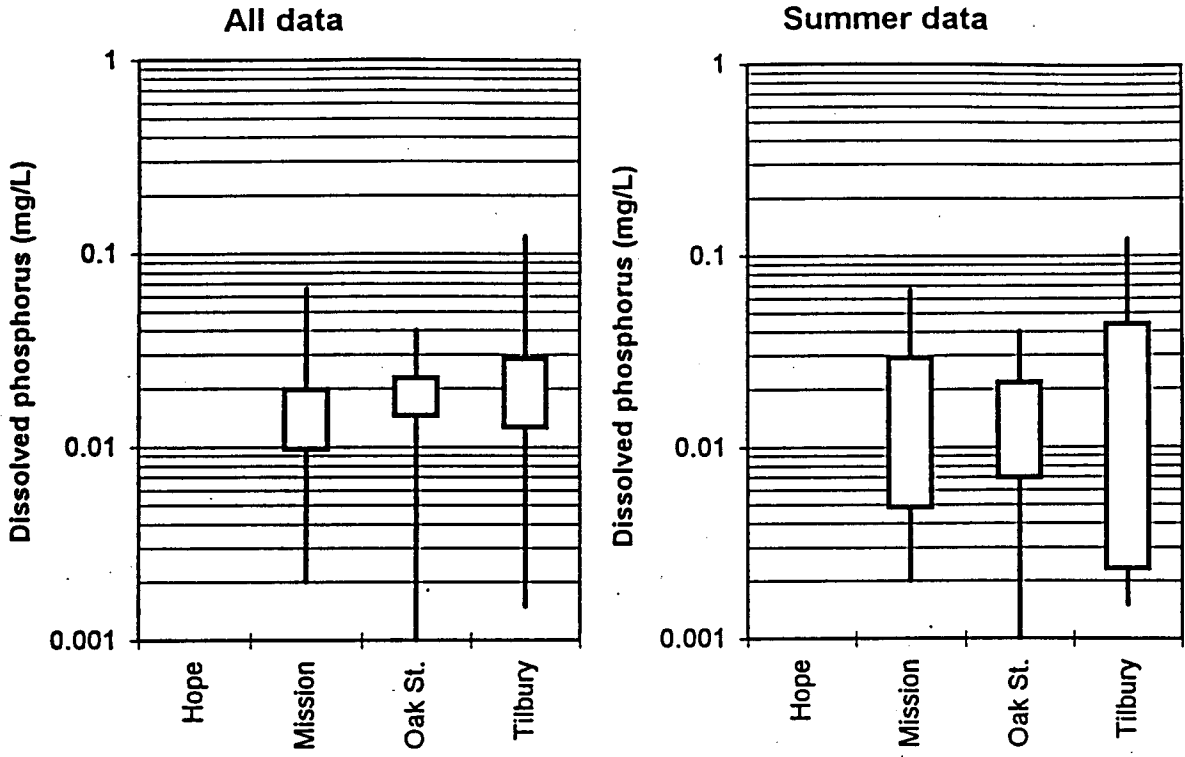


Figure 35. Summary of Dissolved Phosphorus Data, Main River Sites

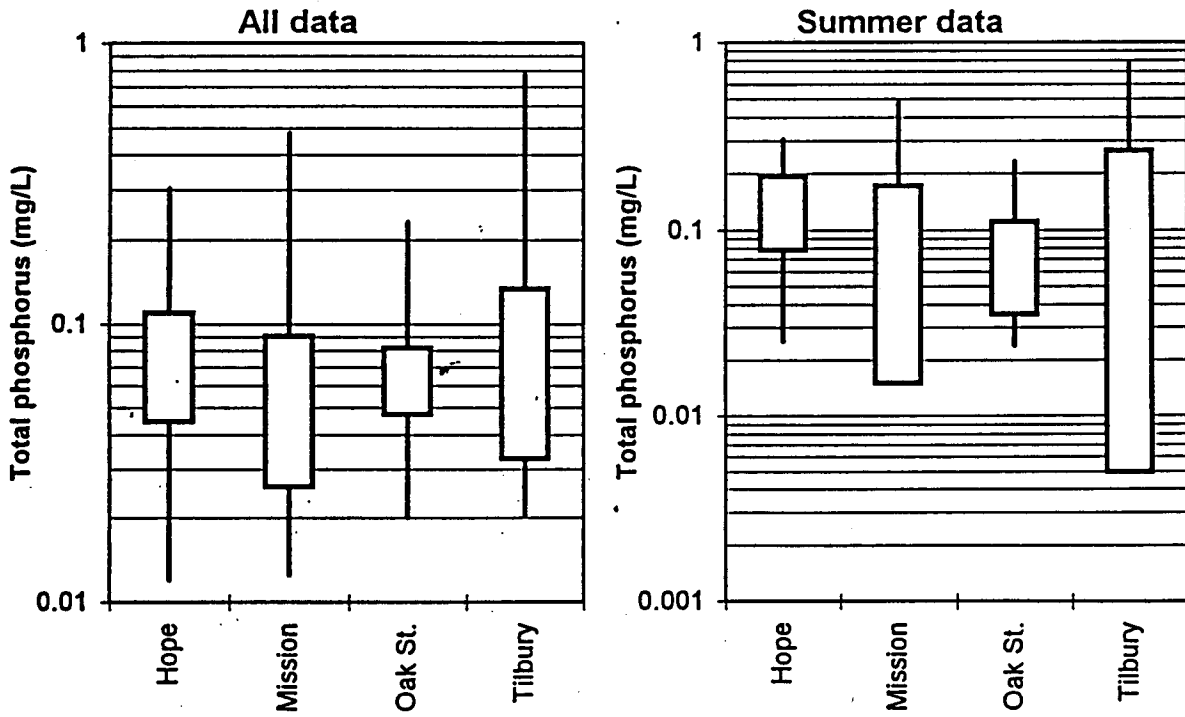


Figure 36. Summary of Total Phosphorus Data, Main River Sites

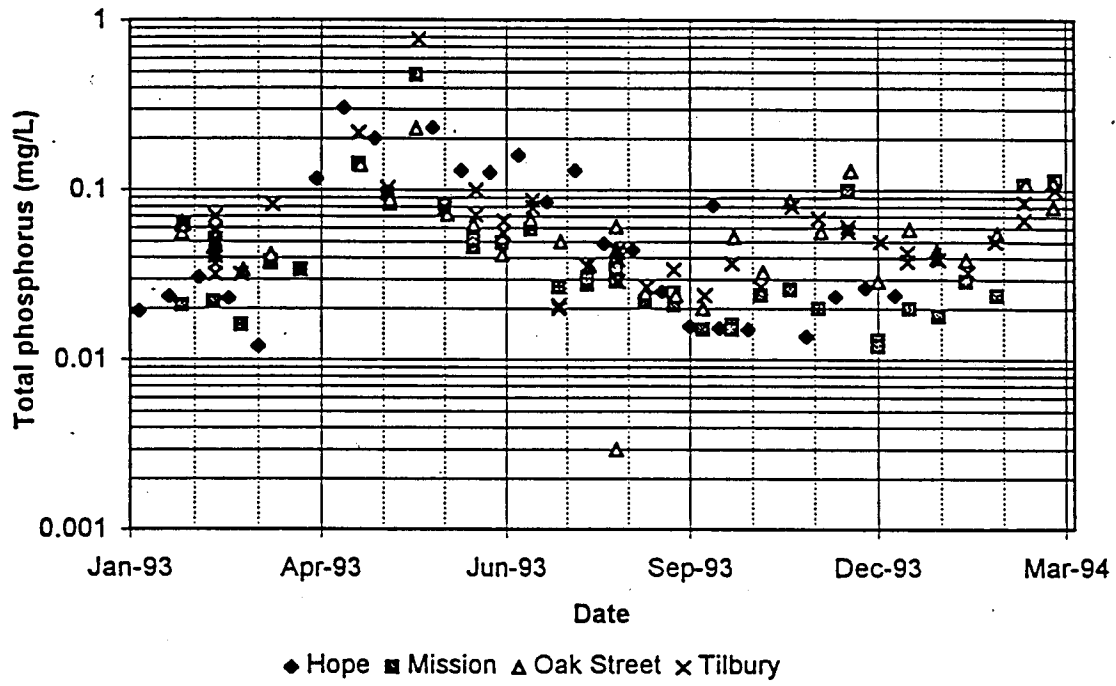


Figure 37. Seasonal Changes in Total Phosphorus, Main River Sites

3.7 Metals

For many of the metals, the majority of the measurements were below the method detection limit (MDL) of the analytical procedure. Table 11 shows the distribution of data for each metal analyzed. A total of 90 samples were analyzed from the three sites. Metal data reported in Drinnan and Clark (1980) are not used for comparison with this study because of problems associated with varying detection limits and overall quality assurance associated with the earlier data set.

3.7.1 Silver (Ag)

Most measurements were below the MDL of 0.0001 mg/L, with only 4 samples measured above the MDL. The maximum concentration measured was 0.0003 mg/L (Figure 38). The first five samples (January to March, 1993) were analysed at a higher MDL of 0.03 mg/L; all samples were below this detection limit. The most sensitive criterion for silver is 0.0001 mg/L (Table 11).

3.7.2 Aluminum (Al)

There were no significant differences between the aluminum values measured at Mission, Tilbury Island or Oak Street Bridge sites for total aluminum (Figure 39). Data collected at Hope appeared to be higher than the downstream sites but the difference was not significant. A similar pattern is apparent when "summer only" values are compared (Figure 39).

When the data are compared to water quality criteria for the protection of aquatic life most of the aluminum values exceeded the federal guideline and provincial criterion of a maximum of 0.1 mg/L (Tables 8 and 11). Aluminum is a common element in terrestrial material and it is likely that the high values measured in the Fraser River reflect natural material that has been eroded from upstream.

The maximum concentration for aluminum at Mission, Tilbury Island and Oak Street Bridge occurred on the same day (May 17, 1993). These same samples were also very high in suspended solids (maximum value for the data set) while arsenic, chromium, copper, iron, nickel and zinc were nearly an order of magnitude higher than at most of the other sampling times. These results illustrate the association of these elements with the particulate material in the river.

Table 11. Comparison of Metal Data with Water Quality Objectives and Guidelines for the Protection of Aquatic Life

Metal	Total No. Measurements	No. of Measurements < MDL¹	90th Percentile (mg/L)	Maximum Value (mg/L)	Water Quality Guidelines (mg/L)²
Ag	90	86	<0.03	0.0003; <0.03	0.0001
Al	90	28	0.99	8.4	0.1
As	90	7	0.001	0.0035	0.05
Ba	90	0	0.026	0.2	-
Cd	90	87	<0.0002	0.0011	0.0002
Co	90	90	<0.015	<0.015	-
Cr	90	61	0.005	0.018	0.002 (plankton) 0.02 (fish)
Cu	90	17	0.005	0.016	0.002/0.004
Fe	90	0	1.24	13.7	0.3
Hg	90	90	<0.00005	<0.00005	0.0001
Mo	90	81	<0.004	0.004	2
Ni	90	43	<0.0005	0.023	0.025
Pb	90	71	<0.003	0.003	0.001/0.003
Se	90	90	<0.0005	<0.0005	0.001
Sn	90	86	<0.03	<0.03	-
Zn	90	29	0.022	0.09	0.03/0.05

¹ MDL = method detection limit.

² The most sensitive of the criteria, guideline or objective from Table 8 is reported in this table. The second number for Cu, Pb and Zn refers to the specific Fraser River objective.

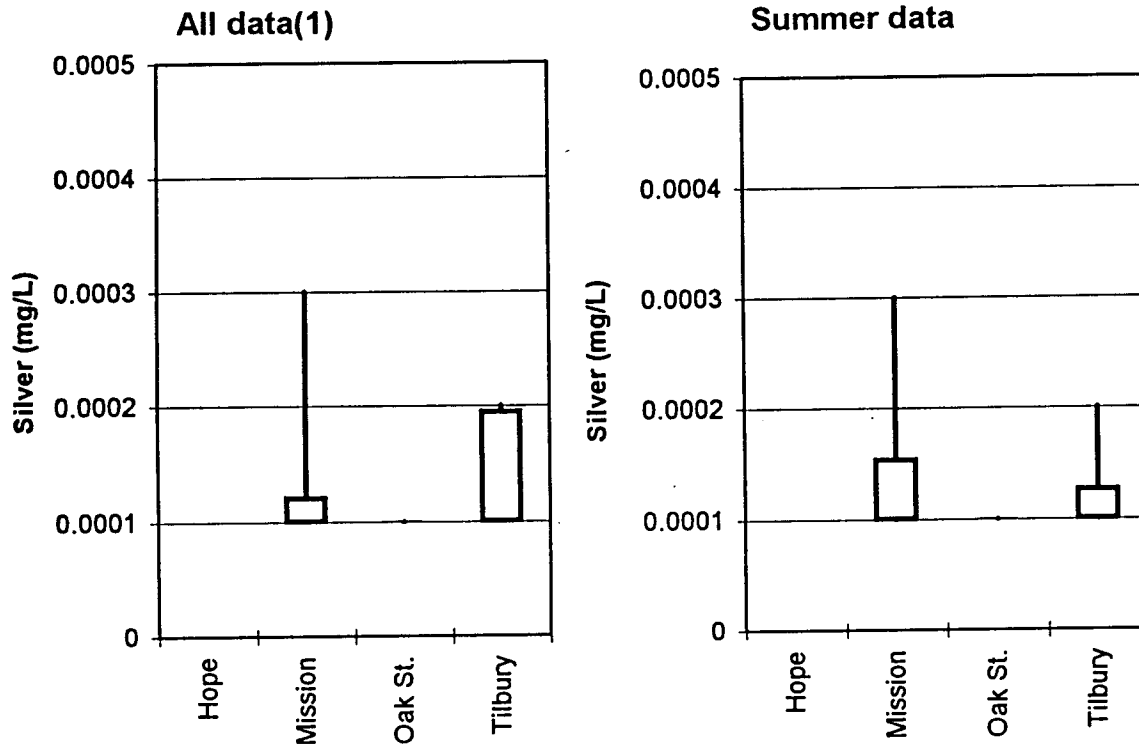


Figure 38. Summary of Total Silver Data, Main River Sites

1. Only data from analysis with an MDL of 0.0001 mg/L (April 1993 to March 1994) are presented in the figure

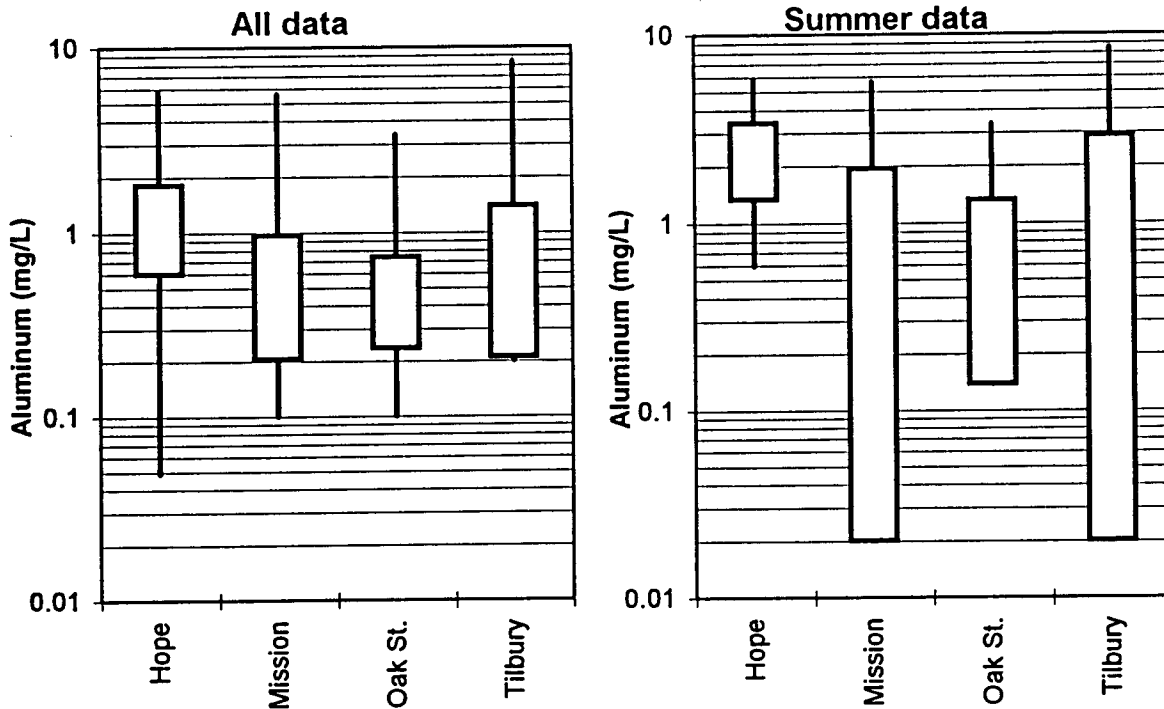


Figure 39. Summary of Total Aluminum Data, Main River Sites

3.7.3 Arsenic (As)

All but seven measurements for total arsenic were above the detection limits (0.0001 to 0.001 mg/L; Table 11). There were no significant differences between any of the sites, including Hope, either for all the data or for the "summer only" values (Figure 40). The median concentrations for Hope, Mission, Tilbury Island and Oak Street Bridge were all 0.0005 mg/L. The results are similar to those summarized by Swain *et al.*, 1995.

All measurements were well below the water quality guideline of 0.05 mg/L for the protection of freshwater aquatic life.

3.7.4 Barium (Ba)

There were no significant differences in barium concentrations between any sites for all data or when summer data were compared (Figure 41).

There are no water quality criteria for barium.

3.7.5 Cadmium (Cd)

Eighty-seven of 90 measurements for total cadmium were below the detection limits of 0.0001 mg/L or 0.0002 mg/L. Of the three remaining measurements, two were at the MDL; while the maximum concentration, observed at the Mission site, was 0.0011 mg/L (Figure 42).

Only one value exceeded the water quality objective of 0.0002 mg/L.

3.7.6 Cobalt (Co)

All measurements of total cobalt were below the MDLs of 0.004 mg/L and 0.015 mg/L (Table 11). The data from the Hope site had a lower MDL and averaged about 0.0008 mg/L (Figure 43).

There are no water quality criteria for cobalt.

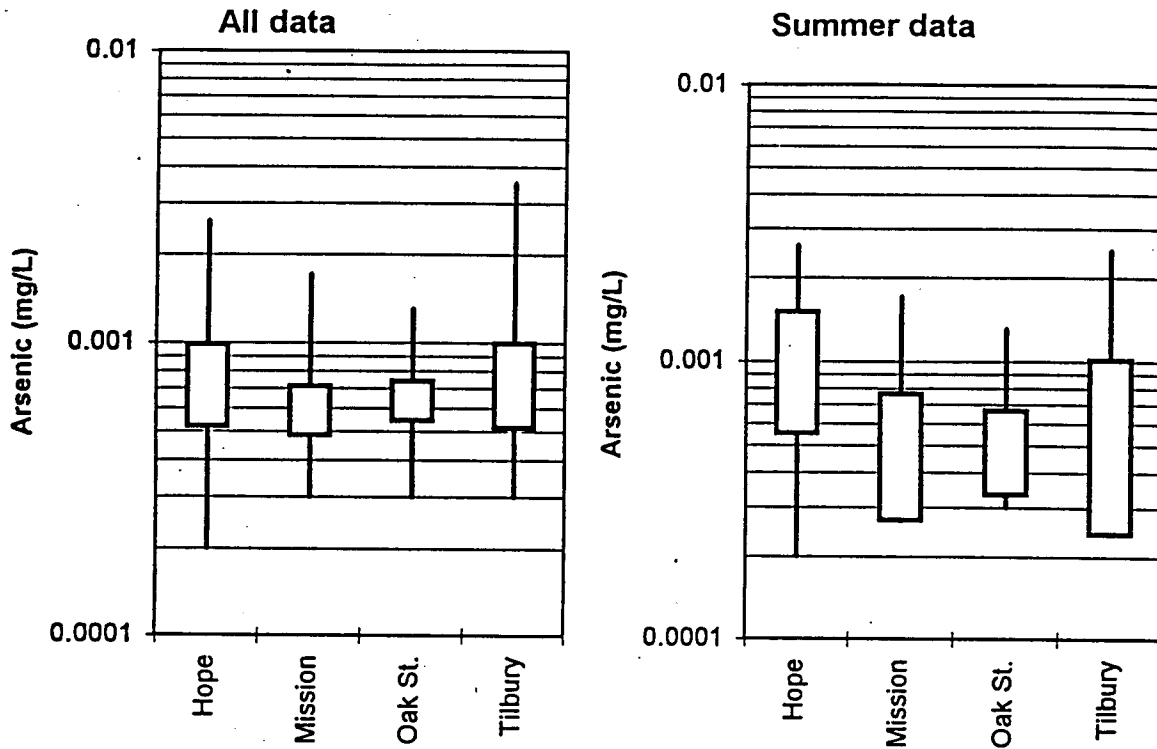


Figure 40. Summary of Total Arsenic Data, Main River Sites

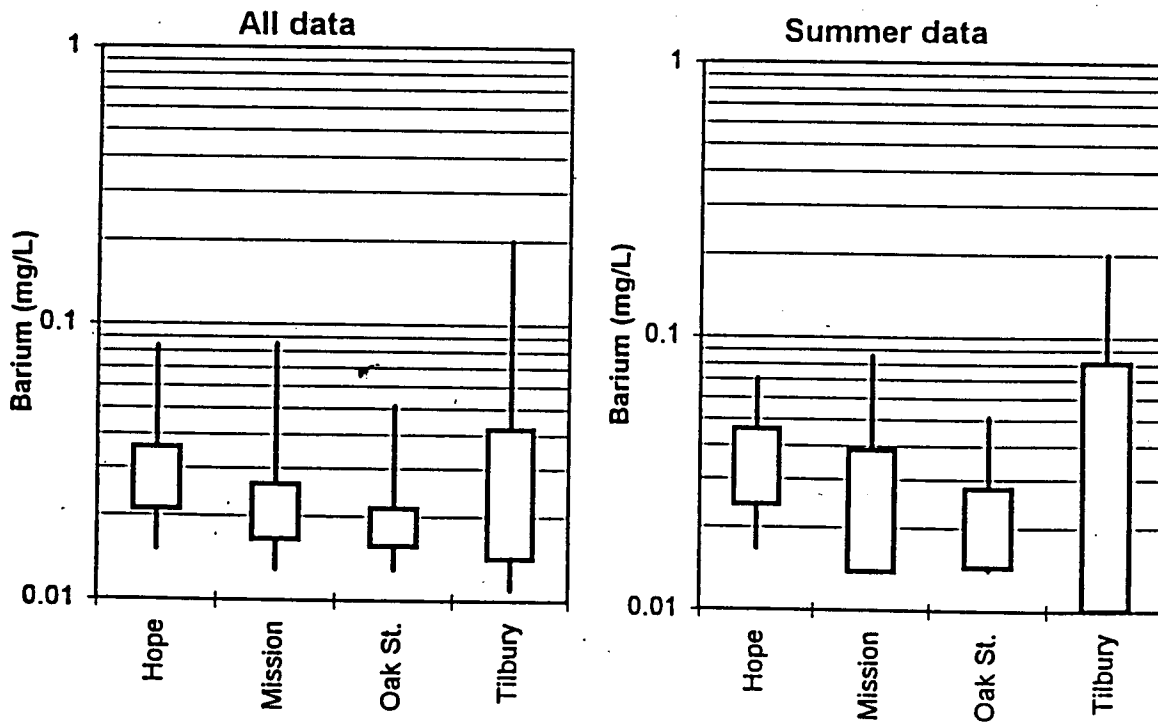


Figure 41. Summary of Barium Data, Main River Sites

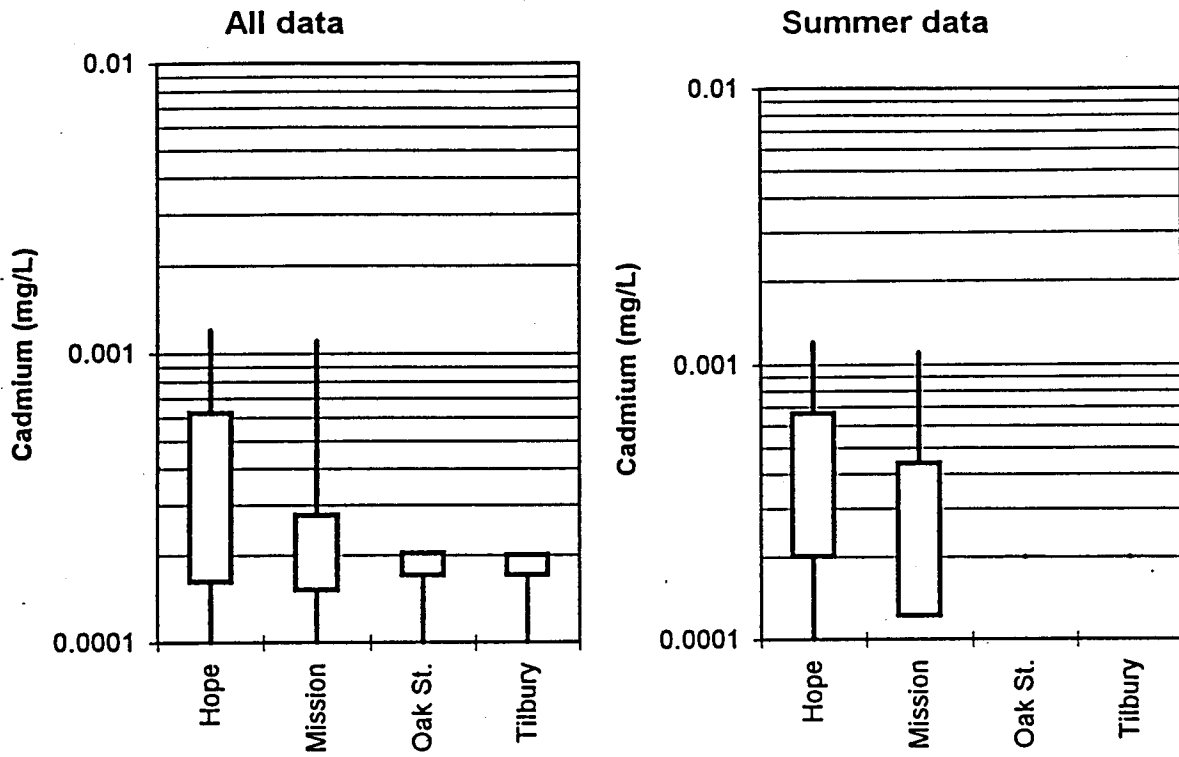


Figure 42. Summary of Total Cadmium Data, Main River Sites

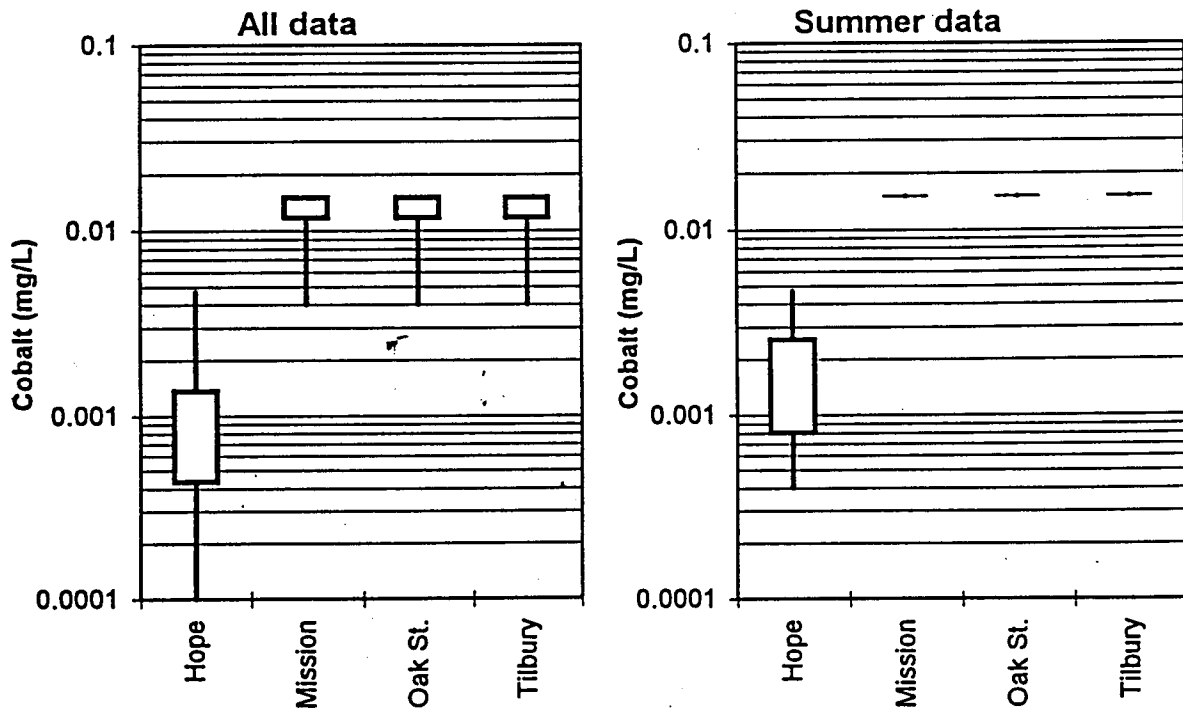


Figure 43. Summary of Total Cobalt Data, Main River Sites

3.7.7 Chromium (Cr)

Sixty-one of 90 measurements for total chromium were below the detection limits (0.001-0.005 mg/L; Table 11). The medians for all four sites were 0.001 mg/L. There was no significant difference between the different sites, including Hope (Figure 44).

All measurements were below the BC MOELP criterion and CCREM water quality guideline of 0.02 mg/L for the protection of aquatic life but a few measurements (seven, maximum 0.018 mg/L) exceeded the BCMOELP criterion of 0.002 mg/L for phytoplankton and zooplankton. The highest chromium values corresponded with high suspended material in the river.

3.7.8 Copper (Cu)

Seventeen of the 90 measurements were below the detection limit (0.001 mg/L). There were no significant differences in total copper concentration between any of the sites, including Hope (Figure 45). The median concentrations were 0.001 mg/L at Mission and 0.002 mg/L for Hope, Tilbury Island and Oak Street Bridge. Many of the measurements exceeded the provincial criterion and federal guideline of 0.002 mg/L (based on a hardness of <60 mg/L) for the protection of freshwater aquatic life; however, all but six measurements were below the Fraser River objective of a maximum of 0.006 mg/L. (Three of the six were measured on the same date at all three sites when suspended solids were also high. Hardness ranged between 44-102 mg/L.) The 90th percentile was 0.005 mg/L at Mission and Tilbury Island and 0.004 mg/L at Oak Street Bridge.

The seasonal pattern for copper is scattered but there are generally higher values during the high flow periods (Figure 46). The highest copper concentrations corresponded to very high suspended sediment values as well as high levels of several other metals. A comparison of copper concentration and non-filterable residue was found to be significant ($r^2=0.52$). Swain *et al.* (1995) report mean concentrations for total copper between 0.002 mg/L and 0.004 mg/L. The occasional high value in the North Arm, reported by Swain *et al.* (1995) was believed to be associated with storm water discharges which were estimated to increase the concentration of copper by 0.001 mg/L during low river flow.

3.7.9 Iron (Fe)

There were no significant differences in the concentration of total iron in samples collected at Mission, Tilbury Island or Oak Street Bridge stations; the concentration of iron at Hope was generally higher compared to the downstream sites (Figure 47). The median concentration for total iron was 0.58 mg/L at Hope, 0.30 mg/L at Mission, 0.51 mg/L at Tilbury Island and 0.47 mg/L at Oak Street Bridge. Similar values were also reported in Drinnan and Clark (1980) and for other water quality sites in the river (Swain, *et al.*, 1995).

The seasonal pattern for total iron parallels river flow, with higher concentrations during the period May to June (>1.0 mg/L) and lowest values in November to February (<1.0 mg/L) (Figure 48). A regression analysis showed iron to be strongly correlated with non-filterable residue ($r^2 = 0.89$). Examination of the data from specific dates (Appendices VII, VIII & IX) showed that the highest concentration of iron corresponded with very high suspended solids and with several other metals, including arsenic, chromium, copper, iron, nickel and zinc.

The water quality guideline/criteria for the protection of aquatic life recommended by both federal (CCREM, 1987) and provincial (BC MOELP, 1994) agencies is 0.3 mg/L. This value was exceeded on many occasions, however, the strong association of iron with the particulate matter in the river likely means that much of the iron is derived from upstream erosion and may not be available to biota.

3.7.10 Mercury (Hg)

All measurements for total mercury were below the MDL of 0.00005 mg/L (Table 11). The most sensitive criterion is 0.00001 mg/L.

3.7.11 Manganese (Mn)

There were no significant differences in the concentration of total manganese between the sample sites, including Hope (Figure 49).

The BCMOELP criterion for the protection of freshwater aquatic life is 0.1 mg/L. This was exceeded only on two occasions (Mission and Oak Street Bridge), both on the same date. The concentration of suspended solids was also elevated in these samples.

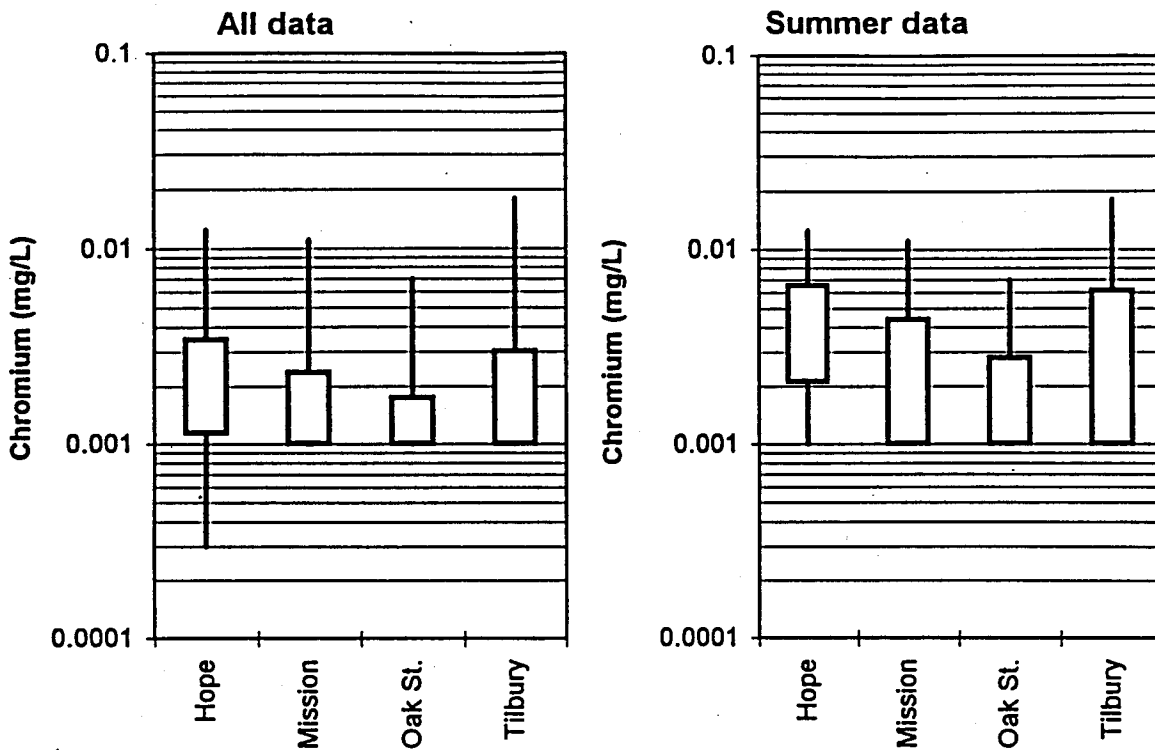


Figure 44. Summary of Total Chromium Data, Main River Sites

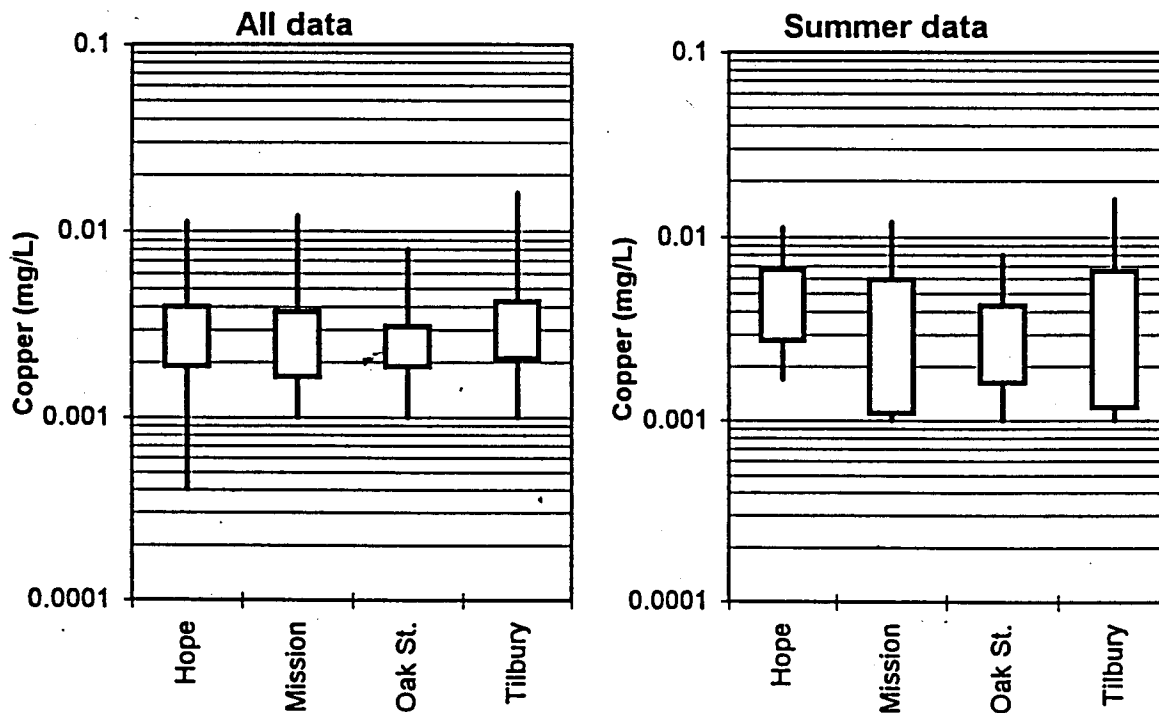


Figure 45. Summary of Total Copper Data, Main River Sites

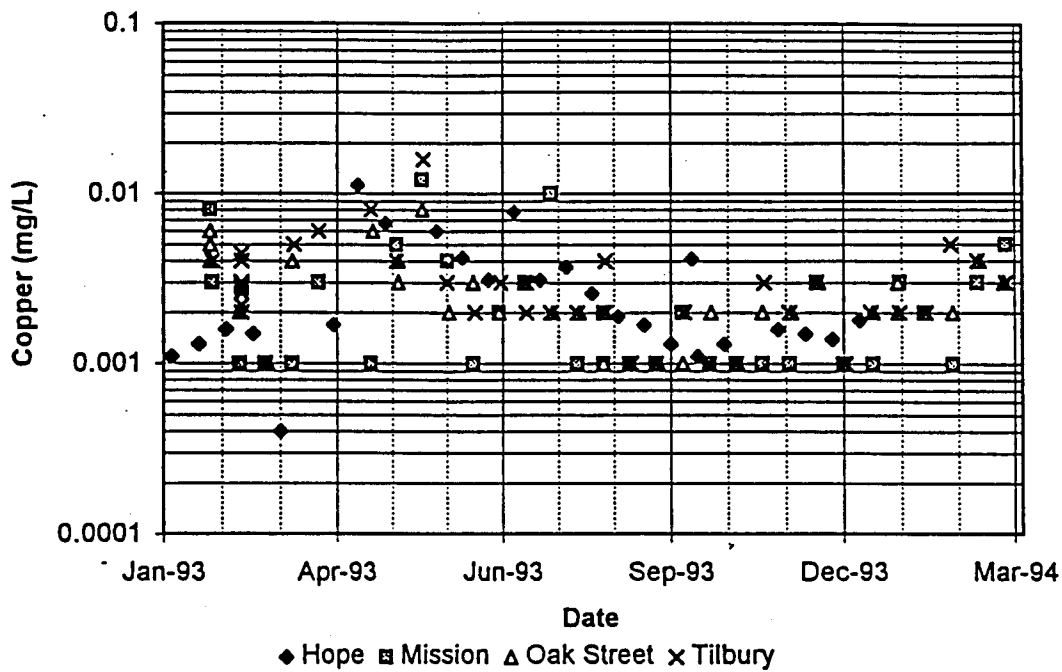


Figure 46. Seasonal Changes in Total Copper, Main River Sites

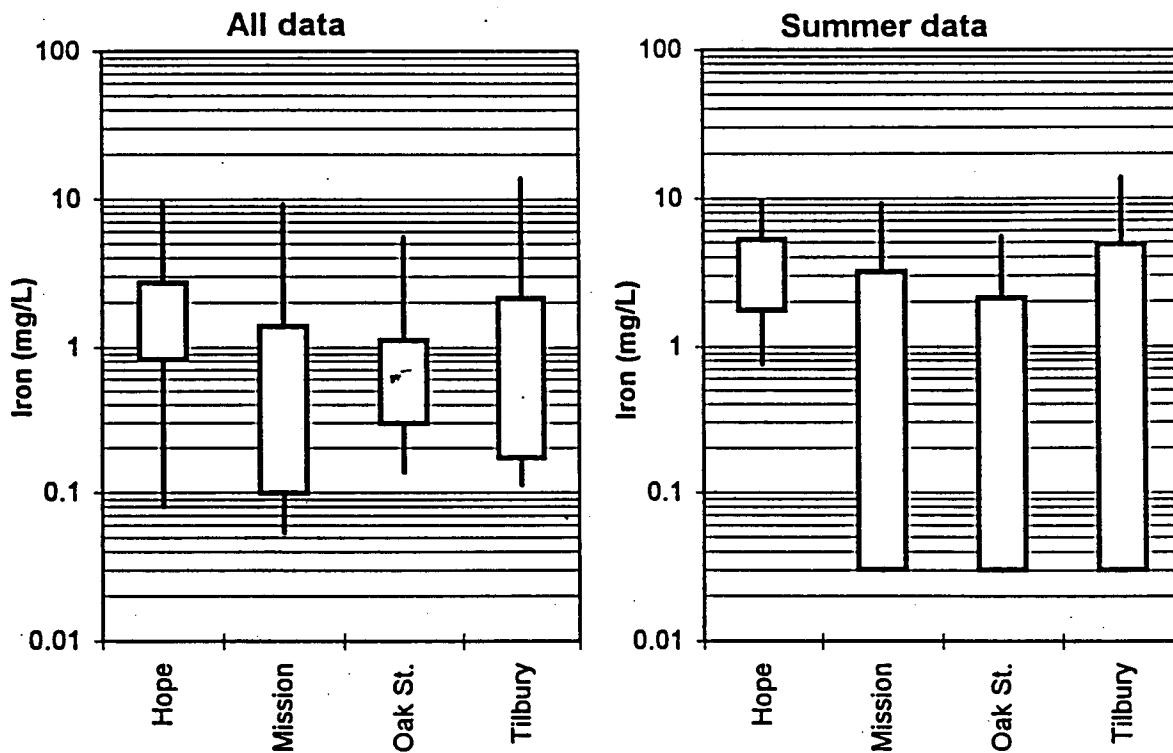


Figure 47. Summary of Total Iron Data, Main River Sites

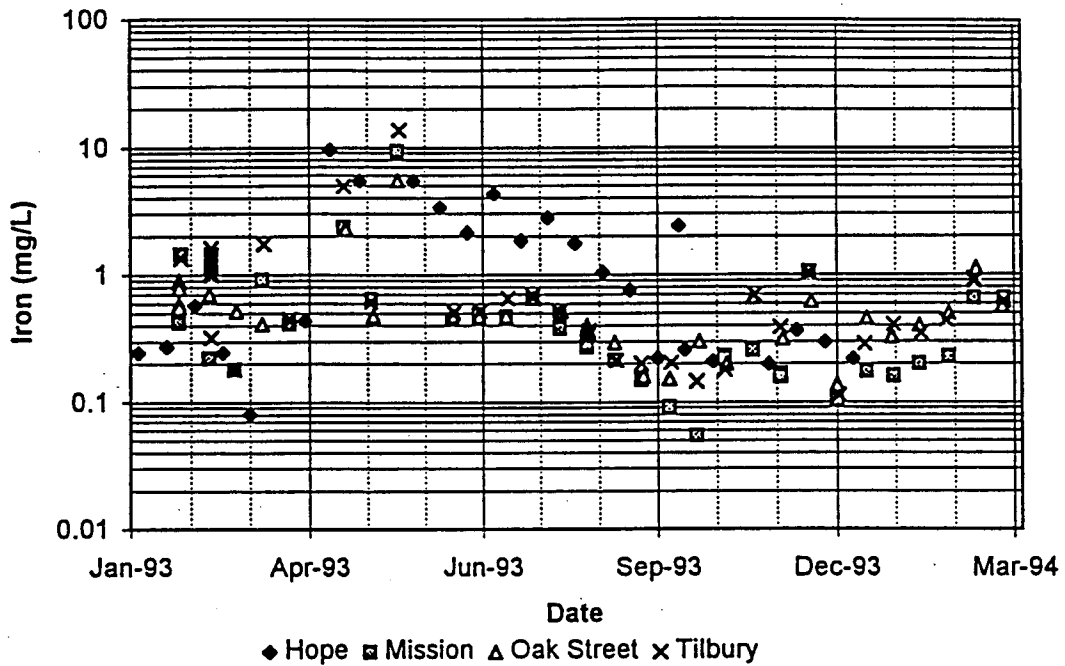


Figure 48. Seasonal Changes in Total Iron, Main River Sites

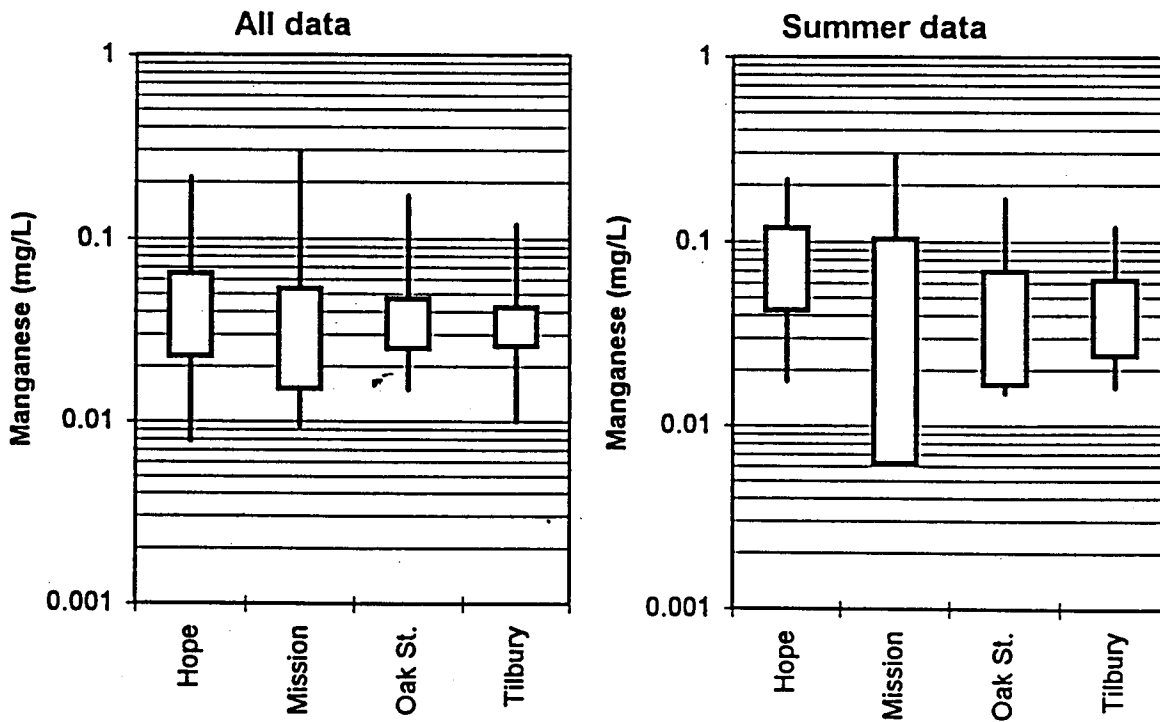


Figure 49. Summary of Total Manganese Data, Main River Sites

3.7.12 Molybdenum (Mo)

Eighty-one of 90 measurements were below the MDLs of 0.001, 0.004 and 0.005 mg/L. Due to a lower MDL (0.0004 mg/L) the concentration at Hope appeared to be lower (Figure 50). All measurements were below the most sensitive criterion for aquatic life of 2.0 mg/L.

3.7.13 Nickel (Ni)

Approximately half of the samples had measurable levels of total nickel (47 of 90 measurements; Table 11). There were no significant differences in the concentration of nickel between the study sites, including Hope, when either all the data were examined or when “summer only” data were used (Figure 51).

Higher concentrations of nickel were generally associated with higher suspended solids. All measurements were below the provincial criterion and federal guideline of 0.025 mg/L for the protection of freshwater aquatic life.

3.7.14 Lead (Pb)

There were no significant differences in total lead between the sample sites, including Hope (Figure 52), but most of the lead measurements (71 of 90) were below the detection limits of 0.001 and 0.003 mg/L (Table 11). The CCREM guideline for the protection of freshwater aquatic life is 0.001 mg/L; therefore, all measurable values (19 samples) exceeded this guideline. However, the maximum concentration at all three sites was 0.003 mg/L which is below both the BCMOELP criterion and the Fraser River objective (Table 11). Lead measurements in the North Arm reported by Swain *et al.*, (1995) appear to be slightly higher (0.003 mg/L - 0.004 mg/L) than those measured in this study, but this may be a consequence of many of the measurements being close to, or below the MDL of 0.001 mg/L. A suggested increase from the 1979-1980 compared to 1985-1993 may also be a sampling artifact if proportionately more samples are collected during a period with higher suspended solids.

3.7.15 Selenium (Se)

All 90 of the measurements for total selenium were below the minimum detection limits of 0.0005 and 0.03 mg/L.

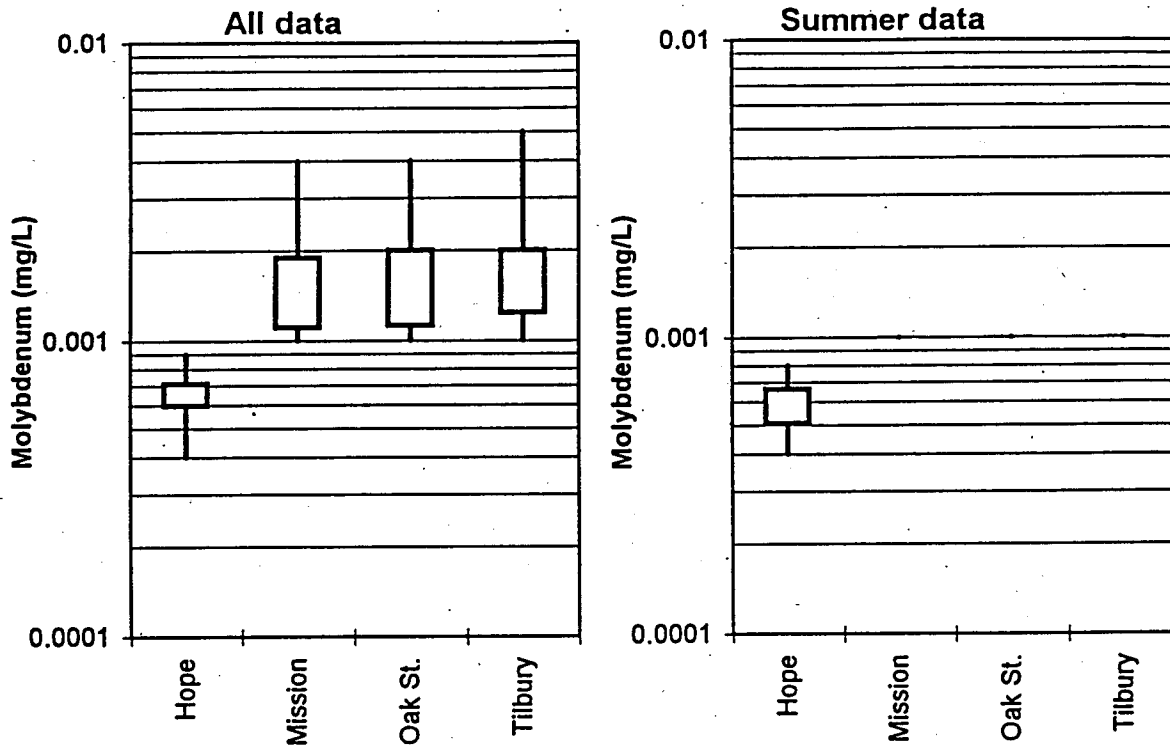


Figure 50. Summary of Total Molybdenum Data, Main River Sites

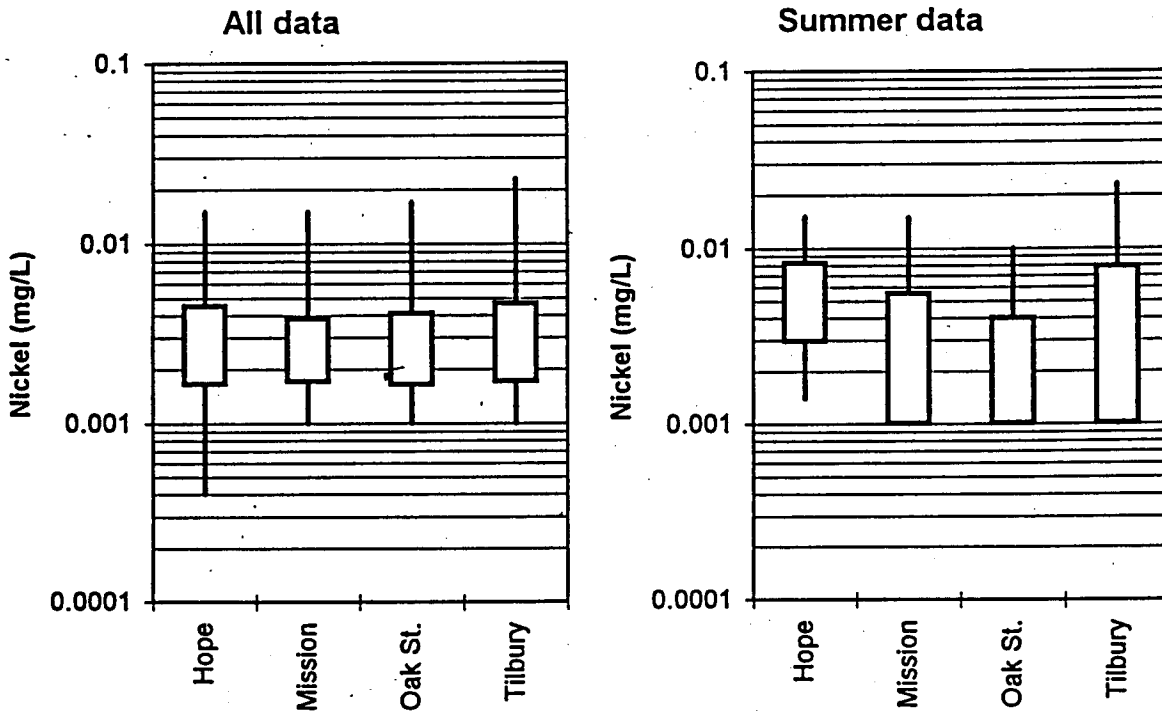


Figure 51. Summary of Total Nickel Data, Main River Sites

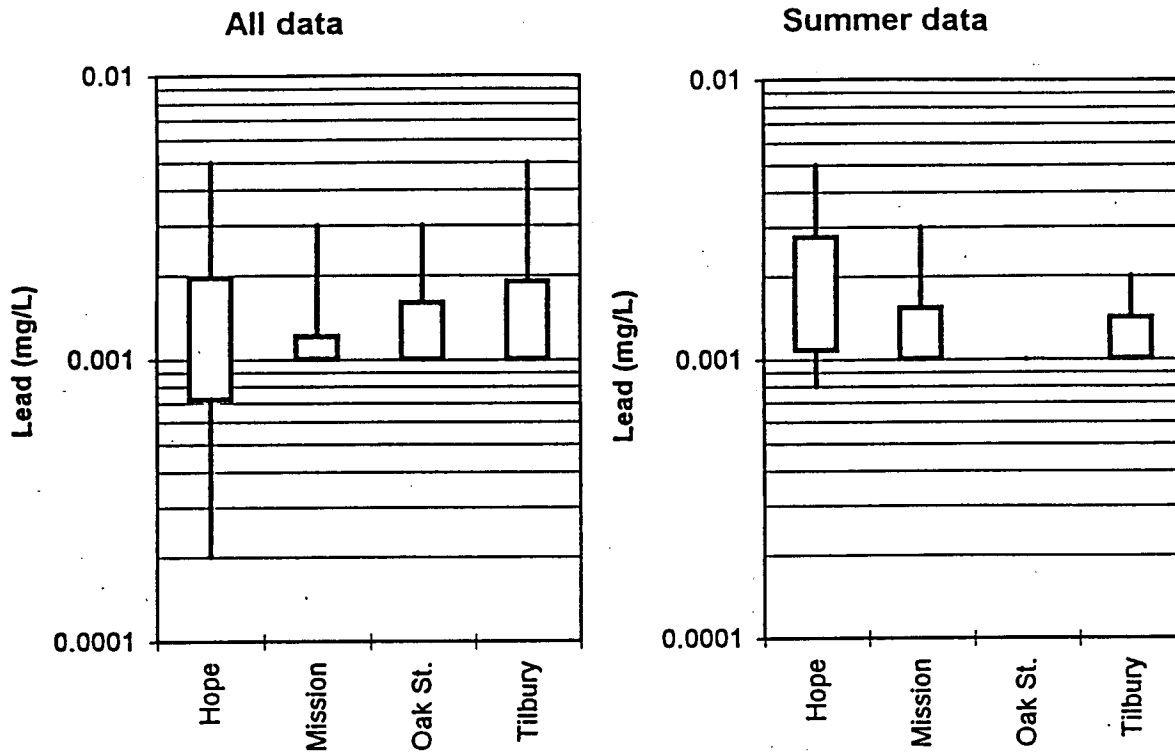


Figure 52. Summary of Total Lead Data, Main River Sites

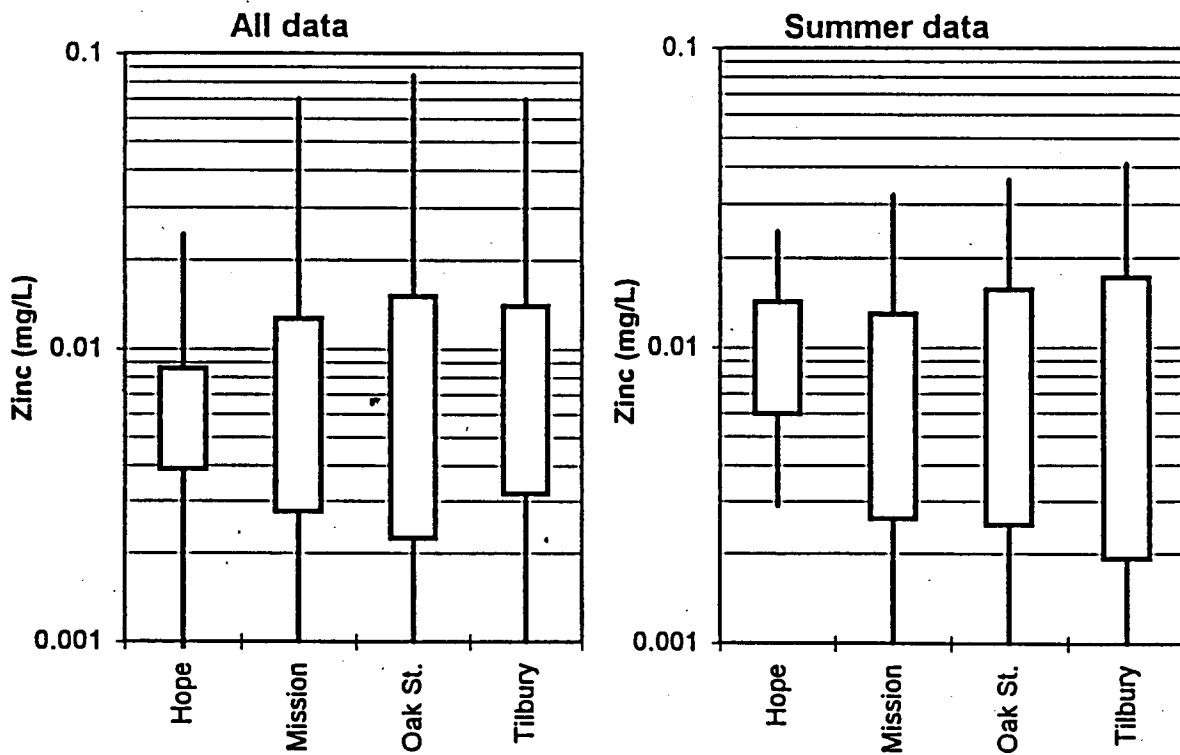


Figure 53. Summary of Total Zinc Data, Main River Sites

3.7.16 Tin (Sn)

The initial detection limit for total tin was 0.02 mg/L (January - March, 1993) and four of the 15 measurements exceeded the MDL (range was 0.03-0.05 mg/L). For the remainder of the program, the detection limit was 0.3 mg/L and all of the 75 samples were less than the MDL.

3.7.17 Zinc (Zn)

Zinc was detected in 61 of 90 samples (with detection limits from 0.01 to 0.001 mg/L; Table 11). There were no significant differences in total zinc between any of the study sites or with data collected at Hope (Figure 53). Inspection of the data indicated that higher concentrations of total zinc were associated with higher suspended solid levels which in turn were associated with higher Fraser River flows. The median concentration was 0.003 mg/L at Hope and 0.005 mg/L at the Mission, Tilbury Island and Oak Street Bridge sites. Similar ranges in concentration were reported for the 1985-1993 period (Swain *et al.*, 1995).

Six measurements (maximum concentration was 0.09 mg/L) exceeded the criterion of 0.03 mg/L set by BC MOELP and CCREM for the protection of freshwater aquatic life (Table 11). The Fraser River objective of 0.05 mg/L was exceeded three times, once each at Tilbury Island, Oak Street Bridge and Mission, during the same sampling period. Three of the six samples were associated with high suspended solids.

3.8 Total Organic Carbon

There were no significant differences among the Mission, Tilbury Island or Oak Street Bridge sites for total organic carbon (TOC) either for all the data or the "summer only" values (Figure 54).

3.9 Fecal Coliforms

Fecal coliform levels at Mission were significantly lower compared to the Tilbury Island and Oak Street Bridge sites when all data were included in the analysis but there were no differences when the "summer only" data (April to September, inclusive) were compared (Figure 55). The "summer only" data at Tilbury Island and Oak Street Bridge were also close to an order of magnitude lower compared to the entire data set. The decrease in fecal coliform levels during the summer is likely a combined consequence of dilution from higher river flow, disinfection of the effluent at the Annacis Island STP, and lower storm water and combined sewer overflow discharge contributions (higher fecal coliforms in the receiving environment are generally associated with higher rainfall events; Drinnan *et. al*, 1995; Miller *et. al*, 1994).

The seasonal pattern in fecal coliform levels is shown in Figure 56, and the lower concentrations during the period April to September are apparent. The objective for the Fraser River is a geometric mean of <1000 fecal coliforms (FC)/100 mL (based on five or more samples collected within a 30-day period) and a maximum of 4000 FC/100 mL for any individual sample (Swain and Holms, 1985), but this is applicable only for the period between April and October. This objective was met at all three sites. The objective for primary recreation activities is a geometric mean of 200 FC/100 mL (based on five or more samples) which was also met during the months of June to September (the time period when local health authorities monitor public beaches) but not during the "winter" period.

High values at some sites, particularly Oak Street Bridge, are likely the result of stormwater discharges during and after large rainfall events. High levels of fecal coliforms (>4,000 FC/100 mL) on March 22, 1993, November 29, 1993, February 22, 1994 and March 7, 1994 all corresponded to high rainfall prior to, or during, sampling. Rainfall is considered an important factor governing fecal coliform levels in the river since high fecal coliform loadings are generally associated with rainfall events as stormwater runoff and combined stormwater/sewage overflows (CSO) discharges increase.

An intensive study of fecal coliform levels in the lower Fraser (Rocchini, *et al.*, 1981) showed that while there was considerable variability in the data, there were significant differences between sampling day, distance from shore and time of day (tide). The most significant effect was time of day (likely a consequence of changes in the tide), followed by distance from shore and day of the week. The higher concentrations measured near the shore were likely due to shoreline discharges.

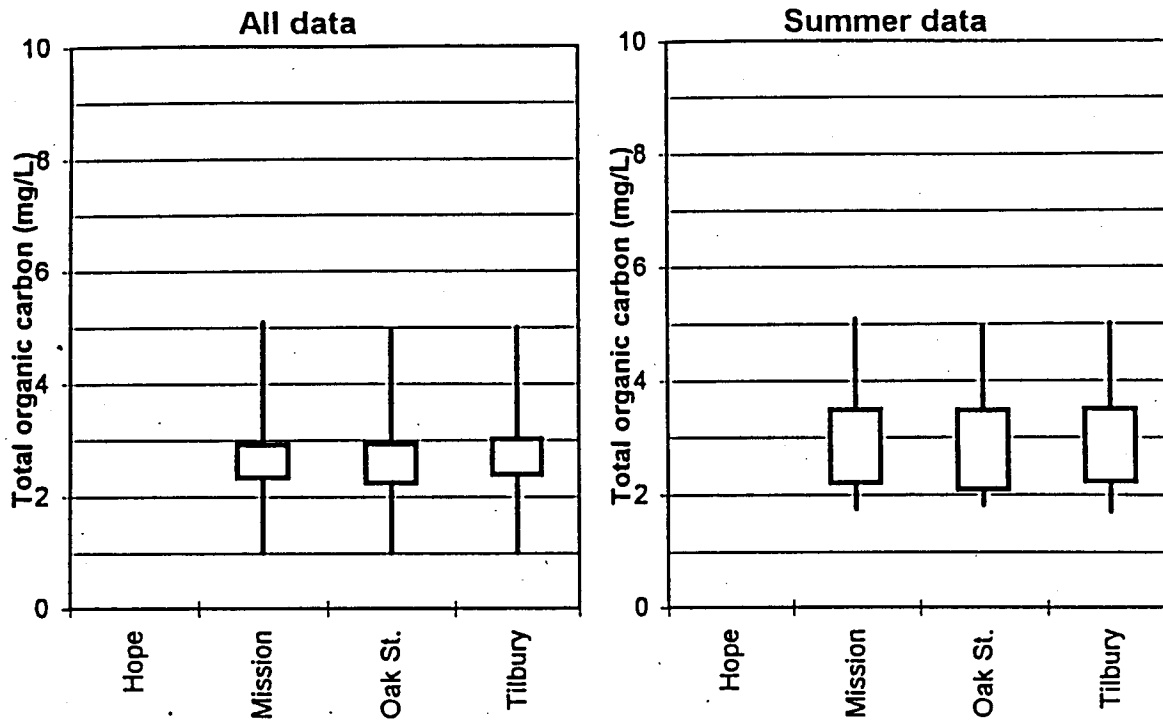


Figure 54. Summary of Total Organic Carbon Data, Main River Sites

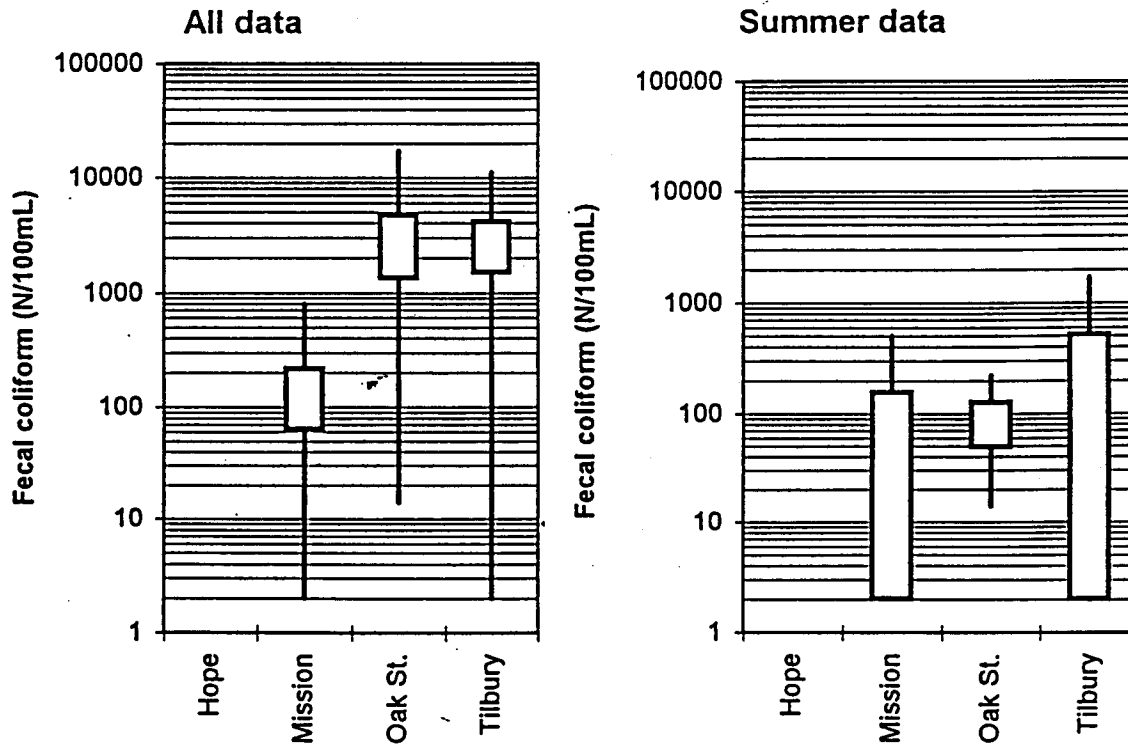


Figure 55. Summary of Fecal Coliform Data, Main River Sites

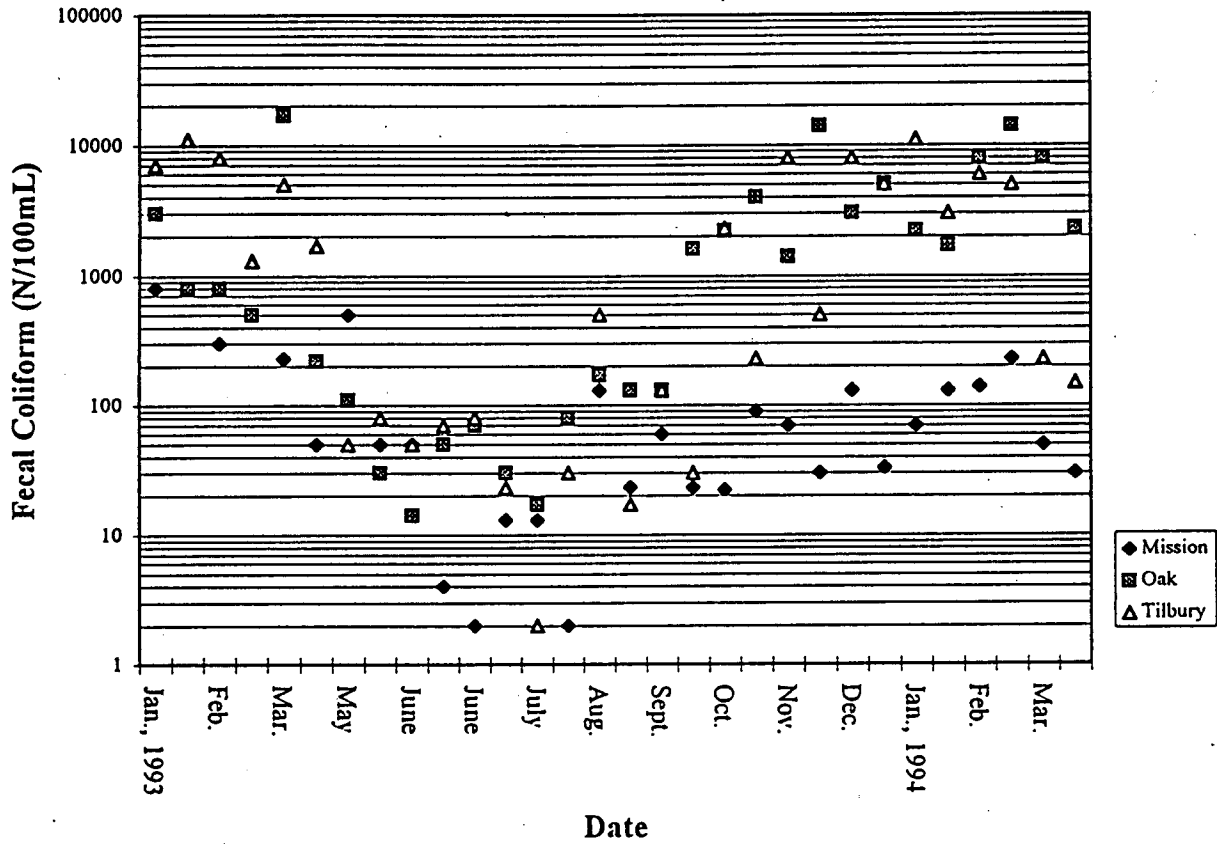


Figure 56. Seasonal Changes in Fecal Coliforms, Main River Sites

3.10 Organic Compounds

Samples were collected at approximately one month intervals throughout the study period (17 sampling dates) and analyzed for adsorbable organic halides (AOX), chlorinated phenolics and nonylphenol. Resin and fatty acids, organochlorine pesticides, TCMTB and PCBs were analyzed four times on an event basis: February 22-23, 1993 (low flow conditions; May 17-18, 1993 (freshet); October 18-19, 1993 (first flush); and February 21-23, 1994 (low flow). Tables 3, 4 and 5 (Section 2) list the individual compounds. Most measurements were below the method detection limit (MDL) or, if present, close to the MDL.

Because of the infrequent measurable values, figures for the individual resin acids, fatty acids, organo-chlorine pesticides, TCMTB and PCBs are not presented.

3.10.1 Adsorbable Organic Halides (AOX)

There was no significant difference in the concentration of AOX among any of the three sites from this study or with data from Hope. When all of the data are compared, the concentration at Hope appears slightly higher but this is not apparent when only the "summer" sub-set are compared (Figure 57). The median AOX concentration was 0.02 mg/L at the three study sites compared to 0.03 mg/L at Hope. The detection limit was 0.01 mg/L.

AOX is a measure of the total amount of halogenated organic compounds present and the source is primarily from the use of chlorine in the bleaching process at pulp mills. Pulp mills are located upstream in the Fraser River, at Prince George and Quesnel, and on the Thompson River at Kamloops. Measurements of AOX upstream of Prince George were generally below 0.005 mg/L; levels downstream of Quesnel were about 0.150 mg/L (Hatfield Consultants, 1994). Dilution, adsorption to particles and chemical degradation are likely reasons for the decrease in concentration below Hope.

3.10.2 Chlorophenolics

Samples were analyzed for 39 individual chlorophenolic compounds. Most measurements were below the detection limit; measurable concentrations were generally near the MDL (see Figures 58-62). None of the individual compounds exceeded their respective water quality guideline or criterion, where they exist (many of the congeners do not have established water quality criteria)(CCREM, 1987; BC MOELP, 1994). The Fraser River Objective of 0.0002 mg/L for total chlorophenol (calculated by summing the values of all congeners) was also never exceeded.

There were no significant differences between the sites at Mission, Oak Street Bridge and Tilbury Island (Figure 58). Because of the number of "less than" measurements for chlorophenolic compounds, seasonal patterns were not apparent, although there was a trend towards higher numbers of detectable measurements during lower river flows. There was no apparent seasonal pattern for total chlorophenol (Figure 59).

Drinnan *et al.* (1988) compiled all chlorophenol data collected up to 1987, downstream from Kanaka Creek, in a single database. Eighty-six percent of the 206 water samples had detectable levels of one or more chlorophenolic compounds. The median and 90th percentile of the calculated total chlorophenol for these data were 0.00015 mg/L and 0.0021 mg/L respectively. Highest concentrations of total CP were generally adjacent to known sources (primarily wood-treatment facilities using CPs as anti-sapstain agents). The nearly one order of magnitude decrease in total chlorophenol concentration in the water between the pre-1987 data and the present 1993/1994 data set likely reflects regulatory and operational changes by the forest industry which has resulted in a decrease in the number of mills using chlorophenates from 73 in 1988 to 0 in 1990 (Environment Canada, 1991b).

3.10.3 Nonylphenol

Nonylphenol was not detected in any samples (MDL = 0.000005 mg/L).

3.10.4 TCMTB

TCMTB (2-[thiocyanomethyl] thiobenzothiazole) is an anti-sapstain compound used by the forest industry. It was not detected in any of the samples analyzed; however, the detection limit was high (MDL = 0.005 mg/L).

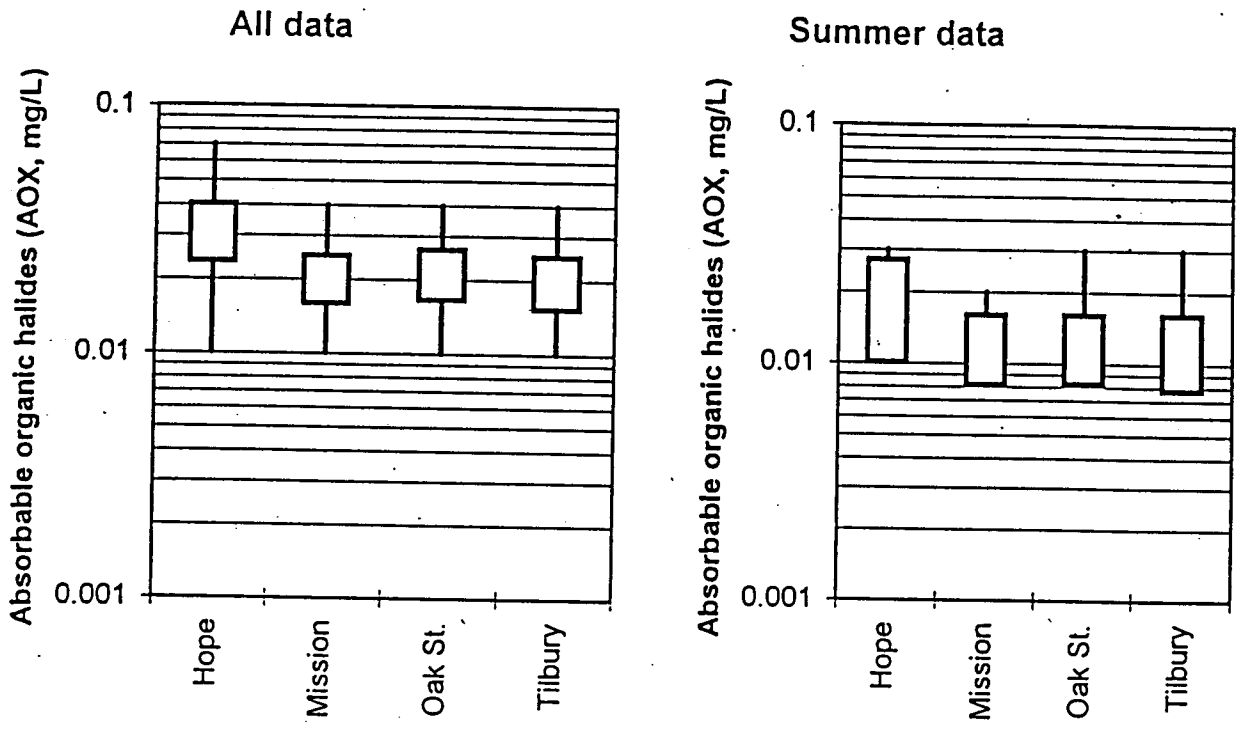


Figure 57. Summary of Absorbable Organic Halide (AOX) Data, Main River Sites

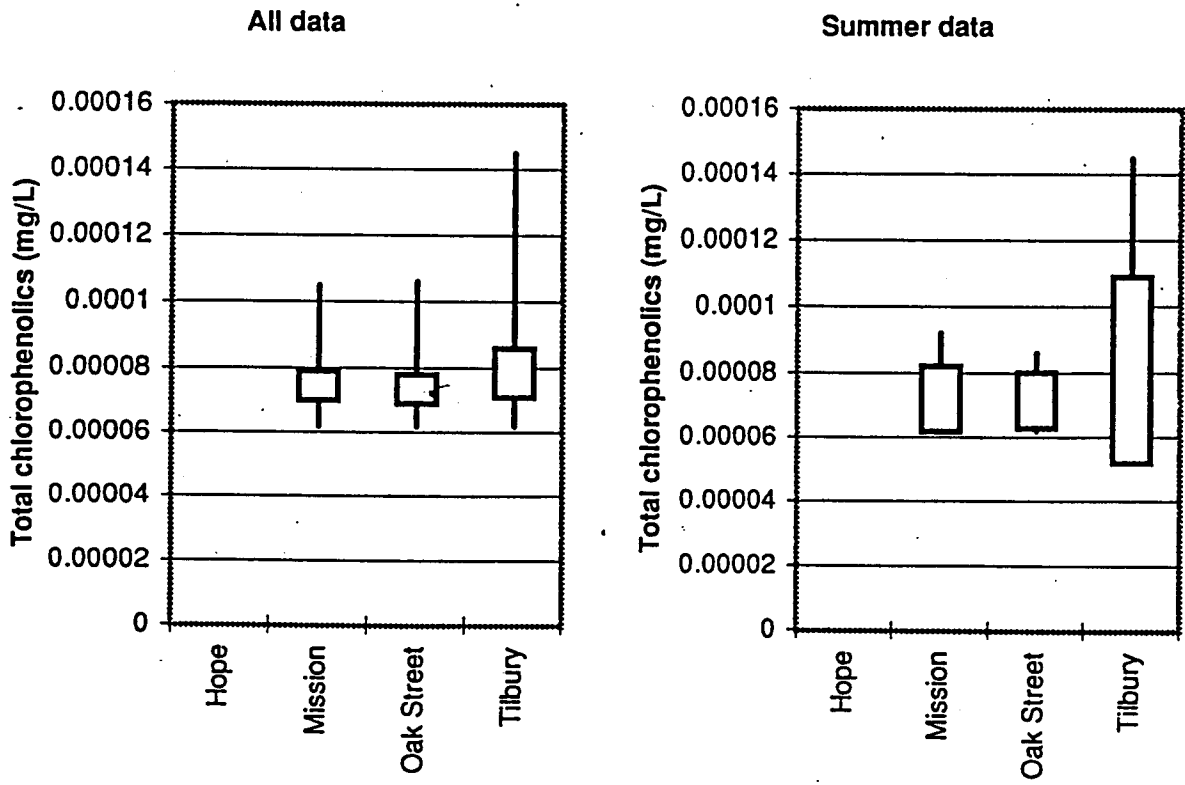


Figure 58. Summary of Total Chlorophenolics Data (Calculated), Main River Sites

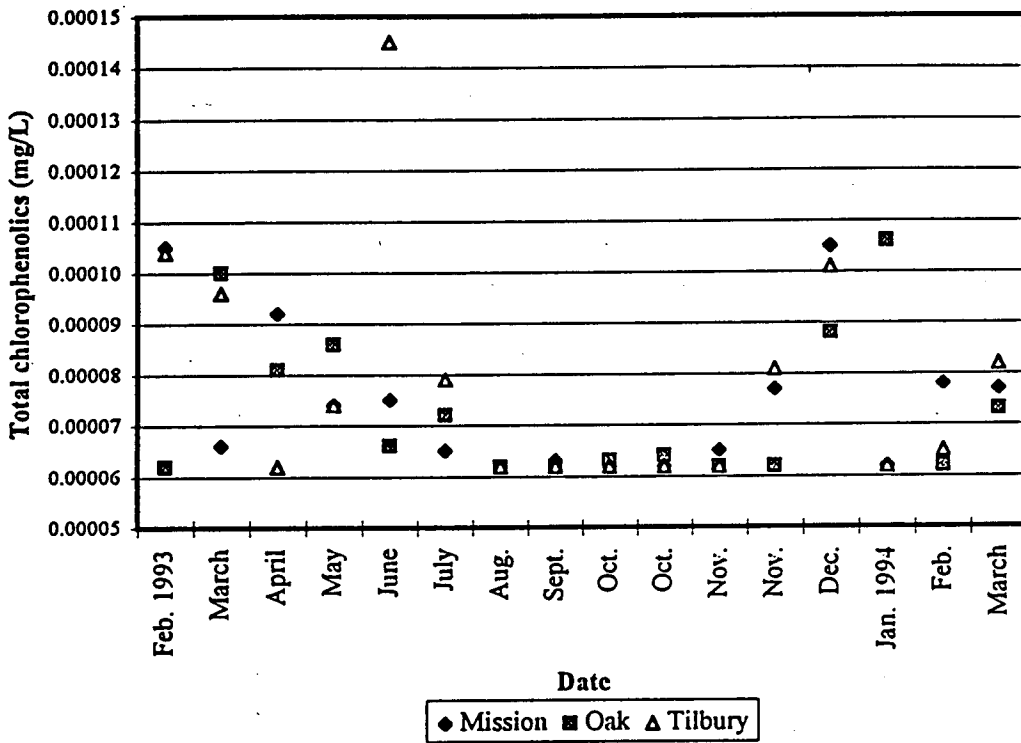


Figure 59. Seasonal Changes in Total Chlorophenolics, Main River Sites

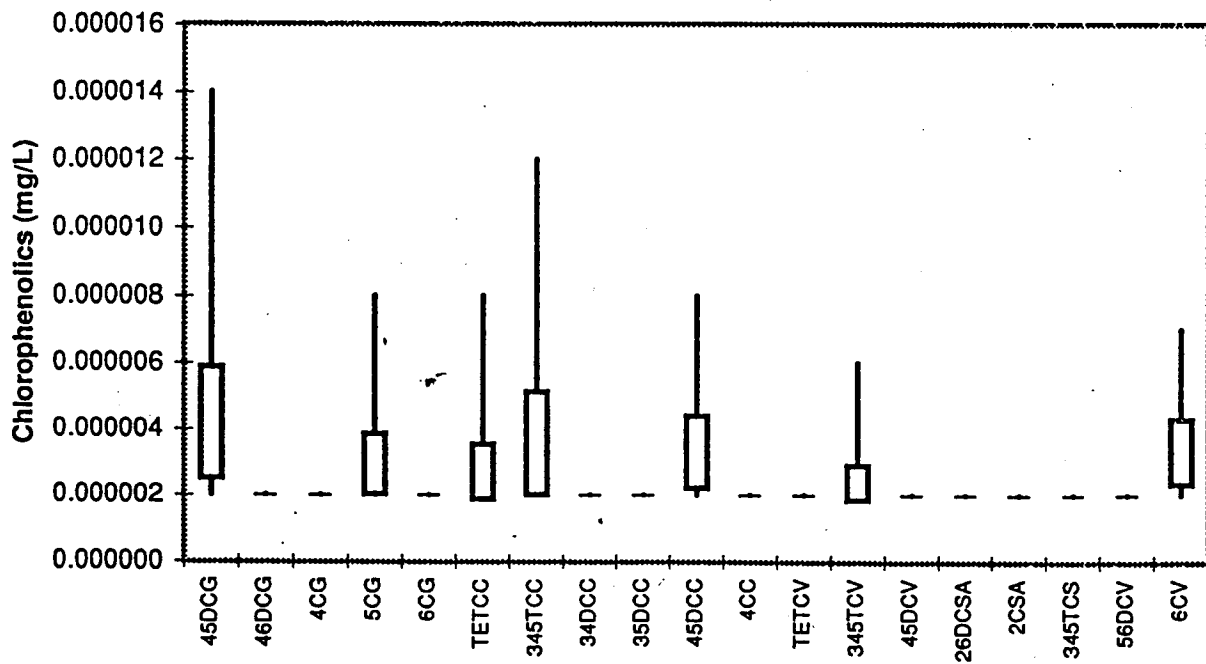
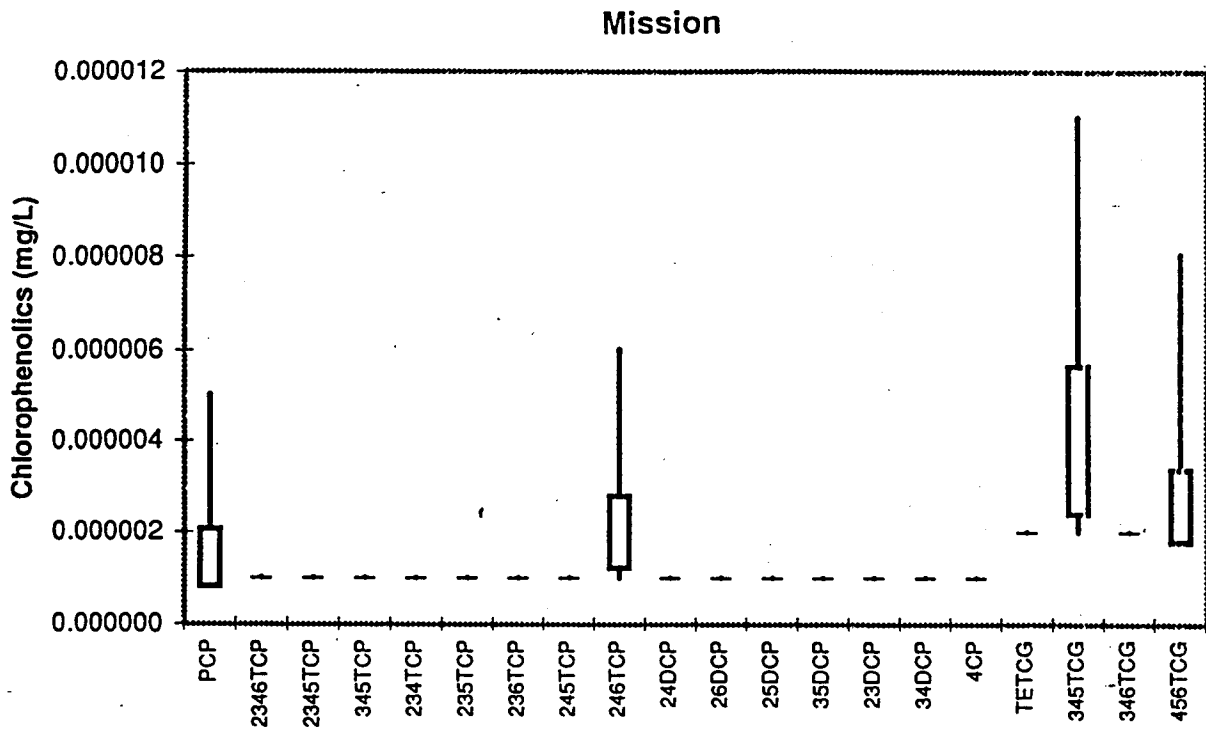


Figure 60. Summary of Individual Chlorophenolic Compounds, Mission.
 (See Table 3 for the Key to the Chemical Compound Codes)

Tilbury

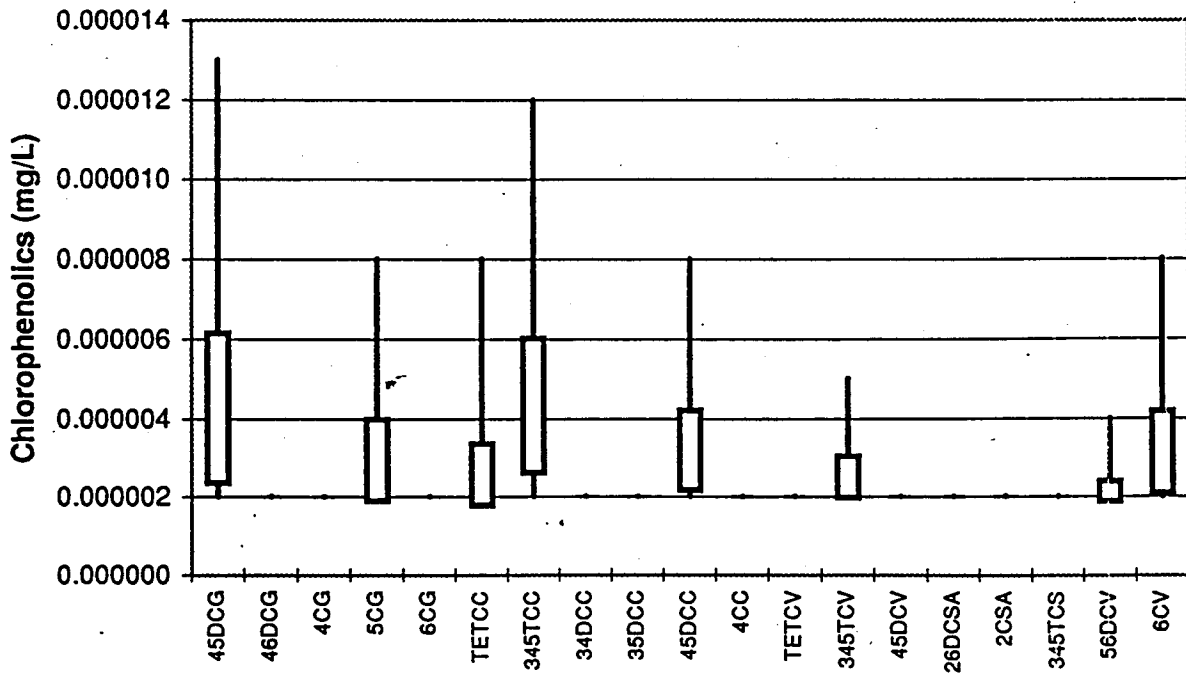
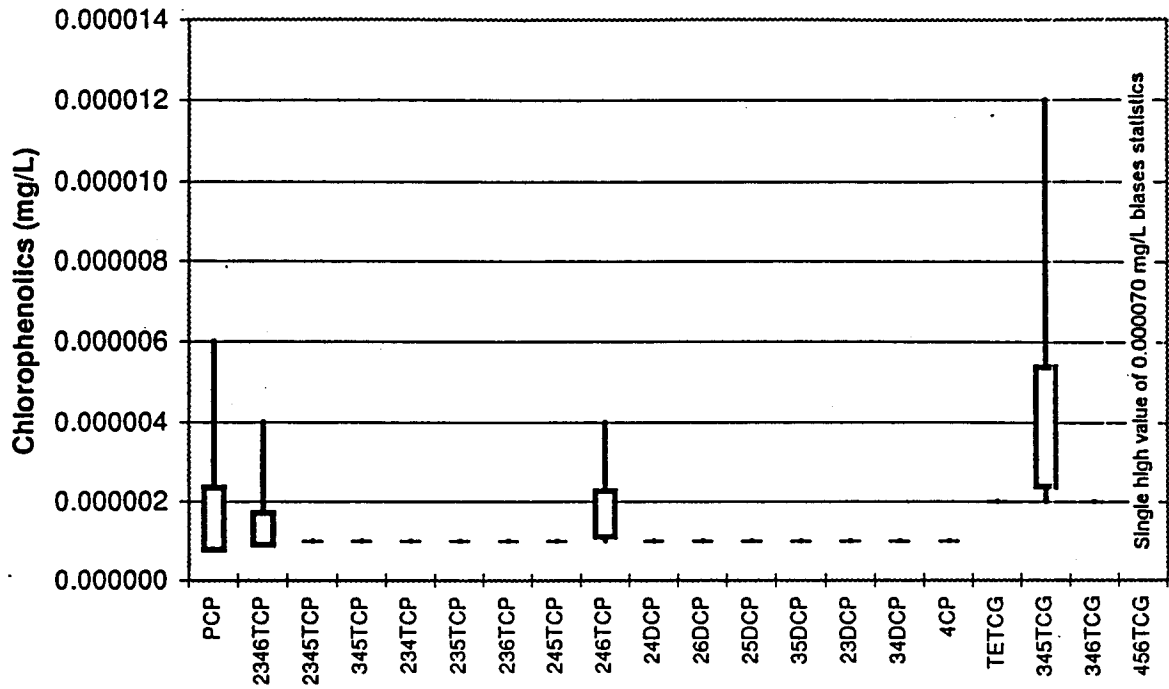


Figure 61. Summary of Individual Chlorophenolic Compounds, Tilbury Island. (See Table 3 for the Key to the Chemical Compound Codes)

Oak Street

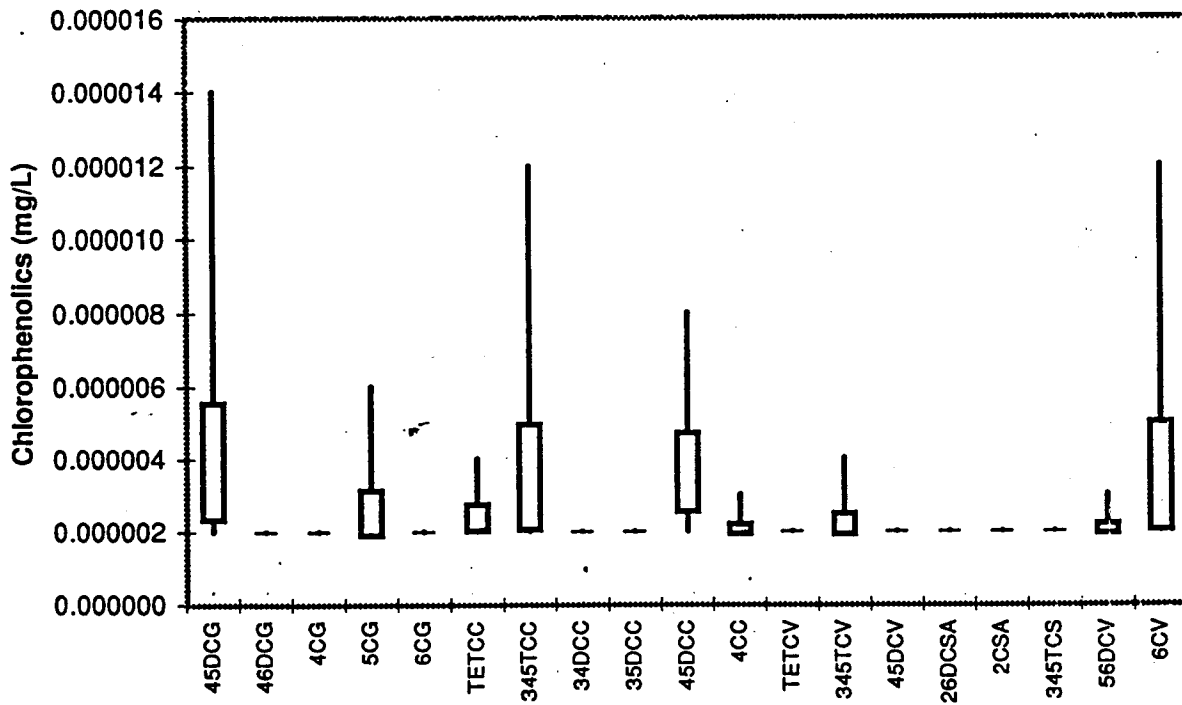
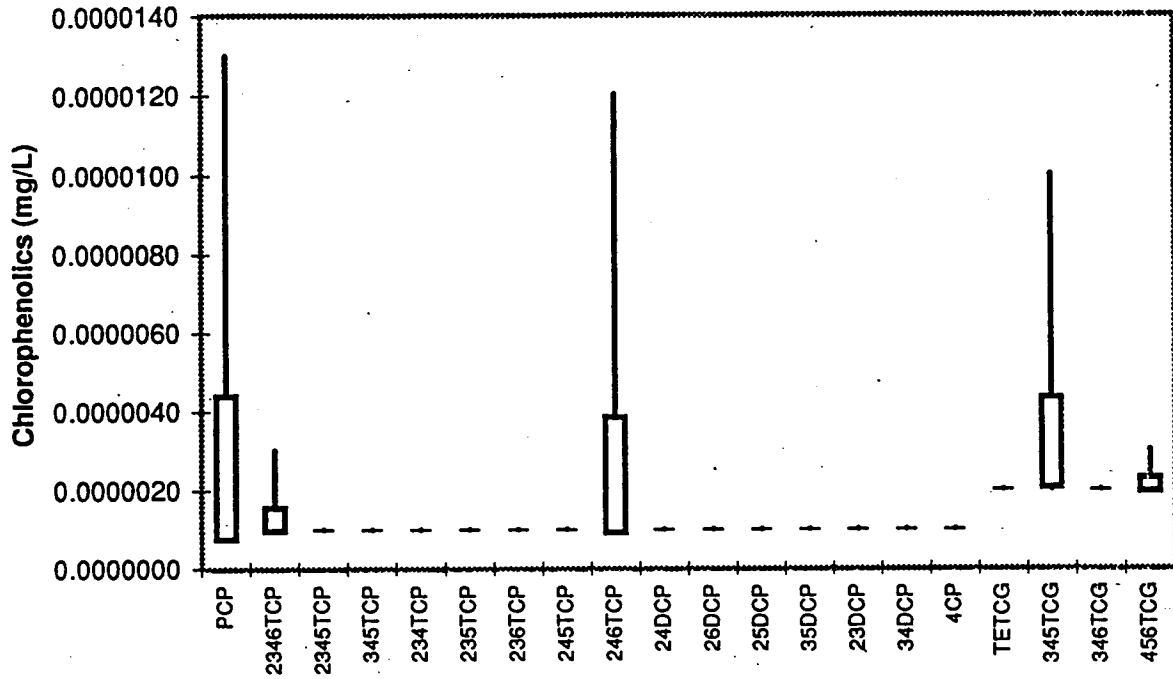


Figure 62. Summary of Individual Chlorophenolic Compounds, Oak Street Bridge.
 (See Table 3 for the Key to the Chemical Compound Codes)

3.10.5 Resins and Fatty Acids

Samples were analyzed for 20 individual resin and fatty acid compounds on four occasions. Only 14 of 240 measurements exceeded their respective detection limit, and all of these compounds were fatty acids. The measurable values are presented in Table 12. All 14 values were sampled on two dates (October/93 and February/94), both during low flow. Palmitic acid was above the MDL in four samples; stearic and linoleic acids in three samples; and myristic and oleic acids in one sample. There are no water quality guidelines for these compounds.

The infrequent occurrence and low concentrations of these compounds suggest that water quality concerns are likely to be low.

Table 12. Summary of Measurable Fatty Acid Compounds

Compound	MDL (mg/L)	Sample Value (mg/L)	Site	Date
Palmitic Acid	0.0005	0.0007	Mission	Oct/93
		0.001	Tilbury Island	Oct/93
		0.0033	Tilbury Island	Feb/94
		0.0024	Oak Street Bridge	Feb/94
Stearic Acid	"	0.0005	Tilbury Island	Oct/93
		0.0034	Tilbury Island	Feb/94
		0.0025	Oak Street Bridge	Feb/94
Myristic Acid	"	0.0005	Mission	Oct/93
		0.0007	Oak Street Bridge	Feb/94
Oleic Acid	"	0.0018	Tilbury Island	Feb/94
		0.0008	Oak Street Bridge	Feb/94
Linoleic Acid	"	0.0009	Tilbury Island	Oct/93
		0.0005	Tilbury Island	Feb/94
		0.001	Oak Street Bridge	Oct/93

3.10.6 Organochlorine Pesticides and Polychlorinated Biphenols (PCBs)

Samples were analyzed for 24 individual organochlorine pesticide compounds (see Table 5). There were only two (of 96 total) detectable measurements - one each for DDD pp' (0.000011 mg/L) and hexachlorobenzene (0.000001 mg/L), both of which occurred in February 1993 at Oak Street Bridge. The low concentrations and infrequent occurrence of measurable values suggest that there are no water quality concerns.

PCBs were analyzed in the same 17 samples. All measurements were below the detection limit of 0.00002 mg/L.

4.0 RESULTS AND DISCUSSION - SLOUGHS

The complete slough data set is presented in Appendix X. An inspection of the data, particularly specific conductivity data (Appendix X and XI), revealed that the sloughs were often affected by the intrusion of marine water, particularly in the bottom samples.

4.1 Water Temperature and Dissolved Oxygen

Water temperatures ranged between 3.5°C and 7°C with McDonald and Eburne Sloughs showing slightly higher average values (Figure 63a).

All dissolved oxygen values were greater than the minimum value of 6.5 mg/L set by federal and provincial guidelines and criteria (Table 11); the overall minimum concentration was 8.6 mg/L, recorded at Deas Slough. Percent saturation in the sloughs tended to be lower than at the main river sites but still exceeded 80% for all samples. Only Deas Slough showed a consistent difference in percent saturation between the surface and bottom waters (95% at the surface versus 81% near the bottom). McDonald Slough and Eburne Slough showed the lowest average dissolved oxygen concentration (Figure 63b). Field profile data for dissolved oxygen show a consistent decrease with depth in all six sloughs, corresponding with an increase in specific conductivity (Appendix XI).

Beak (1991, 1993, cited in Swain *et al.*, 1995) measured dissolved oxygen profiles on two occasions each in 1991 and 1992 at the same six sloughs that were sampled in this present study. They reported a consistent decrease in dissolved oxygen levels with depth and a more rapid decrease within one metre of the bottom, likely as a result of microbial decomposition. Lowest values were associated with higher conductivity; the more dense saline water is less likely to be flushed from the bottom of the slough. The lowest value was 2.0 mg/L near the bottom of Eburne Slough.

Measurements of dissolved oxygen were taken in a number of sloughs and side channels in April, August and October, 1978 (Bergerud and Alexander, 1981). The mean concentration for dissolved oxygen in several North Arm and Main Arm sloughs ranged from 12.2 mg/L in April to 9.1 mg/L in August. The oxygen concentration generally decreased with depth and at some sites the concentration was as low as 1.5 mg/L near the bottom.

The decrease in oxygen with depth in sloughs is not unexpected. There is less flushing and mixing of the water, especially during low flow periods, resulting in less atmospheric exchange of oxygen in the more dense bottom water. The accumulation of organic material on the bottom increases the oxygen demand relative to surface waters.

4.2 pH and Alkalinity

There was very little variability in pH and no apparent differences among the sloughs (Figure 63c). All measurements were between pH 6.0 and 7.0 and within water quality guidelines and criteria (Table 11).

Alkalinity also didn't vary much with depth. Gundersen and Eburne Sloughs had the lowest alkalinity measures (Figure 63d).

4.3 Non-filterable Residue

In general, the non-filterable residue concentration in most of the sloughs was similar to that in the main reaches of the Fraser River for the same period, ranging between 6 mg/L and 15 mg/L (Figure 64a). There was one very high value in Eburne Slough (252 mg/L) but other parameters normally associated with high suspended material (e.g., aluminum and iron) were not higher when compared to other slough samples.

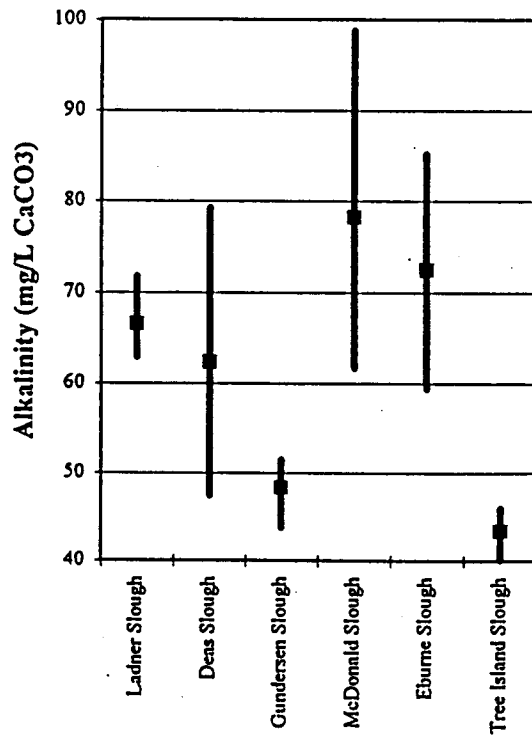
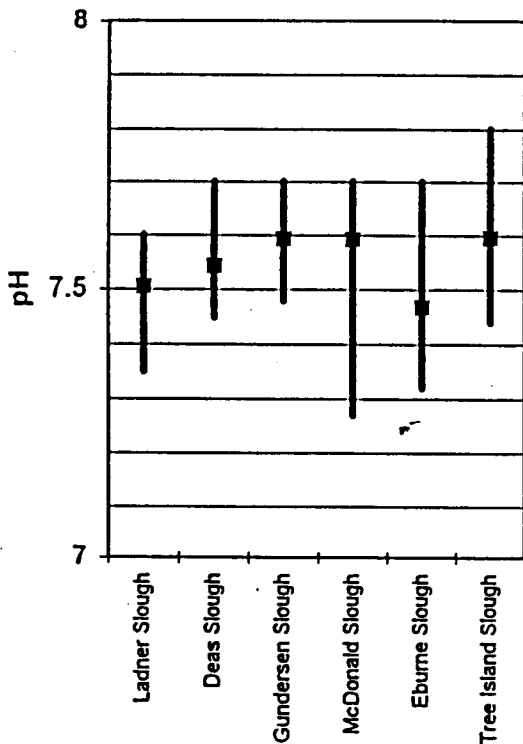
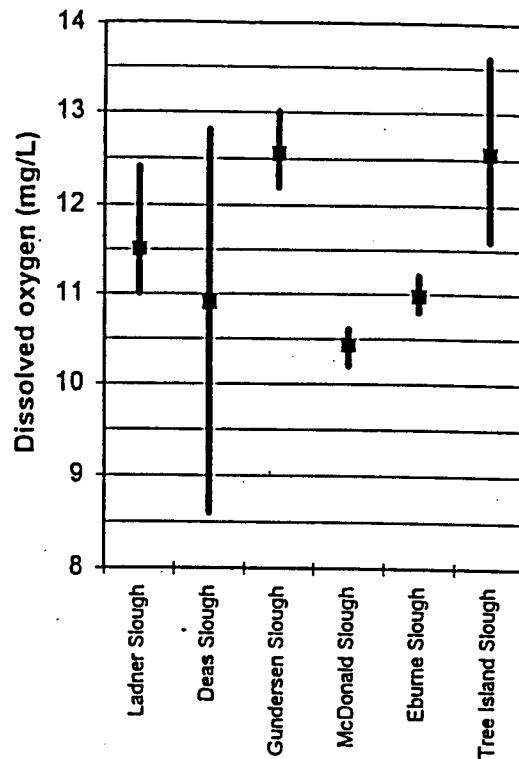
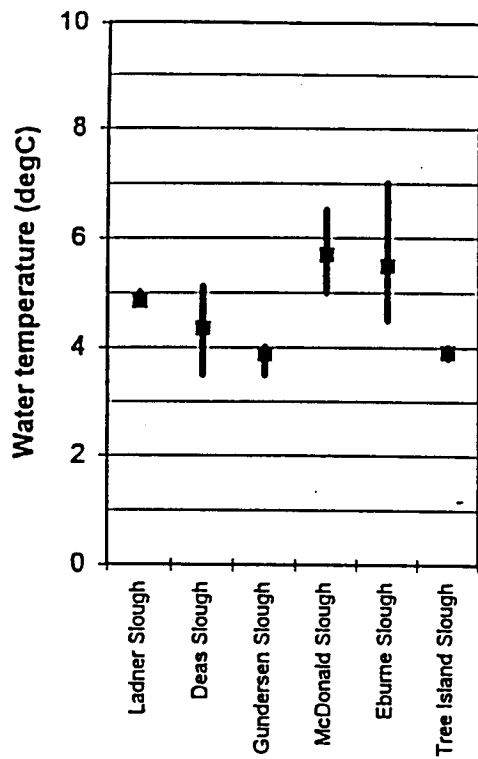


Figure 63. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)
 a) Water Temperature; b) Dissolved Oxygen; c) pH; d) Total Alkalinity

4.4 Dissolved Ions

Specific conductivity, filterable residue, hardness and the dissolved ions calcium, magnesium, potassium, sodium, chloride, fluoride and sulphate (Figures 64-66) were all lower in Gundersen and Tree Island sloughs compared to the other four sloughs. Gundersen and Tree Island sloughs are the furthest upstream of those sampled and therefore less likely to be influenced by the intruding salt wedge. Deas, Eburne, Ladner and McDonald sloughs had similar ranges; most of the "dissolved ion" concentrations at these downstream sloughs were about an order of magnitude greater than at Gundersen or Tree Island. Field profile data showed a consistent increase in specific conductivity with depth (Appendix XI).

4.5 Nutrients

4.5.1 Nitrogen

There were no large differences between the six sloughs for ammonia although Ladner Slough and Deas Slough were slightly higher compared to the other sloughs (Figure 67a). Concentrations ranged between a low of 0.01 mg/L and a maximum of 0.18 mg/L for all the sloughs and similar to values measured at the main river site during the same period (compare with Figure 29); the maximum concentration was measured in the bottom waters of Deas Slough. All ammonia values were well below water quality criteria (BC MOELP, 1994).

There was also no apparent difference between the six sloughs for dissolved nitrite/nitrate and total nitrogen (Figures 67b,c).

4.5.2. Phosphorus

Dissolved phosphorus and total phosphorus also were similar at the six sloughs, although the range in values for both parameters were slightly lower in Gundersen and Tree Island sloughs (Figures 68a,b). Overall, dissolved and total phosphorus ranged between about 0.01 and 0.07 mg/L-P and were similar to the main river sites (compare to Figures 35, 36).

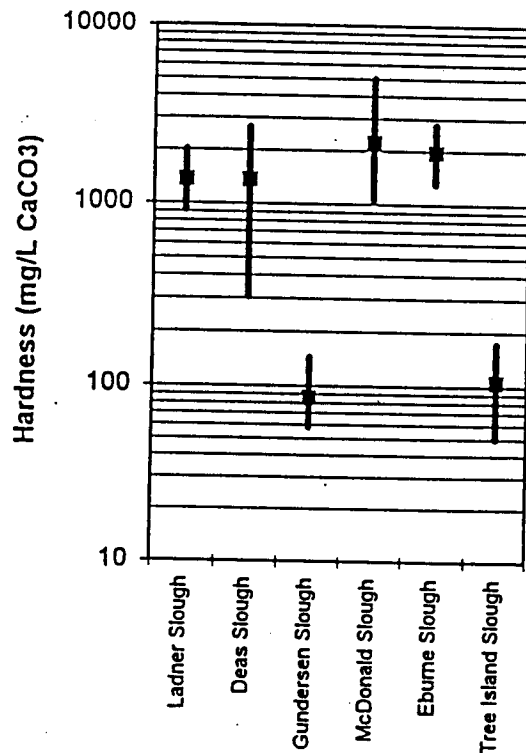
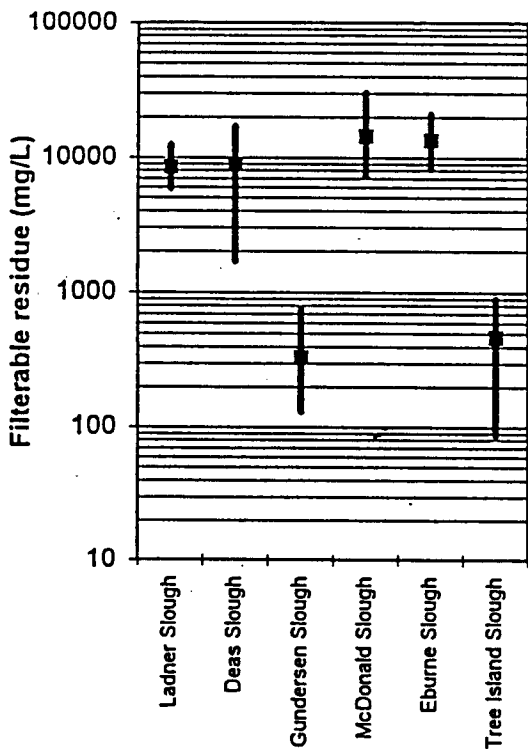
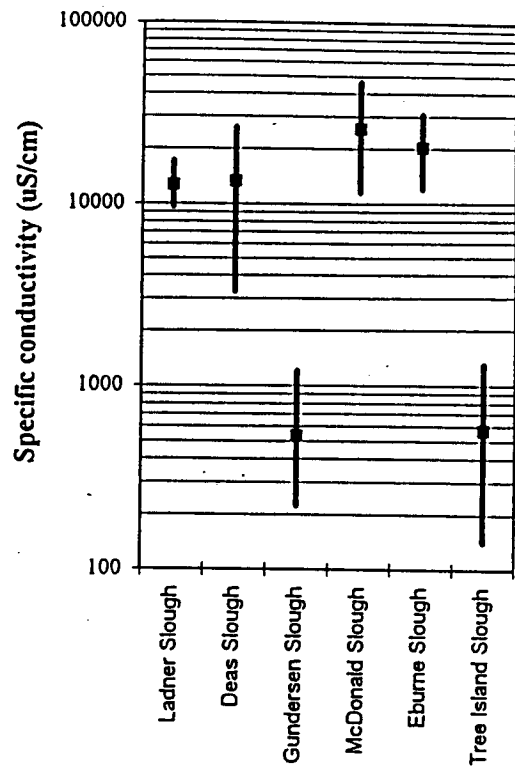
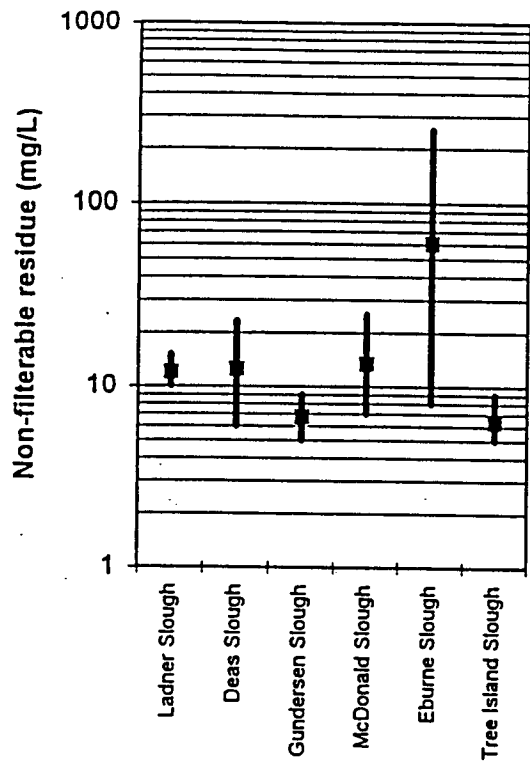


Figure 64. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)
 a) Non-Filterable Residue; b) Conductivity; c) Filterable Residue; d) Hardness

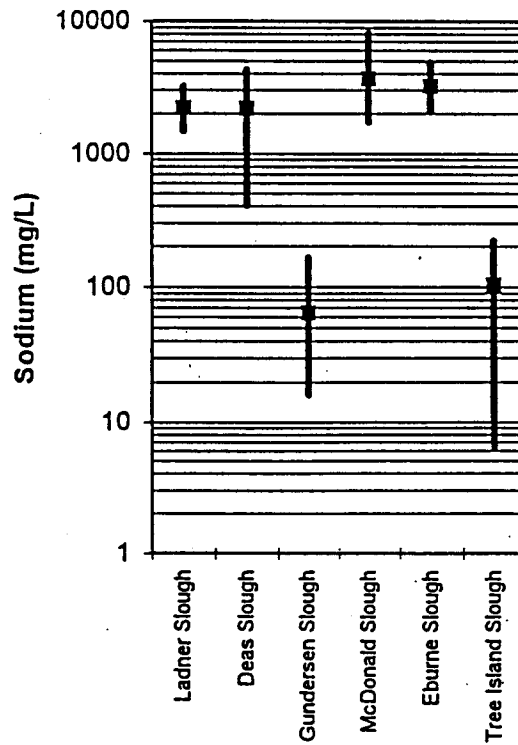
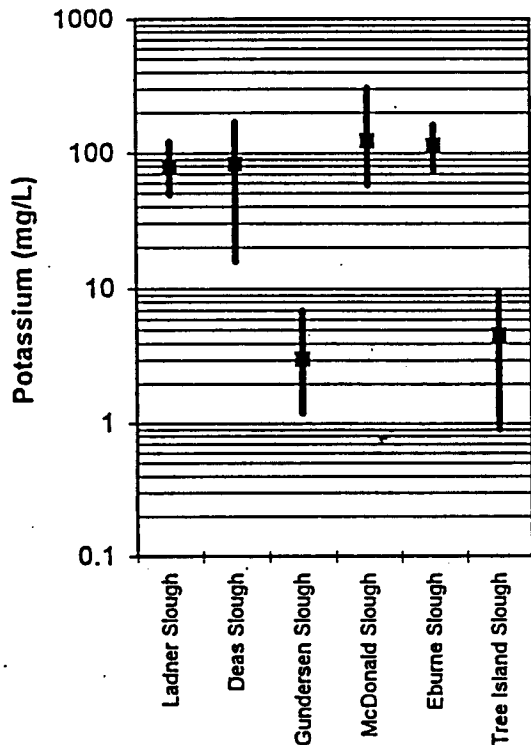
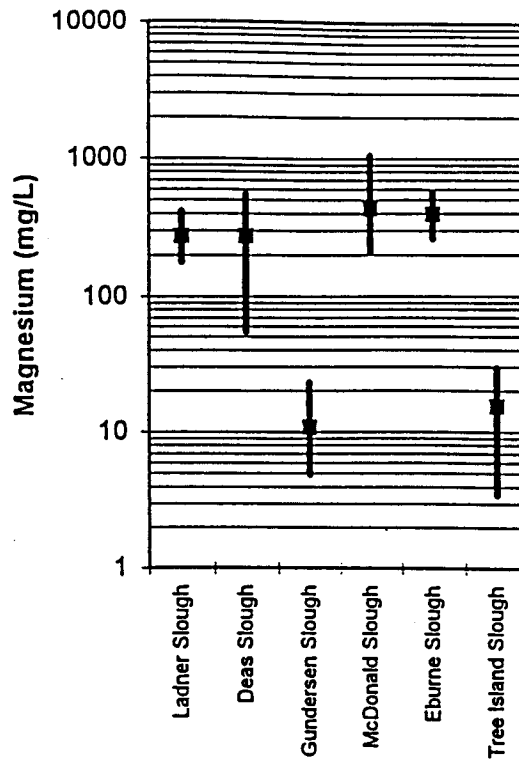
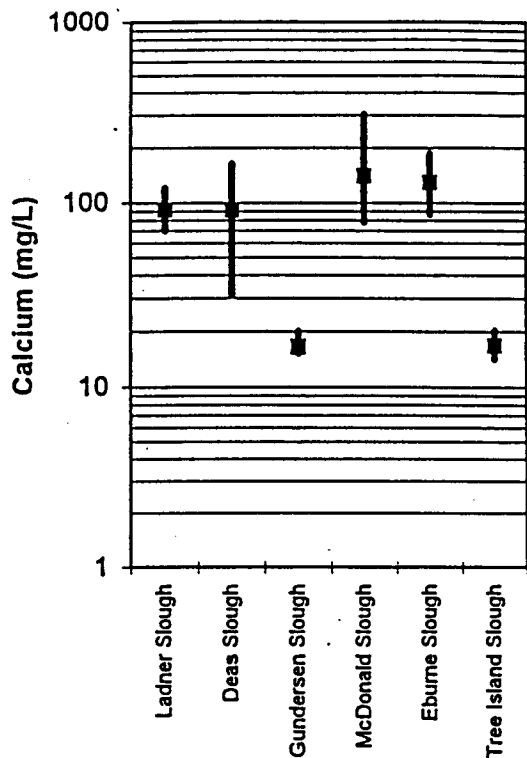


Figure 65. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)
 a) Calcium; b) Magnesium; c) Potassium; d) Sodium

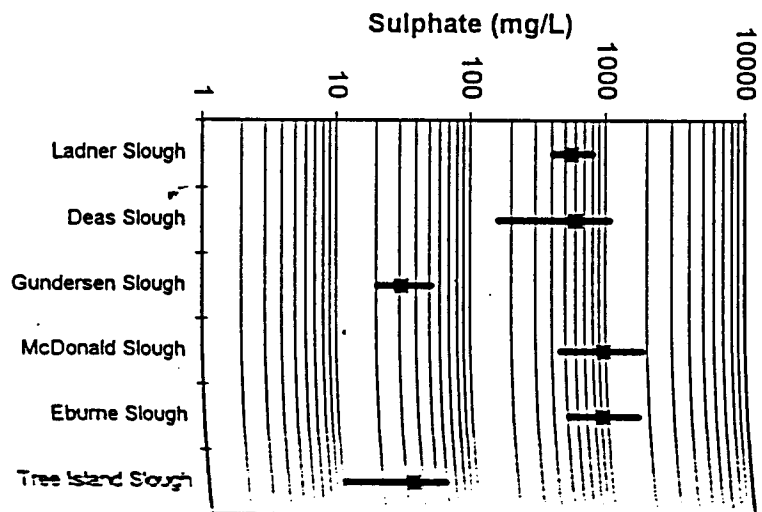
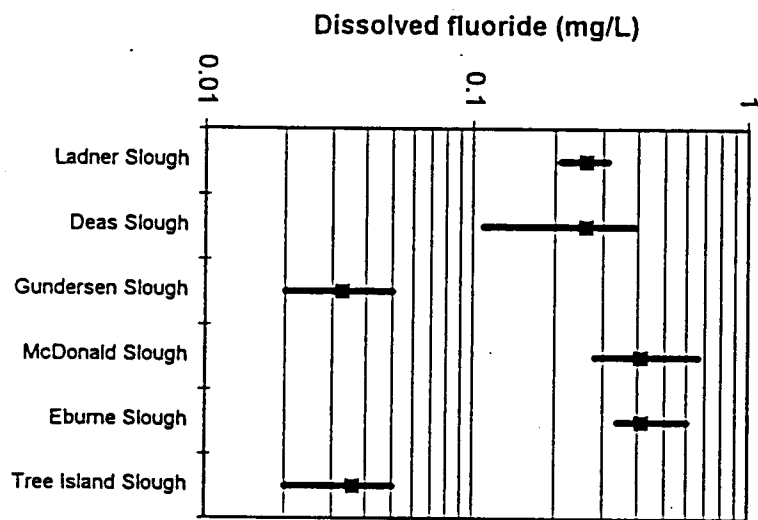
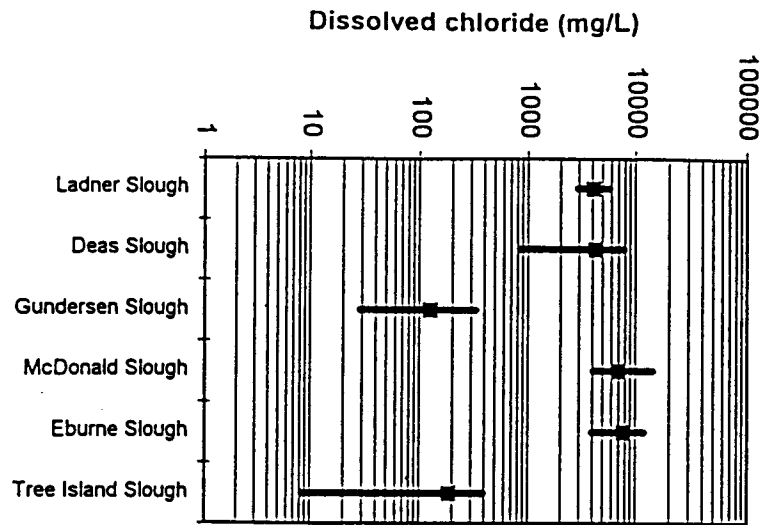


Figure 66. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)
 a) Chloride; b) Fluoride; c) Sulphate

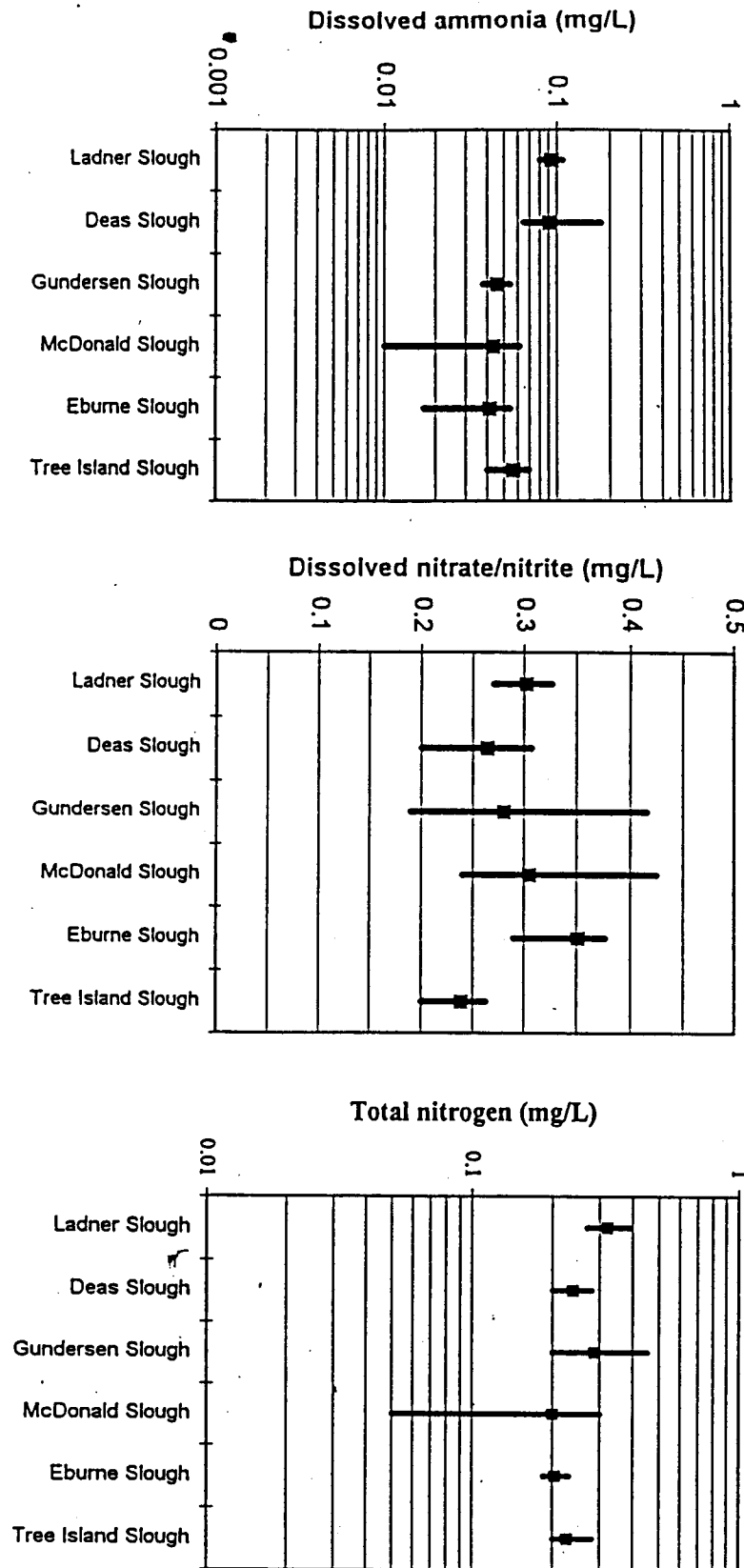


Figure 67. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)
 a) Ammonia; b) Nitrite/Nitrate; c) Total Nitrogen

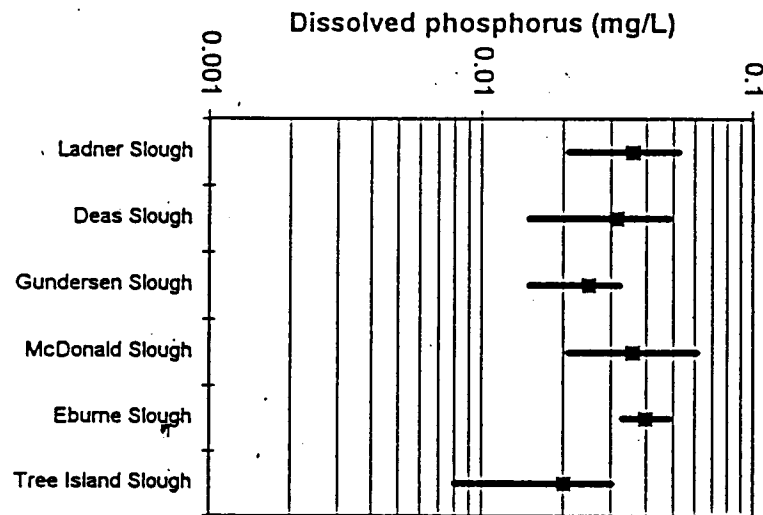
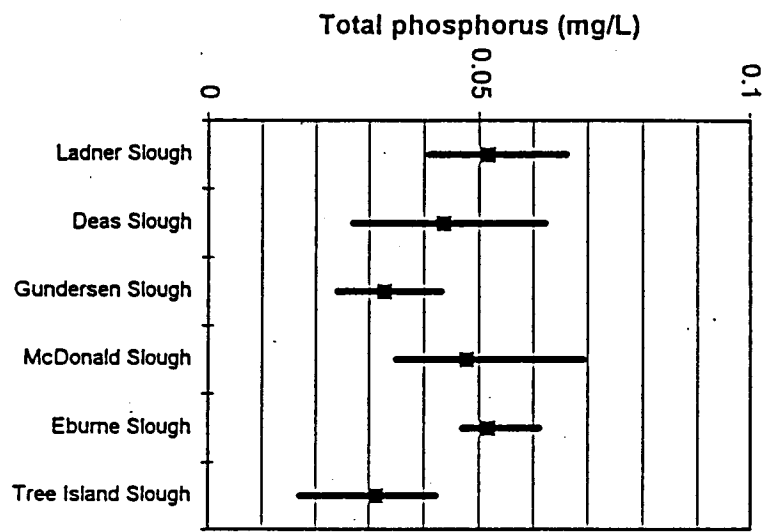


Figure 68. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)
 a) Total Phosphorus; b) Dissolved Phosphorus

4.6 Metals

Data are presented in Figures 69-71 and in the Tables of Appendix X. The figures represent the mean and range for the four measurements (two depths x two dates) taken at each slough. In order to calculate the mean, "less than" values were entered as the detection limit. However, the detection limit for many of the metals changed part way through the study due to a change in analytical laboratories. The result is that for certain metals (e.g., Al, As, Ba, Mo, Sn, Zn) some maximums of the range shown in the figures represent the higher detection limit. The detection limit for each parameter is included in the tables of Appendix X.

Measurements for total cobalt, lead, mercury, selenium, and silver were all below the MDL. All cadmium values were below the MDL except for one measurement at the detection limit of 0.0001 mg/L. Most chromium values were below the MDL except for three measurements at the detection limit of 0.001 mg/L. Some of the MDLs for cadmium, chromium, cobalt and lead were higher than stated guidelines.

Half or more of the measurements for arsenic, barium, manganese, molybdenum, nickel, tin and zinc were greater than the MDL but none of the samples exceeded established water quality criteria or guidelines for the protection of freshwater aquatic life (Table 11).

Aluminum (Figure 69a) and iron (Figure 70a) generally exceeded water quality criteria or guidelines (Table 11) but these metals are frequently associated with particulate material from natural sources and may not be readily available to aquatic biota. Copper (Figure 70c) also exceeded federal water quality guidelines (CCREM, 1987) or provincial criteria (BC MOELP, 1995) but did not exceed the provincial objective for the Fraser River (Swain *et al.*, 1995).

There were no large differences in the concentration of most metals between the six sloughs sampled although Gundersen Slough and Tree Island Slough appeared to have lower values. This is largely a reflection of lower detection limits for samples from these two sloughs. Higher and more variable detection limits were measured in downstream sloughs that experienced more saline conditions.

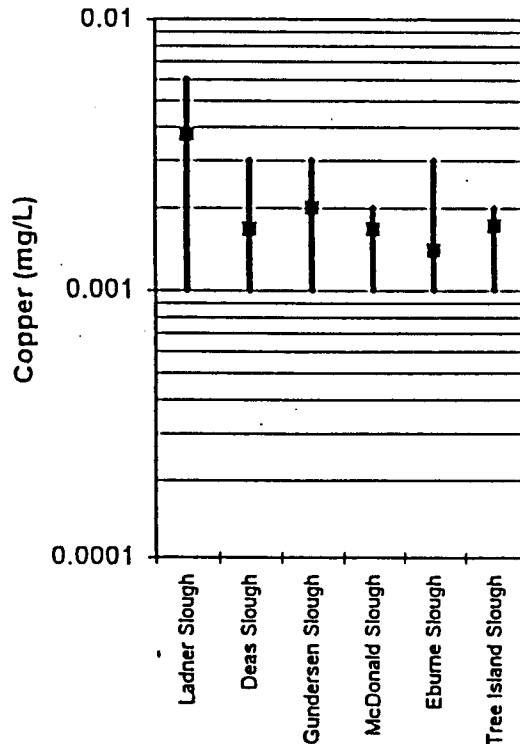
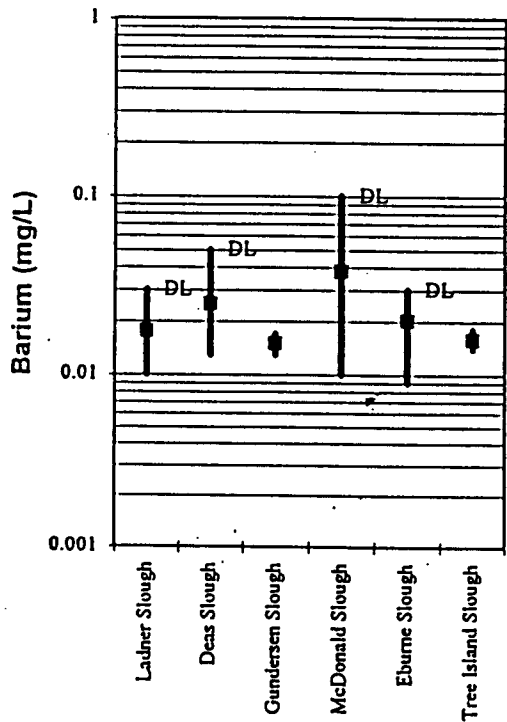
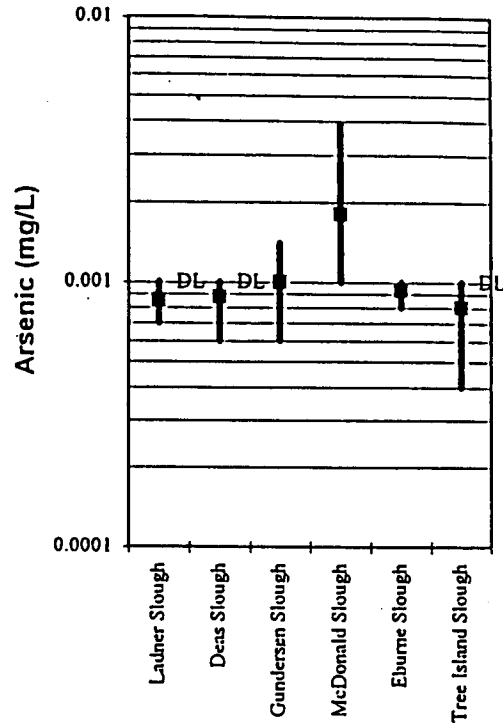
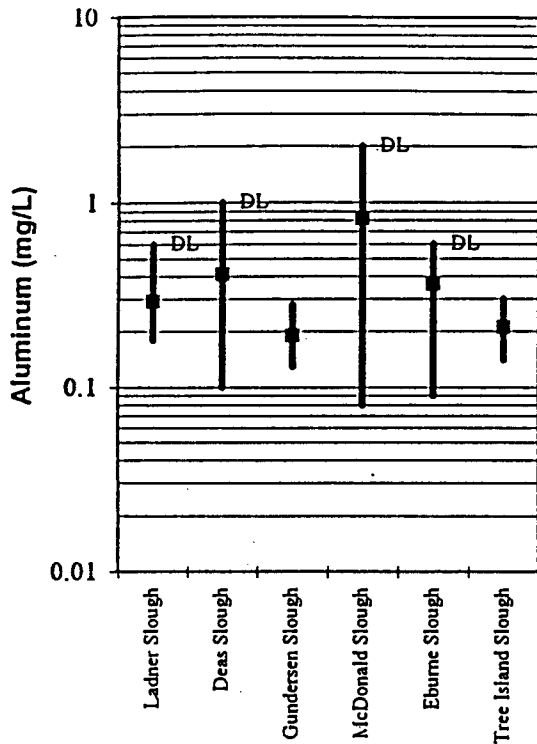


Figure 69. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)
a) Total Aluminum; b) Total Arsenic; c) Barium; d) Total Copper
 Note: DL= detection limit (the maximum value represents a detection limit)

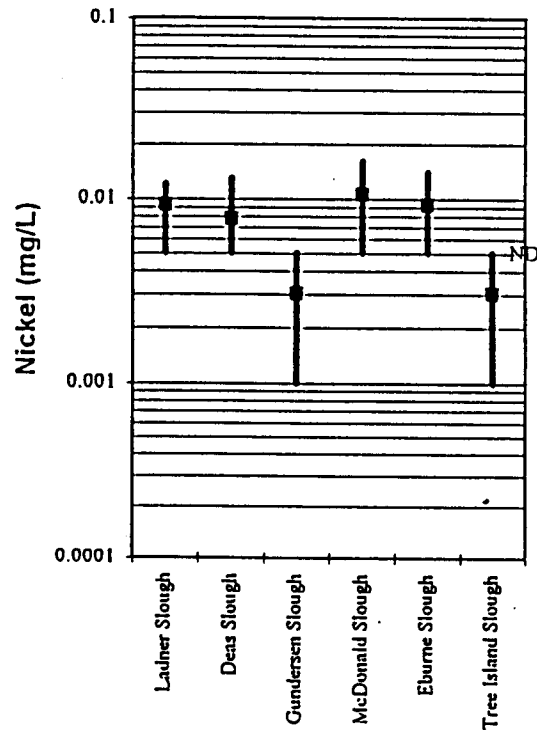
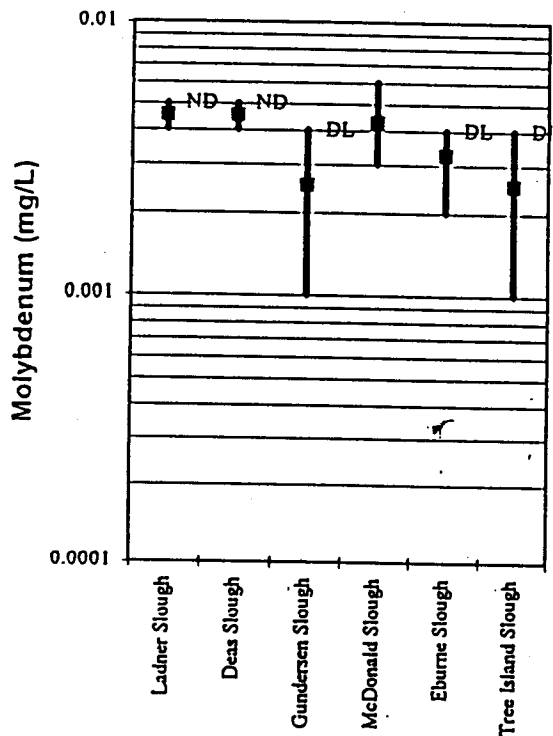
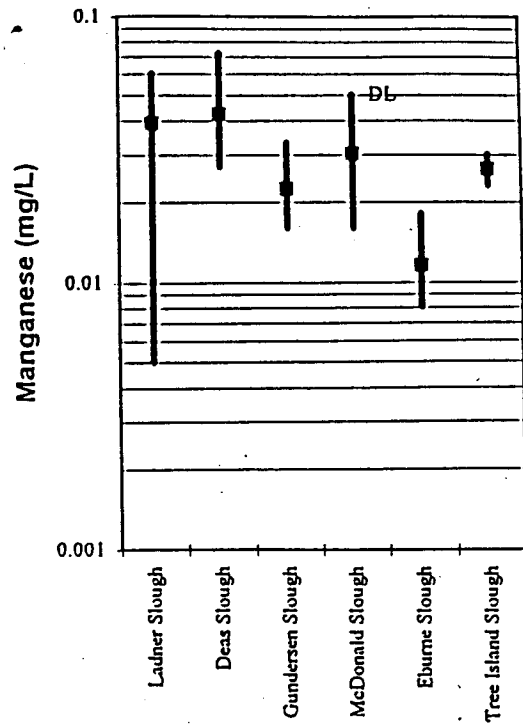
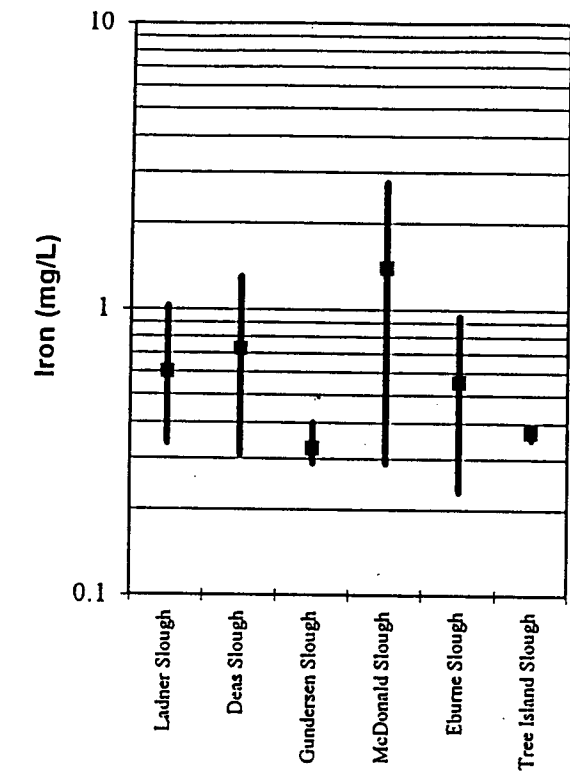
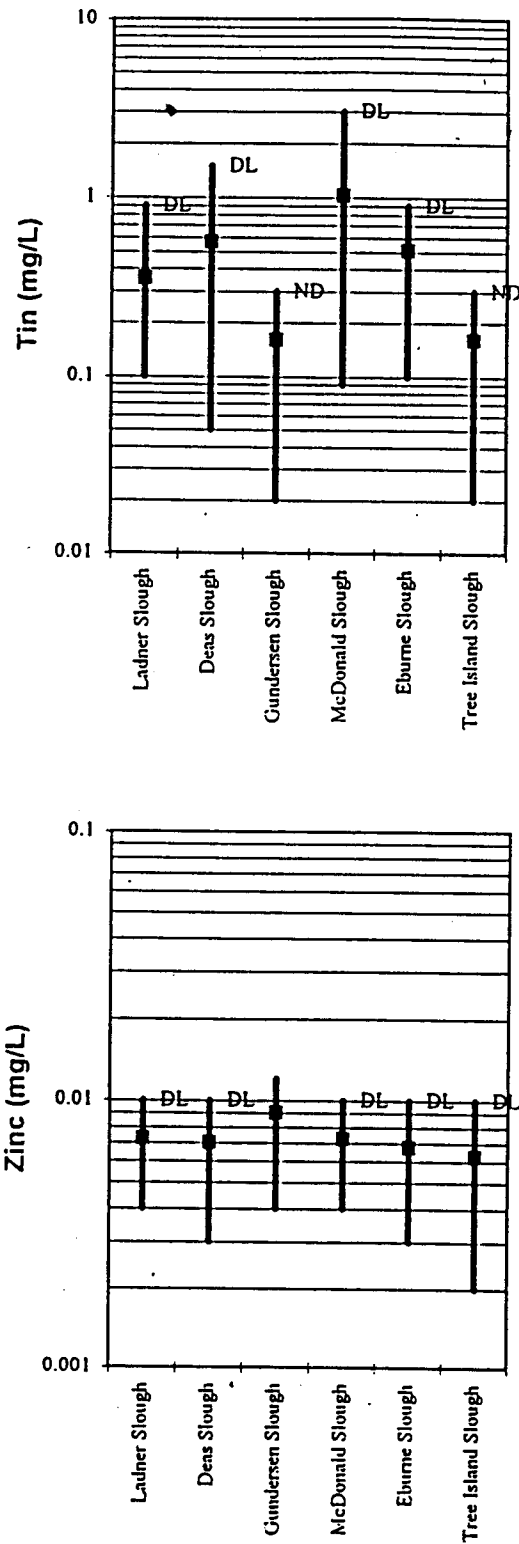


Figure 70. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates
a) Total Iron; b) Total Manganese; c) Total Molybdenum; d) Total Nickel
 Note: DL= detection limit (the maximum value represents a detection limit); ND=no detects



**Figure 71. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)
a) Total Tin; b) Total Zinc**

Note: DL= detection limit (the maximum value represents a detection limit); ND=no detects

4.7 Fecal Coliform Bacteria

All six sloughs had high fecal coliform levels, with somewhat higher levels in the North Arm sloughs (McDonald, Eburne, and Tree Island). The maxima ranged between 2300 FC/100 mL and 5000 FC/100 mL (Figure 72a). The high levels likely reflect the effects of high rainfall and stormwater runoff. The Fraser River Objective of a maximum of 4000 FC/100 mL is applicable only between April and September.

4.8 Total Organic Carbon

Total organic carbon levels were similar to levels measured at the main river sites with an overall range between <2 mg/L and <10 mg/L (detection limit). The maximum detected value was 3 mg/L. There were no apparent differences among sloughs (Figure 72b).

4.9 Adsorbable Organic Halides (AOX)

The range in AOX was 0.02 mg/L to 0.04 mg/L over all sloughs (Figure 72c). The concentration in the sloughs are similar to those from the main river sites (see Figure 57).

4.10 Chlorophenolics

Most measurements for the individual chlorophenolic compounds were below the detection limit (837 of a total of 936 parameter/site/time/depth measurements), or when detectable, values were close to the MDL. Data for the individual compounds are presented in Appendix X. None of the individual compounds or groups of compounds, exceeded their respective water quality guideline, when available. (Most compounds do not have established guidelines; Table 11 presents those for tri-, tetra- and pentachlorophenol.)

The concentration of total chlorophenolics (sum of all compounds, with the MDL used in cases where the value was reported as below detection) was similar to those measured in the main river sites (Figure 72d and Figure 58, respectively). Total chlorophenols were below the provincial water quality objective for the Fraser River (BCMOELP, 1994).

4.11 Nonylphenol

All measurements of nonylphenol were below the detection limit of 0.000005 mg/L.

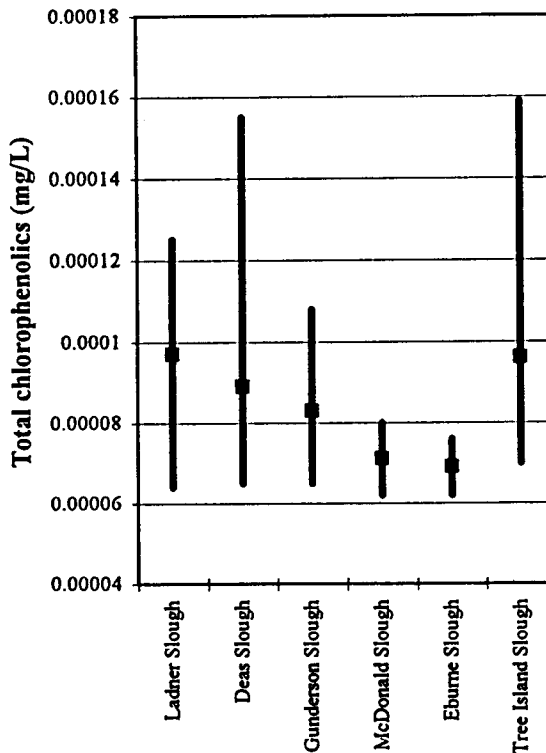
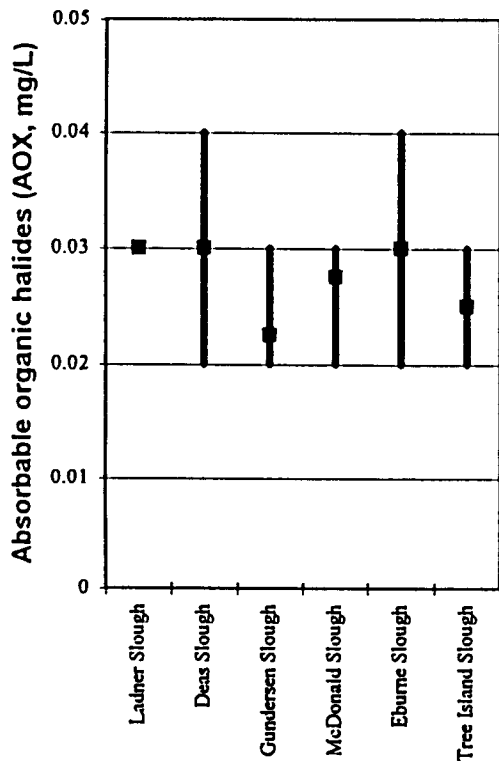
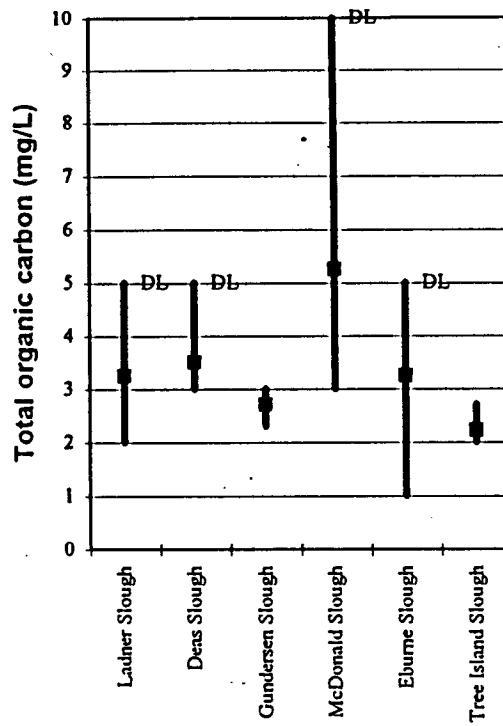
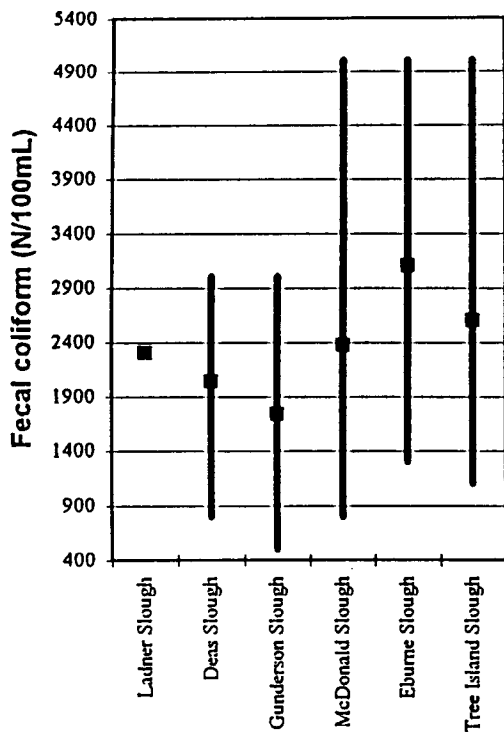


Figure 72. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)

a) Fecal Coliforms; b) Total Organic Carbon; c) AOX; d) Total Chlorophenolics

Note: DL= detection limit (the maximum value represents a detection limit)

4.12 Resin and Fatty Acids

All resin acids and most fatty acid levels were below the MDL (434 of 480 measurements; Figure 73a). The 46 measurable values were distributed among the six sloughs as shown in Table 13. Only fatty acids were detected in the samples. There were no apparent differences between sloughs for total resin and fatty acids although Deas and Ladner Sloughs had one sample (Feb./93-surface) with elevated levels of the fatty acids: stearic, palmitic, and oleic acids. There are insufficient data to determine the significance of the apparent higher levels in Ladner Slough. None of the individual compounds exceeded water quality guidelines or criteria, where available (CCREM, 1987; BC MOELP, 1994).

Table 13. Number of Measurable Fatty Acid Compounds in Fraser River Sloughs

Slough	No. Measurements >MDL
Deas	8
Eburne	9
Gundersen	5
Ladner	12
McDonald	4
Tree Island	8

4.13 TCMTB

TCMTB (2-[thiocyanomethyl] thiobenzothiazole) was not detected in any of the samples analyzed (MDL = 0.005 mg/L).

4.14 Organochlorine Pesticides and PCBs

Only one compound, hexachlorobenzene, was greater than the detection limit. A concentration of 0.00001 mg/L, measured in McDonald Slough, is less than the objective of 0.000065 mg/L (CCREM, 1987).

All measurements of PCBs were below the detection limit of 0.00002 mg/L.

4.15 Polycyclic Aromatic Hydrocarbons (PAHs)

Low molecular weight PAH (LPAH), high molecular weight PAH (HPAH) and total PAH were calculated by summing the concentration of the individual compounds. For these calculations, PAH levels found to be below the detection limit were set at zero. The results are shown in Figures 73b,c,d. Five of the six sloughs - Ladner, Deas, McDonald, Eburne and Tree Island - had similar concentrations of LPAH, HPAH and total PAH, with total PAH ranging between 0.00005 mg/L and 0.0003 mg/L. Gundersen Slough appeared higher, particularly because of the Feb., 1993 surface sample which had a total PAH concentration of 0.0012 mg/L, primarily due to higher levels of naphthalene and phenanthrene.

Several individual PAH compounds exceeded BCMOELP water quality criteria (Table 14) but both the measured values and the criteria are at, or close to, the MDL. The elevated values, particularly at Gundersen Slough which has a commercial wharf facility, likely reflect contamination from creosote pilings and hydrocarbon combustion.

Table 14. PAH Values in Fraser River Sloughs Exceeding Water Quality Criteria for the Protection of Freshwater Aquatic Life

Slough	WQ Criterion (mg/L)	Tree I.	Ladner	Ladner	Gundersen	Gundersen	Gundersen
Depth		1.0	1.0	5.0	1.0	1.0	4.0
Date		94-02	94-02	94-02	93-02	94-02	94-02
Compound (MDL)							
Pyrene (0.00001 mg/L)	0.00002	0.00003	0.00003	0.00003		0.00003	0.00014
Benzo(a)pyrene (0.00001 mg/L)	0.00001						0.00002
Phenanthrene (0.00001 mg/L)	0.0003				0.00037		

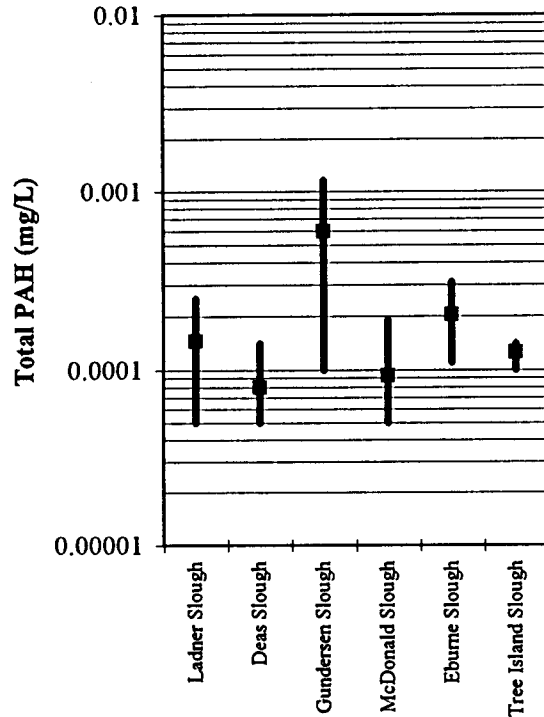
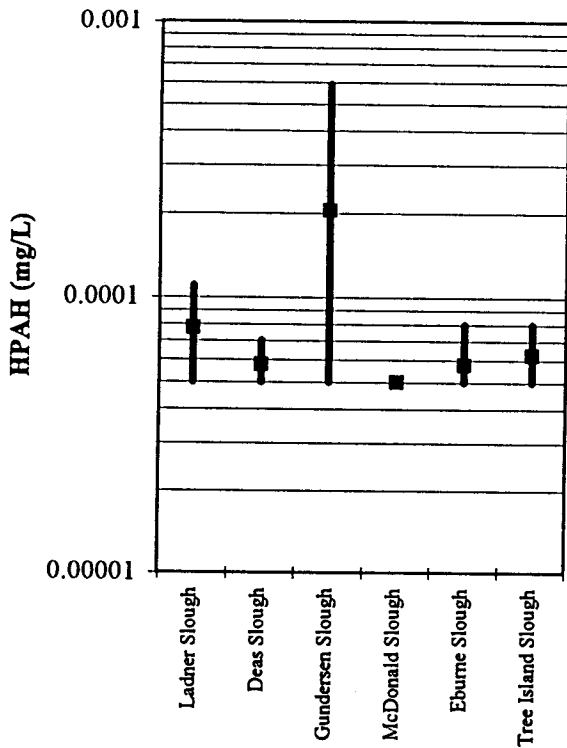
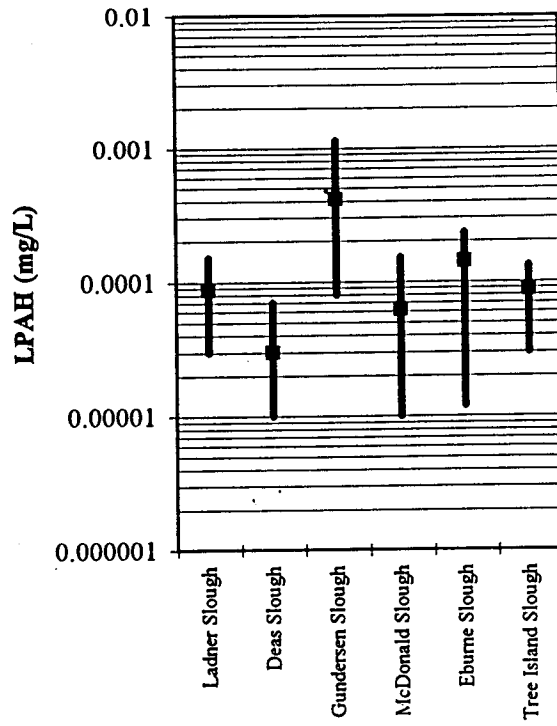
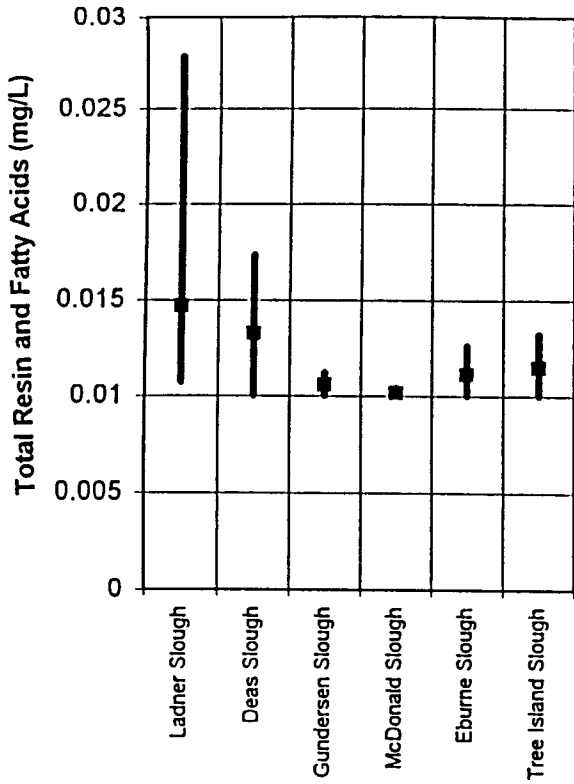


Figure 73. Mean and Range of All Data for Sloughs (Surface and Bottom on Two Dates)
 a) Total Resin and Fatty Acids; b) LPAH; c) HPAH; d) Total PAH

5.0 CONCLUSIONS

5.1 Water Quality - Main River Sites

5.1.1 Cross-sectional Profiles

Cross-sectional profile data were collected at the three main river sites on three (Mission) or four (Oak Street Bridge and Tilbury Island) dates. Both the parametric analysis on selected parameters and the non-parametric analysis on all parameters indicate that there were no consistent nor significant differences between stations at any site. The data indicate large cross-sectional differences on some sampling dates but not during other periods. Overall, the mid-channel station used for most of the sampling program can be considered representative of the river.

5.1.2 Physical Parameters and Inorganic Ions

Most parameters were not significantly different among the three regular sites or between these sites and Hope. Differences were found only with those parameters which reflect the amount of dissolved material in the water, due to seawater intrusion at downstream sites. Specific conductance, hardness, filterable residue, and dissolved magnesium, potassium, sodium, chloride and sulphate ions were all significantly lower at Mission and Hope compared to data collected at Tilbury Island and Oak Street Bridge. The latter two sites were not significantly different from each other with respect to these same parameters. The differences between sites was not readily apparent for "summer only" data (April to September); however, the tendency of higher values downstream suggests that even at higher river flows and sampling at the end of the ebb tide, the effects of seawater intrusion are still apparent.

5.1.3 Nutrients

Nitrite/nitrate and total nitrogen were not significantly different between the Hope and Mission sites when compared to Tilbury Island and Oak Street Bridge. Dissolved ammonia was significantly higher at Oak St. and Tilbury sites compared with the Mission site, but the difference was not apparent when "summer only" data were compared. The results suggest that ammonia may be higher towards the mouth of the river, perhaps due to municipal discharges. However, the overall concentrations of ammonia in the river are low and well below water quality guidelines.

There were no differences between the three sites for total phosphorus or dissolved phosphorus and no evidence of an increase due to municipal discharges. Total phosphorus was highly correlated with suspended material.

5.1.4 Metals

The laboratory procedure for metal analysis used during this study was carried out on unfiltered samples and the results are reported as "total metals" which can include not only metals present in dissolved form but also those adsorbed or bound to suspended solids in the water column. For most metals, the majority of measurements were below the detection limit (exceptions included Al, As, Ba, Cu, Fe, Ni, and Zn). A regression analysis comparing copper and iron with non-filterable residue showed a high correlation with iron ($r^2 = 0.89$) and lower, but still significant, correlation with copper ($r^2 = 0.52$).

The data for all metals from the Mission, Tilbury Island and Oak Street Bridge sites, and for some metals from the Hope site, were compared by assigning a value equal to the detection limit for all measurements reported below detection. This represents a "worst case" scenario. There was no evidence of any differences in the concentration of metals between Mission (and Hope) and the downstream sites at Tilbury Island and Oak Street Bridge although the average concentration at Hope for many of the metals, particularly those associated with particulate matter (Al, Fe), was often higher than further downstream.

Most metal values were below the guidelines, criteria, and objectives set by CCREM (1987), BCMOELP (1994), and Swain and Holms (1985) for the protection of freshwater aquatic life. Aluminum, copper, iron, and zinc frequently exceeded the guidelines, criteria or objectives set by the federal and provincial agencies, usually in samples with higher suspended solids. These metals are likely in particles from upstream river erosion, and therefore not biologically available.

The high number of measurements that were below the analytical detection limit complicates the interpretation of the data. However, most of the measurements were below guidelines and criteria established to protect aquatic biota. The high correlation between some metals and particulate material could result in accumulations of these metals in the bottom sediments and may reach concentrations that are known to affect benthic organisms.

5.1.5 Fecal Coliforms

Fecal coliforms were higher at both Tilbury Island in the Main Arm and Oak Street Bridge, in the North Arm, compared to the upstream site at Mission. Fecal coliform levels during the summer period (April to September) were clearly lower than between October and March. The lower concentrations in summer were attributed to chlorination at the Annacis Island STP, increased dilution during freshet and lower precipitation. (Rainfall is considered an important factor governing fecal coliform levels in the river since high fecal coliform loadings are generally associated with rainfall events as stormwater runoff and combined stormwater/sewage overflows (CSO) discharges increase.) Several individual high

measurements of fecal coliforms, especially at the Oak Street Bridge, were observed. These appeared to be associated with rainfall events. A major CSO outlet is just upstream of the Oak Street Bridge site. The data met Fraser River objectives, which are applicable only for the summer period. The objectives would not be met during the winter period.

5.1.6 Organic Compounds

Most of the measurements for chlorophenolic compounds, resin and fatty acids, organochlorine pesticides, PCBs, TCMTB and adsorbable organic halides (AOX) were below or near the detection limit. A few individual compounds were slightly above water quality guidelines/criteria but there was no evidence of differences between the upstream sites at Hope and Mission and those at Tilbury Island and Oak Street Bridge. A decrease during the summer for some groups of organics (AOX, total chlorophenolics) is likely a dilution effect from increased river flow.

Total chlorophenolic concentrations appeared to have decreased by nearly an order of magnitude based on a comparison of the data collected in this study with a compilation of water quality data collected prior to 1988. The trend reflects the decrease in use of chlorophenates as a anti-sapstain agent by the forest industry.

5.2 Water Quality - Sloughs

The water quality in the six sloughs sampled was generally good. Some parameters reflected the presence of marine waters (all samples were collected in February when the salt wedge penetrates the furthest upstream). There were few differences between the sloughs except those furthest upstream, Tree Island Slough and Gundersen Slough, which showed the least effects from seawater intrusions.

Dissolved oxygen was lower in the sloughs compared to the main river sites but all measurements met water quality guidelines. Nitrogen and phosphorus concentrations were similar to those measured at the main river sites for the same time period.

Measurements for most metals in the sloughs were similar to those measured at the main river sites and below the maximum concentrations set for the protection of aquatic life (CCREM, 1987; BC MOELP, 1995). Aluminum, copper and iron concentrations in the sloughs were similar to concentrations at the Mission, Tilbury Island and Oak Street Bridge sites during low flow periods. Many of the measurements for these three metals exceeded water quality guidelines but generally these values were associated with higher suspended solid levels. There was no evidence of consistently elevated concentrations of metals that would pose a threat to aquatic life.

There was also no evidence of consistently higher concentrations of organic compounds (chlorophenolics, resin and fatty acids and PCBs) in the sloughs when compared to the main river sites. Most measurements were below the detection limit and all were within water quality guidelines or criteria.

The concentration of LPAH, HPAH and total PAH compounds was similar between most of the sloughs but Gundersen Slough showed slightly higher levels, mainly due to elevated levels of naphthalene and phenanthrene in one sample. Three individual PAH compounds exceeded, slightly, their respective water quality guideline - pyrene (in five of 24 samples), benzo(a)pyrene (one sample) and phenanthrene (one sample).

6.0 RECOMMENDATIONS

In general, there were few differences in the parameters measured between the study sites at Mission, Tilbury Island and Oak Street Bridge that could not be explained by either seawater intrusion or river flow. Except for fecal coliform bacteria, there was no evidence of an increase in parameters in the lower reaches of the river attributable to municipal or industrial discharges. It was concluded, on the basis of this 15-month water quality survey, that the concentration of nutrients, metals and organic contaminants in the waters of the Fraser River, and the sloughs sampled, were within or near guidelines set for the protection of aquatic life.

Many metals and organic compounds adhere to particles and as a result accumulate in the bottom sediments when the suspended material settles out. There was evidence of this association with particulate material in this present study. Other studies conducted by FREMP have looked at contaminants in sediments and biota. Based on the conclusions of this present study, especially the large number of measurements below the analytical detection limit, it is recommended that future projects focus on sediments and biota. Sediment samples will integrate episodic introductions of contaminants that might be missed when sampling the water. In addition, the effects of river flow and seawater intrusion would be reduced.

Continued sampling for fecal coliforms should be considered in order to monitor the effects of storm water and CSO discharges, particularly if public use during the winter period is significant.

7.0 REFERENCES

Bergerud, W.A. and L.J. Alexander. 1981. Survey of dissolved oxygen in 1978. APD Bulletin 18. Report prepared for the Fraser River Estuary Study, Water Quality Work Group by Assessment and Planning Division, B.C. Ministry of Environment. 107 pp.

BC MOELP, 1994. Water quality criteria. Approved and working criteria for water quality. B.C. Ministry of Environment, Lands and Parks, Victoria, B.C.

CCREM. 1987. Canadian water quality guidelines. Prepared by the Task Force on Water Quality Guidelines of the Canadian Council of Resource and Environment Ministers. Environment Canada, Ottawa. 218 pp. + appendices.

Drinnan, R.W. and M.J.R. Clark. 1980. Water Chemistry, 1970-1978. Fraser River Estuary Report, Water Quality Work Group. Government of Canada and Province of British Columbia, Victoria, B.C. 160 pp.

Drinnan, R.W., E. White and P. Wainwright. 1988. Distribution of chlorophenol information in the Fraser River estuary. Report prepared by Aquatic Science Consultants Ltd., Nanaimo, B.C. to the Water Quality Branch, Environment Canada, Vancouver, B.C. 61 pp. + 9 tables + 44 figures.

Drinnan, R.W., B. Humphrey, B. Emmett, B. Austin and D. Hull. 1995. Saanich Inlet water use study. Report prepared for the Water Quality Branch, B.C. Ministry of Environment, Lands and Parks, 195 pp.

Environment Canada. 1991a. HYDAT CD-ROM.

Environment Canada. 1991b. The State of Canada's Environment. Environment Canada SOE report, Ottawa.

FREMP. 1991. Water Quality Plan, Monitoring and Objectives. Standing Committee on the Fraser River Estuary Water Quality Plan. Fraser River Estuary Management Program. New Westminster, B.C.

FREMP. 1994. Water Quality Plan: Monitoring Data Report, January to March 1993. Technical Report Series 93-02; DOE-FRAP 1993-31. Fraser River Estuary Management Program. New Westminster, B.C.

FREMP. 1996. Fraser River Estuary Environmental Quality Report. Fraser River Estuary Management Program. Burnaby, B.C.

GVRD. 1992. Samplers manual for bacteriological samples. Report prepared by the Greater Vancouver Regional District, Vancouver, B.C.

Harrison, P.J., D.L. Mackas, B.W. Frost, R.W. Macdonald, E.A. Crecelius. 1994. An Assessment of Nutrients, Plankton and some Pollutants in the Water Column of Juan de Fuca Strait, Strait of Georgia and Puget Sound and their Transboundary Transport. In: Wilson, R.C.H., R.J. Beamish, Fran Aikens, J. Bell (eds.). Review of the marine environment and biota of Strait of Georgia, Puget Sound and Juan de Fuca Strait. Can. Tech. Rep. Fish. Aquat. Sci. 1948.

Hatfield Consultants Ltd. 1994. Upper Fraser River environmental effects monitoring (EEM) pre-design reference document. Prepared for Northwood Pulp and Timber Ltd., Canadian Forest Products Ltd., Quesnel River Pulp Company and Cariboo Pulp & Paper Company.

IRC Inc. 1994. Field component, 1993/94 Fraser River Water Quality Program. Final Report.

McDevitt, C.A., D.J. McLeay, and A. Brown. 1994. Effluent characterization study. FREMP Technical Report WQWM 93-13. Prepared for the Fraser River Estuary Management Program by Technology Resource Inc. and McLeay Associates Ltd. 182 pp.

Miller, R.A., R.W. Drinnan and D. Hull. 1994. Stormwater quality survey - 1994. Saanich-Central Saanich border to the View Royal-Colwood Border, including Victoria Harbour, Portage Inlet and Esquimalt Harbour. Report by the Engineering Department, Capital Regional District, Victoria, B.C. 44 pp. + 6 appendices.

Moore, K. 1993. Contaminant loadings to the Fraser River estuary. Technical Report WQWM 93-04, Fraser River Estuary Management Program, New Westminster, B.C. 92 pp.

Morse, D. 1994. Water quality plan, monitoring data report, January to March, 1993. FREMP Tech. Rep. Series FREMP 93-02, DOE FRAP 1993-31. Prepared for the Fraser River Estuary Management Program. 29 pp. + appendices.

Norecol, Dames & Moore, Inc. 1994. An initial dilution zone impact assessment of selected industries in the Fraser River estuary. FREMP Technical Report WQWM 93-06. Prepared for the Fraser River Estuary Management Program, New Westminster, B.C. 46 pp. + appendices.

Pommen, L.W. 1994. AOX Values from the Water Quality Monitoring Site at Hope. BC Environment.

Rocchini, R.J., W.A. Bergerud and R.W. Drinnan. 1981. Survey of fecal coliforms in 1978. APD Bulletin 21. Prepared for the Fraser River Estuary Study, Water Quality Work Group by Assessment and Planning Division, B.C. Ministry of Environment. 20 pp.

Swain, L.G and G.B. Holms. 1985. Water quality assessment and objectives. Fraser Delta Area, Fraser River Sub Basin. Kanaka Creek to the mouth. Water Quality Branch, BC Ministry of Environment. 16 pp.

Swain, L.G. and D.G. Walton. 1990. Report on the 1989 Fraser River sediment monitoring program. Water Quality Branch, Ministry of Environment, Lands and Parks, Victoria, B.C.

Swain, L.G. and D.G. Walton. 1991. Report on the 1990 lower Fraser River and Boundary Bay sediment chemistry and toxicity program. Water Quality Branch, Ministry of Environment, Lands and Parks, Victoria, B.C.

Swain, L.G. and D.G. Walton. 1993. Chemistry and toxicity of sediments from sloughs and routine monitoring sites in the Fraser River estuary - 1992. Fraser River Estuary Monitoring Program. Water Quality Branch, Ministry of Environment, Lands and Parks, Victoria, B.C.

Swain, L.G., B. Phippen, H. Lewis, S. Brown, G. Bamford, D. Newsom, I. Lundman and D. Walton. 1995. Water quality assessment and objectives for the Fraser River from Hope to Sturgeon and Roberts Banks. First Update, Technical Appendix. Draft document prepared by the Water Quality Branch, B.C. Ministry of Environment, Lands and Parks, Victoria, B.C. 592 pp.

Tetra Tech Inc. 1986. Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, Seattle, Washington. Final Report TC-3991-04.

US EPA. 1986a. Quality criteria for water. United States Environmental Protection Agency, Office of Water Regulations and Standards. Washington, D.C. 395 pp.

US EPA. 1991. Chlorinated phenolics in wastewater by in-situ acetylation and GC/MS, Method 1653. United States Environmental Protection Agency.

APPENDIX I

DETAILED SAMPLING SITE LOCATIONS

TABLE OF CONTENTS

1.0 DETAILED SAMPLING SITE DESCRIPTIONS.....	1
1.1 Site and Vessel Positioning	1
1.2 Sample Sites and Station Location.....	1

TABLES

Table I-1. Water Sampling Locations for Main River Sites (Phase 1).....	2
Table I-2. Water Sampling Locations for Cross-Sectional Profiles at Main River Sites	3
Table I-3. Water Sampling Locations for Slough Profiles.....	4

FIGURES

Figure I-1. Reference Water Quality Monitoring Site (URS) at Mission.....	5
Figure I-2. North Arm Water Quality Monitoring Site at Oak Street Bridge	6
Figure I-3. Main Arm Water Quality Monitoring Site at Tilbury Island.....	7
Figure I-4. Water Quality Monitoring Site at Ladner Slough, Main Arm.....	8
Figure I-5. Water Quality Monitoring Site at Deas Slough, Main Arm.....	9
Figure I-6. Water Quality Monitoring Site at Gunderson Slough, Main Arm.....	10
Figure I-7. Water Quality Monitoring Site at Tree Island Slough, North Arm.....	11
Figure I-8. Water Quality Monitoring Site at Eburne Slough, North Arm.	12
Figure I-9. Water Quality Monitoring Site at Mcdonald Slough, North Arm.	13

1.0 DETAILED SAMPLING SITE DESCRIPTIONS

The following descriptions of each water sampling station were provided by IRC Integrated Resource Consultants Inc. IRC provided all of the field sample collection services for the project.

In addition to the information summarized below, IRC prepared a sampling report (IRC, 1994) containing progress reports for each sampling period, completed chain of custody forms for each sample batch delivered to the laboratories and a copy of the terms of reference for this study.

1.1 Site and Vessel Positioning

Vessel support was used for every sample collection event. All sampling locations and transects were plotted on hydrographic chart 9491 and on topographic map 92G1 prior to the field activities. Latitude and longitude co-ordinates were derived for accurate vessel positioning. In the field, water quality sample locations were determined using a Furuno Model 1250 Global Positioning System with ROM card video display, Furuno 24 mile radar and Furuno colour depth sounder. An on-board log of vessel positions, weather conditions, sea state, time of sample collection and sampling depth was maintained. Field data reported in this appendix were derived from this log.

1.2 Sample Sites and Station Location

Tables I-1 and I-2 describe the mid-channel and cross-section water sampling locations at Mission, Oak Street Bridge and Tilbury Island. Site details are shown in Figures I-1, I-2 and I-3. Table 3 describes the location of the water sampling site for each of the six sloughs. Detailed maps of the sites at Ladner, Deas, Gunderson, Tree Island, Eburne and McDonald Slough are presented in Figures I-4 through I-9.

References

IRC. Integrated Resouce Consultants Inc. 1994. 1993/94 Fraser River Water Quality Monitoring Program. Prepared for the Fraser River Estuary Management Program. New Westminster, B.C.

Table I-1. Water Sampling Locations for Main River Sites (Phase 1)

Sampling Site	Station Number	Site Designation Used in Other Programs¹	Latitude/ Longitude	Sampling Site Description
Mission (Fig. I-1)	M3	URS	49°8.18' N 122°16.80' W	Midchannel, 1.69 km upstream of the railway bridge in line with the picnic bench in the grove of large trees on the south shore and the food processing plant on the north shore.
Oak Street Bridge (Fig. I-2)	OS3	NA-3	49°12.11' N 123°7.15' W	Midchannel, 370 m upstream of the Oak Street Bridge in line with the upstream sawmill conveyor on the north shore and the middle of the Fraser River Terminal dock on the south shore.
Tilbury Island (Fig. I-3)	T3	MA-3	49°8.86' N 123°1.93' W	Midchannel, between the flashing red buoy at the downstream end of the Tilbury Cement Dock on the south shore and the pilings with the staff gauge 100 m upstream of the flashing green light on the north shore.
<p>NOTES: Sampling occurred every two weeks from April 19/20, 1993 to March 21/22, 1994.</p> <p>Sampling Depths = 1 metre below the surface.</p>				

¹ The Mission site (M3) corresponds to the Upstream Reference Site (URS) referred to in other monitoring programs. The Oak Street Bridge site and Tilbury Island site have similarly been referred to as NA-3 (North Arm) and MA-3 (Main Arm) sites in other programs.

**Table I-2. Water Sampling Locations for Cross-Sectional Profiles
at Main River Sites**

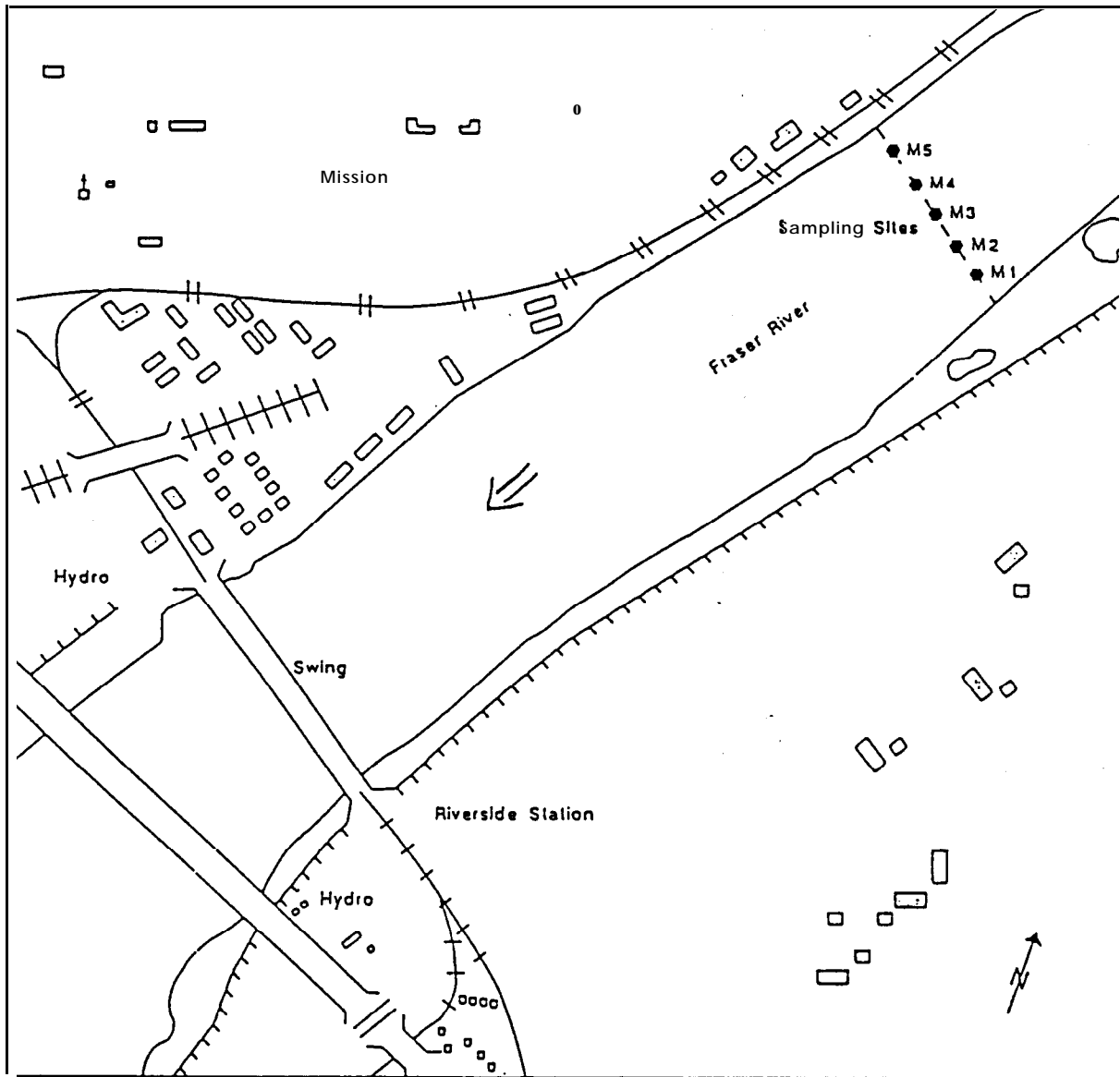
Sampling Site	Station No.	Latitude	Longitude
Mission (Figure I-1)	M1	49°08.11' N	122°16.72' W
	M2	49°08.15' N	122°16.75' W
	M3	49°08.18' N	122°16.80' W
	M4	49°08.21' N	122°16.83' W
	M5	49°08.24' N	122°16.86' W
Oak Street Bridge (Figure I-2)	OS1	49°12.06' N	123°07.13' W
	OS2	49°12.08' N	123°07.14' W
	OS3	49°12.11' N	123°07.15' W
	OS4	49°12.14' N	123°07.17' W
	OS5	49°12.17' N	123°07.18' W
Tilbury Island (Figure I-3)	T1	49°08.76' N	123°01.81'
	T2	49°08.81' N	123°01.85'
	T3	49°08.86' N	123°01.93'
	T4	49°08.90' N	123°01.99'
	T5	49°08.94' N	123°02.04'
<p>NOTES</p> <ol style="list-style-type: none"> 1. Cross-sectional sampling dates: May 31/June 1, 1993; October 4/5, 1993; and February 7/8, 1994. 2. Sampling depths = 1 metre below surface. 3. The mid-channel station (designated #3) at each site corresponds to sampling locations used in Phase 1 of this program. 			

Table I-3. Water Sampling Locations for Slough Profiles

Sampling Site	Station No.	Site Nos. Used in Other Studies	Sampling Depths (metres)	Latitude/ Longitude	Sampling Site Description
Ladner Slough (Fig.I-4)	LS1	S-1	1.0 5.0	49°05.54'N 123°05.40'W	Midchannel, immediately opposite the red government wharf ramp on the north shore and the marina on the south shore.
Deas Slough (Fig. I-5)	DS1	S-2	1.0 6.5	49°7.04'N 123°3.72'W	Midchannel, upstream of the Deas Overpass, directly opposite the marina in the deepest portion of the slough.
Gunderson Slough (Fig.I-6)	GS1	S-3	1.0 4.0	49°10.39'N 122°55.11'W	Midchannel, opposite the red government wharf, in line with the pipeline crossing markers.
Tree Island Slough (Fig. I-7)	TI1	NA-1	1.0 3.0	49°11.08'N 122°57.7'W	Midchannel, between the two dead trees on the western shore and the three pilings near the high tide mark on the eastern shore.
Eburne Slough (Fig. I-8)	ES1	S-4	1.0 3.5	49°12.16'N 123°08.58'W	Midchannel, directly opposite the loading dock on the north shore (east of Borden Chemicals).
McDonald Slough (Fig. I-9)	MS1	MA-2	1.0 5.5	49°12.78'N 123°11.26'W	Midchannel, immediately opposite the first small embayment on Iona Island.

122° 18.45'
49° a.401

122° 16.45'
49° 8.40'



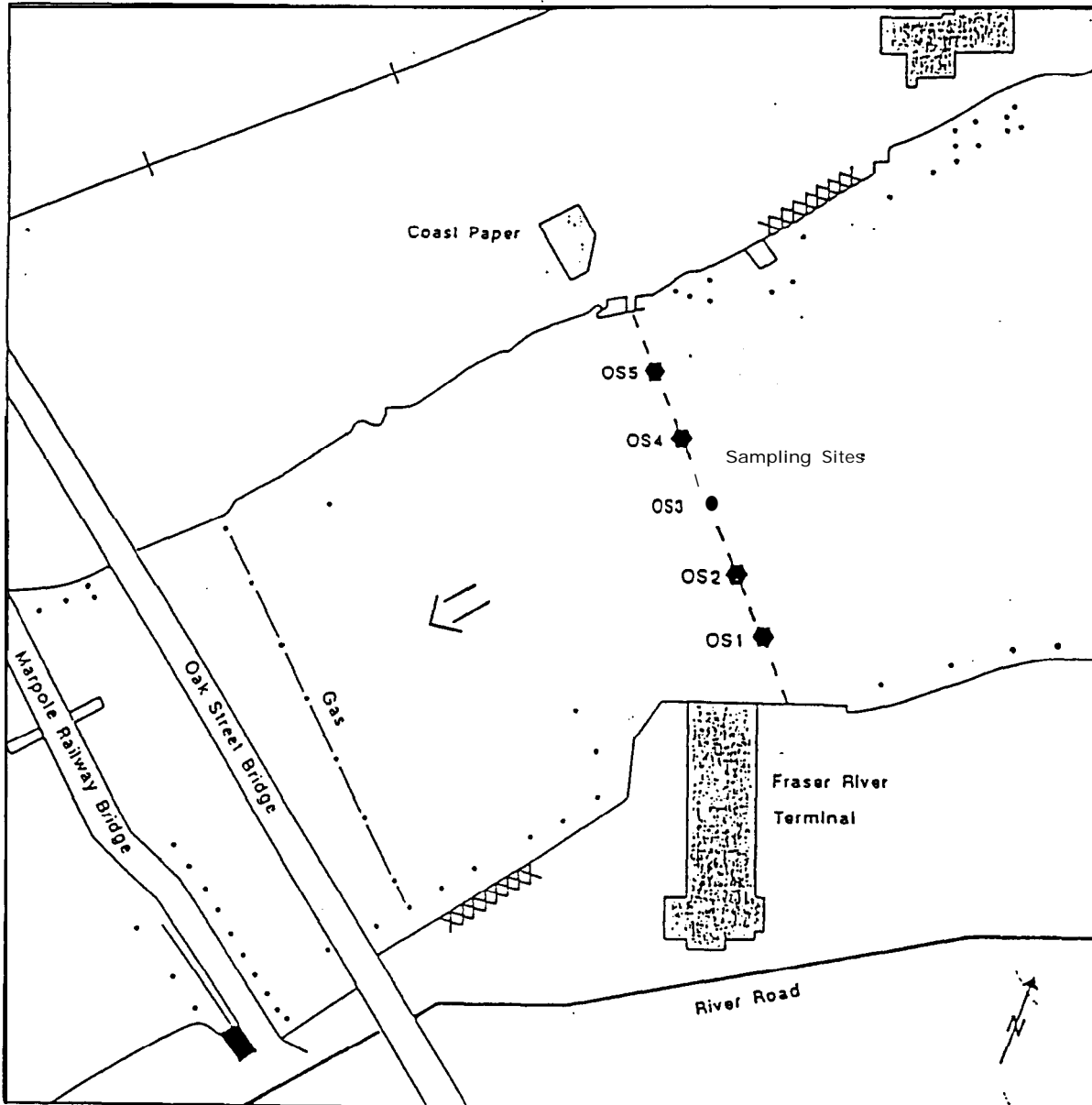
122° 10.45'
49° 7.25'

122° 16.45'
49° 7.25'

Figure I-1. Reference Water Quality Monitoring Site (URS) at Mission - M3 denotes the regular sample site; M1, M2, M4 and M5 are the additional sample stations for the cross-section profile. (←=Direction of river flow)

123° 7.53'
49° 12.32'

123° 6.04'
49° 12.32'



123° 7.53'
49° 11.86'

123° 6.04'
49° 11.88'

Figure I-2. North Arm Water Quality Monitoring Site at Oak Street Bridge - OS3 denotes the regular sample site; OS1 OS2, OS4 and OS5 are the additional sample stations for the cross-section profile. (← Direction of river flow)

123° 2.45'
49° 9.08'

123° 1.75'
49° 9.08'

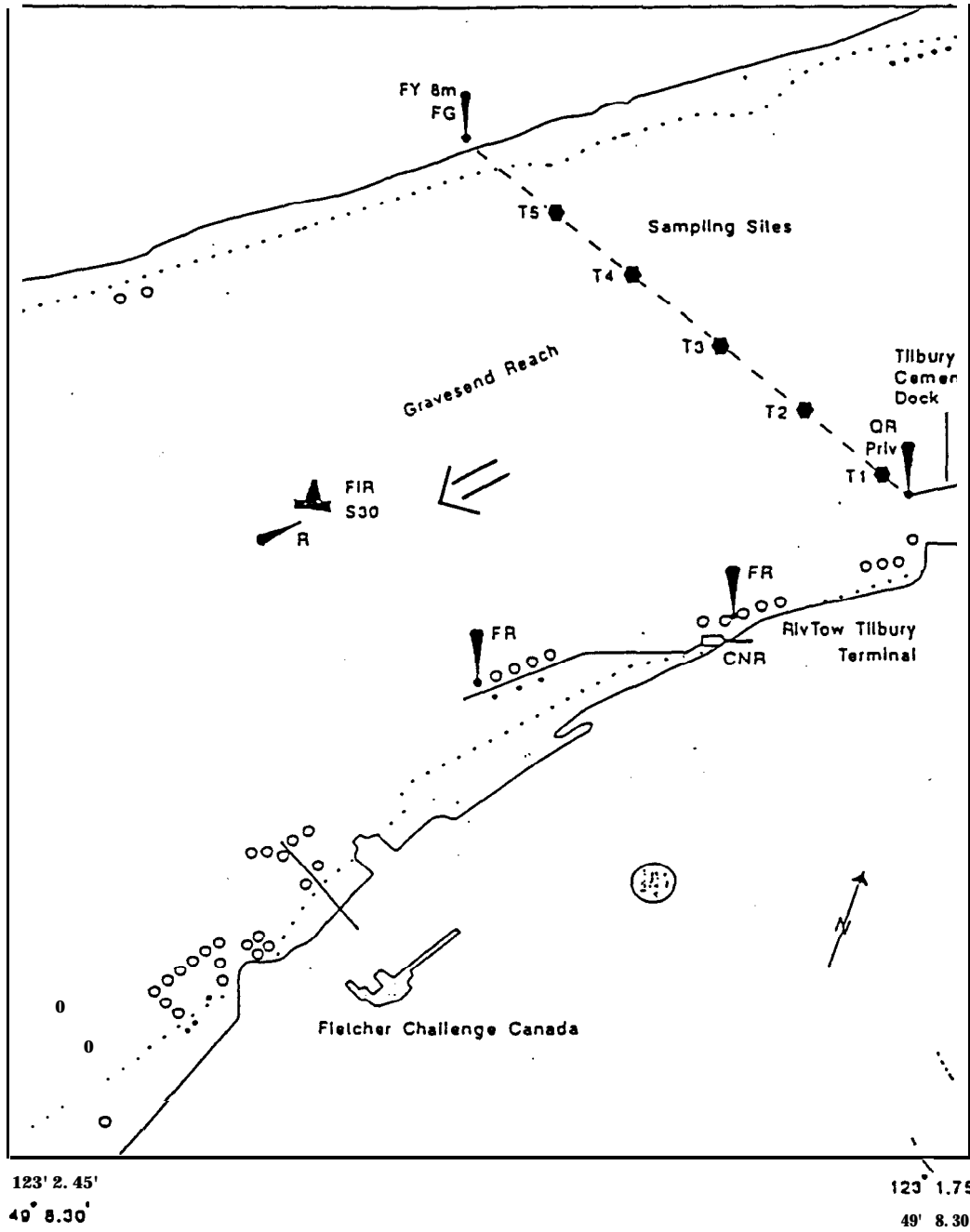
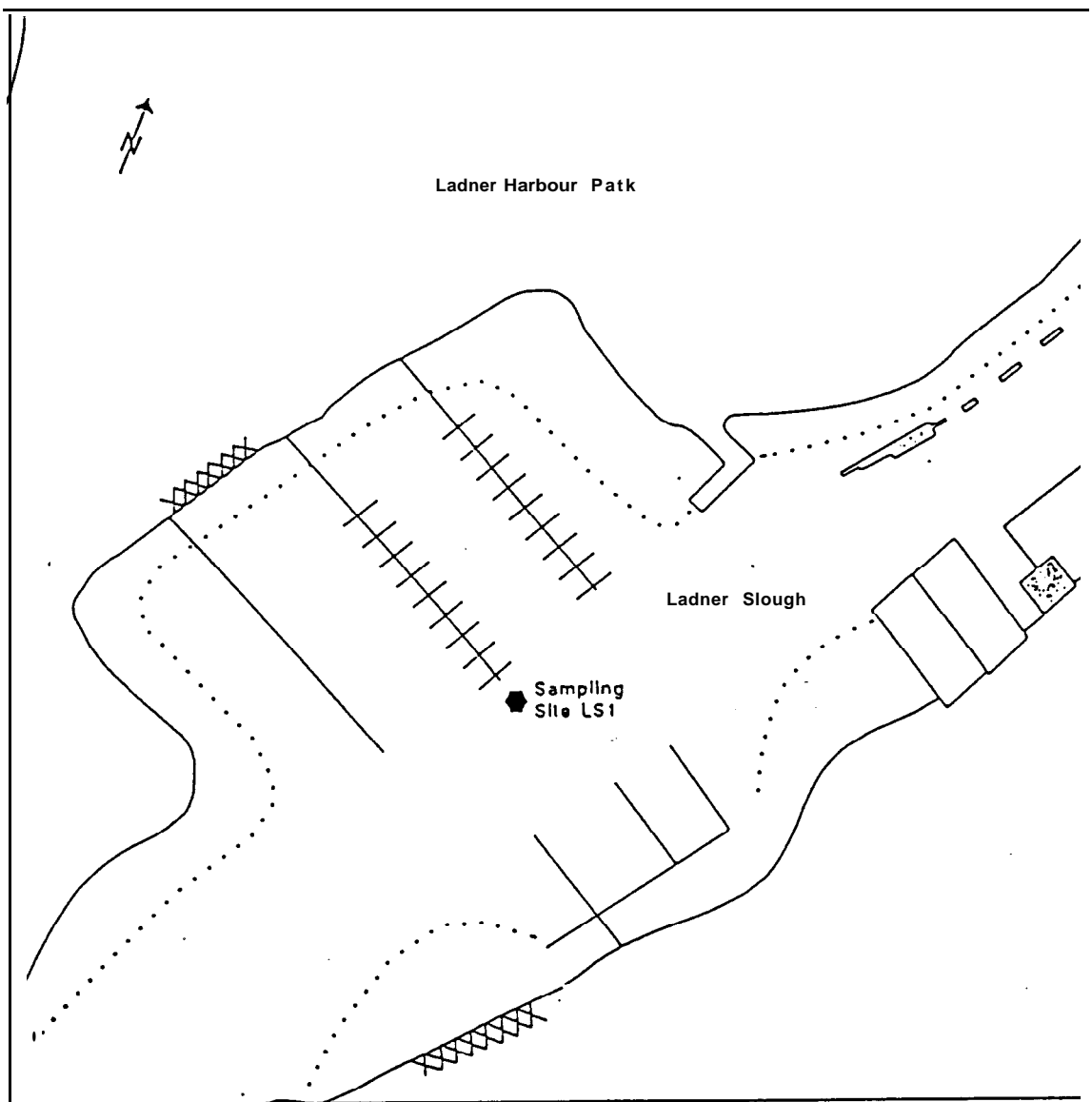


Figure I-3. Main Arm Water Quality Monitoring Site at Tilbury Island - T3 denotes the regular sample site; T1, T2, T4 and T5 are the additional sample stations for the cross-section profile. (<=Direction of river flow)

123° 5.54'
49° 5.67'

123° 5.23'
49° 5.67'



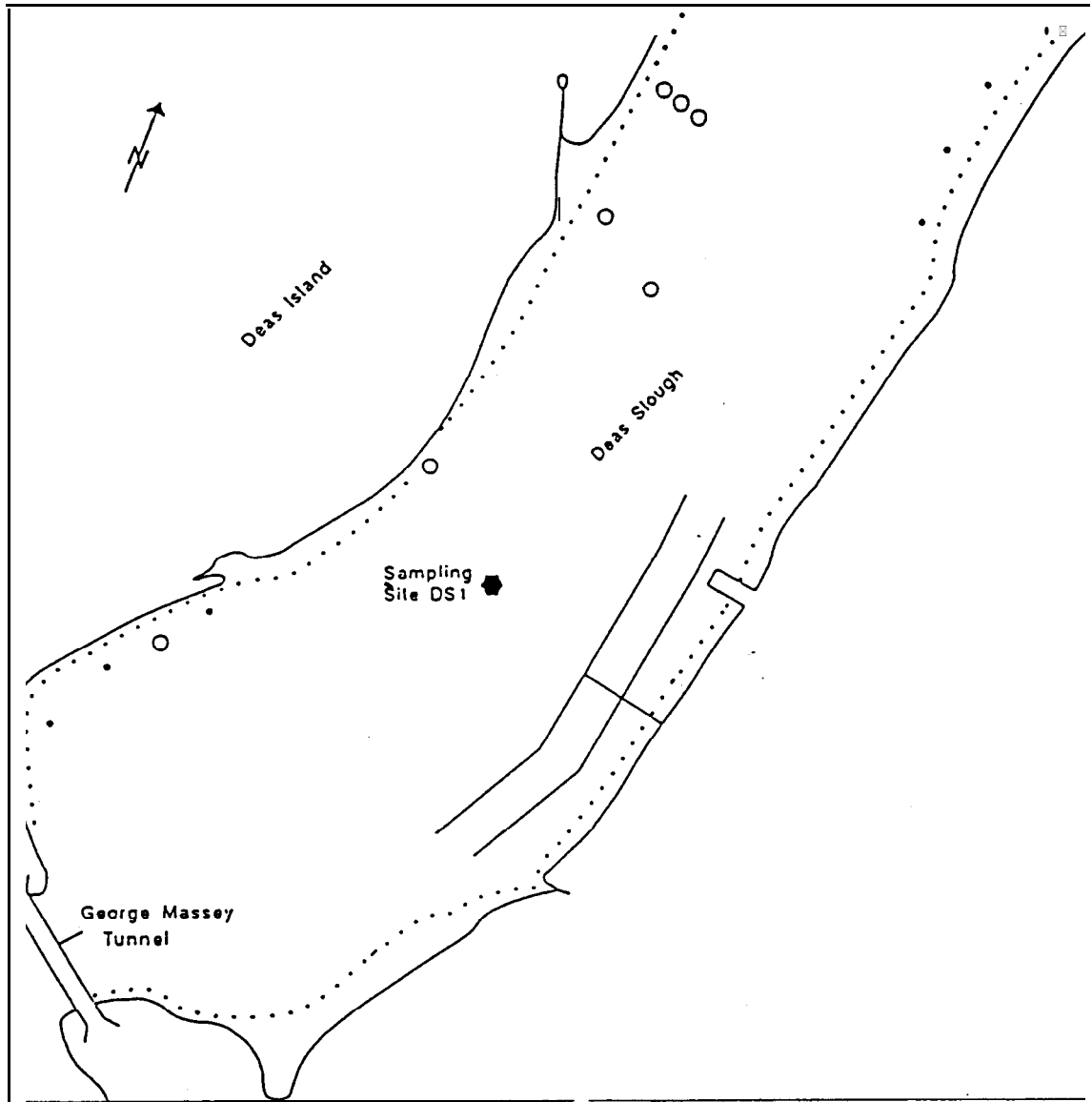
123° 5.54'
49° 5.46'

123° 5.23'
49° 5.46'

Figure I-4 Water Quality Monitoring Site at Ladner Slough, Main Arm.

123° 3.97'
49° 7.25'

123° 3.40'
49° 7.25'



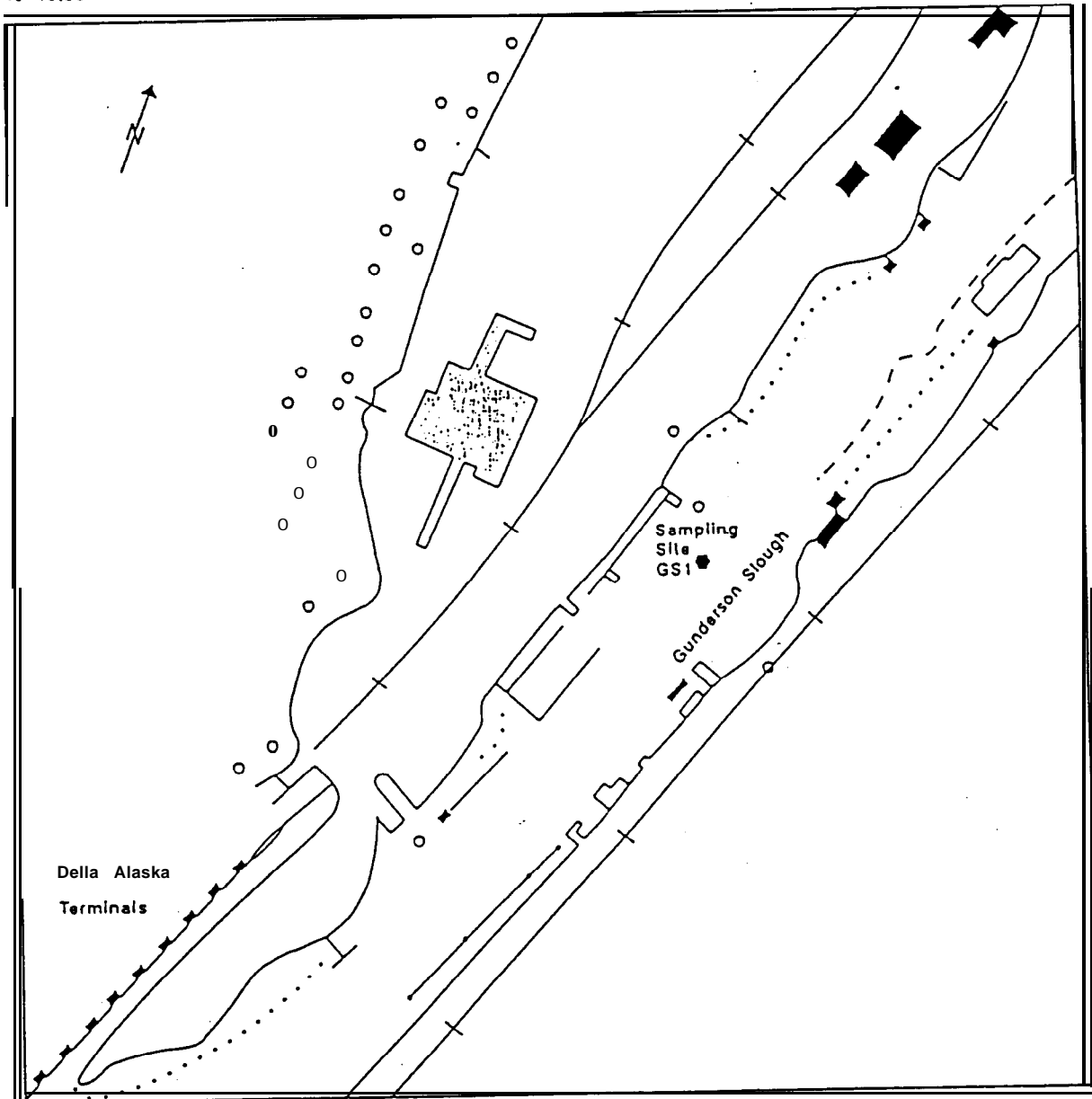
123° 3.97'
49° 6.66'

123° 3.40'
49° 6.66'

Figure I-5 Water Quality Monitoring Site at Deas Slough, Main Arm.

122° 55.40'
49° 10.53'

122° 54.95'
49° 10.57'



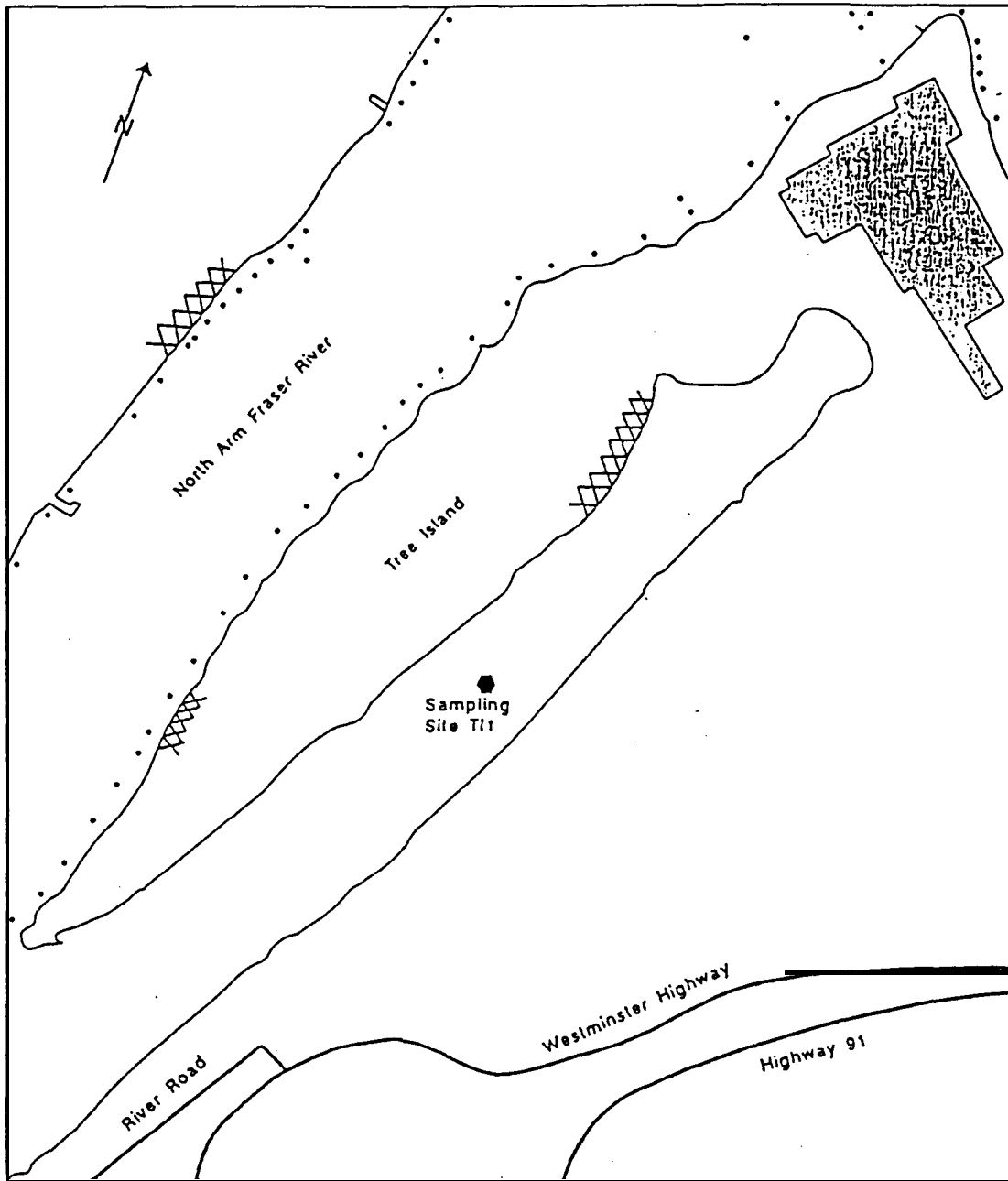
122° 55.07'
49° 10.18'

122° 54.92'
49° 10.22'

Figure I-6 Water Quality Monitoring Site at Gunderson Slough, Main Arm.

123° 58.00'
49° 11.37'

123° 57.36'
49° 11.37'



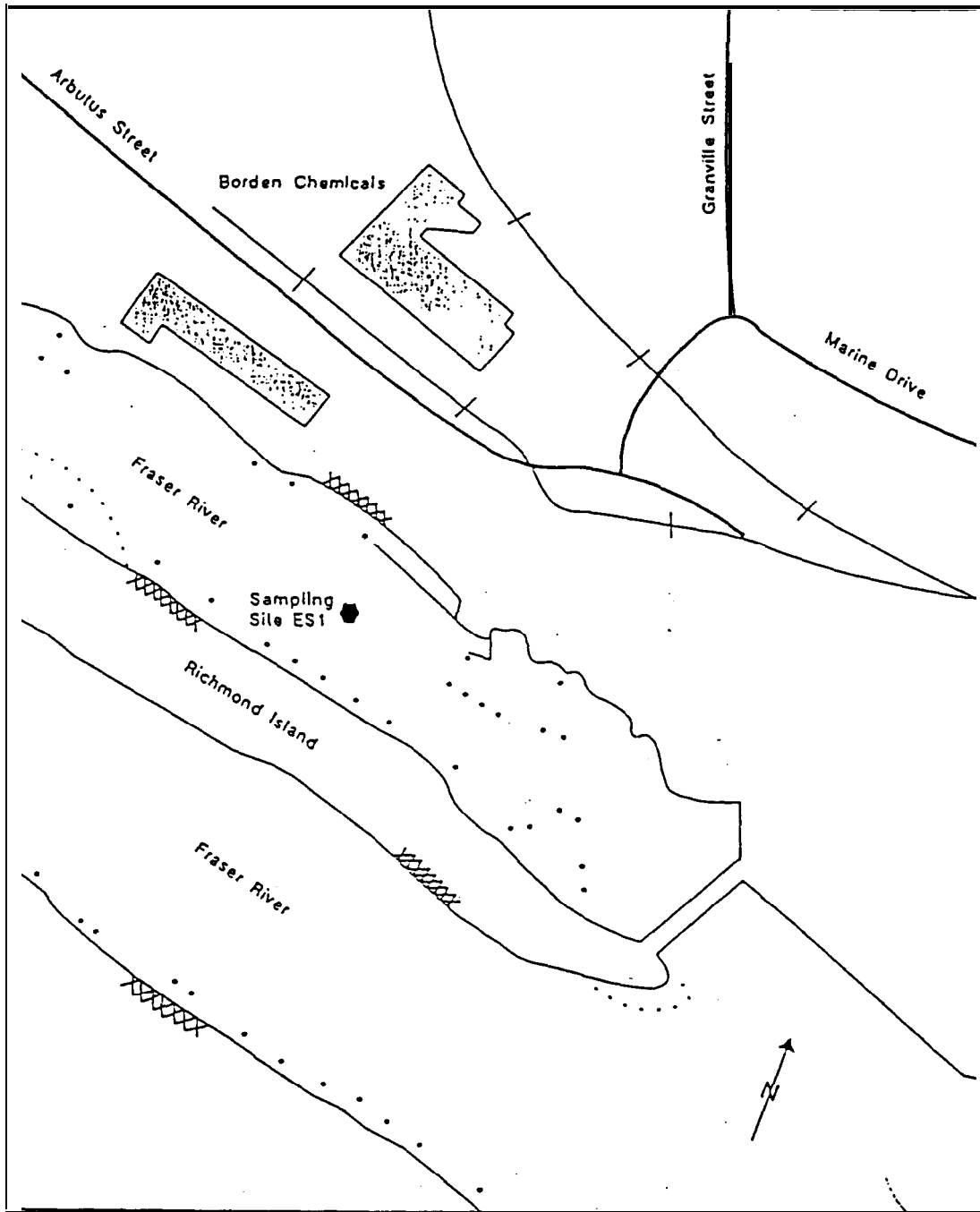
123° 58.00'
49° 10.66'

123° 57.36'
49° 10.66'

Figure I-7 Water Quality Monitoring Site at Tree Island Slough, North Arm.

123° 8.77'
49° 12.43'

123° 8.22'
49° 12.43'



123° 0.77'
49° 11.08'

123° 8.22'
49° 11.98'

Figure I-8 Water Quality Monitoring Site at Eburne Slough, North Arm.

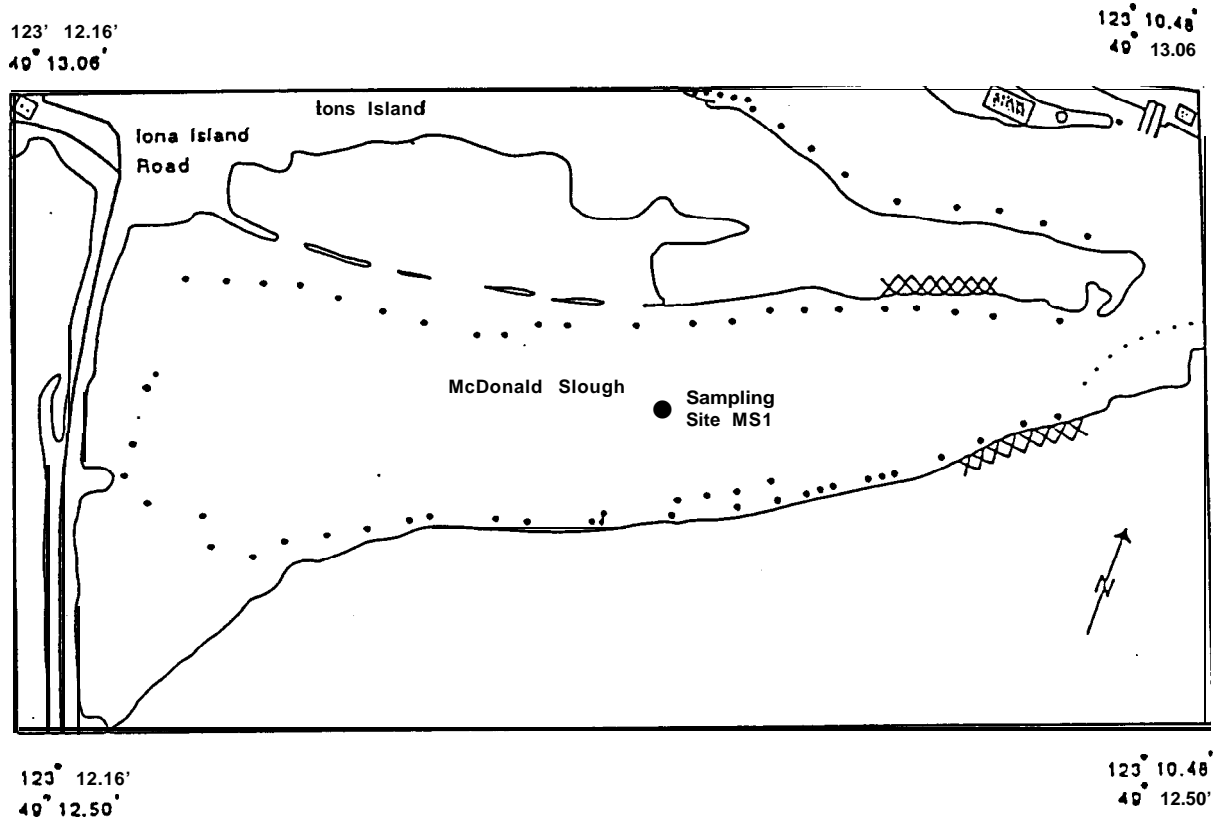


Figure I-9 Water Quality Monitoring Site at Mcdonald Slough, North Arm.

APPENDIX II

DETAILED LABORATORY PROCEDURES

TABLE OF CONTENTS

1.0 INTRODUCTION	1
1.1 Sample Containers and Preservatives	1
1.2 Method Detection Limits.....	3
2.0 PHYSICAL AND INORGANIC VARIABLES	5
3.0 ANIONS AND NUTRIENTS.....	6
4.0 TOTAL METALS	9
5.0 ORGANIC COMPOUNDS	11
6.0 BACTERIOLOGY.....	14

LIST OF TABLES

Table II-1. Bottle and Preservative Guide	2
Table II-2. Method Detection Limits from the Two Laboratories Providing Inorganic Water Quality Variable Analysis.....	4

1.0 INTRODUCTION

The following method summaries were provided by Zenon Environmental Laboratories (Zenon). Zenon provided analytical services for both inorganic and organic variables from initiation of the program until March 31, 1993. On April 19, 1993 Analytical Services Laboratories (ASL) became the contract laboratory for the inorganic variables. With the few exceptions noted below, the ASL procedures and method detection limits (MDLs) were equivalent to those described by Zenon.

1.1 Sample Containers and Preservatives

A list of bottle types and preservatives used for sample collection is given below in Table II-1. The 2-litre polyethylene bottles were used as received from the laboratory. The 500 mL polyethylene bottles used for the collection of samples for metal analyses were soaked in 25% nitric acid (HNO_3) and rinsed with deionised water following the Environment Canada procedures manual (Environment Canada, 1992).

Amber glass bottles with Teflon-lined caps, used for collecting samples for organic analyses (500 mL, 1-L and 4-L sizes), were purchased commercially from Eagle Picher. These bottles were cleaned using the following procedure:

1. Initial washing in laboratory-grade, non-phosphate detergent;
2. Rinsed 3 times with distilled water;
3. Rinsed with 1:1 nitric acid;
4. Rinsed three times with ASTM-Type 1 organic-free water;
5. Oven-dried for one hour;
6. Rinsed with hexane; and finally;
7. Oven-dried for one hour.

All samples were stored on board the vessel in coolers with ice packs at approximately 4°C immediately after packaging. The samples were maintained under these conditions until delivery to the laboratories. Each delivery occurred within 16 hours of sample collection. All samples were clearly labelled and were accompanied by a sample transfer sheet.

Samples were received at the laboratory, packed in coolers with ice packs or ice. At the laboratory the samples were stored in a refrigerator at 4°C until analyzed. All samples were stored at the laboratory for a period of four weeks after the data were reported.

Table II-1. Bottle and Preservative Guide

Inorganic Parameters	Maximum Holding Time	Sample Container	Preservation (Hold at 4°C)
pH	48 hours	2-L Polyethylene	None
Conductivity	"	Included in 2-L	"
Alkalinity	"	"	"
Hardness	"	"	"
Suspended solids (NFR)	7 days	"	"
Dissolved Solids (FR)	7 days	"	"
NO ₂ + NO ₃	48 hours	"	"
Ammonia	"	"	"
TKN	7 days	"	H ₂ SO ₄ (1:1 in lab)
Total Phosphorus	48 hours	"	"
Diss. Phosphorus	"	"	Lab filtration
Chloride	7 days	"	None
Sulphate	"	"	"
Fluoride	"	"	"
Mercury	14 days	500 mL or 1L glass	6 mL 10% potassium dichromate + 6 mL Conc. H ₂ SO ₄
Metals, Total	"	500 mL Poly.	2 mL Conc. H ₂ SO ₄
Organic Parameters			
TOC	48 hours	Included in 2L	None
Chlorophenols+	4 days, extract	4L pre-cleaned amber glass	"
Nonylphenol+	"	"	"
TCMTB	"	"	"
Resin & Fatty Acids	3 days, extract	"	Field: 4 NaOH pellets
PAHs	7 days, extract	"	None
Organochlorine Pesticides/PCBs	"	"	"
AOX	"	Included in 2L	"
Fecal Coliforms	24 hours	Sterile 250 mL Poly.	"

1.2 Method Detection Limits

Detection limits were determined using the US Environmental Protection Agency Method SW-846. Briefly, a matrix spike at a concentration of three to five times the estimated detection limit is analyzed eight to ten times by the normal procedure. The detection limit is defined as three times the standard deviation of the determinations. At the detection limit, duplicates would be expected to agree with each other to 100%. The limit of quantitation is defined as 3.3 times the limit of detection. At the limit of quantitation, duplicates would be expected to agree to within 30%.

A summary of Zenon and ASL method detection limits for inorganic variables is presented in Table II-2.

In each of the following method descriptions, the heading identifies the variable, followed by the section number from *Standard Methods for the Examination of Water and Wastewater* (APHA, 1992) where a detailed description of the specific method can be found.

**Table II-2. Method Detection Limits from the Two Laboratories
Providing Inorganic Water Quality Variable Analysis**

Analytical Variable	Method Detection Limit (MDL) (mg/L)	
	Zenon	ASL
pH	0.1 pH units	0.2 pH units
Conductivity, Specific	1 uS/cm	0.2 uS/cm
Alkalinity, Total (pH 4.5)	0.5	0.5
Hardness, Total (Calc.)	0.1	0.05
Residue, Non-filterable	4.0	1.0
Residue, Filterable	4.0	1.0
Nitrogen, NO ₂ +NO ₃	0.02	0.005
Nitrogen, Ammonia	0.005	0.005
Nitrogen, Total Kjel.	0.04	0.05
Phosphorus, Total	0.003	0.001
Phosphorus, Dissolved	0.003	0.001
Total Organic Carbon	3.0	0.50
Chloride	0.5	0.2
Sulphate	1.0	0.5
Fluoride	0.1	0.02
Mercury, Total	0.00005	0.00005
Cadmium, Total (GFAA ¹)	0.0001	0.0002
Copper, Total (ICP ¹ or GFAA)	0.001	0.001
Lead, Total (GFAA)	0.003	0.001
Nickel, Total (GFAA)	0.005	0.001
Zinc, Total (ICP)	0.01	0.001
Chromium, Total (ICP)	0.005	0.001
Arsenic, Total (Hydride ICP)	0.001	0.0001

¹ GFAA = graphite furnace atomic absorption spectrophotometer; ICP = inductively coupled plasma spectrophotometer.

2.0 PHYSICAL AND INORGANIC VARIABLES

pH (SM 4500-H+):

pH was measured with a standard pH electrode that had been calibrated against externally prepared and validated buffer solutions. Measurement was performed prior to alkalinity titration using the Metrohm Model 636 Titroprocessor.

Conductivity (SM 2510):

The sample was equilibrated at 25°C for 90 minutes in a water bath and the conductivity was measured using a calibrated Metrohm Model 660 Conductometer.

Total Suspended Solids - [Non-Filterable residue] (SM 209C):

A well-mixed sample was filtered through a pre-weighed standard 0.45 um filter and dried to constant weight at 103-105°C. The residue retained on the filter represented the total suspended solids.

Total Dissolved Solids - [Filterable Residue] (SM 2540D):

The method utilized by Zenon incorporated a measured aliquot of homogenized sample which was vacuum filtered through a 0.45 um filter. The filtrate was then evaporated on a steam bath and further dried at 105°C to constant weight. The remaining residue was expressed as the total dissolved solids. The steam bath used was custom fabricated. The analytical balance used was a Mettler AE163.

ASL determined total dissolved solids by calculation, using all anions, cations and total organic carbon as described in SM 2540.

Hardness (SM 2340 B):

Hardness was calculated from the concentrations of calcium and magnesium determined by Inductively coupled plasma (ICP) analysis of an unpreserved, filtered sample using method SM 3120 B. Hardness is defined by the following equation:

$$\text{Hardness mg/L (equivalent CaCO}_3\text{)} = 2.497[\text{Ca, mg/L}] + 4.118[\text{Mg, mg/L}]$$

3.0 ANIONS AND NUTRIENTS

Alkalinity Total 4.5 (SM 2320 B):

The sample was titrated with dilute sulphuric acid to a pH of 4.5 to determine the total alkalinity. The acid neutralizing capacity of the sample was expressed as a concentration of calcium carbonate. If the pH of the sample was greater than 8.3, the sample was titrated to the phenolphthalein endpoint (pH 8.3), and then the pH 4.5 endpoint to allow for calculation of the bicarbonate concentration. A Metrohm Autotitrator, Model 636 coupled to a Metrohm Model E503 Autosampler, was used to perform the analysis.

Chloride (SM 4500-Cl- E):

The chloride in the sample displaces thiocyanate ion from mercuric thiocyanate by the formation of a soluble mercuric chloride. The liberated thiocyanate ion reacts with the ferric ion to produce the red ferric thiocyanate complex which is measured colorimetrically at 480 nm. The intensity of the red complex was measured at 480 nm against external standards using a Technicon AutoanalyzerTM - II, continuous flow instrument.

Fluoride (SM 4500 C):

Fluoride was measured using an ion-selective electrode. A total ionic strength adjustment buffer (TISAB) was added to the standards and samples prior to analysis to break up fluoride complexes and ensure a uniform ionic strength background. Millivolt readings from the samples were compared to known fluoride standards. An Orion standard calomel reference and fluoride selective electrode coupled to an Orion Research Microprocessor Ionanalyzer/901 provided direct measurement of fluoride concentration based on the millivolt readings.

Sulphate (SM 4500-SO4- F):

Sulphate ion reacts with an acidic solution of barium chloride and methylthymol blue to form barium sulphate. At high pH, through the addition of NaOH, excess barium reacts with methylthymol blue to form a blue chelate. The unreacted methylthymol blue is a grey complex and is proportional to the sulphate concentration. The intensity of the grey complex was measured at 460 nm against external standards using a Technicon TRAACSTM, Model 800, continuous flow instrument.

Nitrogen, (Nitrate-Nitrite) (SM-4500-NO3- F):

Samples were analyzed using an automated colorimetric method (Technicon TRAACS™, Model 800, continuous flow instrument) in which nitrate is reduced to nitrite at pH 7.5 in a copper-cadmium reductor cell. The nitrite reacts under acidic conditions with sulfanilamide to form a diazo compound. This compound is then coupled with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a reddish-purple azo dye that was measured at 520 nm to determine the nitrate/nitrite concentration. To determine the nitrate concentration, the reduction step is bypassed and the resulting nitrite value obtained is subtracted from the total nitrite value obtained using the reduction procedure.

Nitrogen (Ammonia) (SM 4500-NH3 C):

This automated procedure utilizes the Berthelot Reaction, in which indophenol, a blue-coloured compound, is produced when a solution of an ammonium salt is added to sodium phenoxide, and then followed with the addition of sodium hypochlorite. EDTA was added to prevent the precipitation of metal hydroxides. Sodium nitroprusside was added to intensify the blue colour. This complex was measured at 630 nm using a Technicon TRAACS™, Model 800, continuous flow instrument.

Nitrogen, Total Kjeldahl (SM 4500, N-org B):

Zenon digested the water sample process in a hot block with a mixture of sulphuric acid, mercuric oxide and potassium sulphate to convert the free ammonia and organic nitrogen compounds to ammonium bisulphate. The digestate was then analyzed for Kjeldahl nitrogen using an automated colorimetric method. An emerald green coloured ammonium salicylate complex is formed by the reaction of ammonia, sodium salicylate, sodium nitroprusside and sodium hypochlorite in a buffered alkaline medium at a pH of 12.8-13.0. The ammonia salicylate complex was measured at 660 nm using a Technicon TRAACS™, Model 800, continuous flow instrument.

ASL analysed the sampled digested, as described above, by specific ion potentiometry using a combination reference-ammonia ion selective electrode (EPA Method 354.4)

Phosphorus, Total and Dissolved Total (SM 4500-P):

Persulphate digestion and oxidation were employed to release phosphorus from organic and inorganic matter in the sample. The method measures all orthophosphates and condensed phosphates, both dissolved and particulate. For dissolved total phosphorous, the sample was prefiltered through a 0.45 um filter prior to digestion. After digestion, the

liberated orthophosphate forms molybdophosphoric acid in ammonium molybdate solution. Molybdophosphoric acid was reduced by stannous chloride to the intensely coloured molybdenum blue, which was measured at 660 nm using a Technicon TRAACS™, Model 800, continuous flow instrument.

Total Organic Carbon (SM 505A):

Zenon determined total organic carbon as follows: A small, accurately measured volume of sample was injected into the total carbon port of a Beckman Carbon Analyser 915A, to determine total carbon. At 950°C, packing material impregnated with cobalt oxide aids in the combustion of all carbonaceous material to CO₂. The CO₂ is then swept into an infrared analyser for measurement. Inorganic carbon was determined by injecting an aliquot of the sample into a tube packed with quartz chips wetted with phosphoric acid. At 150°C the inorganic carbon is released as CO₂ and detected in an infrared analyser. Total organic carbon was determined from the difference of the total and inorganic carbon measurements.

ASL determined total carbon and dissolved organic carbon using method SM 5310 A and C where carbon liberated from the matrix by a persulphate-UV digestion was quantified colorimetrically.

4.0 TOTAL METALS

For most of the metals, the samples were initially scanned by Inductively coupled argon plasma (ICAP) emission spectrometry. To achieve lower method detection limits, a more sensitive Zeeman corrected graphite furnace atomic absorption spectrometry (AAS) procedure was required for some elements as described in the following sections.

Total Metals, by ICAP (SM 3030B/D & 3120 B):

The samples were first digested with nitric acid to dissolve suspended solids and remove organics by oxidation and volatilization. After digestion, samples were aspirated into an inductively coupled argon plasma (ICAP) for excitation of the atoms and subsequent emission of electromagnetic radiation. The amount of radiation emitted is proportional to the analyte's concentration. The Thermo Jarrell Ash ICAP 61E, a fully automated and simultaneous spectrometer, was used to measure the concentration of 32 elements.

Total Metals, by AAS (SM 3030 B/D & 3113 B):

Zenon used the following analysis procedure for cadmium, lead and nickel. Samples were first digested with nitric acid to dissolve suspended solids and remove organics by oxidation and volatilization. Digestates were then introduced into a graphite furnace where drying, charring, and atomization takes place. The atomic absorption of cadmium, lead and nickel were measured at 228.8, 283.3, 232.0 nm, respectively, and compared to intensity readings of calibration standards. A Varian Spectr AA-400 graphite furnace is coupled to a Varian Zeeman Graphite Tube Atomizer and a Varian Atomic Absorption Spectrometer to complete the analysis.

ASL analysed digested samples for cadmium, chromium, copper, lead, molybdenum, nickel, silver and zinc by graphite furnace AA with Zeeman background correction (EPA Method 7000).

Arsenic and Selenium (SM 3500-B & 3114C):

Samples were digested with a mixture of hydrochloric acid and potassium persulphate. Digested samples were reduced with sodium borohydride to form metal hydrides. The arsenic and selenium hydrides were separated from the liquid phase in a phase separator and were swept into an inductively coupled argon plasma for excitation and subsequent measurement of the emission spectra by simultaneous spectrophotometry. The emission signals were quantified using digested arsenic/selenium calibration standards. The hydride

generator is completely automated and is interfaced to a Thermo Jarrell Ash ICAP 61E simultaneous spectrometer.

Mercury (SM 303 F):

All forms of mercury were converted to inorganic mercury using a mixture of nitric and sulphuric acids, potassium permanganate and potassium persulphate in a water bath at 95°C. Excess permanganate was reduced using hydroxylamine hydrochloride. Inorganic mercury was then reduced to its elemental state using SnCl₂ and was measured using cold vapour atomic absorption spectrophotometry at a wavelength of 253.7 nm (Milton Roy Mercury Monitor).

5.0 ORGANIC COMPOUNDS

Zenon Laboratories provided the analytical services for organic compounds for the entire 15-month period of the monitoring program. The following descriptions were supplied by Zenon.

Chlorophenolic Compounds (US EPA Method 1653):

This procedure description applies to the analysis of chlorophenols, chloroguaiacols, chlorocatechols, and nonylphenol and is summary of US EPA Method 1653. The key feature of the method is that all determinations were performed by gas chromatograph mass spectroscopy (GC/MS) using selected ion monitoring to achieve the low detection limits required while providing a high degree of data confidence.

A large water sample (four litres) is adjusted to neutral pH. Potassium carbonate buffer is added and the pH is raised to between 9 and 11.5. Stable, isotopically labelled, analogs of the compounds to be analyzed for are added to the sample as surrogates. The following surrogates were used to track the recoveries during the chlorophenolic analyses:

- 2,4-dichlorophenol (ring-D3);
- pentachlorophenol (13C6);
- 4,5-dichlorocatechol (13C6);
- tetrachlorocatechol (13C6);
- 4-chloroguaiacol (13C6);
- 4,5,6-trichloroguaiacol (13C6);
- 3,4,5,6-tetrachloroguaiacol (13C6);
- 5-chlorovanillin (13C6).

The chlorophenolics are converted to acetates by addition of acetic anhydride. After acetylation, the solution is extracted with hexane. The hexane is concentrated to a final volume of 100 mL, an instrument internal standard is added, and an aliquot of the concentrated extract is injected into the gas chromatograph. The compounds separated by the GC are detected using selected ion monitoring mass spectroscopy.

Detection limits of 0.000001 mg/L (1 ng/L) were achieved for the chlorophenols, with slightly higher detection limits of 0.000002 mg/L (2 ng/L) for the chlorocatechols and chloroguaiacols.

Nonylphenol was included in this chlorophenolics scan. The MDL for nonylphenol was 0.00002 mg/L (20 ng/L).

Resin and Fatty Acids (Modified - BC Ministry of Environment)

Water samples were spiked with the surrogate nonadecanoic acid. The pH of the sample was adjusted to a pH of 9.0 and the sample was extracted with methyl tertiary butyl ether (MTBE). The extract was dried over sodium sulphate, concentrated and methylated with diazomethane. The methylated extract was analyzed by GC/MS using selected ion monitoring instead of the usual flame ionization detection (FID) method.

Detection limits obtained for this method were 0.0005 mg/L using a four litre sample.

PCBs and Organochlorine Pesticides (BC Ministry of the Environment Method)

A one litre water sample was extracted three times with 80, 50 and 50 mL portions of dichloromethane, after the addition of the surrogate dibromobiphenyl. The extract was then dried, concentrated by rotary evaporation, and cleaned up on Florisil prior to gas chromatograph/electron capture detection (GC/ECD) analysis. Quantitation was achieved by matching the eight most prominent peaks to either the individual Aroclors 1242, 1254 or 1260 or a 1:1:1 mixture of the Aroclors depending on the best match.

Detection limits obtained from a four litre sample varied from 0.000001 mg/L to 0.00001 mg/L (1-10 ng/L) for the organochlorine pesticides. Detection limits for PCB and toxaphene analyses were 0.0002 mg/L and 0.00005 mg/L (20 ng/L and 5 ng/L), respectively.

2 - (Thiocyanomethylthio) benzothiazole (TCMTB) (Environment Canada)

An aliquot of the water sample was extracted with dichloromethane and cleaned on Florisil (deactivated with 1% water). The solvent was exchanged for acetonitrile and analyzed by high pressure liquid chromatography (HPLC).

The detection limit obtained for this analysis was 0.005 mg/L.

Polycyclic Aromatic Hydrocarbons (PAH) (US EPA Method 8270)

The deuterated surrogates naphthalene-d8, acenaphthene-d10, phenanthrene-d10, chrysene-d12 and perylene-d12 were added to an aliquot of water sample which was then extracted with dichloromethane. The extract was cleaned up on silica gel and concentrated to 1 mL. Analytical quantitation is performed by GC/MS with a Hewlett Packard 5890 GC and HP 5970 mass selective detector (MSD) using selected ion monitoring.

The detection limits were 0.00001 mg/L (10 ng/L) for the low molecular weight PAH compounds and 0.00005 mg/L (50 ng/L) for most high molecular weight PAH compounds.

Adsorbable Organic Halides (AOX) (SM 5320)

The water samples were preserved with nitric acid and stored at 4°C. An appropriate sample aliquot was passed through two granular activated carbon columns in series. The columns were then rinsed with potassium nitrate solution to remove any inorganic halides. Each column was combusted and the adsorbed organohalides were converted to HX which was then micro-coulometrically titrated in the cell.

The detection limit obtained for the water samples was 0.01 mg/L.

Zenon subcontracted this work to Econotech, a local lab with extensive experience in this analysis.

6.0 BACTERIOLOGY

Fecal Coliforms - SM 9221 E1

A multiple tube fermentation technique was used to determine the fecal coliform counts for this study. The analyses were conducted at the GVRD bacteriology laboratory. A presumptive test to determine the presence of coliform bacteria was carried out followed by the verification for fecal coliforms.

Presumptive Test:

The samples were diluted and aliquots pipetted into tubes containing Lauryl Tryptose Broth (LTB). The tubes were incubated at 35 °C, and all tubes having evolved carbon dioxide buildup and growth at 24 and 48 hours, or just heavy growth at 48 hours were tested for the presence of fecal coliforms.

Verification of Fecal Coliforms:

All presumptive positive LTB tubes were inoculated into EC tubes and placed into a water bath set at 44.5 °C. The tubes were examined after 24 hours for the presence of gas (positive) and all of the results were recorded. The most probable number (MPN) value is derived from a combination of negative and positive tubes using standard MPN tables.

The MDL for this procedure was <2 MPN/100 mL.

References

APHA and WWA. 1992. Standard methods for the examination of water and wastewater. 18th Edition. American Public Health Association and American Water Works Association.

Environment Canada. 1992. Procedures manual for sample container cleaning. Report by Environment Canada, Conservation and Protection Directorate, Pacific and Yukon Region.

APPENDIX III

**REPLICATE AND INTER-LABORATORY COMPARISON RESULTS
AND
ANALYSIS OF STANDARD REFERENCE MATERIALS**

Table III-1. Analysis of Standard Reference Materials as QA Samples

Lab ID Sample ID SITE Parameter	Certified range of values @ 95% confidence ION-91 & NBS 1643	Zenon Ref. Sample ION-91 & NBS 1643 93-01-29	ASL FR0130 Blind Ref. ION-91 & TM-21 93-08-10	ASL FR0271 Blind Ref. ION-91 & TM-21 94-03-22	Certified range of values @ 95% confidence ION-91 & TM-21
Physical Tests:					
pH	7.14 - 8.18	7.40	7.40	7.41	7.14 - 8.18
Specific Conductance (SC)	100.07 - 88.47	97.0	95.3	94	100.07 - 88.47
Suspended Solids (NFR)	na	na	<1	<1	na
Dissolved Solids (FR)	na	na	40	56	na
Hardness Total	50.28 - 39.10	na	47.6	45.4	50.28 - 39.10
Anions:					
Alkalinity Total @ pH 4.5	45.16 - 37.36	43.3	41.8	42.1	45.16 - 37.36
Chloride Dissolved	1.47 - 1.05	1.3	1.26	1.5	1.47 - 1.05
Fluoride Dissolved	0.078 - 0.026	<0.1	0.03	0.04	0.078 - 0.026
Sulfate	3.60 - 2.94	3.2	3.6	3.9	3.60 - 2.94
Nutrients:					
Nitrogen Amn. Diss(N)	0.003	<0.005	<0.005	<0.005	0.003
Nitrogen Kjel. Tot(N)	0.14 - 0.02	0.05	0.10	0.1	0.14 - 0.02
Nitro NO3+NO2 D	0.35 - 0.23	0.290	0.286	0.33	0.35 - 0.23
Phosphorus Dissolved	na	na	<0.001	0.003	na
Phosphorus Total	0.008 - 0.001	na	0.001	0.005	0.008 - 0.001
TOTAL METALS					
Aluminum	0.120 - 0.110	0.11	<0.2	<0.20	0.04
Arsenic	0.083 - 0.081	0.0917	<0.0001	<0.0001	na
Barium	0.0527 - 0.0465	0.058	0.02	0.025	0.032 - 0.0129
Cadmium	0.0132 - 0.0112	0.0125	0.0054	0.0039	0.0063 - 0.0035
Calcium	na	na	na	13.3	na
Chromium	0.020 - 0.018	0.022	0.008	0.007	0.0087 - 0.0055
Cobalt	0.0243 - 0.0227	0.023	<0.015	<0.015	0.006
Copper	0.0251 - 0.0195	0.023	0.008	0.008	0.0098 - 0.0054
Iron	0.110 - 0.104	0.13	<0.03	<0.030	0.01
Lead	0.0362 - 0.0344	0.038	0.004	0.005	0.0071 - 0.0039
Magnesium	na	na	1.80	2.96	na
Manganese	0.0377 - 0.0329	0.036	0.008	0.007	0.008 - 0.004
Mercury	na	na	<0.00005	<0.00005	na
Molybdenum	0.106 - 0.102	0.111	0.006	0.006	0.007
Nickel	0.0679 - 0.0533	0.063	0.007	0.006	0.0090 - 0.0042
Potassium	na	na	<2	<2.0	na
Selenium	na	na	<0.0005	<0.0005	na
Silver	0.0025 - 0.0019	na	<0.0001	<0.0001	na
Sodium	na	na	3	<2.0	na
Tin	na	na	<0.3	<0.30	na
Zinc	0.0748 - 0.0730	0.085	0.009	0.005	0.0097 - 0.0053
ORGANIC PARAMETERS:					
Carbon Total Organic	na	na	1.49	1.54	1.83 - 0.73

na - not analysed

NBS 1643c = former US National Bureau of Standards trace metal standard in water
 Ion 91 = CCIW - National Water Research Institute Major Ion Standard
 TT-21 = CCIW - National Water Research Institute Trace Metal Standard

APPENDIX IV

ANALYTICAL RESULTS FOR QA REPLICATE DATA

Minimum Detection Limits for Total Metals Analysis

Laboratory	Zenon	ASL	EC LAB	UNITS
	MDL From: 93-01 To: 93-03	MDL From: 93-04 To: 94-03	MDL	
Physical Tests:				
Dissolved Oxygen				mg/L
Water Temperature				deg C
Air Temperature				"
pH				
Field pH				
Specific Conductance(SC)	1	0.2	2	uS/cm
Field SC				uS/cm
Suspended Solids (NFR)	4	1	10	mg/L
Dissolved Solids (FR)	4	1	10	"
Hardness Total				mg/L CaCO ₃
Anions:				
Alkalinity Total @ pH 4.5	0.5	0.5		mg/L CaCO ₃
Chloride Dissolved	0.5	0.2	0.2	mg/L
Fluoride Dissolved	0.1	0.02	0.02	"
Sulfate	1	0.5	0.5	"
Nutrients:				
Nitrogen Amm.Diss(N)	0.005	0.005	0.002	mg N/L
Nitrogen Kjel.Tot(N)	0.04	0.05		"
Nitro NO ₃ +NO ₂ D	0.02	0.005	0.002	"
Phosphorus Dissolved	0.003	0.001		mg P/L
Phosphorus Total	0.003	0.001	0.002	"
TOTAL METALS				
Aluminum	0.06	0.02	0.002	mg/L
Arsenic	0.001	0.0001	-	"
Barium	0.001	0.01	0.0002	"
Cadmium	0.0001	0.0002	0.0001	"
Calcium	0.05	0.05	0.1	"
Chromium	0.005	0.001	0.0002	"
Cobalt	0.004	0.015	0.0001	"
Copper	0.001	0.001	0.0002	"
Iron	0.05	0.03	0.0004	"
Lead	0.003	0.001	0.0002	"
Magnesium	0.02	0.01	0.1	"
Manganese	0.002	0.005	0.0001	"
Mercury	0.00005	0.00005	0.000005	"
Molybdenum	0.004	0.001	0.0001	"
Nickel	0.005	0.001	0.0002	"
Potassium	0.4	2	0.1	"
Selenium	0.03	0.0005	-	"
Silver	0.03	0.0001	-	"
Sodium	0.4	2	0.1	"
Tin	0.02	0.3	-	"
Zinc	0.01	0.001	0.0002	"
ORGANIC PARAMETERS				
Carbon Total Organic	0.5	0.5		mg/L

Replicate Data: Physical, Inorganic and Metal Data

Lab ID Client ID SITE		EC Lab FR0018 Tilbury Rep 2 93-02-10	EC Lab FR0020 Tilbury Rep 3 93-02-10	EC Lab FR0022 Tilbury Rep 5 93-02-10	EC Lab FR0024 Tilbury Rep 7 93-02-10	EC Lab FR0026 Tilbury Rep 9 93-02-10	Average of 5 Reps	Std Dev of 5 Reps
Sampled On:	Units							
Latitude (N)		49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86		
Longitude (W)		123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93		
Physical Tests:								
Dissolved Oxygen	mg/L	-	-	-	-	-	-	-
Water Temperature	deg C	-	-	-	-	-	-	-
Air Temperature	"	-	-	-	-	-	-	-
pH		7.51	7.53	7.53	7.57	7.59	7.55	0.03
Field pH		-	-	-	-	-	-	-
Specific Conductance (SC)	uS/cm	726.0	572.0	482.0	380.0	290.0	490.00	169.25
Field SC	uS/cm	-	-	-	-	-	-	-
Suspended Solids (NFR)	mg/L	40	30	40	40	20	34.00	8.94
Dissolved Solids (FR)	"	390	310	260	210	170	268.00	86.14
Hardness Total	mg/L CaCO3	103	92	86.6	77	69	85.52	13.17
Anions:								
Alkalinity Total @ pH 4.5	mg/L CaCO3	47	47	47	47	47	47.00	0.00
Chloride Dissolved	mg/L	160	118	93.3	77.1	50	99.68	41.81
Fluoride Dissolved	"	0.06	0.05	0.05	0.05	0.05	0.05	0.00
Sulfate	"	30.0	26.0	23.8	20.5	16.8	23.42	5.06
Nutrients:								
Nitrogen Amm.Diss(N)	mg N/L	0.102	0.113	0.099	0.090	0.076	0.10	0.01
Nitrogen Kjel.Tot(N)	"	-	-	-	-	-	-	-
Nitro NO3+NO2 D	"	0.190	0.190	0.190	0.190	0.190	0.19	0.00
Phosphorus Dissolved	mg P/L	0.019	0.018	0.016	0.015	0.012	0.02	0.00
Phosphorus Total	"	0.041	0.057	0.070	0.059	0.048	0.06	0.01
TOTAL METALS								
Aluminum	mg/L	0.75	0.85	0.96	0.76	0.63	0.79	0.12
Arsenic	"	-	-	-	-	-	-	-
Barium	"	0.02	0.02	0.02	0.02	0.17	0.05	0.07
Cadmium	"	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0000
Calcium	"	18.1	18.0	18.2	17.3	16.8	17.68	0.61
Chromium	"	0.0016	0.0019	0.0023	0.0018	0.0015	0.0018	0.0003
Cobalt	"	0.0007	0.0008	0.0008	0.0006	0.0005	0.0007	0.0001
Copper	"	0.0028	0.0029	0.0044	0.0026	0.0022	0.0030	0.0008
Iron	"	1.18	1.44	1.61	1.28	1.04	1.31	0.22
Lead	"	0.0003	0.0004	0.0008	0.0004	0.0006	0.0005	0.0002
Magnesium	"	14.00	11.40	10.00	8.20	6.60	10.04	2.86
Manganese	"	0.0321	0.0362	0.0398	0.0329	0.0292	0.0340	0.0041
Mercury	"	<	<	<	<	<	-	-
Molybdenum	"	0.0007	0.0008	0.0007	0.0007	0.0007	0.0007	0.0000
Nickel	"	0.0200	0.0024	0.0028	0.0021	0.0019	0.0058	0.0079
Potassium	"	-	-	-	-	-	-	-
Selenium	"	-	-	-	-	-	-	-
Silver	"	-	-	-	-	-	-	-
Sodium	"	97.2	72.7	58.8	43.9	29.6	60.44	26.12
Tin	"	-	-	-	-	-	-	-
Zinc	"	0.004	0.005	0.005	0.004	0.003	0.004	0.001
ORGANIC PARAMETERS:								
Carbon Total Organic	mg/L	3.0	2.9	3.1	3.0	2.9	3.0	0.08

Replicate Data: Physical, Inorganic and Metal Data

Lab ID Client ID SITE		EC Lab FR0018 Tilbury Rep 2 93-02-10	EC Lab FR0020 Tilbury Rep 3 93-02-10	EC Lab FR0022 Tilbury Rep 5 93-02-10	EC Lab FR0024 Tilbury Rep 7 93-02-10	EC Lab FR0026 Tilbury Rep 9 93-02-10	Average of 5 Reps	Std Dev of 5 Reps
Sampled On:	Units							
Latitude (N)		49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86		
Longitude (W)		123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93		
Physical Tests:								
Dissolved Oxygen	mg/L	-	-	-	-	-	-	-
Water Temperature	deg C	-	-	-	-	-	-	-
Air Temperature	"	-	-	-	-	-	-	-
pH		7.51	7.53	7.53	7.57	7.59	7.55	0.03
Field pH		-	-	-	-	-	-	-
Specific Conductance (SC)	uS/cm	726.0	572.0	482.0	380.0	290.0	490.00	169.25
Field SC	uS/cm	-	-	-	-	-	-	-
Suspended Solids (NFR)	mg/L	40	30	40	40	20	34.00	8.94
Dissolved Solids (FR)	"	390	310	260	210	170	268.00	86.14
Hardness Total	mg/L CaCO3	103	92	86.6	77	69	85.52	13.17
Anions:								
Alkalinity Total @ pH 4.5	mg/L CaCO3	47	47	47	47	47	47.00	0.00
Chloride Dissolved	mg/L	160	118	93.3	77.1	50	99.68	41.81
Fluoride Dissolved	"	0.06	0.05	0.05	0.05	0.05	0.05	0.00
Sulfate	"	30.0	26.0	23.8	20.5	16.8	23.42	5.06
Nutrients:								
Nitrogen Amm.Diss(N)	mg N/L	0.102	0.113	0.099	0.090	0.076	0.10	0.01
Nitrogen Kjel.Tot(N)	"	-	-	-	-	-	-	-
Nitro NO3+NO2 D	"	0.190	0.190	0.190	0.190	0.190	0.19	0.00
Phosphorus Dissolved	mg P/L	0.019	0.018	0.016	0.015	0.012	0.02	0.00
Phosphorus Total	"	0.041	0.057	0.070	0.059	0.048	0.06	0.01
TOTAL METALS								
Aluminum	mg/L	0.75	0.85	0.96	0.76	0.63	0.79	0.12
Arsenic	"	-	-	-	-	-	-	-
Barium	"	0.02	0.02	0.02	0.02	0.17	0.05	0.07
Cadmium	"	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0000
Calcium	"	18.1	18.0	18.2	17.3	16.8	17.68	0.61
Chromium	"	0.0016	0.0019	0.0023	0.0018	0.0015	0.0018	0.0003
Cobalt	"	0.0007	0.0008	0.0008	0.0006	0.0005	0.0007	0.0001
Copper	"	0.0028	0.0029	0.0044	0.0026	0.0022	0.0030	0.0008
Iron	"	1.18	1.44	1.61	1.28	1.04	1.31	0.22
Lead	"	0.0003	0.0004	0.0008	0.0004	0.0006	0.0005	0.0002
Magnesium	"	14.00	11.40	10.00	8.20	6.60	10.04	2.86
Manganese	"	0.0321	0.0362	0.0398	0.0329	0.0292	0.0340	0.0041
Mercury	"	<	<	<	<	<	<	-
Molybdenum	"	0.0007	0.0008	0.0007	0.0007	0.0007	0.0007	0.0000
Nickel	"	0.0200	0.0024	0.0028	0.0021	0.0019	0.0058	0.0079
Potassium	"	-	-	-	-	-	-	-
Selenium	"	-	-	-	-	-	-	-
Silver	"	-	-	-	-	-	-	-
Sodium	"	97.2	72.7	58.8	43.9	29.6	60.44	26.12
Tin	"	-	-	-	-	-	-	-
Zinc	"	0.004	0.005	0.005	0.004	0.003	0.004	0.001
ORGANIC PARAMETERS:								
Carbon Total Organic	mg/L	3	3	3	3	3	2.98	0.08

Replicate Data: Physical, Inorganic and Metal Data

Lab ID Client ID SITE		Zenon FR0019 Tilbury Rep 1 93-02-10	Zenon FR0021 Tilbury Rep 4 93-02-10	Zenon FR0023 Tilbury Rep 6 93-02-10	Zenon FR0025 Tilbury Rep 8 93-02-10	Zenon FR0027 Tilbury Rep 10 93-02-10	Average of 5 Reps	Std Dev of 5 Reps
Sampled On:	Units							
Latitude (N)		49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86		
Longitude (W)		123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93		
Physical Tests:								
Dissolved Oxygen	mg/L	-	-	-	-	-	-	-
Water Temperature	deg C	-	-	-	-	-	-	-
Air Temperature	"	-	-	-	-	-	-	-
pH		7.70	7.60	7.60	7.70	7.60	7.64	0.05
Field pH		-	-	-	-	-	-	-
Specific Conductance (SC)	uS/cm	667.0	505.0	474.0	321.0	287.0	450.8	153.2
Field SC	uS/cm	-	-	-	-	-	-	-
Suspended Solids (NFR)	mg/L	37	53	55	49	35	45.8	9.2
Dissolved Solids (FR)	"	356	272	247	175	153	240.6	81.1
Hardness Total	mg/L CaCO3	95.9	84.1	81.3	67.7	62.6	78.32	13.3
Anions:								
Alkalinity Total @ pH 4.5	mg/L CaCO3	49.3	49.4	49.2	49.3	42.3	48	3
Chloride Dissolved	mg/L	153	109	100	5.7	47.2	83	57.3
Fluoride Dissolved	"	<	<	<	<	0.10	-	-
Sulfate	"	27.5	21.2	19.6	13.7	12.4	18.88	6.1
Nutrients:								
Nitrogen Amm. Diss(N)	mg N/L	0.076	0.093	0.065	0.055	0.058	0.069	0.015
Nitrogen Kjel. Tot(N)	"	0.26	0.24	0.24	0.19	0.17	0.22	0.04
Nitro NO3+NO2 D	"	0.190	0.200	0.190	0.180	0.180	0.188	0.008
Phosphorus Dissolved	mg P/L	0.017	0.020	0.016	0.015	0.016	0.017	0.002
Phosphorus Total	"	0.051	0.043	0.047	0.032	0.037	0.042	0.008
TOTAL METALS								
Aluminum	mg/L	0.60	0.79	0.78	0.67	0.11	0.59	0.28
Arsenic	"	<	<	0.0010	<	0.0010	-	-
Barium	"	0.02	0.02	0.02	0.02	0.01	0.02	-
Cadmium	"	<	<	<	<	<	-	-
Calcium	"	17.3	16.7	16.5	15.6	15.1	16.24	0.9
Chromium	"	<	<	<	<	<	-	-
Cobalt	"	<	<	<	<	<	-	-
Copper	"	0.0030	0.0040	0.0040	0.0030	0.0020	0.0032	0.0008
Iron	"	1.04	1.39	1.38	1.15	0.32	1.06	0.44
Lead	"	<	<	<	<	<	-	-
Magnesium	"	12.80	10.30	9.73	6.97	6.04	9.17	2.71
Manganese	"	0.0320	0.0400	0.0400	0.0350	0.0200	0.0334	0.0082
Mercury	"	<	<	<	<	<	-	-
Molybdenum	"	<	<	<	<	<	-	-
Nickel	"	<	<	0.0100	<	0.0050	0.0075	0.0035
Potassium	"	3.7	2.8	2.8	2.1	1.7	2.62	0.8
Selenium	"	<	<	<	<	<	-	-
Silver	"	<	<	<	<	<	-	-
Sodium	"	77.9	55.9	51.6	29.9	25.7	48.2	21.2
Tin	"	0.03	<	0.02	<	<	-	-
Zinc	"	<	<	<	<	<	-	-
ORGANIC PARAMETERS:								
Carbon Total Organic	mg/L	3	2	2	2	3	2	1

Replicate Data: Physical, Inorganic and Metal Data

Lab ID Client ID SITE		ASL FR0143 Tilbury Replicate 93-08-24	ASL FR0144 Tilbury Replicate 93-08-24	ASL FR0145 Tilbury Replicate 93-08-24	ASL FR0146 Tilbury Replicate 93-08-24	ASL FR0147 Tilbury Replicate 93-08-24	ASL FR0148 Tilbury Replicate 93-08-24	Average of 6 Reps	Std Dev of 6 Reps
Sampled On:	Units								
Latitude (N)		49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86		
Longitude (W)		123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93		
Physical Tests:									
Dissolved Oxygen	mg/L	9.0	-	-	-	-	-	-	-
Water Temperature	deg C	17.2	-	-	-	-	-	-	-
Air Temperature	"	15.8	-	-	-	-	-	-	-
pH		7.71	7.72	7.71	7.72	7.73	7.70	7.72	0.01
Field pH		7.5	-	-	-	-	-	-	-
Specific Conductance (SC)	uS/cm	104.0	105.0	105.0	120.0	104.0	104.0	107.60	6.95
Field SC	uS/cm	88	-	-	-	-	-	-	-
Suspended Solids (NFR)	mg/L	35	31	31	34	33	33	32.40	1.34
Dissolved Solids (FR)	"	56	57	55	62	57	55	57.20	2.86
Hardness Total	mg/L CaCO3	50.7	51.2	50.9	50.8	51.4	50.7	51.00	0.29
Anions:									
Alkalinity Total @ pH 4.5	mg/L CaCO3	41	41.6	40.7	42	41.1	41.5	41.38	0.50
Chloride Dissolved	mg/L	1.8	1.8	1.7	6(5.5)	1.8	1.8	1.78	0.05
Fluoride Dissolved	"	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00
Sulfate	"	8.2	8.4	7.9	9.1	9.2	6.8	8.28	0.98
Nutrients:									
Nitrogen Amm.Diss(N)	mg N/L	0.009	0.009	0.011	0.005	0.008	0.009	0.008	0.002
Nitrogen Kjel.Tot(N)	"	0.23	0.14	0.17	0.17	0.16	0.11	0.15	0.02
Nitro NO3+NO2 D	"	0.025	0.025	0.077	0.020	0.032	0.022	0.035	0.024
Phosphorus Dissolved	mg P/L	0.020	0.019	0.012	0.016	0.013	0.013	0.015	0.003
Phosphorus Total	"	0.043	0.039	0.044	0.043	0.043	0.029	0.040	0.006
TOTAL METALS									
Aluminum	mg/L	0.30	0.30	0.30	0.33	0.33	0.32	0.313	0.015
Arsenic	"	0.0005	0.0004	0.0004	0.0005	0.0005	0.0004	0.0005	0.0001
Barium	"	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.000
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-
Calcium	"	15.40	15.60	15.50	15.40	15.60	15.40	15.48	0.10
Chromium	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	-	-
Copper	"	0.002	0.002	0.004	0.002	0.002	0.002	0.002	0.001
Iron	"	0.34	0.34	0.34	0.36	0.36	0.37	0.349	0.013
Lead	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Magnesium	"	2.97	3.00	2.98	2.97	3.01	2.96	2.982	0.019
Manganese	"	0.024	0.024	0.025	0.025	0.024	0.026	0.025	0.001
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	"	0.001	0.001	<0.001	<0.001	0.001	<0.001	0.001	0.000
Potassium	"	<2	<2	<2	<2	<2	<2	-	-
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Sodium	"	2.9	2.9	2.9	2.9	2.9	2.9	2.9	0.0
Tin	"	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	-	-
Zinc	"	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
ORGANIC PARAMETERS:									
Carbon Total Organic	mg/L	2.0	2.0	2.0	2.1	2.1	2.1	2.0	0.1

Replicate Data: Physical, Inorganic and Metal Data

Lab ID Client ID SITE		Zenon FR0004 Oak Rep 1 93-01-25	Zenon FR0005 Oak Rep 2 93-01-25	Zenon FR0006 Oak Rep 3 93-01-25	Zenon FR0007 Oak Rep 4 93-01-25	Zenon FR0008 Oak Rep 5 93-01-25	Average of 5 Reps	Std Dev of 5 Reps
Sampled On:	Units							
Latitude (N)		49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11		
Longitude (W)		123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15		
Physical Tests:								
Dissolved Oxygen	mg/L	-	-	-	-	-	-	-
Water Temperature	deg C	-	-	-	-	-	-	-
Air Temperature	"	-	-	-	-	-	-	-
pH		7.40	7.40	7.40	7.40	7.40	7.40	0.00
Field pH		-	-	-	-	-	-	-
Specific Conductance (SC)	uS/cm	3900.0	3770.0	3970.0	3670.0	3970.0	3856.00	132.21
Field SC	uS/cm	-	-	-	-	-	-	-
Suspended Solids (NFR)	mg/L	21	18	17	14	16	17.20	2.59
Dissolved Solids (FR)	"	2270	2200	2310	2120	2310	2242.00	81.67
Hardness Total	mg/L CaCO3	395	392	419	366	394	393.20	18.78
Anions:								
Alkalinity Total @ pH 4.5	mg/L CaCO3	54.4	54.3	54.6	54.1	54.5	54.38	0.19
Chloride Dissolved	mg/L	1100	1070	1140	1050	1130	1098.00	38.34
Fluoride Dissolved	"	0.11	0.13	0.13	0.13	0.13	0.13	0.01
Sulfate	"	161.0	163.0	183.0	177.0	179.0	172.60	9.94
Nutrients:								
Nitrogen Amm.Diss(N)	mg N/L	0.085	0.088	0.096	0.093	0.086	0.090	0.005
Nitrogen Kjel.Tot(N)	"	0.35	0.36	0.35	0.34	0.34	0.35	0.01
Nitro NO3+NO2 D	"	0.270	0.270	0.270	0.280	0.270	0.272	0.004
Phosphorus Dissolved	mg P/L	0.019	0.020	0.015	0.021	0.019	0.019	0.002
Phosphorus Total	"	0.065	0.064	0.062	0.056	0.063	0.062	0.004
TOTAL METALS								
Aluminum	mg/L	0.57	0.51	0.45	0.45	0.26	0.45	0.12
Arsenic	"	0.0020	0.0010	<	<	0.0010	0.00	0.00
Barium	"	0.02	0.02	0.02	0.02	0.02	0.02	0.00
Cadmium	"	<	<	<	<	<	-	-
Calcium	"	43.4	43.3	45.4	41.1	43.3	43.30	1.52
Chromium	"	<	<	<	<	<	-	-
Cobalt	"	<	<	<	<	<	-	-
Copper	"	0.005	0.006	0.006	0.005	0.006	0.006	0.001
Iron	"	0.90	0.87	0.79	0.78	0.56	0.78	0.13
Lead	"	<	<	<	<	<	-	-
Magnesium	"	69.60	68.90	74.30	64.00	69.50	69.26	3.65
Manganese	"	0.042	0.042	0.041	0.040	0.039	0.041	0.001
Mercury	"	<	<	<	<	<	-	-
Molybdenum	"	<	<	<	<	<	-	-
Nickel	"	<	0.006	0.006	<	<	0.006	0.000
Potassium	"	20.3	19.8	21.6	18.5	20.0	20.04	1.11
Selenium	"	<	<	<	<	<	-	-
Silver	"	<	<	<	<	<	-	-
Sodium	"	513	511	554	495	517	518.00	21.79
Tin	"	<	0.03	0.04	<	<	0.04	0.01
Zinc	"	0.015	0.019	0.015	<	0.012	0.015	0.003
ORGANIC PARAMETERS:								
Carbon Total Organic	mg/L	3	3	3	3	3	3	0

Replicate Data: Physical, Inorganic and Metal Data

Lab ID Client ID SITE		ASL FR0131 Oak	ASL FR0132 Oak	ASL FR0133 Oak	ASL FR0134 Oak	ASL FR0135 Oak	ASL FR0136 Oak	Average of 6 Reps	Std Dev of 6 Reps
Sampled On:	Units	Replicate 93-08-23	Replicate 93-08-23	Replicate 93-08-23	Replicate 93-08-23	Replicate 93-08-23	Replicate 93-08-23		
Latitude (N)		49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11		
Longitude (W)		123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15		
Physical Tests:									
Dissolved Oxygen	mg/L	8.4	-	-	-	-	-	-	-
Water Temperature	deg C	18.5	-	-	-	-	-	-	-
Air Temperature	"	16.5	-	-	-	-	-	-	-
pH		7.40	7.45	7.45	7.45	7.45	7.45	7.45	0.00
Field pH		7.5	-	-	-	-	-	-	-
Specific Conductance (SC)	uS/cm	97.7	97.9	97.7	97.7	98.0	98.2	97.90	0.21
Field SC	uS/cm	90	-	-	-	-	-	-	-
Suspended Solids (NFR)	mg/L	22	22	21	25	22	25	23.00	1.87
Dissolved Solids (FR)	"	51	51	52	52	52	53	52.00	0.71
Hardness Total	mg/L CaCO3	44.8	44.3	46.6	46.2	46.6	46.2	45.98	0.96
Anions:									
Alkalinity Total @ pH 4.5	mg/L CaCO3	37.4	38.3	38	37.7	38	41.8	38.76	1.71
Chloride Dissolved	mg/L	1.6	1.4	1.5	1.6	1.6	1.1	1.44	0.21
Fluoride Dissolved	"	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.00
Sulfate	"	7.6	7.7	7.5	7.7	7.4	7.5	7.56	0.13
Nutrients:									
Nitrogen Amm. Diss(N)	mg N/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Nitrogen Kjeld. Tot(N)	"	0.20	0.14	0.19	0.15	0.21	0.13	0.16	0.03
Nitro NO3+NO2 D	"	0.027	0.027	0.027	0.024	0.035	0.025	0.028	0.004
Phosphorus Dissolved	mg P/L	0.012	0.013	0.013	0.013	0.012	0.013	0.013	0.000
Phosphorus Total	"	0.061	0.045	0.044	0.044	0.041	0.045	0.044	0.002
TOTAL METALS									
Aluminum	mg/L	0.27	0.27	0.27	0.27	0.27	0.27	0.270	0.000
Arsenic	"	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000
Barium	"	0.02	0.02	0.02	0.02	0.02	0.02	0.015	0.000
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-
Calcium	"	13.60	13.50	14.20	14.10	14.20	14.10	13.95	0.31
Chromium	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	-	-
Copper	"	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.000
Iron	"	0.39	0.35	0.40	0.34	0.36	0.36	0.367	0.024
Lead	"	<0.001	0.002	0.001	<0.001	<0.001	0.001	-	-
Magnesium	"	2.64	2.60	2.72	2.68	2.72	2.69	2.68	0.05
Manganese	"	0.024	0.023	0.025	0.024	0.025	0.024	0.024	0.001
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Molybdenum	"	<0.001	<0.001	<0.001	0.002	0.001	0.001	-	-
Nickel	"	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
Potassium	"	<2	<2	<2	<2	<2	<2	-	-
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Sodium	"	2.8	2.8	2.9	2.9	2.9	2.9	2.9	0.1
Tin	"	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	-	-
Zinc	"	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
ORGANIC PARAMETERS:									
Carbon Total Organic	mg/L	1.9	1.9	1.9	1.9	1.9	2.0	1.9	0.0

Replicate Data: Chlorophenols and AOX

Laboratory			Zenon	Zenon	Zenon	Zenon
Client ID			FR0042	FR0045	FR0178	FR0179
SITE			Tilbury	Tilbury	Oak	Oak
				duplicate		duplicate
Sampled on:			93-02-22		93-10-19	
	MDL	UNITS				
Chlorophenolics:						
Pentachlorophenol	0.000001	mg/L	<	<	<	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	"	<	<	<	<
2,3,4,5-Tetrachlorophenol	"	"	<	<	<	<
3,4,5-Trichlorophenol	"	"	<	<	<	<
2,3,4-Trichlorophenol	"	"	<	<	<	<
2,3,5-Trichlorophenol	"	"	<	<	<	<
2,3,6-Trichlorophenol	"	"	<	<	<	<
2,4,5-Trichlorophenol	"	"	<	<	<	<
2,4,6-Trichlorophenol	"	"	<	<	<	<
2,4-Dichlorophenol	"	"	<	<	<	<
2,6-Dichlorophenol	"	"	<	<	<	<
2,5-Dichlorophenol	"	"	<	<	<	<
3,5-Dichlorophenol	"	"	<	<	<	<
2,3-Dichlorophenol	"	"	<	<	<	<
3,4-Dichlorophenol	"	"	<	<	<	<
4-Chlorophenol	"	"	<	<	<	<
Tetrachloroguaiacol	0.000002	"	<	<	<	<
3,4,5-Trichloroguaiacol	"	"	0.000007	0.000007	<	<
3,4,6-Trichloroguaiacol	"	"	<	<	<	<
4,5,6-Trichloroguaiacol	"	"	0.000003	0.000003	<	<
4,5-Dichloroguaiacol	"	"	0.000013	0.000014	<	<
4,6-Dichloroguaiacol	"	"	<	<	<	<
4-Chloroguaiacol	"	"	<	<	<	<
5-Chloroguaiacol	"	"	<	<	<	<
6-Chloroguaiacol	"	"	<	<	<	<
Tetrachlorocatechol	"	"	0.000002	0.000002	<	<
3,4,5-Trichlorocatechol	"	"	0.000006	0.000007	<	<
3,4-Dichlorocatechol	"	"	<	<	<	<
3,5-Dichlorocatechol	"	"	<	<	<	<
4,5-Dichlorocatechol	"	"	0.000006	0.000007	<	<
4-Chlorocatechol	"	"	<	<	<	<
Tetrachloroveratrole	"	"	<	<	<	<
3,4,5-Trichloroveratrole	"	"	0.000005	0.000004	<	<
4,5-Dichloroveratrole	"	"	<	<	<	<
2,6-Dichlorosyringaldehyde	"	"	<	<	<	<
2-Chlorosyringaldehyde	"	"	<	<	<	<
3,4,5-Trichlorosyringol	"	"	<	<	<	<
Trichlorotrimethoxybenzene	"	"	<	<	<	<
5,6-Dichlorovanillin	"	"	0.000002	<	<	<
6-Chlorovanillin	"	"	0.000008	0.00001	<	<
Nonylphenol	0.000005	"	<	<	<	<
Surrogate Recovery		%				
d3-Dichlorophenol		"		91	56	45
13C6-Pentachlorophenol		"		93	95	78
13C6-Chloroguaiacol		"		82	77	55
13C6-Trichloroguaiacol		"		90	89	70
13C6-Tetrachloroguaiacol		"		92	102	85
13C6-Dichlorocatechol		"		83	68	47
13C6-Tetrachlorocatechol		"		86	95	72
13C6-Chlorovanillin		"		67	86	63
Absorbable Organic Halides						
Lab ID	Zenon	Zenon	Zenon	Zenon	Zenon	Zenon
Client ID	FR0009	FR0012	FR0070	FR0072	FR0084	FR0086
SITE	Mission	Mission	Mission	Mission	Oak	Oak
		duplicate		duplicate		duplicate
Sampled On:	93-01-25	93-01-25	93-04-19	93-04-19	93-05-17	93-05-17
Adsorbable Org Halide (mg/L)	0.04	0.03	0.02	0.02	0.01	0.01

Replicate Data: Acids, Pesticides and PCBs

Laboratory			Zenon	Zenon	Zenon	Zenon
Client ID			FR0048	FR0050	FR0084	FR0086
SITE			Oak	Oak	Oak	Oak
				duplicate		duplicate
Sampled On:			93-02-23	93-02-22	93-05-17	93-05-17
	MDL	UNITS				
Resin and Fatty Acids						
Abietic Acid	0.0005	mg/L	<	<	<	<
Arachidic Acid	"	"	<	<	<	<
Behenic Acid	"	"	<	<	<	<
Chlorodehydroabietic	"	"	<	<	<	<
Dehydroabietic Acid	"	"	<	<	<	<
Dichlorodehydroabietic	"	"	<	<	<	<
Isopimaric Acid	"	"	<	<	<	<
Lauric Acid	"	"	<	<	<	<
Levo Pimaric Acid	"	"	<	<	<	<
Lignoceric Acid	"	"	<	<	<	<
Linoleic Acid	"	"	<	<	<	<
Linolenic Acid	"	"	<	<	<	<
Myristic Acid	"	"	<	<	<	<
Neoabietic Acid	"	"	<	<	<	<
Oleic Acid	"	"	<	<	<	<
Palmitric Acid	"	"	<	<	<	0.0012
Palustric Acid	"	"	<	<	<	<
Pimaric Acid	"	"	<	<	<	<
Sandaraco Pimaric Acid	"	"	<	<	<	<
Stearic Acid	"	"	<	<	<	<
Surrogate Recovery						
Nonadecanoic Acid		%	50	48	74	63
Organochlorine Pesticides and PCBs						
Aldrin	0.000001	mg/L	<	<	<	<
BHC alpha-	"	"	<	<	<	<
BHC beta-	"	"	<	<	<	<
BHC delta-	"	"	<	<	<	<
Chlordane alpha-	0.000005	"	<	<	<	<
Chlordane gamma-	"	"	<	<	<	<
DDE p p'-	"	"	<	<	<	<
DDD p p'-	"	"	0.000011	0.000007	<	<
DDT p p'-	"	"	<	<	<	<
Dieldrin	"	"	<	<	<	<
Endosulfan I	"	"	<	<	<	<
Endosulfan II	"	"	<	<	<	<
Endosulfan sulphate	0.00001	"	<	<	<	<
DDT o p'-	0.000005	"	<	<	<	<
Endrin	0.000005	"	<	<	<	<
Hexachlorobenzene	0.0000005	"	0.000001	0.000001	<	<
Heptachlor	0.000001	"	<	<	<	<
Heptachlor epoxide	0.000002	"	<	<	<	<
Lindane BHC gamma-	0.000001	"	<	<	<	<
Methoxychlor	0.00001	"	<	<	<	<
Mirex	0.00001	"	<	<	<	<
Nonachlor trans-	0.000005	"	<	<	<	<
Oxychlordane	0.000005	"	<	<	<	<
Toxaphene	0.00005	"	<	<	<	<
PCBs - Total	0.00002	"	<	<	<	<
Surrogate Recovery						
Dibromobiphenyl		%	92	81		

APPENDIX V

CROSS SECTION DATA, MAIN RIVER SITES

Minimum Detection Limits for Total Metals Analysis

Laboratory	Zenon	ASL	UNITS
	MDL From: 93-01 To: 93-03	MDL From: 93-04 To: 94-03	
Physical Tests:			
Dissolved Oxygen			mg/L
Water Temperature			deg C
Air Temperature			"
pH			"
Field pH			"
Specific Conductance(SC)	1	0.2	uS/cm
Field SC			uS/cm
Suspended Solids (NFR)	4	1	mg/L
Dissolved Solids (FR)	4	1	"
Hardness Total			mg/L CaCO3
Anions:			
Alkalinity Total @ pH 4.5	0.5	0.5	mg/L CaCO3
Chloride Dissolved	0.5	0.2	mg/L
Fluoride Dissolved	0.1	0.02	"
Sulfate	1	0.5	"
Nutrients:			
Nitrogen Amm.Diss(N)	0.005	0.005	mg N/L
Nitrogen Kjel.Tot(N)	0.04	0.05	"
Nitro NO3+NO2 D	0.02	0.005	"
Phosphorus Dissolved	0.003	0.001	mg P/L
Phosphorus Total	0.003	0.001	"
TOTAL METALS			
Aluminum	0.06	0.02	mg/L
Arsenic	0.001	0.0001	"
Barium	0.001	0.01	"
Cadmium	0.0001	0.0002	"
Calcium	0.05	0.05	"
Chromium	0.005	0.001	"
Cobalt	0.004	0.015	"
Copper	0.001	0.001	"
Iron	0.05	0.03	"
Lead	0.003	0.001	"
Magnesium	0.02	0.01	"
Manganese	0.002	0.005	"
Mercury	0.00005	0.00005	"
Molybdenum	0.004	0.001	"
Nickel	0.005	0.001	"
Potassium	0.4	2	"
Selenium	0.03	0.0005	"
Silver	0.03	0.0001	"
Sodium	0.4	2	"
Tin	0.02	0.3	"
Zinc	0.01	0.001	"
ORGANIC PARAMETERS			
Carbon Total Organic	0.5	0.5	mg/L

Lab ID		ASL FR0097	ASL FR0098	ASL FR0099	ASL FR0100	ASL FR0101	ASL FR0102
Client ID		Mission	Mission	Mission	Mission	Mission	Mission
SITE	Units	X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep.
Sampled On:		93-05-31	93-05-31	93-05-31	93-05-31	93-05-31	93-05-31
Latitude (N)		49 - 8.11	49 - 8.15	49 - 8.18	49 - 8.21	49 - 8.24	49 - 8.11
Longitude (W)		122 - 16.72	122 - 16.7	122 - 16.8	122 - 16.83	122 - 16.8	122 - 16.72
Physical Tests:							
Dissolved Oxygen	mg/L	11.2	11.2	11.2	11	10.8	10.9
Water Temperature	deg C	13.9	13.8	13.8	13.7	13.4	13.4
Air Temperature	"	16.3	16.3	16.3	16.3	16.3	16.3
pH		7.75	7.76	7.72	7.70	7.65	7.75
Field pH		7.3	7.2	7.3	7.2	7.2	7.4
Specific Conductance (SC)	uS/cm	94.0	97.9	92.5	90.3	83.8	87.9
Field SC	uS/cm	74	65	74	68	62	75
Suspended Solids (NFR)	mg/L	64	91	179	81	63	83
Dissolved Solids (FR)	"	46	51	45	44	40	47
Hardness Total	mg/L CaCO3	42.1	47.6	39.8	39.7	34.7	44.5
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	39.9	40.9	38.7	37.3	33.8	40.1
Chloride Dissolved	mg/L	1.2	0.8	1.3	1.3	1.1	0.8
Fluoride Dissolved	"	0.03	0.03	0.03	0.03	0.03	0.03
Sulfate	"	5.5	6.4	5.8	6.1	6.1	5.9
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	0.007	<0.005	0.007	<0.005	<0.005	0.007
Nitrogen Kjel.Tot(N)	"	0.14	0.14	0.11	0.12	0.11	0.15
Nitro NO3+NO2 D	"	0.071	0.079	0.069	0.071	0.07	0.078
Phosphorus Dissolved	mg P/L	0.007	0.007	0.005	0.007	0.008	0.009
Phosphorus Total	"	0.108	0.099	0.082	0.066	0.061	0.08
TOTAL METALS							
Aluminum	mg/L	1.1	0.98	0.71	0.78	0.46	0.73
Arsenic	"	0.0007	0.0007	0.0006	0.0005	0.0004	0.0006
Barium	"	0.024	0.025	0.024	0.022	0.018	0.023
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	11.8	13.5	11.5	11.4	10.2	12.8
Chromium	"	0.002	0.002	0.001	0.001	<0.001	0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.004	0.004	0.004	0.004	0.002	0.004
Iron	"	-	-	-	-	-	-
Lead	"	0.001	0.001	0.001	0.001	<0.001	0.001
Magnesium	"	3.05	3.37	2.69	2.73	2.24	3.07
Manganese	"	0.054	0.059	0.054	0.05	0.033	0.05
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	0.004	0.003	0.003	0.003	0.001	0.003
Potassium	"	<2	<2	<2	<2	<2	<2
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	0.0001	0.0001	0.0003	0.0001	0.0001	0.0001
Sodium	"	<2	2	<2	<2	<2	<2
Tin	"	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc	"	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.30	2.55	2.35	2.35	2.00	2.35

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0165	FR0166	FR0167	FR0168	FR0169	FR0170
SITE	Units	Mission	Mission	Mission	Mission	Mission	Mission
Sampled On:		X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep.
		93-10-04	93-10-04	93-10-04	93-10-04	93-10-04	93-10-04
Latitude (N)		49 - 8.11	49 -8.15	49 - 8.18	49 - 8.21	49 - 8.24	49 - 8.11
Longitude (W)		122 - 16.7	122 - 16.75	122 - 16.80	122 - 16.83	122 - 16.86	122 - 16.72
Physical Tests:							
Dissolved Oxygen	mg/L	9.6	9.5	9.5	9.5	9.5	9.6
Water Temperature	deg C	13.9	13.9	13.9	13.9	14	13.9
Air Temperature	"	13.8	13.8	13.8	13.8	13.8	13.8
pH		7.26	7.43	7.48	7.45	7.49	7.54
Field pH		7.75	7.7	7.75	7.8	7.75	7.75
Specific Conductance (SC)	uS/cm	125	123	131	122	123	121
Field SC	uS/cm	120	118	117	117	118	119
Suspended Solids (NFR)	mg/L	5	4	4	2	10	6
Dissolved Solids (FR)	"	68	70	67	67	66	67
Hardness Total	mg/L CaCO3	61.9	62.7	62.2	60	59.2	60.8
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	50.9	53.9	50.2	50.7	48.7	50.5
Chloride Dissolved	mg/L	1.5	1.4	1.4	1.3	1.4	1.5
Fluoride Dissolved	"	0.03	0.03	0.03	0.03	0.04	0.03
Sulfate	"	10.3	10.4	9.9	10.4	10.2	10.3
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	0.043	0.043	0.043	0.043	0.047	0.044
Nitrogen Kjel.Tot(N)	"	0.174	0.187	0.2	0.238	0.234	0.189
Nitro NO3+NO2 D	"	0.047	0.047	0.039	0.039	0.038	0.043
Phosphorus Dissolved	mg P/L	0.01	0.011	0.01	0.008	0.01	0.01
Phosphorus Total	"	0.015	0.016	0.015	0.015	0.015	0.016
TOTAL METALS							
Aluminum	mg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	"	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004
Barium	"	0.017	0.015	0.015	0.014	0.016	0.016
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	18.3	18.6	18.6	17.8	17.6	18
Chromium	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	<0.001	0.002	0.002	0.001	0.002	0.001
Iron	"	0.103	0.114	0.091	0.199	0.164	0.102
Lead	"	<0.001	<0.001	<0.001	0.002	0.002	<0.001
Magnesium	"	3.97	3.94	3.82	3.78	3.69	3.84
Manganese	"	0.012	0.011	0.011	0.013	0.015	0.012
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Potassium	"	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	3.6	3.6	3.5	3.5	3.4	3.4
Tin	"	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	<0.001	0.002	0.004	0.003	0.002	0.001
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.09	2.09	2.14	2.14	2.14	2.19

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0229	FR0230	FR0231	FR0232	FR0233	FR0234
SITE	Units	Mission	Mission	Mission	Mission	Mission	Mission
		X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep.
Sampled On:		94-02-07	94-02-07	94-02-07	94-02-07	94-02-07	94-02-07
Latitude (N)		49 - 8.11	49 - 8.15	49 - 8.18	49 - 8.21	49 - 8.24	49 - 8.11
Longitude (W)		122 - 16.72	122 - 16.75	122 - 16.80	122 - 16.83	122 - 16.86	122 - 16.72
Physical Tests:							
Dissolved Oxygen	mg/L	12.8	12.6	12.7	12.8	12.8	12.7
Water Temperature	deg C	1.1	1	1	0.9	1	1
Air Temperature	"	-4	-4	-4	-4	-4	-4
pH		7.28	7.51	7.5	7.54	7.54	7.51
Field pH		7.45	7.45	7.4	7.5	7.55	7.4
Specific Conductance (SC)	uS/cm	141	137	135	136	132	132
Field SC	uS/cm	78	76	76	76	76	77
Suspended Solids (NFR)	mg/L	12	7	8	9	11	7
Dissolved Solids (FR)	"	84	85	87	86	86	86
Hardness Total	mg/L CaCO3	55.2	58.3	58.4	58.7	58.6	58.7
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	53.4	52.6	53.7	52.3	52.1	53.3
Chloride Dissolved	mg/L	2	1.9	1.9	1.9	1.8	1.8
Fluoride Dissolved	"	0.04	0.04	0.04	0.04	0.04	0.04
Sulfate	"	9.5	9.4	10.1	9.8	10.1	9.2
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	0.017	0.014	0.031	0.015	0.015	0.019
Nitrogen Kjehl.Tot(N)	"	0.17	0.17	0.16	0.17	0.15	0.18
Nitro NO3+NO2 D	"	0.14	0.134	0.133	0.129	0.13	0.139
Phosphorus Dissolved	mg P/L	0.015	0.015	0.015	0.015	0.015	0.015
Phosphorus Total	"	0.029	0.027	0.029	0.028	0.029	0.027
TOTAL METALS							
Aluminum	mg/L	<0.20	<0.20	<0.20	0.21	<0.20	<0.20
Arsenic	"	0.0006	0.0006	0.0005	0.0007	0.0006	0.002
Barium	"	0.019	0.019	0.019	0.018	0.019	0.019
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	15.6	16.6	16.6	16.7	16.7	16.7
Chromium	"	0.001	0.001	0.001	<0.001	0.001	0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.002	0.002	0.002	<0.001	0.002	0.002
Iron	"	0.212	0.195	0.199	0.174	0.223	0.219
Lead	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	"	3.93	4.11	4.11	4.12	4.12	4.13
Manganese	"	0.019	0.017	0.017	0.018	0.023	0.021
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Nickel	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Potassium	"	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	3.6	3.8	3.8	3.8	3.8	3.8
Tin	"	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.002	0.002	0.001	0.002	0.002	0.001
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.7	2.7	2.7	2.7	2.8	2.6

Lab ID		Zenon	Zenon	Zenon	Zenon	Zenon	Zenon
Client ID		FR0059	FR0060	FR0061	FR0062	FR0063	FR0064
SITE	Units	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury
Sampled On:		X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep
		93-03-09	93-03-09	93-03-09	93-03-09	93-03-09	93-03-09
Latitude (N)		49 - 8.76	49 - 8.81	49 - 8.86	49 - 8.90	49 - 8.94	49 - 8.76
Longitude (W)		123 - 1.81	123 - 1.85	123 - 1.93	123 - 1.99	123 - 2.04	123 - 1.81
Physical Tests:							
Dissolved Oxygen	mg/L	-	-	8.8			
Water Temperature	deg C	-	-	5.2			
Air Temperature	"	-	-	8			
pH		7.5	7.6	7.6	7.5	7.6	7.6
Field pH		-	-	7.45			
Specific Conductance (SC)	uS/cm	289	188	160	159	174	208
Field SC	uS/cm	-	-	100			
Suspended Solids (NFR)	mg/L	62	69	53	45	49	63
Dissolved Solids (FR)	"	159	111	96	81	102	123
Hardness Total	mg/L CaCO3	66.1	58.9	56	55.2	56	60.1
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	46.7	46.6	46	45.9	45.9	46.6
Chloride Dissolved	mg/L	47.1	20.2	12.2	11.9	16.1	25.3
Fluoride Dissolved	"	<	<	<	<	<	<
Sulfate	"	18.8	15.5	14.6	14.5	14.9	16.3
Nutrients:							
Nitrogen Amm. Diss(N)	mg N/L	0.048	0.057	0.036	0.078	0.067	0.048
Nitrogen Kjel. Tot(N)	"	0.22	<	<	<	0.29	0.26
Nitro NO3+NO2 D	"	0.18	0.19	0.18	0.17	0.18	0.17
Phosphorus Dissolved	mg P/L	0.017	0.011	0.007	0.01	0.014	0.009
Phosphorus Total	"	0.093	0.086	0.082	0.077	0.073	0.092
TOTAL METALS							
Aluminum	mg/L	1.08	1.18	0.97	0.95	0.88	1.1
Arsenic	"	0.001	0.001	0.001	0.001	<	0.001
Barium	"	0.026	0.022	0.02	0.019	0.019	0.018
Cadmium	"	<	<	<	<	<	<
Calcium	"	15.2	15	14.8	14.6	14.6	15
Chromium	"	<	<	<	<	<	<
Cobalt	"	<	<	<	<	<	<
Copper	"	0.004	0.005	0.005	0.004	0.003	0.0038
Iron	"	1.94	2.08	1.74	1.68	1.55	1.93
Lead	"	<	<	<	<	<	<
Magnesium	"	6.83	5.21	4.63	4.54	4.74	5.51
Manganese	"	0.057	0.06	0.052	0.051	0.044	0.055
Mercury	"	<	<	<	<	<	<
Molybdenum	"	<	<	<	<	<	<
Nickel	"	<	0.005	<	<	<	<
Potassium	"	1.8	1.3	1.1	1.1	1	1.4
Selenium	"	<	<	<	<	<	<
Silver	"	<	<	<	<	<	<
Sodium	"	27.1	12.7	9	8.9	11	15.7
Tin	"	<	<	<	<	<	<
Zinc	"	<	0.01	<	0.01	<	<
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	3	3	3	3	3	2

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0091	FR0092	FR0093	FR0094	FR0095	FR0096
SITE	Units	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury
Sampled On:		X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep.
		93-05-31	93-05-31	93-05-31	93-05-31	93-05-31	93-05-31
Latitude (N)		49 - 8.76	49 - 8.81	49 - 8.86	49 - 8.90	49 - 8.94	49 - 8.76
Longitude (W)		123 - 1.81	123 - 1.85	123 - 1.93	123 - 1.99	123 - 2.04	123 - 1.81
Physical Tests:							
Dissolved Oxygen	mg/L	10.2	10.4	10.4	10.3	10.2	10.2
Water Temperature	deg C	14.3	14.2	14.2	14.1	14	14.2
Air Temperature	"	17.1	17.1	17.1	17.1	17.1	17.1
pH		7.64	7.66	7.66	7.65	7.61	7.65
Field pH		7.5	7.5	7.5	7.4	7.5	7.5
Specific Conductance (SC)	uS/cm	91.2	90.2	89.1	89.0	88.6	90.7
Field SC	uS/cm	70	70	70	70	71	69
Suspended Solids (NFR)	mg/L	74	89	158	95	93	93
Dissolved Solids (FR)	"	46	47	44	45	44	48
Hardness Total	mg/L CaCO3	44.6	46	43.6	41.3	40.7	42.4
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	36.6	39.1	36.5	37.6	36.3	38.9
Chloride Dissolved	mg/L	1.9	1.6	1.1	1.8	1.3	1.5
Fluoride Dissolved	"	0.03	0.03	0.03	0.03	0.03	0.03
Sulfate	"	6.1	5.8	5.7	6	6.2	6
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	<0.005	<0.005	<0.005	0.024	0.011	<0.005
Nitrogen Kjel.Tot(N)	"	0.14	0.15	0.15	0.17	0.12	0.12
Nitro NO3+NO2 D	"	0.086	0.077	0.069	0.081	0.079	0.077
Phosphorus Dissolved	mg P/L	0.011	0.009	0.007	0.01	0.01	0.008
Phosphorus Total	"	0.047	0.059	0.078	0.079	0.082	0.1
TOTAL METALS							
Aluminum	mg/L	0.62	0.69	0.7	0.63	0.6	0.62
Arsenic	"	0.0006	0.0007	0.0006	0.0006	0.0006	0.0005
Barium	"	0.019	0.023	0.023	0.023	0.023	0.024
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	13.4	13.8	12.9	12.3	12.1	12.3
Chromium	"	0.001	0.002	0.001	0.001	0.002	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.004	0.005	0.003	0.003	0.004	0.005
Iron	"	-	-	-	-	-	-
Lead	"	0.001	0.001	0.001	0.001	0.001	0.004
Magnesium	"	2.7	2.83	2.77	2.56	2.57	2.84
Manganese	"	0.045	0.054	0.046	0.047	0.05	0.066
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	0.002	0.003	0.002	0.002	0.002	<0.001
Potassium	"	<2	<2	<2	<2	<2	<2
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	0.0001	0.0003	0.0002	0.0001	0.00001	<0.00001
Sodium	"	<2	<2	<2	<2	<2	2.2
Tin	"	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc	"	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.40	2.50	2.30	2.35	2.25	2.25

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0171	FR0172	FR0173	FR0174	FR0175	FR0176
SITE	Units	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury
		X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep.
Sampled On:		93-10-05	93-10-05	93-10-05	93-10-05	93-10-05	93-10-05
Latitude (N)		49 - 8.76	49 - 8.81	49 - 8.86	49 - 8.90	49 - 8.94	49 - 8.76
Longitude (W)		123 - 1.81	123 - 1.85	123 - 1.93	123 - 1.99	123 - 2.04	123 - 1.81
Physical Tests:							
Dissolved Oxygen	mg/L	9.4	9.5	9.4	9.4	9.5	9.4
Water Temperature	deg C	14.2	14.3	14.2	14.3	14.5	14.3
Air Temperature	"	12	12	12	12	12	12
pH		7.48	7.47	7.43	7.5	7.53	7.53
Field pH		7.55	7.6	7.65	7.65	7.65	7.6
Specific Conductance (SC)	uS/cm	302	141	130	129	133	210
Field SC	uS/cm	235	130	123	125	128	178
Suspended Solids (NFR)	mg/L	8	7	7	6	6	7
Dissolved Solids (FR)	"	155	77	70	71	72	112
Hardness Total	mg/L CaCO3	72.5	59.1	57	57.7	56.7	65.2
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	48.3	49.8	48.9	49.1	48.9	49.6
Chloride Dissolved	mg/L	51.1	7	4.1	4.8	6	26.6
Fluoride Dissolved	"	0.03	0.03	0.03	0.03	0.03	0.03
Sulfate	"	16.9	12	10.8	10.2	10.4	14.1
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	0.023	0.025	0.027	0.041	0.037	0.033
Nitrogen Kjel.Tot(N)	"	0.171	0.165	0.228	0.303	0.198	0.249
Nitro NO3+NO2 D	"	0.044	0.052	0.046	0.041	0.052	0.051
Phosphorus Dissolved	mg P/L	0.009	0.011	0.011	0.014	0.013	0.009
Phosphorus Total	"	0.018	0.019	0.024	0.027	0.029	0.021
TOTAL METALS							
Aluminum	mg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	"	0.0004	0.0004	0.0005	0.0004	0.0004	0.0004
Barium	"	0.013	0.015	0.017	0.015	0.015	0.015
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	17.7	17	16.6	16.9	16.4	17.3
Chromium	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.001	0.001	0.002	0.002	0.002	0.001
Iron	"	0.202	0.152	0.202	0.141	0.195	0.169
Lead	"	<0.001	0.001	0.001	<0.001	0.002	<0.001
Magnesium	"	6.87	4.03	3.79	3.75	3.82	5.34
Manganese	"	0.017	0.012	0.015	0.012	0.015	0.015
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Potassium	"	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	33	6.9	5.1	5.5	6.1	18.4
Tin	"	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.004	0.008	0.006	0.003	0.003	0.003
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.19	2.41	2.25	2.14	2.19	2.14

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0223	FR0224	FR0225	FR0226	FR0227	FR0228
SITE	Units	Oak	Oak	Oak	Oak	Oak	Oak
Sampled On:		X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep.
		94-02-07	94-02-07	94-02-07	94-02-07	94-02-07	94-02-07
Latitude (N)		49 - 12.06	49 - 12.08	49 - 12.11	49 - 12.14	49 - 12.17	49 - 12.06
Longitude (W)		123 - 7.13	123 - 7.14	123 - 7.15	123 - 7.17	123 - 7.18	123 - 7.13
Physical Tests:							
Dissolved Oxygen	mg/L	12	12	12.2	12.2	12	11.9
Water Temperature	deg C	2.5	2.3	2.2	2.2	2.2	2.2
Air Temperature	"	-4	-4	-4	-4	-4	-4
pH		7.07	7.15	7.07	7.14	7.12	7.09
Field pH		7.45	7.5	7.5	7.5	7.5	7.5
Specific Conductance (SC)	uS/cm	897	459	455	660	755	743
Field SC	uS/cm	600	280	270	205	420	380
Suspended Solids (NFR)	mg/L	23	19	13	15	7	19
Dissolved Solids (FR)	"	494	284	276	86	86	452
Hardness Total	mg/L CaCO3	114	81.4	80.1	98.9	104	103
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	45.1	44.2	44.7	44.6	44.8	44.4
Chloride Dissolved	mg/L	192	98.7	94.7	156	181	182
Fluoride Dissolved	"	0.05	0.05	0.04	0.05	0.05	0.05
Sulfate	"	37.7	21	20.3	27.6	32.4	31.9
Nutrients:							
Nitrogen Amm. Diss(N)	mg N/L	0.041	0.038	0.039	0.041	0.043	0.051
Nitrogen Kjel. Tot(N)	"	0.28	0.25	0.23	0.23	0.22	0.25
Nitro NO3+NO2 D	"	0.169	0.167	0.166	0.169	0.17	0.171
Phosphorus Dissolved	mg P/L	0.024	0.021	0.024	0.023	0.023	0.029
Phosphorus Total	"	0.043	0.04	0.039	0.043	0.035	0.045
TOTAL METALS							
Aluminum	mg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	"	0.0008	0.0006	0.0008	0.0005	0.0008	0.0005
Barium	"	0.015	0.015	0.015	0.015	0.015	0.018
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	18	16	16	17	17.1	16.9
Chromium	"	0.002	0.001	0.001	0.002	0.002	0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	<0.001	0.002	0.002	0.002	0.002	0.003
Iron	"	0.5	0.383	0.399	0.269	0.347	0.739
Lead	"	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Magnesium	"	16.7	10	9.76	13.7	14.8	14.8
Manganese	"	0.03	0.029	0.028	0.02	0.026	0.046
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	0.001	0.002	0.001	<0.001	0.001	0.002
Potassium	"	4.9	3.1	3	3.8	4.3	4.2
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	111	57.4	55.2	87.9	96.6	95.9
Tin	"	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.004	0.002	0.002	0.002	0.005	0.002
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.9	2.8	2.7	2.7	2.7	2.9

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0235	FR0236	FR0237	FR0238	FR0239	FR0240
SITE	Units	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury
Sampled On:		X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep
		94-02-08	94-02-08	94-02-08	94-02-08	94-02-08	94-02-08
Latitude (N)		49 - 8.76	49 - 8.81	49 - 8.86	49 - 8.90	49 - 8.94	49 - 8.76
Longitude (W)		123 - 1.81	123 - 1.85	123 - 1.93	123 - 1.99	123 - 2.04	123 - 1.81
Physical Tests:							
Dissolved Oxygen	mg/L	11.9	12	12.2	12.4	12.2	12
Water Temperature	deg C	2.3	2.3	2.2	2.2	2.2	2.3
Air Temperature	"	-1	-1	-1	-1	-1	-1
pH		7.6	7.63	7.58	7.63	7.62	7.63
Field pH		7.46	7.5	7.55	7.55	7.5	7.5
Specific Conductance (SC)	uS/cm	6790	4030	3730	4180	4920	6470
Field SC	uS/cm	3900	2500	2200	2200	2800	3900
Suspended Solids (NFR)	mg/L	18	4	6	11	17	35
Dissolved Solids (FR)	"	4820	2540	2400	2720	3180	4250
Hardness Total	mg/L CaCO3	752	416	394	447	527	684
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	46.4	44.8	45.4	45.6	45.7	46.9
Chloride Dissolved	mg/L	2220	1170	1100	1260	1450	1960
Fluoride Dissolved	"	0.17	0.1	0.1	0.1	0.12	0.14
Sulfate	"	299	167	157	172	208	285
Nutrients:							
Nitrogen Amm. Diss(N)	mg N/L	0.057	0.053	0.055	0.057	0.061	0.046
Nitrogen Kjel. Tot(N)	"	0.24	0.21	0.19	0.19	0.19	0.19
Nitro NO3+NO2 D	"	0.197	0.188	0.183	0.183	0.185	0.195
Phosphorus Dissolved	mg P/L	0.024	0.022	0.023	0.024	0.025	0.025
Phosphorus Total	"	0.048	0.028	0.033	0.036	0.05	0.066
TOTAL METALS							
Aluminum	mg/L	<0.40	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	"	0.0008	0.0006	0.0006	0.0038	0.0009	0.001
Barium	"	<0.020	<0.010	0.011	0.01	<0.010	<0.010
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	55.1	35	33.8	36.7	41	50.1
Chromium	"	0.001	0.001	0.002	0.002	<0.001	0.001
Cobalt	"	<0.030	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	<0.001	0.002	0.002	0.002	<0.001	0.005
Iron	"	0.641	0.346	0.347	0.379	0.49	0.706
Lead	"	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	"	149	79.7	75.3	86.2	103	136
Manganese	"	0.02	0.013	0.014	0.014	0.018	0.027
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	0.002	0.001	0.001	0.001	0.001	0.002
Nickel	"	0.001	0.001	0.001	0.001	0.002	0.003
Potassium	"	45	22.7	21.4	24.4	29.8	38.6
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	0.0002	0.0001	0.0001	0.0001	0.0002	0.0002
Sodium	"	1220	611	577	662	785	1030
Tin	"	<0.60	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.005	0.004	0.006	0.012	0.004	0.002
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.9	3.6	3.2	3.2	2.5	8.2

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0104	FR0105	FR0106	FR0107	FR0108	FR0109
SITE	Units	Oak	Oak	Oak	Oak	Oak	Oak
		X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep
Sampled On:		93-06-01	93-06-01	93-06-01	93-06-01	93-06-01	93-06-01
Latitude (N)		49 - 12.06	49 - 12.08	49 - 12.11	49 - 12.14	49 - 12.17	49 - 12.06
Longitude (W)		123 - 7.13	123 - 7.14	123 - 7.15	123 - 7.17	123 - 7.18	123 - 7.13
Physical Tests:							
Dissolved Oxygen	mg/L	10.6	10.4	10.2	10.2	10.2	10.1
Water Temperature	deg C	14.5	14.3	14.8	14.1	14.5	14.3
Air Temperature	"	21.5	21.5	21.5	21.5	21.5	21.5
pH		7.40	7.50	7.55	7.55	7.50	7.55
Field pH		7.3	7.4	7.3	7.4	7.4	7.4
Specific Conductance (SC)	uS/cm	75.0	73.0	71.0	72.0	71.0	73.0
Field SC	uS/cm	97	92	91	92	91	94
Suspended Solids (NFR)	mg/L	59	66	58	53	37	38
Dissolved Solids (FR)	"	50	45	45	47	46	48
Hardness Total	mg/L CaCO3	41	40.6	39.9	42	41.7	41.1
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	38.2	36.1	34.9	35.3	35.5	37.0
Chloride Dissolved	mg/L	3.2	1.9	1.6	1.8	1.8	2.5
Fluoride Dissolved	"	0.03	0.03	0.03	0.03	0.03	0.03
Sulfate	"	6.3	4.8	6	6.3	5.3	5.3
Nutrients:							
Nitrogen Amm. Diss(N)	mg N/L	0.019	0.009	0.006	0.006	0.007	0.013
Nitrogen Kjel. Tot(N)	"	0.15	0.2	0.17	0.14	0.12	0.13
Nitro NO3+NO2 D	"	0.078	0.078	0.083	0.083	0.082	0.078
Phosphorus Dissolved	mg P/L	0.015	0.011	0.01	0.01	0.008	0.012
Phosphorus Total	"	0.079	0.074	0.072	0.061	0.065	0.035
TOTAL METALS							
Aluminum	mg/L	0.43	0.43	0.43	0.45	0.44	0.3
Arsenic	"	0.0005	0.0005	0.0004	0.0004	0.0005	0.0004
Barium	"	0.02	0.02	0.017	0.018	0.018	0.018
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	12.3	12.3	12.1	12.7	12.6	12.4
Chromium	"	0.001	0.001	<0.001	<0.001	0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.004	0.003	0.002	0.004	0.004	0.002
Iron	"						
Lead	"	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Magnesium	"	2.51	2.43	2.35	2.49	2.46	2.45
Manganese	"	0.047	0.04	0.038	0.042	0.039	0.038
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	0.001	0.001	<0.001	0.001	0.001	<0.001
Potassium	"	<2	<2	<2	<2	<2	<2
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0002
Sodium	"	3.4	2.4	2.1	2.6	2.5	2.9
Tin	"	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc	"	0.005	<0.005	<0.005	<0.005	0.009	<0.005
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.35	2.30	2.45	2.40	2.30	2.40

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0158	FR0159	FR0160	FR0161	FR0162	FR0163
SITE	Units	Oak	Oak	Oak	Oak	Oak	Oak
Sampled On:		X-sec 1	X-sec 2	X-sec 3	X-sec 4	X-sec 5	X-sec 1 rep
		93-10-04	93-10-04	93-10-04	93-10-04	93-10-04	93-10-04
Latitude (N)		49 - 12.06	49 - 12.08	49 - 12.11	49 - 12.14	49 - 12.17	49 - 12.06
Longitude (W)		123 - 7.13	123 - 7.14	123 - 7.15	123 - 7.17	123 - 7.18	123 - 7.13
Physical Tests:							
Dissolved Oxygen	mg/L	9.2	9.1	9.1	9	9.1	9
Water Temperature	deg C	15	15.1	15	15	15	15
Air Temperature	"	13	13	13	13	13	13
pH		6.95	7.04	7.13	7.19	7.33	7.29
Field pH		7.35	7.45	7.55	7.55	7.5	7.65
Specific Conductance (SC)	uS/cm	158	182	170	162	176	229
Field SC	uS/cm	220	170	155	158	160	160
Suspended Solids (NFR)	mg/L	8	8	6	5	5	7
Dissolved Solids (FR)	"	89	98	94	92	102	126
Hardness Total	mg/L CaCO3	61.8	63.2	62.4	62.6	64.1	68.7
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	48.9	48.7	48.5	48.8	49	49
Chloride Dissolved	mg/L	14.5	18.9	15.9	15.7	20.6	32.5
Fluoride Dissolved	"	0.03	0.04	0.04	0.04	0.04	0.04
Sulfate	"	11.7	13	12.5	12.2	12.3	14.2
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	0.03	0.031	0.025	0.027	0.027	0.028
Nitrogen Kjel.Tot(N)	"	0.243	0.209	0.215	0.182	0.155	0.25
Nitro NO3+NO2 D	"	0.046	0.082	0.048	0.046	0.048	0.052
Phosphorus Dissolved	mg P/L	0.012	0.012	0.011	0.013	0.01	0.012
Phosphorus Total	"	0.021	0.023	0.02	0.017	0.017	0.021
TOTAL METALS							
Aluminum	mg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	"	0.0005	0.0005	0.0006	0.0006	0.0006	0.0007
Barium	"	0.012	0.014	0.014	0.011	0.013	0.012
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	17.5	17.7	17.6	17.7	18.1	18.3
Chromium	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.001	0.005	0.001	0.001	0.001	0.001
Iron	"	0.155	0.15	0.151	0.136	0.167	0.181
Lead	"	<0.001	0.005	0.001	<0.001	<0.001	<0.001
Magnesium	"	4.4	4.62	4.48	4.47	4.59	5.6
Manganese	"	0.017	0.017	0.017	0.014	0.017	0.015
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Potassium	"	<2.0	<2.0	2.1	<2.0	2.7	2.1
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	11.8	14.6	12.7	12.8	14.2	23.4
Tin	"	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.004	0.005	0.002	0.001	0.003	0.003
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.14	2.19	2.09	2.09	2.19	2.14

**Results of the Kruskal-Wallis One-way ANOVA
on Cross-Sectional Profile Data.**

Parameter	Mission		Oak Street Bridge		Tilbury Island	
	P ¹	P(ties) ²	P	P(ties)	P	P(ties)
Ag	95	41	97	41	95	89
Al	94	91	52	49	99	98
Alkalinity	72	71	96	96	83	83
Analyzable organic halides	NA	NA	NA	NA	NA	NA
As	60	58	95	95	73	72
Ba	92	92	72	71	100	100
Ca	99	99	98	98	92	92
Cd	100	NA	100	NA	100	NA
Co	100	NA	100	NA	97	41
Cr	89	52	93	69	96	87
Cu	84	78	67	66	97	97
Dissolved chloride	97	97	95	95	88	88
Dissolved fluoride	95	90	100	100	100	100
Dissolved ammonia	95	95	95	95	51	51
Dissolved nitrate/nitrite	88	88	100	100	90	90
Dissolved oxygen	100	100	99	99	95	95
Dissolved phosphorous	97	97	71	70	49	49
Fecal coliform	NA	NA	NA	NA	NA	NA
Fe	88	88	75	75	99	99
Field pH	99	99	93	92	98	98
Filterable residue	98	98	87	86	83	83
Hardness	99	99	97	97	80	80
Hg	100	NA	100	NA	100	NA
K	100	NA	98	97	100	100
Mg	99	99	97	97	81	81
Mn	100	100	84	84	76	76
Mo	100	NA	100	NA	97	41
Na	99	99	95	95	83	83
Non-filterable residue	93	93	68	68	99	99
Ni	94	86	80	59	85	77
Pb	89	52	93	53	70	22
pH	94	94	97	97	91	91
Specific conductivity	91	91	94	94	83	83
Se	100	NA	100	NA	100	NA
Sn	100	NA	93	69	97	41
Sulphate	98	98	99	99	87	87
Total organic carbon	97	97	100	100	52	51
Total nitrogen	98	98	80	80	95	95
Total phosphorous	99	99	83	83	98	98
Water temperature	100	100	99	99	93	93
Zn	91	90	79	77	31	30

¹P is the probability that the stations are the same within the site

²P(ties) compensates for tied values.

APPENDIX VI

WATER QUALITY DATA FOR FEDERAL/PROVINCIAL SITE AT HOPE

			Code	PY0331	PY0331	PY0331	PY0331	PY0331
				05-Jan-93	19-Jan-93	02-Feb-93	16-Feb-93	02-Mar-93
Specific Conductance Lab			uS/cm	161	149	154	165	172
ANIONS								
Alkalinity	Total		mg/L CaCO3	63	64	61	64	66
Chloride	Dissolved		mg/L	1.6	1.8	1.6	2	2.4
Fluoride	Dissolved		"	0.07	0.06	0.06	0.06	0.06
Sulphate	Dissolved		"	12.3	12.6	13.1	13.2	15
Hardness	Calc.		"	71.3	67.7	65.1	66.4	71.8
NUTRIENTS								
Nitrogen Tot	Dissolved	uv Rep.1	mg/L N	0.19	0.19	0.21	0.16	0.24
Nitrogen Tot	Dissolved	uv Rep.2	"	0.21	0.19	0.21	0.18	0.23
Nitrogen Tot	Dissolved	uv Rep.3	"	0.19	0.18	0.21	0.16	0.19
Nitrogen	Nitrate	Nitrite Re.1	"	0.128	0.129	0.143	0.106	0.17
Nitrogen	Nitrate	Nitrite Re.2	"	0.13	0.117	0.145	0.127	0.172
Nitrogen	Nitrate	Nitrite Re.3	"	0.118	0.111	0.151	0.102	0.14
Phosphorus	Total Rep.1		mg/L P	0.018	0.023	0.031	0.02	0.012
Phosphorus	Total Rep.2		"	0.025	0.023	0.036	0.027	0.012
Phosphorus	Total Rep.3		"	0.015	0.025	0.025	0.022	0.012
METALS								
Aluminium	Total	ICP/CONC	mg/L	0.187	0.232	0.417	0.188	0.049
Arsenic	Total	ICP	"	0.0004	0.0004	0.0005	0.0006	0.0005
Barium	Total	ICP/CONC	"	0.0186	0.0182	0.0194	0.0187	0.083
Cadmium	Total	ICP/CONC	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	Non-Filterab	Extr. ICP	"	20.8	19.5	18.3	18.5	20.1
Cobalt	Total	ICP/CONC	"	0.0002	0.0002	0.0004	0.0002	0.0001
Chromium	Total	ICP/CONC	"	0.0005	0.001	0.001	0.0007	0.0003
Copper	Total	ICP/CONC	"	0.0011	0.0013	0.0016	0.0015	0.0004
Iron	Total	ICP/CONC	"	0.245	0.272	0.579	0.245	0.0805
Lead	Total	ICP/CONC	"	<0.0002	0.0002	0.0003	<0.0002	<0.0002
Magnesium	Non-Filterab	Extr. ICP	"	4.7	4.6	4.7	4.9	5.2
Manganese	Total	ICP/CONC	"	0.0088	0.0092	0.017	0.0079	0.0078
Mercury	Total	FAA	"	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Molybdenum	Total	ICP/CONC	"	0.0009	0.0008	0.0007	0.0009	0.0007
Nickel	Total	ICP/CONC	"	0.0008	0.0011	0.0017	0.0009	0.0004
Potassium	Non-Filterab	Extr. AA	"	0.84	0.94	0.81	1.03	0.82
Selenium	Total	ICP	"	0.0002	0.0001	0.0001	0.0002	0.0002
Sodium	Non-Filterab	Extr. ICP	"	4	5	4.6	5.1	5.7
Zinc	Total	ICP/CONC	"	0.0012	0.0022	0.0021	0.012	0.0009
AOX			mg/L	0.03	0.05	0.04		0.07

			Code	PY0331	PY0331	PY0331	PY0331	PY0331
				30-Mar-93	12-Apr-93	27-Apr-93	25-May-93	08-Jun-93
Specific Conductance Lab			uS/cm	158	130	121	100	100
ANIONS								
Alkalinity	Total		mg/L CaCO3	63	54	53	44	41
Chloride	Dissolved		mg/L	2.1	1.5	1.4	0.6	0.7
Fluoride	Dissolved		"	0.04	0.05	0.06	0.05	0.05
Sulphate	Dissolved		"	11.3	8.4	8.2	5.8	6.8
Hardness	Calc.		"	67.5	61.7	59.6	48.1	48.9
NUTRIENTS								
Nitrogen Tot	Dissolved	uv Rep.1	mg/L N	0.27	0.36	0.27	0.18	0.09
Nitrogen Tot	Dissolved	uv Rep.2	"	0.27	0.37	0.32	0.14	0.09
Nitrogen Tot	Dissolved	uv Rep.3	"	0.24	0.36	0.3	0.14	0.1
Nitrogen	Nitrate	Nitrite Re.1	"	0.16	0.178	0.1	0.085	0.021
Nitrogen	Nitrate	Nitrite Re.2	"	0.167	0.193	0.154	0.073	0.026
Nitrogen	Nitrate	Nitrite Re.3	"	0.142	0.183	0.127	0.062	0.039
Phosphorus	Total Rep.1		mg/L P	0.112	0.29	0.2	0.181	0.142
Phosphorus	Total Rep.2		"	0.121	0.3	0.2	0.209	0.143
Phosphorus	Total Rep.3		"	0.114	0.32	0.203	0.304	0.103
METALS								
Aluminium	Total	ICP/CONC	mg/L	0.308	5.83	3.38	3.59	2.47
Arsenic	Total	ICP	"	0.0013	0.0026	0.0017	0.0014	0.0002
Barium	Total	ICP/CONC	"	0.0245	0.0706	0.0446	0.043	0.05
Cadmium	Total	ICP/CONC	"	<0.0001	0.0012	0.0007	0.0007	
Calcium	Non-Filterab	Extr. ICP	"	18.8	17.4	16.9	15	15.3
Cobalt	Total	ICP/CONC	"	0.0001	0.0047	0.0027	0.0027	0.0004
Chromium	Total	ICP/CONC	"	0.0008	0.0124	0.007	0.0061	0.0043
Copper	Total	ICP/CONC	"	0.0017	0.0112	0.0067	0.006	0.0042
Iron	Total	ICP/CONC	"	0.435	9.53	5.4	5.4	3.36
Lead	Total	ICP/CONC	"	<0.0002	0.005	0.0027	0.0029	0.0016
Magnesium	Non-Filterab	Extr. ICP	"	5	4.4	4.3	2.6	2.6
Manganese	Total	ICP/CONC	"	0.0115	0.213	0.12	0.126	0.0698
Mercury	Total	FAA	"	7E-06	8E-06	<0.000005	<0.000005	
Molybdenum	Total	ICP/CONC	"	0.0006	0.0007	0.0006	0.0004	0.0006
Nickel	Total	ICP/CONC	"	0.0008	0.0151	0.0085	0.0082	0.0052
Potassium	Non-Filterab	Extr. AA	"	0.97	0.91	0.84	0.69	0.76
Selenium	Total	ICP	"	0.0002	0.0003	0.0002	<0.0002	0.0012
Sodium	Non-Filterab	Extr. ICP	"	5	3.2	2.9	1.6	1.7
Zinc	Total	ICP/CONC	"	0.0019	0.0243	0.0147	0.0132	0.012
AOX			mg/L	0.04	0.03	0.02		

			Code	PY0331	PY0331	PY0331	PY0331	PY0331
				22-Jun-93	06-Jul-93	20-Jul-93	03-Aug-93	17-Aug-93
Specific Conductance	Lab		uS/cm	108	112	117	112	114
ANIONS								
Alkalinity	Total		mg/L CaCO ₃	44	47	48	46	47
Chloride	Dissolved		mg/L	0.7	0.7	0.7	0.7	0.7
Fluoride	Dissolved		"	0.04	0.06	0.03	0.05	0.05
Sulphate	Dissolved		"	7.6	6.8	5.8	7.7	9.1
Hardness	Calc.		"	45.5	55.8	69.7	55.3	55.4
NUTRIENTS								
Nitrogen Tot	Dissolved	uv Rep.1	mg/L N	0.11	0.18	0.1	0.1	0.06
Nitrogen Tot	Dissolved	uv Rep.2	"	0.11	0.17	0.1	0.11	0.07
Nitrogen Tot	Dissolved	uv Rep.3	"	0.1	0.18	0.11	0.36	0.05
Nitrogen	Nitrate	Nitrite Re.1	"	0.046	0.038	0.025	0.021	0.01
Nitrogen	Nitrate	Nitrite Re.2	"	0.049	0.035	0.028	0.022	0.023
Nitrogen	Nitrate	Nitrite Re.3	"	0.045	0.042	0.028	0.021	<0.002
Phosphorus	Total Rep.1		mg/L P	0.107	0.16	0.085	0.12	0.049
Phosphorus	Total Rep.2		"	0.14	0.16	0.083	0.13	0.049
Phosphorus	Total Rep.3		"	0.133	0.16	0.086	0.14	0.048
METALS								
Aluminium	Total	ICP/CONC	mg/L	1.6	3.23	1.47	1.94	1.24
Arsenic	Total	ICP	"	0.0008	0.0015	0.0009	0.0006	0.0008
Barium	Total	ICP/CONC	"	0.0261	0.0386	0.0263	0.0297	0.0213
Cadmium	Total	ICP/CONC	"	0.0002	0.0004	0.0002	0.0003	0.0002
Calcium	Non-Filterab	Extr. ICP	"	13.7	16.7	22	16.6	16.8
Cobalt	Total	ICP/CONC	"	0.0011	0.0022	0.0011	0.0015	0.0009
Chromium	Total	ICP/CONC	"	0.0025	0.0045	0.0028	0.0037	0.0019
Copper	Total	ICP/CONC	"	0.0031	0.0078	0.0031	0.0037	0.0026
Iron	Total	ICP/CONC	"	2.11	4.3	1.83	2.76	1.76
Lead	Total	ICP/CONC	"	0.0012	0.0022	0.001	0.0016	0.0013
Magnesium	Non-Filterab	Extr. ICP	"	2.8	3.5	3.6	3.4	3.3
Manganese	Total	ICP/CONC	"	0.0528	0.1	0.0463	0.0653	0.0409
Mercury	Total	FAA	"	<0.000005	6E-06	6E-06	1.3E-05	<0.000005
Molybdenum	Total	ICP/CONC	"	0.0006	0.0005	0.0006	0.0006	0.0006
Nickel	Total	ICP/CONC	"	0.0035	0.0068	0.0036	0.0045	0.0028
Potassium	Non-Filterab	Extr. AA	"	0.65	0.77	0.7	0.79	0.7
Selenium	Total	ICP	"	0.0001	0.0001	0.0001	<0.0001	0.00014
Sodium	Non-Filterab	Extr. ICP	"	1.9	2.2	2.5	2.4	2.2
Zinc	Total	ICP/CONC	"	0.0055	0.0125	0.0057	0.0078	0.007
AOX			mg/L				0.01	<0.01

			Code	PY0331	PY0331	PY0331	PY0331	PY0331
				31-Aug-93	14-Sep-93	28-Sep-93	09-Oct-93	12-Oct-93
Specific Conductance	Lab		uS/cm	111	114	134	136	145
ANIONS								
Alkalinity	Total		mg/L CaCO ₃	45	48	52	56	55
Chloride	Dissolved		mg/L	0.7	1.4	1.3	1	1.1
Fluoride	Dissolved		"	0.04	0.04	0.06	0.05	0.06
Sulphate	Dissolved		"	10.1	9	9.1	7.6	8.7
Hardness	Calc.		"	54.4	54.1	60.4	61.2	62.2
NUTRIENTS								
Nitrogen Tot	Dissolved	uv Rep.1	mg/L N	0.11	0.09	0.12	0.25	0.11
Nitrogen Tot	Dissolved	uv Rep.2	"	0.11	0.08	0.11	0.23	0.11
Nitrogen Tot	Dissolved	uv Rep.3	"	0.1	0.08	0.12	0.24	0.11
Nitrogen	Nitrate	Nitrite Re.1	"	0.043	0.036	0.025	0.155	0.047
Nitrogen	Nitrate	Nitrite Re.2	"	0.057	0.027	0.026	0.127	0.036
Nitrogen	Nitrate	Nitrite Re.3	"	0.038	0.03	0.026	0.146	0.047
Phosphorus	Total Rep.1		mg/L P	0.038	0.023	0.015	0.092	0.015
Phosphorus	Total Rep.2		"	0.048	0.024	0.016	0.1	0.015
Phosphorus	Total Rep.3		"	0.048	0.029	0.016	0.052	0.016
METALS								
Aluminium	Total	ICP/CONC	mg/L	0.771	0.596	0.185	1.35	0.21
Arsenic	Total	ICP	"	0.0004	0.0004	0.0004	0.0011	0.0003
Barium	Total	ICP/CONC	"	0.0178	0.0167	0.0153	0.026	0.0152
Cadmium	Total	ICP/CONC	"	0.0001	0.0001	<0.0001	0.0002	<0.0001
Calcium	Non-Filterab	Extr. ICP	"	16.4	16.2	17.6	18.5	18.1
Cobalt	Total	ICP/CONC	"	0.0007	0.0004	0.0002	0.0014	0.0002
Chromium	Total	ICP/CONC	"	0.0013	0.001	0.0004	0.0025	0.0005
Copper	Total	ICP/CONC	"	0.0019	0.0017	0.0013	0.0041	0.0011
Iron	Total	ICP/CONC	"	1.04	0.755	0.221	2.4	0.257
Lead	Total	ICP/CONC	"	0.0008	0.0008	0.0003	0.0015	0.0003
Magnesium	Non-Filterab	Extr. ICP	"	3.2	3.3	4	3.7	4.1
Manganese	Total	ICP/CONC	"	0.0293	0.0175	0.009	0.0799	0.0084
Mercury	Total	FAA	"	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Molybdenum	Total	ICP/CONC	"	0.0004	0.0008	0.0008	0.0004	0.0008
Nickel	Total	ICP/CONC	"	0.0020	0.0014	0.0008	0.0037	0.0007
Potassium	Non-Filterab	Extr. AA	"	0.8	0.75	0.85	0.6	0.7
Selenium	Total	ICP	"	0.0001	<0.0001	0.0002	0.0002	0.0001
Sodium	Non-Filterab	Extr. ICP	"	2.2	2.3	3.2	2.4	3.3
Zinc	Total	ICP/CONC	"	0.0051	0.0029	0.0025	0.0073	0.0021
AOX			mg/L	0.01	0.01	0.02		0.03

			Code	PY0331	PY0331	PY0331	PY0331	PY0331
				26-Oct-93	23-Nov-93	07-Dec-93	21-Dec-93	04-Jan-94
Specific Conductance Lab			uS/cm	141	152	165	163	157
ANIONS								
Alkalinity	Total		mg/L CaCO3	56	61	66	65	63
Chloride	Dissolved		mg/L	1	1.8	2.3	2.2	1.8
Fluoride	Dissolved		"	0.05	0.06	0.05	0.06	0.06
Sulphate	Dissolved		"	10.8	11.2	11.8	12.3	11.6
Hardness	Calc.		"	62.1	70.6	77.3	76.2	73.9
NUTRIENTS								
Nitrogen Tot	Dissolved	uv Rep.1	mg/L N	0.1	0.17	7.8	0.2	0.22
Nitrogen Tot	Dissolved	uv Rep.2	"	0.11	0.18	7.4	0.2	0.24
Nitrogen Tot	Dissolved	uv Rep.3	"	0.11	0.16	8	0.21	0.23
Nitrogen	Nitrate	Nitrite Re.1	"	0.051	0.096	0.122	0.118	0.146
Nitrogen	Nitrate	Nitrite Re.2	"	0.053	0.109	0.118	0.113	0.152
Nitrogen	Nitrate	Nitrite Re.3	"	0.057	0.095	0.138	0.129	0.147
Phosphorus	Total Rep.1		mg/L P	0.015	0.013	0.023	0.026	0.022
Phosphorus	Total Rep.2		"	0.016	0.014	0.024	0.026	0.026
Phosphorus	Total Rep.3		"	0.014	0.014	0.024	0.028	0.024
METALS								
Aluminium	Total	ICP/CONC	mg/L	0.167	0.126	0.23	0.175	0.143
Arsenic	Total	ICP	"	0.0004	0.0004	0.0004	0.0004	0.0004
Barium	Total	ICP/CONC	"	0.0161	0.0155	0.018	0.0178	0.0173
Cadmium	Total	ICP/CONC	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	Non-Filterab	Extr. ICP	"	17.9	20.3	22.3	21.9	21.1
Cobalt	Total	ICP/CONC	"	0.0001	0.0002	0.0003	0.0002	0.0002
Chromium	Total	ICP/CONC	"	0.0005	0.0004	0.0006	0.0005	0.0005
Copper	Total	ICP/CONC	"	0.0013	0.0016	0.0015	0.0014	0.0018
Iron	Total	ICP/CONC	"	0.208	0.199	0.364	0.295	0.219
Lead	Total	ICP/CONC	"	0.0002	<0.0002	<0.0002	<0.0002	0.0002
Magnesium	Non-Filterab	Extr. ICP	"	4.2	4.8	5.3	5.2	5.2
Manganese	Total	ICP/CONC	"	0.0079	0.0085	0.0147	0.013	0.0081
Mercury	Total	FAA	"	<0.000005	<0.000005	<0.000005	<0.000005	6E-06
Molybdenum	Total	ICP/CONC	"	0.0007	0.0007	0.0006	0.0006	0.0007
Nickel	Total	ICP/CONC	"	0.0006	0.0008	0.0011	0.0010	0.0009
Potassium	Non-Filterab	Extr. AA	"	0.7	0.8	0.9	0.8	0.9
Selenium	Total	ICP	"	0.0001	0.0001	0.0001	<0.0001	<0.0001
Sodium	Non-Filterab	Extr. ICP	"	3.4	4.2	4.9	4.7	4.3
Zinc	Total	ICP/CONC	"	0.0027	0.002	0.0021	0.0029	0.0027
AOX			mg/L	0.02	0.04	0.05	0.04	0.03

APPENDIX VII

WATER QUALITY DATA FOR MISSION SITE

Minimum Detection Limits for Total Metals Analysis

Laboratory	Zenon	ASL	UNITS
	MDL From: 93-01 To: 93-03	MDL From: 93-04 To: 94-03	
Physical Tests:			
Dissolved Oxygen			mg/L
Water Temperature			deg C
Air Temperature			"
pH			"
Field pH			"
Specific Conductance(SC)	1	0.2	uS/cm
Field SC			uS/cm
Suspended Solids (NFR)	4	1	mg/L
Dissolved Solids (FR)	4	1	"
Hardness Total			mg/L CaCO3
Anions:			
Alkalinity Total @ pH 4.5	0.5	0.5	mg/L CaCO3
Chloride Dissolved	0.5	0.2	mg/L
Fluoride Dissolved	0.1	0.02	"
Sulfate	1	0.5	"
Nutrients:			
Nitrogen Amn.Diss(N)	0.005	0.005	mg N/L
Nitrogen Kjel.Tot(N)	0.04	0.05	"
Nitro NO3+NO2 D	0.02	0.005	"
Phosphorus Dissolved	0.003	0.001	mg P/L
Phosphorus Total	0.003	0.001	"
TOTAL METALS			
Aluminum	0.06	0.02	mg/L
Arsenic	0.001	0.0001	"
Barium	0.001	0.01	"
Cadmium	0.0001	0.0002	"
Calcium	0.05	0.05	"
Chromium	0.005	0.001	"
Cobalt	0.004	0.015	"
Copper	0.001	0.001	"
Iron	0.05	0.03	"
Lead	0.003	0.001	"
Magnesium	0.02	0.01	"
Manganese	0.002	0.005	"
Mercury	0.00005	0.00005	"
Molybdenum	0.004	0.001	"
Nickel	0.005	0.001	"
Potassium	0.4	2	"
Selenium	0.03	0.0005	"
Silver	0.03	0.0001	"
Sodium	0.4	2	"
Tin	0.02	0.3	"
Zinc	0.01	0.001	"
ORGANIC PARAMETERS			
Carbon Total Organic	0.5	0.5	mg/L

Minimum Detection Limits for Organic Analysis

Laboratory	Zenon			Zenon	
ORGANIC PARAMETERS	MDL	UNITS		MDL	UNITS
Adsorbable Organic Halide (AOX):	0.01	mg/L	Resin and Fatty Acids:		
Chlorophenolics:			Abietic Acid	0.0005	mg/L
Pentachlorophenol	0.000001	mg/L	Arachidic Acid	0.0005	"
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	"	Behenic Acid	0.0005	"
2,3,4,5-Tetrachlorophenol	"	"	Chlorodehydroabietic	0.0005	"
3,4,5-Trichlorophenol	"	"	Dehydroabietic Acid	0.0005	"
2,3,4-Trichlorophenol	"	"	Dichlorodehydroabietic	0.0005	"
2,3,5-Trichlorophenol	"	"	Isopimaric Acid	0.0005	"
2,3,6-Trichlorophenol	"	"	Lauric Acid	0.0005	"
2,4,5-Trichlorophenol	"	"	Levo Pimaric Acid	0.0005	"
2,4,6-Trichlorophenol	"	"	Lignoceric Acid	0.0005	"
2,4-Dichlorophenol	"	"	Linoleic Acid	0.0005	"
2,6-Dichlorophenol	"	"	Linolenic Acid	0.0005	"
2,5-Dichlorophenol	"	"	Myristic Acid	0.0005	"
3,5-Dichlorophenol	"	"	Neoabietic Acid	0.0005	"
2,3-Dichlorophenol	"	"	Oleic Acid	0.0005	"
3,4-Dichlorophenol	"	"	Palmitric Acid	0.0005	"
4-Chlorophenol	"	"	Palustric Acid	0.0005	"
Tetrachloroguaiacol	0.000002	"	Pimaric Acid	0.0005	"
3,4,5-Trichloroguaiacol	"	"	Sandaraco Pimaric Acid	0.0005	"
3,4,6-Trichloroguaiacol	"	"	Stearic Acid	0.0005	"
4,5,6-Trichloroguaiacol	"	"			
4,5-Dichloroguaiacol	"	"	Antisapstain Compounds:		
4,6-Dichloroguaiacol	"	"	TCMTB	0.005	mg/L
4-chloroguaiacol	"	"	Organochlorine Pesticides and PCBs:		
5-Chloroguaiacol	"	"	Aldrin	0.000001	mg/L
6-Chloroguaiacol	"	"	BHC alpha-	0.000001	"
Tetrachlorocatechol	"	"	BHC beta-	0.000001	"
3,4,5-Trichlorocatechol	"	"	BHC delta-	0.000001	"
3,4-Dichlorocatechol	"	"	Chlordane alpha-	0.000005	"
3,5-Dichlorocatechol	"	"	Chlordane gamma-	0.000005	"
4,5-Dichlorocatechol	"	"	DDE p p'-	0.000005	"
4-Chlorocatechol	"	"	DDD p p'-	0.000005	"
Tetrachloroveratrole	"	"	DDT p p'-	0.000005	"
3,4,5-Trichloroveratrole	"	"	Dieldrin	0.000005	"
4,5-Dichloroveratrole	"	"	Endosulfan I	0.000005	"
2,6-Dichlorosyringaldehyde	"	"	Endosulfan II	0.000005	"
2-Chlorosyringaldehyde	"	"	Endosulfan sulphate	0.00001	"
3,4,5-Trichlorosyringol	"	"	DDT o p'-	0.000005	"
Trichlorotrimethoxybenzene	"	"	Endrin	0.000005	"
5,6-Dichlorovanillin	"	"	Hexachlorobenzene	5E-07	"
6-Chlorovanillin	"	"	Heptachlor	0.000001	"
Nonylphenol	0.000005	"	Heptachlor epoxide	0.000002	"
			Lindane BHC gamma-	0.000001	"
			Methoxychlor	0.00001	"
			Mirex	0.00001	"
			Nonachlor trans-	0.000005	"
			Oxychlordane	0.000005	"
			Toxaphene	0.00005	"
			PCBs - Total	0.00002	"

- 1) All results are blank corrected
- 2) Organic analyses are not corrected for surrogate recoveries except for isotope dilution methods
- 3) MDL = Minimum Detectable Limit
- 4) <= Less than MDL

Lab ID		Zenon	Zenon	Zenon	Zenon	Zenon	ASL	ASL
Client ID		FR0009	FR0015	FR0046	FR0058	FR0066	FR0070	FR0076
SITE	UNITS	Mission	Mission	Mission	Mission	Mission	Mission	Mission
Sampled On:		93-01-25	93-02-09	93-02-22	93-03-08	93-03-22	93-04-19	93-05-03
Latitude (N)		49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18
Longitude (W)		122 - 16.8	122 - 16.8	122 - 16.8	122 - 16.8	122 - 16.8	122 - 16.8	122 - 16.80
Physical Tests:								
Dissolved Oxygen	mg/L	13.4	13.8	13.4	8.8	-	11.2	11
Water Temperature	deg C	1	5	1	5.1	-	7	9.5
Air Temperature	"	3	6	0	10	-	11	10.5
pH		7.5	7.5	7.4	7.6	7.6	7.39	7.3
Field pH		7.1	7.2	7.7	7.35	-	7.15	6.9
Specific Conductance (SC)	uS/cm	143	136	146	138	132	119	121
Field SC	uS/cm	95	80	110	3300	-	210	140
Suspended Solids (NFR)	mg/L	13	5	4	20	9	55	59
Dissolved Solids (FR)	"	86	83	91	90	83	83	79
Hardness Total	mg/L CaCO3	62.7	56.5	58.5	54.7	55.6	59	57.2
Anions:								
Alkalinity Total @ pH 4.5	mg/L CaCO3	56.4	53	58.4	53.5	52.2	48.3	46
Chloride Dissolved	mg/L	2.3	2.3	2.2	2.4	2	1.9	1.6
Fluoride Dissolved	"	<	<	<	<	<	0.04	0.04
Sulfate	"	12.8	14	14.4	10.5	11.8	8.3	6.8
Nutrients:								
Nitrogen Amm.Diss(N)	mg N/L	0.036	0.028	0.016	0.018	0.008	0.008	
Nitrogen Kjel.Tot(N)	"	0.16	0.1	<	0.15	0.11	0.27	0.27
Nitro NO3+NO2 D	"	0.15	0.16	0.13	0.15	0.15	0.137	0.15
Phosphorus Dissolved	mg P/L	<	0.008	0.009	0.01	0.014	0.02	0.043
Phosphorus Total	"	0.021	0.022	0.016	0.037	0.034	0.142	0.094
TOTAL METALS								
Aluminum	mg/L	0.32	0.1	0.07	0.57	0.24	1.94	0.58
Arsenic	"	<	<	0.001	<	<	0.0003	0.0006
Barium	"	0.018	0.015	0.014	0.017	0.017	0.035	0.026
Cadmium	"	<	<	<	<	<	<0.0002	0.0011
Calcium	"	18.2	16.4	16.9	15.7	15.8	16.2	16.3
Chromium	"	<	<	<	<	<	0.003	0.001
Cobalt	"	<	<	<	<	<	<0.015	<0.015
Copper	"	0.008	0.001	<	<	0.003	0.001	0.005
Iron	"	0.42	0.22	0.18	0.91	0.41	2.34	0.638
Lead	"	<	<	<	<	<	0.001	<0.001
Magnesium	"	4.2	3.77	3.96	3.76	3.91	4.51	3.99
Manganese	"	0.021	0.013	0.012	0.028	0.016	0.064	0.056
Mercury	"	<	<	<	<	<	<0.00005	<0.00005
Molybdenum	"	<	<	<	<	<	<0.001	<0.001
Nickel	"	0.008	<	<	<	<	0.004	0.003
Potassium	"	1.2	1	0.8	0.8	0.8	<2.0	<2.0
Selenium	"	<	<	<	<	<	<0.0005	<0.0005
Silver	"	<	<	<	<	<	<0.0001	<0.0001
Sodium	"	4.29	3.5	4.1	4.1	4	3.4	3.1
Tin	"	<	<	<	<	<	<0.30	<0.30
Zinc	"	0.014	<	<	<	0.07	0.011	<0.005
BACTERIOLOGICAL:								
Fecal Coliform	MPN/100 mL	800	800	300	-	230	50	500
ORGANIC PARAMETERS:								
Total Organic Carbon	mg/L	3.0	1.0	2.0	2.0	3.0	0.5	4.0

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0087	FR0099	FR0111	FR0115	FR0119	FR0123
SITE	UNITS	Mission	Mission X-sec 3	Mission	Mission	Mission	Mission
Sampled On:		93-05-17	93-05-31	93-06-14	93-06-28	93-07-12	93-07-26
Latitude (N)		49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18
Longitude (W)		122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80
Physical Tests:							
Dissolved Oxygen	mg/L	10.8	11.2	10.6	10.6	9.6	9.9
Water Temperature	deg C	12.8	13.8	13.5	15.6	16.0	18.1
Air Temperature	"	13.3	16.3	15.0	17.5	17.2	20.2
pH		7.50	7.72	7.64	7.50	7.60	7.55
Field pH		7.5	7.3	7.6	7.9	7.7	7.4
Specific Conductance (SC)	uS/cm	102.0	92.5	96.6	101.0	105.0	106.0
Field SC	uS/cm	79	74	69	83	80	91
Suspended Solids (NFR)	mg/L	377	179	50	54	57	30
Dissolved Solids (FR)	"	66	45	52	53	56	56
Hardness Total	mg/L CaCO3	81.8	39.8	48.1	51.6	44.2	47.7
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	50.6	38.7	38.3	41.8	48.2	45.6
Chloride Dissolved	mg/L	2.3	1.3	1.1	1	0.9	1.1
Fluoride Dissolved	"	0.04	0.03	0.04	0.04	0.04	0.04
Sulfate	"	10.5	5.8	8.5	7.0	8.5	8.8
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	0.013	0.007	<0.005	0.027	<0.005	0.009
Nitrogen Kjel.Tot(N)	"	0.75	0.11	0.15	0.09	0.12	0.14
Nitro NO3+NO2 D	"	0.113	0.069	0.069	0.052	0.056	0.100
Phosphorus Dissolved	mg P/L	0.066	0.005	0.008	0.002	0.007	0.004
Phosphorus Total	"	0.478	0.082	0.046	0.049	0.059	0.027
TOTAL METALS							
Aluminum	mg/L	5.6	0.71	0.39	0.45	0.58	0.46
Arsenic	"	0.0017	0.0006	0.0004	0.0004	0.0003	0.0005
Barium	"	0.085	0.024	0.02	0.02	0.02	0.02
Cadmium	"	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	16.1	11.5	14.5	14.60	12.70	14.10
Chromium	"	0.011	0.001	<0.001	<0.001	<0.001	0.006
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.012	0.004	0.001	0.002	0.003	0.010
Iron	"	9.22		0.45	0.49	0.47	0.65
Lead	"	0.003	0.001	0.001	<0.001	<0.001	<0.001
Magnesium	"	5.09	2.69	2.89	3.07	3.01	3.05
Manganese	"	0.292	0.054	0.034	0.033	0.023	0.032
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	0.015	0.003	0.002	0.002	0.004	0.002
Potassium	"	<2	<2	<2	<2	<2	<2
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	2.9	<2	2.1	2.1	2.2	2.3
Tin	"	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc	"	0.032	<0.005	0.005	<0.005	<0.005	0.008
BACTERIOLOGICAL:							
Fecal Coliform	MPN/100 mL	50	50	4	<2	13	13
ORGANIC PARAMETERS:							
Total Organic Carbon	mg/L	5.1	3.9	2.4	2.3	2.7	3.0

Lab ID		ASL	ASL	ASL	ASL	ASL
Client ID		FR0127	FR0137	FR0151	FR0155	FR0167
SITE	UNITS	Mission	Mission Replicate	Mission	Mission	Mission X-sec 3
Sampled On:		93-08-09	93-08-23	93-09-06	93-09-20	93-10-04
Latitude (N)		49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18
Longitude (W)		122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80
Physical Tests:						
Dissolved Oxygen	mg/L	9.8	9.2	9.4	9.1	9.5
Water Temperature	deg C	18.9	18.4	17.5	14.2	13.9
Air Temperature	"	19.2	17.1	22.1	12.9	13.8
pH		7.55	7.77	7.68	7.2	7.48
Field pH		7.5	7.5	7.5	7.55	7.75
Specific Conductance (SC)	uS/cm	104.0	103.0	105.0	120	131
Field SC	uS/cm	92	90	108	105	117
Suspended Solids (NFR)	mg/L	26	24	16	9	4
Dissolved Solids (FR)	"	53	55	59	59	67
Hardness Total	mg/L CaCO3	50.9	50	52.6	52.2	62.2
Anions:						
Alkalinity Total @ pH 4.5	mg/L CaCO3	42.7	41.6	44.1	44.3	50.2
Chloride Dissolved	mg/L	1.2	1.3	0.8	0.7	1.4
Fluoride Dissolved	"	0.03	0.04	0.03	0.03	0.03
Sulfate	"	6.2	8.0	8.8	8.1	9.9
Nutrients:						
Nitrogen Amm.Diss(N)	mg N/L	<0.005	<0.005	0.006	0.007	0.043
Nitrogen Kjel.Tot(N)	"	0.15	0.10	0.17	0.129	0.2
Nitro NO3+NO2 D	"	0.029	0.015	0.023	0.029	0.039
Phosphorus Dissolved	mg P/L	0.025	0.010	0.008	0.008	0.01
Phosphorus Total	"	0.028	0.032	0.022	0.021	0.015
TOTAL METALS						
Aluminum	mg/L	0.38	0.27	<0.2	<0.20	<0.20
Arsenic	"	0.0003	0.0005	0.0003	0.0004	0.0004
Barium	"	0.02	0.02	0.02	0.018	0.015
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	15.00	15.30	15.80	16.2	18.6
Chromium	"	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.001	0.001	0.001	<0.001	0.002
Iron	"	0.38	0.30	0.21	0.153	0.091
Lead	"	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	"	3.27	2.86	3.21	3.32	3.82
Manganese	"	0.022	0.018	0.017	0.011	0.011
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	<0.001	0.001	<0.001	<0.001	<0.001
Potassium	"	<2	<2	<2	<2	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	2.4	2.2	2	3	3.5
Tin	"	<0.3	<0.3	<0.3	<0.30	<0.30
Zinc	"	0.009	<0.005	0.002	<0.001	0.004
BACTERIOLOGICAL:						
Fecal Coliform	MPN/100 mL	2	130	23	60	23
ORGANIC PARAMETERS:						
Total Organic Carbon	mg/L	2.9	2.3	2.0	1.8	1.8

Lab ID		ASL	ASL	ASL	ASL	ASL
Client ID		FR0177	FR0182	FR0186	FR0190	FR0208
SITE		Mission	Mission	Mission	Mission	Mission
	UNITS					
Sampled On:		93-10-18	93-11-01	93-11-15	93-11-29	93-12-13
Latitude (N)		49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18
Longitude (W)		122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80
Physical Tests:						
Dissolved Oxygen	mg/L	10.6	9.2	11	12.7	11.6
Water Temperature	deg C	11.1	8.9	5.5	3	3.9
Air Temperature	"	11.5	8.5	4	5.5	7.5
pH		7.75	7.68	7.73	7.7	7.52
Field pH		7.6	7.65	7.8	7.3	7.45
Specific Conductance (SC)	uS/cm	118	120	128	131	120
Field SC	uS/cm	82	145	82	78	75
Suspended Solids (NFR)	mg/L	8	9	11	1	34
Dissolved Solids (FR)	"	64	66	68	90	84
Hardness Total	mg/L CaCO3	56.8	59.7	62	61.5	55.5
Anions:						
Alkalinity Total @ pH 4.5	mg/L CaCO3	48.4	49	51.5	53.6	46.8
Chloride Dissolved	mg/L	1.3	1.6	1.8	1.4	2.6
Fluoride Dissolved	"	0.06	0.04	0.04	0.05	0.04
Sulfate	"	10.6	10.9	9.7	12.6	10
Nutrients:						
Nitrogen Amm.Diss(N)	mg N/L	0.027	0.031	0.029	0.029	0.034
Nitrogen Kjel.Tot(N)	"	0.186	0.17	0.185	0.196	0.233
Nitro NO3+NO2 D	"	0.044	0.087	0.092	0.166	0.318
Phosphorus Dissolved	mg P/L	0.01	0.015	0.006	0.02	0.028
Phosphorus Total	"	0.016	0.024	0.026	0.02	0.099
TOTAL METALS						
Aluminum	mg/L	<0.20	0.21	0.22	<0.20	1.29
Arsenic	"	0.0004	0.0005	0.0003	0.0005	0.0006
Barium	"	0.017	0.016	0.018	0.016	0.026
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	16.6	17.5	17.9	17.9	15.8
Chromium	"	<0.001	<0.001	<0.001	<0.001	0.002
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	<0.001	<0.001	0.001	<0.001	0.003
Iron	"	0.054	0.22	0.254	0.167	1.05
Lead	"	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	"	3.73	3.85	4.21	4.08	3.89
Manganese	"	0.01	0.014	0.017	0.017	0.046
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	0.001	<0.001
Nickel	"	<0.001	<0.001	<0.001	0.001	0.001
Potassium	"	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	3.2	3.1	3	4	3.2
Tin	"	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.001	0.007	0.004	0.002	0.002
BACTERIOLOGICAL:						
Fecal Coliform	MPN/100 mL	22	90	70	30	130
ORGANIC PARAMETERS:						
Total Organic Carbon	mg/L	2.1	2.2	3.0	3.4	2.3

Lab ID		ASL	ASL	ASL	ASL	ASL
Client ID		FR0212	FR0216	FR0220	FR0231	FR0259
SITE		Mission	Mission	Mission	Mission	Mission
	UNITS				X-sec 3	
Sampled On:		93-12-27	94-01-11	94-01-25	94-02-07	94-02-22
Latitude (N)		49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18
Longitude (W)		122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80
Physical Tests:						
Dissolved Oxygen	mg/L	11.6	11.8	12.6	12.7	12.4
Water Temperature	deg C	2.7	4.2	3.9	1	3.8
Air Temperature	"	5	8	8.5	-4	7
pH		7.18	7.43	7.91	7.5	7.63
Field pH		7.6	7.25	7.35	7.4	7.8
Specific Conductance (SC)	uS/cm	133	114	120	135	143
Field SC	uS/cm	89	75	74	76	82
Suspended Solids (NFR)	mg/L	9	5	4	8	8
Dissolved Solids (FR)	"	72	70	76	87	86
Hardness Total	mg/L CaCO3	63.2	49.7	54.4	58.4	57.4
Anions:						
Alkalinity Total @ pH 4.5	mg/L CaCO3	51.5	44.4	47.9	53.7	53
Chloride Dissolved	mg/L	1.9	1.6	1.8	1.9	2
Fluoride Dissolved	"	0.04	0.04	0.05	0.04	0.04
Sulfate	"	11.5	10	9.8	10.1	10
Nutrients:						
Nitrogen Amm.Diss(N)	mg N/L	0.022	0.018	0.017	0.031	0.026
Nitrogen Kjel.Tot(N)	"	0.151	0.147	0.149	0.16	0.21
Nitro NO3+NO2 D	"	0.148	0.199	0.154	0.133	0.189
Phosphorus Dissolved	mg P/L	0.01	0.014	0.013	0.015	0.017
Phosphorus Total	"	0.013	0.02	0.018	0.029	0.024
TOTAL METALS						
Aluminum	mg/L	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	"	0.0006	0.0004	0.0008	0.0005	0.0005
Barium	"	0.015	0.013	0.018	0.019	0.018
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	18.4	14.1	15.5	16.6	16.1
Chromium	"	<0.001	0.001	0.001	0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.001	0.001	0.003	0.002	0.001
Iron	"	0.104	0.172	0.158	0.199	0.225
Lead	"	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	"	4.2	3.54	3.79	4.11	4.16
Manganese	"	0.013	0.013	0.012	0.017	0.016
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	0.001	<0.001	0.001	0.001	<0.001
Nickel	"	0.001	<0.001	<0.001	<0.001	<0.001
Potassium	"	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	4.2	3.5	3.7	3.8	4.3
Tin	"	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.001	0.004	0.004	0.001	0.007
BACTERIOLOGICAL:						
Fecal Coliform	MPN/100 mL	33	70	130	140	230
ORGANIC PARAMETERS:						
Total Organic Carbon	mg/L	2.6	2.5	2.2	2.3	2.7

Lab ID		ASL	ASL
Client ID		FR0264	FR0268
SITE		Mission	Mission
	UNITS		
Sampled On:		94-03-07	94-03-22
Latitude (N)		49 - 8.18	49 - 8.18
Longitude (W)		122 - 16.80	122 - 16.80
Physical Tests:			
Dissolved Oxygen	mg/L	12.8	11.7
Water Temperature	deg C	4.1	5.2
Air Temperature	"	10	6
pH		7.56	7.56
Field pH		7.55	7.65
Specific Conductance (SC)	uS/cm	117	124
Field SC	uS/cm	75	80
Suspended Solids (NFR)	mg/L	59	48
Dissolved Solids (FR)	"	78	81
Hardness Total	mg/L CaCO3	52.5	56.6
Anions:			
Alkalinity Total @ pH 4.5	mg/L CaCO3	45.1	47
Chloride Dissolved	mg/L	2.3	2.3
Fluoride Dissolved	"	0.06	0.04
Sulfate	"	9.8	8.9
Nutrients:			
Nitrogen Amm.Diss(N)	mg N/L	0.019	0.015
Nitrogen Kjel.Tot(N)	"	0.27	0.2
Nitro NO3+NO2 D	"	0.178	0.159
Phosphorus Dissolved	mg P/L	0.034	0.003
Phosphorus Total	"	0.107	0.114
TOTAL METALS			
Aluminum	mg/L	0.58	0.6
Arsenic	"	0.0006	0.0005
Barium	"	0.024	0.027
Cadmium	"	<0.0002	<0.0002
Calcium	"	14.7	15.7
Chromium	"	<0.001	<0.001
Cobalt	"	<0.015	<0.015
Copper	"	0.003	0.005
Iron	"	0.647	0.649
Lead	"	<0.001	<0.001
Magnesium	"	3.83	4.23
Manganese	"	0.047	0.041
Mercury	"	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001
Nickel	"	0.003	0.002
Potassium	"	<2.0	<2.0
Selenium	"	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001
Sodium	"	3.7	3.7
Tin	"	<0.30	<0.30
Zinc	"	0.007	0.002
BACTERIOLOGICAL:			
Fecal Coliform	MPN/100 mL	50	30
ORGANIC PARAMETERS:			
Total Organic Carbon	mg/L	2.3	2.1

Lab ID Client ID SITE		Zenon FR0046 Mission	Zenon FR0066 Mission	Zenon FR0070 Mission	Zenon FR0087 Mission	Zenon FR0111 Mission	Zenon FR0119 Mission	Zenon FR0127 Mission
	UNITS							
Sampled On:		93-02-22	93-03-22	93-04-19	93-05-17	93-06-14	93-07-12	93-08-09
Latitude (N)		49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18
Longitude (W)		122 - 16.8	122 - 16.8	122 - 16.8	122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80
ORGANIC PARAMETERS:								
Adsorbable Org. Halide (AOX)	mg/L	0.04	0.03	0.02	<0.01	<0.01	0.01	<0.01
Chlorophenolics:								
Pentachlorophenol	mg/L	<	<	<	<	0.000004	<	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	<	<	<	<	<	<	<
2,3,4,5-Tetrachlorophenol	"	<	<	<	<	<	<	<
3,4,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,4-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,6-Trichlorophenol	"	<	<	<	<	<	<	<
2,4,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,4,6-Trichlorophenol	"	<	<	<	<	0.000002	<	<
2,4-Dichlorophenol	"	<	<	<	<	<	<	<
2,6-Dichlorophenol	"	<	<	<	<	<	<	<
2,5-Dichlorophenol	"	<	<	<	<	<	<	<
3,5-Dichlorophenol	"	<	<	<	<	<	<	<
2,3-Dichlorophenol	"	<	<	<	<	<	<	<
3,4-Dichlorophenol	"	<	<	<	<	<	<	<
4-Chlorophenol	"	<	<	<	<	<	<	<
Tetrachloroguaiacol	"	<	<	<	<	<	<	<
3,4,5-Trichloroguaiacol	"	0.000011	<	0.000009	<	<	<	<
3,4,6-Trichloroguaiacol	"	<	<	<	<	<	<	<
4,5,6-Trichloroguaiacol	"	<	<	0.000004	0.000008	<	<	<
4,5-Dichloroguaiacol	"	0.000014	0.000006	0.000004	0.000002	0.000005	<	<
4,6-Dichloroguaiacol	"	<	<	<	<	<	<	<
4-Chloroguaiacol	"	<	<	<	<	<	<	<
5-Chloroguaiacol	"	<	<	<	<	0.000008	0.000005	<
6-Chloroguaiacol	"	<	<	<	<	<	<	<
Tetrachlorocatechol	"	0.000003	<	0.000005	0.000008	<	<	<
3,4,5-Trichlorocatechol	"	0.000008	<	0.000008	<	0.000002	<	<
3,4-Dichlorocatechol	"	<	<	<	<	<	<	<
3,5-Dichlorocatechol	"	<	<	<	<	<	<	<
4,5-Dichlorocatechol	"	0.000008	<	0.000006	<	<	<	<
4-Chlorocatechol	"	<	<	<	<	<	<	<
Tetrachloroveratrole	"	<	<	<	<	<	<	<
3,4,5-Trichloroveratrole	"	0.000006	<	0.000003	<	<	<	<
4,5-Dichloroveratrole	"	<	<	<	<	<	<	<
2,6-Dichlorosyringaldehyde	"	<	<	<	<	<	<	<
2-Chlorosyringaldehyde	"	<	<	<	<	<	<	<
3,4,5-Trichlorosyringol	"	<	<	<	<	<	<	<
Trichlorotrimethoxybenzene	"	<	<	<	<	<	<	<
5,6-Dichlorovanillin	"	0.000002	<	<	<	<	<	<
6-Chlorovanillin	"	0.000007	<	0.000007	<	0.000002	<	<
Nonylphenol	"	<	<	<	<	<	<	<

Lab ID		Zenon	Zenon	Zenon	Zenon	Zenon
Client ID		FR0151	FR0167	FR0177	FR0182	FR0190
SITE		Mission	Mission	Mission	Mission	Mission
Sampled On:	UNITS	93-09-06	93-10-04	93-10-18	93-11-01	93-11-29
Latitude (N)		49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18
Longitude (W)		122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80
ORGANIC PARAMETERS:						
Adsorbable Org. Halide (AOX)	mg/L	<0.01	0.02	---	0.02	0.02
Chlorophenolics:						
Pentachlorophenol	mg/L	<	<	<	<	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	<	<	<	<	<
2,3,4,5-Tetrachlorophenol	"	<	<	<	<	<
3,4,5-Trichlorophenol	"	<	<	<	<	<
2,3,4-Trichlorophenol	"	<	<	<	<	<
2,3,5-Trichlorophenol	"	<	<	<	<	<
2,3,6-Trichlorophenol	"	<	<	<	<	<
2,4,5-Trichlorophenol	"	<	<	<	<	<
2,4,6-Trichlorophenol	"	<	<	<	0.000003	0.000004
2,4-Dichlorophenol	"	<	<	<	<	<
2,6-Dichlorophenol	"	<	<	<	<	<
2,5-Dichlorophenol	"	<	<	<	<	<
3,5-Dichlorophenol	"	<	<	<	<	<
2,3-Dichlorophenol	"	<	<	<	<	<
3,4-Dichlorophenol	"	<	<	<	<	<
4-Chlorophenol	"	<	<	<	<	<
Tetrachloroguaiacol	"	<	<	<	<	0.000002
3,4,5-Trichloroguaiacol	"	<	<	<	<	0.000005
3,4,6-Trichloroguaiacol	"	<	<	<	<	<
4,5,6-Trichloroguaiacol	"	<	<	<	<	<
4,5-Dichloroguaiacol	"	0.000002	0.000002	<	0.000002	<
4,6-Dichloroguaiacol	"	<	<	<	<	<
4-Chloroguaiacol	"	<	<	<	<	<
5-Chloroguaiacol	"	0.000003	0.000002	<	0.000003	<
6-Chloroguaiacol	"	<	<	<	<	<
Tetrachlorocatechol	"	<	<	<	<	<
3,4,5-Trichlorocatechol	"	<	<	<	<	0.000005
3,4-Dichlorocatechol	"	<	<	<	<	<
3,5-Dichlorocatechol	"	<	<	<	<	<
4,5-Dichlorocatechol	"	<	<	<	<	0.000004
4-Chlorocatechol	"	<	<	<	<	<
Tetrachloroveratrole	"	<	<	<	<	<
3,4,5-Trichloroveratrole	"	<	<	<	<	0.000002
4,5-Dichloroveratrole	"	<	<	<	<	<
2,6-Dichlorosyringaldehyde	"	<	<	<	<	<
2-Chlorosyringaldehyde	"	<	<	<	<	<
3,4,5-Trichlorosyringol	"	<	<	<	<	<
Trichlorotrimethoxybenzene	"	<	<	<	<	<
5,6-Dichlorovanillin	"	<	<	<	<	<
6-Chlorovanillin	"	<	<	<	<	0.000006
Nonylphenol	"	<	<	<	<	<

Lab ID	Zenon	Zenon	Zenon	Zenon
Client ID	FR0212	FR0220	FR0259	FR0268
SITE	Mission	Mission	Mission	Mission
UNITS				
Sampled On:	93-12-27	94-01-25	94-02-22	94-03-22
Latitude (N)	49 - 8.18	49 - 8.18	49 - 8.18	49 - 8.18
Longitude (W)	122 - 16.80	122 - 16.80	122 - 16.80	122 - 16.80
ORGANIC PARAMETERS:				
Adsorbable Org. Halide (AOX)	mg/L	0.03	0.02	0.03
Chlorophenolics:				
Pentachlorophenol	mg/L	<	<	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	<	<	<
2,3,4,5-Tetrachlorophenol	"	<	<	<
3,4,5-Trichlorophenol	"	<	<	<
2,3,4-Trichlorophenol	"	<	<	<
2,3,5-Trichlorophenol	"	<	<	<
2,3,6-Trichlorophenol	"	<	<	<
2,4,5-Trichlorophenol	"	<	<	<
2,4,6-Trichlorophenol	"	0.000006	<	0.000004
2,4-Dichlorophenol	"	<	<	<
2,6-Dichlorophenol	"	<	<	<
2,5-Dichlorophenol	"	<	<	<
3,5-Dichlorophenol	"	<	<	<
2,3-Dichlorophenol	"	<	<	<
3,4-Dichlorophenol	"	<	<	<
4-Chlorophenol	"	<	<	<
Tetrachloroguaiacol	"	<	<	<
3,4,5-Trichloroguaiacol	"	0.000010	<	0.000005
3,4,6-Trichloroguaiacol	"	<	<	<
4,5,6-Trichloroguaiacol	"	<	<	0.000003
4,5-Dichloroguaiacol	"	0.000008	<	0.000007
4,6-Dichloroguaiacol	"	<	<	<
4-Chloroguaiacol	"	<	<	<
5-Chloroguaiacol	"	0.000006	<	<
6-Chloroguaiacol	"	<	<	<
Tetrachlorocatechol	"	<	<	<
3,4,5-Trichlorocatechol	"	0.000012	<	<
3,4-Dichlorocatechol	"	<	<	<
3,5-Dichlorocatechol	"	<	<	<
4,5-Dichlorocatechol	"	0.000008	<	0.000004
4-Chlorocatechol	"	<	<	<
Tetrachloroveratrole	"	<	<	<
3,4,5-Trichloroveratrole	"	0.000003	<	0.000002
4,5-Dichloroveratrole	"	<	<	<
2,6-Dichlorosyringaldehyde	"	<	<	<
2-Chlorosyringaldehyde	"	<	<	<
3,4,5-Trichlorosyringol	"	<	<	<
Trichlorotrimethoxybenzene	"	<	<	<
5,6-Dichlorovanillin	"	<	<	<
6-Chlorovanillin	"	0.000005	<	0.000004
Nonylphenol	"	<	<	<

Lab ID Client ID SITE		Zenon FR0046 Mission	Zenon FR0087 Mission	Zenon FR0177 Mission	Zenon FR0259 Mission
Sampled On:	UNITS	93-02-22	93-05-17	93-10-18	94-02-22
Latitude (N) Longitude (W)		49 - 8.18 122 - 16.8	49 - 8.18 122 - 16.80	49 - 8.18 122 - 16.80	49 - 8.18 122 - 16.80
ORGANIC PARAMETERS:					
Resin and Fatty Acids:					
Abietic Acid	mg/L	<	<	<	<
Arachidic Acid	"	<	<	<	<
Behenic Acid	"	<	<	<	<
Chlorodehydroabietic	"	<	<	<	<
Dehydroabietic Acid	"	<	<	<	<
Dichlorodehydroabietic	"	<	<	<	<
Isopimaric Acid	"	<	<	<	<
Lauric Acid	"	<	<	<	<
Levo Pimaric Acid	"	<	<	<	<
Lignoceric Acid	"	<	<	<	<
Linoleic Acid	"	<	<	<	<
Linolenic Acid	"	<	<	<	<
Myristic Acid	"	<	<	0.0005	<
Neobietic Acid	"	<	<	<	<
Oleic Acid	"	<	<	<	<
Palmitric Acid	"	<	<	0.0007	<
Palustric Acid	"	<	<	<	<
Pimaric Acid	"	<	<	<	<
Sandaraco Pimaric Acid	"	<	<	<	<
Stearic Acid	"	<	<	<	<
Antisapstain Compounds:					
TCMTB	mg/L	<	<	<	<
Organochlorine Pesticides and PCBs:					
Aldrin	mg/L	---	<	<	<
BHC alpha-	"	---	<	<	<
BHC beta-	"	---	<	<	<
BHC delta-	"	---	<	<	<
Chlordane alpha-	"	---	<	<	<
Chlordane gamma-	"	---	<	<	<
DDE p p'-	"	---	<	<	<
DDD p p'-	"	---	<	<	<
DDT p p'-	"	---	<	<	<
Dieldrin	"	---	<	<	<
Endosulfan I	"	---	<	<	<
Endosulfan II	"	---	<	<	<
Endosulfan sulphate	"	---	<	<	<
DDT o p'-	"	---	<	<	<
Endrin	"	---	<	<	<
Hexachlorobenzene	"	---	<	<	<
Heptachlor	"	---	<	<	<
Heptachlor epoxide	"	---	<	<	<
Lindane BHC gamma-	"	---	<	<	<
Methoxychlor	"	---	<	<	<
Mirex	"	---	<	<	<
Nonachlor trans-	"	---	<	<	<
Oxychlordane	"	---	<	<	<
Toxaphene	"	---	<	<	<
PCBs - Total	"	---	<	<	<

APPENDIX VIII

WATER QUALITY DATA FOR TILBURY ISLAND SITE

Minimum Detection Limits for Total Metals Analysis

Laboratory	Zenon MDL From: 93-01 To: 93-03	ASL MDL From: 93-04 To: 94-03	UNITS
Physical Tests:			
Dissolved Oxygen			mg/L
Water Temperature			deg C
Air Temperature			"
pH			"
Field pH			"
Specific Conductance(SC)	1	0.2	uS/cm
Field SC			uS/cm
Suspended Solids (NFR)	4	1	mg/L
Dissolved Solids (FR)	4	1	"
Hardness Total			mg/L CaCO3
Anions:			
Alkalinity Total @ pH 4.5	0.5	0.5	mg/L CaCO3
Chloride Dissolved	0.5	0.2	mg/L
Fluoride Dissolved	0.1	0.02	"
Sulfate	1	0.5	"
Nutrients:			
Nitrogen Amm.Diss(N)	0.005	0.005	mg N/L
Nitrogen Kjel.Tot(N)	0.04	0.05	"
Nitro NO3+NO2 D	0.02	0.005	"
Phosphorus Dissolved	0.003	0.001	mg P/L
Phosphorus Total	0.003	0.001	"
TOTAL METALS			
Aluminum	0.06	0.02	mg/L
Arsenic	0.001	0.0001	"
Barium	0.001	0.01	"
Cadmium	0.0001	0.0002	"
Calcium	0.05	0.05	"
Chromium	0.005	0.001	"
Cobalt	0.004	0.015	"
Copper	0.001	0.001	"
Iron	0.05	0.03	"
Lead	0.003	0.001	"
Magnesium	0.02	0.01	"
Manganese	0.002	0.005	"
Mercury	0.00005	0.00005	"
Molybdenum	0.004	0.001	"
Nickel	0.005	0.001	"
Potassium	0.4	2	"
Selenium	0.03	0.0005	"
Silver	0.03	0.0001	"
Sodium	0.4	2	"
Tin	0.02	0.3	"
Zinc	0.01	0.001	"
ORGANIC PARAMETERS			
Carbon Total Organic	0.5	0.5	mg/L

Minimum Detection Limits for Organic Analysis

Laboratory	Zenon			Zenon	
	MDL	UNITS		MDL	UNITS
ORGANIC PARAMETERS					
Adsorbable Organic Halide (AOX):	0.01	mg/L	Resin and Fatty Acids:		
Chlorophenolics:			Abietic Acid	0.0005	mg/L
Pentachlorophenol	0.000001	mg/L	Arachidic Acid	0.0005	"
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	"	Behenic Acid	0.0005	"
2,3,4,5-Tetrachlorophenol	"	"	Chlorodehydroabietic	0.0005	"
3,4,5-Trichlorophenol	"	"	Dehydroabietic Acid	0.0005	"
2,3,4-Trichlorophenol	"	"	Dichlorodehydroabietic	0.0005	"
2,3,5-Trichlorophenol	"	"	Isopimaric Acid	0.0005	"
2,3,6-Trichlorophenol	"	"	Lauric Acid	0.0005	"
2,4,5-Trichlorophenol	"	"	Levo Pimaric Acid	0.0005	"
2,4,6-Trichlorophenol	"	"	Lignoceric Acid	0.0005	"
2,4-Dichlorophenol	"	"	Linoleic Acid	0.0005	"
2,6-Dichlorophenol	"	"	Linolenic Acid	0.0005	"
2,5-Dichlorophenol	"	"	Myristic Acid	0.0005	"
3,5-Dichlorophenol	"	"	Neoabietic Acid	0.0005	"
2,3-Dichlorophenol	"	"	Oleic Acid	0.0005	"
3,4-Dichlorophenol	"	"	Palmitric Acid	0.0005	"
4-Chlorophenol	"	"	Palustric Acid	0.0005	"
Tetrachloroguaiacol	0.000002	"	Pimaric Acid	0.0005	"
3,4,5-Trichloroguaiacol	"	"	Sandaraco Pimaric Acid	0.0005	"
3,4,6-Trichloroguaiacol	"	"	Stearic Acid	0.0005	"
4,5,6-Trichloroguaiacol	"	"			
4,5-Dichloroguaiacol	"	"	Antisapstain Compounds:		
4,6-Dichloroguaiacol	"	"	TCMTB	0.005	mg/L
4-chloroguaiacol	"	"	Organochlorine Pesticides and PCBs:		
5-Chloroguaiacol	"	"	Aldrin	0.000001	mg/L
6-Chloroguaiacol	"	"	BHC alpha-	0.000001	"
Tetrachlorocatechol	"	"	BHC beta-	0.000001	"
3,4,5-Trichlorocatechol	"	"	BHC delta-	0.000001	"
3,4-Dichlorocatechol	"	"	Chlordane alpha-	0.000005	"
3,5-Dichlorocatechol	"	"	Chlordane gamma-	0.000005	"
4,5-Dichlorocatechol	"	"	DDE p p'-	0.000005	"
4-Chlorocatechol	"	"	DDD p p'-	0.000005	"
Tetrachloroveratrole	"	"	DDT p p'-	0.000005	"
3,4,5-Trichloroveratrole	"	"	Dieldrin	0.000005	"
4,5-Dichloroveratrole	"	"	Endosulfan I	0.000005	"
2,6-Dichlorosyringaldehyde	"	"	Endosulfan II	0.000005	"
2-Chlorosyringaldehyde	"	"	Endosulfan sulphate	0.00001	"
3,4,5-Trichlorosyringol	"	"	DDT o p'-	0.000005	"
Trichlorotrimethoxybenzene	"	"	Endrin	0.000005	"
5,6-Dichlorovanillin	"	"	Hexachlorobenzene	5E-07	"
6-Chlorovanillin	"	"	Heptachlor	0.000001	"
Nonylphenol	0.000005	"	Heptachlor epoxide	0.000002	"
			Lindane BHC gamma-	0.000001	"
			Methoxychlor	0.00001	"
			Mirex	0.00001	"
			Nonachlor trans-	0.000005	"
			Oxychlordane	0.000005	"
			Toxaphene	0.00005	"
			PCBs - Total	0.00002	"

- 1) All results are blank corrected
- 2) Organic analyses are not corrected for surrogate recoveries except for isotope dilution methods
- 3) MDL = Minimum Detectable Limit
- 4) <= Less than MDL

Lab ID	Zenon	Zenon	Zenon	Zenon	Zenon	ASL	ASL	ASL	
Client ID	FR0013	FR0016	FR0042	FR0061	FR0065	FR0069	FR0075	FR0088	
SITE	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	
UNITS				X-sec 3					
Sampled On:	93-01-26	93-02-10	93-02-22	93-03-09	93-03-22	93-04-19	93-05-03	93-05-18	
Latitude (N)	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	
Longitude (W)	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	
Physical Tests:									
Dissolved Oxygen	mg/L	12.8	12	12.6	8.8	-	11.4	10.8	11.2
Water Temperature	deg C	2	4	3	5.2	-	8.1	9.6	14
Air Temperature	"	4	4	5	8	-	12.2	10.8	25.2
pH		7.3	7.6	7.3	7.6	7.5	7.35	7.42	7.84
Field pH		7.3	7.05	7.15	7.45	-	7.45	7.25	7.6
Specific Conductance (SC)	uS/cm	284	951	4090	160	3440	140	135	114.0
Field SC	uS/cm	150	185	2000	100	-	95	77	88
Suspended Solids (NFR)	mg/L	35	35	9	53	10	88	59	685
Dissolved Solids (FR)	"	156	507	2370	96	1980	132	101	70
Hardness Total	mg/L CaCO3	66.8	120	384	56	346	60.1	54.6	102
Anions:									
Alkalinity Total @ pH 4.5	mg/L CaCO3	46.6	49.8	55.7	46	50.1	44.2	44	51.9
Chloride Dissolved	mg/L	44.3	233	1170	12.2	990	8	2.7	2.8
Fluoride Dissolved	"	<	<	0.11	<	0.12	0.06	0.04	0.04
Sulfate	"	15.5	38.9	166	14.6	132	8.6	6.7	70.8
Nutrients:									
Nitrogen Amm.Diss(N)	mg N/L	0.068	0.081	0.073	0.036	0.053	0.017	0.019	0.007
Nitrogen Kjel.Tot(N)	"	0.3	0.22	0.19	<	0.28	0.35	0.31	0.73
Nitro NO3+NO2 D	"	0.26	0.19	0.16	0.18	0.21	0.155	0.166	0.109
Phosphorus Dissolved	mg P/L	0.006	0.019	0.019	0.007	0.019	0.026	0.025	0.122
Phosphorus Total	"	0.063	0.041	0.032	0.082	0.034	0.217	0.103	0.774
TOTAL METALS:									
Aluminum	mg/L	1.12	0.52	<	0.97	0.23	3.81	0.5	8.4
Arsenic	"	<	0.001	0.001	0.001	<	0.0003	0.0007	0.0025
Barium	"	0.02	0.015	0.014	0.02	0.015	0.05	0.024	0.112
Cadmium	"	<	<	<	<	<	<0.0002	<0.0002	<0.0002
Calcium	"	16.1	18.7	39.3	14.8	34.7	15.3	15.5	17.2
Chromium	"	<	<	<	<	<	0.007	0.001	0.018
Cobalt	"	<	<	<	<	<	<0.015	<0.015	<0.015
Copper	"	0.004	0.002	<	0.005	0.006	0.008	0.004	0.016
Iron	"	1.34	0.99	0.18	1.74	0.45	4.94	0.61	13.7
Lead	"	<	<	<	<	0.003	0.002	<0.001	0.002
Magnesium	"	6.45	17.8	69.4	4.63	63.1	4.32	3.83	5.43
Manganese	"	0.041	0.032	0.022	0.052	0.022	0.119	0.059	-
Mercury	"	<	<	<	<	<	<0.00005	<0.00005	<0.00005
Molybdenum	"	<	<	<	<	<	<0.001	<0.001	<0.001
Nickel	"	<	<	<	<	<	0.007	0.003	0.023
Potassium	"	1.8	5.2	20.2	1.1	18.9	<2	<2	<2
Selenium	"	<	<	<	<	<	<0.0005	<0.0005	<0.0005
Silver	"	<	<	<	<	<	<0.0001	<0.0001	<0.0001
Sodium	"	25.3	117	574	9	495	7.3	3.5	2.8
Tin	"	<	0.03	0.04	<	<	<0.30	<0.30	<0.3
Zinc	"	<	<	<	<	0.07	0.027	<0.005	0.041
BACTERIOLOGICAL:									
Fecal Coliform	MPN/100 m	7000	11000	8000	1300	5000	1700	50	80
ORGANIC PARAMETERS:									
Total Organic Carbon	mg/L	3.0	3.0	1.0	3.0	4.0	4.1	5.0	3.8

Lab ID	ASL	ASL	ASL	ASL	ASL	ASL	
Client ID	FR0093	FR0112	FR0116	FR0120	FR0122	FR0126	
SITE	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	
UNITS	X-sec 3						
Sampled On:	93-05-31	93-06-15	93-06-29	93-07-13	93-07-26	93-08-09	
Latitude (N)	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	
Longitude (W)	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	
Physical Tests:							
Dissolved Oxygen	mg/L	10.4	10.4	9.8	9.5	9.0	9.1
Water Temperature	deg C	14.2	14.2	16.0	16.5	17.5	19.0
Air Temperature	"	17.1	17.1	18.1	18.5	16.0	18.2
pH		7.66	7.84	7.50	7.90	7.50	7.46
Field pH		7.5	7.4	7.6	7.7	7.4	7.5
Specific Conductance (SC)	uS/cm	89.1	94.5	100.0	117.0	107.0	104.0
Field SC	uS/cm	70	67	75	82	100	98
Suspended Solids (NFR)	mg/L	158	60	62	72	44	39
Dissolved Solids (FR)	"	44	52	53	54	55	56
Hardness Total	mg/L CaCO3	43.6	47.9	48.2	43.7	48.4	51
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	36.5	37.5	43.2	44.4	45.1	44.8
Chloride Dissolved	mg/L	1.1	1.5	0.6	1.3	1.1	1.5
Fluoride Dissolved	"	0.03	0.04	0.04	0.04	0.04	0.03
Sulfate	"	5.7	8.1	6.9	8.3	6.7	6.7
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	<0.005	0.005	0.021	0.012	0.005	0.007
Nitrogen Kjel.Tot(N)	"	0.15	0.15	0.18	0.14	0.15	0.23
Nitro NO3+NO2 D	"	0.069	0.077	0.058	0.052	0.043	0.029
Phosphorus Dissolved	mg P/L	0.007	0.009	0.002	0.008	0.006	0.027
Phosphorus Total	"	0.078	0.071	0.056	0.087	0.021	0.036
TOTAL METALS:							
Aluminum	mg/L	0.7	0.45	0.46	0.46	0.42	0.46
Arsenic	"	0.0006	0.0004	0.0005	0.0004	0.0006	0.0004
Barium	"	0.023	0.02	0.02	0.02	0.02	0.20
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002
Calcium	"	12.9	14.4	14.50	12.00	14.20	14.90
Chromium	"	0.001	<0.001	<0.001	<0.001	0.001	0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.003	0.002	0.003	0.002	0.002	0.002
Iron	"	-	0.50	0.52	0.65	0.67	0.51
Lead	"	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	"	2.77	2.86	2.91	3.33	3.15	3.35
Manganese	"	0.046	0.037	0.038	0.048	0.035	0.032
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	0.002	0.002	0.001	0.003	0.002	0.004
Potassium	"	<2	<2	<2	<2	<2	<2
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	<2	2.0	2.2	2.9	2.5	2.6
Tin	"	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc	"	<0.005	<0.005	<0.005	<0.005	0.008	0.004
BACTERIOLOGICAL:							
Fecal Coliform	MPN/100 m	50	70	80	23	<2	30
ORGANIC PARAMETERS:							
Total Organic Carbon	mg/L	2.3	2.1	2.6	2.8	2.7	3.4

Lab ID	ASL	ASL	ASL	ASL	ASL	ASL	
Client ID	FR0143	FR0152	FR0154	FR0173	FR0174A	FR0181	
SITE	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	
UNITS	Replicate			X-sec 3			
Sampled On:	93-08-24	93-09-07	93-09-20	93-10-05	93-10-18	93-11-01	
Latitude (N)	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	
Longitude (W)	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	
Physical Tests:							
Dissolved Oxygen	mg/L	9.0	9.2	9.2	9.4	10.4	9.3
Water Temperature	deg C	17.2	18.2	15	14.2	12	9.4
Air Temperature	"	15.8	16.2	11	12	11.9	9
pH		7.71	7.68	7	7.43	7.6	7.63
Field pH		7.5	7.4	7.5	7.65	7.5	7.35
Specific Conductance (SC)	uS/cm	104.0	106.0	119	130	132	140
Field SC	uS/cm	88	109	225	123	200	191
Suspended Solids (NFR)	mg/L	35	16	16	7	21	9
Dissolved Solids (FR)	"	56	60	59	70	71	71
Hardness Total	mg/L CaCO3	50.7	51.9	48.3	57	58.6	59.9
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	41	43.9	42.6	48.9	48.2	49.4
Chloride Dissolved	mg/L	1.8	1.7	1.4	4.1	5.2	3.9
Fluoride Dissolved	"	0.04	0.03	0.03	0.03	0.06	0.04
Sulfate	"	8.2	8.7	9.3	10.8	10.8	11
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	0.009	0.015	0.011	0.027	0.039	0.031
Nitrogen Kjel.Tot(N)	"	0.23	0.16	0.154	0.228	0.169	0.17
Nitro NO3+NO2 D	"	0.025	0.034	0.035	0.046	0.054	0.07
Phosphorus Dissolved	mg P/L	0.020	0.011	0.011	0.011	0.015	0.013
Phosphorus Total	"	0.043	0.027	0.034	0.024	0.037	0.027
TOTAL METALS:							
Aluminum	mg/L	0.30	<0.2	<0.20	<0.20	<0.20	<0.20
Arsenic	"	0.0005	0.0003	0.0003	0.0005	0.0004	0.0005
Barium	"	0.02	0.02	0.016	0.017	0.014	0.016
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	15.40	15.50	15.3	16.6	17.1	17.3
Chromium	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.002	0.001	<0.001	0.002	<0.001	<0.001
Iron	"	0.34	0.21	0.2	0.202	0.145	0.179
Lead	"	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Magnesium	"	2.97	3.19	3.22	3.79	3.86	4.09
Manganese	"	0.024	0.016	0.018	0.015	0.016	0.014
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Potassium	"	<2	<2	<2	<2.0	<2.0	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	3	3	4	5.1	5.5	5.3
Tin	"	<0.3	<0.3	<0.30	<0.30	<0.30	<0.30
Zinc	"	<0.005	0.003	<0.001	0.006	<0.001	0.004
BACTERIOLOGICAL:							
Fecal Coliform	MPN/100 m	500	17	130	30	2300	230
ORGANIC PARAMETERS:							
Total Organic Carbon	mg/L	2.0	1.8	1.7	2.3	2.0	2.5

Lab ID	ASL	ASL	ASL	ASL	ASL	ASL
Client ID	FR0188	FR0189	FR0207	FR0213	FR0215	FR221
SITE	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury	Tilbury
UNITS						
Sampled On:	93-11-16	93-11-29	93-12-13	93-12-28	94-01-10	94-01-25
Latitude (N)	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86
Longitude (W)	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93
Physical Tests:						
Dissolved Oxygen	mg/L	10.6	12.4	11.6	11.8	12.2
Water Temperature	deg C	5.5	3	4.8	2.8	4.9
Air Temperature	"	3	6	6	1	6.5
pH		7.46	7.85	7.5	7.26	7.37
Field pH		7.4	7.35	7.4	7.4	7.3
Specific Conductance (SC)	uS/cm	463	699	131	700	1420
Field SC	uS/cm	280	450	70	431	800
Suspended Solids (NFR)	mg/L	57	27	44	31	15
Dissolved Solids (FR)	"	238	432	88	371	820
Hardness Total	mg/L CaCO3	91.9	108	47	109	186
Anions:						
Alkalinity Total @ pH 4.5	mg/L CaCO3	49.7	45.9	38.6	43.2	41.2
Chloride Dissolved	mg/L	98.6	164	10.4	174	398
Fluoride Dissolved	"	0.06	0.06	0.04	0.04	0.05
Sulfate	"	22.5	31.5	9	32.1	59.4
Nutrients:						
Nitrogen Amm.Diss(N)	mg N/L	0.059	0.056	0.096	0.047	0.055
Nitrogen Kjel.Tot(N)	"	0.345	0.23	0.353	0.235	0.229
Nitro NO3+NO2 D	"	0.124	0.17	0.347	0.177	0.279
Phosphorus Dissolved	mg P/L	0.012	0.027	0.039	0.015	0.024
Phosphorus Total	"	0.08	0.068	0.061	0.05	0.038
TOTAL METALS:						
Aluminum	mg/L	0.51	0.2	1.02	<0.20	<0.20
Arsenic	"	0.0004	0.0005	0.0007	0.0005	0.0005
Barium	"	0.019	0.015	0.021	0.014	0.011
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	19.2	18.9	12.5	19	19.6
Chromium	"	0.001	<0.001	0.001	<0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.003	0.002	0.003	0.001	0.002
Iron	"	0.698	0.389	1.02	0.113	0.285
Lead	"	<0.001	<0.001	0.001	<0.001	<0.001
Magnesium	"	10.6	15	3.82	14.9	33.2
Manganese	"	0.047	0.025	0.047	0.01	0.02
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	0.001	0.001
Nickel	"	<0.001	0.002	0.002	0.001	0.002
Potassium	"	2.6	3.9	<2.0	4	9.9
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	55	95.6	8	99.4	220
Tin	"	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.005	0.002	0.006	<0.001	0.005
BACTERIOLOGICAL:						
Fecal Coliform	MPN/100 m	8000	500	8000	5000	11000
ORGANIC PARAMETERS:						
Total Organic Carbon	mg/L	3.9	2.4	2.6	2.1	2.0

Lab ID		ASL	ASL	ASL	ASL
Client ID		FR0237	FR0256	FR0263	FR0269
SITE		Tilbury	Tilbury	Tilbury	Tilbury
	UNITS	X-sec 3			
Sampled On:		94-02-08	94-02-21	94-03-07	94-03-22
Latitude (N)		49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86
Longitude (W)		123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93
Physical Tests:					
Dissolved Oxygen	mg/L	12.2	12.2	12.3	11.4
Water Temperature	deg C	2.2	4.2	4.8	4.9
Air Temperature	"	-1	1	6.5	5.5
pH		7.58	7.33	7.53	7.55
Field pH		7.55	7.45	7.55	7.45
Specific Conductance (SC)	uS/cm	3730	2900	215	203
Field SC	uS/cm	2200	1700	145	130
Suspended Solids (NFR)	mg/L	6	17	85	39
Dissolved Solids (FR)	"	2400	1800	134	130
Hardness Total	mg/L CaCO3	394	299	54.5	60.6
Anions:					
Alkalinity Total @ pH 4.5	mg/L CaCO3	45.4	43.3	38.6	47
Chloride Dissolved	mg/L	1100	830	33.6	25.9
Fluoride Dissolved	"	0.1	0.21	0.04	0.05
Sulfate	"	157	119	11.9	11.3
Nutrients:					
Nitrogen Amm.Diss(N)	mg N/L	0.055	0.069	0.024	0.024
Nitrogen Kjel.Tot(N)	"	0.19	0.315	0.27	0.17
Nitro NO3+NO2 D	"	0.183	0.264	0.235	0.182
Phosphorus Dissolved	mg P/L	0.023	0.017	0.014	0.043
Phosphorus Total	"	0.033	0.05	0.067	0.101
TOTAL METALS:					
Aluminum	mg/L	<0.20	<0.20	0.72	0.56
Arsenic	"	0.0006	0.0005	0.0008	0.0007
Barium	"	0.011	0.011	0.026	0.024
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	33.8	26.8	13	15.1
Chromium	"	0.002	<0.001	0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015
Copper	"	0.002	0.005	0.004	0.003
Iron	"	0.347	0.442	0.917	0.62
Lead	"	<0.001	<0.005	<0.001	<0.001
Magnesium	"	75.3	56.5	5.37	5.54
Manganese	"	0.014	0.019	0.056	0.037
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	0.001	<0.005	<0.001	<0.001
Nickel	"	0.001	0.002	0.004	0.002
Potassium	"	21.4	16.4	<2.0	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	0.0001	<0.001	<0.0001	<0.0001
Sodium	"	577	435	20.2	17.5
Tin	"	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.006	0.02	0.007	0.003
BACTERIOLOGICAL:					
Fecal Coliform	MPN/100 m	6000	5000	230	150
ORGANIC PARAMETERS:					
Total Organic Carbon	mg/L	3.2	1.7	2.4	3.3

Lab ID Client ID SITE		Zenon FR0013 Tilbury	Zenon FR0042 Tilbury	Zenon FR0065 Tilbury	Zenon FR0069 Tilbury	Zenon FR0088 Tilbury	Zenon FR0112 Tilbury	Zenon FR0120 Tilbury
Sampled On:	UNITS	93-01-26	93-02-22	93-03-22	93-04-19	93-05-18	93-06-15	93-07-13
Latitude (N) Longitude (W)		49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93
ORGANIC PARAMETERS: Adsorbable Org. Halide (AOX)	mg/L	0.03	0.04	0.03	0.02	0.01	<0.01	<0.01
Chlorophenolics:								
Pentachlorophenol	mg/L	<	<	<	<	<	0.000005	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	<	<	<	<	<	<	<
2,3,4,5-Tetrachlorophenol	"	<	<	<	<	<	<	<
3,4,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,4-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,6-Trichlorophenol	"	<	<	<	<	<	<	<
2,4,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,4,6-Trichlorophenol	"	<	<	<	<	<	0.000003	<
2,4-Dichlorophenol	"	<	<	<	<	<	<	<
2,6-Dichlorophenol	"	<	<	<	<	<	<	<
2,5-Dichlorophenol	"	<	<	<	<	<	<	<
3,5-Dichlorophenol	"	<	<	<	<	<	<	<
2,3-Dichlorophenol	"	<	<	<	<	<	<	<
3,4-Dichlorophenol	"	<	<	<	<	<	<	<
4-Chlorophenol	"	<	<	<	<	<	<	<
Tetrachloroguaiacol	"	<	<	<	<	<	<	<
3,4,5-Trichloroguaiacol	"	0.000012	0.000007	<	0.000005	<	<	<
3,4,6-Trichloroguaiacol	"	<	<	<	<	<	<	<
4,5,6-Trichloroguaiacol	"	<	0.000003	<	0.000003	0.000070	<	<
4,5-Dichloroguaiacol	"	0.000013	0.000013	<	0.000003	0.000002	0.000005	<
4,6-Dichloroguaiacol	"	<	<	<	<	<	<	<
4-Chloroguaiacol	"	<	<	<	<	<	<	<
5-Chloroguaiacol	"	<	<	<	<	0.000006	0.000008	<
6-Chloroguaiacol	"	<	<	<	<	<	<	<
Tetrachlorocatechol	"	<	0.000002	<	0.000003	0.000008	0.000002	<
3,4,5-Trichlorocatechol	"	0.000012	0.000006	<	0.000006	0.000007	0.000003	<
3,4-Dichlorocatechol	"	<	<	<	<	<	<	<
3,5-Dichlorocatechol	"	<	<	<	<	<	<	<
4,5-Dichlorocatechol	"	<	0.000006	<	<	<	0.000003	<
4-Chlorocatechol	"	<	<	<	<	<	<	<
Tetrachloroveratrole	"	<	<	<	<	<	<	<
3,4,5-Trichloroveratrole	"	0.000005	0.000005	<	0.000002	<	<	<
4,5-Dichloroveratrole	"	<	<	<	<	<	<	<
2,6-Dichlorosyringaldehyde	"	<	<	<	<	<	<	<
2-Chlorosyringaldehyde	"	<	<	<	<	<	<	<
3,4,5-Trichlorosyringol	"	<	<	<	<	<	<	<
Trichlorotrimethoxybenzene	"	<	<	<	<	<	<	<
5,6-Dichlorovanillin	"	0.000004	0.000002	<	<	<	<	<
6-Chlorovanillin	"	0.000008	0.000008	<	0.000004	<	<	<
Nonylphenol	"	<	<	<	<	<	<	<

Lab ID Client ID SITE		Zenon FR0126 Tilbury	Zenon FR0152 Tilbury	Zenon FR0173 Tilbury X-sec 3	Zenon FR0174A Tilbury	Zenon FR0189 Tilbury	Zenon FR0213 Tilbury	Zenon FR221 Tilbury
Sampled On:	UNITS	93-08-09	93-09-07	93-10-05	93-10-18	93-11-29	93-12-28	94-01-25
Latitude (N) Longitude (W)		49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93
ORGANIC PARAMETERS: Adsorbable Org. Halide (AOX)	mg/L	<	<0.01	0.02	—	0.02	0.02	0.02
Chlorophenolics:								
Pentachlorophenol	mg/L	<	<	<	<	<	<	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	<	<	<	<	0.000002	0.000004	<
2,3,4,5-Tetrachlorophenol	"	<	<	<	<	<	<	<
3,4,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,4-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,6-Trichlorophenol	"	<	<	<	<	<	<	<
2,4,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,4,6-Trichlorophenol	"	<	<	<	<	0.000004	0.000004	<
2,4-Dichlorophenol	"	<	<	<	<	<	<	<
2,6-Dichlorophenol	"	<	<	<	<	<	<	<
2,5-Dichlorophenol	"	<	<	<	<	<	<	<
3,5-Dichlorophenol	"	<	<	<	<	<	0.000001	<
2,3-Dichlorophenol	"	<	<	<	<	<	<	<
3,4-Dichlorophenol	"	<	<	<	<	<	<	<
4-Chlorophenol	"	<	<	<	<	<	<	<
Tetrachloroguaiacol	"	<	<	<	<	0.000002	0.000002	<
3,4,5-Trichloroguaiacol	"	<	<	<	<	0.000007	0.000007	<
3,4,6-Trichloroguaiacol	"	<	<	<	<	<	<	<
4,5,6-Trichloroguaiacol	"	<	<	<	<	<	<	<
4,5-Dichloroguaiacol	"	<	<	0.000002	<	<	0.000007	<
4,6-Dichloroguaiacol	"	<	<	<	<	<	<	<
4-Chloroguaiacol	"	<	<	<	<	<	<	<
5-Chloroguaiacol	"	<	<	<	<	<	0.000007	<
6-Chloroguaiacol	"	<	<	<	<	<	<	<
Tetrachlorocatechol	"	<	0.000002	<	<	<	<	<
3,4,5-Trichlorocatechol	"	<	<	<	<	0.000006	0.000011	<
3,4-Dichlorocatechol	"	<	<	<	<	<	<	<
3,5-Dichlorocatechol	"	<	<	<	<	<	<	<
4,5-Dichlorocatechol	"	<	<	<	<	0.000007	0.000008	<
4-Chlorocatechol	"	<	<	<	<	<	<	<
Tetrachloroveratrole	"	<	<	<	<	<	<	<
3,4,5-Trichloroveratrole	"	<	<	<	<	0.000003	0.000003	<
4,5-Dichloroveratrole	"	<	<	<	<	<	<	<
2,6-Dichlorosyringaldehyde	"	<	<	<	<	<	<	<
2-Chlorosyringaldehyde	"	<	<	<	<	<	<	<
3,4,5-Trichlorosyringol	"	<	<	<	<	<	<	<
Trichlorotrimethoxybenzene	"	<	<	<	<	<	<	<
5,6-Dichlorovanillin	"	<	<	<	<	<	<	<
6-Chlorovanillin	"	<	<	<	<	<	0.000004	<
Nonylphenol	"	<	<	<	<	<	<	<

Lab ID Client ID SITE		Zenon FR0256 Tilbury	Zenon FR0269 Tilbury
Sampled On:	UNITS	94-02-21	94-03-22
Latitude (N) Longitude (W)		49 - 8.86 123 - 1.93	49 - 8.86 123 - 1.93
ORGANIC PARAMETERS: Adsorbable Org. Halide (AOX)	mg/L	0.03	0.02
Chlorophenolics:			
Pentachlorophenol	mg/L	<	0.000006
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	<	0.000002
2,3,4,5-Tetrachlorophenol	"	<	<
3,4,5-Trichlorophenol	"	<	<
2,3,4-Trichlorophenol	"	<	<
2,3,5-Trichlorophenol	"	<	<
2,3,6-Trichlorophenol	"	<	<
2,4,5-Trichlorophenol	"	<	<
2,4,6-Trichlorophenol	"	0.000002	0.000003
2,4-Dichlorophenol	"	<	<
2,6-Dichlorophenol	"	<	<
2,5-Dichlorophenol	"	<	<
3,5-Dichlorophenol	"	<	<
2,3-Dichlorophenol	"	<	<
3,4-Dichlorophenol	"	<	<
4-Chlorophenol	"	<	<
Tetrachloroguaiacol	"	<	<
3,4,5-Trichloroguaiacol	"	<	0.000004
3,4,6-Trichloroguaiacol	"	<	<
4,5,6-Trichloroguaiacol	"	<	<
4,5-Dichloroguaiacol	"	0.000003	0.000006
4,6-Dichloroguaiacol	"	<	<
4-Chloroguaiacol	"	<	<
5-Chloroguaiacol	"	<	<
6-Chloroguaiacol	"	<	<
Tetrachlorocatechol	"	<	0.000004
3,4,5-Trichlorocatechol	"	<	<
3,4-Dichlorocatechol	"	<	<
3,5-Dichlorocatechol	"	<	<
4,5-Dichlorocatechol	"	0.000003	0.000004
4-Chlorocatechol	"	<	<
Tetrachloroveratrole	"	<	<
3,4,5-Trichloroveratrole	"	<	<
4,5-Dichloroveratrole	"	<	<
2,6-Dichlorosyringaldehyde	"	<	<
2-Chlorosyringaldehyde	"	<	<
3,4,5-Trichlorosyringol	"	<	<
Trichlorotrimethoxybenzene	"	<	<
5,6-Dichlorovanillin	"	<	<
6-Chlorovanillin	"	0.000002	0.000004
Nonylphenol	"	<	<

Lab ID Client ID SITE		Zenon FR0042 Tilbury	Zenon FR0088 Tilbury	Zenon FR0174A Tilbury	Zenon FR0256 Tilbury
	UNITS				
Sampled On:		93-02-22	93-05-18	93-10-18	94-02-21
Latitude (N)		49 - 8.86	49 - 8.86	49 - 8.86	49 - 8.86
Longitude (W)		123 - 1.93	123 - 1.93	123 - 1.93	123 - 1.93
Resin and Fatty Acids:					
Abietic Acid	mg/L	<	<	<	<
Arachidic Acid	"	<	<	<	<
Behenic Acid	"	<	<	<	<
Chlorodehydroabietic	"	<	<	<	<
Dehydroabietic Acid	"	<	<	<	<
Dichlorodehydroabietic	"	<	<	<	<
Isopimaric Acid	"	<	<	<	<
Lauric Acid	"	<	<	<	<
Levo Pimaric Acid	"	<	<	<	<
Lignoceric Acid	"	<	<	<	<
Linoleic Acid	"	<	<	0.0009	0.0005
Linolenic Acid	"	<	<	<	<
Myristic Acid	"	<	<	<	<
Neoabietic Acid	"	<	<	<	<
Oleic Acid	"	<	<	<	0.0018
Palmitric Acid	"	<	<	0.001	0.0033
Palustric Acid	"	<	<	<	<
Pimaric Acid	"	<	<	<	<
Sandaraco Pimaric Acid	"	<	<	<	<
Stearic Acid	"	<	<	0.0005	0.0034
Antisapstain Compounds:					
TCMTB	mg/L	<	<	<	<
Organochlorine Pesticides and PCBs:					
Aldrin	mg/L	--	<	<	<
BHC alpha-	"	--	<	<	<
BHC beta-	"	--	<	<	<
BHC delta-	"	--	<	<	<
Chlordane alpha-	"	--	<	<	<
Chlordane gamma-	"	--	<	<	<
DDE p p'-	"	--	<	<	<
DDD p p'-	"	--	<	<	<
DDT p p'-	"	--	<	<	<
Dieldrin	"	--	<	<	<
Endosulfan I	"	--	<	<	<
Endosulfan II	"	--	<	<	<
Endosulfan sulphate	"	--	<	<	<
DDT o p'-	"	--	<	<	<
Endrin	"	--	<	<	<
Hexachlorobenzene	"	--	<	<	<
Heptachlor	"	--	<	<	<
Heptachlor epoxide	"	--	<	<	<
Lindane BHC gamma-	"	--	<	<	<
Methoxychlor	"	--	<	<	<
Mirex	"	--	<	<	<
Nonachlor trans-	"	--	<	<	<
Oxychlordane	"	--	<	<	<
Toxaphene	"	--	<	<	<
PCBs - Total	"	--	<	<	<

APPENDIX IX

WATER QUALITY DATA FOR OAK STREET BRIDGE SITE

Minimum Detection Limits for Total Metals Analysis

Laboratory	Zenon	ASL	UNITS
	MDL	MDL	
	From: 93-01 To: 93-03	From: 93-04 To: 94-03	
Physical Tests:			
Dissolved Oxygen			mg/L
Water Temperature			deg C
Air Temperature			"
pH			"
Field pH			"
Specific Conductance(SC)	1	0.2	uS/cm
Field SC			uS/cm
Suspended Solids (NFR)	4	1	mg/L
Dissolved Solids (FR)	4	1	"
Hardness Total			mg/L CaCO3
Anions:			
Alkalinity Total @ pH 4.5	0.5	0.5	mg/L CaCO3
Chloride Dissolved	0.5	0.2	mg/L
Fluoride Dissolved	0.1	0.02	"
Sulfate	1	0.5	"
Nutrients:			
Nitrogen Amm.Diss(N)	0.005	0.005	mg N/L
Nitrogen Kjel.Tot(N)	0.04	0.05	"
Nitro NO3+NO2 D	0.02	0.005	"
Phosphorus Dissolved	0.003	0.001	mg P/L
Phosphorus Total	0.003	0.001	"
TOTAL METALS			
Aluminum	0.06	0.02	mg/L
Arsenic	0.001	0.0001	"
Barium	0.001	0.01	"
Cadmium	0.0001	0.0002	"
Calcium	0.05	0.05	"
Chromium	0.005	0.001	"
Cobalt	0.004	0.015	"
Copper	0.001	0.001	"
Iron	0.05	0.03	"
Lead	0.003	0.001	"
Magnesium	0.02	0.01	"
Manganese	0.002	0.005	"
Mercury	0.00005	0.00005	"
Molybdenum	0.004	0.001	"
Nickel	0.005	0.001	"
Potassium	0.4	2	"
Selenium	0.03	0.0005	"
Silver	0.03	0.0001	"
Sodium	0.4	2	"
Tin	0.02	0.3	"
Zinc	0.01	0.001	"
ORGANIC PARAMETERS			
Carbon Total Organic	0.5	0.5	mg/L

Minimum Detection Limits for Organic Analysis

Laboratory	Zenon			Zenon	
ORGANIC PARAMETERS	MDL	UNITS		MDL	UNITS
Adsorbable Organic Halide (AOX):	0.01	mg/L	Resin and Fatty Acids:		
Chlorophenolics:			Abietic Acid	0.0005	mg/L
Pentachlorophenol	0.000001	mg/L	Arachidic Acid	0.0005	"
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	"	Behenic Acid	0.0005	"
2,3,4,5-Tetrachlorophenol	"	"	Chlorodehydroabietic	0.0005	"
3,4,5-Trichlorophenol	"	"	Dehydroabietic Acid	0.0005	"
2,3,4-Trichlorophenol	"	"	Dichlorodehydroabietic	0.0005	"
2,3,5-Trichlorophenol	"	"	Isopimaric Acid	0.0005	"
2,3,6-Trichlorophenol	"	"	Lauric Acid	0.0005	"
2,4,5-Trichlorophenol	"	"	Levo Pimaric Acid	0.0005	"
2,4,6-Trichlorophenol	"	"	Lignoceric Acid	0.0005	"
2,4-Dichlorophenol	"	"	Linoleic Acid	0.0005	"
2,6-Dichlorophenol	"	"	Linolenic Acid	0.0005	"
2,5-Dichlorophenol	"	"	Myristic Acid	0.0005	"
3,5-Dichlorophenol	"	"	Neoabietic Acid	0.0005	"
2,3-Dichlorophenol	"	"	Oleic Acid	0.0005	"
3,4-Dichlorophenol	"	"	Palmitric Acid	0.0005	"
4-Chlorophenol	"	"	Palustric Acid	0.0005	"
Tetrachloroguaiacol	0.000002	"	Pimaric Acid	0.0005	"
3,4,5-Trichloroguaiacol	"	"	Sandaraco Pimaric Acid	0.0005	"
3,4,6-Trichloroguaiacol	"	"	Stearic Acid	0.0005	"
4,5,6-Trichloroguaiacol	"	"			
4,5-Dichloroguaiacol	"	"	Antisapstain Compounds:		
4,6-Dichloroguaiacol	"	"	TCMTB	0.005	mg/L
4-chloroguaiacol	"	"	Organochlorine Pesticides and PCBs:		
5-Chloroguaiacol	"	"	Aldrin	0.000001	mg/L
6-Chloroguaiacol	"	"	BHC alpha-	0.000001	"
Tetrachlorocatechol	"	"	BHC beta-	0.000001	"
3,4,5-Trichlorocatechol	"	"	BHC delta-	0.000001	"
3,4-Dichlorocatechol	"	"	Chlordane alpha-	0.000005	"
3,5-Dichlorocatechol	"	"	Chlordane gamma-	0.000005	"
4,5-Dichlorocatechol	"	"	DDE p p'-	0.000005	"
4-Chlorocatechol	"	"	DDD p p'-	0.000005	"
Tetrachloroveratrole	"	"	DDT p p'-	0.000005	"
3,4,5-Trichloroveratrole	"	"	Dieldrin	0.000005	"
4,5-Dichloroveratrole	"	"	Endosulfan I	0.000005	"
2,6-Dichlorosyringaldehyde	"	"	Endosulfan II	0.000005	"
2-Chlorosyringaldehyde	"	"	Endosulfan sulphate	0.00001	"
3,4,5-Trichlorosyringol	"	"	DDT o p'-	0.000005	"
Trichlorotrimethoxybenzene	"	"	Endrin	0.000005	"
5,6-Dichlorovanillin	"	"	Hexachlorobenzene	5E-07	"
6-Chlorovanillin	"	"	Heptachlor	0.000001	"
Nonylphenol	0.000005	"	Heptachlor epoxide	0.000002	"
			Lindane BHC gamma-	0.000001	"
			Methoxychlor	0.00001	"
			Mirex	0.00001	"
			Nonachlor trans-	0.000005	"
			Oxychlordane	0.000005	"
			Toxaphene	0.00005	"
			PCBs - Total	0.00002	"

- 1) All results are blank corrected
- 2) Organic analyses are not corrected for surrogate recoveries except for isotope dilution methods
- 3) MDL = Method Detectable Limit
- 4) <= Less than MDL

Lab ID Client ID SITE	Units	Zenon FR0001 Oak	Zenon FR14 Oak	Zenon FR0048 Oak	Zenon FR0053 Oak X-sec 3	Zenon FR0067 Oak	ASL FR0073 Oak	ASL FR0078 Oak	ASL FR0084 Oak
Sampled On:		93-01-25	93-02-09	93-02-23	93-03-08	93-03-23	93-04-20	93-05-04	93-05-17
Latitude (N) Longitude (W)		49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15
Physical Tests:									
Dissolved Oxygen	mg/L	11.2	12	12.4	10.4		11.3	10.8	10.4
Water Temperature	deg C	3	6	5	6		9.1	10	13.5
Air Temperature	"	5	11	8	7		11	15	22.5
pH		7.4	7.4	7.6	7.6	7.3	7.46	6.91	7.50
Field pH		7	7.05	7.15	7.3		7.25	7.25	7.1
Specific Conductance (SC)	uS/cm	4220	5700	6360	5260	1320	115	118	97.3
Field SC	uS/cm	2200	3200	3400	98		80	73	80
Suspended Solids (NFR)	mg/L	16	22	14	18	32	76	55	224
Dissolved Solids (FR)	"	2460	2580	3830	3030	725	60	55	64
Hardness Total (Calc.)	mg/L CaCO3	456	580	634	548	147	50.1	48.3	62.2
Anions:									
Alkalinity Total @ pH 4.5	mg/L CaCO3	54.8	51.7	58.7	58.2	45.0	40.1	41.2	47.8
Chloride Dissolved	mg/L	1220	1700	1920	1520	343	4.6	3.2	2.7
Fluoride Dissolved	"	0.14	0.15	0.16	0.16	< 0.10	0.04	0.03	0.04
Sulfate	"	190	315	274	203	52.2	8.7	5.8	10.9
Nutrients:									
Nitrogen Amm.Diss(N)	mg N/L	0.089	0.042	0.089	0.054	0.061	<0.005	0.018	0.011
Nitrogen Kjel.Tot(N)	"	0.32	0.28	0.24	0.25	0.3	0.28	0.27	0.4
Nitro NO3+NO2 D	"	0.27	0.24	0.17	0.17	0.25	0.15	0.172	0.111
Phosphorus Dissolved	mg P/L	0.018	0.009	0.015	0.018	0.029	0.03	0.023	0.04
Phosphorus Total	"	0.062	0.046	0.034	0.042	0.074	0.14	0.088	0.23
TOTAL METALS									
Aluminum	mg/L	0.27	0.33	0.19	0.1	0.24	1.86	0.45	3.37
Arsenic	"	0.001	0.001	0.001	<	0.001	0.0004	0.0006	0.0013
Barium	"	0.019	0.014	0.019	0.019	0.016	0.032	0.015	0.051
Cadmium	"	<	0.0001	<	<	<	<0.0002	<0.0002	<0.0002
Calcium	"	49.3	47.5	54.3	47.8	19.7	13.5	13.8	14.4
Chromium	"	<	<	<	<	<	0.003	0.001	0.007
Cobalt	"	<	<	<	<	<	<0.015	<0.015	<0.015
Copper	"	0.004	0.002	<	0.004	0.004	0.006	0.004	0.008
Iron	"	0.588	0.7	0.52	0.41	0.57	2.27	0.47	5.48
Lead	"	<	<	<	<	<	0.001	<0.001	0.001
Magnesium	"	80.8	112	121	104	23.7	3.96	3.38	5.17
Manganese	"	0.041	0.034	0.036	0.03	0.034	0.062	0.033	0.17
Mercury	"	<	<	<	<	<	<0.00005	<0.00005	<0.00005
Molybdenum	"	<	<	<	<	<	0.001	<0.001	<0.001
Nickel	"	<	<	<	<	0.017	0.005	0.002	0.01
Potassium	"	23.4	30.2	33	30.3	7	<2	<2	<2
Selenium	"	<	<	<	<	<	<0.0005	<0.0005	<0.0005
Silver	"	<	<	<	<	<	0.0001	<0.0001	<0.0001
Sodium	"	573	808	909	834	170	4.8	3.8	2.5
Tin	"	0.05	0.04	<	<	<	<0.30	<0.3	<0.3
Zinc	"	0.022	<	<	<	0.09	0.011	<0.005	0.022
BACTERIOLOGICAL:									
Fecal Coliform	MPN /100 mL	3000	800	800	500	17000	220	110	30
ORGANIC PARAMETERS:									
Carbon Total Organic	mg/L	3.0	1.0	2.0	3.0	8.0	4.9	4.9	3.0

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0106	FR0110	FR0114	FR0118	FR0124	FR0128
SITE	Units	Oak	Oak	Oak	Oak	Oak	Oak
Sampled On:		X-sec 3					
		93-06-01	93-06-14	93-06-28	93-07-12	93-07-27	93-08-10
Latitude (N)		49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11
Longitude (W)		123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15
Physical Tests:							
Dissolved Oxygen	mg/L	10.2	10.8		9.5	9.4	9.1
Water Temperature	deg C	14.8	13.5		16.3	18.5	19.0
Air Temperature	"	21.5	17.5		16.5	18.2	17.0
pH		7.55	7.54	7.25	7.44	7.46	7.70
Field pH		7.3	7.5		7.7	7.3	7.5
Specific Conductance (SC)	uS/cm	71.0	89.0	98.7	100.0	103.0	100.0
Field SC	uS/cm	91	62		79	90	90
Suspended Solids (NFR)	mg/L	58	51	52	42	37	36
Dissolved Solids (FR)	"	45	48	52	54	53	55
Hardness Total (Calc.)	mg/L CaCO3	39.9	43.6	48.4	41.3	46.6	46.6
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	34.9	34.4	39.2	44.2	40.9	39.9
Chloride Dissolved	mg/L	1.6	1.5	1.5	1.7	1.9	1.1
Fluoride Dissolved	"	0.03	0.03	0.04	0.04	0.04	0.03
Sulfate	"	6	7.4	6.5	8.1	6.4	7.3
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	0.006	<0.005	0.023	<0.005	0.010	0.006
Nitrogen Kjel.Tot(N)	"	0.17	0.15	0.10	0.17	0.20	0.17
Nitro NO3+NO2 D	"	0.083	0.081	0.059	0.057	0.047	0.033
Phosphorus Dissolved	mg P/L	0.01	0.006	0.003	0.001	0.007	0.014
Phosphorus Total	"	0.072	0.063	0.053	0.065	0.050	0.036
TOTAL METALS							
Aluminum	mg/L	0.43	0.30	0.39	0.52	0.40	0.43
Arsenic	"	0.0004	0.0004	0.0004	0.0004	0.0005	0.0004
Barium	"	0.017	0.02	0.02	0.02	0.02	0.02
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	12.1	13.2	14.60	11.90	13.70	13.90
Chromium	"	<0.001	<0.001	<0.001	0.001	0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.002	0.003	0.002	0.003	0.002	0.002
Iron	"		0.48	0.48	0.46	0.66	0.52
Lead	"	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	"	2.35	2.60	2.89	2.82	3.02	2.94
Manganese	"	0.038	0.034	0.029	0.026	0.033	0.032
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Nickel	"	<0.001	0.002	<0.001	0.003	0.001	<0.001
Potassium	"	<2	<2	<2	<2	<2	<2
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	2.1	2.2	2.5	2.6	3.1	3.0
Tin	"	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc	"	<0.005	0.036	<0.005	0.005	0.010	<0.001
BACTERIOLOGICAL:							
Fecal Coliform	MPN /100 mL	14	50	70	30	17	80
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	2.5	2.0	2.4	3.2	2.3	2.3

Lab ID		ASL	ASL	ASL	ASL	ASL	ASL
Client ID		FR0131	FR0150	FR0156	FR0160	FR0178	FR0183
SITE	Units	Oak	Oak	Oak	Oak X-sec 3	Oak	Oak
Sampled On:		93-08-23	93-09-06	93-09-21	93-10-04	93-10-19	93-11-02
Latitude (N)		49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11
Longitude (W)		123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15
Physical Tests:							
Dissolved Oxygen	mg/L	8.4	9.4	9	9.1	9.6	9.6
Water Temperature	deg C	18.5	18.0	14	15	11.5	9.5
Air Temperature	"	16.5	15.0	11	13	11	9
pH		7.40	7.52	7.35	7.13	7.59	7.51
Field pH		7.5	7.5	7.45	7.55	7.6	7.3
Specific Conductance (SC)	uS/cm	97.7	130.0	125	170	187	143
Field SC	uS/cm	90	140	100	155	125	170
Suspended Solids (NFR)	mg/L	22	7	13	6	24	14
Dissolved Solids (FR)	"	51	72	62	94	43	76
Hardness Total (Calc.)	mg/L CaCO3	44.8	52.6	49.1	62.4	61.9	58.3
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	37.4	43.1	43.5	48.5	48.2	48.2
Chloride Dissolved	mg/L	1.6	8.3	2.8	15.9	17.3	7.8
Fluoride Dissolved	"	0.04	0.03	0.04	0.04	0.05	0.04
Sulfate	"	7.6	9.6	9.8	12.5	12.5	10.6
Nutrients:							
Nitrogen Amm. Diss(N)	mg N/L	<0.005	0.007	<0.005	0.025	0.043	0.044
Nitrogen Kjel. Tot(N)	"	0.20	0.21	0.149	0.215	0.189	0.15
Nitro NO3+NO2 D	"	0.027	0.028	0.039	0.048	0.054	0.082
Phosphorus Dissolved	mg P/L	0.012	0.011	0.014	0.011	0.02	0.024
Phosphorus Total	"	0.061	0.025	0.024	0.02	0.053	0.033
TOTAL METALS							
Aluminum	mg/L	0.27	<0.2	<0.20	<0.20	<0.20	<0.20
Arsenic	"	0.0005	0.0003	0.0004	0.0006	0.0005	0.0005
Barium	"	0.02	0.02	0.014	0.014	0.017	0.014
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	13.60	15.20	15.4	17.6	17	16.5
Chromium	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.001	0.001	<0.001	0.001	0.002	<0.001
Iron	"	0.39	0.29	0.158	0.151	0.299	0.199
Lead	"	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Magnesium	"	2.64	3.54	3.25	4.48	4.72	4.11
Manganese	"	0.024	0.020	0.015	0.017	0.027	0.016
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	"	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Potassium	"	<2	<2	<2	2.1	<2.0	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	2.8	7	5	12.7	12.3	7.6
Tin	"	<0.3	<0.3	<0.30	<0.30	<0.30	<0.30
Zinc	"	<0.005	0.002	<0.001	0.002	0.001	0.004
BACTERIOLOGICAL:							
Fecal Coliform	MPN /100 mL	170	130	130	1600	2200	4000
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	1.9	1.9		2.1	2.3	2.7

Lab ID Client ID SITE	Units	ASL FR0185 Oak	ASL FR0191 Oak	ASL FR0210 Oak	ASL FR0211 Oak	ASL FR0218 Oak	ASL FR0219 Oak
Sampled On:		93-11-15	93-11-30	93-12-14	93-12-27	94-01-11	94-01-24
Latitude (N) Longitude (W)		49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15
Physical Tests:							
Dissolved Oxygen	mg/L	10.8	12	11.4	11.6	11.6	11.9
Water Temperature	deg C	5.5	3	4.8	2.8	4.9	4.9
Air Temperature	"	4	7	6.5	1	6.5	8.8
pH		7.64	7.48	7.24	6.91	7.09	7.15
Field pH		7.3	7.3	7.25	7.4	7.3	7.25
Specific Conductance (SC)	uS/cm	218	4430	146	1340	163	170
Field SC	uS/cm	120	2600	85	820	110	110
Suspended Solids (NFR)	mg/L	34	10	30	10	28	11
Dissolved Solids (FR)	"	112	2640	94	720	93	104
Hardness Total (Calc.)	mg/L CaCO3	69.1	493	44.5	176	45.4	50.4
Anions:							
Alkalinity Total @ pH 4.5	mg/L CaCO3	48.7	48.5	32.7	49.5	35	41.5
Chloride Dissolved	mg/L	28.1	1320	17.1	361	21.2	19.5
Fluoride Dissolved	"	0.04	0.11	0.03	0.05	0.04	0.04
Sulfate	"	13	192	8.9	57.4	10.5	10.9
Nutrients:							
Nitrogen Amm.Diss(N)	mg N/L	0.037	0.083	0.059	0.06	0.035	0.05
Nitrogen Kjel.Tot(N)	"	0.274	0.36	0.282	0.2	0.135	0.18
Nitro NO3+NO2 D	"	0.118	0.164	0.362	0.199	0.292	0.192
Phosphorus Dissolved	mg P/L	0.007	0.03	0.033	0.017	0.033	0.026
Phosphorus Total	"	0.086	0.057	0.13	0.029	0.059	0.044
TOTAL METALS							
Aluminum	mg/L	0.49	<0.20	0.4	<0.20	0.3	0.22
Arsenic	"	0.0004	0.0006	0.0007	0.0004	0.0006	0.0011
Barium	"	0.019	0.014	0.017	0.014	0.013	0.017
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	18.2	43	11.6	23.8	11.3	12.8
Chromium	"	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	"	0.002	0.002	0.003	<0.001	0.002	0.003
Iron	"	0.665	0.314	0.619	0.137	0.456	0.331
Lead	"	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Magnesium	"	5.76	93.5	3.78	28.2	4.17	4.48
Manganese	"	0.036	0.029	0.039	0.017	0.031	0.025
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	0.002	<0.001	0.001	<0.001	0.001
Nickel	"	<0.001	0.002	0.002	0.001	0.001	0.002
Potassium	"	<2.0	26	<2.0	7.8	<2.0	<2.0
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	17.9	703	11.8	209	15.1	14.4
Tin	"	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.005	0.002	0.008	0.002	0.007	0.003
BACTERIOLOGICAL:							
Fecal Coliform	MPN /100 mL	1400	14000	3000	5000	2200	1700
ORGANIC PARAMETERS:							
Carbon Total Organic	mg/L	4.2	1.4	2.8	2.0	2.7	2.1

Lab ID		ASL	ASL	ASL	ASL
Client ID		FR0225	FR0260	FR0266	FR0267
SITE		Oak	Oak	Oak	Oak
	Units	X-sec 3			
Sampled On:		94-02-07	94-02-22	94-03-08	94-03-21
Latitude (N)		49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11
Longitude (W)		123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15
Physical Tests:					
Dissolved Oxygen	mg/L	12.2	11.8	12.4	11.4
Water Temperature	deg C	2.2	4.8	4.7	5
Air Temperature	"	-4	3	3	1
pH		7.07	7.44	7.41	7.34
Field pH		7.5	7.4	7.55	7.6
Specific Conductance (SC)	uS/cm	455	1070	251	335
Field SC	uS/cm	270	650	160	212
Suspended Solids (NFR)	mg/L	13	38	78	31
Dissolved Solids (FR)	"	276	667	167	206
Hardness Total (Calc.)	mg/L CaCO3	80.1	133	61	66.8
Anions:					
Alkalinity Total @ pH 4.5	mg/L CaCO3	44.7	42.7	33.8	41.8
Chloride Dissolved	mg/L	94.7	281	49	63.4
Fluoride Dissolved	"	0.04	0.04	0.04	0.04
Sulfate	"	20.3	43.9	13	15.9
Nutrients:					
Nitrogen Amm. Diss(N)	mg N/L	0.039	0.057	0.045	0.047
Nitrogen Kjehl. Tot(N)	"	0.23	0.26	0.28	0.26
Nitro NO3+NO2 D	"	0.166	0.252	0.226	0.2
Phosphorus Dissolved	mg P/L	0.024	0.031	0.034	0.017
Phosphorus Total	"	0.039	0.056	0.109	0.08
TOTAL METALS					
Aluminum	mg/L	<0.20	0.33	0.77	0.47
Arsenic	"	0.0008	0.0006	0.0009	0.0005
Barium	"	0.015	0.016	0.025	0.019
Cadmium	"	<0.0002	<0.0002	<0.0002	<0.0002
Calcium	"	16	17.9	13.4	14
Chromium	"	0.001	<0.001	0.001	<0.001
Cobalt	"	<0.015	<0.015	<0.015	<0.015
Copper	"	0.002	0.002	0.004	0.003
Iron	"	0.399	0.499	1.11	0.564
Lead	"	<0.001	<0.001	0.001	<0.001
Magnesium	"	9.76	21.5	6.68	7.74
Manganese	"	0.028	0.029	0.063	0.032
Mercury	"	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	"	<0.001	<0.001	<0.001	<0.001
Nickel	"	0.001	0.001	0.004	0.002
Potassium	"	3	6.3	<2.0	2.3
Selenium	"	<0.0005	<0.0005	<0.0005	<0.0005
Silver	"	<0.0001	<0.0001	<0.0001	<0.0001
Sodium	"	55.2	155	32.2	38.9
Tin	"	<0.30	<0.30	<0.30	<0.30
Zinc	"	0.002	0.084	0.007	0.003
BACTERIOLOGICAL:					
Fecal Coliform	MPN /100 mL	8000	14000	8000	2300
ORGANIC PARAMETERS:					
Carbon Total Organic	mg/L	2.7	2.3	2.5	2.4

Lab ID Client ID SITE	Units	Zenon FR0001 Oak	Zenon FR0048 Oak	Zenon FR0067 Oak	Zenon FR0073 Oak	Zenon FR0084 Oak	Zenon FR0110 Oak	Zenon FR0118 Oak
Sampled On:		93-01-25	93-02-23	93-03-23	93-04-20	93-05-17	93-06-14	93-07-12
Latitude (N) Longitude (W)		49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15
ORGANIC PARAMETERS:								
Adsorbable Org. Halide (AOX)	mg/L	0.04	0.03	0.03	0.02	0.01	—	0.01
Chlorophenolics:								
Pentachlorophenol	mg/L	<	<	0.000013	<	0.000003	0.000003	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	<	<	<	<	<	<	<
2,3,4,5-Tetrachlorophenol	"	<	<	<	<	<	<	<
3,4,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,4-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,3,6-Trichlorophenol	"	<	<	<	<	<	<	<
2,4,5-Trichlorophenol	"	<	<	<	<	<	<	<
2,4,6-Trichlorophenol	"	<	<	<	<	<	0.000003	<
2,4-Dichlorophenol	"	<	<	<	<	<	<	<
2,6-Dichlorophenol	"	<	<	<	<	<	<	<
2,5-Dichlorophenol	"	<	<	<	<	<	<	<
3,5-Dichlorophenol	"	<	<	<	<	<	<	<
2,3-Dichlorophenol	"	<	<	<	<	<	<	<
3,4-Dichlorophenol	"	<	<	<	<	<	<	<
4-Chlorophenol	"	<	<	<	<	<	<	<
Tetrachloroguaiacol	"	<	<	<	<	<	<	<
3,4,5-Trichloroguaiacol	"	<	0.000005	<	0.000005	<	<	<
3,4,6-Trichloroguaiacol	"	<	<	<	<	<	<	<
4,5,6-Trichloroguaiacol	"	<	0.000003	<	0.000003	0.000002	<	<
4,5-Dichloroguaiacol	"	<	0.000014	0.000005	0.000004	<	0.000004	<
4,6-Dichloroguaiacol	"	<	<	<	<	<	<	<
4-Chloroguaiacol	"	<	<	<	<	<	<	<
5-Chloroguaiacol	"	<	<	<	<	<	0.000005	0.000002
6-Chloroguaiacol	"	<	<	<	<	<	<	<
Tetrachlorocatechol	"	0.000002	0.000003	<	0.000004	0.000003	<	<
3,4,5-Trichlorocatechol	"	0.000002	0.000006	<	0.000007	0.000003	0.000002	<
3,4-Dichlorocatechol	"	<	<	<	<	<	<	<
3,5-Dichlorocatechol	"	<	<	<	<	<	<	<
4,5-Dichlorocatechol	"	<	0.000006	0.000006	0.000006	<	<	<
4-Chlorocatechol	"	<	<	<	<	<	0.000003	<
Tetrachloroveratrole	"	<	<	<	<	<	<	<
3,4,5-Trichloroveratrole	"	<	0.000004	<	0.000002	<	<	<
4,5-Dichloroveratrole	"	<	<	<	<	<	<	<
2,6-Dichlorosyringaldehyde	"	<	<	<	<	<	<	<
2-Chlorosyringaldehyde	"	<	<	<	<	<	<	<
3,4,5-Trichlorosyringol	"	<	<	<	<	<	<	<
Trichlorotrimethoxybenzene	"	<	<	<	<	<	<	<
5,6-Dichlorovanillin	"	<	0.000003	<	<	<	<	<
6-Chlorovanillin	"	0.000002	0.000012	<	0.000009	<	0.000002	<
Nonylphenol	"	<	<	<	<	<	<	<

Lab ID Client ID SITE		Zenon FR0128 Oak	Zenon FR0150 Oak	Zenon FR0160 Oak X-sec 3	Zenon FR0178 Oak	Zenon FR0183 Oak	Zenon FR0191 Oak
Sampled On:	Units	93-08-10	93-09-06	93-10-04	93-10-19	93-11-02	93-11-30
Latitude (N) Longitude (W)		49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15
ORGANIC PARAMETERS: Adsorbable Org. Halide (AOX)	mg/L	<0.01	<0.01	0.02	--	0.02	0.02
Chlorophenolics:							
Pentachlorophenol	mg/L	<	<	<	<	<	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	<	<	<	<	<	0.000003
2,3,4,5-Tetrachlorophenol	"	<	<	<	<	<	<
3,4,5-Trichlorophenol	"	<	<	<	<	<	<
2,3,4-Trichlorophenol	"	<	<	<	<	<	<
2,3,5-Trichlorophenol	"	0.000001	<	<	<	<	<
2,3,6-Trichlorophenol	"	<	<	<	<	<	<
2,4,5-Trichlorophenol	"	<	<	<	<	<	<
2,4,6-Trichlorophenol	"	0.000001	<	0.000002	<	<	0.000012
2,4-Dichlorophenol	"	<	<	<	<	<	<
2,6-Dichlorophenol	"	<	<	<	<	<	<
2,5-Dichlorophenol	"	<	<	<	<	<	<
3,5-Dichlorophenol	"	<	<	<	<	<	<
2,3-Dichlorophenol	"	<	<	<	<	<	<
3,4-Dichlorophenol	"	<	<	<	<	<	<
4-Chlorophenol	"	<	<	<	<	<	<
Tetrachloroguaiacol	"	<	<	<	<	<	0.000002
3,4,5-Trichloroguaiacol	"	<	<	<	<	<	0.000006
3,4,6-Trichloroguaiacol	"	<	<	<	<	<	<
4,5,6-Trichloroguaiacol	"	<	<	<	<	<	<
4,5-Dichloroguaiacol	"	<	<	0.000003	<	<	<
4,6-Dichloroguaiacol	"	<	<	<	<	<	<
4-Chloroguaiacol	"	<	<	<	<	<	<
5-Chloroguaiacol	"	<	0.000003	<	<	<	<
6-Chloroguaiacol	"	<	<	<	<	<	<
Tetrachlorocatechol	"	<	<	<	<	<	<
3,4,5-Trichlorocatechol	"	<	<	<	<	<	0.000006
3,4-Dichlorocatechol	"	<	<	<	<	<	<
3,5-Dichlorocatechol	"	<	<	<	<	<	<
4,5-Dichlorocatechol	"	<	<	0.000002	<	<	0.000006
4-Chlorocatechol	"	<	<	<	<	<	<
Tetrachloroveratrole	"	<	<	<	<	<	<
3,4,5-Trichloroveratrole	"	<	<	<	<	<	0.000002
4,5-Dichloroveratrole	"	<	<	<	<	<	<
2,6-Dichlorosyringaldehyde	"	<	<	<	<	<	<
2-Chlorosyringaldehyde	"	<	<	<	<	<	<
3,4,5-Trichlorosyringol	"	<	<	<	<	<	<
Trichlorotrimethoxybenzene	"	<	<	<	<	<	<
5,6-Dichlorovanillin	"	<	<	<	<	<	<
6-Chlorovanillin	"	<	<	0.000002	<	<	0.000003
Nonylphenol	"	<	<	<	<	<	<

Lab ID Client ID SITE	Units	Zenon FR0211 Oak	Zenon FR0219 Oak	Zenon FR0260 Oak	Zenon FR0267 Oak
Sampled On:		93-12-27	94-01-24	94-02-22	94-03-21
Latitude (N) Longitude (W)		49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15	49 - 12.11 123 - 7.15
ORGANIC PARAMETERS:					
Adsorbable Org. Halide (AOX)	mg/L	0.03	0.02	0.03	0.02
Chlorophenolics:					
Pentachlorophenol	mg/L	<	<	<	0.000010
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	0.000002	<	<	0.000002
2,3,4,5-Tetrachlorophenol	"	<	<	<	<
3,4,5-Trichlorophenol	"	<	<	<	<
2,3,4-Trichlorophenol	"	<	<	<	<
2,3,5-Trichlorophenol	"	<	<	<	<
2,3,6-Trichlorophenol	"	<	<	<	<
2,4,5-Trichlorophenol	"	<	<	<	<
2,4,6-Trichlorophenol	"	0.000006	<	0.000003	0.000002
2,4-Dichlorophenol	"	<	<	<	<
2,6-Dichlorophenol	"	<	<	<	<
2,5-Dichlorophenol	"	<	<	<	<
3,5-Dichlorophenol	"	<	<	<	<
2,3-Dichlorophenol	"	<	<	<	<
3,4-Dichlorophenol	"	<	<	<	<
4-Chlorophenol	"	<	<	<	<
Tetrachloroguaiacol	"	<	<	<	<
3,4,5-Trichloroguaiacol	"	0.000010	<	0.000003	0.000002
3,4,6-Trichloroguaiacol	"	<	<	<	<
4,5,6-Trichloroguaiacol	"	<	<	<	<
4,5-Dichloroguaiacol	"	0.000008	<	0.000005	0.000004
4,6-Dichloroguaiacol	"	<	<	<	<
4-Chloroguaiacol	"	<	<	<	<
5-Chloroguaiacol	"	0.000006	<	<	<
6-Chloroguaiacol	"	<	<	<	<
Tetrachlorocatechol	"	<	<	<	0.000004
3,4,5-Trichlorocatechol	"	0.000012	<	<	<
3,4-Dichlorocatechol	"	<	<	<	<
3,5-Dichlorocatechol	"	<	<	<	<
4,5-Dichlorocatechol	"	0.000008	<	0.000005	0.000003
4-Chlorocatechol	"	<	<	<	<
Tetrachloroveratrole	"	<	<	<	<
3,4,5-Trichloroveratrole	"	0.000003	<	<	<
4,5-Dichloroveratrole	"	<	<	<	<
2,6-Dichlorosyringaldehyde	"	<	<	<	<
2-Chlorosyringaldehyde	"	<	<	<	<
3,4,5-Trichlorosyringol	"	<	<	<	<
Trichlorotrimethoxybenzene	"	<	<	<	<
5,6-Dichlorovanillin	"	<	<	<	0.000002
6-Chlorovanillin	"	0.000005	<	0.000004	0.000003
Nonylphenol	"	<	<	<	<

Lab ID	Zenon	Zenon	Zenon	Zenon
Client ID	FR0048	FR0084	FR0178	FR0260
SITE	Oak	Oak	Oak	Oak
Units				
Sampled On:	93-02-23	93-05-17	93-10-19	94-02-22
Latitude (N)	49 - 12.11	49 - 12.11	49 - 12.11	49 - 12.11
Longitude (W)	123 - 7.15	123 - 7.15	123 - 7.15	123 - 7.15
Resin and Fatty Acids:				
Abietic Acid	mg/L	<	<	<
Arachidic Acid	"	<	<	<
Behenic Acid	"	<	<	<
Chlorodehydroabietic	"	<	<	<
Dehydroabietic Acid	"	<	<	<
Dichlorodehydroabietic	"	<	<	<
Isopimaric Acid	"	<	<	<
Lauric Acid	"	<	<	<
Levo Pimaric Acid	"	<	<	<
Lignoceric Acid	"	<	<	<
Linoleic Acid	"	<	<	0.001
Linolenic Acid	"	<	<	<
Myristic Acid	"	<	<	0.0007
Neoabietic Acid	"	<	<	<
Oleic Acid	"	<	<	0.0008
Palmitric Acid	"	<	<	0.0024
Palustric Acid	"	<	<	<
Pimaric Acid	"	<	<	<
Sandaraco Pimaric Acid	"	<	<	<
Stearic Acid	"	<	<	0.0025
Antisapstain Compounds:				
TCMTB	mg/L	0.007	<	<
Organochlorine Pesticides and PCBs				
Aldrin	mg/L	<	<	<
BHC alpha-	"	<	<	<
BHC beta-	"	<	<	<
BHC delta-	"	<	<	<
Chlordane alpha-	"	<	<	<
Chlordane gamma-	"	<	<	<
DDE p p'-	"	<	<	<
DDD p p'-	"	0.000011	<	<
DDT p p'-	"	<	<	<
Dieldrin	"	<	<	<
Endosulfan I	"	<	<	<
Endosulfan II	"	<	<	<
Endosulfan sulphate	"	<	<	<
DDT o p'-	"	<	<	<
Endrin	"	<	<	<
Hexachlorobenzene	"	0.000001	<	<
Heptachlor	"	<	<	<
Heptachlor epoxide	"	<	<	<
Lindane BHC gamma-	"	<	<	<
Methoxychlor	"	<	<	<
Mirex	"	<	<	<
Nonachlor trans-	"	<	<	<
Oxychlorane	"	<	<	<
Toxaphene	"	<	<	<
PCBs - Total	"	<	<	<

APPENDIX X

WATER QUALITY DATA FOR MAIN ARM AND NORTH ARM SLOUGHS

Lab ID Client ID SITE	Zenon MDL From 93-01 To 93-03	ASL MDL From 93-04 To 94-03	UNITS	Zenon FR0035 McDonald SL Surface - 1m 1.0m 93-02-11	ASL FR0249 McDonald SL Surface - 1m 1.0 m 94-02-23	Zenon FR0036 McDonald SL Bottom + 1m 6.0m 93-02-11	ASL FR0250 McDonald SL Bottom + 1m 5.5 m 94-02-23
Sampled On:							
Latitude (N) Longitude (W)				49 - 12.78 123 - 11.26	49 - 12.78 123 - 11.26	49 - 12.78 123 - 11.26	49 - 12.78 123 - 11.26
Physical Tests:							
Dissolved Oxygen			mg/L	10.6	10.5	10.4	10.2
Water Temperature			deg C	5	5.1	6.5	6.1
Air Temperature			"	2	1	2	1
pH				7.6	7.27	7.7	7.58
Field pH				7.2	7.85	7.35	7.8
Specific Conductance(SC)	1	0.2	uS/cm	11600	16000	28200	46000
Field SC			uS/cm	8100	9500	10000	24000
Suspended Solids (NFR)	4	1	mg/L	7	13	19	25
Dissolved Solids (FR)	4	1	"	7820	-	19000	30300
Hardness Total			mg/L CaCO3	1060	-	2780	5030
Anions:							
Alkalinity Total @ pH 4.5	0.5	0.5	mg/L CaCO3	61.7	68.8	83.4	98.7
Chloride Dissolved	0.5	0.2	mg/L	4430	4890	9800	14000
Fluoride Dissolved	0.1	0.02	"	0.28	0.34	0.56	0.66
Sulfate	1	0.5	"	460	657	1730	1830
Nutrients:							
Nitrogen Amm.Diss(N)	0.005	0.005	mg N/L	0.061	-	0.049	0.01
Nitrogen Kjel.Tot(N)	0.04	0.05	"	0.3	0.195	0.25	<0.050
Nitro NO3+NO2 D	0.02	0.005	"	0.24	0.353	0.31	0.424
Phosphorus Dissolved	0.003	0.001	mg P/L	0.021	0.037	0.044	0.061
Phosphorus Total	0.003	0.001	"	0.035	0.042	0.062	0.069
TOTAL METALS							
Aluminum	0.06	0.02	mg/L	0.08	0.92	0.27	<2.0
Arsenic	0.001	0.0001	"	<	0.0039	0.001	0.0013
Barium	0.001	0.01	"	0.012	<0.030	0.01	<0.10
Cadmium	0.0001	0.0002	"	0.0001	<0.001	<	<0.002
Calcium	0.05	0.05	"	78.1	111	187	304
Chromium	0.005	0.001	"	<	<0.001	<	0.001
Cobalt	0.004	0.015	"	<	<0.045	<	<0.15
Copper	0.001	0.001	"	0.002	<0.001	0.002	<0.001
Iron	0.05	0.03	"	0.29	2.74	0.5	2
Lead	0.003	0.001	"	<	<0.010	<	<0.010
Magnesium	0.02	0.01	"	210	350	561	1040
Manganese	0.002	0.005	"	0.024	0.03	0.016	<0.05
Mercury	0.00005	0.00005	"	<	<0.00005	<	<0.00005
Molybdenum	0.004	0.001	"	<	0.003	<	0.006
Nickel	0.005	0.001	"	0.008	0.013	0.005	0.016
Potassium	0.4	2	"	57.5	104	160	303
Selenium	0.03	0.0005	"	<	<0.0005	<	<0.0005
Silver	0.03	0.0001	"	<	<0.001	<	<0.001
Sodium	0.4	2	"	1730	-	4770	8190
Tin	0.02	0.3	"	0.09	<0.90	0.12	<3.0
Zinc	0.01	0.001	"	<	0.004	<	<0.005
BACTERIOLOGICAL:							
Fecal Coliform			mpn /100ml	800	5000	-	1300

Lab ID Client ID SITE	Zenon MDL From 93-01 To 93-03	ASL MDL From 93-04 To 94-03	Zenon FR0037 Eburne SL Surface - 1m 1.0m 93-02-11	ASL FR0251 Eburne SL Surface - 1m 1.0 m 94-02-23	Zenon FR0038 Eburne SL Bottom + 1m 4.0m 93-02-11	ASL FR0252 Eburne SL Bottom + 1m 3.5 m 94-02-23
Sampled On:						
Latitude (N) Longitude (W)			49 - 12.16 123 - 8.58	49 - 12.16 123 - 8.58	49 - 12.16 123 - 8.58	49 - 12.16 123 - 8.58
Physical Tests:						
Dissolved Oxygen			11.2	10.9	10.8	11
Water Temperature			5.5	4.5	7	4.9
Air Temperature			2	1	2	1
pH			7.7	7.38	7.6	7.32
Field pH			7.3	7.65	7.45	7.7
Specific Conductance(SC)	1	0.2	20800	12000	30500	17400
Field SC			17500	7000	21000	10500
Suspended Solids (NFR)	4	1	252	8	17	12
Dissolved Solids (FR)	4	1	13500	8250	20900	12400
Hardness Total			1740	1300	2770	1960
Anions:						
Alkalinity Total @ pH 4.5	0.5	0.5	73.3	59.4	85.1	71.6
Chloride Dissolved	0.5	0.2	11800	3950	11200	5860
Fluoride Dissolved	0.1	0.02	0.44	0.34	0.6	0.34
Sulfate	1	0.5	901	515	1660	756
Nutrients:						
Nitrogen Amm.Diss(N)	0.005	0.005	0.037	0.054	0.017	0.051
Nitrogen Kjel.Tot(N)	0.04	0.05	0.23	0.19	0.21	0.185
Nitro NO3+NO2 D	0.02	0.005	0.29	0.374	0.34	0.373
Phosphorus Dissolved	0.003	0.001	0.033	0.037	0.048	0.04
Phosphorus Total	0.003	0.001	0.053	0.048	0.061	0.049
TOTAL METALS						
Aluminum	0.06	0.02	0.14	<0.60	0.09	<0.60
Arsenic	0.001	0.0001	0.001	0.0008	0.001	0.0009
Barium	0.001	0.01	0.011	<0.030	0.009	<0.030
Cadmium	0.0001	0.0002	<	<0.001	<	<0.001
Calcium	0.05	0.05	121	86	186	126
Chromium	0.005	0.001	<	<0.001	<	<0.001
Cobalt	0.004	0.015	<	<0.045	<	<0.045
Copper	0.001	0.001	0.001	<0.001	0.003	<0.001
Iron	0.05	0.03	0.34	0.696	0.23	0.944
Lead	0.003	0.001	<	<0.010	<	<0.010
Magnesium	0.02	0.01	348	263	559	399
Manganese	0.002	0.005	0.018	0.01	0.008	<0.01
Mercury	0.00005	0.00005	<	<0.00005	<	<0.00005
Molybdenum	0.004	0.001	<	0.002	<	0.003
Nickel	0.005	0.001	<	0.013	<	0.014
Potassium	0.4	2	96.9	74.4	160	119
Selenium	0.03	0.0005	<	<0.0005	<	<0.0005
Silver	0.03	0.0001	<	<0.001	<	<0.001
Sodium	0.4	2	2880	2060	4820	3120
Tin	0.02	0.3	0.13	<0.90	0.1	<0.90
Zinc	0.01	0.001	<	0.004	<	0.003
BACTERIOLOGICAL:						
Fecal Coliform			1300	5000	-	3000

Lab ID Client ID SITE	Zenon MDL From 93-01 To 93-03	ASL MDL From 93-04 To 94-03	Zenon FR0039 Tree Is. SL Surface - 1m 1.0m 93-02-10	ASL FR0253 Tree Is. SL Surface - 1m 1.0 m 94-02-22	Zenon FR0040 Tree Is. SL Bottom + 1m 3.0m 93-02-10	ASL/Zenon FR0254 Tree Is. SL Bottom + 1m 3.0 m 94-02-22
Sampled On:						
Latitude (N) Longitude (W)			49 - 11.08 122 - 57.70	49 - 11.08 122 - 57.70	49 - 11.08 122 - 57.70	49 - 11.08 122 - 57.70
Physical Tests:						
Dissolved Oxygen			13.6	11.6	13.2	11.8
Water Temperature			4	3.8	4	3.8
Air Temperature			11.5	6	11.5	6
pH			7.7	7.47	7.7	7.44
Field pH			7.25	7.65	7.15	7.6
Specific Conductance(SC)	1	0.2	142	660	172	1290
Field SC			90	450	155	900
Suspended Solids (NFR)	4	1	5	7	5	5
Dissolved Solids (FR)	4	1	87	330	102	842
Hardness Total			50.3	78.1	51.9	160
Anions:						
Alkalinity Total @ pH 4.5	0.5	0.5	45.9	40.1	45.7	41.7
Chloride Dissolved	0.5	0.2	8.4	125	17	360
Fluoride Dissolved	0.1	0.02	<	0.04	<	0.05
Sulfate	1	0.5	11.2	29.5	10.5	55
Nutrients:						
Nitrogen Amm.Diss(N)	0.005	0.005	0.04	0.051	0.054	0.069
Nitrogen Kjel.Tot(N)	0.04	0.05	0.2	0.22	0.2	0.28
Nitro NO3+NO2 D	0.02	0.005	0.2	0.252	0.21	0.26
Phosphorus Dissolved	0.003	0.001	0.014	0.024	0.008	0.026
Phosphorus Total	0.003	0.001	0.022	0.038	0.017	0.038
TOTAL METALS						
Aluminum	0.06	0.02	0.14	0.3	0.14	0.25
Arsenic	0.001	0.0001	<	0.0004	<	0.0008
Barium	0.001	0.01	0.014	0.018	0.014	0.017
Cadmium	0.0001	0.0002	<	<0.0002	<	<0.0002
Calcium	0.05	0.05	14.4	14.4	14.6	19.3
Chromium	0.005	0.001	<	<0.001	<	<0.001
Cobalt	0.004	0.015	<	<0.015	<	<0.015
Copper	0.001	0.001	0.002	0.002	0.001	0.002
Iron	0.05	0.03	0.35	0.386	0.37	0.373
Lead	0.003	0.001	<	<0.001	<	<0.001
Magnesium	0.02	0.01	3.49	10.3	3.74	27.2
Manganese	0.002	0.005	0.023	0.03	0.027	0.025
Mercury	0.00005	0.00005	<	<0.00005	<	<0.00005
Molybdenum	0.004	0.001	<	0.001	<	0.001
Nickel	0.005	0.001	<	<0.001	<	<0.001
Potassium	0.4	2	0.9	3	1.1	8.1
Selenium	0.03	0.0005	<	<0.0005	<	<0.0005
Silver	0.03	0.0001	<	<0.0001	<	<0.0001
Sodium	0.4	2	6.5	64.5	9.4	202
Tin	0.02	0.3	<	<0.30	<	<0.30
Zinc	0.01	0.001	<	0.003	<	0.002
BACTERIOLOGICAL:						
Fecal Coliform			1100	1700	-	5000

Lab ID Client ID SITE	Zenon MDL From 93-01 To 93-03	ASL MDL From 93-04 To 94-03	Zenon FR0028 Ladner SI Surface - 1m 1.0m 93-02-10	ASL FR0242 Ladner SI Surface - 1m 1.0 m 94-02-21	Zenon FR0029 Ladner SI Bottom + 1m 5.0m 93-02-10	ASL FR0243 Ladner SI Bottom + 1m 5.0 m 94-02-21
Sampled On:						
Latitude (N) Longitude (W)			49 - 5.54 123 - 5.40	49 - 5.54 123 - 5.40	49 - 5.54 123 - 5.40	49 - 5.54 123 - 5.40
Physical Tests:						
Dissolved Oxygen			11.4	11	12.4	11.2
Water Temperature			4.8	4.8	4.8	5
Air Temperature			4	6.5	4	6.5
pH			7.6	7.35	7.6	7.47
Field pH			7.2	7.65	7.4	7.55
Specific Conductance(SC)	1	0.2	9620	12500	11300	17100
Field SC			7100	9000	8000	10500
Suspended Solids (NFR)	4	1	11	10	12	15
Dissolved Solids (FR)	4	1	5820	9040	6960	12300
Hardness Total			912	1460	1060	1990
Anions:						
Alkalinity Total @ pH 4.5	0.5	0.5	63.8	67.4	62.9	71.7
Chloride Dissolved	0.5	0.2	2900	4100	3520	5740
Fluoride Dissolved	0.1	0.02	0.21	0.24	0.27	0.31
Sulfate	1	0.5	409	558	459	797
Nutrients:						
Nitrogen Amm.Diss(N)	0.005	0.005	0.107	0.096	0.089	0.08
Nitrogen Kjel.Tot(N)	0.04	0.05	0.31	0.39	0.27	0.31
Nitro NO3+NO2 D	0.02	0.005	0.29	0.326	0.27	0.322
Phosphorus Dissolved	0.003	0.001	0.021	0.052	0.022	0.048
Phosphorus Total	0.003	0.001	0.041	0.066	0.043	0.056
TOTAL METALS						
Aluminum	0.06	0.02	0.18	<0.60	0.18	<0.20
Arsenic	0.001	0.0001	<	0.0007	<	0.0007
Barium	0.001	0.01	0.015	<0.030	0.015	<0.010
Cadmium	0.0001	0.0002	<	<0.001	<	<0.002
Calcium	0.05	0.05	70.2	95.2	79.6	120
Chromium	0.005	0.001	<	0.001	<	<0.001
Cobalt	0.004	0.015	<	<0.045	<	<0.015
Copper	0.001	0.001	0.006	0.002	0.006	0.001
Iron	0.05	0.03	0.54	1.02	0.49	0.339
Lead	0.003	0.001	<	<0.005	<	<0.005
Magnesium	0.02	0.01	179	296	210	410
Manganese	0.002	0.005	0.06	0.04	0.051	0.005
Mercury	0.00005	0.00005	<	<0.00005	<	<0.00005
Molybdenum	0.004	0.001	<	<0.005	<	<0.005
Nickel	0.005	0.001	<	0.012	0.008	0.012
Potassium	0.4	2	49.1	90.5	58.1	120
Selenium	0.03	0.0005	<	<0.0005	<	<0.0005
Silver	0.03	0.0001	<	<0.001	<	<0.001
Sodium	0.4	2	1480	2370	1760	3200
Tin	0.02	0.3	0.1	<0.90	0.11	<0.30
Zinc	0.01	0.001	<	0.004	<	<0.005
BACTERIOLOGICAL:						
Fecal Coliform			2300	2300	-	2300

Lab ID Client ID SITE	Zenon MDL From 93-01 To 93-03	ASL MDL From 93-04 To 94-03	Zenon FR0030 Deas SL Surface - 1m 1.0m 93-02-10	ASL FR0244 Deas SL Surface - 1m 1.0 m 94-02-21	Zenon FR0031 Deas SL Bottom + 1m 4.0m 93-02-10	ASL FR0245 Deas SL Bottom + 1m 6.5 m 94-02-21
Sampled On:						
Latitude (N) Longitude (W)			49 - 7.04 123 - 3.72	49 - 7.04 123 - 3.72	49 - 7.04 123 - 3.72	49 - 7.04 123 - 3.72
Physical Tests:						
Dissolved Oxygen			12.8	11.9	8.6	10.3
Water Temperature			3.5	4.3	4.5	5.1
Air Temperature			4	6	4	6
pH			7.7	7.45	7.5	7.45
Field pH			7.25	7.55	6.65	7.5
Specific Conductance(SC)	1	0.2	3290	7450	16500	26000
Field SC			2000	4350	13000	13400
Suspended Solids (NFR)	4	1	6	12	7	21
Dissolved Solids (FR)	4	1	1830	5140	10800	16900
Hardness Total			305	843	1410	2650
Anions:						
Alkalinity Total @ pH 4.5	0.5	0.5	51.9	47.4	70.6	79.2
Chloride Dissolved	0.5	0.2	910	2400	5440	7820
Fluoride Dissolved	0.1	0.02	0.13	0.2	0.34	0.39
Sulfate	1	0.5	206	330	715	1070
Nutrients:						
Nitrogen Amm.Diss(N)	0.005	0.005	0.067	0.065	0.176	0.083
Nitrogen Kjel.Tot(N)	0.04	0.05	0.2	0.27	0.4	0.28
Nitro NO3+NO2 D	0.02	0.005	0.2	0.307	0.27	0.307
Phosphorus Dissolved	0.003	0.001	0.015	0.034	0.028	0.048
Phosphorus Total	0.003	0.001	0.027	0.044	0.039	0.062
TOTAL METALS						
Aluminum	0.06	0.02	0.14	<0.40	0.1	<1.0
Arsenic	0.001	0.0001	<	0.0006	<	0.0009
Barium	0.001	0.01	0.013	<0.020	0.017	<0.050
Cadmium	0.0001	0.0002	<	<0.0004	<	<0.001
Calcium	0.05	0.05	31.4	59.3	101	162
Chromium	0.005	0.001	<	<0.001	<	<0.001
Cobalt	0.004	0.015	<	<0.030	<	<0.075
Copper	0.001	0.001	0.002	0.003	0.002	<0.001
Iron	0.05	0.03	0.38	0.912	0.31	1.29
Lead	0.003	0.001	<	<0.005	<	<0.005
Magnesium	0.02	0.01	55	169	280	545
Manganese	0.002	0.005	0.027	0.04	0.072	0.03
Mercury	0.00005	0.00005	<	<0.00005	<	<0.00005
Molybdenum	0.004	0.001	<	<0.005	<	<0.005
Nickel	0.005	0.001	<	0.008	<	0.013
Potassium	0.4	2	15.8	51.1	78.2	169
Selenium	0.03	0.0005	<	<0.0005	<	<0.0005
Silver	0.03	0.0001	<	<0.001	<	<0.001
Sodium	0.4	2	408	1320	2350	4260
Tin	0.02	0.3	0.05	<0.60	0.1	<1.5
Zinc	0.01	0.001	<	0.003	<	<0.005
BACTERIOLOGICAL:						
Fecal Coliform			3000	800	-	2300

Lab ID Client ID SITE	Zenon MDL From 93-01 To 93-03	ASL MDL From 93-04 To 94-03	Zenon FR0032 Gundersen SL Surface - 1m 1.0m 93-02-10	ASL FR0246 Gundersen SL Surface - 1m 1.0 m 94-02-22	Zenon FR0033 Gundersen SL Bottom + 1m 4.0m 93-02-10	ASL FR0247 Gundersen SL Bottom + 1m 4.0 m 94-02-22
Sampled On:						
Latitude (N) Longitude (W)			49 - 10.39 122 - 55.11	49 - 10.39 122 - 55.11	49 - 10.39 122 - 55.11	49 - 10.39 122 - 55.11
Physical Tests:						
Dissolved Oxygen			13	12.2	12.8	12.2
Water Temperature			4	3.5	4	4
Air Temperature			11.5	4	11.5	4
pH			7.7	7.48	7.7	7.49
Field pH			7.05	7.65	7.25	7.55
Specific Conductance(SC)	1	0.2	225	448	272	1190
Field SC			150	350	170	700
Suspended Solids (NFR)	4	1	5	9	6	7
Dissolved Solids (FR)	4	1	130	284	150	751
Hardness Total			58.1	79.3	60.5	144
Anions:						
Alkalinity Total @ pH 4.5	0.5	0.5	50.8	43.8	51.4	47
Chloride Dissolved	0.5	0.2	28.8	100	41.5	328
Fluoride Dissolved	0.1	0.02	<	0.04	<	0.05
Sulfate	1	0.5	24.4	20.5	25.9	51.4
Nutrients:						
Nitrogen Amm.Diss(N)	0.005	0.005	0.038	0.05	0.041	0.054
Nitrogen Kjel.Tot(N)	0.04	0.05	0.45	0.26	0.2	0.23
Nitro NO3+NO2 D	0.02	0.005	0.19	0.294	0.22	0.415
Phosphorus Dissolved	0.003	0.001	0.015	0.032	0.02	0.032
Phosphorus Total	0.003	0.001	0.026	0.038	0.024	0.043
TOTAL METALS						
Aluminum	0.06	0.02	0.13	<0.20	0.16	0.28
Arsenic	0.001	0.0001	<	0.0006	<	0.0014
Barium	0.001	0.01	0.013	0.016	0.014	0.017
Cadmium	0.0001	0.0002	<	<0.0002	<	<0.0002
Calcium	0.05	0.05	15.2	15.3	15.4	19.9
Chromium	0.005	0.001	<	<0.001	<	0.001
Cobalt	0.004	0.015	<	<0.015	<	<0.015
Copper	0.001	0.001	0.002	0.002	0.001	0.003
Iron	0.05	0.03	0.29	0.295	0.32	0.398
Lead	0.003	0.001	<	<0.001	<	<0.001
Magnesium	0.02	0.01	4.9	9.96	5.36	22.8
Manganese	0.002	0.005	0.016	0.022	0.018	0.033
Mercury	0.00005	0.00005	<	<0.00005	<	<0.00005
Molybdenum	0.004	0.001	<	0.001	<	0.001
Nickel	0.005	0.001	0.005	0.001	<	0.001
Potassium	0.4	2	1.2	2.9	1.3	6.9
Selenium	0.03	0.0005	<	<0.0005	<	<0.0005
Silver	0.03	0.0001	<	<0.0001	<	<0.0001
Sodium	0.4	2	16.2	57.5	19.3	164
Tin	0.02	0.3	<	<0.30	<	<0.30
Zinc	0.01	0.001	<	0.004	<	0.012
BACTERIOLOGICAL:						
Fecal Coliform			500	3000	-	1700

Lab ID Client ID SITE	Zenon MDL	UNITS	Zenon FR0035 McDonald Sl. Surface - 1m 1.0m 93-02-11	Zenon FR0249 McDonald Sl. Surface - 1m 1.0 m 94-02-23	Zenon FR0036 McDonald Sl. Bottom + 1m 6.0m 93-02-11	Zenon FR0250 McDonald Sl. Bottom + 1m 5.5 m 94-02-23
Sampled On:						
Latitude (N) Longitude (W)			49 - 12.78 123 - 11.26	49 - 12.78 123 - 11.26	49 - 12.78 123 - 11.26	49 - 12.78 123 - 11.26
ORGANIC PARAMETERS:						
Carbon Total Organic	0.5	mg /L	3	<5	3	<10
Adsorbable Org. Halide as Cl	0.01	"	0.03	0.03	0.03	0.02
Chlorophenolics:						
Pentachlorophenol	0.000001	mg/L	<	<	<	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	"	"	<	<	<	<
2,3,4,5-Tetrachlorophenol	"	"	<	<	<	<
3,4,5-Trichlorophenol	"	"	<	<	<	<
2,3,4-Trichlorophenol	"	"	<	<	<	<
2,3,5-Trichlorophenol	"	"	<	<	<	<
2,3,6-Trichlorophenol	"	"	<	<	<	<
2,4,5-Trichlorophenol	"	"	<	<	<	<
2,4,6-Trichlorophenol	"	"	<	<	<	<
2,4-Dichlorophenol	"	"	<	<	<	<
2,6-Dichlorophenol	"	"	<	<	<	<
2,5-Dichlorophenol	"	"	<	<	<	<
3,5-Dichlorophenol	"	"	<	<	<	<
2,3-Dichlorophenol	"	"	<	<	<	<
3,4-Dichlorophenol	"	"	<	<	<	<
4-Chlorophenol	"	"	<	<	<	<
Tetrachloroguaiacol	0.000002	"	<	<	<	<
3,4,5-Trichloroguaiacol	"	"	0.000004	<	0.000002	<
3,4,6-Trichloroguaiacol	"	"	<	<	<	<
4,5,6-Trichloroguaiacol	"	"	0.000002	<	<	<
4,5-Dichloroguaiacol	"	"	0.000005	0.000003	0.000003	<
4,6-Dichloroguaiacol	"	"	<	<	<	<
4-chloroguaiacol	"	"	<	<	<	<
5-Chloroguaiacol	"	"	<	<	0.000009	<
6-Chloroguaiacol	"	"	<	<	<	<
Tetrachlorocatechol	"	"	<	<	0.000006	<
3,4,5-Trichlorocatechol	"	"	0.000006	<	0.000004	<
3,4-Dichlorocatechol	"	"	<	<	<	<
3,5-Dichlorocatechol	"	"	<	<	<	<
4,5-Dichlorocatechol	"	"	<	<	<	<
4-Chlorocatechol	"	"	<	<	<	<
Tetrachloroveratrole	"	"	<	<	<	<
3,4,5-Trichloroveratrole	"	"	0.000003	<	<	<
4,5-Dichloroveratrole	"	"	<	<	<	<
2,6-Dichlorosyringaldehyde	"	"	<	<	<	<
2-Chlorosyringaldehyde	"	"	<	<	<	<
3,4,5-Trichlorosyringol	"	"	<	<	<	<
Trichlorotrimethoxybenzene	"	"	<	<	<	<
5,6-Dichlorovanillin	"	"	<	<	<	<
6-Chlorovanillin	"	"	0.000007	0.000005	0.000006	0.000002
Nonylphenol	0.000005	"	<	<	<	<
Resin and Fatty Acids:						
Abietic Acid	0.0005	mg/L	<	<	<	<
Arachidic Acid	0.0005	"	<	<	<	<
Behenic Acid	0.0005	"	<	<	<	<
Chlorodehydroabietic	0.0005	"	<	<	<	<
Dehydroabietic Acid	0.0005	"	<	<	<	<
Dichlorodehydroabietic	0.0005	"	<	<	<	<
Isopimaric Acid	0.0005	"	<	<	<	<
Lauric Acid	0.0005	"	<	<	<	<
Levo Pimaric Acid	0.0005	"	<	<	<	<
Lignoceric Acid	0.0005	"	<	<	<	<
Linoleic Acid	0.0005	"	<	<	<	<
Linolenic Acid	0.0005	"	<	<	<	<
Myristic Acid	0.0005	"	<	<	<	0.0007
Neobietic Acid	0.0005	"	<	<	<	<
Oleic Acid	0.0005	"	<	<	<	<
Palmitric Acid	0.0005	"	<	0.0005	0.0009	<
Palustric Acid	0.0005	"	<	<	<	<
Pimaric Acid	0.0005	"	<	<	<	<
Sandaraco Pimaric Acid	0.0005	"	<	<	<	<
Stearic Acid	0.0005	"	<	0.0006	<	<

Lab ID Client ID SITE	Zenon MDL	UNITS	Zenon FR0035 McDonald Sl. Surface - 1m 1.0m 93-02-11	Zenon FR0249 McDonald Sl. Surface - 1m 1.0 m 94-02-23	Zenon FR0036 McDonald Sl. Bottom + 1m 6.0m 93-02-11	Zenon FR0250 McDonald Sl. Bottom + 1m 5.5 m 94-02-23
Sampled On:						
Antisapstain Compounds: TCMTB	0.005	mg/L	<	<	<	<
Organochlorine Pesticides and PCBs						
Aldrin	0.000001	mg/L	<	<	<	<
BHC alpha-	0.000001	.	<	<	<	<
BHC beta-	0.000001	.	<	<	<	<
BHC delta-	0.000001	.	<	<	<	<
Chlordane alpha-	0.000005	.	<	<	<	<
Chlordane gamma-	0.000005	.	<	<	<	<
DDE p p'-	0.000005	.	<	<	<	<
DDD p p'-	0.000005	.	<	<	<	<
DDT p p'-	0.000005	.	<	<	<	<
Dieldrin	0.000005	.	<	<	<	<
Endosulfan I	0.000005	.	<	<	<	<
Endosulfan II	0.000005	.	<	<	<	<
Endosulfan sulphate	0.00001	.	<	<	<	<
DDT o p'-	0.000005	.	<	<	<	<
Endrin	0.000005	.	<	<	<	<
Hexachlorobenzene	0.0000005	.	<	<	0.000001	<
Heptachlor	0.000001	.	<	<	<	<
Heptachlor epoxide	0.000002	.	<	<	<	<
Lindane BHC gamma-	0.000001	.	<	<	<	<
Methoxychlor	0.00001	.	<	<	<	<
Mirex	0.00001	.	<	<	<	<
Nonachlor trans-	0.000005	.	<	<	<	<
Oxychlordane	0.000005	.	<	<	<	<
Toxaphene	0.00005	.	<	<	<	<
PCBs - Total	0.00002	.	<	<	<	<
Polyaromatic Hydrocarbons:						
Benzo(a)anthracene	0.00001	mg/L	<	0.00003	<	0.00002
7 12-Dimethylbenz(a)anthracene	0.00005	.	<	<	<	<
Dibenz(a h)anthracene	0.00001	.	<	<	<	<
Chrysene	0.00001	.	<	<	<	<
Benzo(b+k)fluoranthene	0.00001	.	<	<	<	<
3-Methylcholanthrene	0.00002	.	<	<	<	<
Benzo(j)fluoranthene	0.00001	.	<	<	<	<
Benzo(g h i)perylene	0.00002	.	<	<	<	<
Benzo(c)phenanthrene	0.00001	.	<	<	<	<
Pyrene	0.00001	.	0.00001	<	0.00001	<
Benzo(a)pyrene	0.00001	.	<	<	<	<
Dibenzo(a h)pyrene	0.00005	.	<	<	<	<
Dibenzo(a i)pyrene	0.00005	.	<	<	<	<
Dibenzo(a l)pyrene	0.00005	.	<	<	<	<
Indeno(1 2 3-c d)pyrene	0.00001	.	<	<	<	<
Acenaphthene	0.00001	.	<	0.00001	<	<
Acenaphthylene	0.00001	.	<	<	<	<
Anthracene	0.00001	.	<	<	<	<
Fluoranthene	0.00001	.	<	0.00001	<	<
Fluorene	0.00001	.	<	0.00001	<	<
Naphthalene	0.00001	.	0.00003	0.00009	<	0.00002
Phenanthrene	0.00001	.	0.00003	0.00004	<	0.00002
Total PAH	0.00005	.	0.00007	0.00019	<	0.00006
Total low MW PAH	0.00005	.	0.00006	0.00015	<	<
Total high MW PAH	0.00005	.	<	<	<	<

Lab ID Client ID SITE	Zenon MDL	Zenon FR0037 Eburne Sl. Surface - 1m 1.0m 93-02-11	Zenon FR0251 Eburne Sl. Surface - 1m 1.0 m 94-02-23	Zenon FR0038 Eburne Sl. Bottom + 1m 4.0m 93-02-11	Zenon FR0252 Eburne Sl. Bottom + 1m 3.5 m 94-02-23
Sampled On:					
Latitude (N) Longitude (W)		49 - 12.16 123 - 8.58	49 - 12.16 123 - 8.58	49 - 12.16 123 - 8.58	49 - 12.16 123 - 8.58
ORGANIC PARAMETERS:					
Carbon Total Organic	0.5	1	<5	2	<5
Adsorbable Org. Halide as Cl	0.01	0.03	0.02	0.04	0.03
Chlorophenolics:					
Pentachlorophenol	0.000001	<	<	<	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	.	<	<	<	0.000002
2,3,4,5-Tetrachlorophenol	.	<	<	<	<
3,4,5-Trichlorophenol	.	<	<	<	<
2,3,4-Trichlorophenol	.	<	<	<	<
2,3,5-Trichlorophenol	.	<	<	<	<
2,3,6-Trichlorophenol	.	<	<	<	<
2,4,5-Trichlorophenol	.	<	<	<	<
2,4,6-Trichlorophenol	.	<	0.000002	<	0.000002
2,4-Dichlorophenol	.	<	<	<	<
2,6-Dichlorophenol	.	<	<	<	<
2,5-Dichlorophenol	.	<	<	<	<
3,5-Dichlorophenol	.	<	<	<	<
2,3-Dichlorophenol	.	<	<	<	<
3,4-Dichlorophenol	.	<	<	<	<
4-Chlorophenol	.	<	<	<	<
Tetrachloroguaiacol	0.000002	<	<	<	<
3,4,5-Trichloroguaiacol	.	0.000003	<	<	<
3,4,6-Trichloroguaiacol	.	<	<	<	<
4,5,6-Trichloroguaiacol	.	<	<	<	<
4,5-Dichloroguaiacol	.	<	0.000004	<	0.000003
4,6-Dichloroguaiacol	.	<	<	<	<
4-chloroguaiacol	.	<	<	<	<
5-Chloroguaiacol	.	0.000007	<	<	<
6-Chloroguaiacol	.	<	<	<	<
Tetrachlorocatechol	.	<	<	<	<
3,4,5-Trichlorocatechol	.	0.000005	<	<	<
3,4-Dichlorocatechol	.	<	<	<	<
3,5-Dichlorocatechol	.	<	<	<	<
4,5-Dichlorocatechol	.	<	<	<	0.000003
4-Chlorocatechol	.	<	<	<	<
Tetrachloroveratrole	.	<	<	<	<
3,4,5-Trichloroveratrole	.	0.000002	<	<	<
4,5-Dichloroveratrole	.	<	<	<	<
2,6-Dichlorosyringaldehyde	.	<	<	<	<
2-Chlorosyringaldehyde	.	<	<	<	<
3,4,5-Trichlorosyringol	.	<	<	<	<
Trichlorotrimethoxybenzene	.	<	<	<	<
5,6-Dichlorovanillin	.	<	<	<	<
6-Chlorovanillin	.	0.000007	0.000006	<	0.000004
Nonylphenol	0.000005	<	<	<	<
Resin and Fatty Acids:					
Abietic Acid	0.0005	<	<	<	<
Arachidic Acid	0.0005	<	<	<	<
Behenic Acid	0.0005	<	<	<	<
Chlorodehydroabietic	0.0005	<	<	<	<
Dehydroabietic Acid	0.0005	<	<	<	<
Dichlorodehydroabietic	0.0005	<	<	<	<
Isopimaric Acid	0.0005	<	<	<	<
Lauric Acid	0.0005	<	<	<	<
Levo Pimaric Acid	0.0005	<	<	<	<
Lignoceric Acid	0.0005	<	<	<	<
Linoleic Acid	0.0005	<	0.0008	<	<
Linolenic Acid	0.0005	<	<	<	<
Myristic Acid	0.0005	<	0.0007	<	<
Neobietic Acid	0.0005	<	<	<	<
Oleic Acid	0.0005	0.0012	0.0018	<	0.0009
Palmitric Acid	0.0005	<	0.0008	<	0.0008
Palustric Acid	0.0005	<	<	<	<
Pimaric Acid	0.0005	<	<	<	<
Sandaraco Pimaric Acid	0.0005	<	<	<	<
Stearic Acid	0.0005	<	0.001	<	0.001

Lab ID Client ID SITE	Zenon MDL	Zenon FR0037 Eburne Sl. Surface - 1m 1.0m 93-02-11	Zenon FR0251 Eburne Sl. Surface - 1m 1.0m 94-02-23	Zenon FR0038 Eburne Sl. Bottom + 1m 4.0m 93-02-11	Zenon FR0252 Eburne Sl. Bottom + 1m 3.5m 94-02-23
Sampled On:					
Antisepstain Compounds:					
TCMTB	0.005	<	<	<	<
Organochlorine Pesticides and PCBs					
Aldrin	0.000001	<	<	<	<
BHC alpha-	0.000001	<	<	<	<
BHC beta-	0.000001	<	<	<	<
BHC delta-	0.000001	<	<	<	<
Chlordane alpha-	0.000005	<	<	<	<
Chlordane gamma-	0.000005	<	<	<	<
DDE p p'-	0.000005	<	<	<	<
DDD p p'-	0.000005	<	<	<	<
DDT p p'-	0.000005	<	<	<	<
Dieldrin	0.000005	<	<	<	<
Endosulfan I	0.000005	<	<	<	<
Endosulfan II	0.000005	<	<	<	<
Endosulfan sulphate	0.00001	<	<	<	<
DDT o p'-	0.000005	<	<	<	<
Endrin	0.000005	<	<	<	<
Hexachlorobenzene	0.0000005	<	<	<	<
Heptachlor	0.000001	<	<	<	<
Heptachlor epoxide	0.000002	<	<	<	<
Lindane BHC gamma-	0.000001	<	<	<	<
Methoxychlor	0.00001	<	<	<	<
Mirex	0.00001	<	<	<	<
Nonachlor trans-	0.000005	<	<	<	<
Oxychlorane	0.000005	<	<	<	<
Toxaphene	0.00005	<	<	<	<
PCBs - Total	0.00002	<	<	<	<
Polyaromatic Hydrocarbons:					
Benzo(a)anthracene	0.00001	<	0.00002	<	0.00003
7 12-Dimethylbenz(a)anthracene	0.00005	<	<	<	<
Dibenz(a h)anthracene	0.00001	<	<	<	<
Chrysene	0.00001	<	0.00001	<	<
Benzo(b+k)fluoranthene	0.00001	<	<	<	<
3-Methylcholanthrene	0.00002	<	<	<	<
Benzo(j)fluoranthene	0.00001	<	<	<	<
Benzo(g h i)perylene	0.00002	<	<	<	<
Benzo(c)phenanthrene	0.00001	<	<	<	<
Pyrene	0.00001	0.00001	0.00002	0.00001	<
Benzo(a)pyrene	0.00001	<	<	<	<
Dibenzo(a h)pyrene	0.00005	<	<	<	<
Dibenzo(a i)pyrene	0.00005	<	<	<	<
Dibenzo(a l)pyrene	0.00005	<	<	<	<
Indeno(1 2 3-c d)pyrene	0.00001	<	<	<	<
Acenaphthene	0.00001	0.00001	0.00003	<	0.00002
Acenaphthylene	0.00001	<	<	<	<
Anthracene	0.00001	<	<	<	<
Fluoranthene	0.00001	0.00001	0.00003	<	<
Fluorene	0.00001	<	0.00002	<	0.00002
Naphthalene	0.00001	0.00004	0.00014	<	0.00014
Phenanthrene	0.00001	0.00007	0.00004	0.0001	0.00004
Total PAH	0.00005	0.00014	0.00031	0.00011	0.00025
Total low MW PAH	0.00005	0.00012	0.00023	0.0001	0.00022
Total high MW PAH	0.00005	<	0.00008	<	<

Lab ID Client ID SITE	Zenon MDL	Zenon FR0039 Tree Is. Sl. Surface - 1m 1.0m 93-02-10	Zenon FR0253 Tree Is. Sl. Surface - 1m 1.0 m 94-02-22	Zenon FR0040 Tree Is. Sl. Bottom + 1m 3.0m 93-02-10	Zenon FR0254 Tree Is. Sl. Bottom + 1m 3.0 m 94-02-22
Sampled On:					
Latitude (N) Longitude (W)		49 - 11.08 122 - 57.70	49 - 11.08 122 - 57.70	49 - 11.08 122 - 57.70	49 - 11.08 122 - 57.70
ORGANIC PARAMETERS:					
Carbon Total Organic	0.5	2	2.2	2	2.7
Adsorbable Org. Halide as Cl	0.01	0.03	0.02	0.02	0.03
Chlorophenolics:					
Pentachlorophenol	0.000001	<	<	<	<
2,3,4,6+2,3,5,6-Tetrachlorophenol	.	<	<	<	<
2,3,4,5-Tetrachlorophenol	.	<	<	<	<
3,4,5-Trichlorophenol	.	<	<	<	<
2,3,4-Trichlorophenol	.	<	<	<	<
2,3,5-Trichlorophenol	.	<	<	<	<
2,3,6-Trichlorophenol	.	<	<	<	<
2,4,5-Trichlorophenol	.	<	<	<	<
2,4,6-Trichlorophenol	.	<	0.000002	<	<
2,4-Dichlorophenol	.	<	<	<	<
2,6-Dichlorophenol	.	<	<	<	<
2,5-Dichlorophenol	.	<	<	<	<
3,5-Dichlorophenol	.	<	<	<	<
2,3-Dichlorophenol	.	<	<	<	<
3,4-Dichlorophenol	.	<	<	<	<
4-Chlorophenol	.	<	<	<	<
Tetrachloroguaiacol	0.000002	<	<	<	<
3,4,5-Trichloroguaiacol	.	0.000005	0.000003	0.000007	0.000002
3,4,6-Trichloroguaiacol	.	<	<	<	<
4,5,6-Trichloroguaiacol	.	0.000004	0.000002	0.000005	0.000002
4,5-Dichloroguaiacol	.	<	0.000005	0.000018	0.000004
4,6-Dichloroguaiacol	.	<	<	<	<
4-chloroguaiacol	.	<	<	<	<
5-Chloroguaiacol	.	<	<	0.000007	<
6-Chloroguaiacol	.	<	<	<	<
Tetrachlorocatechol	.	<	<	<	<
3,4,5-Trichlorocatechol	.	0.000009	<	<	<
3,4-Dichlorocatechol	.	<	<	<	<
3,5-Dichlorocatechol	.	<	<	<	<
4,5-Dichlorocatechol	.	<	0.000003	<	<
4-Chlorocatechol	.	<	<	<	<
Tetrachloroveratrole	.	<	<	<	<
3,4,5-Trichloroveratrole	.	<	<	<	<
4,5-Dichloroveratrole	.	<	<	<	<
2,6-Dichlorosyringaldehyde	.	<	<	<	<
2-Chlorosyringaldehyde	.	<	<	<	<
3,4,5-Trichlorosyringol	.	<	<	<	<
Trichlorotrimethoxybenzene	.	<	<	<	<
5,6-Dichlorovanillin	.	<	<	0.000007	<
6-Chlorovanillin	.	0.000009	0.000006	0.000070	0.000008
Nonylphenol	0.000005	<	<	<	<
Resin and Fatty Acids:					
Abietic Acid	0.0005	<	<	<	<
Arachidic Acid	0.0005	<	<	<	<
Behenic Acid	0.0005	<	<	<	<
Chlorodehydroabietic	0.0005	<	<	<	<
Dehydroabietic Acid	0.0005	<	<	<	<
Dichlorodehydroabietic	0.0005	<	<	<	<
Isopimaric Acid	0.0005	<	<	<	<
Lauric Acid	0.0005	<	<	<	<
Levo Pimaric Acid	0.0005	<	<	<	<
Lignoceric Acid	0.0005	<	<	<	<
Linoleic Acid	0.0005	<	<	<	<
Linolenic Acid	0.0005	<	<	<	<
Myristic Acid	0.0005	<	0.0005	<	0.0007
Neobietic Acid	0.0005	<	<	<	<
Oleic Acid	0.0005	<	0.0011	<	<
Palmitric Acid	0.0005	<	0.001	0.0007	0.0016
Palustric Acid	0.0005	<	<	<	<
Pimaric Acid	0.0005	<	<	<	<
Sandaraco Pimaric Acid	0.0005	<	<	<	<
Stearic Acid	0.0005	<	0.0009	<	0.0017

Lab ID Client ID SITE	Zenon MDL	Zenon FR0039 Tree Is. Sl. Surface - 1m 1.0m 93-02-10	Zenon FR0253 Tree Is. Sl. Surface - 1m 1.0 m 94-02-22	Zenon FR0040 Tree Is. Sl. Bottom + 1m 3.0m 93-02-10	Zenon FR0254 Tree Is. Sl. Bottom + 1m 3.0 m 94-02-22
Sampled On:					
Antisapstain Compounds: TCMTB	0.005	<	<	<	<
Organochlorine Pesticides and PCBs					
Aldrin	0.000001	<	<	<	<
BHC alpha-	0.000001	<	<	<	<
BHC beta-	0.000001	<	<	<	<
BHC delta-	0.000001	<	<	<	<
Chlordane alpha-	0.000005	<	<	<	<
Chlordane gamma-	0.000005	<	<	<	<
DDE p p'-	0.000005	<	<	<	<
DDD p p'-	0.000005	<	<	<	<
DDT p p'-	0.000005	<	<	<	<
Dieldrin	0.000005	<	<	<	<
Endosulfan I	0.000005	<	<	<	<
Endosulfan II	0.000005	<	<	<	<
Endosulfan sulphate	0.00001	<	<	<	<
DDT o p'-	0.000005	<	<	<	<
Endrin	0.000005	<	<	<	<
Hexachlorobenzene	0.0000005	<	<	<	<
Heptachlor	0.000001	<	<	<	<
Heptachlor epoxide	0.000002	<	<	<	<
Lindane BHC gamma-	0.000001	<	<	<	<
Methoxychlor	0.00001	<	<	<	<
Mirex	0.00001	<	<	<	<
Nonachlor trans-	0.000005	<	<	<	<
Oxychlordane	0.000005	<	<	<	<
Toxaphene	0.00005	<	<	<	<
PCBs - Total	0.00002	<	<	<	<
Polyaromatic Hydrocarbons:					
Benz(a)anthracene	0.00001	<	0.00002	<	0.00002
7 12-Dimethylbenz(a)anthracene	0.00005	<	<	<	<
Dibenz(a h)anthracene	0.00001	<	<	<	<
Chrysene	0.00001	<	0.00001	<	0.00001
Benzo(b+k)fluoranthene	0.00001	<	0.00001	<	0.00001
3-Methylcholanthrene	0.00002	<	<	<	<
Benzo(j)fluoranthene	0.00001	<	<	<	<
Benzo(g h i)perylene	0.00002	<	<	<	<
Benzo(c)phenanthrene	0.00001	<	<	<	<
Pyrene	0.00001	<	0.00003	<	0.00002
Benzo(a)pyrene	0.00001	<	<	<	<
Dibenzo(a h)pyrene	0.00005	<	<	<	<
Dibenzo(a i)pyrene	0.00005	<	<	<	<
Dibenzo(a l)pyrene	0.00005	<	<	<	<
Indeno(1 2 3-c d)pyrene	0.00001	<	<	<	<
Acenaphthene	0.00001	0.00003	<	0.00002	<
Acenaphthylene	0.00001	<	<	<	<
Anthracene	0.00001	<	<	<	<
Fluoranthene	0.00001	<	<	<	0.00002
Fluorene	0.00001	0.00002	<	0.00002	<
Naphthalene	0.00001	0.00008	<	0.00009	0.00003
Phenanthrene	0.00001	<	0.00003	<	0.00003
Total PAH	0.00005	0.00013	0.0001	0.00013	0.00014
Total low MW PAH	0.00005	0.00013	<	0.00013	0.00006
Total high MW PAH	0.00005	<	0.00007	<	0.00008

Lab ID Client ID SITE	Zenon MDL	Zenon FR0028 Ladner Sl. Surface - 1m 1.0m 93-02-10	Zenon FR0242 Ladner Sl. Surface - 1m 1.0 m 94-02-21	Zenon FR0029 Ladner Sl. Bottom + 1m 5.0m 93-02-10	Zenon FR0243 Ladner Sl. Bottom + 1m 5.0 m 94-02-21
Sampled On:					
Latitude (N) Longitude (W)		49 - 5.54 123 - 5.40	49 - 5.54 123 - 5.40	49 - 5.54 123 - 5.40	49 - 5.54 123 - 5.40
ORGANIC PARAMETERS:					
Carbon Total Organic	0.5	3	<2	3	<5
Adsorbable Org. Halide as Cl	0.01	0.03	0.03	0.03	0.03
Chlorophenolics:					
Pentachlorophenol	0.000001	<	0.000002	<	0.000002
2,3,4,6+2,3,5,6-Tetrachlorophenol	.	<	<	<	<
2,3,4,5-Tetrachlorophenol	.	<	<	<	<
3,4,5-Trichlorophenol	.	<	<	<	<
2,3,4-Trichlorophenol	.	<	<	<	<
2,3,5-Trichlorophenol	.	<	<	<	<
2,3,6-Trichlorophenol	.	<	<	<	<
2,4,5-Trichlorophenol	.	<	<	<	<
2,4,6-Trichlorophenol	.	<	0.000002	<	0.000003
2,4-Dichlorophenol	.	<	<	<	<
2,6-Dichlorophenol	.	<	<	<	<
2,5-Dichlorophenol	.	<	<	<	<
3,5-Dichlorophenol	.	<	<	<	<
2,3-Dichlorophenol	.	<	<	<	<
3,4-Dichlorophenol	.	<	<	<	<
4-Chlorophenol	.	<	<	<	<
Tetrachloroguaiacol	0.000002	<	<	<	<
3,4,5-Trichloroguaiacol	.	0.000005	<	<	<
3,4,6-Trichloroguaiacol	.	<	<	<	<
4,5,6-Trichloroguaiacol	.	<	<	<	<
4,5-Dichloroguaiacol	.	0.000012	0.000002	0.000006	0.000027
4,6-Dichloroguaiacol	.	<	<	<	<
4-chloroguaiacol	.	<	<	<	<
5-Chloroguaiacol	.	<	<	<	<
6-Chloroguaiacol	.	<	<	<	<
Tetrachlorocatechol	.	<	<	<	<
3,4,5-Trichlorocatechol	.	0.000005	<	0.000007	<
3,4-Dichlorocatechol	.	<	<	<	<
3,5-Dichlorocatechol	.	<	<	<	<
4,5-Dichlorocatechol	.	<	<	<	<
4-Chlorocatechol	.	<	<	<	<
Tetrachloroveratrole	.	<	<	<	<
3,4,5-Trichloroveratrole	.	<	<	<	<
4,5-Dichloroveratrole	.	<	<	<	<
2,6-Dichlorosyringaldehyde	.	<	<	<	<
2-Chlorosyringaldehyde	.	<	<	<	<
3,4,5-Trichlorosyringol	.	<	<	<	<
Trichlorotrimethoxybenzene	.	<	<	<	<
5,6-Dichlorovanillin	.	0.000006	<	<	<
6-Chlorovanillin	.	0.000041	0.000002	0.000007	0.000037
Nonylphenol	0.000005	<	<	<	<
Resin and Fatty Acids:					
Abietic Acid	0.0005	<	<	<	<
Arachidic Acid	0.0005	<	<	<	<
Behenic Acid	0.0005	<	<	<	<
Chlorodehydroabietic	0.0005	<	<	<	<
Dehydroabietic Acid	0.0005	<	<	<	<
Dichlorodehydroabietic	0.0005	<	<	<	<
Isopimaric Acid	0.0005	<	<	<	<
Lauric Acid	0.0005	<	<	<	<
Levo Pimaric Acid	0.0005	<	<	<	<
Lignoceric Acid	0.0005	<	<	<	<
Linoleic Acid	0.0005	<	<	<	<
Linolenic Acid	0.0005	<	<	<	<
Myristic Acid	0.0005	0.0012	0.0005	<	<
Neobietic Acid	0.0005	<	<	<	<
Oleic Acid	0.0005	0.0022	0.0008	<	<
Palmitric Acid	0.0005	0.0064	0.0006	0.0016	0.0007
Palustric Acid	0.0005	<	<	<	<
Pimaric Acid	0.0005	<	<	<	<
Sandaraco Pimaric Acid	0.0005	<	<	<	<
Stearic Acid	0.0005	0.01	0.0011	0.0015	0.001

Lab ID Client ID SITE	Zenon MDL	Zenon FR0028 Ladner St. Surface - 1m 1.0m 93-02-10	Zenon FR0242 Ladner St. Surface - 1m 1.0 m 94-02-21	Zenon FR0029 Ladner St. Bottom + 1m 5.0m 93-02-10	Zenon FR0243 Ladner St. Bottom + 1m 5.0 m 94-02-21
Sampled On:					
Antisapstain Compounds:					
TCMTB	0.005	<	<	<	<
Organochlorine Pesticides and PCBs					
Aldrin	0.000001	<	<	<	<
BHC alpha-	0.000001	<	<	<	<
BHC beta-	0.000001	<	<	<	<
BHC delta-	0.000001	<	<	<	<
Chlordane alpha-	0.000005	<	<	<	<
Chlordane gamma-	0.000005	<	<	<	<
DDE p p'-	0.000005	<	<	<	<
DDD p p'-	0.000005	<	<	<	<
DDT p p'-	0.000005	<	<	<	<
Dieldrin	0.000005	<	<	<	<
Endosulfan I	0.000005	<	<	<	<
Endosulfan II	0.000005	<	<	<	<
Endosulfan sulphate	0.00001	<	<	<	<
DDT o p'-	0.000005	<	<	<	<
Endrin	0.000005	<	<	<	<
Hexachlorobenzene	0.0000005	<	<	<	<
Heptachlor	0.000001	<	<	<	<
Heptachlor epoxide	0.000002	<	<	<	<
Lindane BHC gamma-	0.000001	<	<	<	<
Methoxychlor	0.00001	<	<	<	<
Mirex	0.00001	<	<	<	<
Nonachlor trans-	0.000005	<	<	<	<
Oxychlorodane	0.000005	<	<	<	<
Toxaphene	0.00005	<	<	<	<
PCBs - Total	0.00002	<	<	<	<
Polyaromatic Hydrocarbons:					
Benz(a)anthracene	0.00001	<	0.00003	<	0.00003
7 12-Dimethylbenz(a)anthracene	0.00005	<	<	<	<
Dibenz(a h)anthracene	0.00001	<	<	<	<
Chrysene	0.00001	<	0.00001	<	<
Benzo(b+k)fluoranthene	0.00001	<	<	<	0.00001
3-Methylcholanthrene	0.00002	<	<	<	<
Benzo(j)fluoranthene	0.00001	<	<	<	<
Benzo(g h i)perylene	0.00002	<	<	<	<
Benzo(c)phenanthrene	0.00001	<	<	<	<
Pyrene	0.00001	<	0.00003	<	0.00003
Benzo(a)pyrene	0.00001	<	<	<	<
Dibenzo(a h)pyrene	0.00005	<	<	<	<
Dibenzo(a i)pyrene	0.00005	<	<	<	<
Dibenzo(a l)pyrene	0.00005	<	<	<	<
Indeno(1 2 3-c d)pyrene	0.00001	<	<	<	<
Acenaphthene	0.00001	0.00001	0.00001	<	0.00002
Acenaphthylene	0.00001	<	<	<	<
Anthracene	0.00001	<	<	<	<
Fluoranthene	0.00001	<	0.00004	<	0.00003
Fluorene	0.00001	<	0.00001	<	0.00002
Naphthalene	0.00001	0.00004	0.00005	0.00002	0.00007
Phenanthrene	0.00001	0.00001	0.00004	0.00001	0.00004
Total PAH	0.00005	0.00006	0.00022	<	0.00025
Total low MW PAH	0.00005	0.00006	0.00011	<	0.00015
Total high MW PAH	0.00005	<	0.00011	<	0.0001

Lab ID Client ID SITE	Zenon MDL	Zenon FR0030 Deas Sl. Surface - 1m 1.0m 93-02-10	Zenon FR0244 Deas Sl. Surface - 1m 1.0 m 94-02-21	Zenon FR0031 Deas Sl. Bottom + 1m 4.0m 93-02-10	Zenon FR0245 Deas Sl. Bottom + 1m 6.5 m 94-02-21
Sampled On:					
Latitude (N) Longitude (W)		49 - 7.04 123 - 3.72	49 - 7.04 123 - 3.72	49 - 7.04 123 - 3.72	49 - 7.04 123 - 3.72
ORGANIC PARAMETERS:					
Carbon Total Organic	0.5	3	<3	3	<5
Adsorbable Org. Halide as Cl	0.01	0.02	0.03	0.03	0.04
Chlorophenolics:					
Pentachlorophenol	0.000001	<	0.000002	<	0.000001
2,3,4,6+2,3,5,6-Tetrachlorophenol	.	<	<	<	<
2,3,4,5-Tetrachlorophenol	.	<	<	<	<
3,4,5-Trichlorophenol	.	<	<	<	<
2,3,4-Trichlorophenol	.	<	<	<	<
2,3,5-Trichlorophenol	.	<	<	<	<
2,3,6-Trichlorophenol	.	<	<	<	<
2,4,5-Trichlorophenol	.	<	<	<	<
2,4,6-Trichlorophenol	.	<	0.000002	<	0.000002
2,4-Dichlorophenol	.	<	<	<	<
2,6-Dichlorophenol	.	<	<	<	<
2,5-Dichlorophenol	.	<	<	<	<
3,5-Dichlorophenol	.	<	<	<	<
2,3-Dichlorophenol	.	<	<	<	<
3,4-Dichlorophenol	.	<	<	<	<
4-Chlorophenol	.	<	<	<	<
Tetrachloroguaiacol	0.000002	<	<	<	<
3,4,5-Trichloroguaiacol	.	0.000006	0.000002	<	<
3,4,6-Trichloroguaiacol	.	<	<	<	<
4,5,6-Trichloroguaiacol	.	0.000005	<	<	<
4,5-Dichloroguaiacol	.	0.000018	0.000003	0.000004	0.000003
4,6-Dichloroguaiacol	.	<	<	<	<
4-chloroguaiacol	.	<	<	<	<
5-Chloroguaiacol	.	<	<	<	<
6-Chloroguaiacol	.	<	<	<	<
Tetrachlorocatechol	.	<	<	<	<
3,4,5-Trichlorocatechol	.	0.000006	<	0.000006	<
3,4-Dichlorocatechol	.	<	<	<	<
3,5-Dichlorocatechol	.	<	<	<	<
4,5-Dichlorocatechol	.	<	0.000002	<	<
4-Chlorocatechol	.	<	<	<	<
Tetrachloroveratrole	.	<	<	<	<
3,4,5-Trichloroveratrole	.	<	<	<	<
4,5-Dichloroveratrole	.	<	<	<	<
2,6-Dichlorosyringaldehyde	.	<	<	<	<
2-Chlorosyringaldehyde	.	<	<	<	<
3,4,5-Trichlorosyringol	.	<	<	<	<
Trichlorotrimethoxybenzene	.	<	<	<	<
5,6-Dichlorovanillin	.	0.000009	<	<	<
6-Chlorovanillin	.	0.000061	0.000003	<	0.000003
Nonylphenol	0.000005	<	<	<	<
Resin and Fatty Acids:					
Abietic Acid	0.0005	<	<	<	<
Arachidic Acid	0.0005	<	<	<	<
Behenic Acid	0.0005	<	<	<	<
Chlorodehydroabietic	0.0005	<	<	<	<
Dehydroabietic Acid	0.0005	<	<	<	<
Dichlorodehydroabietic	0.0005	<	<	<	<
Isopimaric Acid	0.0005	<	<	<	<
Lauric Acid	0.0005	<	<	<	<
Levo Pimaric Acid	0.0005	<	<	<	<
Lignoceric Acid	0.0005	<	<	<	<
Linoleic Acid	0.0005	<	<	<	<
Linolenic Acid	0.0005	<	<	<	<
Myristic Acid	0.0005	<	<	<	0.0005
Neobietic Acid	0.0005	<	<	<	<
Oleic Acid	0.0005	0.002	<	<	<
Palmitric Acid	0.0005	0.0038	0.0006	<	0.0014
Palustric Acid	0.0005	<	<	<	<
Pimaric Acid	0.0005	<	<	<	<
Sandaraco Pimaric Acid	0.0005	<	<	<	<
Stearic Acid	0.0005	0.003	0.0011	<	0.0007

Lab ID Client ID SITE	Zenon MDL	Zenon FR0030 Deas Sl. Surface - 1m 1.0m 93-02-10	Zenon FR0244 Deas Sl. Surface - 1m 1.0 m 94-02-21	Zenon FR0031 Deas Sl. Bottom + 1m 4.0m 93-02-10	Zenon FR0245 Deas Sl. Bottom + 1m 6.5 m 94-02-21
Sampled On:					
Antisapstain Compounds:					
TCMTB	0.005	<	<	<	<
Organochlorine Pesticides and PCBs					
Aldrin	0.000001	<	<	<	<
BHC alpha-	0.000001	<	<	<	<
BHC beta-	0.000001	<	<	<	<
BHC delta-	0.000001	<	<	<	<
Chlordane alpha-	0.000005	<	<	<	<
Chlordane gamma-	0.000005	<	<	<	<
DDE p p'-	0.000005	<	<	<	<
DDD p p'-	0.000005	<	<	<	<
DDT p p'-	0.000005	<	<	<	<
Dieldrin	0.000005	<	<	<	<
Endosulfan I	0.000005	<	<	<	<
Endosulfan II	0.000005	<	<	<	<
Endosulfan sulphate	0.00001	<	<	<	<
DDT o p'-	0.000005	<	<	<	<
Endrin	0.000005	<	<	<	<
Hexachlorobenzene	0.0000005	<	<	<	<
Heptachlor	0.000001	<	<	<	<
Heptachlor epoxide	0.000002	<	<	<	<
Lindane BHC gamma-	0.000001	<	<	<	<
Methoxychlor	0.00001	<	<	<	<
Mirex	0.00001	<	<	<	<
Nonachlor trans-	0.000005	<	<	<	<
Oxychlordane	0.000005	<	<	<	<
Toxaphene	0.00005	<	<	<	<
PCBs - Total	0.00002	<	<	<	<
Polyaromatic Hydrocarbons:					
Benzo(a)anthracene	0.00001	<	0.00002	<	0.00002
7 12-Dimethylbenzo(a)anthracene	0.00005	<	<	<	<
Dibenzo(a h)anthracene	0.00001	<	<	<	<
Chrysene	0.00001	<	<	<	<
Benzo(b+k)fluoranthene	0.00001	<	0.00001	<	<
3-Methylcholanthrene	0.00002	<	<	<	<
Benzo(j)fluoranthene	0.00001	<	<	<	<
Benzo(g h i)perylene	0.00002	<	<	<	<
Benzo(c)phenanthrene	0.00001	<	<	<	<
Pyrene	0.00001	<	0.00002	<	0.00002
Benzo(a)pyrene	0.00001	<	<	<	<
Dibenzo(a h)pyrene	0.00005	<	<	<	<
Dibenzo(a i)pyrene	0.00005	<	<	<	<
Dibenzo(a l)pyrene	0.00005	<	<	<	<
Indeno(1 2 3-c d)pyrene	0.00001	<	<	<	<
Acenaphthene	0.00001	<	<	<	<
Acenaphthylene	0.00001	<	<	<	<
Anthracene	0.00001	<	<	<	<
Fluoranthene	0.00001	<	0.00002	<	0.00002
Fluorene	0.00001	<	<	<	<
Naphthalene	0.00001	0.00002	0.00004	<	0.00001
Phenanthrene	0.00001	<	0.00003	<	0.00001
Total PAH	0.00005	<	0.00014	<	0.00008
Total low MW PAH	0.00005	<	0.00007	<	<
Total high MW PAH	0.00005	<	0.00007	<	0.00006

Lab ID Client ID SITE	Zenon MDL	Zenon FR0032 Gundersen Sl. Surface - 1m 1.0m 93-02-10	Zenon FR0246 Gundersen Sl. Surface - 1m 1.0 m 94-02-22	Zenon FR0033 Gundersen Sl. Bottom + 1m 4.0m 93-02-10	Zenon FR0247 Gundersen Sl. Bottom + 1m 4.0 m 94-02-22
Sampled On:					
Latitude (N) Longitude (W)		49 - 10.39 122 - 55.11	49 - 10.39 122 - 55.11	49 - 10.39 122 - 55.11	49 - 10.39 122 - 55.11
ORGANIC PARAMETERS:					
Carbon Total Organic	0.5	3	2.5	3	2.3
Adsorbable Org. Halide as Cl	0.01	0.02	0.02	0.03	0.02
Chlorophenolics:					
Pentachlorophenol	0.000001	^	^	^	0.000004
2,3,4,6+2,3,5,6-Tetrachlorophenol	.	^	^	^	^
2,3,4,5-Tetrachlorophenol	.	^	^	^	^
3,4,5-Trichlorophenol	.	^	^	^	^
2,3,4-Trichlorophenol	.	^	^	^	^
2,3,5-Trichlorophenol	.	^	^	^	^
2,3,6-Trichlorophenol	.	^	^	^	^
2,4,5-Trichlorophenol	.	^	^	^	^
2,4,6-Trichlorophenol	.	^	0.000003	^	0.000001
2,4-Dichlorophenol	.	^	^	^	^
2,6-Dichlorophenol	.	^	^	^	^
2,5-Dichlorophenol	.	^	^	^	^
3,5-Dichlorophenol	.	^	^	^	^
2,3-Dichlorophenol	.	^	^	^	^
3,4-Dichlorophenol	.	^	^	^	^
4-Chlorophenol	.	^	^	^	^
Tetrachloroguaiacol	0.000002	^	^	^	^
3,4,5-Trichloroguaiacol	.	0.000005	0.000005	0.000008	^
3,4,6-Trichloroguaiacol	.	^	^	^	^
4,5,6-Trichloroguaiacol	.	0.000004	^	0.000004	^
4,5-Dichloroguaiacol	.	0.000008	0.000012	^	0.000002
4,6-Dichloroguaiacol	.	^	^	^	^
4-chloroguaiacol	.	^	^	^	^
5-Chloroguaiacol	.	^	^	^	^
6-Chloroguaiacol	.	^	^	^	^
Tetrachlorocatechol	.	^	^	^	^
3,4,5-Trichlorocatechol	.	^	^	^	^
3,4-Dichlorocatechol	.	^	^	^	^
3,5-Dichlorocatechol	.	^	^	^	^
4,5-Dichlorocatechol	.	^	0.000002	^	^
4-Chlorocatechol	.	^	^	^	^
Tetrachloroveratrole	.	^	^	^	^
3,4,5-Trichloroveratrole	.	^	^	^	^
4,5-Dichloroveratrole	.	^	^	^	^
2,6-Dichlorosyringaldehyde	.	^	^	^	^
2-Chlorosyringaldehyde	.	^	^	^	^
3,4,5-Trichlorosyringol	.	^	^	^	^
Trichlorotrimethoxybenzene	.	^	^	^	^
5,6-Dichlorovanillin	.	^	0.000005	^	^
6-Chlorovanillin	.	0.000010	0.000030	0.000008	0.000002
Nonylphenol	0.000005	^	^	^	^
Resin and Fatty Acids:					
Abietic Acid	0.0005	^	^	^	^
Arachidic Acid	0.0005	^	^	^	^
Behenic Acid	0.0005	^	^	^	^
Chlorodehydroabietic	0.0005	^	^	^	^
Dehydroabietic Acid	0.0005	^	^	^	^
Dichlorodehydroabietic	0.0005	^	^	^	^
Isopimaric Acid	0.0005	^	^	^	^
Lauric Acid	0.0005	^	^	^	^
Levo Pimaric Acid	0.0005	^	^	^	^
Lignoceric Acid	0.0005	^	^	^	^
Linoleic Acid	0.0005	^	^	^	^
Linolenic Acid	0.0005	^	^	^	^
Myristic Acid	0.0005	^	^	^	^
Neoabietic Acid	0.0005	^	^	^	^
Oleic Acid	0.0005	^	0.0004	^	^
Palmitric Acid	0.0005	^	0.001	^	0.001
Palustric Acid	0.0005	^	^	^	^
Pimaric Acid	0.0005	^	^	^	^
Sandaraco Pimaric Acid	0.0005	^	^	^	^
Stearic Acid	0.0005	^	0.0012	^	0.0012

Lab ID Client ID SITE	Zenon MDL	Zenon FR0032 Gundersen Sl. Surface - 1m 1.0m 93-02-10	Zenon FR0246 Gundersen Sl. Surface - 1m 1.0 m 94-02-22	Zenon FR0033 Gundersen Sl. Bottom + 1m 4.0m 93-02-10	Zenon FR0247 Gundersen Sl. Bottom + 1m 4.0 m 94-02-22
Sampled On:					
Antisapstain Compounds:					
TCMTB	0.005	<	<	<	<
Organochlorine Pesticides and PCBs					
Aldrin	0.000001	<	<	<	<
BHC alpha-	0.000001	<	<	<	<
BHC beta-	0.000001	<	<	<	<
BHC delta-	0.000001	<	<	<	<
Chlordane alpha-	0.000005	<	<	<	<
Chlordane gamma-	0.000005	<	<	<	<
DDE p p'-	0.000005	<	<	<	<
DDD p p'-	0.000005	<	<	<	<
DDT p p'-	0.000005	<	<	<	<
Dieldrin	0.000005	<	<	<	<
Endosulfan I	0.000005	<	<	<	<
Endosulfan II	0.000005	<	<	<	<
Endosulfan sulphate	0.00001	<	<	<	<
DDT o p'-	0.000005	<	<	<	<
Endrin	0.000005	<	<	<	<
Hexachlorobenzene	0.0000005	<	<	<	<
Heptachlor	0.000001	<	<	<	<
Heptachlor epoxide	0.000002	<	<	<	<
Lindane BHC gamma-	0.000001	<	<	<	<
Methoxychlor	0.00001	<	<	<	<
Mirex	0.00001	<	<	<	<
Nonachlor trans-	0.000005	<	<	<	<
Oxychlorane	0.000005	<	<	<	<
Toxaphene	0.00005	<	<	<	<
PCBs - Total	0.00002	<	<	<	<
Polyaromatic Hydrocarbons:					
Benz(a)anthracene	0.00001	<	0.00003	<	0.00004
7 12-Dimethylbenz(a)anthracene	0.00005	<	<	<	<
Dibenz(a h)anthracene	0.00001	<	<	<	<
Chrysene	0.00001	<	0.00002	<	0.00006
Benzo(b+k)fluoranthene	0.00001	<	0.00002	<	0.00009
3-Methylcholanthrene	0.00002	<	<	<	<
Benzo(j)fluoranthene	0.00001	<	<	<	<
Benzo(g h i)perylene	0.00002	<	<	<	0.00005
Benzo(c)phenanthrene	0.00001	<	<	<	0.00001
Pyrene	0.00001	0.00001	0.00003	0.00001	0.00014
Benzo(a)pyrene	0.00001	<	<	<	0.00002
Dibenzo(a h)pyrene	0.00005	<	<	<	<
Dibenzo(a i)pyrene	0.00005	<	<	<	<
Dibenzo(a l)pyrene	0.00005	<	<	<	<
Indeno(1 2 3-c d)pyrene	0.00001	<	<	<	0.00004
Acenaphthene	0.00001	<	0.00001	<	0.00002
Acenaphthylene	0.00001	<	<	<	0.00001
Anthracene	0.00001	<	<	<	0.00001
Fluoranthene	0.00001	<	0.00003	0.00001	0.00014
Fluorene	0.00001	<	<	<	0.00003
Naphthalene	0.00001	0.00077	0.00004	0.00001	0.00017
Phenanthrene	0.00001	0.00037	0.00003	0.00007	0.0001
Total PAH	0.00005	0.0012	0.00021	0.0001	0.00093
Total low MW PAH	0.00005	0.0011	0.00008	0.00008	0.00034
Total high MW PAH	0.00005	<	0.00013	<	0.00059

APPENDIX XI

FIELD PROFILE DATA, MAIN AND NORTH ARM SLOUGHS

PROJECT: Fraser River Estuary Management Program, New Westminster

SAMPLE DATE / TIME: 11 February 1993 / 0850 PST

SITE ID: MacDonald Slough: Latitude 49°12.78'N Longitude 123°11.26'W

DEPTH (metres)	TEMPERATURE (C°)	DISSOLVED OXYGEN ⁽¹⁾ (ppm)	CONDUCTIVITY ⁽²⁾ (µmhos/cm)	SALINITY ⁽³⁾ (‰)	pH ⁽³⁾
0	4.5	11.6	8000	7.0	
1	5.0	10.6	8100	7.3	7.20
2	5.5	11.0	15000	14.0	
3	6.0	10.4	20000	20.0	
4	6.0	10.4	21000	21.0	
5	6.5	10.4	24000	24.0	
6	6.5	10.4	24500	24.5	7.35
7	6.5	10.4	25000	25.0	

NOTES: Sampling position was in mid channel. High tide was at 0825 PST.

- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
- (2) Conductivity was determined with a YSI Model 33 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date.
- (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in Beak's laboratory prior to each sampling date.

PROJECT: Fraser River Estuary Management Program, New Westminster

SAMPLE DATE / TIME: 10 February 1993 / 1015 PST

SITE ID: Gunderson Slough: Latitude 49°10.39'N Longitude 122°55.11'W

DEPTH (metres)	TEMPERATURE (C°)	DISSOLVED OXYGEN ⁽¹⁾ (ppm)	CONDUCTIVITY ⁽²⁾ (µmhos/cm)	SALINITY ⁽³⁾ (‰)	pH ⁽³⁾
0	4.0	13.0	145	1.0	
1	4.0	13.0	150	1.0	7.05
2	4.0	13.0	150	1.0	
3	4.0	12.8	160	1.0	
4	4.0	12.8	170	1.0	7.05
5	4.0	10.8	340	1.0	

NOTES: Sampling position was in mid channel. High tide was at 0750 PST.

- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
- (2) Conductivity was determined with a YSI Model 33 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date.
- (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in Beak's laboratory prior to each sampling date.

PROJECT: Fraser River Estuary Management Program, New Westminster

SAMPLE DATE / TIME: 10 February 1993 / 1140 PST

SITE ID: Tree Island Slough: Latitude 49°11.08'N Longitude 122°57.70'W

DEPTH (metres)	TEMPERATURE (C°)	DISSOLVED OXYGEN ⁽¹⁾ (ppm)	CONDUCTIVITY ⁽²⁾ (µmhos/cm)	SALINITY ⁽²⁾ (‰)	pH ⁽³⁾
0	4.0	13.6	90	0.5	
1	4.0	13.6	90	0.5	7.25
2	4.0	13.6	105	0.5	
3	4.0	13.2	155	0.5	7.15
4	4.0	11.2	850	1.0	

NOTES: Sampling position was in mid channel. High tide was at 0750 PST.

- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
- (2) Conductivity was determined with a YSI Model 33 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date.
- (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in Beak's laboratory prior to each sampling date.

PROJECT: Fraser River Estuary Management Program, New Westminster

SAMPLE DATE / TIME: 09 February 1993 / 1315 PST

SITE ID: Deas Slough: Latitude 49°07.04'N Longitude 123°03.72'W

DEPTH (metres)	TEMPERATURE (C°)	DISSOLVED OXYGEN ⁽¹⁾ (ppm)	CONDUCTIVITY ⁽²⁾ (µmhos/cm)	SALINITY ⁽²⁾ (‰)	pH ⁽³⁾
0	4.0	13.0	1900	3.0	
1	3.5	12.8	2000	3.0	7.25
2	3.5	12.0	1500	3.5	
3	4.0	11.4	7000	6.0	
4	4.5	8.6	13000	12.5	6.65
5	4.5	7.6	14000	13.5	

NOTES: Sampling position was in mid channel. High tide was at 0715 PST.

- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
- (2) Conductivity was determined with a YSI Model 33 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date.
- (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in Beak's laboratory prior to each sampling date.

PROJECT: Fraser River Estuary Management Program, New Westminster

SAMPLE DATE / TIME: 09 February 1993 / 0915 PST

SITE ID: Ladner Slough: Latitude 49°05.54'N Longitude 123°05.40'W

DEPTH (metres)	TEMPERATURE (C°)	DISSOLVED OXYGEN ⁽¹⁾ (ppm)	CONDUCTIVITY ⁽²⁾ (µmhos/cm)	SALINITY ⁽²⁾ (‰)	pH ⁽³⁾
0	4.2	11.5	7000	6.0	
1	4.2	11.5	7000	6.5	7.20
2	4.2	11.5	7500	6.5	
3	4.2	11.6	8500	7.5	
4	4.2	11.7	9000	8.0	
5	4.2	11.6	9500	8.5	7.40
6	4.5	6.6	11000	9.5	

NOTES: Sampling position was in mid channel. High tide was at 0715 PST.

- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
- (2) Conductivity was determined with a YSI Model 33 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date.
- (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in Beak's laboratory prior to each sampling date.

PROJECT: Fraser River Estuary Management Program, New Westminster

SAMPLE DATE / TIME: 11 February 1993 / 1045 PST

SITE ID: Eburne Slough: Latitude 49°12.16'N Longitude 123°08.58'W

DEPTH (metres)	TEMPERATURE (C°)	DISSOLVED OXYGEN ⁽¹⁾ (ppm)	CONDUCTIVITY ⁽²⁾ (µmhos/cm)	SALINITY ⁽²⁾ (‰)	pH ⁽³⁾
0	5.5	12.0	10000	9.0	
1	5.5	11.2	17500	14.0	7.30
2	6.0	10.6	20000	19.0	
3	6.5	10.0	21000	19.0	
4	7.0	10.8	22000	20.0	7.45
5	6.5	8.0	23000	22.0	

NOTES: Sampling position was in mid channel. High tide was at 0825 PST.

(1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.

(2) Conductivity was determined with a YSI Model 33 meter precalibrated and adjusted in Beak's laboratory prior to each sampling date.

(3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in Beak's laboratory prior to each sampling date.

Slough Profiles

Sample Date / Time: 21 February 1994 / 1005 PST

Site ID: Ladner Slough: Latitude 49°05.54'N Longitude 123°05.40'W

Depth (metres)	Temperature (C°)	Dissolved Oxygen ⁽¹⁾ (mg/L)	Conductivity ⁽²⁾ (µmhos/cm)	Salinity ⁽²⁾ (‰)	pH ⁽³⁾
0	4.5	11.2	8500	7.8	7.50
1*	4.8	11.0	9000	8.0	7.65
2	4.9	11.0	9400	8.4	7.60
3	5.0	11.0	9800	9.0	7.65
4	5.0	11.1	10200	9.1	7.60
5*	5.0	11.2	10500	9.5	7.55
6	5.1	9.8	10800	9.6	7.50

- NOTES: Sampling position was in mid channel and high tide of 4.4 meters was at 0605' PST.
- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
 - (2) Conductivity and salinity were determined with a YSI Model 33 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date.
 - (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in IRC's laboratory prior to each sampling date.
 - (*) Sampling depths.

Slough Profiles

Sample Date / Time: 21 February 1994 / 0830 PST

Site ID: Deas Slough: Latitude 49°07.04'N Longitude 123°03.72'W

Depth (metres)	Temperature (C°)	Dissolved Oxygen ⁽¹⁾ (mg/L)	Conductivity ⁽²⁾ (µmhos/cm)	Salinity ⁽²⁾ (‰)	pH ⁽³⁾
0	4.1	12.1	3300	3.3	7.50
1*	4.3	11.9	4300	3.9	7.55
2	4.4	11.7	4500	4.1	7.55
3	4.5	11.2	5000	4.5	7.65
4	4.7	10.6	8500	8.1	7.55
5	5.1	10.2	12800	11.8	7.50
6.5*	5.1	10.3	13400	12.5	7.50
7.5	5.1	10.4	14000	13.2	7.50

NOTES: Sampling position was in mid channel and high tide of 4.4 meters was at 0605 PST.

(1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.

(2) Conductivity and salinity were determined with a YSI Model 33 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date.

(3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in IRC's laboratory prior to each sampling date.

(*) Sampling depths.

Slough Profiles

Sample Date / Time: 22 February 1994 / 0800 PST

Site ID: Gunderson Slough: Latitude 49°10.39'N Longitude 122°55.11'W

Depth (metres)	Temperature (C°)	Dissolved Oxygen ⁽¹⁾ (mg/L)	Conductivity ⁽²⁾ (μmhos/cm)	Salinity ⁽²⁾ (‰)	pH ⁽³⁾
0	3.5	12.2	220	---	7.70
1*	3.5	12.2	270	---	7.70
2	3.5	12.2	350	---	7.65
3	3.7	12.1	520	---	7.60
4*	4.0	12.0	700	---	7.55
4.5	4.1	11.7	800	---	7.50

NOTES: Sampling position was in mid channel and high tide of 4.4 meters was at 0625 PST.

- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
- (2) Conductivity and salinity were determined with a YSI Model 33 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date.
- (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in IRC's laboratory prior to each sampling date.
- (*) Sampling depths.

Slough Profiles

Sample Date / Time: 23 February 1994 / 0825 PST

Site ID: MacDonal Slough: Latitude 49°12.78'N Longitude 123°11.26'W

Depth (metres)	Temperature (C°)	Dissolved Oxygen ⁽¹⁾ (mg/L)	Conductivity ⁽²⁾ (µmhos/cm)	Salinity ⁽²⁾ (‰)	pH ⁽³⁾
0	4.3	10.9	7500	7.0	7.70
1*	5.1	10.5	9500	8.5	7.85
2	5.9	10.1	19000	17.5	7.85
3	6.0	10.0	20500	20.0	7.85
4	6.1	10.1	23500	23.2	7.85
5	6.1	10.1	23700	23.7	7.85
5.5*	6.1	10.2	24000	24.2	7.80
6.3	6.2	10.1	24500	24.8	7.70

NOTES: Sampling position was in mid channel and high tide of 4.4 meters was at 0645 PST.

- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
- (2) Conductivity and salinity were determined with a YSI Model 33 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date.
- (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in IRC's laboratory prior to each sampling date.
- (*) Sampling depths.

Slough Profiles

Sample Date / Time: 23 February 1994 / 0950 PST

Site ID: Eburne Slough: Latitude 49°12.16'N Longitude 123°08.58'W

Depth (metres)	Temperature (C°)	Dissolved Oxygen ⁽¹⁾ (mg/L)	Conductivity ⁽²⁾ (µmhos/cm)	Salinity ⁽²⁾ (‰)	pH ⁽³⁾
0	4.3	11.1	3700	3.0	7.75
1*	4.5	10.9	7000	6.3	7.65
2	4.8	11.0	9300	7.8	7.70
3	4.8	11.0	9800	8.4	7.70
3.5*	4.9	11.0	10500	9.5	7.70
4.1	5.0	10.8	11500	10.0	7.60

NOTES: Sampling position was in mid channel and high tide of 4.4 meters was at 0645 PST.

- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
- (2) Conductivity and salinity were determined with a YSI Model 33 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date.
- (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in IRC's laboratory prior to each sampling date.
- (*) Sampling depths.

Slough Profiles

Sample Date / Time: 22 February 1994 / 0945 PST

Site ID: Tree Island Slough: Latitude 49°11.08'N Longitude 122°57.70'W

Depth (metres)	Temperature (C°)	Dissolved Oxygen ⁽¹⁾ (mg/L)	Conductivity ⁽²⁾ (µmhos/cm)	Salinity ⁽²⁾ (‰)	pH ⁽³⁾
0	3.5	12.0	320	---	7.65
1*	3.8	11.6	450	---	7.65
2	4.0	11.8	600	0.2	7.65
3*	3.8	11.8	900	0.5	7.60
3.5	4.0	11.6	950	1.1	7.60

NOTES: Sampling position was in mid channel and high tide of 4.4 meters was at 0625 PST.

- (1) Dissolved oxygen and temperature were determined with a YSI Model 54 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date. Dissolved oxygen values were adjusted for salinity where appropriate.
- (2) Conductivity and salinity were determined with a YSI Model 33 meter precalibrated and adjusted in IRC's laboratory prior to each sampling date.
- (3) pH was determined with a Canlab Model 607 pH meter precalibrated with buffer solutions in IRC's laboratory prior to each sampling date.
- (*) Sampling depths.