Environmental Protection
3rd Floor, Kapilano 100, Park Royal
West Vancouver, B.C. V7T 1A2

Our file:
4685-82/10-1

July 25, 1988

Mr. A.E. Birkbeck
Senior Research Consultant
Applied Biology Division
B.C. Research
3650 Wesbrook Mall
Vancouver, B.C.
V6S 2L2

RECEIVED
JUL 29 1988
LOWER MAINLAND REGION
FILE No.

Dear Mr. Birkbeck:

Re: Richmond Lanfill Monitoring

This is to acknowledge receipt of your letter dated July 12 and to advise you that we have no objection to your ceasing monitoring until October 1988.

We should also schedule a meeting for early October to discuss the results to date and the future of the system.

Yours truly,

M. Ito
Chief, Environmental Protection Branch
Pacific & Yukon Region

cc: B. Chang, DFO, New Westminster
M. Wong, WMB, Surrey

BC RESEARCH
3650 Wesbrook Mall
Vancouver, B.C.
Canada V6S 2L2
Phone (604) 224-4331
Cable-RESEARCHBC
Telex 04-507256

EP REGION
DG EP W/LC CWS F & P PERS PLAN COM CORE AES PARKS FEARO YUKON
JUL 11 1988
COD EE DA R & L SPAD COO
LETTER NO.
FILE NO. 4605-82/88-1

July 7, 1988
Our file: 2-51-790

Environment Canada
Environment Protection Branch
3rd Floor, Kapilano 100
Park Royal
West Vancouver, B.C.
V7T 1A2

Attention: Mr. M. Ito, Manager
Environmental Protection Branch

Gentlemen:

Re: Leachate Monitoring Richmond Landfill

Enclosed are monitoring data for leachates at Richmond Landfill obtained during June, 1988 and final effluent flow and temperature data for March, April, and May, 1988. Also enclosed is the 96 h. LC50 for May 18, 1988 and the second quarter surface water and groundwater monitoring data for 1988.

Yours truly,

B.C. RESEARCH CORPORATION

Merv Aiken

Merv Aiken, for
A.E. Birkbeck
Senior Research Consultant
Applied Biology Division

AB:mw
encl.

cc: Mr. R. Pearce
Mr. P. Andru
Mr. G. Pettenuzzo

RECEIVED
JUL 29 1988
LOWER MAINLAND REGION
FILE No.

RICHMOND LANDFILL

2-41-100-790-10012

96-h STATIC LC50 BIOASSAY RESULTS OF
QUARTERLY GRAB SAMPLE

SAMPLE TAKEN: May 18, 1988 SAMPLE pH 7.6
SAMPLE RECEIVED: May 18, 1988 SAMPLE D.O. 6.8 mg/L
TEST STARTED: May 18, 1988 SAMPLE CONDUCTANCE 2000 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.6	8.8	10.0	9.4	100.0	100	100	100	100	>100
6.3	6.7	10.4	9.8	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10 Test temperature (C) 15.0
Test volume (liters) 4.0 Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.39 +/- 0.10 g Length 3.5 +/- 0.3 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 96.0 ug/L (90, 110) and 87.2 ug/L (80, 100)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	5.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	15

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST B.C. RESEARCH

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

WEEKLY MONITORING
FOR JUNE, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 0276

SUBMITTED BY BC RESEARCH

Sampling Sites: 1 Lagoon Influent (thru Apr '86)
2 Lagoon Effluent
3 Final Effluent
4 First Spray Area Effluent
5 Application to #2 Spray Area
6 #7 Ditch Overflow into River
7 Auxiliary Pump
8 Municipal Site > (lagoon influent
9 South Lagoon Ditch > from May '86)

SITE	DATE	TIME	PH	BOD5 (mg/L)	COD (mg/L)	ORGANIC CARBON (mg/L)	SUSPENDED SOLIDS (mg/L)	AMMONIA (mgN/L)	DISSOLVED OXYGEN (mg/L)	SULFIDE (mg/L)	TEMPERATURE (degree C)
02	880609	0945	8.1	26.	155.	29.	45.2	0.7	8.2	L0.50	18.0
	880621	0945	7.8	21.	138.	46.	2.0	2.5	2.3	L0.50	22.0
03	880609	0800	8.0	62.	110.	66.	30.9	4.1	10.4	L0.50	17.5
	880621	0800	7.6	29.	88.	18.	13.8	4.8	6.9	L0.50	17.0
08	880609	0915	6.8	50.	187.	30.	6.6	86.6	0.8	2.80	15.0
	880621	0915	6.4	50.	189.	30.	7.5	87.4	0.9	4.90	15.5
09	880609	0930	6.8	35.	217.	85.	5.3	30.4	0.7	16.20	15.5
	880621	0930	6.7	27.	217.	77.	3.6	31.9	0.7	11.70	15.5

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DAILY DISCHARGE FLOWS AND TEMPERATURES, FINAL EFFLUENT
FOR MARCH, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

TOTAL PRECIPITATION FOR MONTH -- 138.2 mm

DAY	FLOW (cubic meters/day)	TEMPERATURE (degrees C)
1	3715	7.5
2	3888	7.5
3	4752	7.2
4	4406	6.2
5	3888	5.7
6	3628	6.4
7	3628	6.9
8	6134	6.1
9	6048	6.1
10	6220	6.6
11	5097	5.7
12	3196	6.9
13	4838	6.4
14	4665	6.7
15	3801	6.7
16	3456	7.0
17	3283	7.0
18	3196	7.7
19	3110	7.8
20	3283	7.3
21	3196	7.9
22	4233	6.6
23	5356	6.2
24	5875	5.5
25	6912	5.2
26	5529	6.0
27	5616	6.2
28	6134	5.3
29	6480	6.6
30	6048	8.4
31	6307	8.3

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DAILY DISCHARGE FLOWS AND TEMPERATURES. FINAL EFFLUENT
FOR APRIL, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

TOTAL PRECIPITATION FOR MONTH -- 91.2 mm

DAY	FLOW (cubic meters/day)	TEMPERATURE (degrees C)
1	6566	7.8
2	7257	7.4
3	6566	7.3
4	7084	8.1
5	9590	6.1
6	8035	7.4
7	7257	7.9
8	5097	7.9
9	6480	9.1
10	6998	10.0
11	7171	10.1
12	7084	11.5
13	7344	10.7
14	7084	11.5
15	7171	12.5
16	7516	11.2
17	7862	9.9
18	7516	11.1
19	6912	11.7
20	5270	13.1
21	4060	13.0
22	4320	13.0
23	3715	11.7
24	3283	10.0
25	3283	10.9
26	2246	12.2
27	4060	11.8
28	3801	11.2
29	3715	11.5
30	4060	11.1

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DAILY DISCHARGE FLOWS AND TEMPERATURES. FINAL EFFLUENT
FOR MAY, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

TOTAL PRECIPITATION FOR MONTH -- 144.0 mm

DAY	FLOW (cubic meters/day)	TEMPERATURE (degrees C)
1	3974	10.1
2	4579	8.6
3	5356	10.8
4	5356	13.0
5	4838	13.0
6	4233	13.0
7	4147	14.0
8	4060	15.1
9	4060	13.5
10	3888	14.6
11	3283	15.6
12	3283	16.3
13	4320	14.7
14	5270	15.6
15	5270	15.1
16	6480	13.6
17	5788	13.2
18	5961	12.0
19	5529	14.5
20	3801	15.6
21	3456	17.0
22	3542	15.1
23	4665	13.4
24	5011	15.4
25	3369	16.0
26	3110	15.8
27	3369	14.5
28	4233	15.2
29	5011	15.9
30	5097	15.9
31	5011	15.1

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	880518 0800 hrs	880518 0815 hrs	880518 0830 hrs	880518 0845 hrs	880518 0900 hrs
PH	7.8	6.9	6.5	6.4	6.8
Temperature (deg C)	11.0	13.0	13.0	12.0	11.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	10.0	18.0	12.0	0.8	7.5
Ammonia (mgN/l)	4.10	0.70	0.70	L0.50	0.56
Dissolved (mg/l)					
BOD5	22	5	12	8	14
Oxygen	7.7	2.8	3.3	4.7	7.6
Nitrite	0.091	0.045	0.055	0.014	0.014
Nitrate	1.240	0.672	1.010	0.034	0.006
Copper	0.0040	0.0090	0.0110	0.0050	0.0040
Iron	0.50	1.30	2.42	2.25	5.30
Manganese	1.10	0.36	0.24	0.54	2.00
Sodium	500.0	170.0	21.2	25.0	69.0
Potassium	515.0	197.0	67.5	85.0	50.0
Chloride	600.0	76.0	23.0	27.0	126.0
Sulfate	74	50	28	L1	8
Total (mg/l)					
Dissolved Phosphorus	0.043	0.310	0.390	0.130	0.100
Lead	L0.001	L0.001	L0.001	L0.001	L0.001
Zinc	L0.0200	0.0300	0.0300	L0.0200	L0.0200
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY GROUNDWATER MONITORING (WELLS)
FOR SECOND QUARTER, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

	WEST SITE #3	WEST SITE #4	EAST SITE #6	EAST SITE #7
	880518 0900 hrs	880518 0930 hrs	880518 0945 hrs	880518 0945 hrs
PH	6.5	5.8	6.1	6.5
Total Suspended Solids (mg/l)	161.0	419.0	85.0	1400.0
Ammonia (mgN/l)	L0.50	4.20	0.70	12.20
Dissolved (mg/l)				
BOD5	L10	30	39	45
Nitrite	0.003	0.036	0.037	L.002
Nitrate	0.008	0.065	0.079	0.016
Iron	0.2	17.3	1.7	14.6
Manganese	0.09	0.32	0.13	0.77
Sodium	8.5	47.0	2.6	245.0
Potassium	16.1	884.0	15.0	252.0
Chloride	1.4	67.0	1.3	670.0
Sulfate	19.0	L1.0	7.0	L1.0
Total Dissolved Phosphorus (mg/l)	0.190	0.270	0.450	1.860
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05

RECEIVED
JUL 29 1988
LOWER MAINLAND REGION
FILE No.

BC RESEARCH
3650 Wesbrook Mall
Vancouver, B.C.,
Canada V6S 2L2
Phone (604) 224-4331
Cable RESEARCHINC
Telex 04-507748

C & P
P & Y REGION
DG | DEPB
EP | PGG
IWL | BIOGP
CWS | AIR
P & A | LABS
PERS | STSS
PLAN | COO
COM | REG
CORE | T.A
AES | R & L
PARKS | SP/O
FEARO | COO
YUKON
JUL 18 1988
LETTER NO.
FILE NO. 4655-03/10-1

July 12, 1988
Our File: 2-51-790

Environment Canada
Environmental Protection Branch
3rd Floor, Kapilano 100
Park Royal
West Vancouver, B.C.
V7T 1A2

Attention: Mr. M. Ito, Manager, Environmental Protection Branch

Re: Leachate Monitoring, Richmond Landfill

Gentlemen:

Enclosed are final effluent flow and temperature data for June, 1988. These are for record keeping purposes. I also enclose our computer printouts showing flow, temperature and precipitation data since monitoring commenced, as well as monthly summary reports for April, May and June, 1988.

You will note that rainfall during the April to June period was higher than in the same period last year. Leachate flows were correspondingly higher. However ammonia removal is excellent. The monthly average ammonia nitrogen levels in the final discharge were 4.7, 3.2 and 4.5 mgN/L during April, May and June. The effluent is non-toxic to rainbow trout.

Although final effluent BOD_5 values vary between 29 mg/L and 49 mg/L over the period and are somewhat higher than those required by the Provincial Pollution Control Permit (30 mg/L), I raise the question whether we should continue to monitor this discharge through the summer season. In 1987 monitoring ceased (except for that required for the provincial permit) at the beginning of July and recommenced in October.

If you are in agreement with this please let us know by telephone and by written copy. As I will be on holiday in the last two weeks of July, please contact Dr. Blair Wallace in my absence.

Yours truly ,

B.C. RESEARCH CORPORATION

A.E. Birkbeck
Senior Research Consultant
Division of Applied Biology

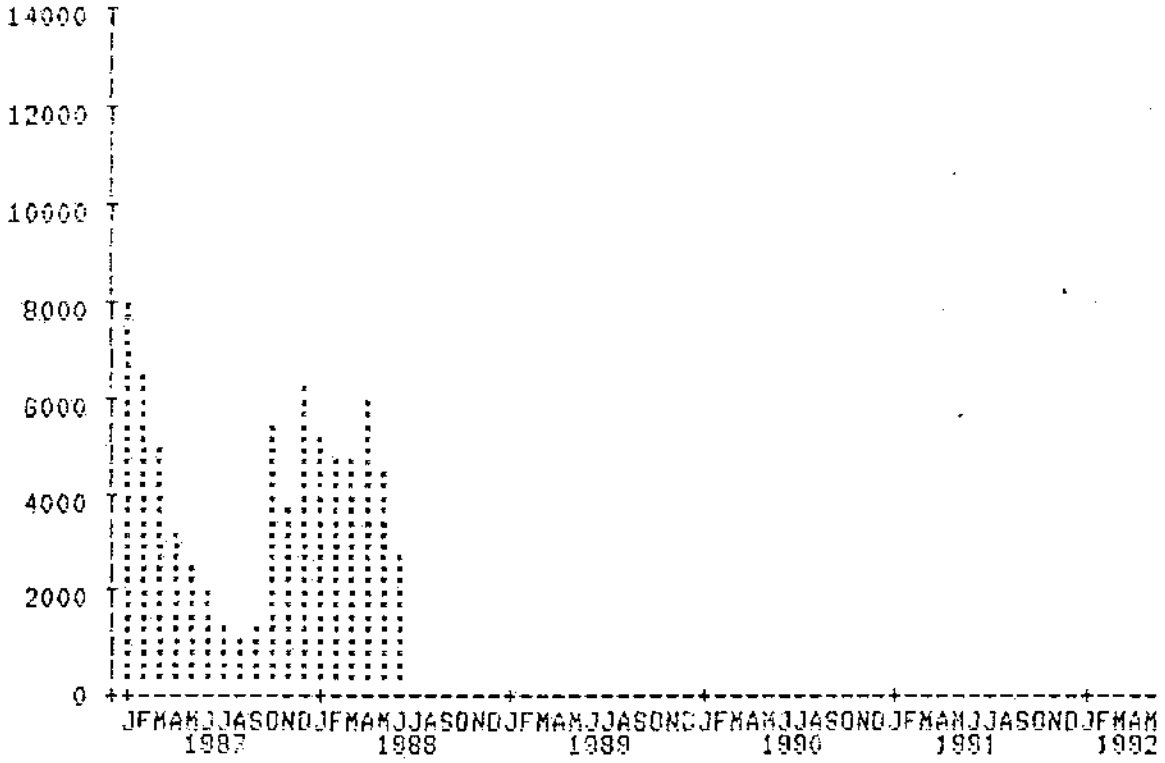
AEB/bz
Encl.

cc: Mr. R. Pearce
Mr. P. Andru
Mr. G. Pettennuzzo

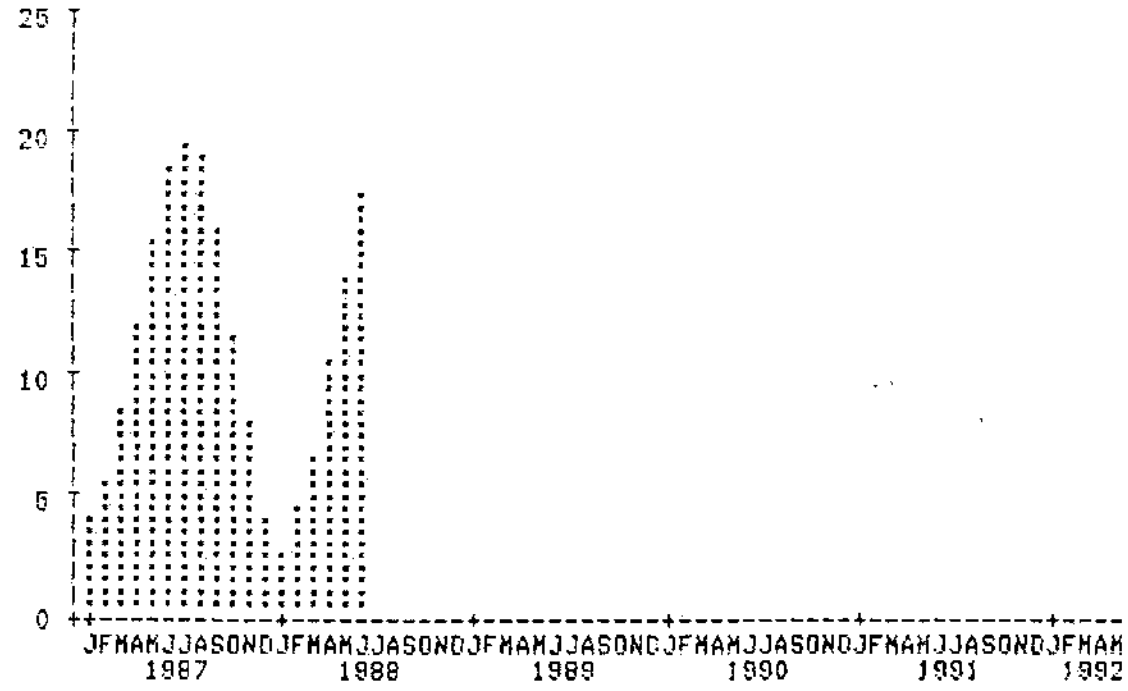
LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

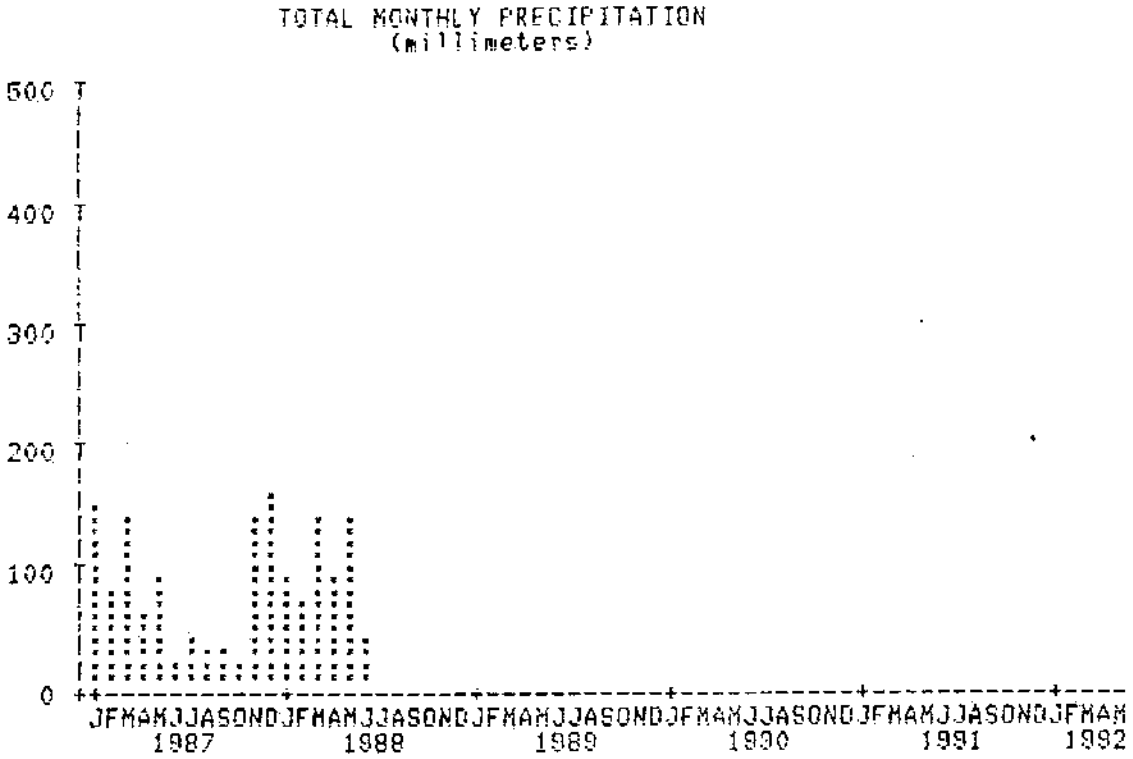
MEAN DAILY FLOW & TEMPERATURE, MONTHLY RAINFALL
FOR PERIOD JAN/87 TO JUN/92

MEAN DAILY FLOW
(cubic meter)



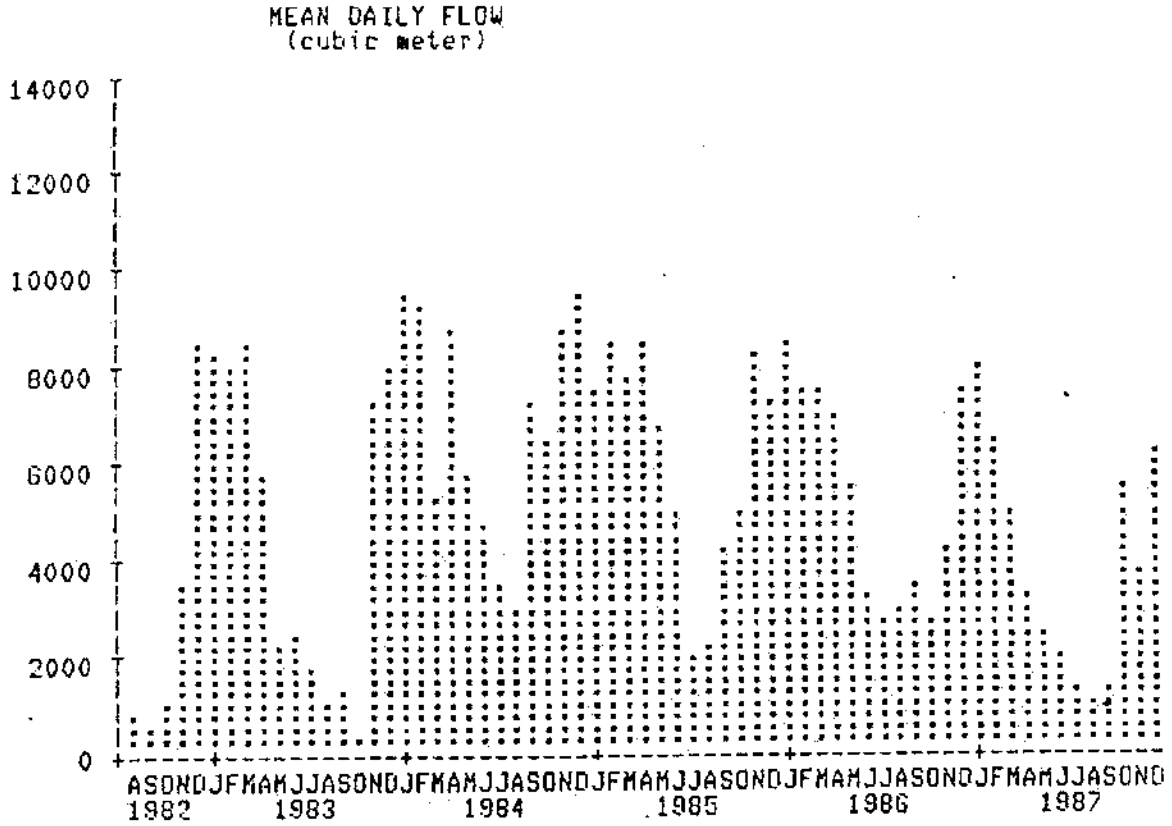
MEAN TEMPERATURE
(degree C)

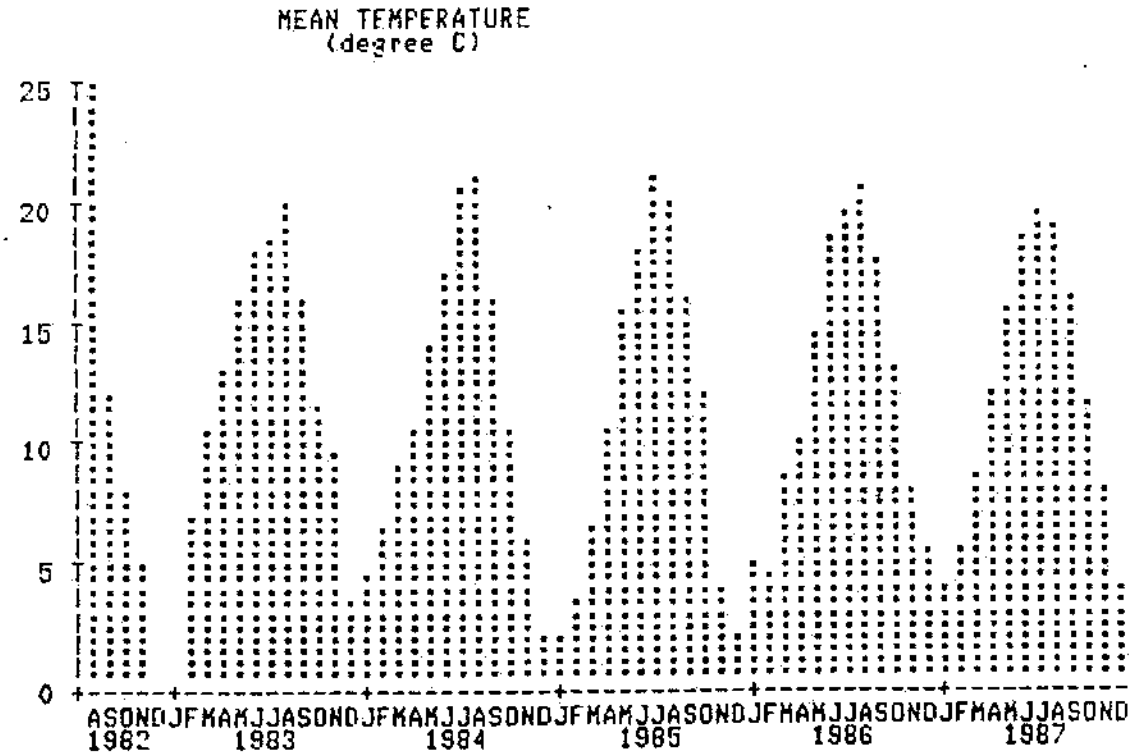


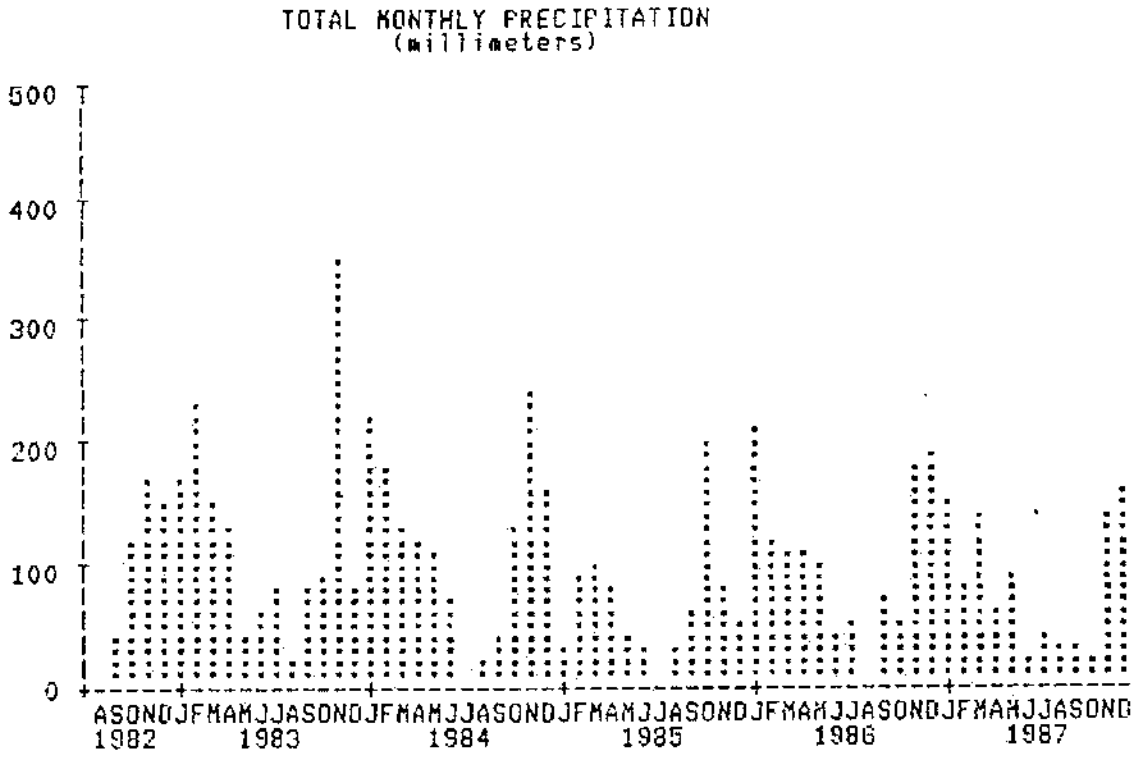

TOTAL MONTHLY PRECIPITATION
(millimeters)
500
400
300
200
100
0
JFMAMJJASONDJFMAMJJASONDJFMAMJJASONDJFMAMJJASONDJFMAMJJASONDJFMAM
1987
1988
1989
1990
1991
1992

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

MEAN DAILY FLOW & TEMPERATURE. MONTHLY RAINFALL
FOR PERIOD AUG/82 TO JAN/88





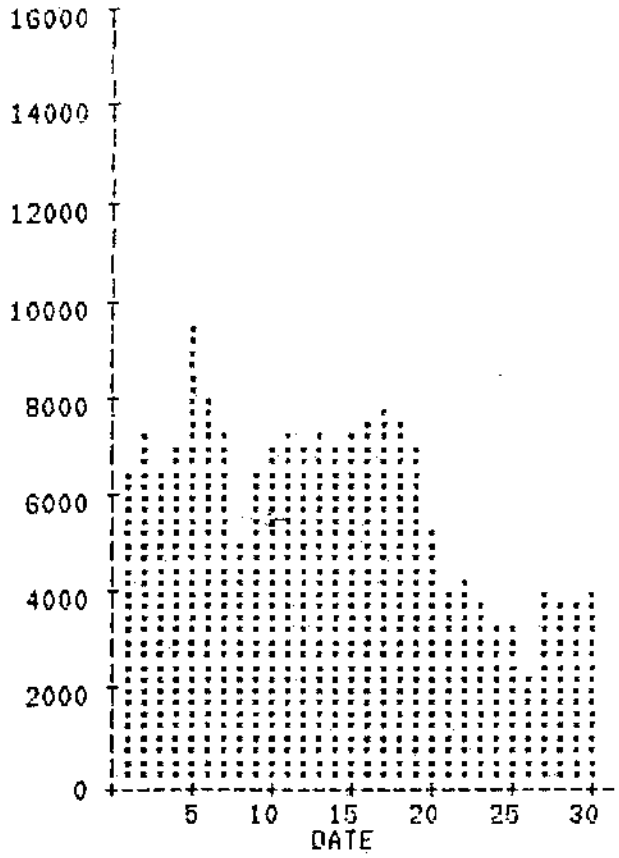

TOTAL MONTHLY PRECIPITATION
(millimeters)
500
400
300
200
100
0
ASONDJFMAMJJASONDJFMAMJJASONDJFMAMJJASONDJFMAMJJASONDJFMAMJJASOND
1982
1983
1984
1985
1986
1987

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SUMMARY REPORT - APRIL, 1988

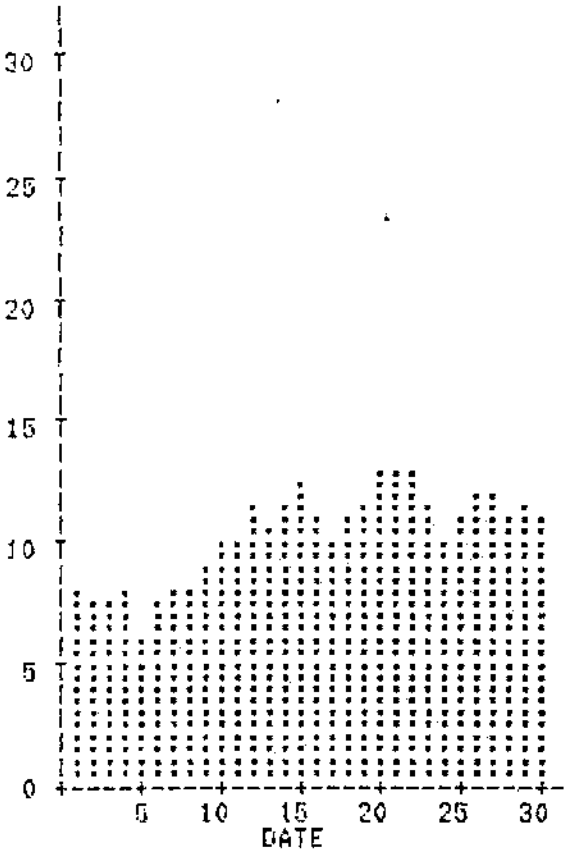
Sampling Sites
1 Lagoon Influent
2 Lagoon Effluent
3 Final Effluent
4 First Spray Area Effluent
5 Application to #2 Spray Area

DAILY FLOW
(cubic meter)



Mean flow = 5947. cubic meter
(Standard Deviation = 1843.)
Rainfall for month = 91.2 mm

TEMPERATURE
(degree C)



Mean Temperature = 10.3 degree C
(Standard Deviation = 2.0)

ASSAY SUMMARY

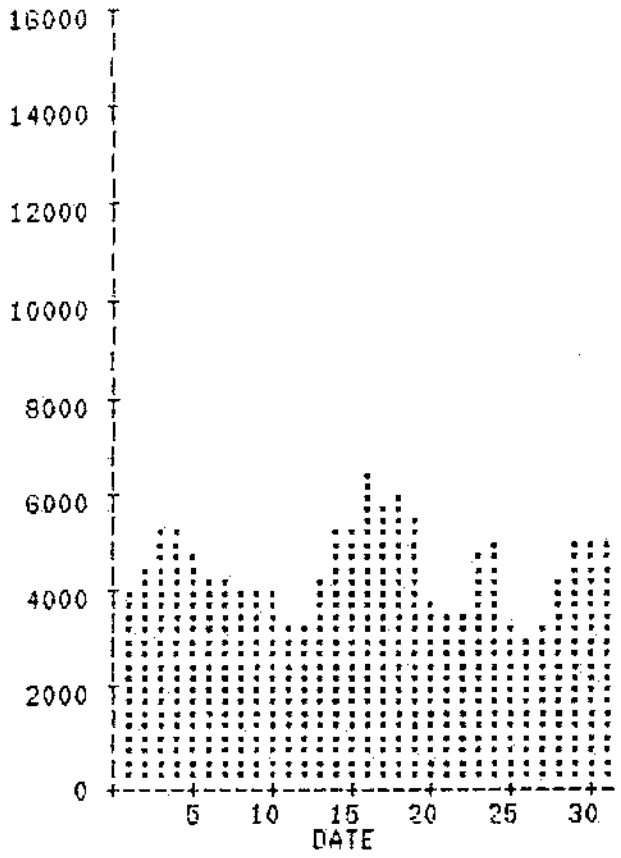
	MEAN CONCENTRATION (mg/L)					MEAN LOADING (kg/day)				
	SITES					SITES				
	1	2	3	4	5	1	2	3	4	5
BOD5	NA	106.	49.	NA	NA	NA	688.	236.	NA	NA
COD	NA	172.	90.	NA	NA	NA	941.	530.	NA	NA
Organic Carbon	NA	94.	85.	NA	NA	NA	501.	471.	NA	NA
Suspended Solids	NA	77.1	24.8	NA	NA	NA	390.2	140.5	NA	NA
Ammonia	NA	15.6	4.7	13.2	8.5	NA	107.5	27.1	71.8	50.8
Dissolved Oxygen	NA	20.0	7.5	6.2	5.2	NA	114.0	42.9	33.0	25.7
Sulfide	NA	L0.50	L0.50	NA	L0.50	NA	L2.85	L2.85	NA	L2.85
pH	NA	8.0	7.8	7.3	7.3					
Temp (C)	NA	14.3	10.5	14.0	13.3					

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SUMMARY REPORT - MAY, 1988

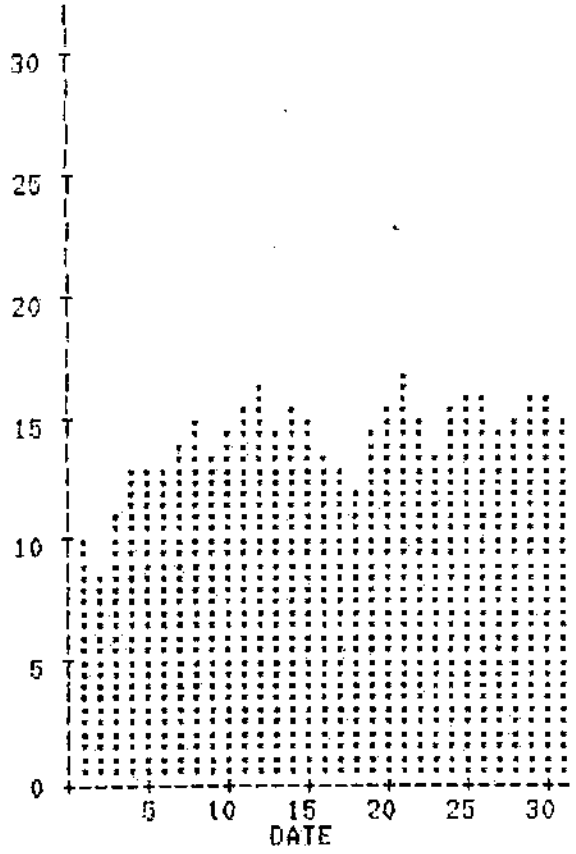
Sampling Sites
1 Lagoon Influent
2 Lagoon Effluent
3 Final Effluent
4 First Spray Area Effluent
5 Application to #2 Spray Area

DAILY FLOW
(cubic meter)



Mean flow = 4495. cubic meter
(Standard Deviation = 894.)
Rainfall for month = 144.0 mm

TEMPERATURE
(degree C)



Mean Temperature = 14.2 degree C
(Standard Deviation = 3.9)

ASSAY SUMMARY

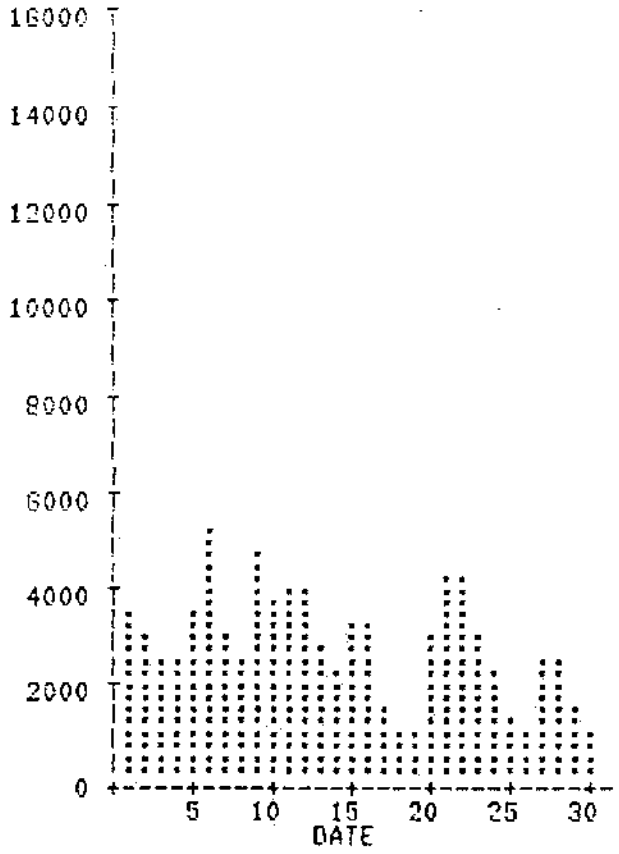
	MEAN CONCENTRATION (mg/L)					MEAN LOADING (kg/day)				
	SITES					SITES				
	1	2	3	4	5	1	2	3	4	5
BOD5	NA	72.	29.	NA	NA	NA	328.	91.	NA	NA
COD	NA	183.	77.	NA	NA	NA	520.	244.	NA	NA
Organic Carbon	NA	101.	93.	NA	NA	NA	322.	293.	NA	NA
Suspended Solids	NA	40.8	9.3	NA	NA	NA	129.8	29.5	NA	NA
Ammonia	NA	3.7	3.2	21.0	13.6	NA	11.8	10.1	66.9	43.3
Dissolved Oxygen	NA	20.0	8.1	4.8	5.4	NA	63.8	25.8	15.5	17.5
Sulfide	NA	L0.50	L0.50	NA	L0.50	NA	L1.60	L1.60	NA	L1.60
pH	NA	8.3	7.8	7.3	7.4					
Temp (C)	NA	19.5	15.5	18.5	18.5					

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SUMMARY REPORT - JUNE. 1988

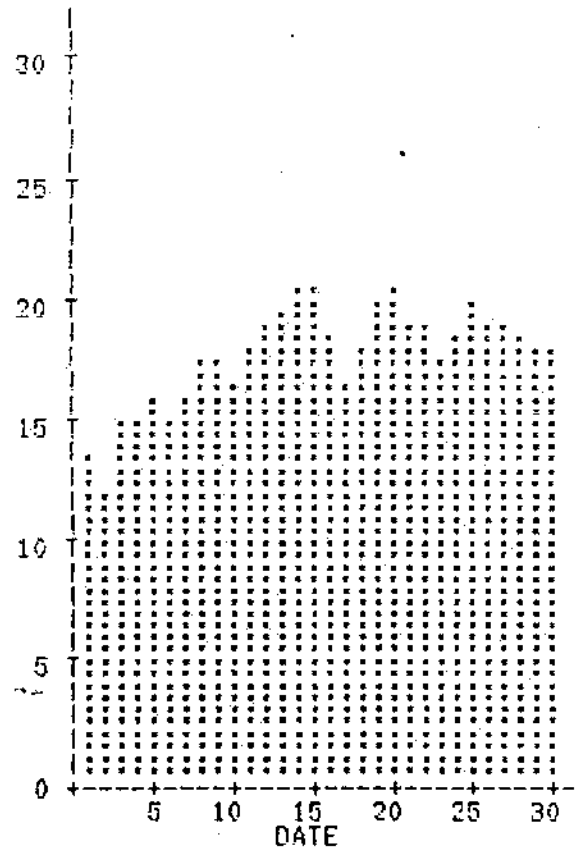
Sampling Sites
1 Lagoon Influent
2 Lagoon Effluent
3 Final Effluent
4 First Spray Area Effluent
5 Application to #2 Spray Area

DAILY FLOW
(cubic meter)



Mean flow = 2796. cubic meter
(Standard Deviation = 1164.)
Rainfall for month = 39.0 mm

TEMPERATURE
(degree C)



Mean Temperature = 17.7 degree C
(Standard Deviation = 2.1)

ASSAY SUMMARY

	MEAN CONCENTRATION (mg/L) SITES					MEAN LOADING (kg/day) SITES				
	1	2	3	4	5	1	2	3	4	5
BOD5	NA	24.	46.	NA	NA	NA	107.	210.	NA	NA
COD	NA	147.	99.	NA	NA	NA	666.	451.	NA	NA
Organic Carbon	NA	38.	42.	NA	NA	NA	168.	196.	NA	NA
Suspended Solids	NA	23.6	22.4	NA	NA	NA	111.7	103.2	NA	NA
Ammonia	NA	1.6	4.5	17.5	10.0	NA	7.1	20.1	79.2	44.1
Dissolved Oxygen	NA	5.3	8.6	4.6	5.4	NA	24.5	39.6	21.1	24.9
Sulfide	NA	L0.50	L0.50	NA	L0.50	NA	L2.27	L2.27	NA	L2.27
pH	NA	8.0	7.8	7.2	7.3					
Temp (C)	NA	20.0	17.3	19.3	19.5					

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DAILY DISCHARGE FLOWS AND TEMPERATURES, FINAL EFFLUENT
FOR JUNE, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

TOTAL PRECIPITATION FOR MONTH -- 39.0 mm

DAY	FLOW (cubic meters/day)	TEMPERATURE (degrees C)
1	3456	13.3
2	2937	12.0
3	2592	15.2
4	2592	15.2
5	3542	16.2
6	5184	15.1
7	2937	15.9
8	2592	17.7
9	4752	17.6
10	3801	16.6
11	3888	18.0
12	3888	18.9
13	2764	19.6
14	2246	20.7
15	3369	20.5
16	3369	18.4
17	1382	16.4
18	1036	17.8
19	950	20.1
20	3024	20.5
21	4320	19.1
22	4233	18.8
23	3110	17.5
24	2246	18.7
25	1209	20.0
26	1123	19.2
27	2419	18.9
28	2592	18.6
29	1382	17.8
30	950	17.9

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Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/01/01	0																	IN	Effluent was frozen.
91/01/02	0																	IN	No flow data was
91/01/03	0																	IN	available from
91/01/04	0																	IN	Jan 1 to Jan 14
91/01/05	0																	IN	
91/01/06	0																	IN	
91/01/07	0																	IN	
91/01/08	0																	IN	
91/01/09	0																	IN	
91/01/10	0																	IN	
91/01/11	0																	IN	
91/01/12	0																	IN	
91/01/13	0																	IN	
91/01/14	0																	IN	
91/01/15	2592																	IN	
91/01/16	2592																	IN	
91/01/17	3024																	IN	
91/01/18	2851																	IN	
91/01/19	2592																	IN	
91/01/20	1037																	IN	
91/01/21	691																	IN	
91/01/22	432																	IN	
91/01/23	346																	IN	
91/01/24	259																	IN	
91/01/25	259																	IN	
91/01/26	173																	IN	
91/01/27	173																	IN	
91/01/28	259																	IN	
91/01/29	173																	IN	
91/01/30	172																	IN	1
91/01/31	346																	IN	

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Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/02/01	518																	IN	
91/02/02	432																	IN	
91/02/03	346																	IN	
91/02/04	432																	IN	
91/02/05	259																	IN	
91/02/06	259	30	< 10	0.6	0.023	0.17	636	25.1	0.001	1.5	0.65	23.5	456	0.065	< 0.01	< 0.05	0.04	IN	
91/02/07	259																	IN	
91/02/08	518																	IN	
91/02/09	346																	IN	
91/02/10	346																	IN	
91/02/11	346																	IN	
91/02/12	605																	IN	
91/02/13	432																	IN	
91/02/14	518																	IN	
91/02/15	432																	IN	
91/02/16	605																	IN	
91/02/17	950																	IN	
91/02/18	864																	IN	
91/02/19	1382																	IN	
91/02/20	950																	IN	
91/02/21	1037																	IN	
91/02/22	864																	IN	
91/02/23	778																	IN	
91/02/24	1037																	IN	
91/02/25	950																	IN	
91/02/26	1037																	IN	
91/02/27	1123																	IN	
91/02/28	1382																	IN	

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Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

Date (1991)	Discharge	Parameter *																Compliance	Comment
		TSS	BOD5	NH3-N	NO2-	NO3-	Cl-	SO4=	Cu Diss.	Fe Diss.	Mn Diss.	K Diss.	Na Diss.	P Total	Pb Total	Hg Total	Zn Total		
(YY/MM/DD)	m3/d	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L		
91/03/01	1555																	IN	
91/03/02	2592																	IN	
91/03/03	2765																	IN	
91/03/04	950																	IN	
91/03/05	950																	IN	
91/03/06	950																	IN	
91/03/07	691																	IN	
91/03/08	864																	IN	
91/03/09	605																	IN	
91/03/10	691																	IN	
91/03/11	864																	IN	
91/03/12	1037																	IN	
91/03/13	691																	IN	
91/03/14	691																	IN	
91/03/15	864																	IN	
91/03/16	778																	IN	
91/03/17	864																	IN	
91/03/18	950																	IN	
91/03/19	1469																	IN	
91/03/20	1123																	IN	
91/03/21	1382																	IN	
91/03/22	1037																	IN	
91/03/23	1210																	IN	
91/03/24	1469																	IN	
91/03/25	1382																	IN	
91/03/26	1037																	IN	
91/03/27	864																	IN	
91/03/28	778																	IN	
91/03/29	778																	IN	
91/03/30	864																	IN	3
91/03/31	864																	IN	

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Harbour Commission
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Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/04/01	950																	IN	
91/04/02	691																	IN	
91/04/03	1123																	IN	
91/04/04	864																	IN	
91/04/05	1296																	IN	
91/04/06	1555																	IN	
91/04/07	950																	IN	
91/04/08	950																	IN	
91/04/09	1814																	IN	
91/04/10	1642																	IN	
91/04/11	1210																	IN	
91/04/12	1037																	IN	
91/04/13	950																	IN	
91/04/14	778																	IN	
91/04/15	605																	IN	
91/04/16	605																	IN	
91/04/17	518																	IN	
91/04/18	2333																	IN	
91/04/19	3888																	IN	
91/04/20	4406																	IN	
91/04/21	4406																	IN	
91/04/22	4320																	IN	
91/04/23	4320																	IN	
91/04/24	4234																	IN	
91/04/25	4406																	IN	
91/04/26	4406																	IN	
91/04/27	4666																	IN	
91/04/28	5270																	IN	
91/04/29	3456																	IN	
91/04/30	2592																	IN	4

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Main Arm

Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/05/01	2160																	IN	
91/05/02	605																	IN	
91/05/03	778																	IN	
91/05/04	691																	IN	
91/05/05	778																	IN	
91/05/06	1123																	IN	
91/05/07	2592																	IN	
91/05/08	4147																	IN	
91/05/09	4838																	IN	
91/05/10	6653																	IN	
91/05/11	6653																	IN	
91/05/12	6566																	IN	
91/05/13	8122																	IN	
91/05/14	7171	11	< 10	4.54	0.143	1.28	676	37.1	0.004	0.3	0.79	38	526	0.017	0.001	< 0.05	0.012	IN	
91/05/15	2851																	IN	
91/05/16	3110																	IN	
91/05/17	3024																	IN	
91/05/18	2678																	IN	
91/05/19	2678																	IN	
91/05/20	3024																	IN	
91/05/21	2765																	IN	
91/05/22	1901																	IN	
91/05/23	2333																	IN	
91/05/24	3024																	IN	
91/05/25	2938																	IN	
91/05/26	2938																	IN	
91/05/27	3542																	IN	
91/05/28	2938																	IN	
91/05/29	3110																	IN	
91/05/30	2419																	IN	5
91/05/31	2246																	IN	

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Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/06/01	3283																	IN	
91/06/02	4838																	IN	
91/06/03	3715																	IN	
91/06/04	1987																	IN	
91/06/05	1901																	IN	
91/06/06	1728																	IN	
91/06/07	1814																	IN	
91/06/08	1814																	IN	
91/06/09	2246																	IN	
91/06/10	2419																	IN	
91/06/11	1728																	IN	
91/06/12	2160																	IN	
91/06/13	3110																	IN	
91/06/14	4061																	IN	
91/06/15	5184																	IN	
91/06/16	9158																	IN	
91/06/17	10454																	OUT	
91/06/18	11837																	OUT	Flow data from
91/06/19	13738																	OUT	June to October, 1991
91/06/20	9763																	IN	was not reliable, or
91/06/21	9590																	IN	not available since
91/06/22	12960																	OUT	debris from beaver
91/06/23	13738																	OUT	dams had caused the
91/06/24	14429																	OUT	weir gauges to
91/06/25	14602																	OUT	malfunction.
91/06/26	14688																	OUT	
91/06/27	14774																	OUT	
91/06/28	14774																	OUT	
91/06/29	14429																	OUT	
91/06/30	14170																	OUT	
91/08/27		3	< 10	< 1	< 0.01	< 0.01	699	11	< 0.05	1.4	0.11	29	570	0.098	< 0.001	< 0.05	0.002	IN	

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Harbour Commission
Main Arm

Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/11/01	173																	IN	
91/11/02	173																	IN	
91/11/03	0																	IN	
91/11/04	259																	IN	
91/11/05	259																	IN	
91/11/06	173																	IN	
91/11/07	173																	IN	
91/11/08	259																	IN	
91/11/09	259																	IN	
91/11/10	173																	IN	
91/11/11	518																	IN	
91/11/12	518																	IN	
91/11/13	346	10	18	0.27	< 0.025	0.05	566	22	0.003	1.1	1.10	28	431	0.055	0.001	< 0.05	0.006	IN	
91/11/14	346																	IN	
91/11/15	259																	IN	
91/11/16	346																	IN	
91/11/17	259																	IN	
91/11/18	259																	IN	
91/11/19	691																	IN	
91/11/20	518																	IN	
91/11/21	432																	IN	
91/11/22	346																	IN	
91/11/23	346																	IN	
91/11/24	518																	IN	
91/11/25	432																	IN	
91/11/26	346																	IN	
91/11/27	346																	IN	
91/11/28	346																	IN	
91/11/29	173																	IN	
91/11/30	86																	IN	

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Harbour Commission
Main Arm

Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/12/01	173																	IN	
91/12/02	173																	IN	
91/12/03	259																	IN	
91/12/04	259																	IN	
91/12/05	432																	IN	
91/12/06	432																	IN	
91/12/07	346																	IN	
91/12/08	346																	IN	
91/12/09	346																	IN	
91/12/10	86																	IN	
91/12/11	0																	IN	
91/12/12	86																	IN	
91/12/13	86																	IN	
91/12/14	86																	IN	
91/12/15	86																	IN	
91/12/16	86																	IN	
91/12/17	0																	IN	
91/12/18	259																	IN	
91/12/19	605																	IN	
91/12/20	950																	IN	
91/12/21	691																	IN	
91/12/22	432																	IN	
91/12/23	518																	IN	
91/12/24	432																	IN	
91/12/25	346																	IN	
91/12/26	346																	IN	
91/12/27	346																	IN	
91/12/28	432																	IN	
91/12/29	432																	IN	
91/12/30	432																	IN	8
91/12/31	605																	IN	

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Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

		Parameter *																	
Date (1991) (YY/MM/DD)	Discharge m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
Maximum	14774	30	18	4.54	0.143	1.28	699	37.1	0.004	1.5	1.10	38.0	570	0.098	< 0.01	< 0.05	0.040	OUT	Flow above limit
Minimum	0	3	< 10	0.27	< 0.01	< 0.01	566	11.0	0.001	0.3	0.11	23.5	431	0.017	< 0.001	< 0.05	0.002	IN	
Mean	2049	14	< 12	< 1.61	< 0.083	< 0.50	644	23.8	< 0.003	1.1	0.66	29.6	496	0.059	< 0.003	< 0.05	0.015	IN	
Std. Dev.	3194	12	4	1.98	0.085	0.68	58	10.7	0.002	0.5	0.41	6.1	64	0.033	0.005	0	0.017		
Maximum x Maximum																			
Minimum x Minimum																			
Mean x Mean																			

Note: < values included in calculations

* Permitted levels and monitoring parameters as required before October 27, 1992 amendment.

Please see December 1992 data sheet for October 27, 1992 amended permitted levels and monitoring parameter requirements.

PE6276
Fraser River
Harbour Commission
Main Arm

Date (1991) (YY/MM/DD)	Discharge m3/d	Loadings TSS kg/d	BOD5 kg/d	NH3-N kg/d	NO2- kg/d	NO3- kg/d	Cl- kg/d	SO4= kg/d	Cu Diss. kg/d	Fe Diss. kg/d	Mn Diss. kg/d	K Diss. kg/d	Na Diss. kg/d	P Total kg/d	Pb Total kg/d	Hg Total kg/d	Zn Total kg/d
91/02/06	259	7.770	2.590	0.1554	0.0060	0.0440	164.7	6.501	0.0003	0.3885	0.1684	6.087	118.1	0.0168	0.0026	1.3E-05	0.0104
91/05/14	7171	78.88	71.71	32.56	1.025	9.179	4848	266.0	0.0287	2.151	5.665	272.5	3772	0.1219	0.0072	0.0004	0.0861
91/11/13	346	3.460	6.228	0.0934	0.0087	0.0173	195.8	7.612	0.0010	0.3806	0.3806	9.688	149.1	0.0190	0.0003	1.7E-05	0.0021
Maximum	14774	78.88	71.71	32.56	1.025	9.179	4848	266.0	0.0287	2.151	5.665	272.5	3772	0.1219	0.0072	0.0004	0.0861
Minimum	0	3.460	2.590	0.0934	0.0060	0.0173	164.7	6.501	0.0003	0.3806	0.1684	6.087	118	0.0168	0.0003	1.3E-05	0.0021
Mean	2049	30.04	26.84	10.94	0.3467	3.080	1736	93.39	0.0100	0.9735	2.071	96.09	1346	0.0526	0.0034	0.0001	0.0328
Std. Dev.	3194	42.36	38.90	18.72	0.5878	5.282	2695	149.5	0.0162	1.020	3.114	152.8	2101	0.0600	0.0035	0.0002	0.0463
Maximum x Maximum		443.2	265.9	67.07	2.113	18.91	10327	548.1	0.0591	22.16	16.25	561.4	8421	1.448	< 1.477	<0.0007	0.5910
Minimum x Minimum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean x Mean		27.66	<24.58	<3.298	<0.1700	<1.024	1320	48.76	<0.0061	2.202	1.357	60.69	1016	0.1204	< 0.0061	< 0.0001	0.0307

Note: < values included in calculations

* Permitted levels and monitoring parameters as required before October 27, 1992 amendment.

Please see December 1992 data sheet for October 27, 1992 amended permitted levels and monitoring parameter requirements.

BC RESEARCH
BRITISH COLUMBIA RESEARCH CORPORATION
3650 Wesbrook Mall
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Fax: (604) 224-0540
Tel: (604) 224-4331

November 7, 1991
Project No: 2-51-790

Fraser River Harbour Commission
Suite 500-719 Columbia Street
New Westminster, B.C.
V3M 1B1

Attention: Ms. Pat Weber, Environmental Control Officer

Subject: Deposition of Wood Waste at the Fraser Port Site

Dear Ms. Weber:

In regard to the deposition of the wood waste presently stored at the Surrey Dock site the following calculations and comments can be made.

It is understood that the volume of wood waste is approximately 10,000 m^3 and it is proposed to deposit this material on the Fraser Port Richmond site in the area immediately south of the leachate treatment system aeration lagoons. This area of land was never filled with waste and was held in reserve as a contingency in the event that the existing leachate treatment facility could not meet the requirements of the Provincial Pollution Control Permit and Environment Canada. Providing the commission maintain the existing treatment approach, compliance will continue and this land area will not be needed.

The wood waste will be deposited at a depth of 1 m and then will be covered with 1 m of sand. For a 10,000 m^3 volume of wood waste at 1 m depth the area required will be 1 hectare.

Lagoon Capacity, Leachate Volume and Retention Time

The capacity of the lagoon system is 63,500 m^3. Leachate is only produced in quantities during the winter months and the calculated average leachate flow during the months, December to April for the past three years is 3973 m^3/day. (This value has been calculated from the data presented in a report reviewing data for 1988-1990 dated April 1991). The average leachate production is therefore 15 m^3/hectare/day from the 265 hectare site. The lagoons only treat leachate derived from a portion of the site, namely the "50 acre" municipal landfill site and the area immediately south of the lagoon. We estimate the latter to be about 37.5 hectares area, the former is 20.2 hectares. Total catchment area is therefore 57.7 hectares and the leachate flow from both areas will be:

$$\frac{3973}{265} \times 57.7 \text{ m}^3/\text{day} = 865 \text{ m}^3/\text{day}.$$

For a lagoon capacity of 63,500 m^3 the retention time will be 13.4 days. The deposition of the material will have no impact on the retention time of leachate in the aeration lagoon.

Wood Waste Leachate Characteristics

In recent tests carried out on behalf of Fletcher-Challenge Ltd. wood waste leachate from a storage pile several meters deep (ranging from 2 to 20 m) was characterized. The 5-day biochemical oxygen demand was 550 mg/L and the chemical oxygen demand was 1100 mg/L. The leachate contained negligible concentrations of nitrogen (see Table 1 attached), and 16 mg/L of iron.

Ammonia nitrogen has been clearly defined as the prime toxic substance present in leachate from the Fraser Port Richmond site (FPRS). As wood waste leachate only contains 0.4 mg N/L ammonia nitrogen there will be no significant contribution to toxicity due to the nitrogen content of the wood waste. However wood waste leachate is toxic to fish probably due to its content of tannin, lignins and resin acids. Wood waste leachates do contain high concentrations of iron (Table 2).

The only significant input on the lagoon system will be increases in the loadings of biochemical oxygen demand BOD_5 and chemical oxygen demand.

It should be remembered that in the original tests to define the biodegradability of leachates from the FPRS it was shown that providing aeration lagoon retention time was greater than seven days a significant (>60%) reduction in BOD_5 occurred.

Typical removals of BOD_5 and COD obtained for wood waste leachate in different treatment systems are shown in Table 3. It can be concluded that a significant fraction of the oxygen demand in wood waste leachate is biodegradable.

Calculation of increase in loadings for BOD_5 and COD

Calculations have been made to estimate the increase in loadings of BOD_5 and COD caused by the hog fuel placement.

These calculations show that:

BOD_5 load from "50 acre" site	= 11.5 kg/day
BOD_5 load from "South Lagoon ditch"	= 16.9 kg/day
BOD_5 load from Hog fuel	= 8.25 kg/day
Total loading	= 36.65 kg/day

In the combined leachate BOD_5 concentration will be in the order of 42.3 mg/L. The lagoon area is 6.35 hectares and even for a facultative lagoon (a lagoon relying on oxygen transfer from the atmosphere through the lagoon surface only) one would expect the oxygen transfer to the system to be well in excess of the required 36.65 kg/day. A rule of thumb oxygen transfer is about 25 kg O_2/hectare/day (i.e. the entire lagoon will

provide roughly 160 kg O_2/day). The mechanical aeration units provide additional oxygen to satisfy the demand for nitrogen conversion and to elevate dissolved oxygen.

For chemical oxygen demand:

COD load from "50 acre" site	=	94.84 kg/day
COD load from South Lagoon Ditch	=	118.12 kg/day
COD load from Hog Fuel	=	16.5 kg/day
Total Load	=	239.46 kg/day

Average concentration before treatment will be 276.7 mg/L.

It is considered that the aerated lagoon will obtain in excess of 50% removal for both BOD_5 and COD at a retention time of 13.4 days. The permit level for BOD_5 should be achieved before the treated leachate passes to the spray irrigation system. However examination of Table 2 in the report of April 1991 shows that the final effluent exceeded 30 mg/L BOD_5 on two occasions out of twenty-six during the period 1988 to 1990. The average BOD_5 was less than 15 mg/L during the period.

In conclusion the placement of the 10,000 tons of hog fuel, presently stored at the Fraser Surrey Docks, will have some impact on the waste treatment plant at the Fraser Port Richmond site. It will elevate BOD_5 and COD loadings but the system has a large excess capacity was designed to treat much larger volumes of wood waste leachate and it is unlikely that there will be any significant change in the effluent quality.

Yours truly,

BRITISH COLUMBIA RESEARCH CORPORATION

A.E. Birkbeck
Senior Research Consultant
Applied Biology Division

AEB/lgg
Encls.

TABLE 1
CHARACTERISTICS OF LEACHATES FROM VARIOUS TYPES OF LANDFILLED WASTES

	MUNICIPAL REFUSE				
	Richmond	Coquitlam	Vancouver (Burns Bog)	Wood Waste	Demolition Waste
pH	6.6 to 8.2	6.4	7.2	6.5	7.5
Biochemical Oxygen Demand (mg/L)	70 (480)	133	—	550	150
Chemical Oxygen Demand (mg/L)	—	1250	454	1100	250
Ammonia Nitrogen (mg/L)	100	157	275*	0.4	10.0
Phosphorus (mg P/L)	<1	<1	<1	1	1
Toxicity (% v/v) 96h - LC50	7 to 70	—	—	40	40
Sulphide mg S/L	1 to 10	—	—	1.5	1 to 10

*Total Kjeldahl nitrogen

( )Maximum observed value

NOV 7 '91 14:25 FROM 224-0540 TO 8552411 PAGE.005/008

TABLE 2
CONCENTRATIONS OF METALS IN LEACHATES FROM LANDFILLED WASTES

	MUNICIPAL REFUSE			
	Richmond	Coquitlam	Vancouver Landfill (Burns Bog)	Wood Waste
Waste Type				
Zinc	0.06 to 0.25	<0.23	0.11 to 1.3	0.05
Lead	0.003 to 0.17	<0.035	0.05 to 0.2	<0.02
Copper	<0.005	<0.08	0.01 to 0.02	0.005
Arsenic	<0.02	<0.16	0.02	<0.2
Mercury	0.05 to 0.19	0.5	0.06 to 0.2	<5
Cadmium	<0.001	0.5	0.01	<0.002
Manganese	1.9 to 6.1	3.1	0.5	1.9
Iron	2.7 to 4.1	43	6.2	16.1

All values in mg/L except mercury which is in µg/L.

* data corresponds to 80% of 50 observations.

NOV 7 '91 14:25 FROM 224-0540 TO 8552411277 PAGE.005/008

TABLE 3

TREATMENT OF WOOD WASTE LEACHATES IN LABORATORY SCALE SYSTEMS

METHOD OF TREATMENT	RETENTION TIME (days)	BIOCHEMICAL OXYGEN DEMAND			CHEMICAL OXYGEN DEMAND			TOXICITY* 96h-LC50	
		INFLUENT (mg/L)	EFFLUENT (mg/L)	REMOVED (%)	INFLUENT (mg/L)	EFFLUENT (mg/L)	REMOVED (%)	INFLUENT	EFFLUENT
Activated Sludge									
(1) Fluidized bed	1	535	371	31	1726	1419	18	41	100
(2) Sequencing batch	5	550	32	94	1084	350	67	41	>100
(3) Flow through	6	550	18	97	1084	339	69	41	>100
Aerated Lagoon	3	535	555	0	1726	1580	8	41	>100
Engineered Marsh	10	535	525	4	1726	1400	19	41	88.5
		463	263	43	1024	721	29	75	>100

* Using rainbow trout as test species

NOV. 15. 1991 2:26PM 224-0540 10 8552411 27/ PAGE.007/009

TABLE 4

CHARACTERISTICS OF LEACHATE AND LAGOON EFFLUENT AT FRASER PORT RICHMOND

SITE	5-day BIOCHEMICAL OXYGEN DEMAND mg/L	CHEMICAL OXYGEN DEMAND mg/L	ORGANIC CARBON mg/L	AMMONIA mg N/L
#8 Municipal Site	38	313	85	81
#9 South Lagoon Ditch	<28	210	64	23
Lagoon Effluent	<31	169	51	20
Wood Waste	550	1100	N/A	0.4
Permit Target	30	200	N/A	<10

TABLE 1

CHARACTERISTICS OF LEACHATES FROM VARIOUS TYPES OF LANDFILLED WASTES

	MUNICIPAL REFUSE			Wood Waste	Demolition Waste
	Richmond	Coquitlam	Vancouver (Burns Bog)		
pH	6.6 to 8.2	6.4	7.2	6.5	7.5
Biochemical Oxygen Demand (mg/L)	70 (480)	133	—	550	150
Chemical Oxygen Demand (mg/L)	—	1250	454	1100	250
Ammonia Nitrogen (mg/L)	100	157	275*	0.4	10.0
Phosphorus (mg P/L)	<1	<1	<1	1	1
Toxicity (% v/v) 96h - LC50	7 to 70	—	—	40	40
Sulphide mg S/L	1 to 10	—	—	1.5	1 to 10

*Total Kjeldahl nitrogen

( )Maximum observed value

CONCENTRATIONS OF METALS IN LEACHATES FROM LANDFILLED WASTES

	MUNICIPAL REFUSE			
	Richmond	Coquitlam	Vancouver Landfill (Burns Bog)	Wood Waste
Waste Type				
Zinc	0.06 to 0.25	<0.23	0.11 to 1.3	0.05
Lead	0.003 to 0.17	<0.035	0.05 to 0.2	<0.02
Copper	<0.005	<0.08	0.01 to 0.02	0.005
Arsenic	<0.02	<0.16	0.02	<0.2
Mercury	0.05 to 0.19	0.5	0.06 to 0.2	<5
Cadmium	<0.001	0.5	0.01	<0.002
Manganese	1.9 to 6.1	3.1	0.5	1.9
Iron	2.7 to 4.1	43	6.2	16.1

All values in mg/L except mercury which is in µg/L.

* data corresponds to 80% of 50 observations.

FROM 224-0548 10 05524112/ PAGE.006/006

TABLE 4

CHARACTERISTICS OF LEACHATE AND LAGOON EFFLUENT AT FRASER PORT RICHMOND

SITE	5-day BIOCHEMICAL OXYGEN DEMAND mg/L	CHEMICAL OXYGEN DEMAND mg/L	ORGANIC CARBON mg/L	AMMONIA mg N/L
#8 Municipal Site	38	313	85	81
#9 South Lagoon Ditch	<28	210	64	23
Lagoon Effluent	<31	169	51	20
Wood Waste	550	1100	N/A	0.4
Permit Target	30	200	N/A	<10

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SURFACE WATER MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

PE-06276
Data

SAMPLING SITES:

1 2-NO. 7 ROAD DITCH AT BLUNDELL RD.
2 3-NO. 7 ROAD DITCH AT NURSERY GATE
3 4-NORTH DRAINAGE DITCH
4 5-SOUTH EAST DRAINAGE DITCH

	1	2	3	4
Date	12/13/94	12/13/94	12/13/94	12/13/94
pH	6.5	6.7	6.4	6.3
Temperature (C)	4.0	4.0	4.0	3.5
Dissolved Oxygen (mg/L)	5.3	4.7	7.6	3.9
Acidity pH 8.3 (mg CaCO3/L)	27.0	33.0	18.9	38.6
Ammonia (mgN/L)	1.75	1.90	1.09	0.24
Chemical Oxygen Demand (mg/L)	62	113	279	118
Nitrite Nitrogen (mg/L)	0.070	0.102	< 0.05	< 0.05
Nitrate Nitrogen (mg/L)	0.935	0.484	0.278	0.660
Dissolved Sulfate (mg/L)	59	79	29	< 1
Total Dissolved Phosphorus (mg/L)	0.108	0.064	0.108	0.048
Total Aluminum (mg/L)	0.65	0.83	0.71	0.23
Total Copper (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Total Lead (mg/L)	< 0.001	< 0.001	< 0.001	< 0.001
Total Iron (mg/L)	7.50	4.70	4.90	15.00
Total Manganese (mg/L)	0.56	0.54	0.48	1.10
Total Zinc (mg/L)	0.04	0.04	0.02	< 0.02

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SURFACE WATER MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

2-NO. 7 ROAD DITCH AT BLUNDELL RD.
3-NO. 7 ROAD DITCH AT NURSERY GATE
4-NORTH DRAINAGE DITCH
5-SOUTH EAST DRAINAGE DITCH

	2	3	4	5
Date	06/22/94	06/22/94	06/22/94	06/22/94
pH	6.7	6.5	6.4	6.4
Temperature (C)	19	17.5	18	14
Dissolved Oxygen (mg/L)	7.5	6.4	7.0	3.3
Acidity pH 8.3 (mg CaCO3/L)	13.0	11.0	25.0	32.0
Ammonia (mgN/L)	0.29	0.28	0.11	0.31
Chemical Oxygen Demand (mg/L)	42	38	156	71
Nitrite Nitrogen (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Nitrate Nitrogen (mg/L)	0.270	0.294	0.097	0.194
Dissolved Sulfate (mg/L)	10.0	8.0	15.0	7.0
Total Dissolved Phosphorus (mg/L)	0.275	0.300	0.130	0.405
Total Aluminum (mg/L)	0.49	0.30	0.39	0.16
Total Copper (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Total Lead (mg/L)	0.001	0.001	0.001	0.001
Total Iron (mg/L)	4.00	3.10	4.40	20.00
Total Manganese (mg/L)	0.15	0.13	0.42	1.20
Total Zinc (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SURFACE WATER MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

2-NO. 7 ROAD DITCH AT BLUNDELL ROAD
3-NO. 7 ROAD DITCH AT NURSERY GATE
4-NORTH DRAINAGE DITCH
5-SOUTH EAST DRAINAGE DITCH

	2	3	4	5
Date	12/16/93	12/16/93	12/16/93	12/16/93
pH	7.8	7.2	6.3	6.7
Acidity pH 8.3 (mg CaCO3/L)	40.0	55.0	45.0	47.0
Ammonia (mgN/L)	0.94	0.75	0.27	0.54
Chemical Oxygen Demand (mg/L)	92	67	43	60
Nitrite Nitrogen (mg/L)	0.05	0.05	< 0.05	< 0.05
Nitrate Nitrogen (mg/L)	4.45	4.4	0.76	0.54
Dissolved Sulfate (mg/L)	52.0	36.0	33.0	21.0
Total Dissolved Phosphorus (mg/L)	0.200	0.220	0.220	0.070
Total Aluminum (mg/L)	1.00	0.92	0.58	0.12
Total Copper (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Total Lead (mg/L)	0.007	< 0.001	0.003	< 0.001
Total Iron (mg/L)	7.1	11.0	3.5	8.4
Total Manganese (mg/L)	0.41	0.42	0.47	1.30
Total Zinc (mg/L)	0.04	0.03	0.02	< 0.02

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BCRI

April 13, 1994
File No: 2-51-790

Mr. Dennis Barlow
Ministry of Environment
Waste Management Branch
15326 - 103A Avenue
Surrey, B.C.
V3R 7A2

RECEIVED
APR 18 1994
LOWER MAINLAND REGION
FILE NO. PE06276

Dear Mr. Barlow:

Subject: Permit No. PE-6276

The attached tables contain the analytical and bioassay results for the first quarterly monitoring of the final discharge at the Fraser Port Richmond landfill site. The flow and precipitation records for the months January to March are enclosed. The field measurements are as follows:

Date	Temperature (°C)	Dissolved Oxygen (mg/L)
January 6, 1994	5.0	7.0
February 17, 1994	6.5	5.4
March 9, 1994	9.0	6.3

If you have any questions or comments please call me at 224-4331.

Sincerely,

BCRI

Janet Pickard
Biologist
Environmental Sciences and Engineering

enclosure:

cc: Mr. R. Pearce
Mr. G. Hughes
Mr. Bill Tou

BC Research Inc.
3650 Westbrook Mall
Vancouver, BC
Canada V6S 2L2
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USA
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PE06276

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 FINAL DISCHARGE

	1
Date	03/09/94
pH	7.4
Temperature (C)	9.0
Dissolved Oxygen (mg/L)	6.3
Acidity pH 8.3 (mg CaCO3/L)	8.0
Total Suspended Solids (mg/L)	9.0
Ammonia (mgN/L)	2.9
BOD5 (mg/L)	< 10
Chemical Oxygen Demand (mg/L)	49
Nitrite Nitrogen (mgN/L)	0.110
Nitrate Nitrogen (mgN/L)	0.310
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	1.6
Total Manganese (mg/L)	1.0
Total Aluminum (mg/L)	< 0.10
Dissolved Sulfate (mg/L)	24
Total Dissolved Phosphorus (mg/L)	< 0.005
Total Lead (mg/L)	< 0.001
Total Zinc (mg/L)	< 0.05
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	0.044

BC RESEARCH
B.C. Research Inc.
3650 Wesbrook Mall
Vancouver, B.C.
Canada V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

January 28, 1993
File No: 2-51-790

RECEIVED
JAN 31 1994
FILE NO. PE06276

Mr. Dennis Barlow
Ministry of Environment
Waste Management Branch
15326 - 103A Avenue
Surrey, B.C.
V3R 7A2

Dear Mr. Barlow:

Subject: Permit No. PE-6276

The attached tables contain the analytical and bioassay results for the fourth quarterly monitoring of the final discharge at the Fraser Port Richmond landfill site. The biannual analytical results of samples taken from the four wells and the four surface water sites around the landfill are also enclosed. The flow and precipitation records for the months September to December are enclosed.

	FIELD MEASUREMENTS	
	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
DATE		
Oct. 27, 1993	12	3.6
Nov. 26, 1993	2.5	10.8
Dec. 16, 1993	5.5	6.9

If you have any questions or comments please call me at 224-4331.

Yours truly,

BRITISH COLUMBIA RESEARCH INC.

Janet Pickard

J. Pickard
Biologist
Applied Biology Division

cc: *Mr. R. Pearce*
Mr. G. Hughes
Mr. Bill Tou

encls.

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 FINAL DISCHARGE

	1
Date	12/16/93
pH	7.9
Dissolved Oxygen (mg/L)	6.9
Temperature (C)	5.5
Acidity pH 8.3 (mg CaCO3/L)	24.0
Total Suspended Solids (mg/L)	8.0
Ammonia (mgN/L)	4.60
BOD5 (mg/L)	< 10
Chemical Oxygen Demand (mg/L)	62
Nitrite Nitrogen (mg/L)	0.94
Nitrate Nitrogen (mg/L)	7.96
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	2.4
Total Manganese (mg/L)	0.94
Total Aluminum (mg/L)	< 0.10
Dissolved Sulfate (mg/L)	24
Total Dissolved Phosphorus (mg/L)	0.040
Total Lead (mg/L)	0.001
Total Zinc (mg/L)	< 0.02
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	0.089

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 FINAL DISCHARGE

	1
Date	09/30/93
pH	8.3
Temperature (C)	18.5
Dissolved Oxygen (mg/L)	10.7
Acidity pH 8.3 (mg CaCO3/L)	< 0.5
Total Suspended Solids (mg/L)	7.0
Ammonia (mgN/L)	1.26
BOD5 (mg/L)	20
Chemical Oxygen Demand (mg/L)	68
Nitrite Nitrogen (mg/L)	0.175
Nitrate Nitrogen (mg/L)	1.12
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	0.84
Total Manganese (mg/L)	0.54
Total Aluminum (mg/L)	< 0.1
Dissolved Sulfate (mg/L)	2.0
Total Dissolved Phosphorus (mg/L)	0.024
Total Lead (mg/L)	< 0.001
Total Zinc (mg/L)	< 0.05
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	0.058

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 FINAL DISCHARGE
2 FINAL DISCHARGE

	1	2
Date	05/20/93	05/26/93
pH	8.0	7.8
Temperature (C)	12.5	20.5
Dissolved Oxygen (mg/L)	6.5	12.2
Acidity pH 8.3 (mg CaCO3/L)	8.0	8.0
Total Suspended Solids (mg/L)	13.0	11.0
Ammonia (mgN/L)	4.60	0.95
BOD5 (mg/L)	43	35
Chemical Oxygen Demand (mg/L)	70	75
Nitrite Nitrogen (mg/L)	0.270	0.327
Nitrate Nitrogen (mg/L)	1.04	1.21
Total Copper (mg/L)	< 0.05	< 0.05
Total Iron (mg/L)	1.30	1.20
Total Manganese (mg/L)	0.82	0.40
Total Aluminum (mg/L)	< 0.10	< 0.10
Dissolved Sulfate (mg/L)	8	13
Total Dissolved Phosphorus (mg/L)	0.280	0.030
Total Lead (mg/L)	0.001	0.002
Total Zinc (mg/L)	< 0.04	< 0.04
Resin Acids (mg/L)	< 0.005	< 0.005
Fatty Acids (mg/L)	0.232	0.214

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 FINAL DISCHARGE

	1
Date	03/24/93
pH	7.9
Dissolved Oxygen (mg/L)	6.4
Temperature (C)	7.0
Acidity pH 8.3 (mg CaCO3/L)	27.0
Total Suspended Solids (mg/L)	9.5
Ammonia (mgN/L)	6.23
BOD5 (mg/L)	< 10.0
Chemical Oxygen Demand (mg/L)	87
Nitrite Nitrogen (mg/L)	0.116
Nitrate Nitrogen (mg/L)	3.013
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	2.00
Total Manganese (mg/L)	0.86
Total Aluminum (mg/L)	< 0.1
Dissolved Sulfate (mg/L)	20.0
Total Dissolved Phosphorus (mg/L)	< 0.002
Total Lead (mg/L)	< 0.001
Total Zinc (mg/L)	< 0.02
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	0.405

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 FINAL DISCHARGE

	1
Date	02/01/93
pH	8.0
Dissolved Oxygen (mg/L)	7.1
Temperature (C)	2.5
Acidity pH 8.3 (mg CaCO3/L)	17.5
Total Suspended Solids (mg/L)	18.0
Ammonia (mgN/L)	7.60
BOD5 (mg/L)	18.0
Chemical Oxygen Demand (mg/L)	64
Nitrite Nitrogen (mg/L)	0.041
Nitrate Nitrogen (mg/L)	3.659
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	8.50
Total Manganese (mg/L)	1.90
Total Aluminum (mg/L)	< 0.10
Dissolved Sulfate (mg/L)	8.0
Total Dissolved Phosphorus (mg/L)	< 0.005
Total Lead (mg/L)	0.001
Total Zinc (mg/L)	< 0.04
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	< 0.005

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 FINAL DISCHARGE

	1
Date	06/22/94
pH	8.2
Temperature (C)	23.0
Dissolved Oxygen (mg/L)	> 20.0
Acidity pH 8.3 (mg CaCO3/L)	7.5
Total Suspended Solids (mg/L)	6.0
Ammonia (mgN/L)	0.69
BOD5 (mg/L)	< 10.0
Chemical Oxygen Demand (mg/L)	58
Nitrite Nitrogen (mg/L)	< 0.05
Nitrate Nitrogen (mg/L)	2.958
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	1.60
Total Manganese (mg/L)	0.30
Total Aluminum (mg/L)	< 0.10
Dissolved Sulfate (mg/L)	16.0
Total Dissolved Phosphorus (mg/L)	0.045
Total Lead (mg/L)	< 0.001
Total Zinc (mg/L)	< 0.05
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	0.029

BCRI

October 25, 1994
File No: 2-51-790

Mr. Dennis Barlow
Ministry of Environment
Waste Management Branch
15326 -- 103A Avenue
Surrey, B.C.
V3R 7A2

RECEIVED
OCT 28 1994
LOWER MAINLAND REGION
FILE NO. PE-06276

Dear Mr. Barlow:

Subject: Permit No. PE-6276

The attached tables contain the analytical and bioassay results for the third quarterly monitoring of the final discharge at the Fraser Port Richmond landfill site. The final discharge flow and precipitation records for the months of July, August, and September are enclosed. The stilling well (a galvanized culvert) supporting the weir flow gauge has corroded and is being replaced. This accounts for the missing data on the last two days of September. The field measurements are as follows:

Date	Temperature (°C)	Dissolved Oxygen (mg/L)
July 6, 1994	17.0	8.2
August 24, 1994	18.0	5.0
September 16, 1994	20.0	11.4

If you have any questions or comments please call me at 224-4331.

Sincerely,

BCRI
Janet Pickard

Janet Pickard
Biologist
Environmental Sciences and Engineering

Enclosures:

cc: Mr. R. Pearce
Mr. G. Hughes
Mr. Bill Tou

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
Canada
Tel: (604) 224-4331
Fax: (604) 224-0540
USA
Tel: (206) 738-0958
Fax: (206) 733-3590

D-6

BCRI

July 20, 1994
File No: 2-51-790

RECEIVED
JUL 22 1994
LOWER MAINLAND REGION
FILE NO. PE-06276

Mr. Dennis Barlow
Ministry of Environment
Waste Management Branch
15326 - 103A Avenue
Surrey, B.C.
V3R 7A2

Dear Mr. Barlow:

Subject: Permit No. PE-6276

The attached tables contain the analytical and bioassay results for the second quarterly monitoring of the final discharge at the Fraser Port Richmond landfill site and the biannual monitoring of the surrounding surface and groundwater sites. The flow and precipitation records for the months April to June are enclosed. The field measurements for the final discharge are as follows:

Date	Temperature (°C)	Dissolved Oxygen (mg/L)
April 7, 1994	8.5	5.7
May 25, 1994	16	8.7
June 22, 1994	23	> 20

If you have any questions or comments please call me at 224-4331.

Sincerely,

BCRI
Janet Pickard

Janet Pickard
Biologist
Environmental Sciences and Engineering

enclosure:

cc: Mr. R. Pearce
Mr. G. Hughes
Mr. Bill Tou

BC Research Inc.
3650 Westbrook Mall
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PE-6276 RICHMOND LANDFILL, FRASER RIVER HARBOR COMMISSION

FINAL EFFLUENT INTO NO. 7 ROAD DITCH

PARAMETER	UNITS	PERMIT LIMIT	1990-1	1990-2	1990-3	1990-4	1991-1	1991-2	1991-3	1991-4	1992-1	1992-2	1992-3
			Feb-22-90	May-29-90	Jul-18-90	Nov-07-90	Feb-06-91	May-14-91	Aug-27-91	Nov-13-91	Feb-25-92	May-26-92	Aug-20-92
pH		6.5 - 8.5	6.9	7.6	7.8	8.2	8.1	8.3	8.4	7.4	7.8	7.9	7.9
Temperature	C	---	2.5	15.0	20.0	9.5	6.5	13.5	15.5	8.5	12.0	20.0	22.0
96H LC50	%	100 (low limit)	> 100	> 100	> 100	> 100	> 100	> 100	> 100	> 100	> 100	> 100	> 100
TSS	mg/L	40	16	10	6	14	30	11	3	10	15	4	11
Ammonia	mg/L N	---	2.67	8.10	0.44	0.57	0.60	4.54	< 1	0.27	4.40	1.44	0.13
BOD	mg/L	30	< 10	14	< 10	< 10	< 10	< 10	< 10	18	13	13	13
Diss. Oxygen	mg/L	---	8.2	8.5	6.6	6.4	6.0	6.5	7.3	6.9	6.7	9.8	10.7
Nitrite	mg/L N	---	0.047	0.164	1.1	0.036	0.023	0.143	< 0.01	< 0.025	< 0.010	0.158	< 0.010
Nitrate	mg/L N	---	1.28	1.32	1.80	1.21	0.17	1.28	< 0.01	0.05	2.27	1.23	0.70
Copper (dissolved)	mg/L	0.2	0.01	0.03	0.04	0.04	0.001	0.004	< 0.05	0.003	0.002	< 0.050	< 0.050
Iron (dissolved)	mg/L	12	2.4	0.1	0.1	0.7	1.5	0.3	1.4	1.1	0.3	0.3	0.4
Manganese (dissolved)	mg/L	3.30	1.06	1.16	0.09	0.52	0.65	0.79	0.11	1.10	0.87	0.86	0.81
Sodium	mg/L	---	1000	1110	1460	712	456	526	570	431	431	709	759
Potassium	mg/L	---	67.5	55.0	30.6	32.6	23.5	38.0	29.0	28.0	30.0	41.0	44.0
Chloride	mg/L	---	100	1880	2450	1160	636	676	699	566	929	1180	1510
Sulfate	mg/L	250.0	516.0	143.0	122.0	68.5	25.1	37.1	11.0	22.0	67.0	22.0	7.0
Phosphorus (total dissolved	mg/L	---	0.014	0.012	0.017	0.012	0.065	0.017	0.098	0.055	0.021	0.021	0.042
Lead (total)	mg/L	0.05	< 0.1	0.003	0.001	0.002	< 0.01	0.001	< 0.001	0.001	< 0.001	0.002	< 0.001
Zinc (total)	mg/L	0.500	0.060	0.022	0.009	0.110	0.040	0.012	0.002	0.006	0.020	0.002	0.003
Mercury (total)	ug/L	0.6	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

1992-4
Dec-2-92

8
1.96
20
< 0.020
1.400
< 0.05 (Total)
3.20 (Total)
1.40 (Total)
15.7
0.040
< 0.10
< 0.04

COD 55
Acidity pH 8.3 38
Al (Total) < 0.10
Resin Acids < 0.005
Fatty Acids < 0.005

SITE 2: NO. 7 ROAD DITCH AT BLUNDELL ROAD				MONITORING DATA									
PARAMETER	UNITS	PERMIT LIMIT	1990-1	1990-2	1990-3	1990-4	1991-1	1991-2	1991-3	1991-4	1992-1	1992-2	1992-3
		(DISCHARGE)	Feb-22-90	May-29-90	Jul-18-90	Nov-07-90	Feb-06-91	May-14-91	Aug-27-91	Nov-13-91	Feb-25-92	May-26-92	Aug-20-92
pH		6.5 - 8.5	6.8	6.8	7.3	7.5	7.1	7.9	6.0	5.5	6.9	6.5	7.4
Temperature	C	- - -	3.5	16.5	23.0	8.0	6.5	12.0	20.0	9.8	10.0	19.0	23.0
TSS	mg/L	40	19	39	35	36	26	30	28	41	21	17	16
Ammonia	mg/L N	- - -	1.22	0.32	0.03	0.66	0.91	0.09	< 1	0.52	1.57	0.02	0.13
BOD	mg/L	30	< 10	< 10	< 10	< 10	< 10	< 10	13	20	12	21	21
Diss. Oxygen	mg/L	- - -	6.9	5.6	6.8	6.3	5.6	10	3.7	6.1	4.3	< 1.0	8.1
Nitrite	mg/L N	- - -	0.026	0.050	0.007	0.023	0.017	0.009	0.020	0.018	< 0.010	< 0.010	< 0.010
Nitrate	mg/L N	- - -	0.450	0.100	0.060	0.830	0.940	0.190	0.194	2.750	0.625	0.566	0.061
Copper (dissolved)	mg/L	0.2	0.019	0.02	0.003	0.012	0.002	0.001	0.007	< 0.010	0.006	< 0.05	< 0.050
Iron (dissolved)	mg/L	12	4.1	4.2	1.2	2.4	2.6	1.3	6.8	2.6	5.4	3.6	1.1
Manganese (dissolved)	mg/L	3.30	0.38	0.15	0.05	0.22	0.23	0.09	0.20	0.24	0.35	0.20	< 0.05
Sodium	mg/L	- - -	36.1	18.1	5.8	20.2	22.0	9.9	21.0	20.0	36.0	12.0	4.10
Potassium	mg/L	- - -	7.4	3.2	2.7	6.7	4.8	1.4	4.6	6.4	5.9	6.0	3.0
Chloride	mg/L	- - -	42.2	23.1	7.0	27.0	28.8	14.1	37.4	27.7	45.0	18.0	6.8
Sulfate	mg/L	250.0	41.0	13.7	7.0	35.1	31.9	7.4	9.0	42.0	27.0	15.0	9.2
Phosphorus (total dissolved	mg/L	- - -	0.300	0.143	0.142	0.046	0.055	0.047	0.369	0.254	0.138	0.374	0.038
Lead (total)	mg/L	0.05	< 0.1	0.001	< 0.001	0.002	< 0.01	0.002	0.002	0.002	< 0.001	0.002	0.001
Zinc (total)	mg/L	0.500	0.070	0.060	0.017	0.120	0.040	0.010	0.010	0.043	0.022	0.018	0.008
Mercury (total)	ug/L	0.6	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

SITE 3: NO. 7 ROAD DITCH AT NURSERY GATE				MONITORING DATA									
PARAMETER	UNITS	PERMIT LIMIT	1990-1	1990-2	1990-3	1990-4	1991-1	1991-2	1991-3	1991-4	1992-1	1992-2	1992-3
		(DISCHARGE)	Feb-22-90	May-29-90	Jul-18-90	Nov-07-90	Feb-06-91	May-14-91	Aug-27-91	Nov-13-91	Feb-25-92	May-26-92	Aug-20-92
pH		6.5 - 8.5	6.7	6.7	7.3	7.2	7.3	7.8	5.9	5.5	7.0	6.7	7.1
Temperature	C	---	3.5	15.5	23.0	8.5	5.8	12.5	19.0	10.0	9.0	18.5	18.9
TSS	mg/L	40	23	17	29	95	16	40	15	3	27	18	13
Ammonia	mg/L N	---	0.87	0.11	0.05	0.48	1.86	0.27	< 1	0.07	0.64	< 0.01	0.13
BOD	mg/L	30	< 10	< 10	< 10	< 10	< 10	< 10	13	< 10	< 10	16	16
Diss. Oxygen	mg/L	---	5.9	6.1	7.9	5.3	5.6	6.6	1.7	5.9	3.2	2.6	4.3
Nitrite	mg/L N	---	0.026	0.01	< 0.005	0.025	0.02	0.01	0.02	< 0.005	< 0.010	< 0.01	< 0.010
Nitrate	mg/L N	---	0.750	0.120	0.100	1.390	0.460	0.220	0.639	0.153	0.870	0.663	0.181
Copper (dissolved)	mg/L	0.2	0.014	0.005	0.001	0.012	0.01	0.001	0.004	0.004	0.006	< 0.05	< 0.050
Iron (dissolved)	mg/L	12.0	6.2	2.1	1.1	2.7	2.5	2.6	6.9	1.9	7.0	1.7	1.3
Manganese (dissolved)	mg/L	3.3	0.36	0.1	0.05	0.19	0.29	0.23	0.28	0.23	0.33	0.28	< 0.05
Sodium	mg/L	---	26.2	9.2	4.5	12.7	38.6	27.7	23.0	20.0	23.0	17.0	3.7
Potassium	mg/L	---	3.6	2.0	2.2	6.0	8.5	2.0	4.1	3.7	3.2	4.0	3.4
Chloride	mg/L	---	42.4	13.2	5.4	20.2	39.1	16.5	39.5	19.5	36.0	35.0	6.4
Sulfate	mg/L	250.0	23.0	9.1	7.5	28.3	38.1	10.8	10.0	17.0	21.0	15.0	8.9
Phosphorus (total dissolved	mg/L	---	0.176	0.134	0.077	0.091	0.042	0.033	0.357	0.120	0.138	0.267	0.223
Lead (total)	mg/L	0.05	< 0.1	0.001	< 0.001	0.002	< 0.01	0.001	0.002	0.001	0.001	0.001	0.003
Zinc (total)	mg/L	0.500	0.070	0.020	0.020	0.200	0.040	0.020	0.013	0.018	0.023	0.015	0.017
Mercury (total)	ug/L	0.6	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

SITE 4: NORTH DRAINAGE DITCH NEAR NO. 7 ROAD DITCH				MONITORING DATA									
PARAMETER	UNITS	PERMIT LIMIT	1990-1	1990-2	1990-3	1990-4	1991-1	1991-2	1991-3	1991-4	1992-1	1992-2	1992-3
		(DISCHARGE)	Feb-22-90	May-29-90	Jul-18-90	Nov-07-90	Feb-06-91	May-14-91	Aug-27-91	Nov-13-91	Feb-25-92	May-26-92	Aug-20-92
pH		6.5 - 8.5	6.7	6.2	7	7.2	6.4	7.6	6.3	5.7	5.8	6.4	7.0
Temperature	C	- - -	3.0	14.5	17.5	9.0	5.0	12.5	16.5	9.2	11.0	17.0	16.5
TSS	mg/L	40	13	15	4	56	2	12	8	43	13	3	6
Ammonia	mg/L N	- - -	0.28	0.03	0.33	0.14	0.08	0.12	< 1	0.36	< 0.01	< 0.01	0.17
BOD	mg/L	30	< 10	< 10	< 10	< 10	< 10	< 10	13	< 10	10	< 10	< 10
Diss. Oxygen	mg/L	- - -	7.9	7.5	7	6.1	7.9	8.6	8.5	4.7	6.8	6.3	7.1
Nitrite	mg/L N	- - -	0.026	0.03	0.005	0.017	0.024	0.063	< 0.01	< 0.050	< 0.010	< 0.01	< 0.010
Nitrate	mg/L N	- - -	0.20	0.03	< 0.02	0.06	< 0.02	0.10	0.03	2.98	0.09	0.20	< 0.010
Copper (dissolved)	mg/L	0.2	0.008	0.007	0.003	0.005	0.001	0.004	0.004	0.008	0.009	< 0.05	< 0.050
Iron (dissolved)	mg/L	1.2	3.9	3.8	6.9	1.2	1.7	4.6	5.2	3.7	2.5	7.7	1.7
Manganese (dissolved)	mg/L	3.30	0.43	0.55	1.46	0.29	0.22	0.85	1.50	0.26	0.25	1.10	1.30
Sodium	mg/L	- - -	20.5	14.8	14.7	34.1	15.5	16.4	12.0	16.0	7.2	7.0	9.9
Potassium	mg/L	- - -	2.7	3.3	3.2	5.5	2.1	3.2	2.8	5.5	1.2	2.0	2.6
Chloride	mg/L	- - -	36.3	25.6	13.3	43.3	29.3	23.7	13.7	26.4	8.8	8.0	11.9
Sulfate	mg/L	250.0	18.3	7.8	6.4	48.2	12.6	14.8	3.0	38.0	5.0	6.0	4.0
Phosphorus (total dissolved	mg/L	- - -	0.100	0.058	0.044	0.035	0.051	0.091	0.346	0.190	0.043	0.055	0.086
Lead (total)	mg/L	0.05	< 0.1	< 0.001	0.003	0.001	< 0.01	0.007	0.002	0.001	0.001	< 0.001	< 0.001
Zinc (total)	mg/L	0.500	0.030	0.050	0.030	0.110	0.006	0.030	0.011	0.040	0.005	0.009	0.010
Mercury (total)	ug/L	0.6	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.08	< 0.05

SITE 5: SE DRAINAGE DITCH AT NELSON ROAD FLOODGATE				MONITORING DATA									
PARAMETER	UNITS	PERMIT LIMIT	1990-1	1990-2	1990-3	1990-4	1991-1	1991-2	1991-3	1991-4	1992-1	1992-2	1992-3
		(DISCHARGE)	Feb-22-90	May-29-90	Jul-18-90	Nov-07-90	Feb-06-91	May-14-91	Aug-27-91	Nov-13-91	Feb-25-92	May-26-92	Aug-20-92
pH		6.5 - 8.5	6.8	6.4	7.2	7.5	7.2	7.7	6.0	5.5	6.7	6.5	7.0
Temperature	C	- - -	4.5	17.5	20.0	8.5	5.3	17.0	18.0	9.0	9.5	17.0	18.0
TSS	mg/L	40	9	11	20	15	11	18	16	18	11	67	21
Ammonia	mg/L N	- - -	0.25	0.01	0.28	0.07	0.48	0.29	< 1	0.33	0.51	0.03	0.09
BOD	mg/L	30	< 10	< 10	< 10	< 10	< 10	< 10	18	23	< 10	13	13
Diss. Oxygen	mg/L	- - -	7.6	6.6	4.1	5.4	7.1	2.9	2.6	6.2	4.6	1.9	5.8
Nitrite	mg/L N	- - -	0.016	0.008	< 0.005	0.019	0.018	0.03	< 0.01	< 0.020	< 0.010	< 0.01	< 0.010
Nitrate	mg/L N	- - -	0.080	0.020	< 0.02	0.880	0.060	< 0.02	0.010	0.680	0.294	0.460	0.020
Copper (dissolved)	mg/L	0.2	0.025	0.004	0.002	0.06	0.013	< 0.001	0.002	0.015	0.001	< 0.05	< 0.050
Iron (dissolved)	mg/L	12.0	7.4	8.6	8.7	4.9	7.3	17.9	8.7	6.2	10.0	5.1	3.4
Manganese (dissolved)	mg/L	3.30	1.14	0.55	1.02	0.35	1.03	1.45	1.00	0.42	1.22	1.30	0.12
Sodium	mg/L	- - -	27.4	17.3	36.6	16.6	20.4	32.8	29.0	14.0	19.0	27.0	10.0
Potassium	mg/L	- - -	2.7	4.3	3.4	9.9	2.6	2.3	5.5	9.7	3.2	2.1	16.0
Chloride	mg/L	- - -	28.2	26.3	35.0	24.3	22.3	52.5	28.2	21.8	25.0	41.0	39.8
Sulfate	mg/L	250.0	15.6	16.7	2.2	20.0	10.2	7.7	9.0	18.0	7.0	< 1.0	14.1
Phosphorus (total dissolved	mg/L	- - -	0.228	0.112	0.015	0.578	0.036	0.068	0.327	1.54	0.065	0.164	1.30
Lead (total)	mg/L	0.05	< 0.1	< 0.001	< 0.001	0.003	< 0.01	< 0.001	0.001	0.002	< 0.001	0.002	< 0.001
Zinc (total)	mg/L	0.5	0.04	0.03	< 0.005	0.09	0.01	< 0.005	0.003	0.028	0.007	0.017	0.011
Mercury (total)	ug/L	0.6	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

GROUNDWATER WELL #1: WEST SITE #3													
PARAMETER	UNITS		1991-2	1991-4	1992-2	1992-4							
pH		6.5 - 8.5	6.0	5.2	N/A - DRY								
TSS	mg/L	40	262	77	N/A - DRY								
Ammonia	mg/L N	---	0.08	0.33	N/A - DRY								
BOD	mg/L	30	< 10	15	N/A - DRY								
Nitrite	mg/L N	---	0.006	< 0.005	N/A - DRY								
Nitrate	mg/L N	---	0.08	0.055	N/A - DRY								
Iron (dissolved)	mg/L	12	0.3	0.7	N/A - DRY								
Manganese (dissolved)	mg/L	3.30	0.04	0.05	N/A - DRY								
Sodium	mg/L	---	5.9	7.0	N/A - DRY								
Potassium	mg/L	---	1.5	0.7	N/A - DRY								
Chloride	mg/L	---	1.8	2.8	N/A - DRY								
Sulfate	mg/L	250.0	5.0	9.0	N/A - DRY								
Phosphorus (total dissolved	mg/L	---	0.375	0.166	N/A - DRY								
Mercury (total)	ug/L	0.6	< 0.05	0.06	N/A - DRY								

GROUNDWATER WELL #2:	**WEST SITE #4**												
PARAMETER	**UNITS**		**1991-2**	**1991-4**	**1992-2**	**1992-4**							
pH		6.5 - 8.5	5.6	5.2	5.6								
TSS	mg/L	40	5	142	41								
Ammonia	mg/L N	- - -	3.44	4.00	3.78								
BOD	mg/L	30	17	27	31								
Nitrite	mg/L N	- - -	0.066	< 0.005	< 0.01								
Nitrate	mg/L N	- - -	< 0.02	0.011	0.483								
Iron (dissolved)	mg/L	12.0	16.5	23.0	22.0								
Manganese (dissolved)	mg/L	3.3	0.24	0.33	0.25								
Sodium	mg/L	- - -	39.5	41.0	40.0								
Potassium	mg/L	- - -	3.3	3.5	3.2								
Chloride	mg/L	- - -	50.5	47.3	58.0								
Sulfate	mg/L	250.0	11.6	< 1.0	8.0								
Phosphorus (total dissolved	mg/L	- - -	0.044	0.143	0.112								
Mercury (total)	ug/L	0.6	< 0.05	0.08	< 0.05								

GROUNDWATER WELL #3:	**EAST SITE #6**												
PARAMETER	**UNITS**		**1991-2**	**1991-4**	**1992-2**	**1992-4**							
pH		6.5 - 8.5	5.6	5.4	5.6								
TSS	mg/L	40	37	13	8								
Ammonia	mg/L N	- - -	0.01	0.01	0.04								
BOD	mg/L	30	< 10	< 10	< 10								
Nitrite	mg/L N	- - -	< 0.005	< 0.002	< 0.01								
Nitrate	mg/L N	- - -	0.080	0.061	0.035								
Iron (dissolved)	mg/L	12.0	1.1	0.5	13.0								
Manganese (dissolved)	mg/L	3.3	0.06	0.12	0.26								
Sodium	mg/L	- - -	3.4	5.4	158								
Potassium	mg/L	- - -	0.2	0.4	1.2								
Chloride	mg/L	- - -	1.2	3.8	4.0								
Sulfate	mg/L	250.0	12.7	9.0	4.0								
Phosphorus (total dissolved	mg/L	- - -	0.004	0.016	< 0.005								
Mercury (total)	ug/L	0.6	< 0.05	< 0.05	< 0.05								

GROUNDWATER WELL #4: EAST SITE #7													
PARAMETER	UNITS		1991-2	1991-4	1992-2	1992-4							
pH		6.5 - 8.5	6.4	6.2	6.5								
TSS	mg/L	40	105	71	16								
Ammonia	mg/L N	- - -	0.75	1.95	0.03								
BOD	mg/L	30	19	36	17								
Nitrite	mg/L N	- - -	0.006	< 0.005	< 0.010								
Nitrate	mg/L N	- - -	< 0.02	**0.057**	**0.146**								
Iron (dissolved)	mg/L	12.0	30.9	24.0	< 0.5								
Manganese (dissolved)	mg/L	3.30	0.66	0.53	0.05								
Sodium	mg/L	- - -	290	5.3	3.5								
Potassium	mg/L	- - -	1.9	2.0	0.3								
Chloride	mg/L	- - -	250	192	100								
Sulfate	mg/L	250	2.1	< 1.0	6.0								
Phosphorus (total dissolved	mg/L	- - -	0.005	**0.080**	0.243								
Mercury (total)	ug/L	0.6	< 0.05	**0.06**	< 0.05								

PE-6276 NO. 7 ROAD DITCH AT NURSERY GATE

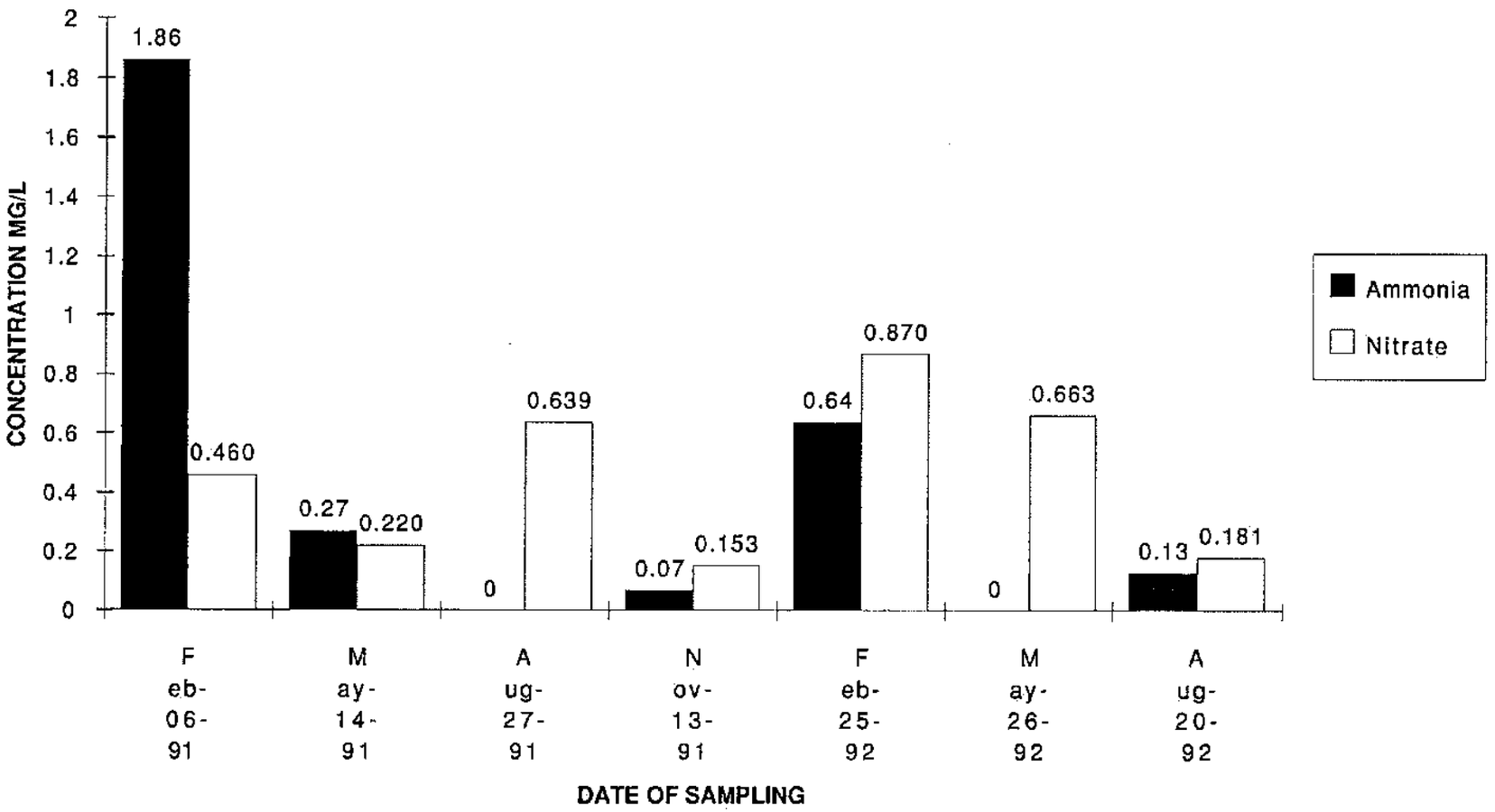


Chart16

PE-6276 NO. 7 ROAD DITCH AT BLUNDELL ROAD

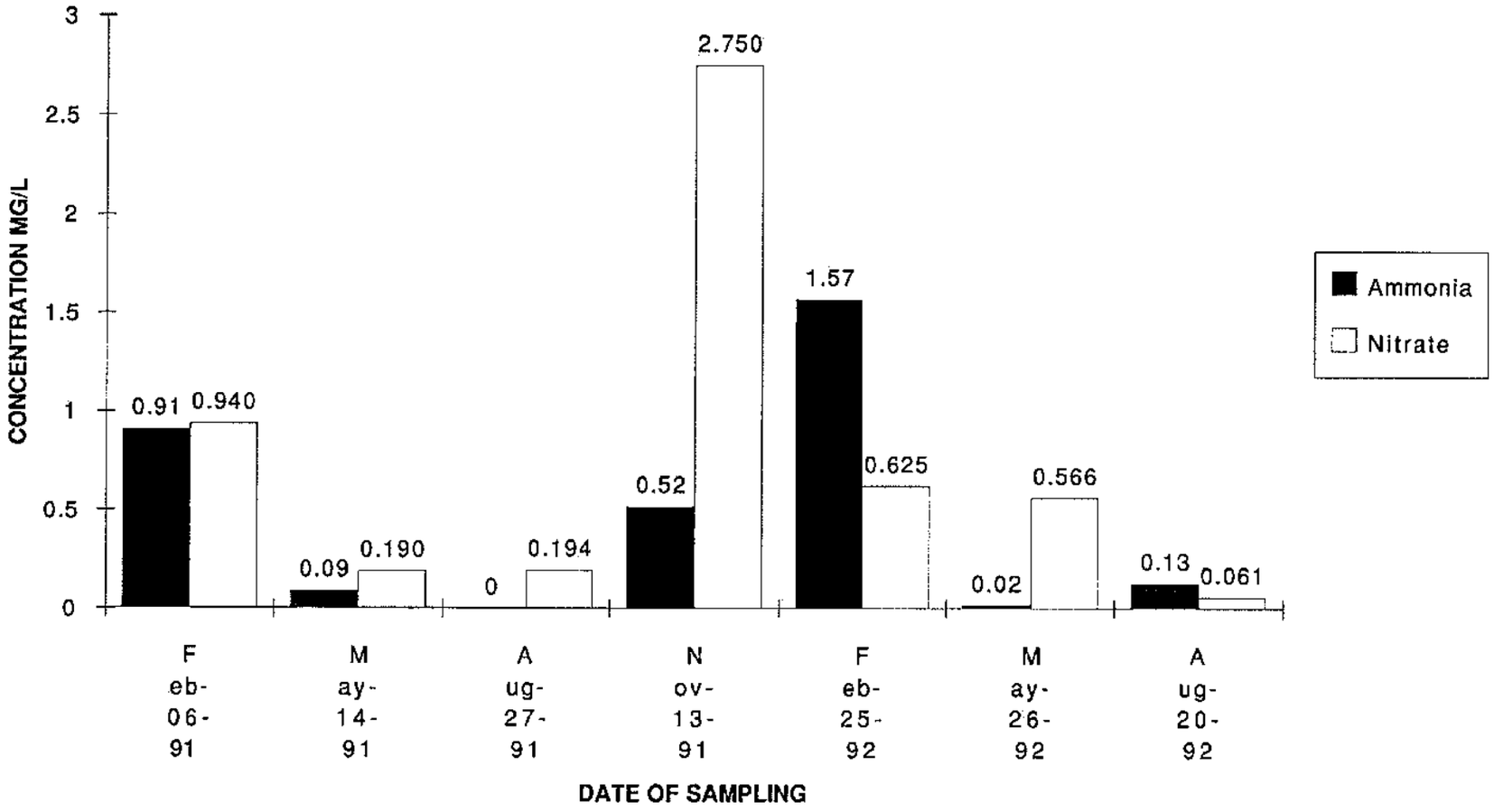


Chart19

PE-6276 FINAL EFFLUENT

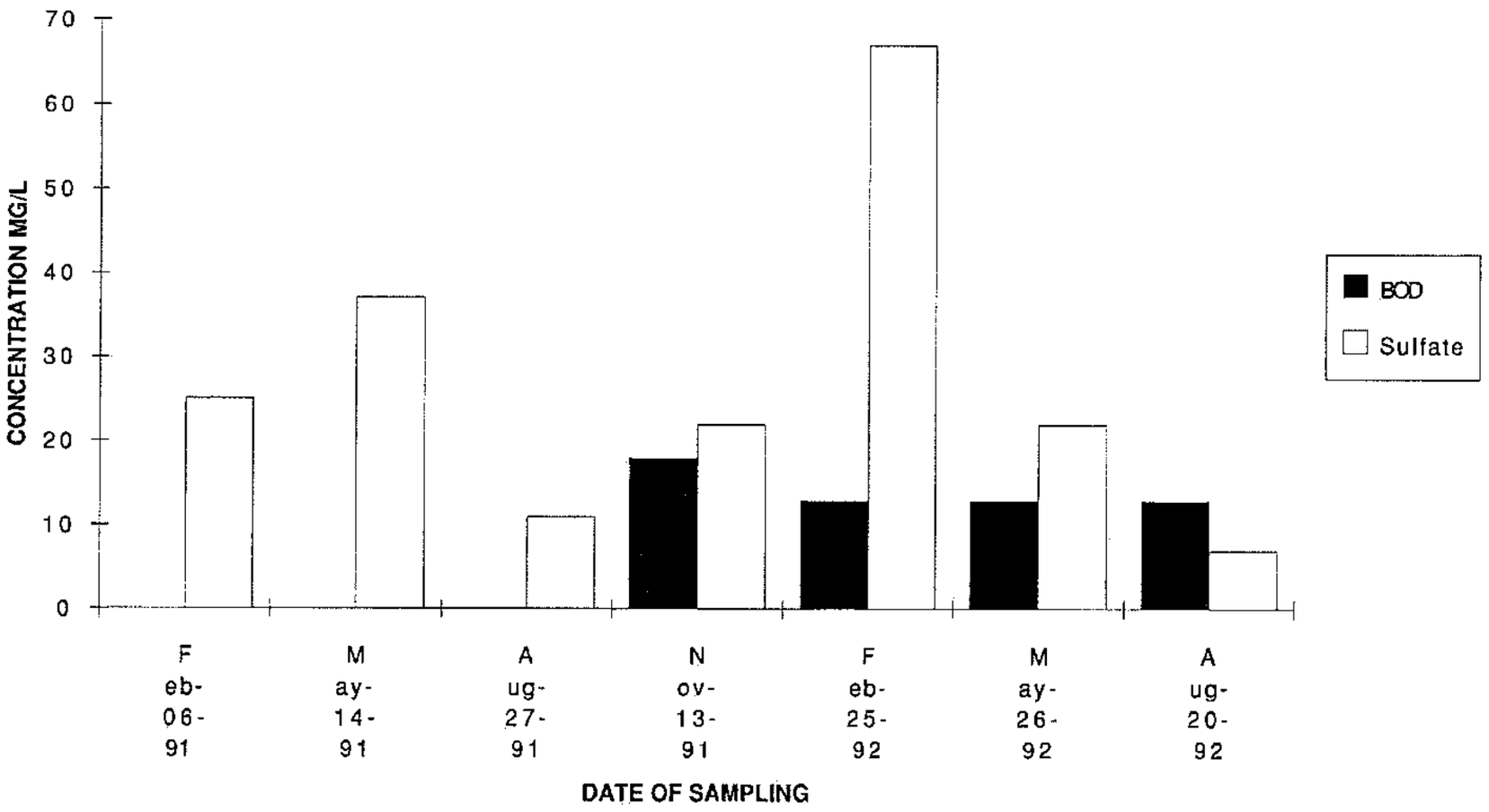
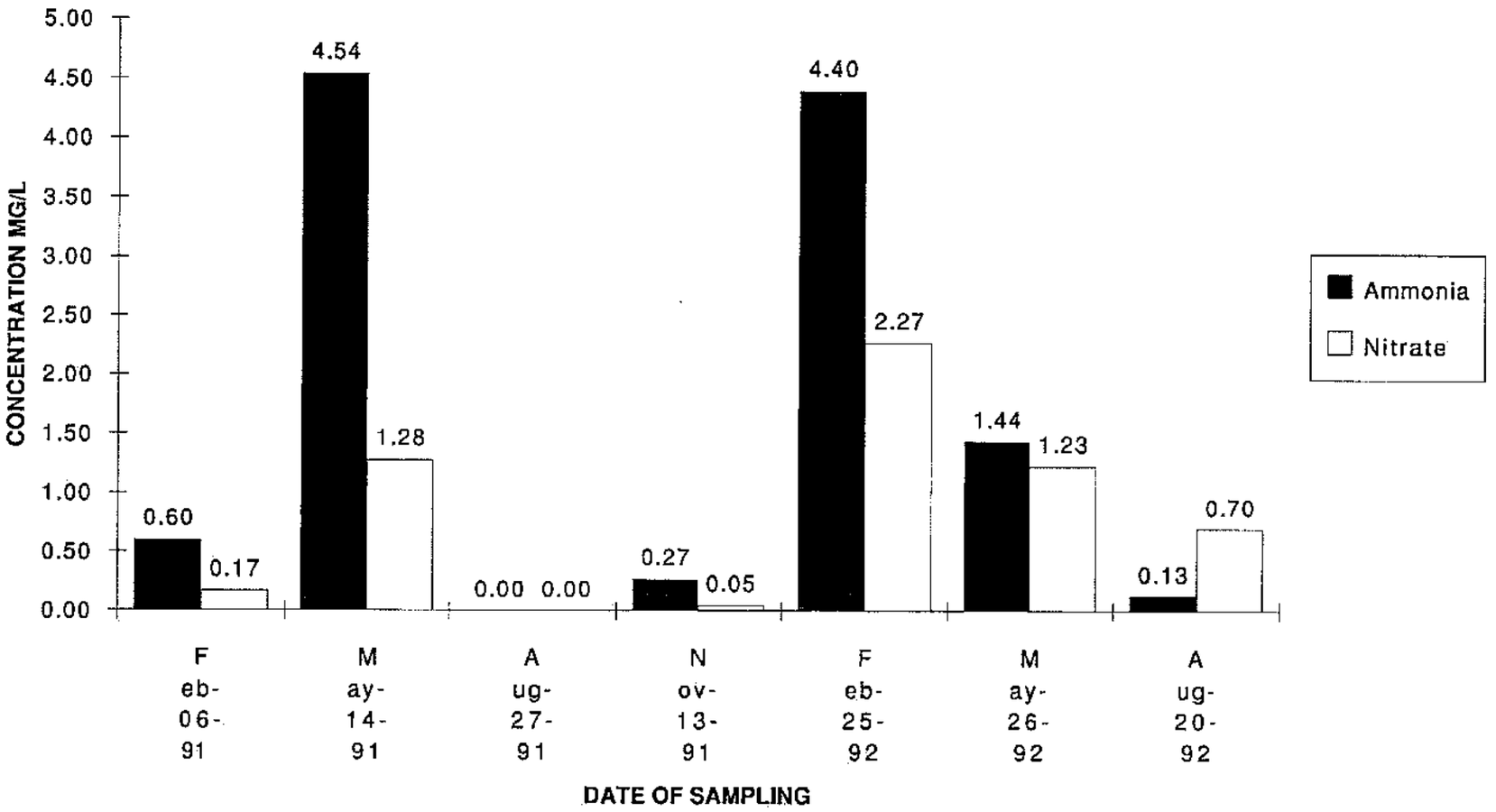


Chart14

PE-6276 FINAL EFFLUENT



PE-06276

RESULTS OF ANALYSIS - Water[1]

File No. F1132

			Effluent
			95 06 07
Physical Tests			
Hardness	CaCO3		406
pH			7.78
Total Suspended Solids			9
Dissolved Anions			
Acidity	CaCO3		19.6
Sulphate	SO4		9.8
Nutrients			
Ammonia Nitrogen		N	1.29
Nitrate Nitrogen		N	3.32
Nitrite Nitrogen		N	0.169
Total Dissolved Phosphate		P	0.006
Total Metals			
Aluminum	T-Al		0.066
Cadmium	T-Cd		<0.0002
Calcium	T-Ca		78.6
Copper	T-Cu		0.002
Iron	T-Fe		1.42
Lead	T-Pb		<0.001
Magnesium	T-Mg		50.9
Manganese	T-Mn		0.251
Mercury	T-Hg		<0.00005
Zinc	T-Zn		<0.005

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per litre except where noted.

RESULTS OF ANALYSIS - Water[1]

File No. F1132

	Effluent 95 06 07	Effluent[2] LRep 95 06 07
Resin and/or Fatty Acids		
Abietic Acid	<0.001	<0.001
Arachidic Acid	<0.001	<0.001
Behenic Acid	<0.001	<0.001
Chlorodehydroabietic Acid	<0.001	<0.001
Dehydroabietic Acid	<0.001	<0.001
Dichlorodehydroabietic Acid	<0.001	<0.001
Isopimaric Acid	<0.001	<0.001
Lauric Acid	<0.001	<0.001
Levopimaric Acid	<0.001	<0.001
Lignoceric Acid	<0.001	<0.001
Linoleic Acid	<0.001	<0.001
Linolenic Acid	<0.001	<0.001
Myristic Acid	<0.001	<0.001
Neoabietic Acid	<0.001	<0.001
Oleic Acid	<0.001	<0.001
Palmitic Acid	<0.001	<0.001
Pimaric Acid	<0.001	<0.001
Sandaracopimaric Acid	<0.001	<0.001
Stearic Acid	<0.001	<0.001
Organic Parameters		
Biochem.Oxygen Demand-Tot BOD-5	<5	-
Chemical Oxygen Demand COD	64	-
Bioassays		
96 hour LC-50	> 100%	-

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per litre except where noted.
[2]LRep = Laboratory Replicate.

Appendix 1 - METHODOLOGY

File No. F1132

Samples were analyzed by methods acceptable to the appropriate regulatory agency. Outlines of the methodologies utilized are as follows:

Moisture

This analysis is carried out gravimetrically by drying the sample to constant weight at 103 C.

Metals in Sediment/Soil

These analyses are carried out using procedures that are consistent with the requirements of the appropriate regulatory agencies and adapted from U.S. EPA Method 3050 (Publ. # SW-846, 3rd ed., Washington, DC 20460). The procedures involve a digestion using a combination of nitric and hydrochloric acids. The resulting extract is bulked to volume with deionized/distilled water. The digested portion is then analysed by a variety of instrumental techniques, which may include specific atomic absorption spectrophotometric techniques (AAS) and/or atomic emission spectrophotometry (ICP), to obtain the required detection limit for each element. Specific details are available upon request.

PLEASE NOTE (When the following elements are reported):

Aluminum, barium, calcium, chromium, iron, magnesium, manganese, molybdenum and vanadium are often associated with the silicate matrix of the sediment. Because of this, the recoveries of these elements may be low using the specified digestion. From an environmental standpoint, this is not usually of concern since the "available" metals are typically the fraction of interest.

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

Metals in Water

These analyses are carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 18th Edition published by the American Public Health Association, 1992. The procedures involve a variety of instrumental analyses including atomic emission spectrophotometry (ICP) and atomic absorption spectrophotometry (AA) to

obtain the required detection limit for each element. Specific details are available on request.

Resin Acids / Fatty Acids in Water

This analysis is carried out in accordance with EPS and Pacific Environmental Institute Methods. The procedure involves extraction of the sample with dichloromethane. The extract is concentrated and derivatized with TBDMS [N-methyl-N(t-butyldimethylsilyl)-trifluoroacetimide]. The TBDMS ester derivatives are cleaned up on a silica gel solid phase extraction (SPE) column and analysed by capillary column gas chromatography with mass spectrometric detection.

1988 Triumph Street, Vancouver, B.C., Canada V5L 1K5

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FAX: (604) 253-6700 TEL: (604) 253-4188

RECEIVED JUL 7 1995

CHEMICAL ANALYSIS REPORT

Date: June 26, 1995

ASL File No. F1132

Report On: 952-1811 Soil and Water Analysis

Report To: **Golder Associates Ltd.**
500 - 4260 Still Creek Drive
Burnaby, BC
V5C 6C6

Attention: **Ms. Heather Matthews**

Received: June 7, 1995

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Brent A. Makelki, B.Sc.
Project Chemist

Joyce Chow, B.Sc.
Project Chemist

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

PE-6276 Data

1 FINAL DISCHARGE

Date	12/13/94
pH	7.6
Temperature (C)	3.0
Dissolved Oxygen (mg/L)	8.0
Toxicity (96-h LC50 Rainbow trout)	> 100
Acidity pH 8.3 (mg CaCO3/L)	19.3
Total Suspended Solids (mg/L)	17.0
Ammonia (mgN/L)	6.55
BOD5 (mg/L)	16.0
Chemical Oxygen Demand (mg/L)	55
Nitrite Nitrogen (mg/L)	0.105
Nitrate Nitrogen (mg/L)	0.916
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	3.50
Total Manganese (mg/L)	1.40
Total Aluminum (mg/L)	< 0.10
Dissolved Sulfate (mg/L)	13
Total Dissolved Phosphorus (mg/L)	< 0.010
Total Lead (mg/L)	< 0.001
Total Zinc (mg/L)	< 0.02
Fatty Acids (mg/L)	0.155
Resin Acids (mg/L)	< 0.005

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

FINAL DISCHARGE

Date	09/16/94
pH	8.1
Temperature (C)	20.0
Dissolved Oxygen (mg/L)	11.4
Acidity pH 8.3 (mg CaCO3/L)	9.7
Total Suspended Solids (mg/L)	9.0
Ammonia (mgN/L)	0.38
BOD5 (mg/L)	< 10
Chemical Oxygen Demand (mg/L)	53
Nitrite Nitrogen (mg/L)	0.09
Nitrate Nitrogen (mg/L)	1.54
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	1.9
Total Manganese (mg/L)	0.58
Total Aluminum (mg/L)	< 0.1
Dissolved Sulfate (mg/L)	8
Total Dissolved Phosphorus (mg/L)	0.052
Total Lead (mg/L)	< 0.001
Total Zinc (mg/L)	< 0.05
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	0.057

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 FINAL DISCHARGE

	1
Date	12/02/92
pH	7.8
Temperature (C)	4.5
Dissolved Oxygen (mg/L)	7.1
Acidity pH 8.3 (mg CaCO3/L)	38.0
Total Suspended Solids (mg/L)	8.4
Ammonia (mgN/L)	1.96
BOD5 (mg/L)	19.5
Chemical Oxygen Demand (mg/L)	55
Nitrite Nitrogen (mg/L)	< 0.020
Nitrate Nitrogen (mg/L)	1.400
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	3.20
Total Manganese (mg/L)	1.40
Total Aluminum (mg/L)	< 0.10
Dissolved Sulfate (mg/L)	15.7
Total Dissolved Phosphorus (mg/L)	0.040
Total Lead (mg/L)	< 0.10
Total Zinc (mg/L)	< 0.04
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	< 0.005

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SURFACE WATER MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

2-NO. 7 ROAD DITCH AT BLUNDELL RD.
3-NO. 7 ROAD DITCH AT NURSERY GATE
4-NORTH DRAINAGE DITCH
5-SOUTH EAST DRAINAGE DITCH
NORTH PERIMETER DITCH AT LEAK THROUGH BERM

	2	3	4	5	N.P.D.
Date	05/26/93	05/26/93	05/26/93	05/26/93	05/26/93
pH	7.8	7.3	7.9	7.6	7.6
Temperature (°C)	18.5	18.5	16.5	14.5	21.0
Dissolved Oxygen (mg/L)	5.3	2.9	4.5	2.7	5.5
Acidity pH 8.3 (mg CaCO3/L)	14.0	44.0	14.0	58.0	80.0
Ammonia (mgN/L)	0.50	0.25	0.50	0.50	20.9
Chemical Oxygen Demand (mg/L)	50	444	29	58	130
Nitrite Nitrogen (mg/L)	0.057	< 0.002	< 0.002	< 0.002	0.610
Nitrate Nitrogen (mg/L)	0.371	0.077	0.550	< 0.05	6.28
Total Copper (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Iron (mg/L)	2.3	18	2.1	20	4.5
Total Manganese (mg/L)	0.15	1.50	0.09	2.10	1.50
Total Aluminum (mg/L)	0.42	1.80	0.54	< 0.10	0.20
Dissolved Sulfate (mg/L)	11.0	5.0	7.0	5.0	6.0
Total Dissolved Phosphorus (mg/L)	0.213	0.300	0.203	0.080	0.052
Total Lead (mg/L)	0.003	0.005	0.001	0.001	0.001
Total Zinc (mg/L)	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SURFACE WATER MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

2 NO. 7 ROAD DITCH AT BLUNDELL RD.
3 NO. 7 ROAD DITCH AT NURSERY GATE
4 NORTH DRAINAGE DITCH
5 SOUTH EAST DRAINAGE DITCH

	2	3	4	5
Date	12/02/92	12/02/92	12/02/92	12/02/92
pH	7.7	6.9	6.0	6.8
Acidity pH 8.3 (mg CaCO3/L)	5.5	30.5	48.0	44.0
Ammonia (mgN/L)	< 1.00	< 1.00	< 1.00	< 1.00
Chemical Oxygen Demand (mg/L)	13	75	191	119
Nitrite Nitrogen (mg/L)	< 0.020	< 0.020	< 0.020	< 0.020
Nitrate Nitrogen (mg/L)	0.441	1.410	0.158	< 0.020
Dissolved Sulfate (mg/L)	20.5	49.0	29.7	11.7
Total Dissolved Phosphorus (mg/L)	< 0.005	0.203	0.095	0.080
Total Aluminum (mg/L)	0.47	1.90	0.88	0.37
Total Copper (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Total Lead (mg/L)	< 0.10	< 0.10	< 0.10	< 0.10
Total Iron (mg/L)	1.10	11.00	4.90	14.00
Total Manganese (mg/L)	0.25	0.60	0.59	1.50
Total Zinc (mg/L)	0.04	0.07	< 0.04	< 0.04

read lower DL

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	08/20/92	08/20/92	08/20/92
pH	7.9	7.4	7.1
TEMPERATURE (C)	22.0	23.0	18.9
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	11.0	16.0	13.0
Ammonia (mgN/L)	0.13	0.13	0.13
BOD5	13	21	16
Dissolved Oxygen (mg/L)	10.7	8.1	4.3
Dissolved Nitrite (mg/L)	< 0.010	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	0.699	0.061	0.181
Dissolved Copper (mg/L)	< 0.050	< 0.050	< 0.050
Dissolved Iron (mg/L)	0.4	1.1	1.3
Dissolved Manganese (mg/L)	0.81	< 0.05	< 0.05
Dissolved Sodium (mg/L)	759.0	4.1	3.7
Dissolved Potassium (mg/L)	44.0	3.0	3.4
Dissolved Chloride (mg/L)	1510.0	6.8	6.4
Dissolved Sulfate (mg/L)	7.0	9.2	8.9
Total Dissolved Phosphorus (mg/L)	0.042	0.038	0.223
Total Lead (mg/L)	< 0.001	0.001	0.003
Total Zinc (mg/L)	0.003	0.008	0.017
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	08/20/92	08/20/92
pH	7.0	7.0
TEMPERATURE (C)	16.5	18.0
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	6.0	21.0
Ammonia (mgN/L)	0.17	0.09
BOD5	< 10	13
Dissolved Oxygen (mg/L)	7.1	5.8
Dissolved Nitrite (mg/L)	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	< 0.010	0.020
Dissolved Copper (mg/L)	< 0.050	< 0.050
Dissolved Iron (mg/L)	1.7	3.4
Dissolved Manganese (mg/L)	1.30	0.12
Dissolved Sodium (mg/L)	9.9	10.0
Dissolved Potassium (mg/L)	2.6	16.0
Dissolved Chloride (mg/L)	11.9	39.8
Dissolved Sulfate (mg/L)	4.0	14.1
Total Dissolved Phosphorus (mg/L)	0.086	1.295
Total Lead (mg/L)	< 0.001	< 0.001
Total Zinc (mg/L)	0.010	0.011
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	05/26/92	05/26/92	05/26/92
pH	7.9	6.5	6.7
TEMPERATURE (C)	20.0	19.0	18.5
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	4.0	17.0	18.0
Ammonia (mgN/L)	1.44	0.02	< 0.01
BOD5	13	21	16
Dissolved Oxygen (mg/L)	9.8	< 1.0	2.6
Dissolved Nitrite (mg/L)	0.158	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	1.229	0.566	0.663
Dissolved Copper (mg/L)	< 0.050	< 0.050	< 0.050
Dissolved Iron (mg/L)	0.3	3.6	1.7
Dissolved Manganese (mg/L)	0.86	0.20	0.28
Dissolved Sodium (mg/L)	709.0	12.0	17.0
Dissolved Potassium (mg/L)	41.0	6.0	4.0
Dissolved Chloride (mg/L)	1175.0	18.0	35.0
Dissolved Sulfate (mg/L)	22.0	15.0	15.0
Total Dissolved Phosphorus (mg/L)	0.021	0.374	0.267
Total Lead (mg/L)	0.002	0.002	0.001
Total Zinc (mg/L)	0.002	0.018	0.015
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	05/26/92	05/26/92
pH	6.4	6.5
TEMPERATURE (C)	17.0	17.0
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	3.0	67.3
Ammonia (mgN/L)	< 0.01	0.03
BOD5	< 10	13
Dissolved Oxygen (mg/L)	6.3	1.9
Dissolved Nitrite (mg/L)	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	0.200	0.460
Dissolved Copper (mg/L)	< 0.050	< 0.050
Dissolved Iron (mg/L)	7.7	5.1
Dissolved Manganese (mg/L)	1.10	1.30
Dissolved Sodium (mg/L)	7.0	27.0
Dissolved Potassium (mg/L)	2.0	2.1
Dissolved Chloride (mg/L)	8.0	41.0
Dissolved Sulfate (mg/L)	6.0	< 1.0
Total Dissolved Phosphorus (mg/L)	0.055	0.164
Total Lead (mg/L)	< 0.001	0.002
Total Zinc (mg/L)	0.009	0.017
Total Mercury (ug/L)	0.08	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate
4	4	North Drainage Ditch
5	5	South East Drainage Ditch

	1	2	3	4	5
Date	02/25/92	02/25/92	02/25/92	02/25/92	02/25/92
pH	7.8	6.9	7.0	5.8	6.7
TEMPERATURE (C)	12.0	10.0	9.0	11.0	9.5
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	15	21	27	13	11
Ammonia (mgN/L)	4.40	1.57	0.64	< 0.01	0.51
BOD5	13	12	< 10	10	< 10
Dissolved Oxygen (mg/L)	6.7	4.3	3.2	6.8	4.6
Dissolved Nitrite (mg/L)	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	2.270	0.625	0.870	0.092	0.294
Dissolved Copper (mg/L)	0.002	0.006	0.006	0.009	0.001
Dissolved Iron (mg/L)	0.3	5.4	7.0	2.5	10.0
Dissolved Manganese (mg/L)	0.87	0.35	0.33	0.25	1.22
Dissolved Sodium (mg/L)	431.0	36.0	23.0	7.2	19.0
Dissolved Potassium (mg/L)	30.0	5.9	3.2	1.2	3.2
Dissolved Chloride (mg/L)	929.0	45.0	36.0	8.8	25.0
Dissolved Sulfate (mg/L)	67.0	27.0	21.0	5.0	7.0
Total Dissolved Phosphorus (mg/L)	0.021	0.138	0.138	0.043	0.065
Total Lead (mg/L)	< 0.001	< 0.001	0.001	0.001	< 0.001
Total Zinc (mg/L)	0.020	0.022	0.023	0.005	0.007
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
Date	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91
pH	7.4	5.5	5.5	5.7	5.5
TEMPERATURE (C)	8.5	9.8	10.0	9.2	9.0
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	10.0	41.0	3.0	43.0	18.0
Ammonia (mgN/L)	0.27	0.52	0.07	0.36	0.33
BOD5	18	20	< 10	< 10	23
Dissolved Oxygen (mg/L)	6.9	6.1	5.9	4.7	6.2
Dissolved Nitrite (mg/L)	< 0.025	0.018	< 0.005	< 0.050	< 0.020
Dissolved Nitrate (mg/L)	0.048	2.750	0.153	2.980	0.680
Dissolved Copper (mg/L)	0.003	< 0.010	0.004	0.008	0.015
Dissolved Iron (mg/L)	1.1	2.6	1.9	3.7	6.2
Dissolved Manganese (mg/L)	1.10	0.24	0.23	0.26	0.42
Dissolved Sodium (mg/L)	431.0	20.0	20.0	16.0	14.0
Dissolved Potassium (mg/L)	28.0	6.4	3.7	5.5	9.7
Dissolved Chloride (mg/L)	566.0	27.7	19.5	26.4	21.8
Dissolved Sulfate (mg/L)	22.0	42.0	17.0	38.0	18.0
Total Dissolved Phosphorus (mg/L)	0.055	0.254	0.120	0.190	1.538
Total Lead (mg/L)	0.001	0.002	0.001	0.001	0.002
Total Zinc (mg/L)	0.006	0.043	0.018	0.040	0.028
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	08/27/91	08/07/91	08/07/91
pH	8.4	6.0	5.9
TEMPERATURE (C)	15.5	20.0	19.0
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	3.5	28.0	15.0
Ammonia (mgN/L)	< 1.00	< 1.00	< 1.00
BOD5	< 10	13	13
Dissolved Oxygen (mg/L)	7.3	3.7	1.7
Dissolved Nitrite (mg/L)	< 0.010	0.020	0.020
Dissolved Nitrate (mg/L)	< 0.010	0.194	0.639
Dissolved Copper (mg/L)	< 0.050	0.007	0.004
Dissolved Iron (mg/L)	1.4	6.8	6.9
Dissolved Manganese (mg/L)	0.11	0.20	0.28
Dissolved Sodium (mg/L)	570.0	21.0	23.0
Dissolved Potassium (mg/L)	29.0	4.6	4.1
Dissolved Chloride (mg/L)	699.0	37.4	39.5
Dissolved Sulfate (mg/L)	11.0	9.0	10.0
Total Dissolved Phosphorus (mg/L)	0.098	0.369	0.357
Total Lead (mg/L)	< 0.001	0.002	0.002
Total Zinc (mg/L)	0.002	0.010	0.013
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

4 4 North Drainage Ditch
5 5 South East Drainage Ditch

	4	5
Date	08/07/91	08/07/91
pH	6.3	6.0
TEMPERATURE (C)	16.5	18.0
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	8.2	16.0
Ammonia (mgN/L)	< 1.00	< 1.00
BOD5	13	18
Dissolved Oxygen (mg/L)	8.5	2.6
Dissolved Nitrite (mg/L)	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	0.026	0.010
Dissolved Copper (mg/L)	0.004	0.002
Dissolved Iron (mg/L)	5.2	8.7
Dissolved Manganese (mg/L)	1.50	1.00
Dissolved Sodium (mg/L)	12.0	29.0
Dissolved Potassium (mg/L)	2.8	5.5
Dissolved Chloride (mg/L)	13.7	28.2
Dissolved Sulfate (mg/L)	3.0	9.0
Total Dissolved Phosphorus (mg/L)	0.346	0.327
Total Lead (mg/L)	0.002	0.001
Total Zinc (mg/L)	0.011	0.003
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	05/14/91	05/14/91	05/14/91
pH	8.3	7.9	7.8
TEMPERATURE (C)	13.5	12.0	12.5
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	11.0	30.0	40.0
Ammonia (mgN/L)	4.54	0.09	0.27
BOD5	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	6.5	10.0	6.6
Dissolved Nitrite (mg/L)	0.143	0.009	0.010
Dissolved Nitrate (mg/L)	1.280	0.190	0.220
Dissolved Copper (mg/L)	0.004	0.001	0.001
Dissolved Iron (mg/L)	0.3	1.3	2.6
Dissolved Manganese (mg/L)	0.79	0.09	0.23
Dissolved Sodium (mg/L)	526.0	9.9	27.7
Dissolved Potassium (mg/L)	38.0	1.4	2.0
Dissolved Chloride (mg/L)	676.0	14.1	16.5
Dissolved Sulfate (mg/L)	37.1	7.4	10.8
Total Dissolved Phosphorus (mg/L)	0.017	0.047	0.033
Total Lead (mg/L)	0.001	0.002	0.001
Total Zinc (mg/L)	0.012	0.010	0.020
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	05/14/91	05/14/91
pH	7.6	7.7
TEMPERATURE (C)	12.5	17.0
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	12.0	18.0
Ammonia (mgN/L)	0.12	0.29
BOD5	< 10	< 10
Dissolved Oxygen (mg/L)	8.6	2.9
Dissolved Nitrite (mg/L)	0.063	0.030
Dissolved Nitrate (mg/L)	0.100	< 0.020
Dissolved Copper (mg/L)	0.004	< 0.001
Dissolved Iron (mg/L)	4.6	17.9
Dissolved Manganese (mg/L)	0.85	1.45
Dissolved Sodium (mg/L)	16.4	32.8
Dissolved Potassium (mg/L)	3.2	2.3
Dissolved Chloride (mg/L)	23.7	52.5
Dissolved Sulfate (mg/L)	14.8	7.7
Total Dissolved Phosphorus (mg/L)	0.091	0.068
Total Lead (mg/L)	0.007	< 0.001
Total Zinc (mg/L)	0.030	< 0.005
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	02/06/91	02/06/91	02/06/91
pH	8.1	7.1	7.3
TEMPERATURE (C)	6.5	6.5	5.8
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	30.0	26.0	16.0
Ammonia (mgN/L)	0.60	0.91	1.86
BOD5	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	6.0	5.6	5.6
Dissolved Nitrite (mg/L)	0.023	0.017	0.020
Dissolved Nitrate (mg/L)	0.170	0.940	0.460
Dissolved Copper (mg/L)	0.001	0.002	0.010
Dissolved Iron (mg/L)	1.5	2.6	2.5
Dissolved Manganese (mg/L)	0.65	0.23	0.29
Dissolved Sodium (mg/L)	456.0	22.0	38.6
Dissolved Potassium (mg/L)	23.5	4.8	8.5
Dissolved Chloride (mg/L)	636.0	28.8	39.1
Dissolved Sulfate (mg/L)	25.1	31.9	38.1
Total Dissolved Phosphorus (mg/L)	0.065	0.055	0.042
Total Lead (mg/L)	< 0.010	< 0.010	< 0.010
Total Zinc (mg/L)	0.040	0.040	0.040
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	02/06/91	02/06/91
pH	6.4	7.2
TEMPERATURE (C)	5.0	5.3
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	2.0	11.0
Ammonia (mgN/L)	0.08	0.48
BOD5	< 10	< 10
Dissolved Oxygen (mg/L)	7.9	7.1
Dissolved Nitrite (mg/L)	0.024	0.018
Dissolved Nitrate (mg/L)	< 0.020	0.060
Dissolved Copper (mg/L)	0.001	0.013
Dissolved Iron (mg/L)	1.7	7.3
Dissolved Manganese (mg/L)	0.22	1.03
Dissolved Sodium (mg/L)	15.5	20.4
Dissolved Potassium (mg/L)	2.1	2.6
Dissolved Chloride (mg/L)	29.3	22.3
Dissolved Sulfate (mg/L)	12.6	10.2
Total Dissolved Phosphorus (mg/L)	0.051	0.036
Total Lead (mg/L)	< 0.010	< 0.010
Total Zinc (mg/L)	0.006	0.010
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
Date	11/07/90	11/07/90	11/07/90	11/07/90	11/07/90
pH	8.2	7.5	7.2	7.2	7.5
TEMPERATURE (C)	9.5	8.0	8.5	9.0	8.5
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	14.0	36.0	95.0	56.0	15.0
Ammonia (mgN/L)	0.57	0.66	0.48	0.14	0.07
BOD5	< 10	< 10	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	6.4	6.3	5.3	6.1	5.4
Dissolved Nitrite (mg/L)	0.036	0.023	0.025	0.017	0.019
Dissolved Nitrate (mg/L)	1.210	0.830	1.390	0.060	0.880
Dissolved Copper (mg/L)	0.040	0.012	0.012	0.005	0.060
Dissolved Iron (mg/L)	0.7	2.4	2.7	1.2	4.9
Dissolved Manganese (mg/L)	0.52	0.22	0.19	0.29	0.35
Dissolved Sodium (mg/L)	712.0	20.2	12.7	34.1	16.6
Dissolved Potassium (mg/L)	32.6	6.7	6.0	5.5	9.9
Dissolved Chloride (mg/L)	1160.0	27.0	20.2	43.3	24.3
Dissolved Sulfate (mg/L)	68.5	35.1	28.3	48.2	20.0
Total Dissolved Phosphorus (mg/L)	0.012	0.046	0.091	0.035	0.578
Total Lead (mg/L)	0.002	0.002	0.002	0.001	0.003
Total Zinc (mg/L)	0.110	0.120	0.200	0.110	0.090
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
Date	07/18/90	07/18/90	07/18/90	07/18/90	07/18/90
pH	7.8	7.3	7.3	7.0	7.2
TEMPERATURE (C)	20.0	23.0	23.0	17.5	20.0
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	6.0	35.0	29.0	4.0	20.0
Ammonia (mgN/L)	0.44	0.03	0.05	0.33	0.28
BOD5	< 10	< 10	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	6.6	6.8	7.9	7.0	4.1
Dissolved Nitrite (mg/L)	1.100	0.007	< 0.005	0.005	< 0.005
Dissolved Nitrate (mg/L)	1.800	0.060	0.100	< 0.020	< 0.020
Dissolved Copper (mg/L)	0.040	0.003	0.001	0.003	0.002
Dissolved Iron (mg/L)	0.1	1.2	1.1	6.9	8.7
Dissolved Manganese (mg/L)	0.09	0.05	0.05	1.46	1.02
Dissolved Sodium (mg/L)	1460.0	5.8	4.5	14.7	36.6
Dissolved Potassium (mg/L)	30.6	2.7	2.2	3.2	3.4
Dissolved Chloride (mg/L)	2450.0	7.0	5.4	13.3	35.0
Dissolved Sulfate (mg/L)	122.0	7.0	7.5	6.4	2.2
Total Dissolved Phosphorus (mg/L)	0.017	0.142	0.077	0.044	0.015
Total Lead (mg/L)	0.001	< 0.001	< 0.001	0.003	< 0.001
Total Zinc (mg/L)	0.009	0.017	0.020	0.030	< 0.005
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

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LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	05/29/90	05/29/90	05/29/90
pH	7.6	6.8	6.7
TEMPERATURE (C)	15.0	16.5	15.5
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	10.0	39.0	17.0
Ammonia (mgN/L)	8.10	0.32	0.11
BOD5	14	< 10	< 10
Dissolved Oxygen (mg/L)	8.5	5.6	6.1
Dissolved Nitrite (mg/L)	0.164	0.015	0.010
Dissolved Nitrate (mg/L)	1.320	0.100	0.120
Dissolved Copper (mg/L)	0.030	0.020	0.005
Dissolved Iron (mg/L)	0.1	4.2	2.1
Dissolved Manganese (mg/L)	1.16	0.15	0.10
Dissolved Sodium (mg/L)	1110.0	18.1	9.2
Dissolved Potassium (mg/L)	55.0	3.2	2.0
Dissolved Chloride (mg/L)	1880.0	23.1	13.2
Dissolved Sulfate (mg/L)	143.0	13.7	9.1
Total Dissolved Phosphorus (mg/L)	0.012	0.143	0.134
Total Lead (mg/L)	0.003	0.001	0.001
Total Zinc (mg/L)	0.022	0.060	0.020
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	05/29/90	05/29/90
pH	6.2	6.4
TEMPERATURE (C)	14.5	17.5
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	15.0	11.0
Ammonia (mgN/L)	0.03	0.01
BOD5	< 10	< 10
Dissolved Oxygen (mg/L)	7.5	6.6
Dissolved Nitrite (mg/L)	0.030	0.008
Dissolved Nitrate (mg/L)	0.030	0.020
Dissolved Copper (mg/L)	0.007	0.004
Dissolved Iron (mg/L)	3.8	8.6
Dissolved Manganese (mg/L)	0.55	0.55
Dissolved Sodium (mg/L)	14.8	17.3
Dissolved Potassium (mg/L)	3.3	4.3
Dissolved Chloride (mg/L)	25.6	26.3
Dissolved Sulfate (mg/L)	7.8	16.7
Total Dissolved Phosphorus (mg/L)	0.058	0.112
Total Lead (mg/L)	< 0.001	< 0.001
Total Zinc (mg/L)	0.050	0.030
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
Date	02/21/90	02/21/90	02/21/90	02/21/90	02/21/90
pH	6.9	6.8	6.7	6.7	6.8
TEMPERATURE (C)	2.5	3.5	3.5	3.0	4.5
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	16.0	19.0	23.0	13.0	9.0
Ammonia (mgN/L)	2.67	1.22	0.87	0.28	0.25
BOD5	<10	< 10	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	8.2	6.9	5.9	7.9	7.6
Dissolved Nitrite (mg/L)	0.047	0.026	0.026	0.026	0.016
Dissolved Nitrate (mg/L)	1.280	0.450	0.750	0.200	0.080
Dissolved Copper (mg/L)	0.010	0.019	0.014	0.008	0.025
Dissolved Iron (mg/L)	2.4	4.1	6.2	3.9	7.4
Dissolved Manganese (mg/L)	1.06	0.38	0.36	0.43	1.14
Dissolved Sodium (mg/L)	999.9	36.1	26.2	20.5	27.4
Dissolved Potassium (mg/L)	67.5	7.4	3.6	2.7	2.7
Dissolved Chloride (mg/L)	99.9	42.2	42.4	36.3	28.2
Dissolved Sulfate (mg/L)	516.0	41.0	23.0	18.3	15.6
Total Dissolved Phosphorus (mg/L)	0.014	0.300	0.176	0.100	0.228
Total Lead (mg/L)	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Total Zinc (mg/L)	0.060	0.070	0.070	0.030	0.040
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
ıte	11/17/89	11/17/89	11/17/89	11/17/89	11/17/89
I	7.4	8.0	6.3	6.1	6.5
EMPERATURE (C)	7.5	8.0	8.0	7.5	7.0
ɔH LC50%	100	NA	NA	NA	NA
ɔtal Suspended Solids (mg/L)	19.0	7.0	20.0	6.0	14.0
ımonia (mgN/L)	4.28	0.63	0.68	0.06	0.31
ɔD5	< 10	< 10	< 10	< 10	< 10
ɪssolved Oxygen (mg/L)	6.3	4.8	3.6	8.2	5.2
ɪssolved Nitrite (mg/L)	0.072	0.026	0.031	< 0.005	< 0.005
ɪssolved Nitrate (mg/L)	1.260	1.430	1.670	0.040	0.050
ɪssolved Copper (mg/L)	0.006	0.030	0.020	0.020	0.020
ɪssolved Iron (mg/L)	4.8	4.4	6.1	3.2	4.5
ɪssolved Manganese (mg/L)	1.56	0.33	0.34	9.74	14.40
ɪssolved Sodium (mg/L)	1490.0	29.0	25.0	25.5	43.4
ɪssolved Potassium (mg/L)	66.0	6.0	4.8	3.1	4.1
ɹssolved Chloride (mg/L)	2600.0	36.7	38.7	25.5	45.2
ɪssolved Sulfate (mg/L)	253.0	58.0	37.0	24.0	15.0
ɔtal Dissolved Phosphorus (mg/L)	0.082	0.067	0.091	0.039	0.026
ɔtal Lead (mg/L)	< 0.100	0.003	0.001	< 0.100	< 0.100
ɔtal Zinc (mg/L)	0.100	0.070	0.040	0.030	0.011
ɔtal Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

ANALYTICAL RESULTS
FRHC RICHMOND LANDFILL SITE
Permit: PE-6276
November 17, 1989

Sampling Sites: 1 Final Effluent
2 #7 Road Ditch at Blundell Road
3 #7 Road Ditch at Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch at Nelson Road Floodgate

	SITE				
	1	2	3	4	5
pH	7.4	8.0	6.3	6.1	6.5
Temperature (°C)	7.5	8.0	8.0	7.5	7.0
96 h LC_{50} (%)	>100	N/A	N/A	N/A	N/A
Total Suspended Solids (mg/L)	19.0	7.0	20.0	6.0	14.0
Ammonia (mg N/L)	4.28	0.63	0.68	0.06	0.31
BOD_5 (mg/L)	<10	<10	<10	<10	<10
Dissolved Oxygen (mg/L)	6.3	4.8	3.6	8.2	5.2
Dissolved Nitrite (mg N/L)	0.072	0.026	0.031	<0.005	<0.005
Dissolved Nitrate (mg N/L)	1.260	1.430	1.670	0.040	0.050
Dissolved Copper (mg/L)	0.006	0.030	0.020	0.020	0.020
Dissolved Iron (mg/L)	4.80	4.37	6.11	3.19	4.54
Dissolved Manganese (mg/L)	1.56	0.33	0.34	9.74	14.40
Dissolved Sodium (mg/L)	1,490	29.0	25.0	25.5	43.4
Dissolved Potassium (mg/L)	66.0	6.0	4.8	3.1	4.1
Dissolved Chloride (mg/L)	2,660	36.7	38.7	25.5	45.2
Dissolved Sulfate (mg/L)	253	58	37	24	15
Total Diss. Phosphorus (mg/L)	0.082	0.067	0.091	0.039	0.026
Total Lead (mg/L)	<0.001	0.003	0.001	<0.001	<0.001
Total Zinc (mg/L)	0.100	0.070	0.040	0.030	0.011
Total mercury (µg/L)	<0.05	<0.05	<0.05	<0.05	<0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
ıte	08/17/89	08/17/89	08/17/89	08/17/89	08/17/89
ł	NA	6.5	6.6	NA	6.8
ΞMPERATURE (C)	NA	18.0	18.0	NA	16.5
5H LC50%	NA	NA	NA	NA	NA
ɔtal Suspended Solids (mg/L)	NA	13.0	12.0	NA	18.0
ɑmonia (mgN/L)	NA	0.19	0.06	NA	0.11
)D5	NA	10	10	NA	10
ıssolved Oxygen (mg/L)	NA	5.8	6.1	NA	7.0
ıssolved Nitrite (mg/L)	NA	0.016	0.005	NA	0.005
ıssolved Nitrate (mg/L)	NA	0.110	0.050	NA	0.030
ıssolved Copper (mg/L)	NA	0.010	0.010	NA	0.010
issolved Iron (mg/L)	NA	1.9	0.8	NA	4.9
ıssolved Manganese (mg/L)	NA	0.04	0.01	NA	0.26
issolved Sodium (mg/L)	NA	5.8	3.3	NA	9.4
issolved Potassium (mg/L)	NA	3.1	1.4	NA	3.5
issolved Chloride (mg/L)	NA	8.8	4.0	NA	16.2
issolved Sulfate (mg/L)	NA	13.0	9.0	NA	12.0
ɔtal Dissolved Phosphorus (mg/L)	NA	0.293	0.149	NA	0.318
ɔtal Lead (mg/L)	NA	0.001	0.001	NA	0.001
ɔtal Zinc (mg/L)	NA	0.030	0.005	NA	0.030
ɔtal Mercury (ug/L)	NA	NA	NA	NA	NA

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1989

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 5276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	890817 0800 hrs	890817 0815 hrs	890817 0830 hrs	890817 0845 hrs	890817 0900 hrs
pH	NA	6.5	6.6	NA	6.8
Temperature (deg C)	NA	18.0	18.0	NA	16.5
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	NA	13.0	12.0	NA	18.0
Ammonia (mgN/l)	NA	0.19	0.06	NA	0.11
Dissolved (mg/l)					
BOD5	NA	L10	L10	NA	L10
Oxygen	NA	5.8	6.1	NA	7.0
Nitrite	NA	0.016	L.005	NA	0.005
Nitrate	NA	0.110	0.060	NA	0.030
Copper	NA	0.0080	0.0100	NA	0.0100
Iron	NA	1.33	0.34	NA	2.94
Manganese	NA	0.04	L0.01	NA	0.25
Sodium	0.0	5.8	3.3	0.0	9.4
Potassium	NA	3.1	1.4	NA	3.5
Chloride	0.0	8.8	4.0	0.0	16.2
Sulfate	NA	13	9	NA	12
Total (mg/l)					
Dissolved Phosphorus	NA	0.293	0.149	NA	0.318
Lead	NA	L0.100	L0.100	NA	L0.100
Zinc	NA	0.0200	L0.0100	NA	0.0200
Mercury (ug/l)	NA	L0.05	L0.05	NA	L0.05

No flow

Dry

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
ate	05/25/89	05/25/89	05/25/89	05/25/89	05/25/89
H	7.6	6.5	6.7	6.2	7.2
EMPERATURE (C)	12.5	10.5	10.5	15.5	13.0
6H LC50%	NA	NA	NA	NA	NA
otal Suspended Solids (mg/L)	44.0	14.0	15.0	12.0	15.0
mmonia (mgN/L)	3.89	0.27	0.04	0.06	0.30
OD5	< 10	< 10	< 10	12	< 10
issolved Oxygen (mg/L)	6.7	6.7	6.9	5.2	6.5
issolved Nitrite (mg/L)	< 0.229	0.009	< 0.005	0.018	< 0.005
issolved Nitrate (mg/L)	1.440	0.170	0.180	< 0.020	< 0.020
issolved Copper (mg/L)	0.004	0.007	0.001	0.030	0.004
issolved Iron (mg/L)	0.8	2.8	0.5	3.3	5.0
issolved Manganese (mg/L)	1.01	0.13	0.03	1.08	1.88
issolved Sodium (mg/L)	768.0	13.9	3.6	31.0	144.0
issolved Potassium (mg/L)	55.0	3.5	0.9	3.6	3.5
issolved Chloride (mg/L)	1170.0	20.2	3.9	46.9	71.0
issolved Sulfate (mg/L)	53.0	23.0	7.0	10.0	7.0
otal Dissolved Phosphorus (mg/L)	0.022	0.270	0.048	0.080	0.015
otal Lead (mg/L)	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
otal Zinc (mg/L)	0.010	0.020	< 0.010	< 0.010	< 0.010
otal Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1989

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	890525 0800 hrs	890525 0815 hrs	890525 0830 hrs	890525 0845 hrs	890525 0900 hrs
PH	7.6	6.5	6.7	6.2	7.2
Temperature (deg C)	12.5	10.5	10.5	15.5	13.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	44.0	14.0	15.0	12.0	15.0
Ammonia (mgN/l)	3.89	0.27	0.04	0.06	0.30
Dissolved (mg/l)					
BOD5	L10	L10	L10	12	L10
Oxygen	6.7	6.7	6.9	5.2	6.5
Nitrite	L.229	0.009	L.005	0.018	L.005
Nitrate	1.440	0.170	0.180	L.020	L.020
Copper	0.0040	0.0070	0.0010	0.0300	0.0040
Iron	0.81	2.78	0.49	3.27	5.04
Manganese	1.01	0.13	0.03	1.08	1.88
Sodium	756.0	13.9	3.6	31.0	144.0
Potassium	55.0	3.5	0.9	3.6	3.5
Chloride	1170.	20.2	3.9	46.9	71.0
Sulfate	53	23	7	10	7
Total (mg/l)					
Dissolved Phosphorus	0.022	0.270	0.048	0.080	0.015
Lead	L0.100	L0.100	L0.100	L0.100	L0.100
Zinc	0.0100	0.0200	L0.0100	L0.0100	L0.0100
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

→ Permit level 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1989

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	890228 0800 hrs	890228 0815 hrs	890228 0830 hrs	890228 0845 hrs	890228 0900 hrs
pH	7.4	6.7	6.7	6.2	6.4
Temperature (deg C)	5.0	5.0	4.5	5.0	5.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	33.0	12.0	13.0	2.0	32.0
Ammonia (mgN/l)	4.65	1.28	2.02	0.06	0.40
Dissolved (mg/l)					
BOD5	L10	L10	14	L10	L10
Oxygen	6.3	6.1	2.4	7.1	7.2
Nitrite	0.094	0.021	0.020	0.018	0.069
Nitrate	5.610	0.540	0.370	L.020	0.360
Copper	0.0030	0.0070	0.0060	0.0030	0.0030
Iron	0.40	3.70	3.21	2.47	17.10
Manganese	1.12	0.39	0.38	0.64	0.93
Sodium	940.0	38.8	44.6	18.6	77.0
Potassium	46.5	6.6	11.1	1.8	3.4
Chloride	1560.	53.9	45.9	31.0	139.0
Sulfate	188	44	59	15	17
Total (mg/l)					
Dissolved Phosphorus	0.072	0.228	0.294	0.064	0.232
Lead	L0.010	L0.100	L0.100	L0.100	L0.100
Zinc	0.0200	0.0300	0.0400	L0.0100	L0.0100
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1988

RECEIVED
JAN 23 1990
LOWER MAINLAND REGION
FILE No.

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	881129 0800 hrs	881129 0830 hrs	881129 0845 hrs	881129 0900 hrs	881129 0915 hrs
PH	7.3	7.1	6.9	6.4	6.7
Temperature (deg C)	6.0	7.0	7.5	7.5	13.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	31.9	13.3	13.4	0.8	6.1
Ammonia (mgN/l)	L0.50	1.30	0.84	L0.50	0.70
Dissolved (mg/l)					
BOD5	12	10	13	L10	13
Oxygen	11.2	5.6	4.5	6.6	5.3
Nitrite	0.010	0.025	0.033	L.002	L.002
Nitrate	0.184	1.200	1.480	L.005	0.044
Copper	0.0350	0.0088	0.0038	0.0036	0.0041
Iron	0.16	2.72	3.06	2.93	2.17
Manganese	1.70	0.29	0.28	1.12	1.29
Sodium	750.0	29.0	23.0	27.0	39.0
Potassium	NA	5.8	3.2	2.2	3.0
Chloride	2100.	23.5	36.5	52.0	40.0
Sulfate	310	54	36	23	26
Total (mg/l)					
Dissolved Phosphorus	0.022	0.165	0.170	0.052	0.038
Lead	0.001	L0.001	L0.001	L0.001	L0.001
Zinc	0.0060	0.0310	0.0200	0.0061	0.0110
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	880817 0800 hrs	880817 0815 hrs	880817 0830 hrs	880817 0845 hrs	880817 0900 hrs
PH	7.5	6.9	6.8	6.1	6.9
Temperature (deg C)	18.5	16.5	16.5	16.0	16.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	8.8	17.2	10.4	10.2	16.7
Ammonia (mgN/l)	0.84	0.70	0.84	0.84	0.56
Dissolved (mg/l)					
BOD5	9	6	6	36	7
Oxygen	5.9	4.8	5.2	4.7	4.4
Nitrite	L.002	L.002	L.002	L.002	L.002
Nitrate	0.350	0.090	0.075	0.090	0.035
Copper	0.0039	0.0028	0.0036	0.0140	0.0089
Iron	0.43	0.70	0.51	6.40	4.10
Manganese	0.29	0.03	0.03	1.24	0.26
Sodium	116.0	4.1	4.9	30.0	14.0
Potassium	47.0	4.4	6.0	19.0	7.4
Chloride	570.0	3.5	5.5	51.0	10.8
Sulfate	185	11	15	9	13
Total (mg/l)					
Dissolved Phosphorus	0.020	0.150	0.690	0.810	0.440
Lead	L0.001	L0.001	L0.001	0.002	0.002
Zinc	L0.0300	L0.0300	L0.0300	L0.0300	L0.0300
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	880518 0800 hrs	880518 0815 hrs	880518 0830 hrs	880518 0845 hrs	880518 0900 hrs
PH	7.8	6.9	6.5	6.4	6.8
Temperature (deg C)	11.0	13.0	13.0	12.0	11.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	10.0	18.0	12.0	0.8	7.5
Ammonia (mgN/l)	4.10	0.70	0.70	L0.50	0.56
Dissolved (mg/l)					
BOD5	22	5	12	8	14
Oxygen	7.7	2.8	3.3	4.7	7.6
Nitrite	0.091	0.045	0.055	0.014	0.014
Nitrate	1.240	0.672	1.010	0.034	0.006
Copper	0.0040	0.0090	0.0110	0.0050	0.0040
Iron	0.50	1.30	2.42	2.25	5.30
Manganese	1.10	0.36	0.24	0.54	2.00
Sodium	500.0	170.0	21.2	25.0	69.0
Potassium	515.0	197.0	67.5	85.0	50.0
Chloride	600.0	76.0	23.0	27.0	126.0
Sulfate	74	50	28	L1	8
Total (mg/l)					
Dissolved Phosphorus	0.043	0.310	0.390	0.130	0.100
Lead	L0.001	L0.001	L0.001	L0.001	L0.001
Zinc	L0.0200	0.0300	0.0300	L0.0200	L0.0200
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

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LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1988

REPORTED TO
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BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	880223 0900 hrs	880223 0815 hrs	880223 0830 hrs	880223 0845 hrs	880223 0900 hrs
PH	7.6	7.0	6.9	6.8	6.7
Temperature (deg C)	4.5	5.0	5.0	4.0	3.5
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	19.4	20.8	17.6	1.8	10.6
Ammonia (mgN/l)	4.20	1.40	1.10	0.70	1.10
Dissolved (mg/l)					
BOD5	35	28	24	35	22
Oxygen	7.5	5.1	5.4	10.0	10.2
Nitrite	0.064	0.040	0.080	L.002	L.002
Nitrate	3.850	0.560	1.100	0.090	0.280
Copper	0.0050	0.0100	0.0030	0.0070	0.0050
Iron	0.20	5.00	5.20	2.50	8.20
Manganese	1.23	0.49	0.53	1.00	0.62
Sodium	805.0	48.0	43.0	25.0	17.5
Potassium	41.0	5.4	3.4	2.4	1.7
Chloride	970.0	74.0	32.0	45.0	52.0
Sulfate	140	52	80	18	7
Total (mg/l)					
Dissolved Phosphorus	0.020	0.150	0.210	0.060	0.180
Lead	L0.001	L0.001	L0.001	L0.001	L0.001
Zinc	0.0300	0.0500	0.0200	0.0400	0.0200
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1987

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 0276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	871117 0800 hrs	871117 0815 hrs	871117 0830 hrs	871117 0845 hrs	871117 0900 hrs
PH	7.5	6.9	6.9	6.6	7.0
Temperature (deg C)	6.0	9.5	6.0	6.0	4.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	18.7	99.9	24.8	1.6	62.6
Ammonia (mgN/l)	5.50	7.70	0.68	0.56	1.32
Dissolved (mg/l)					
BOD5	24	178	19	13	28
Oxygen	8.4	6.1	5.2	7.8	7.6
Nitrite	0.041	L.002	0.048	L.002	0.005
Nitrate	2.000	1.570	2.740	0.093	0.062
Copper	LO.0500	LO.0500	LO.0500	LO.0500	LO.0500
Iron	0.90	8.70	2.90	1.90	0.50
Manganese	2.12	1.00	0.32	3.40	2.00
Sodium	890.0	158.0	40.0	56.0	60.0
Potassium	69.0	45.0	5.2	8.7	4.0
Chloride	1850.	64.0	73.0	210.0	76.0
Sulfate	300	21	35	61	13
Total (mg/l)					
Dissolved Phosphorus	0.063	0.083	0.170	0.150	0.032
Lead	0.002	0.001	LO.001	LO.001	0.002
Zinc	0.0700	0.4000	LO.0500	LO.0500	LO.0500
Mercury (ug/l)	LO.05	LO.05	LO.05	LO.05	LO.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1987

REPORTED TO
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BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	870825 0800 hrs	870825 0815 hrs	870825 0830 hrs	870825 0845 hrs	870825 0900 hrs
pH	7.2	6.9	6.9	6.4	7.0
Temperature (deg C)	18.5	21.5	20.0	18.5	21.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	5.2	24.6	10.4	10.2	8.6
Ammonia (mgN/l)	0.84	0.56	0.84	1.40	0.84
Dissolved (mg/l)					
BOD5	11	10	10	35	10
Oxygen	6.0	5.8	4.4	4.7	6.8
Nitrite	0.092	0.026	L.002	L.002	L.002
Nitrate	1.740	0.040	0.568	0.072	0.020
Copper	L0.0500	L0.0500	L0.0500	L0.0500	L0.0500
Iron	0.39	1.88	2.45	8.90	1.43
Manganese	0.86	0.05	0.08	2.37	0.18
Sodium	650.0	13.3	14.3	27.0	18.8
Potassium	53.0	11.5	8.5	13.8	9.3
Chloride	1040.	13.1	10.4	39.0	18.5
Sulfate	45	11	9	20	8
Total (mg/l)					
Dissolved Phosphorus	0.056	0.167	0.280	0.400	0.080
Lead	L0.001	L0.001	L0.001	L0.001	0.001
Zinc	L0.0200	L0.0200	L0.0020	0.0500	L0.0200
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1987

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 8278

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	870525 1000 hrs	870525 1015 hrs	870525 1030 hrs	870525 1030 hrs	870525 1045 hrs
pH	7.8	7.5	7.4	6.7	6.8
Temperature (deg C)	16.0	15.5	14.0	14.0	16.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	15.2	12.6	17.6	3.2	10.4
Ammonia (mgN/l)	4.34	0.70	0.42	0.56	0.56
Dissolved (mg/l)					
BOD5	28	12	11	19	23
Oxygen	7.4	9.2	8.2	7.2	6.8
Nitrite	0.160	L.002	L.002	L.002	L.002
Nitrate	1.360	0.035	0.040	L.010	L.010
Copper	0.0064	0.0045	0.0031	0.0073	0.0044
Iron	0.22	0.39	0.29	3.54	1.15
Manganese	1.51	0.05	0.04	1.38	1.45
Sodium	825.0	3.7	3.6	19.5	46.0
Potassium	47.0	2.0	1.6	5.9	6.5
Chloride	900.0	3.6	3.3	25.3	71.0
Sulfate	90	8	7	7	2
Total (mg/l)					
Dissolved Phosphorus	0.081	0.220	0.232	0.125	0.152
Lead	L0.001	L0.001	L0.001	L0.001	0.002
Zinc	0.0085	0.0230	0.0100	0.0280	0.0160
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1987

REPORTED TO
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	870217 0800 hrs	870217 0815 hrs	870217 0830 hrs	870217 0845 hrs	870217 0900 hrs
PH	7.6	6.4	6.4	6.1	6.5
Temperature (deg C)	6.0	6.5	6.5	7.0	8.0
96H LC50 (%)	59.6	NA	NA	NA	NA
Total Suspended Solids (mg/l)	16.5	20.0	18.5	19.5	6.6
Ammonia (mgN/l)	7.70	0.98	0.84	0.98	0.56
Dissolved (mg/l)					
BOD5	L10	L10	L10	L10	L10
Oxygen	9.2	7.2	6.1	10.1	9.8
Nitrite	0.032	0.018	0.022	L.002	0.014
Nitrate	2.340	0.860	1.160	0.124	0.348
Copper	0.0042	0.0060	0.0051	0.0052	0.0057
Iron	0.32	2.20	4.11	1.99	3.47
Manganese	1.61	0.32	0.37	0.66	0.50
Sodium	428.0	26.0	27.0	13.0	28.0
Potassium	37.5	4.6	3.2	2.2	2.4
Chloride	656.0	39.4	44.4	21.2	35.6
Sulfate	127	28	23	10	7
Total (mg/l)					
Dissolved Phosphorus	0.142	0.168	0.130	0.090	0.098
Lead	0.006	0.001	0.001	0.001	0.002
Zinc	0.0220	0.0150	0.0080	0.0200	0.0220
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1986

REPORTED TO
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	861202 0800 hrs	861202 0815 hrs	861202 0830 hrs	861202 0845 hrs	861202 0900 hrs
PH	7.6	6.3	6.3	6.0	6.5
Temperature (deg C)	35.0	5.0	5.5	3.5	5.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	15.1	22.0	10.2	1.2	10.9
Ammonia (mgN/l)	10.10	1.00	1.00	1.00	1.00
Dissolved (mg/l)					
BOD5	10	L10	10	L10	L10
Oxygen	8.1	5.5	5.7	7.9	7.6
Nitrite	0.070	NA	NA	NA	NA
Nitrate	1.280	0.810	1.380	0.110	0.590
Copper	0.0028	0.0080	0.0070	0.0030	0.0050
Iron	0.54	1.87	2.45	1.60	7.70
Manganese	1.42	0.31	0.34	0.35	0.50
Sodium	230.0	21.0	21.0	17.0	17.0
Potassium	45.3	5.1	4.9	3.2	5.0
Chloride	860.0	29.0	32.0	25.0	21.0
Sulfate	133	75	37	21	10
Total (mg/l)					
Dissolved Phosphorus	0.200	0.450	0.200	0.130	0.470
Lead	0.001	L0.001	L0.001	L0.001	L0.001
Zinc	0.0210	0.0360	0.0200	0.0090	0.0150
Mercury (ug/l)	L0.05	0.63	L0.05	0.13	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1986

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	860919 0800 hrs	860919 0815 hrs	860919 0845 hrs	860919 0900 hrs	860919 0915 hrs
PH	7.5	7.4	7.2	6.6	7.6
Temperature (deg C)	15.0	14.0	14.0	13.0	16.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	3.2	22.8	18.9	20.0	6.6
Ammonia (mgN/l)	3.50	2.80	0.42	0.98	0.42
Dissolved (mg/l)					
BOD5	L10	L10	L10	L10	L10
Oxygen	2.2	7.6	6.6	3.4	10.2
Nitrite	0.160	0.017	0.018	0.026	0.005
Nitrate	1.260	0.150	0.200	0.090	0.048
Copper	0.0023	0.0024	0.0020	0.0033	0.0020
Iron	0.10	0.51	0.40	4.70	0.05
Manganese	1.67	0.05	0.05	3.00	0.04
Sodium	1125.	8.0	6.1	33.0	3.9
Potassium	54.0	1.7	1.5	4.6	1.0
Chloride	1830.	9.7	6.0	38.0	3.4
Sulfate	63	11	11	15	8
Total (mg/l)					
Dissolved Phosphorus	0.035	0.082	0.125	0.082	0.038
Lead	L0.001	L0.001	L0.001	L0.001	L0.001
Zinc	0.0028	0.0130	0.0044	0.0200	0.0019
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1986

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	860728 0800 hrs	860728 0815 hrs	860728 0830 hrs	860728 0845 hrs	860728 0900 hrs
PH	7.4 ✓	7.0	6.9	6.7	7.7
Temperature (deg C)	17.0	19.0	19.0	12.0	17.5
96H LC50 (%)	>100 ✓	NA	NA	NA	NA
Total Suspended Solids (mg/l)	6.5 ✓	18.0	20.4	44.0	4.0
Ammonia (mgN/l)	3.60	0.28	0.42	0.42	0.28
Dissolved (mg/l)					
BOD5	22 ✓	11	17	20	L10
Oxygen	4.9	6.1	6.0	3.5	9.5
Nitrite	0.340	0.010	0.012	0.034	0.003
Nitrate	3.300	0.095	0.110	0.095	0.042
Copper	0.0062 ✓	0.0021	0.0033	0.0043	0.0025
Iron	0.23	1.00	1.40	4.80	0.26
Manganese	1.82	0.06	0.07	1.50	0.02
Sodium	875.0	5.0	7.0	27.5	2.0
Potassium	57.0	1.8	1.9	5.2	0.3
Chloride	1450.	7.4	10.4	34.0	1.4
Sulfate	70 ✓	7	7	13	7
Total (mg/l)					
Dissolved Phosphorus	0.054	0.192	0.300	0.170	0.016
Lead	L0.001 ✓	L0.001	0.001	L0.001	L0.001
Zinc	0.0022 ✓	0.0043	0.0072	0.0110	0.0120
Mercury (ug/l)	L0.05 ✓	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1986

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	860312 0900 hrs	860312 1000 hrs	860312 1015 hrs	860312 1030 hrs	860312 1045 hrs
PH	7.7	6.7	6.8	6.8	6.7
Temperature (deg C)	7.0	8.0	8.5	8.0	8.0
96H LC50 (%)	32	NA	NA	NA	NA
Total Suspended Solids (mg/l)	23.0	42.4	21.0	1.5	88.0
Ammonia (mgN/l)	15.70	0.56	0.94	0.68	1.40
Dissolved (mg/l)					
BOD5	33	28	26	14	32
Oxygen	9.4	7.8	8.7	10.2	9.2
Nitrite	0.120	0.038	0.031	0.012	0.038
Nitrate	2.950	0.075	0.098	L.005	0.052
Copper	0.0047	0.0072	0.0072	0.0028	0.0074
Iron	0.84	4.75	6.58	2.34	12.60
Manganese	2.19	0.42	0.39	0.89	1.13
Sodium	880.0	45.3	35.8	19.9	47.2
Potassium	54.0	3.3	2.2	1.5	3.2
Chloride	1210.	76.4	58.2	22.0	85.0
Sulfate	215	27	24	2	19
Total (mg/l)					
Dissolved Phosphorus	0.068	0.188	0.143	0.210	0.182
Lead	L0.001	0.002	0.001	0.001	0.002
Zinc	0.0160	0.0280	0.0210	0.0070	0.0270
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1985

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	851211 0900 hrs	851211 0915 hrs	851211 0930 hrs	851211 0945 hrs	851211 1000 hrs
PH	7.4	6.5	6.5	6.3	6.5
Temperature (deg C)	2.0	4.0	3.0	2.0	2.5
96H LC50 (%)	56.4	NA	NA	NA	NA
Total Suspended Solids (mg/l)	12.5	18.5	27.5	L1.0	6.0
Ammonia (mgN/l)	27.30	1.26	1.12	0.56	0.98
Dissolved (mg/l)					
BOD5	15	34	18	12	35
Oxygen	6.2	7.1	5.1	6.8	6.2
Nitrite	0.117	0.036	0.037	0.011	0.041
Nitrate	3.580	2.150	1.770	0.098	0.424
Copper	0.0071	0.0097	0.0080	0.0027	0.0076
Iron	2.90	6.50	8.10	1.70	9.40
Manganese	2.69	0.56	0.58	1.79	0.85
Sodium	785.0	37.3	38.0	30.8	31.3
Potassium	74.0	3.7	3.3	4.3	3.9
Chloride	1315.	65.5	62.0	55.0	55.3
Sulfate	161	37	28	20	13
Total (mg/l)					
Dissolved Phosphorus	L0.010	0.056	0.080	0.200	0.212
Lead	L0.001	0.004	0.001	L0.001	0.002
Zinc	0.0033	0.0180	0.0190	0.0050	0.0240
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1985

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 5276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	850910 0900 hrs	850910 1000 hrs	850910 1030 hrs	850910 1100 hrs	850910 1130 hrs
PH	7.3	6.7	6.7	6.3	6.7
Temperature (deg C)	16.0	16.0	15.5	16.0	14.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	2.9	20.5	28.7	4.5	9.7
Ammonia (mgN/l)	4.90	0.28	L0.10	0.84	L0.10
Dissolved (mg/l)					
BOD5	23	L10	L10	14	13
Oxygen	2.5	6.8	6.1	6.4	8.2
Nitrite	0.330	0.005	L.005	0.044	0.005
Nitrate	3.500	0.038	0.022	0.250	0.016
Copper	0.0060	0.0040	0.0030	0.0030	0.0060
Iron	0.32	0.43	0.33	5.75	3.00
Manganese	3.63	L0.05	L0.05	3.28	0.14
Sodium	940.0	4.5	3.4	103.0	4.9
Potassium	58.3	1.8	1.6	16.8	1.5
Chloride	2280.	10.5	7.4	264.0	126.0
Sulfate	58	7	7	13	7
Total (mg/l)					
Dissolved Phosphorus	0.012	0.204	0.206	0.852	0.100
Lead	0.002	0.004	0.002	0.002	0.002
Zinc	0.0035	0.0300	0.0130	0.0150	0.0048
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1985

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	850606 0800 hrs	850606 0815 hrs	850606 0830 hrs	850606 0845 hrs	850606 0900 hrs
PH	7.8	7.2	7.2	6.8	7.3
Temperature (deg C)	17.0	16.0	15.0	16.0	16.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	12.8	12.4	17.3	28.7	18.0
Ammonia (mgN/l)	18.60	0.42	L0.10	0.70	0.56
Dissolved (mg/l)					
BOD5	46	12	9	20	36
Oxygen	6.5	6.2	5.0	7.1	5.0
Nitrite	0.315	0.014	0.007	0.011	0.010
Nitrate	4.000	0.148	0.052	0.042	0.060
Copper	0.0050	0.0020	0.0030	0.0050	0.0030
Iron	2.89	1.48	1.70	3.70	13.60
Manganese	4.70	0.13	0.06	1.50	0.60
Sodium	890.0	21.0	5.8	42.5	25.0
Potassium	66.0	3.2	2.2	9.6	2.4
Chloride	1640.	55.0	7.0	44.7	38.3
Sulfate	138	8	5	10	10
Total (mg/l)					
Dissolved Phosphorus	0.018	0.107	0.192	1.030	0.145
Lead	L0.001	0.001	0.003	0.003	0.002
Zinc	0.0020	0.0030	0.0110	0.0030	0.0050
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREA .NT MONITORING AT RICHMOND LAND .L
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1985

REPORTED TO
ENVIRONMENT CANADA. ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT. WASTE MANAGEMENT BRANCH. PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1		SITE 2	SITE 3	SITE 4	SITE 5
	850304 0900 hrs		850304 0930 hrs	850304 1000 hrs	850304 1030 hrs	850304 1100 hrs
PH	7.5		7.2	6.6	6.3	7.8
Temperature (deg C)	5.5		5.5	5.5	5.5	6.0
96H LC50 (%)	>49		NA	NA	NA	NA
Total Suspended Solids (mg/l)	26.0	40	16.0	32.0	L1.0	52.7
Ammonia (mgN/l)	17.60	* High toxic	3.90	0.84	0.28	0.28
Dissolved (mg/l)						
BOD5	28	30	29	19	6	20
Oxygen	6.6		8.0	6.4	12.2	7.5
Nitrite	0.064		0.032	0.024	L.005	0.017
Nitrate	3.100		0.440	0.154	0.011	0.037
Copper	0.0057	.2	0.0027	0.0024	0.0018	0.0037
Iron	0.11	12.0	1.12	5.10	1.20	1.70
Manganese	* 3.63	3.3	1.34	0.51	1.00	0.51
Sodium	487.0		150.0	50.0	17.2	31.5
Potassium	52.0		12.9	1.6	0.7	2.0
Chloride	1020.		290.0	97.0	18.0	58.0
Sulfate	156	250.	144	15	38	18
Total (mg/l)						
Dissolved Phosphorus	0.023		0.060	0.115	0.213	0.217
Lead	0.003	.05	0.003	0.007	0.001	0.003
Zinc	0.2200	.3	0.2200	0.0090	0.0030	0.0100
Mercury (ug/l)	L0.10	.0006	L0.10	L0.10	L0.10	L0.10

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1984

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	Discharge SITE 1	No7 Blundell SITE 2	No7 Nursery SITE 3	N. drainage ditch No7 SITE 4	S.E. ditch at Nursery SITE 5
	841204 1000 hrs	841204 1030 hrs	841204 1100 hrs	841204 1115 hrs	841204 1130 hrs
PH	7.8	6.5	6.3	5.9	6.6
Temperature (deg C)	1.0	3.5	5.0	2.5	2.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	18.5 40	15.5	29.0	2.0	8.0
Ammonia (mgN/l)	24.80 * High	1.10	1.12	0.84	1.26
Dissolved (mg/l)					
BOD5	12 30	14	19	L10	31
Oxygen	10.0	6.3	5.7	10.6	7.5
Nitrite	0.063	0.026	0.028	0.013	0.022
Nitrate	1.120	1.400	0.976	0.134	0.028
Copper	0.0049 0.2	0.0086	0.0070	0.0024	0.0026
Iron	1.69 12.0	4.44	8.95	1.41	19.00
Manganese	2.88	0.46	0.53	2.01	2.08
Sodium	243.0 3.3	29.0	35.3	20.8	48.5
Potassium	39.5	2.3	2.1	2.1	2.6
Chlorine	302.5	38.8	47.5	24.5	36.5
Sulfate	185 250	41	31	100	39
Total (mg/l)					
Dissolved Phosphorus	0.183	0.194	0.169	0.330	0.152
Lead	0.004 0.05	0.001	0.001	L0.001	L0.001
Zinc	0.0600 0.5	0.0180	0.0180	0.0080	0.0090
Mercury (ug/l)	L0.05 0.0006	L0.50	L0.50	L0.05	L0.50

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1984

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	Discharge SITE 1		No. 1 Blundell SITE 2	No. 7 Nursery SITE 3	N. drainage ditch near #7 SITE 4	S.E. ditch at Nelson SITE 5
	840919 0800 hrs		840919 0830 hrs	840919 0900 hrs	840919 0930 hrs	840919 1000 hrs
PH	7.5	6.5-8.5	6.8	6.7	6.7	7.2
Temperature (deg C)	14.5		14.5	14.5	15.5	16.5
96H LC50 (%)	>100		NA	NA	NA	NA
Total Suspended Solids (mg/l)	26.0	40	34.7	36.7	22.0	25.3
Ammonia (mgN/l)	5.74		0.28	0.28	0.42	0.98
Dissolved (mg/l)						
BOD5	16	30	3	L3	7	8
Oxygen	4.0		5.0	7.8	8.7	6.8
Nitrite	0.240		L.002	L.002	L.002	L.002
Nitrate	2.620		0.030	0.033	0.418	0.010
Copper	0.0053	0.2	0.0022	0.0040	0.0071	0.0029
Iron	1.06	12.0	1.01	1.01	4.93	6.35
Manganese	1.95	3.3	0.03	0.02	7.77*	1.62
Sodium	280.0		3.7	3.2	25.5	64.0
Potassium	35.6		1.4	1.4	5.8	4.8
Chlorine	302.0		5.0	4.5	24.0	34.5
Sulfate	59	250	9	8	188*	5
Total (mg/l)						
Dissolved Phosphorus	0.012		0.136	0.190	0.052	0.038
Lead	L0.001	0.05	L0.001	L0.001	L0.001	L0.001
Zinc	0.0028	0.5	0.0031	0.0043	0.0400	0.0043
Mercury (ug/l)	L0.05	0.0006	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1984

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 5075

SUBMITTED BY BC RESEARCH

Sampling Sites.

1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1		SITE 2	SITE 3	SITE 4	SITE 5
	840711 0900 hrs		840711 0815 hrs	840711 0830 hrs	840711 0845 hrs	840711 0900 hrs
pH	7.6	6.5-8.5	6.9	7.1	6.8	7.0
Temperature (deg C)	17.5		18.0	18.0	18.5	18.0
96H LC50 (%)	>100		NA	NA	NA	NA
Total Suspended Solids (mg/l)	4.0	40	5.4	10.4	2.0	22.0
Ammonia (mgN/l)	2.80		0.70	0.56	0.84	0.56
Dissolved (mg/l)						
BOD5	16	30	8	13	7	12
Oxygen	4.6		5.4	5.8	6.6	4.5
Nitrite	0.188		0.015	0.007	0.030	0.011
Nitrate	3.850		0.084	0.092	3.350	0.042
Copper	0.0075	0.2	0.0032	0.0018	0.0230	0.0033
Iron	0.74	10	5.46	5.30	5.09	14.30
Manganese	3.12	3.5	0.23	0.22	4.24	0.44
Sodium	930.0		18.3	15.0	13.2	16.2
Potassium	32.4		4.0	2.4	3.0	3.0
Chlorine	335.0		29.0	2.5	1.4	25.0
Sulfate	114	250	15	4	52	10
Total (mg/l)						
Dissolved Phosphorus	0.040		0.279	0.236	0.067	0.350
Lead	0.012	0.5	0.007	0.004	0.006	0.015
Zinc	0.0120	0.5	0.0300	0.0120	0.0300	0.0930
Mercury (ug/l)	LO.10	0.05	LO.10	LO.10	LO.10	LO.10

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1984

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 4576

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1		SITE 2	SITE 3	SITE 4	SITE 5
	~~840306~~ 840306 0800 hrs		840300 0815 hrs	840300 0830 hrs	840300 0845 hrs	840300 0900 hrs
pH	7.1		7.0	6.7	6.3	7.6
Temperature (deg C)	7.0		6.5	5.0	6.0	5.0
96H LC50 (%)	>100		NA	NA	NA	NA
Total Suspended Solids (mg/l)	6.1	40.	5.1	8.8	4.0	13.9
Ammonia (mgN/l)	0.80		0.42	0.43	0.48	0.29
Dissolved (mg/l)						
BOD5	50	30.	1.10	14	16	23
Oxygen	6.8		6.6	8.0	14.2	7.7
Nitrite	0.003		L.002	L.009	0.006	0.003
Nitrate	0.348		1.456	0.460	0.124	0.364
Copper	0.0084	.2	0.0063	0.0062	0.0027	0.0049
Iron	2.80	12.0	5.26	3.54	1.10	12.10
Manganese	2.30	3.3	0.28	0.15	0.07	0.80
Sodium	303.0		29.1	9.6	9.0	24.2
Potassium	23.4		3.3	2.2	2.2	5.0
Chlorine	259.0		61.5	10.0	10.0	43.6
Sulfate	222	250	21	19	19	10
Total (mg/l)						
Dissolved Phosphorus	0.048		0.110	0.100	0.160	0.178
Lead	0.002	.05	0.006	0.003	LC.001	0.005
Zinc	0.0035	.5	0.0110	0.0300	0.0047	0.0031
Mercury (ug/l)	LO 10	.0006	0 10	LO 10	LO 10	LO 10

PE-06276

RESULTS OF ANALYSIS - Water[1]

File No. F1132

			Effluent
			95 06 07
Physical Tests			
Hardness	CaCO3		406
pH			7.78
Total Suspended Solids			9
Dissolved Anions			
Acidity	CaCO3		19.6
Sulphate	SO4		9.8
Nutrients			
Ammonia Nitrogen		N	1.29
Nitrate Nitrogen		N	3.32
Nitrite Nitrogen		N	0.169
Total Dissolved Phosphate		P	0.006
Total Metals			
Aluminum	T-Al		0.066
Cadmium	T-Cd		<0.0002
Calcium	T-Ca		78.6
Copper	T-Cu		0.002
Iron	T-Fe		1.42
Lead	T-Pb		<0.001
Magnesium	T-Mg		50.9
Manganese	T-Mn		0.251
Mercury	T-Hg		<0.00005
Zinc	T-Zn		<0.005

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per litre except where noted.

RESULTS OF ANALYSIS - Water[1]

File No. F1132

	Effluent 95 06 07	Effluent[1] LRep 95 06 07
Resin and/or Fatty Acids		
Abietic Acid	<0.001	<0.001
Arachidic Acid	<0.001	<0.001
Behenic Acid	<0.001	<0.001
Chlorodehydroabietic Acid	<0.001	<0.001
Dehydroabietic Acid	<0.001	<0.001
Dichlorodehydroabietic Acid	<0.001	<0.001
Isopimaric Acid	<0.001	<0.001
Lauric Acid	<0.001	<0.001
Levopimaric Acid	<0.001	<0.001
Lignoceric Acid	<0.001	<0.001
Linoleic Acid	<0.001	<0.001
Linolenic Acid	<0.001	<0.001
Myristic Acid	<0.001	<0.001
Neoabietic Acid	<0.001	<0.001
Oleic Acid	<0.001	<0.001
Palmitic Acid	<0.001	<0.001
Pimaric Acid	<0.001	<0.001
Sandaracopimaric Acid	<0.001	<0.001
Stearic Acid	<0.001	<0.001
Organic Parameters		
Biochem.Oxygen Demand-Tot BOD-5	<5	-
Chemical Oxygen Demand COD	64	-
Bioassays		
96 hour LC-50	> 100%	-

Remarks regarding the analyses appear at the beginning of this report.
< = Less than the detection limit indicated.
[1]Results are expressed as milligrams per litre except where noted.
[2]LRep = Laboratory Replicate.

Appendix 1 - METHODOLOGY File No. F1132

Samples were analyzed by methods acceptable to the appropriate regulatory agency. Outlines of the methodologies utilized are as follows:

Moisture

This analysis is carried out gravimetrically by drying the sample to constant weight at 103 C.

Metals in Sediment/Soil

These analyses are carried out using procedures that are consistent with the requirements of the appropriate regulatory agencies and adapted from U.S. EPA Method 3050 (Publ. # SW-846, 3rd ed., Washington, DC 20460). The procedures involve a digestion using a combination of nitric and hydrochloric acids. The resulting extract is bulked to volume with deionized/distilled water. The digested portion is then analysed by a variety of instrumental techniques, which may include specific atomic absorption spectrophotometric techniques (AAS) and/or atomic emission spectrophotometry (ICP), to obtain the required detection limit for each element. Specific details are available upon request.

PLEASE NOTE (When the following elements are reported):

Aluminum, barium, calcium, chromium, iron, magnesium, manganese, molybdenum and vanadium are often associated with the silicate matrix of the sediment. Because of this, the recoveries of these elements may be low using the specified digestion. From an environmental standpoint, this is not usually of concern since the "available" metals are typically the fraction of interest.

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

Metals in Water

These analyses are carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 18th Edition published by the American Public Health Association, 1992. The procedures involve a variety of instrumental analyses including atomic emission spectrophotometry (ICP) and atomic absorption spectrophotometry (AA) to

obtain the required detection limit for each element. Specific details are available on request.

Resin Acids / Fatty Acids in Water

This analysis is carried out in accordance with EPS and Pacific Environmental Institute Methods. The procedure involves extraction of the sample with dichloromethane. The extract is concentrated and derivatized with TBDMS [N-methyl-N(t-butyldimethylsilyl)-trifluoroacetimide]. The TBDMS ester derivatives are cleaned up on a silica gel solid phase extraction (SPE) column and analysed by capillary column gas chromatography with mass spectrometric detection.

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RECEIVED JUL 07 1995

HML

CHEMICAL ANALYSIS REPORT

Date: June 26, 1995

ASL File No. F1132

Report On: 952-1811 Soil and Water Analysis

Report To: **Golder Associates Ltd.**
500 - 4260 Still Creek Drive
Burnaby, BC
V5C 6C6

Attention: **Ms. Heather Matthews**

Received: June 7, 1995

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Brent A. Makelki, B.Sc.
Project Chemist

Joyce Chow, B.Sc.
Project Chemist

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

PE-6276 Data

SAMPLING SITES:

1 FINAL DISCHARGE

Date	12/13/94
pH	7.6
Temperature (C)	3.0
Dissolved Oxygen (mg/L)	8.0
Toxicity (96-h LC50 Rainbow trout)	> 100
Acidity pH 8.3 (mg CaCO3/L)	19.3
Total Suspended Solids (mg/L)	17.0
Ammonia (mgN/L)	6.55
BOD5 (mg/L)	16.0
Chemical Oxygen Demand (mg/L)	55
Nitrite Nitrogen (mg/L)	0.105
Nitrate Nitrogen (mg/L)	0.916
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	3.50
Total Manganese (mg/L)	1.40
Total Aluminum (mg/L)	< 0.10
Dissolved Sulfate (mg/L)	13
Total Dissolved Phosphorus (mg/L)	< 0.010
Total Lead (mg/L)	< 0.001
Total Zinc (mg/L)	< 0.02
Fatty Acids (mg/L)	0.155
Resin Acids (mg/L)	< 0.005

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

FINAL DISCHARGE

Date	09/16/94
pH	8.1
Temperature (C)	20.0
Dissolved Oxygen (mg/L)	11.4
Acidity pH 8.3 (mg CaCO3/L)	9.7
Total Suspended Solids (mg/L)	9.0
Ammonia (mgN/L)	0.38
BOD5 (mg/L)	< 10
Chemical Oxygen Demand (mg/L)	53
Nitrite Nitrogen (mg/L)	0.09
Nitrate Nitrogen (mg/L)	1.54
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	1.9
Total Manganese (mg/L)	0.58
Total Aluminum (mg/L)	< 0.1
Dissolved Sulfate (mg/L)	8
Total Dissolved Phosphorus (mg/L)	0.052
Total Lead (mg/L)	< 0.001
Total Zinc (mg/L)	< 0.05
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	0.057

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

DISCHARGE MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 FINAL DISCHARGE

	1
Date	12/02/92
pH	7.8
Temperature (C)	4.5
Dissolved Oxygen (mg/L)	7.1
Acidity pH 8.3 (mg CaCO3/L)	38.0
Total Suspended Solids (mg/L)	8.4
Ammonia (mgN/L)	1.96
BOD5 (mg/L)	19.5
Chemical Oxygen Demand (mg/L)	55
Nitrite Nitrogen (mg/L)	< 0.020
Nitrate Nitrogen (mg/L)	1.400
Total Copper (mg/L)	< 0.05
Total Iron (mg/L)	3.20
Total Manganese (mg/L)	1.40
Total Aluminum (mg/L)	< 0.10
Dissolved Sulfate (mg/L)	15.7
Total Dissolved Phosphorus (mg/L)	0.040
Total Lead (mg/L)	< 0.10
Total Zinc (mg/L)	< 0.04
Resin Acids (mg/L)	< 0.005
Fatty Acids (mg/L)	< 0.005

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SURFACE WATER MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

2-NO. 7 ROAD DITCH AT BLUNDELL RD.
3-NO. 7 ROAD DITCH AT NURSERY GATE
4-NORTH DRAINAGE DITCH
5-SOUTH EAST DRAINAGE DITCH
NORTH PERIMETER DITCH AT LEAK THROUGH BERM

	2	3	4	5	N.P.D.
Date	05/26/93	05/26/93	05/26/93	05/26/93	05/26/93
pH	7.8	7.3	7.9	7.6	7.6
Temperature (°C)	18.5	18.5	16.5	14.5	21.0
Dissolved Oxygen (mg/L)	5.3	2.9	4.5	2.7	5.5
Acidity pH 8.3 (mg CaCO3/L)	14.0	44.0	14.0	58.0	80.0
Ammonia (mgN/L)	0.50	0.25	0.50	0.50	20.9
Chemical Oxygen Demand (mg/L)	50	444	29	58	130
Nitrite Nitrogen (mg/L)	0.057	< 0.002	< 0.002	< 0.002	0.610
Nitrate Nitrogen (mg/L)	0.371	0.077	0.550	< 0.05	6.28
Total Copper (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Iron (mg/L)	2.3	18	2.1	20	4.5
Total Manganese (mg/L)	0.15	1.50	0.09	2.10	1.50
Total Aluminum (mg/L)	0.42	1.80	0.54	< 0.10	0.20
Dissolved Sulfate (mg/L)	11.0	5.0	7.0	5.0	6.0
Total Dissolved Phosphorus (mg/L)	0.213	0.300	0.203	0.080	0.052
Total Lead (mg/L)	0.003	0.005	0.001	0.001	0.001
Total Zinc (mg/L)	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

SURFACE WATER MONITORING

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

2 NO. 7 ROAD DITCH AT BLUNDELL RD.
3 NO. 7 ROAD DITCH AT NURSERY GATE
4 NORTH DRAINAGE DITCH
5 SOUTH EAST DRAINAGE DITCH

	2	3	4	5
Date	12/02/92	12/02/92	12/02/92	12/02/92
pH	7.7	6.9	6.0	6.8
Acidity pH 8.3 (mg CaCO3/L)	5.5	30.5	48.0	44.0
Ammonia (mgN/L)	< 1.00	< 1.00	< 1.00	< 1.00
Chemical Oxygen Demand (mg/L)	13	75	191	119
Nitrite Nitrogen (mg/L)	< 0.020	< 0.020	< 0.020	< 0.020
Nitrate Nitrogen (mg/L)	0.441	1.410	0.158	< 0.020
Dissolved Sulfate (mg/L)	20.5	49.0	29.7	11.7
Total Dissolved Phosphorus (mg/L)	< 0.005	0.203	0.095	0.080
Total Aluminum (mg/L)	0.47	1.90	0.88	0.37
Total Copper (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Total Lead (mg/L)	< 0.10	< 0.10	< 0.10	< 0.10
Total Iron (mg/L)	1.10	11.00	4.90	14.00
Total Manganese (mg/L)	0.25	0.60	0.59	1.50
Total Zinc (mg/L)	0.04	0.07	< 0.04	< 0.04

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LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	08/20/92	08/20/92	08/20/92
pH	7.9	7.4	7.1
TEMPERATURE (C)	22.0	23.0	18.9
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	11.0	16.0	13.0
Ammonia (mgN/L)	0.13	0.13	0.13
BOD5	13	21	16
Dissolved Oxygen (mg/L)	10.7	8.1	4.3
Dissolved Nitrite (mg/L)	< 0.010	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	0.699	0.061	0.181
Dissolved Copper (mg/L)	< 0.050	< 0.050	< 0.050
Dissolved Iron (mg/L)	0.4	1.1	1.3
Dissolved Manganese (mg/L)	0.81	< 0.05	< 0.05
Dissolved Sodium (mg/L)	759.0	4.1	3.7
Dissolved Potassium (mg/L)	44.0	3.0	3.4
Dissolved Chloride (mg/L)	1510.0	6.8	6.4
Dissolved Sulfate (mg/L)	7.0	9.2	8.9
Total Dissolved Phosphorus (mg/L)	0.042	0.038	0.223
Total Lead (mg/L)	< 0.001	0.001	0.003
Total Zinc (mg/L)	0.003	0.008	0.017
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	08/20/92	08/20/92
pH	7.0	7.0
TEMPERATURE (C)	16.5	18.0
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	6.0	21.0
Ammonia (mgN/L)	0.17	0.09
BOD5	< 10	13
Dissolved Oxygen (mg/L)	7.1	5.8
Dissolved Nitrite (mg/L)	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	< 0.010	0.020
Dissolved Copper (mg/L)	< 0.050	< 0.050
Dissolved Iron (mg/L)	1.7	3.4
Dissolved Manganese (mg/L)	1.30	0.12
Dissolved Sodium (mg/L)	9.9	10.0
Dissolved Potassium (mg/L)	2.6	16.0
Dissolved Chloride (mg/L)	11.9	39.8
Dissolved Sulfate (mg/L)	4.0	14.1
Total Dissolved Phosphorus (mg/L)	0.086	1.295
Total Lead (mg/L)	< 0.001	< 0.001
Total Zinc (mg/L)	0.010	0.011
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	05/26/92	05/26/92	05/26/92
pH	7.9	6.5	6.7
TEMPERATURE (C)	20.0	19.0	18.5
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	4.0	17.0	18.0
Ammonia (mgN/L)	1.44	0.02	< 0.01
BOD5	13	21	16
Dissolved Oxygen (mg/L)	9.8	< 1.0	2.6
Dissolved Nitrite (mg/L)	0.158	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	1.229	0.566	0.663
Dissolved Copper (mg/L)	< 0.050	< 0.050	< 0.050
Dissolved Iron (mg/L)	0.3	3.6	1.7
Dissolved Manganese (mg/L)	0.86	0.20	0.28
Dissolved Sodium (mg/L)	709.0	12.0	17.0
Dissolved Potassium (mg/L)	41.0	6.0	4.0
Dissolved Chloride (mg/L)	1175.0	18.0	35.0
Dissolved Sulfate (mg/L)	22.0	15.0	15.0
Total Dissolved Phosphorus (mg/L)	0.021	0.374	0.267
Total Lead (mg/L)	0.002	0.002	0.001
Total Zinc (mg/L)	0.002	0.018	0.015
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	05/26/92	05/26/92
pH	6.4	6.5
TEMPERATURE (C)	17.0	17.0
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	3.0	67.3
Ammonia (mgN/L)	< 0.01	0.03
BOD5	< 10	13
Dissolved Oxygen (mg/L)	6.3	1.9
Dissolved Nitrite (mg/L)	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	0.200	0.460
Dissolved Copper (mg/L)	< 0.050	< 0.050
Dissolved Iron (mg/L)	7.7	5.1
Dissolved Manganese (mg/L)	1.10	1.30
Dissolved Sodium (mg/L)	7.0	27.0
Dissolved Potassium (mg/L)	2.0	2.1
Dissolved Chloride (mg/L)	8.0	41.0
Dissolved Sulfate (mg/L)	6.0	< 1.0
Total Dissolved Phosphorus (mg/L)	0.055	0.164
Total Lead (mg/L)	< 0.001	0.002
Total Zinc (mg/L)	0.009	0.017
Total Mercury (ug/L)	0.08	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
Date	02/25/92	02/25/92	02/25/92	02/25/92	02/25/92
pH	7.8	6.9	7.0	5.8	6.7
TEMPERATURE (C)	12.0	10.0	9.0	11.0	9.5
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	15	21	27	13	11
Ammonia (mgN/L)	4.40	1.57	0.64	< 0.01	0.51
BOD5	13	12	< 10	10	< 10
Dissolved Oxygen (mg/L)	6.7	4.3	3.2	6.8	4.6
Dissolved Nitrite (mg/L)	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	2.270	0.625	0.870	0.092	0.294
Dissolved Copper (mg/L)	0.002	0.006	0.006	0.009	0.001
Dissolved Iron (mg/L)	0.3	5.4	7.0	2.5	10.0
Dissolved Manganese (mg/L)	0.87	0.35	0.33	0.25	1.22
Dissolved Sodium (mg/L)	431.0	36.0	23.0	7.2	19.0
Dissolved Potassium (mg/L)	30.0	5.9	3.2	1.2	3.2
Dissolved Chloride (mg/L)	929.0	45.0	36.0	8.8	25.0
Dissolved Sulfate (mg/L)	67.0	27.0	21.0	5.0	7.0
Total Dissolved Phosphorus (mg/L)	0.021	0.138	0.138	0.043	0.065
Total Lead (mg/L)	< 0.001	< 0.001	0.001	0.001	< 0.001
Total Zinc (mg/L)	0.020	0.022	0.023	0.005	0.007
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
Date	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91
pH	7.4	5.5	5.5	5.7	5.5
TEMPERATURE (C)	8.5	9.8	10.0	9.2	9.0
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	10.0	41.0	3.0	43.0	18.0
Ammonia (mgN/L)	0.27	0.52	0.07	0.36	0.33
BOD5	18	20	< 10	< 10	23
Dissolved Oxygen (mg/L)	6.9	6.1	5.9	4.7	6.2
Dissolved Nitrite (mg/L)	< 0.025	0.018	< 0.005	< 0.050	< 0.020
Dissolved Nitrate (mg/L)	0.048	2.750	0.153	2.980	0.680
Dissolved Copper (mg/L)	0.003	< 0.010	0.004	0.008	0.015
Dissolved Iron (mg/L)	1.1	2.6	1.9	3.7	6.2
Dissolved Manganese (mg/L)	1.10	0.24	0.23	0.26	0.42
Dissolved Sodium (mg/L)	431.0	20.0	20.0	16.0	14.0
Dissolved Potassium (mg/L)	28.0	6.4	3.7	5.5	9.7
Dissolved Chloride (mg/L)	566.0	27.7	19.5	26.4	21.8
Dissolved Sulfate (mg/L)	22.0	42.0	17.0	38.0	18.0
Total Dissolved Phosphorus (mg/L)	0.055	0.254	0.120	0.190	1.538
Total Lead (mg/L)	0.001	0.002	0.001	0.001	0.002
Total Zinc (mg/L)	0.006	0.043	0.018	0.040	0.028
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	08/27/91	08/07/91	08/07/91
pH	8.4	6.0	5.9
TEMPERATURE (C)	15.5	20.0	19.0
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	3.5	28.0	15.0
Ammonia (mgN/L)	< 1.00	< 1.00	< 1.00
BOD5	< 10	13	13
Dissolved Oxygen (mg/L)	7.3	3.7	1.7
Dissolved Nitrite (mg/L)	< 0.010	0.020	0.020
Dissolved Nitrate (mg/L)	< 0.010	0.194	0.639
Dissolved Copper (mg/L)	< 0.050	0.007	0.004
Dissolved Iron (mg/L)	1.4	6.8	6.9
Dissolved Manganese (mg/L)	0.11	0.20	0.28
Dissolved Sodium (mg/L)	570.0	21.0	23.0
Dissolved Potassium (mg/L)	29.0	4.6	4.1
Dissolved Chloride (mg/L)	699.0	37.4	39.5
Dissolved Sulfate (mg/L)	11.0	9.0	10.0
Total Dissolved Phosphorus (mg/L)	0.098	0.369	0.357
Total Lead (mg/L)	< 0.001	0.002	0.002
Total Zinc (mg/L)	0.002	0.010	0.013
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

4 4 North Drainage Ditch
5 5 South East Drainage Ditch

	4	5
Date	08/07/91	08/07/91
pH	6.3	6.0
TEMPERATURE (C)	16.5	18.0
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	8.2	16.0
Ammonia (mgN/L)	< 1.00	< 1.00
BOD5	13	18
Dissolved Oxygen (mg/L)	8.5	2.6
Dissolved Nitrite (mg/L)	< 0.010	< 0.010
Dissolved Nitrate (mg/L)	0.026	0.010
Dissolved Copper (mg/L)	0.004	0.002
Dissolved Iron (mg/L)	5.2	8.7
Dissolved Manganese (mg/L)	1.50	1.00
Dissolved Sodium (mg/L)	12.0	29.0
Dissolved Potassium (mg/L)	2.8	5.5
Dissolved Chloride (mg/L)	13.7	28.2
Dissolved Sulfate (mg/L)	3.0	9.0
Total Dissolved Phosphorus (mg/L)	0.346	0.327
Total Lead (mg/L)	0.002	0.001
Total Zinc (mg/L)	0.011	0.003
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	05/14/91	05/14/91	05/14/91
pH	8.3	7.9	7.8
TEMPERATURE (C)	13.5	12.0	12.5
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	11.0	30.0	40.0
Ammonia (mgN/L)	4.54	0.09	0.27
BOD5	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	6.5	10.0	6.6
Dissolved Nitrite (mg/L)	0.143	0.009	0.010
Dissolved Nitrate (mg/L)	1.280	0.190	0.220
Dissolved Copper (mg/L)	0.004	0.001	0.001
Dissolved Iron (mg/L)	0.3	1.3	2.6
Dissolved Manganese (mg/L)	0.79	0.09	0.23
Dissolved Sodium (mg/L)	526.0	9.9	27.7
Dissolved Potassium (mg/L)	38.0	1.4	2.0
Dissolved Chloride (mg/L)	676.0	14.1	16.5
Dissolved Sulfate (mg/L)	37.1	7.4	10.8
Total Dissolved Phosphorus (mg/L)	0.017	0.047	0.033
Total Lead (mg/L)	0.001	0.002	0.001
Total Zinc (mg/L)	0.012	0.010	0.020
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	05/14/91	05/14/91
pH	7.6	7.7
TEMPERATURE (C)	12.5	17.0
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	12.0	18.0
Ammonia (mgN/L)	0.12	0.29
BOD5	< 10	< 10
Dissolved Oxygen (mg/L)	8.6	2.9
Dissolved Nitrite (mg/L)	0.063	0.030
Dissolved Nitrate (mg/L)	0.100	< 0.020
Dissolved Copper (mg/L)	0.004	< 0.001
Dissolved Iron (mg/L)	4.6	17.9
Dissolved Manganese (mg/L)	0.85	1.45
Dissolved Sodium (mg/L)	16.4	32.8
Dissolved Potassium (mg/L)	3.2	2.3
Dissolved Chloride (mg/L)	23.7	52.5
Dissolved Sulfate (mg/L)	14.8	7.7
Total Dissolved Phosphorus (mg/L)	0.091	0.068
Total Lead (mg/L)	0.007	< 0.001
Total Zinc (mg/L)	0.030	< 0.005
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 1 Final Discharge into 7 Rd. Ditch
2 2 No. 7 Rd. Ditch at Blundell Rd.
3 3 No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	02/06/91	02/06/91	02/06/91
pH	8.1	7.1	7.3
TEMPERATURE (C)	6.5	6.5	5.8
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	30.0	26.0	16.0
Ammonia (mgN/L)	0.60	0.91	1.86
BOD5	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	6.0	5.6	5.6
Dissolved Nitrite (mg/L)	0.023	0.017	0.020
Dissolved Nitrate (mg/L)	0.170	0.940	0.460
Dissolved Copper (mg/L)	0.001	0.002	0.010
Dissolved Iron (mg/L)	1.5	2.6	2.5
Dissolved Manganese (mg/L)	0.65	0.23	0.29
Dissolved Sodium (mg/L)	456.0	22.0	38.6
Dissolved Potassium (mg/L)	23.5	4.8	8.5
Dissolved Chloride (mg/L)	636.0	28.8	39.1
Dissolved Sulfate (mg/L)	25.1	31.9	38.1
Total Dissolved Phosphorus (mg/L)	0.065	0.055	0.042
Total Lead (mg/L)	< 0.010	< 0.010	< 0.010
Total Zinc (mg/L)	0.040	0.040	0.040
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	02/06/91	02/06/91
pH	6.4	7.2
TEMPERATURE (C)	5.0	5.3
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	2.0	11.0
Ammonia (mgN/L)	0.08	0.48
BOD5	< 10	< 10
Dissolved Oxygen (mg/L)	7.9	7.1
Dissolved Nitrite (mg/L)	0.024	0.018
Dissolved Nitrate (mg/L)	< 0.020	0.060
Dissolved Copper (mg/L)	0.001	0.013
Dissolved Iron (mg/L)	1.7	7.3
Dissolved Manganese (mg/L)	0.22	1.03
Dissolved Sodium (mg/L)	15.5	20.4
Dissolved Potassium (mg/L)	2.1	2.6
Dissolved Chloride (mg/L)	29.3	22.3
Dissolved Sulfate (mg/L)	12.6	10.2
Total Dissolved Phosphorus (mg/L)	0.051	0.036
Total Lead (mg/L)	< 0.010	< 0.010
Total Zinc (mg/L)	0.006	0.010
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate
4	4	North Drainage Ditch
5	5	South East Drainage Ditch

	1	2	3	4	5
Date	11/07/90	11/07/90	11/07/90	11/07/90	11/07/90
pH	8.2	7.5	7.2	7.2	7.5
TEMPERATURE (C)	9.5	8.0	8.5	9.0	8.5
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	14.0	36.0	95.0	56.0	15.0
Ammonia (mgN/L)	0.57	0.66	0.48	0.14	0.07
BOD5	< 10	< 10	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	6.4	6.3	5.3	6.1	5.4
Dissolved Nitrite (mg/L)	0.036	0.023	0.025	0.017	0.019
Dissolved Nitrate (mg/L)	1.210	0.830	1.390	0.060	0.880
Dissolved Copper (mg/L)	0.040	0.012	0.012	0.005	0.060
Dissolved Iron (mg/L)	0.7	2.4	2.7	1.2	4.9
Dissolved Manganese (mg/L)	0.52	0.22	0.19	0.29	0.35
Dissolved Sodium (mg/L)	712.0	20.2	12.7	34.1	16.6
Dissolved Potassium (mg/L)	32.6	6.7	6.0	5.5	9.9
Dissolved Chloride (mg/L)	1160.0	27.0	20.2	43.3	24.3
Dissolved Sulfate (mg/L)	68.5	35.1	28.3	48.2	20.0
Total Dissolved Phosphorus (mg/L)	0.012	0.046	0.091	0.035	0.578
Total Lead (mg/L)	0.002	0.002	0.002	0.001	0.003
Total Zinc (mg/L)	0.110	0.120	0.200	0.110	0.090
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
Date	07/18/90	07/18/90	07/18/90	07/18/90	07/18/90
pH	7.8	7.3	7.3	7.0	7.2
TEMPERATURE (C)	20.0	23.0	23.0	17.5	20.0
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	6.0	35.0	29.0	4.0	20.0
Ammonia (mgN/L)	0.44	0.03	0.05	0.33	0.28
BOD5	< 10	< 10	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	6.6	6.8	7.9	7.0	4.1
Dissolved Nitrite (mg/L)	1.100	0.007	< 0.005	0.005	< 0.005
Dissolved Nitrate (mg/L)	1.800	0.060	0.100	< 0.020	< 0.020
Dissolved Copper (mg/L)	0.040	0.003	0.001	0.003	0.002
Dissolved Iron (mg/L)	0.1	1.2	1.1	6.9	8.7
Dissolved Manganese (mg/L)	0.09	0.05	0.05	1.46	1.02
Dissolved Sodium (mg/L)	1460.0	5.8	4.5	14.7	36.6
Dissolved Potassium (mg/L)	30.6	2.7	2.2	3.2	3.4
Dissolved Chloride (mg/L)	2450.0	7.0	5.4	13.3	35.0
Dissolved Sulfate (mg/L)	122.0	7.0	7.5	6.4	2.2
Total Dissolved Phosphorus (mg/L)	0.017	0.142	0.077	0.044	0.015
Total Lead (mg/L)	0.001	< 0.001	< 0.001	0.003	< 0.001
Total Zinc (mg/L)	0.009	0.017	0.020	0.030	< 0.005
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

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LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate

	1	2	3
Date	05/29/90	05/29/90	05/29/90
pH	7.6	6.8	6.7
TEMPERATURE (C)	15.0	16.5	15.5
96H LC50%	>100	NA	NA
Total Suspended Solids (mg/L)	10.0	39.0	17.0
Ammonia (mgN/L)	8.10	0.32	0.11
BOD5	14	< 10	< 10
Dissolved Oxygen (mg/L)	8.5	5.6	6.1
Dissolved Nitrite (mg/L)	0.164	0.015	0.010
Dissolved Nitrate (mg/L)	1.320	0.100	0.120
Dissolved Copper (mg/L)	0.030	0.020	0.005
Dissolved Iron (mg/L)	0.1	4.2	2.1
Dissolved Manganese (mg/L)	1.16	0.15	0.10
Dissolved Sodium (mg/L)	1110.0	18.1	9.2
Dissolved Potassium (mg/L)	55.0	3.2	2.0
Dissolved Chloride (mg/L)	1880.0	23.1	13.2
Dissolved Sulfate (mg/L)	143.0	13.7	9.1
Total Dissolved Phosphorus (mg/L)	0.012	0.143	0.134
Total Lead (mg/L)	0.003	0.001	0.001
Total Zinc (mg/L)	0.022	0.060	0.020
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1 4 North Drainage Ditch
2 5 South East Drainage Ditch

	1	2
Date	05/29/90	05/29/90
pH	6.2	6.4
TEMPERATURE (C)	14.5	17.5
96H LC50%	NA	NA
Total Suspended Solids (mg/L)	15.0	11.0
Ammonia (mgN/L)	0.03	0.01
BOD5	< 10	< 10
Dissolved Oxygen (mg/L)	7.5	6.6
Dissolved Nitrite (mg/L)	0.030	0.008
Dissolved Nitrate (mg/L)	0.030	0.020
Dissolved Copper (mg/L)	0.007	0.004
Dissolved Iron (mg/L)	3.8	8.6
Dissolved Manganese (mg/L)	0.55	0.55
Dissolved Sodium (mg/L)	14.8	17.3
Dissolved Potassium (mg/L)	3.3	4.3
Dissolved Chloride (mg/L)	25.6	26.3
Dissolved Sulfate (mg/L)	7.8	16.7
Total Dissolved Phosphorus (mg/L)	0.058	0.112
Total Lead (mg/L)	< 0.001	< 0.001
Total Zinc (mg/L)	0.050	0.030
Total Mercury (ug/L)	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
Date	02/21/90	02/21/90	02/21/90	02/21/90	02/21/90
pH	6.9	6.8	6.7	6.7	6.8
TEMPERATURE (C)	2.5	3.5	3.5	3.0	4.5
96H LC50%	>100	NA	NA	NA	NA
Total Suspended Solids (mg/L)	16.0	19.0	23.0	13.0	9.0
Ammonia (mgN/L)	2.67	1.22	0.87	0.28	0.25
BOD5	<10	< 10	< 10	< 10	< 10
Dissolved Oxygen (mg/L)	8.2	6.9	5.9	7.9	7.6
Dissolved Nitrite (mg/L)	0.047	0.026	0.026	0.026	0.016
Dissolved Nitrate (mg/L)	1.280	0.450	0.750	0.200	0.080
Dissolved Copper (mg/L)	0.010	0.019	0.014	0.008	0.025
Dissolved Iron (mg/L)	2.4	4.1	6.2	3.9	7.4
Dissolved Manganese (mg/L)	1.06	0.38	0.36	0.43	1.14
Dissolved Sodium (mg/L)	999.9	36.1	26.2	20.5	27.4
Dissolved Potassium (mg/L)	67.5	7.4	3.6	2.7	2.7
Dissolved Chloride (mg/L)	99.9	42.2	42.4	36.3	28.2
Dissolved Sulfate (mg/L)	516.0	41.0	23.0	18.3	15.6
Total Dissolved Phosphorus (mg/L)	0.014	0.300	0.176	0.100	0.228
Total Lead (mg/L)	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Total Zinc (mg/L)	0.060	0.070	0.070	0.030	0.040
Total Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
ıte	11/17/89	11/17/89	11/17/89	11/17/89	11/17/89
ı	7.4	8.0	6.3	6.1	6.5
:MPERATURE (C)	7.5	8.0	8.0	7.5	7.0
;H LC50%	100	NA	NA	NA	NA
)tal Suspended Solids (mg/L)	19.0	7.0	20.0	6.0	14.0
ımonia (mgN/L)	4.28	0.63	0.68	0.06	0.31
)D5	< 10	< 10	< 10	< 10	< 10
.ssolved Oxygen (mg/L)	6.3	4.8	3.6	8.2	5.2
.ssolved Nitrite (mg/L)	0.072	0.026	0.031	< 0.005	< 0.005
.ssolved Nitrate (mg/L)	1.260	1.430	1.670	0.040	0.050
.ssolved Copper (mg/L)	0.006	0.030	0.020	0.020	0.020
.ssolved Iron (mg/L)	4.8	4.4	6.1	3.2	4.5
.ssolved Manganese (mg/L)	1.56	0.33	0.34	9.74	14.40
.ssolved Sodium (mg/L)	1490.0	29.0	25.0	25.5	43.4
.ssolved Potassium (mg/L)	66.0	6.0	4.8	3.1	4.1
.ssolved Chloride (mg/L)	2600.0	36.7	38.7	25.5	45.2
.ssolved Sulfate (mg/L)	253.0	58.0	37.0	24.0	15.0
)tal Dissolved Phosphorus (mg/L)	0.082	0.067	0.091	0.039	0.026
)tal Lead (mg/L)	< 0.100	0.003	0.001	< 0.100	< 0.100
)tal Zinc (mg/L)	0.100	0.070	0.040	0.030	0.011
)tal Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

ANALYTICAL RESULTS
FRHC RICHMOND LANDFILL SITE
Permit: PE-6276
November 17, 1989

Sampling Sites: 1 Final Effluent
2 #7 Road Ditch at Blundell Road
3 #7 Road Ditch at Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch at Nelson Road Floodgate

	SITE				
	1	2	3	4	5
pH	7.4	8.0	6.3	6.1	6.5
Temperature (°C)	7.5	8.0	8.0	7.5	7.0
96 h LC_{50} (%)	>100	N/A	N/A	N/A	N/A
Total Suspended Solids (mg/L)	19.0	7.0	20.0	6.0	14.0
Ammonia (mg N/L)	4.28	0.63	0.68	0.06	0.31
BOD_5 (mg/L)	<10	<10	<10	<10	<10
Dissolved Oxygen (mg/L)	6.3	4.8	3.6	8.2	5.2
Dissolved Nitrite (mg N/L)	0.072	0.026	0.031	<0.005	<0.005
Dissolved Nitrate (mg N/L)	1.260	1.430	1.670	0.040	0.050
Dissolved Copper (mg/L)	0.006	0.030	0.020	0.020	0.020
Dissolved Iron (mg/L)	4.80	4.37	6.11	3.19	4.54
Dissolved Manganese (mg/L)	1.56	0.33	0.34	9.74	14.40
Dissolved Sodium (mg/L)	1,490	29.0	25.0	25.5	43.4
Dissolved Potassium (mg/L)	66.0	6.0	4.8	3.1	4.1
Dissolved Chloride (mg/L)	2,660	36.7	38.7	25.5	45.2
Dissolved Sulfate (mg/L)	253	58	37	24	15
Total Diss. Phosphorus (mg/L)	0.082	0.067	0.091	0.039	0.026
Total Lead (mg/L)	<0.001	0.003	0.001	<0.001	<0.001
Total Zinc (mg/L)	0.100	0.070	0.040	0.030	0.011
Total mercury (µg/L)	<0.05	<0.05	<0.05	<0.05	<0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1 Final Discharge into 7 Rd. Ditch
2	2 No. 7 Rd. Ditch at Blundell Rd.
3	3 No. 7 Rd. Ditch at Nursery Gate
4	4 North Drainage Ditch
5	5 South East Drainage Ditch

	1	2	3	4	5
ıte	08/17/89	08/17/89	08/17/89	08/17/89	08/17/89
ł	NA	6.5	6.6	NA	6.8
ΞMPERATURE (C)	NA	18.0	18.0	NA	16.5
5H LC50%	NA	NA	NA	NA	NA
ɔtal Suspended Solids (mg/L)	NA	13.0	12.0	NA	18.0
mmonia (mgN/L)	NA	0.19	0.06	NA	0.11
)D5	NA	10	10	NA	10
ıssolved Oxygen (mg/L)	NA	5.8	6.1	NA	7.0
ıssolved Nitrite (mg/L)	NA	0.016	0.005	NA	0.005
ıssolved Nitrate (mg/L)	NA	0.110	0.050	NA	0.030
ıssolved Copper (mg/L)	NA	0.010	0.010	NA	0.010
ıssolved Iron (mg/L)	NA	1.9	0.8	NA	4.9
ıssolved Manganese (mg/L)	NA	0.04	0.01	NA	0.26
ıssolved Sodium (mg/L)	NA	5.8	3.3	NA	9.4
ıssolved Potassium (mg/L)	NA	3.1	1.4	NA	3.5
ıssolved Chloride (mg/L)	NA	8.8	4.0	NA	16.2
ıssolved Sulfate (mg/L)	NA	13.0	9.0	NA	12.0
ɔtal Dissolved Phosphorus (mg/L)	NA	0.293	0.149	NA	0.318
ɔtal Lead (mg/L)	NA	0.001	0.001	NA	0.001
ɔtal Zinc (mg/L)	NA	0.030	0.005	NA	0.030
ɔtal Mercury (ug/L)	NA	NA	NA	NA	NA

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1989

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	890817 0800 hrs	890817 0815 hrs	890817 0830 hrs	890817 0845 hrs	890817 0900 hrs
PH	NA	6.5	6.6	NA	6.8
Temperature (deg C)	NA	18.0	18.0	NA	16.5
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	NA	13.0	12.0	NA	18.0
Ammonia (mgN/l)	NA	0.19	0.06	NA	0.11
Dissolved (mg/l)					
BOD5	NA	L10	L10	NA	L10
Oxygen	NA	5.8	6.1	NA	7.0
Nitrite	NA	0.016	L.005	NA	0.005
Nitrate	NA	0.110	0.050	NA	0.030
Copper	NA	0.0080	0.0100	NA	0.0100
Iron	NA	1.33	0.34	NA	2.94
Manganese	NA	0.04	L0.01	NA	0.25
Sodium	0.0	5.8	3.3	0.0	9.4
Potassium	NA	3.1	1.4	NA	3.5
Chloride	0.0	8.8	4.0	0.0	15.2
Sulfate	NA	13	9	NA	12
Total (mg/l)					
Dissolved Phosphorus	NA	0.293	0.149	NA	0.318
Lead	NA	L0.100	L0.100	NA	L0.100
Zinc	NA	0.0200	L0.0100	NA	0.0200
Mercury (ug/l)	NA	L0.05	L0.05	NA	L0.05

No flow

Dry

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING - RECEIVING WATER

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	1	Final Discharge into 7 Rd. Ditch
2	2	No. 7 Rd. Ditch at Blundell Rd.
3	3	No. 7 Rd. Ditch at Nursery Gate
4	4	North Drainage Ditch
5	5	South East Drainage Ditch

	1	2	3	4	5
ate	05/25/89	05/25/89	05/25/89	05/25/89	05/25/89
H	7.6	6.5	6.7	6.2	7.2
EMPERATURE (C)	12.5	10.5	10.5	15.5	13.0
6H LC50%	NA	NA	NA	NA	NA
otal Suspended Solids (mg/L)	44.0	14.0	15.0	12.0	15.0
mmonia (mgN/L)	3.89	0.27	0.04	0.06	0.30
OD5	< 10	< 10	< 10	12	< 10
issolved Oxygen (mg/L)	6.7	6.7	6.9	5.2	6.5
issolved Nitrite (mg/L)	< 0.229	0.009	< 0.005	0.018	< 0.005
issolved Nitrate (mg/L)	1.440	0.170	0.180	< 0.020	< 0.020
issolved Copper (mg/L)	0.004	0.007	0.001	0.030	0.004
issolved Iron (mg/L)	0.8	2.8	0.5	3.3	5.0
issolved Manganese (mg/L)	1.01	0.13	0.03	1.08	1.88
issolved Sodium (mg/L)	768.0	13.9	3.6	31.0	144.0
issolved Potassium (mg/L)	55.0	3.5	0.9	3.6	3.5
issolved Chloride (mg/L)	1170.0	20.2	3.9	46.9	71.0
issolved Sulfate (mg/L)	53.0	23.0	7.0	10.0	7.0
otal Dissolved Phosphorus (mg/L)	0.022	0.270	0.048	0.080	0.015
otal Lead (mg/L)	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
otal Zinc (mg/L)	0.010	0.020	< 0.010	< 0.010	< 0.010
otal Mercury (ug/L)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1989

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	890525 0800 hrs	890525 0815 hrs	890525 0830 hrs	890525 0845 hrs	890525 0900 hrs
PH	7.6	6.6	6.7	6.2	7.2
Temperature (deg C)	12.5	10.5	10.5	15.5	13.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	44.0	14.0	15.0	12.0	15.0
Ammonia (mgN/l)	3.89	0.27	0.04	0.06	0.30
Dissolved (mg/l)					
BOD5	L10	L10	L10	12	L10
Oxygen	6.7	6.7	6.9	5.2	6.5
Nitrite	L.229	0.009	L.005	0.018	L.005
Nitrate	1.440	0.170	0.180	L.020	L.020
Copper	0.0040	0.0070	0.0010	0.0300	0.0040
Iron	0.81	2.78	0.49	3.27	5.04
Manganese	1.01	0.13	0.03	1.08	1.89
Sodium	768.0	13.9	3.6	31.0	144.0
Potassium	85.0	3.5	0.9	3.6	3.5
Chloride	1170.	20.2	3.9	46.9	71.0
Sulfate	53	23	7	10	7
Total (mg/l)					
Dissolved Phosphorus	0.022	0.270	0.048	0.080	0.015
Lead	L0.100	L0.100	L0.100	L0.100	L0.100
Zinc	0.0100	0.0200	L0.0100	L0.0100	L0.0100
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

→ female level 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1989

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	890228 0800 hrs	890228 0815 hrs	890228 0830 hrs	890228 0845 hrs	890228 0900 hrs
PH	7.4	6.7	6.7	6.2	6.4
Temperature (deg C)	5.0	5.0	4.5	5.0	6.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	33.0	12.0	18.0	2.0	32.0
Ammonia (mgN/l)	4.65	1.25	2.02	0.06	0.40
Dissolved (mg/l)					
BOD5	L10	L10	14	L10	L10
Oxygen	5.9	6.1	2.4	7.1	7.2
Nitrite	0.094	0.021	0.020	0.018	0.009
Nitrate	5.610	0.640	0.370	L.020	0.360
Copper	0.0030	0.0070	0.0060	0.0030	0.0030
Iron	0.40	3.73	3.21	2.47	17.10
Manganese	1.12	0.38	0.36	0.64	0.93
Sodium	940.0	39.8	44.6	18.6	77.0
Potassium	48.5	6.5	11.1	1.8	3.4
Chloride	1560.	53.8	45.9	31.0	139.0
Sulfate	188	44	59	15	17
Total (mg/l)					
Dissolved Phosphorus	0.072	0.228	0.294	0.064	0.232
Lead	L0.010	L0.100	L0.100	L0.100	L0.100
Zinc	0.0208	0.0300	0.0400	L0.0100	L0.0100
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1988

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	881129 0800 hrs	881129 0830 hrs	881129 0845 hrs	881129 0900 hrs	881129 0915 hrs
PH	7.3	7.1	6.9	6.4	6.7
Temperature (deg C)	6.0	7.0	7.5	7.5	13.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	31.9	13.3	13.4	0.8	6.1
Ammonia (mgN/l)	L0.50	1.30	0.84	L0.50	0.70
Dissolved (mg/l)					
BOD5	12	10	13	L10	13
Oxygen	11.2	5.6	4.5	6.6	5.3
Nitrite	0.010	0.025	0.033	L.002	L.002
Nitrate	0.184	1.200	1.480	L.005	0.044
Copper	0.0350	0.0088	0.0038	0.0036	0.0041
Iron	0.16	2.72	3.06	2.93	2.17
Manganese	1.70	0.29	0.28	1.12	1.29
Sodium	750.0	29.0	23.0	27.0	39.0
Potassium	NA	5.8	3.2	2.2	3.0
Chloride	2100.	23.5	36.5	52.0	40.0
Sulfate	310	54	36	23	26
Total (mg/l)					
Dissolved Phosphorus	0.022	0.165	0.170	0.052	0.038
Lead	0.001	L0.001	L0.001	L0.001	L0.001
Zinc	0.0060	0.0310	0.0200	0.0061	0.0110
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1988

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	880817 0800 hrs	880817 0815 hrs	880817 0830 hrs	880817 0845 hrs	880817 0900 hrs
PH	7.5	6.9	6.8	6.1	6.9
Temperature (deg C)	18.5	16.5	16.5	16.0	16.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	8.8	17.2	10.4	10.2	16.7
Ammonia (mgN/l)	0.84	0.70	0.84	0.84	0.56
Dissolved (mg/l)					
BOD5	9	6	6	36	7
Oxygen	5.9	4.8	5.2	4.7	4.4
Nitrite	L.002	L.002	L.002	L.002	L.002
Nitrate	0.350	0.090	0.075	0.090	0.035
Copper	0.0039	0.0028	0.0036	0.0140	0.0089
Iron	0.43	0.70	0.51	6.40	4.10
Manganese	0.29	0.03	0.03	1.24	0.26
Sodium	116.0	4.1	4.9	30.0	14.0
Potassium	47.0	4.4	6.0	19.0	7.4
Chloride	570.0	3.5	5.5	51.0	10.8
Sulfate	185	11	15	9	13
Total (mg/l)					
Dissolved Phosphorus	0.020	0.150	0.690	0.810	0.440
Lead	L0.001	L0.001	L0.001	0.002	0.002
Zinc	L0.0300	L0.0300	L0.0300	L0.0300	L0.0300
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1988

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	880518 0800 hrs	880518 0815 hrs	880518 0830 hrs	880518 0845 hrs	880518 0900 hrs
PH	7.8	6.9	6.5	6.4	6.8
Temperature (deg C)	11.0	13.0	13.0	12.0	11.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	10.0	18.0	12.0	0.8	7.5
Ammonia (mgN/l)	4.10	0.70	0.70	L0.50	0.56
Dissolved (mg/l)					
BOD5	22	6	12	8	14
Oxygen	7.7	2.8	3.3	4.7	7.6
Nitrite	0.091	0.045	0.055	0.014	0.014
Nitrate	1.240	0.672	1.010	0.034	0.006
Copper	0.0040	0.0090	0.0110	0.0050	0.0040
Iron	0.50	1.30	2.42	2.25	5.30
Manganese	1.10	0.36	0.24	0.54	2.00
Sodium	500.0	170.0	21.2	25.0	69.0
Potassium	515.0	197.0	67.5	85.0	50.0
Chloride	600.0	76.0	23.0	27.0	126.0
Sulfate	74	50	28	L1	8
Total (mg/l)					
Dissolved Phosphorus	0.043	0.310	0.390	0.130	0.100
Lead	L0.001	L0.001	L0.001	L0.001	L0.001
Zinc	L0.0200	0.0300	0.0300	L0.0200	L0.0200
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

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LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1988

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6279

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	880223 0800 hrs	880223 0815 hrs	880223 0830 hrs	880223 0845 hrs	880223 0900 hrs
PH	7.6	7.0	6.9	6.6	6.7
Temperature (deg C)	4.5	5.0	5.0	4.0	3.5
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	19.4	20.8	17.6	1.6	10.6
Ammonia (mgN/l)	4.20	1.40	1.10	0.70	1.10
Dissolved (mg/l)					
BOD5	33	26	24	25	22
Oxygen	7.5	5.1	5.4	10.0	10.2
Nitrite	0.064	0.040	0.050	L.002	L.002
Nitrate	3.850	0.560	1.100	0.080	0.250
Copper	0.0050	0.0100	0.0080	0.0070	0.0050
Iron	0.30	5.00	3.20	2.50	3.20
Manganese	1.22	0.49	0.58	1.00	0.62
Sodium	905.0	48.0	43.0	25.0	17.5
Potassium	41.0	5.4	3.4	2.4	1.7
Chloride	970.0	74.0	82.0	45.0	52.0
Sulfate	140	52	50	13	7
Total (mg/l)					
Dissolved					
Phosphorus	0.020	0.180	0.210	0.060	0.180
Lead	L0.001	L0.001	L0.001	L0.001	L0.001
Zinc	0.0300	0.0500	0.0200	0.0400	0.0200
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1987

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BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	871117 0800 hrs	871117 0815 hrs	871117 0830 hrs	871117 0845 hrs	871117 0900 hrs
PH	7.6	6.9	6.9	6.6	7.0
Temperature (deg C)	5.0	9.5	6.0	6.0	4.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	18.7	99.3	24.5	1.5	62.5
Ammonia (mgN/l)	5.50	7.70	0.98	0.56	1.30
Dissolved (mg/l)					
BOD5	24	175	15	13	26
Oxygen	8.4	6.1	5.2	7.8	7.6
Nitrite	0.041	L.002	0.048	L.002	0.005
Nitrate	2.000	1.570	3.740	0.093	0.062
Copper	LO.0500	LO.0500	LO.0500	LO.0500	LO.0500
Iron	0.90	8.70	2.90	1.90	0.60
Manganese	2.12	1.00	0.32	3.40	2.00
Sodium	990.0	158.0	40.0	86.0	60.0
Potassium	68.0	45.0	5.2	8.7	4.0
Chloride	1850.	64.0	73.0	210.0	76.0
Sulfate	300	21	35	61	13
Total (mg/l)					
-Dissolved Phosphorus	0.063	0.083	0.170	0.150	0.032
Lead	0.002	0.001	LO.001	LO.001	0.002
Zinc	0.0700	0.4000	LO.0500	LO.0500	LO.0500
Mercury (ug/l)	LO.05	LO.05	LO.05	LO.05	LO.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	870825 0800 hrs	870825 0815 hrs	870825 0830 hrs	870825 0845 hrs	870825 0900 hrs
pH	7.2	6.9	6.9	6.4	7.0
Temperature (deg C)	18.5	21.5	20.0	18.5	21.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	5.2	24.6	10.4	10.2	8.6
Ammonia (mgN/l)	0.84	0.56	0.84	1.40	0.84
Dissolved (mg/l)					
BOD5	11	10	10	35	10
Oxygen	6.0	5.8	4.4	4.7	6.8
Nitrite	0.092	0.026	L.002	L.002	L.002
Nitrate	1.740	0.040	0.568	0.072	0.020
Copper	L0.0500	L0.0500	L0.0500	L0.0500	L0.0500
Iron	0.39	1.88	2.45	8.90	1.43
Manganese	0.86	0.05	0.08	2.37	0.18
Sodium	650.0	13.3	14.3	27.0	18.8
Potassium	53.0	11.5	8.5	13.8	9.3
Chloride	1040.	13.1	10.4	39.0	18.5
Sulfate	45	11	9	20	8
Total (mg/l)					
Dissolved Phosphorus	0.056	0.167	0.280	0.400	0.080
Lead	L0.001	L0.001	L0.001	L0.001	0.001
Zinc	L0.0200	L0.0200	L0.0020	0.0500	L0.0200
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	870826 1000 hrs	870826 1015 hrs	870826 1030 hrs	870826 1030 hrs	870826 1045 hrs
pH	7.8	7.8	7.4	6.7	6.8
Temperature (deg C)	16.0	15.5	14.0	14.0	13.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	15.2	12.6	17.6	3.2	10.4
Ammonia (mgN/l)	4.34	0.70	0.42	0.55	0.56
Dissolved (mg/l)					
BOD5	26	12	11	19	23
Oxygen	7.4	9.2	9.2	7.2	8.5
Nitrite	0.150	L.002	L.002	L.002	L.002
Nitrate	1.350	0.025	0.040	L.010	L.010
Copper	0.0064	0.0045	0.0021	0.0073	0.0044
Iron	0.22	0.39	0.29	3.54	1.15
Manganese	1.51	0.05	0.04	1.38	1.45
Sodium	625.0	3.7	3.6	19.5	46.0
Potassium	47.0	2.0	1.6	6.9	6.5
Chloride	900.0	3.6	3.3	25.5	71.0
Sulfate	30	8	7	7	2
Total (mg/l)					
Dissolved Phosphorus	0.061	0.220	0.232	0.125	0.152
Lead	L0.001	L0.001	L0.001	L0.001	0.002
Zinc	0.0085	0.0230	0.0100	0.0280	0.0150
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	870217 0800 hrs	870217 0815 hrs	870217 0830 hrs	870217 0845 hrs	870217 0900 hrs
PH	7.6	6.4	6.4	6.1	6.5
Temperature (deg C)	6.0	6.5	6.5	7.0	8.0
96H LC50 (%)	59.6	NA	NA	NA	NA
Total Suspended Solids (mg/l)	16.5	20.0	18.5	19.5	6.6
Ammonia (mgN/l)	7.70	0.98	0.84	0.98	0.56
Dissolved (mg/l)					
BOD5	L10	L10	L10	L10	L10
Oxygen	9.2	7.2	6.1	10.1	9.8
Nitrite	0.032	0.018	0.022	L.002	0.014
Nitrate	2.340	0.860	1.160	0.124	0.348
Copper	0.0042	0.0060	0.0051	0.0052	0.0057
Iron	0.32	2.20	4.11	1.99	3.47
Manganese	1.61	0.32	0.37	0.66	0.50
Sodium	428.0	26.0	27.0	13.0	28.0
Potassium	37.5	4.6	3.2	2.2	2.4
Chloride	656.0	39.4	44.4	21.2	35.6
Sulfate	127	28	23	10	7
Total (mg/l)					
Dissolved Phosphorus	0.142	0.168	0.130	0.090	0.098
Lead	0.006	0.001	0.001	0.001	0.002
Zinc	0.0220	0.0150	0.0080	0.0200	0.0220
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1986

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	861202 0800 hrs	861202 0815 hrs	861202 0830 hrs	861202 0845 hrs	861202 0900 hrs
PH	7.6	6.3	6.3	6.0	6.5
Temperature (deg C)	35.0	5.0	5.5	3.5	5.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	15.1	22.0	10.2	1.3	10.9
Ammonia (mgN/l)	10.10	1.00	1.00	1.00	1.00
Dissolved (mg/l)					
BOD5	10	L10	10	L10	L10
Oxygen	8.1	5.5	5.7	7.9	7.6
Nitrite	0.070	NA	NA	NA	NA
Nitrate	1.280	0.810	1.380	0.110	0.590
Copper	0.0028	0.0080	0.0070	0.0030	0.0050
Iron	0.54	1.87	2.45	1.60	7.70
Manganese	1.42	0.31	0.34	0.35	0.50
Sodium	230.0	21.0	21.0	17.0	17.0
Potassium	45.3	5.1	4.9	3.2	5.0
Chloride	860.0	29.0	32.0	25.0	21.0
Sulfate	133	75	37	21	10
Total (mg/l)					
Dissolved Phosphorus	0.200	0.450	0.200	0.130	0.470
Lead	0.001	L0.001	L0.001	L0.001	L0.001
Zinc	0.0210	0.0360	0.0200	0.0090	0.0150
Mercury (ug/l)	L0.05	0.63	L0.05	0.13	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1986

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	860919 0800 hrs	860919 0815 hrs	860919 0845 hrs	860919 0900 hrs	860919 0915 hrs
PH	7.5	7.4	7.2	6.6	7.6
Temperature (deg C)	15.0	14.0	14.0	13.0	16.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	3.2	22.8	18.9	20.0	6.6
Ammonia (mgN/l)	3.50	2.80	0.42	0.98	0.42
Dissolved (mg/l)					
BOD5	L10	L10	L10	L10	L10
Oxygen	2.2	7.6	6.6	3.4	10.2
Nitrite	0.160	0.017	0.018	0.026	0.005
Nitrate	1.260	0.150	0.200	0.090	0.048
Copper	0.0023	0.0024	0.0020	0.0033	0.0020
Iron	0.10	0.51	0.40	4.70	0.05
Manganese	1.67	0.05	0.05	3.00	0.04
Sodium	1125.	8.0	6.1	33.0	3.9
Potassium	54.0	1.7	1.5	4.6	1.0
Chloride	1830.	9.7	6.0	38.0	3.4
Sulfate	63	11	11	15	8
Total (mg/l)					
Dissolved Phosphorus	0.035	0.082	0.125	0.082	0.038
Lead	L0.001	L0.001	L0.001	L0.001	L0.001
Zinc	0.0028	0.0130	0.0044	0.0200	0.0019
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1986

REPORTED TO
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	860728 0800 hrs	860728 0815 hrs	860728 0830 hrs	860728 0845 hrs	860728 0900 hrs
PH	7.4 ✓	7.0	6.9	6.7	7.7
Temperature (deg C)	17.0	19.0	19.0	12.0	17.5
96H LC50 (%)	>100 ✓	NA	NA	NA	NA
Total Suspended Solids (mg/l)	6.5 ✓	18.0	20.4	44.0	4.0
Ammonia (mgN/l)	3.60	0.28	0.42	0.42	0.28
Dissolved (mg/l)					
BOD5	22 ✓	11	17	20	L10
Oxygen	4.9	6.1	6.0	3.5	9.5
Nitrite	0.340	0.010	0.012	0.034	0.003
Nitrate	3.300	0.095	0.110	0.095	0.042
Copper	0.0052 ✓	0.0021	0.0033	0.0043	0.0025
Iron	0.23	1.00	1.40	4.80	0.26
Manganese	1.82	0.06	0.07	1.50	0.02
Sodium	875.0	5.0	7.0	27.5	2.0
Potassium	57.0	1.8	1.9	5.2	0.3
Chloride	1450.	7.4	10.4	34.0	1.4
Sulfate	70 ✓	7	7	13	7
Total (mg/l)					
Dissolved Phosphorus	0.054	0.192	0.300	0.170	0.016
Lead	L0.001 ✓	L0.001	0.001	L0.001	L0.001
Zinc	0.0022 ✓	0.0043	0.0072	0.0110	0.0120
Mercury (ug/l)	L0.05 ✓	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1986

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	860312 0900 hrs	860312 1000 hrs	860312 1015 hrs	860312 1030 hrs	860312 1045 hrs
PH	7.7	6.7	6.6	6.3	6.7
Temperature (deg C)	7.0	5.0	8.5	8.0	9.0
BOD LOSS (%)	38	NA	NA	NA	NA
Total Suspended Solids (mg/l)	23.9	42.4	21.0	1.5	88.0
Ammonia (mgN/l)	15.70	0.56	0.94	0.55	1.40
Dissolved (mg/l)					
BOD5	38	25	25	14	32
Oxygen	5.4	7.6	8.7	10.2	8.6
Nitrite	0.120	0.039	0.021	0.012	0.038
Nitrate	2.350	0.075	0.058	L.005	0.052
Copper	0.0047	0.0072	0.0073	0.0029	0.0074
Iron	0.84	4.75	6.55	2.34	12.80
Manganese	2.18	0.42	0.39	0.89	1.13
Sodium	890.0	45.3	35.8	19.9	47.2
Potassium	54.0	3.5	2.2	1.5	2.2
Chloride	1210.	78.4	58.2	22.0	35.6
Sulfate	215	27	24	2	13
Total (mg/l)					
Dissolved Phosphorus	0.068	0.188	0.143	0.210	0.182
Lead	L0.001	0.002	0.001	0.001	0.002
Zinc	0.0180	0.0280	0.0210	0.0070	0.0270
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1985

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	851211 0900 hrs	851211 0915 hrs	851211 0930 hrs	851211 0945 hrs	851211 1000 hrs
PH	7.4	6.5	6.5	6.3	6.5
Temperature (deg C)	2.0	4.0	3.0	2.0	2.5
96H LC50 (%)	56.4	NA	NA	NA	NA
Total Suspended Solids (mg/l)	12.5	18.5	27.5	L1.0	6.0
Ammonia (mgN/l)	27.30	1.26	1.12	0.56	0.98
Dissolved (mg/l)					
BOD5	15	34	19	12	35
Oxygen	6.2	7.1	6.1	6.8	6.2
Nitrite	0.117	0.036	0.037	0.011	0.041
Nitrate	3.580	2.150	1.770	0.098	0.424
Copper	0.0071	0.0097	0.0080	0.0027	0.0076
Iron	2.90	6.50	8.10	1.70	9.40
Manganese	2.69	0.56	0.58	1.79	0.85
Sodium	785.0	37.3	38.0	30.8	31.3
Potassium	74.0	3.7	3.3	4.3	3.9
Chloride	1315.	65.5	62.0	55.0	55.3
Sulfate	161	37	28	20	13
Total (mg/l)					
Dissolved Phosphorus	L0.010	0.056	0.080	0.200	0.212
Lead	L0.001	0.004	0.001	L0.001	0.002
Zinc	0.0033	0.0180	0.0190	0.0050	0.0240
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR THIRD QUARTER, 1985

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	850910 0900 hrs	850910 1000 hrs	850910 1030 hrs	850910 1100 hrs	850910 1130 hrs
PH	7.3	6.7	6.7	6.3	6.7
Temperature (deg C)	16.0	16.0	15.5	16.0	14.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	2.9	20.5	28.7	4.5	9.7
Ammonia (mgN/l)	4.90	0.29	L0.10	0.84	L0.10
Dissolved (mg/l)					
BOD5	23	L10	L10	14	13
Oxygen	2.5	6.8	6.1	6.4	8.2
Nitrite	0.330	0.005	L.005	0.044	0.005
Nitrate	3.500	0.038	0.022	0.250	0.016
Copper	0.0060	0.0040	0.0030	0.0030	0.0060
Iron	0.32	0.43	0.33	5.75	3.00
Manganese	3.63	L0.05	L0.05	3.28	0.14
Sodium	940.0	4.5	3.4	103.0	4.9
Potassium	58.3	1.8	1.6	16.8	1.5
Chloride	2280.	10.5	7.4	264.0	126.0
Sulfate	58	7	7	13	7
Total (mg/l)					
Dissolved Phosphorus	0.012	0.204	0.206	0.852	0.100
Lead	0.002	0.004	0.002	0.002	0.002
Zinc	0.0035	0.0300	0.0130	0.0150	0.0048
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1985

REPORTED TO
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
	850606 0800 hrs	850606 0815 hrs	850606 0830 hrs	850606 0845 hrs	850606 0900 hrs
PH	7.8	7.2	7.2	6.8	7.3
Temperature (deg C)	17.0	16.0	15.0	16.0	16.0
96H LC50 (%)	>100	NA	NA	NA	NA
Total Suspended Solids (mg/l)	12.8	12.4	17.3	28.7	18.0
Ammonia (mgN/l)	18.60	0.42	L0.10	0.70	0.56
Dissolved (mg/l)					
BOD5	46	12	9	20	36
Oxygen	6.5	6.2	5.0	7.1	5.0
Nitrite	0.315	0.014	0.007	0.011	0.010
Nitrate	4.000	0.148	0.052	0.042	0.060
Copper	0.0050	0.0020	0.0030	0.0050	0.0030
Iron	2.89	1.48	1.70	3.70	13.60
Manganese	4.70	0.13	0.06	1.50	0.60
Sodium	890.0	21.0	5.8	42.5	25.0
Potassium	66.0	3.2	2.2	9.6	2.4
Chloride	1640.	55.0	7.0	44.7	38.3
Sulfate	138	8	5	10	10
Total (mg/l)					
Dissolved Phosphorus	0.018	0.107	0.192	1.030	0.145
Lead	L0.001	0.001	0.003	0.003	0.002
Zinc	0.0020	0.0030	0.0110	0.0030	0.0050
Mercury (ug/l)	L0.05	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER. 1985

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1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1		SITE 2	SITE 3	SITE 4	SITE 5
	850304 0900 hrs		850304 0930 hrs	850304 1000 hrs	850304 1030 hrs	850304 1100 hrs
PH	7.5		7.2	6.6	6.3	7.8
Temperature (deg C)	5.5		5.5	5.5	5.5	6.0
96H LC50 (%)	>49		NA	NA	NA	NA
Total Suspended Solids (mg/l)	26.0	40	16.0	32.0	L1.0	52.7
Ammonia (mgN/l)	17.60	* High toxic	3.90	0.84	0.28	0.28
Dissolved (mg/l)						
BOD5	28	30	29	19	6	20
Oxygen	6.6		8.0	6.4	12.2	7.5
Nitrite	0.064		0.032	0.024	L.005	0.017
Nitrate	3.100		0.440	0.154	0.011	0.037
Copper	0.0057	.2	0.0027	0.0024	0.0018	0.0037
Iron	0.11	12.0	1.12	5.10	1.20	1.70
Manganese	* 3.63	3.3	1.34	0.51	1.00	0.51
Sodium	487.0		150.0	50.0	17.2	31.5
Potassium	52.0		12.9	1.6	0.7	2.0
Chloride	1020.		290.0	97.0	18.0	58.0
Sulfate	156	250.	144	15	38	18
Total (mg/l)						
Dissolved Phosphorus	0.023		0.060	0.115	0.213	0.217
Lead	0.003	.05	0.003	0.007	0.001	0.003
Zinc	0.2200	.5	0.2200	0.0090	0.0030	0.0100
Mercury (ug/l)	L0.10	.0005	L0.10	L0.10	L0.10	L0.10

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FOURTH QUARTER, 1984

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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	Discharge SITE 1	No7 Blundell SITE 2	No7 Nursery SITE 3	N. drainage ditch No7 SITE 4	S.E. ditch at Nelson SITE 5
	841204 1000 hrs	841204 1030 hrs	841204 1100 hrs	841204 1115 hrs	841204 1130 hrs
PH	7.8	6.5	6.3	5.9	6.6
Temperature (deg C)	1.0	3.5	5.0	2.5	2.0
96H LC50 (%)	NA	NA	NA	NA	NA
Total Suspended Solids (mg/l)	18.5 40	15.5	29.0	2.0	8.0
Ammonia (mgN/l)	24.80 * High	1.10	1.12	0.84	1.26
Dissolved (mg/l)					
BOD5	12 30	14	19	L10	31
Oxygen	10.0	6.3	5.7	10.6	7.5
Nitrite	0.063	0.026	0.028	0.013	0.022
Nitrate	1.120	1.400	0.976	0.134	0.028
Copper	0.0049 0.2	0.0086	0.0070	0.0024	0.0026
Iron	1.69 2.0	4.44	8.95	1.41	19.00
Manganese	2.88	0.46	0.53	2.01	2.08
Sodium	243.0 3.3	29.0	35.3	20.8	48.5
Potassium	39.5	2.3	2.1	2.1	2.6
Chlorine	302.5	38.8	47.5	24.5	36.5
Sulfate	185 250	41	31	100	39
Total (mg/l)					
Dissolved Phosphorus	0.183	0.194	0.169	0.330	0.152
Lead	0.004 0.05	0.001	0.001	L0.001	L0.001
Zinc	0.0600 0.5	0.0180	0.0180	0.0080	0.0090
Mercury (ug/l)	L0.05 0.0006	L0.50	L0.50	L0.05	L0.50

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
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Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	Discharge SITE 1		No 7 Blundell SITE 2	No 7 Nursery SITE 3	N. drainage ditch at No 7 SITE 4	S.E. ditch at Nelson SITE 5
	840919 0800 hrs		840919 0830 hrs	840919 0900 hrs	840919 0930 hrs	840919 1000 hrs
PH	7.5	6.5-8.5	6.8	6.7	6.7	7.2
Temperature (deg C)	14.5		14.5	14.5	15.5	16.5
96H LC50 (%)	>100		NA	NA	NA	NA
Total Suspended Solids (mg/l)	26.0	40	34.7	36.7	22.0	25.3
Ammonia (mgN/l)	5.74		0.28	0.28	0.42	0.98
Dissolved (mg/l)						
BOD5	16	30	3	L3	7	8
Oxygen	4.0		5.0	7.8	8.7	6.8
Nitrite	0.240		L.002	L.002	L.002	L.002
Nitrate	2.620		0.030	0.033	0.418	0.010
Copper	0.0053	0.2	0.0022	0.0040	0.0071	0.0029
Iron	1.06	12.0	1.01	1.01	4.93	6.35
Manganese	1.95	3.3	0.03	0.02	7.77*	1.62
Sodium	280.0		3.7	3.2	25.5	64.0
Potassium	35.6		1.4	1.4	5.8	4.8
Chlorine	302.0		5.0	4.5	24.0	34.5
Sulfate	59	250	9	8	188*	5
Total (mg/l)						
Dissolved Phosphorus	0.012		0.136	0.190	0.052	0.038
Lead	L0.001	0.05	L0.001	L0.001	L0.001	L0.001
Zinc	0.0028	0.5	0.0031	0.0043	0.0400	0.0043
Mercury (ug/l)	L0.05	0.0006	L0.05	L0.05	L0.05	L0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR SECOND QUARTER, 1994

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6276

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Flapgate

	SITE 1		SITE 2	SITE 3	SITE 4	SITE 5
	940711 0900 hrs		940711 0815 hrs	940711 0630 hrs	940711 0845 hrs	940711 0900 hrs
pH	7.6	6.5-9.5	6.9	7.1	6.8	7.0
Temperature (deg C)	17.5		18.0	18.0	18.5	18.0
%LC50 (%)	>100		NA	NA	NA	NA
Total Suspended Solids (mg/l)	4.5	40	6.4	10.4	2.0	32.0
Ammonia (mgN/l)	2.80		0.70	0.56	0.58	0.56
Dissolved (mg/l)						
BOD	16	30	8	15	7	19
Oxygen	4.6		6.4	5.2	6.6	6.5
Nitrite	0.188		0.015	0.007	0.030	0.011
Nitrate	3.850		0.088	0.092	0.350	0.060
Copper	0.0070	0.4	0.0032	0.0018	0.0280	0.0033
Iron	0.74	10.0	5.46	5.30	3.07	14.30
Manganese	3.12	1.0	0.23	0.22	4.24	0.64
Sodium	330.0		18.3	15.0	10.2	16.1
Potassium	32.4		4.0	3.4	4.0	2.1
Chlorine	356.0		29.0	2.5	1.4	25.0
Sulfate	119	250	15	4	52	10
Total (mg/l)						
Dissolved Phosphorus	0.040		0.270	0.286	0.067	0.230
Lead	0.012	0.5	0.007	0.004	0.006	0.015
Zinc	0.0120	0.5	0.0060	0.0120	0.0300	0.0900
Mercury (ug/l)	LO.10	0.05	LO.10	LO.10	LO.10	LO.10

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

QUARTERLY MONITORING
FOR FIRST QUARTER, 1984

REPORTED TO
ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE
BC MINISTRY OF ENVIRONMENT, WASTE MANAGEMENT BRANCH, PERMIT NO. 6076

SUBMITTED BY BC RESEARCH

Sampling Sites:
1 Final Effluent
2 #7 Road Ditch At Blundell Road
3 #7 Road Ditch At Nursery Gate
4 North Drainage Ditch Near #7 Road Ditch
5 Southeast Drainage Ditch At Nelson Road Floodgate

	SITE 1		SITE 2	SITE 3	SITE 4	SITE 5
	~~840300~~ 840300 0900 hrs		840300 0815 hrs	840300 0830 hrs	840300 0845 hrs	840300 0900 hrs
pH	7.1		7.0	6.7	6.3	7.4
Temperature (deg C)	7.6		5.5	5.0	5.0	5.0
96H LC50 (%)	>100		NA	NA	NA	NA
Total Suspended Solids (mg/l)	6.1	40	13.1	8.8	4.0	12.9
Ammonia (mgN/l)	0.69		0.42	0.43	0.42	0.29
Dissolved (mg/l)						
BOD5	(50)	30	L10	14	16	20
Oxygen	6.8		6.5	5.0	14.2	7.7
Nitrite	0.003		L 002	L 002	0.006	0.003
Nitrate	0.548		1.456	0.460	0.128	0.364
Copper	0.0084	.2	0.0065	0.0063	0.0029	0.0049
Iron	2.80	12.0	3.24	3.54	1.10	12.10
Manganese	2.30	3.3	0.28	0.15	0.37	0.66
Sodium	300.0		29.1	9.6	9.3	24.2
Potassium	25.4		3.5	2.3	2.3	4.0
Chlorine	259.0		61.5	10.0	10.0	42.8
Sulfate	322	250	21	19	19	10
Total (mg/l)						
Dissolved Phosphorous	0.04a		0.110	0.100	0.163	0.173
Lead	0.002	.05	0.004	0.003	L0.001	0.006
Zinc	0.0085	.6	0.0110	0.0300	0.0047	0.0091
Mercury (ug/l)	L0.10	.0006 = .6%	0.10	L0.10	L0.10	L0.10

B.C. LABORATORY SERVICES

Report for form 03008164

MUNICIPAL - LOWER MAINLAND(LARSON) ATTN: BARLOW D L Sample 90018035

Site: NOSITE NORTH LEACHATE DITCH AT ACCESS ROAD

From : 90/12/11: 1245 To : 90/12/11: 1245
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	7.8	pH units	Automated pH Meter (00041220/35/01)
Specific Conductance	1860	uS/cm	Cond. Meter Siebold (00111160/35/01)
Hardness Total	372	mg/L	Calculated Result (0107CALC/--/--)
Biochem. Oxygen Dem.	< 10	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Chemical Oxygen Dem.	43	mg/L	K2Cr207 Dig:Titr. (01160500/04/05)
Acidity pH 8.3	32.0	mg/L	Auto. Potentiometric Titr (01311190/35/01)
Sulfate Dissolved	10.2	mg/L	Auto Methyl Thymol Blue (11211400/35/01)
Aluminum	< 0.10	mg/L	HNO3 Dig: ICP Analysis (Al-T0040/05/02)
Barium	0.18	mg/L	HNO3 Dig: ICP Analysis (Ba-T0040/05/02)
Calcium	93.0	mg/L	HNO3 Dig: ICP Analysis (Ca-T0040/05/02)
Cadmium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cd-T0040/05/02)
Cobalt	< 0.1	mg/L	HNO3 Dig: ICP Analysis (Co-T0040/05/02)
Chromium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cr-T0040/05/02)
Copper	0.01	mg/L	HNO3 Dig: ICP Analysis (Cu-T0040/05/02)

Site: NOSITE NORTH LEACHATE DITCH AT ACCESS ROAD

From :90/12/11:1245 To :90/12/11:1245
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Iron	2.20	mg/L	HNO3 Dig: ICP Analysis (Fe-T0040/05/02)
Magnesium	34.0	mg/L	HNO3 Dig: ICP Analysis (Mg-T0040/05/02)
Manganese	2.40	mg/L	HNO3 Dig: ICP Analysis (Mn-T0040/05/02)
Molybdenum	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Mo-T0040/05/02)
Nickel	< 0.05	mg/L	HNO3 Dig: ICP Analysis (Ni-T0040/05/02)
Lead	0.001	mg/L	HNO3 Dig: HGA Analysis (Pb-T0060/05/02)
Vanadium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (V--T0040/05/02)
Zinc	0.01	mg/L	HNO3 Dig: ICP Analysis (Zn-T0040/05/02)
Potassium Dissolved	24.0	mg/L	Auto. Flame Emmission (K--D1331/35/01)
Nitrogen Amm.Diss(N)	10.7	mg/L	Automated Bertholot meth (11081351/35/01)
Nitrogen NO3+NO2 Dis	0.10	mg/L	Auto. Cadmium Reduction (11091350/35/01)
Nitrogen NO3 Diss(N)	0.08	mg/L	Calculated Result (1110CALC/--/--)
Nitrogen NO2 Diss(N)	0.024	mg/L	Auto. Diazotization (11111354/35/01)
Phosphorus Tot. Diss	0.010	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/35/01)

Site: NOSITE NORTH LEACHATE DITCH AT ACCESS ROAD

From :90/12/11:1245 To :90/12/11:1245
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Sodium Dissolved	217	mg/L	Auto. Flame Emmission (Na-D1331/35/01)
Chloride Dissolved	269	mg/L	Auto. mercuric thiocyan. (11041330/35/01)

MUNICIPAL - LOWER MAINLAND(LARSON) ATTN: BARLOW D L Sample 90018034

Site: NOSITE NORTH LEACHATE PERIMETER AT ACCESS ROAD

From :90/12/11: 1250 To :90/12/14 1250
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	7.2	pH units	Automated pH Meter (00041220/35/01)
Specific Conductance	476	uS/cm	Cond.Meter Siebold (00111160/35/01)
Hardness Total	133	mg/L	Calculated Result (0107CALC/--/--)
Biochem. Oxygen Dem.	< 10	mg/L	Seeded Dil.Nit.Inh.5 Day (01151110/02/01)
Chemical Oxygen Dem.	168	mg/L	K2Cr2O7 Dig:Titr. (01160500/04/05)
Acidity pH 8.3	25.5	mg/L	Auto.Potentiometric Titr (01311190/35/01)
Sulfate Dissolved	20.6	mg/L	Auto Methyl Thymol Blue (11211400/35/01)
Aluminum	0.22	mg/L	HNO3 Dig: ICP Analysis (Al-T0040/05/02)
Barium	0.05	mg/L	HNO3 Dig: ICP Analysis (Ba-T0040/05/02)
Calcium	35.0	mg/L	HNO3 Dig: ICP Analysis (Ca-T0040/05/02)
Cadmium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cd-T0040/05/02)
Cobalt	< 0.1	mg/L	HNO3 Dig: ICP Analysis (Co-T0040/05/02)
Chromium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cr-T0040/05/02)
Copper	0.03	mg/L	HNO3 Dig: ICP Analysis (Cu-T0040/05/02)

Site: NOSITE NORTH LEACHATE PERIMETER AT ACCESS ROAD

From : 90/12/11:1250 To : 90/12/11:1250
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Iron	2.20	mg/L	HNO3 Dig: ICP Analysis (Fe-T0040/05/02)
Magnesium	11.0	mg/L	HNO3 Dig: ICP Analysis (Mg-T0040/05/02)
Manganese	0.71	mg/L	HNO3 Dig: ICP Analysis (Mn-T0040/05/02)
Molybdenum	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Mo-T0040/05/02)
Nickel	< 0.05	mg/L	HNO3 Dig: ICP Analysis (Ni-T0040/05/02)
Lead	< 0.001	mg/L	HNO3 Dig: HGA Analysis (Pb-T0060/05/02)
Vanadium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (V--T0040/05/02)
Zinc	0.03	mg/L	HNO3 Dig: ICP Analysis (Zn-T0040/05/02)
Potassium Dissolved	5.8	mg/L	Auto. Flame Emmission (K--D1331/35/01)
Nitrogen Amm.Diss(N)	1.16	mg/L	Automated Bertholot meth (11081351/35/01)
Nitrogen NO3+NO2 Dis	0.02	mg/L	Auto. Cadmium Reduction (11091350/35/01)
Nitrogen NO3 Diss(N)	?	mg/L	Calculated Result (1110CALC/--/--)
Result of calculation is not defined			
Nitrogen NO2 Diss(N)	0.021	mg/L	Auto. Diazotization (11111354/35/01)
Phosphorus Tot. Diss	0.036	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/35/01)

Site: NOSITE NORTH LEACHATE PERIMETER AT ACCESS ROAD

From :90/12/11:1250 To :90/12/11:1250
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Sodium Dissolved	45.0	mg/L	Auto. Flame Emmission (Na-D1331/35/01)
Chloride Dissolved	69.2	mg/L	Auto. mercuric thiocyan. (11041330/35/01)

Site: NOSITE NORTH PERIMETER AT ZYLMANS

From :90/12/11:1345 To :90/12/11:1345
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	7.5	pH units	Automated pH Meter (00041220/35/01)
Specific Conductance	1170	uS/cm	Cond.Meter Siebold (00111160/35/01)
Hardness Total	226	mg/L	Calculated Result (0107CALC/--/--)
Biochem. Oxygen Dem.	< 10	mg/L	Seeded Dil.Nit.Inh.5 Day (01151110/02/01)
Chemical Oxygen Dem.	147	mg/L	K2Cr2O7 Dig:Titr. (01160500/04/05)
Acidity pH 8.3	30.0	mg/L	Auto.Potentiometric Titr (01311190/35/01)
Sulfate Dissolved	8.5	mg/L	Auto Methyl Thymol Blue (11211400/35/01)
Aluminum	< 0.10	mg/L	HNO3 Dig: ICP Analysis (Al-T0040/05/02)
Barium	0.11	mg/L	HNO3 Dig: ICP Analysis (Ba-T0040/05/02)
Calcium	56.0	mg/L	HNO3 Dig: ICP Analysis (Ca-T0040/05/02)
Cadmium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cd-T0040/05/02)
Cobalt	< 0.1	mg/L	HNO3 Dig: ICP Analysis (Co-T0040/05/02)
Chromium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cr-T0040/05/02)
Copper	0.02	mg/L	HNO3 Dig: ICP Analysis (Cu-T0040/05/02)

Site: NOSITE NORTH PERIMETER AT ZYLMANS

From : 90/12/11: 1345 To : 90/12/11: 1345
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Iron	0.59	mg/L	HNO3 Dig: ICP Analysis (Fe-T0040/05/02)
Magnesium	21.0	mg/L	HNO3 Dig: ICP Analysis (Mg-T0040/05/02)
Manganese	0.47	mg/L	HNO3 Dig: ICP Analysis (Mn-T0040/05/02)
Molybdenum	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Mo-T0040/05/02)
Nickel	< 0.05	mg/L	HNO3 Dig: ICP Analysis (Ni-T0040/05/02)
Lead	0.003	mg/L	HNO3 Dig: HGA Analysis (Pb-T0060/05/02)
Vanadium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (V--T0040/05/02)
Zinc	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Zn-T0040/05/02)
Potassium Dissolved	26.5	mg/L	Auto. Flame Emmission (K--D1331/35/01)
Nitrogen Amm. Diss(N)	17.8	mg/L	Automated Bertholot meth (11081351/35/01)
Nitrogen NO3+NO2 Dis	0.16	mg/L	Auto. Cadmium Reduction (11091350/35/01)
Nitrogen NO3 Diss(N)	0.15	mg/L	Calculated Result (1110CALC/--/--)
Nitrogen NO2 Diss(N)	0.014	mg/L	Auto. Diazotization (11111354/35/01)
Phosphorus Tot. Diss	0.010	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/35/01)

MUNICIPAL - LOWER MAINLAND(LARSON) ATTN: BARLOW D L Sample 90018033

Site: NOSITE NORTH PERIMETER AT ZYLMANS

From :90/12/11:1345 To :90/12/11:1345
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Sodium Dissolved	118	mg/L	Auto. Flame Emmission (Na-D1331/35/01)
Chloride Dissolved	99.0	mg/L	Auto. mercuric thiocyan. (11041330/35/01)

Province of British Columbia — Ministry of Environment

RECEIVED JUL 25 1988

Collator: 9999940

BIOASSAY LABORATORY

SHADED RECTANGLES TO BE FILLED IN BY SAMPLE SUBMITTOR

BIOASSAY RECORD

LOWER MAINLAND REGION

SAMPLE NO: 506

COMPANY or SAMPLE LOCATION: Richmond Landfill

FILE No.

ATTENTION: D. Walton

DESCRIPTION AND AMOUNT OF SAMPLE AND CONTAINER (S)

SAMPLE — final disc.

note: daphnia present in sample

CONTAINER (S) 3x5g. (Plastic)

COLLECTED BY: DW

WITNESS: —

DATE: 14 (DAY) 07 (MONTH) 88 (YEAR)

TIME: 1305 Hrs.

RECEIVED IN LABORATORY BY: G.A

WITNESS: —

DATE: 15 (DAY) 07 (MONTH) 88 (YEAR)

TIME: 1315 Hrs.

ANALYSIS REQUIRED

☑ 96 Hr LC50 ☑ 96 Hr LT50

☐ Other Specified Concentration (s) 100%

RECEIVED FROM: Loomis

SAMPLE ☐ Legal ☑ Routine

DILUTION WATER ☑ Fresh Water ☐ Salt Water

DILUTIONS MEASURED BY ☑ Weight ☑ Whole Sample Of ☐ Volume ☐ Active Ingredient

FISH SPECIES ☑ Rainbow Trout (*Salmo gairdneri*) ☐ Other

ORIGINAL SAMPLE pH	Salinity	DILUTION WATER pH	Hardness	Salinity	BIOASSAY TEMPERATURE	FISH SIZE
7.9	— o/oo	6.0	45 mg/l $CaCO_3$	— o/oo	14 ± 1 °C	☐ Weekly Average ☑ Actual

LOADING DENSITY	FORK LENGTH (Average)	RANGE	WEIGHT (Average)	RANGE
35 gm./l. Or ☐ See Below ☐ See Data Sheet	4.7 cm. ☐ See Data Sheet	3.8 cm. to 5.6 cm. ☐ See Data Sheet	1.0 gm. ☐ See Data Sheet	.8 gm. to 1.6 gm. ☐ See Data Sheet

CONCENTRATION	TEST AMOUNT	START DATE	START pH	START D.O.	START Time	NO. FISH	CUMULATIVE MORTALITY AT TIME (HRS) 24	48	72	96	FINAL pH	FINAL D.O.	Test Vessel
CONTROL	30 kg	15 July 88	6.0	11.2	1345	10	0	0	0	0	6.1	7.2	
100%	30 kg	15 July 88	7.9	8.2	1345	10	0	0	0	0	8.4	9.6	

ANALYSIS RESULTS

sample conductivity 2900 µMOHS. ☑ control conductivity < 10 µMOHS.

96 Hr. LC50 is ..... concentration.

96 Hr. LT50 is ..... at ..... concentration.

Sample was non-toxic to RBT after 96 hours of exposure.

Analyst

20 07 88 (DAY MONTH YEAR) Date

Conc

E.P. 3-1101 revised (01/85)

ENVIRONMENTAL LABORATORY
Report for form 00409505

Lower Mainland - Waste Program ATTN: WALTON D G Sample 88005452

RECEIVED
SEP 28 1988
LOWER MAINLAND REGION
FILE NO.

Site: E206252 FRHC RICH LANDFILL WELL #3

From : 88/07/18: 0000 To : 88/07/18: 0000
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	5.9	pH units	Automated pH Meter (00041220/35/01)
Residue Nonfilt.	94	mg/L	Grav; 9 cm Buchner, 105C (00081070/35/01)
Specific Conductance	445	uS/cm	Cond. Meter Siebold (00111160/35/01)
Biochem. Oxygen Dem.	< 10	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Hardness Dissolved	151	mg/L	Calculated Result (1107CALC/--/--)
Sulfate Dissolved	14.7	mg/L	Auto Methyl Thymol Blue (11211400/35/01)
Mercury	0.00011	mg/L	HNO3/H2SO4 Dig:Man. C. V. (Hg-T0310/06/28)
Boron Dissolved	0.06	mg/L	ICP Analysis (B--D0030/05/13)
Barium Dissolved	0.11	mg/L	ICP Analysis (Ba-D0030/05/13)
Calcium Dissolved	33.1	mg/L	ICP Analysis (Ca-D0030/05/13)
Cadmium Dissolved	< 0.01	mg/L	ICP Analysis (Cd-D0030/05/13)
Cobalt Dissolved	< 0.1	mg/L	ICP Analysis (Co-D0030/05/13)
Chromium Dissolved	< 0.01	mg/L	ICP Analysis (Cr-D0030/05/13)
Copper Dissolved	< 0.01	mg/L	ICP Analysis (Cu-D0030/05/13)

Site: E206252 FRHC RICH LANDFILL WELL #3

From :88/07/18:0000 To :88/07/18:0000
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Iron Dissolved	5.71	mg/L	ICP Analysis (Fe-D0030/05/13)
Potassium Dissolved	3.5	mg/L	Auto. Flame Emmission (K--D1331/35/01)
Magnesium Dissolved	16.5	mg/L	ICP Analysis (Mg-D0030/05/13)
Manganese Dissolved	0.26	mg/L	ICP Analysis (Mn-D0030/05/13)
Molybdenum Dissolved	0.02	mg/L	ICP Analysis (Mo-D0030/05/13)
Nickel Dissolved	< 0.05	mg/L	ICP Analysis (Ni-D0030/05/13)
Lead Dissolved	< 0.1	mg/L	ICP Analysis (Pb-D0030/05/13)
Vanadium Dissolved	< 0.01	mg/L	ICP Analysis (V--D0030/05/13)
Zinc Dissolved	0.02	mg/L	ICP Analysis (Zn-D0030/05/13)
Nitrogen Amm. Diss(N)	3.67	mg/L	Automated Bertholot meth (11081351/35/01)
Nitrogen NO3+NO2 Dis	< 0.02	mg/L	Auto. Cadmium Reduction (11091350/35/01)
Nitrogen NO3 Diss(N)	< 0.02	mg/L	Calculated Result (1110CALC/--/--)
Nitrogen NO2 Diss(N)	0.010	mg/L	Auto. Diazotization (11111354/35/01)
Phosphorus Tot. Diss	1.40	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/35/01)

Site: E206252 FRHC RICH LANDFILL WELL #3

From : 88/07/18: 0000 To : 88/07/18: 0000
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Sodium Dissolved	20.5	mg/L	Auto. Flame Emmission (Na-D1331/35/01)
Chloride Dissolved	50.4	mg/L	Auto. mercuric thiocyan. (11041330/35/01)

Site: E206253 FRHC RICH LANDFILL WELL #4

RECEIVED
1988
LOWER MAINLAND REGION

From :88/07/18:0000 To :88/07/18:0000
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	5.9	pH units	Automated pH Meter (00041220/35/01)
Residue Nonfilt.	43	mg/L	Grav; 9 cm Buchner, 105C (00081070/35/01)
Specific Conductance	450	uS/cm	Cond. Meter Siebold (00111160/35/01)
Biochem. Oxygen Dem.	15	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Hardness Dissolved	89.6	mg/L	Calculated Result (1107CALC/--/--)
Sulfate Dissolved	9.9	mg/L	Auto Methyl Thymol Blue (11211400/35/01)
Mercury	0.00013	mg/L	HNO3/H2SO4 Dig:Man. C.V. (Hg-T0310/06/28)
Boron Dissolved	0.14	mg/L	ICP Analysis (B--D0030/05/13)
Barium Dissolved	0.09	mg/L	ICP Analysis (Ba-D0030/05/13)
Calcium Dissolved	22.2	mg/L	ICP Analysis (Ca-D0030/05/13)
Cadmium Dissolved	< 0.01	mg/L	ICP Analysis (Cd-D0030/05/13)
Cobalt Dissolved	< 0.1	mg/L	ICP Analysis (Co-D0030/05/13)
Chromium Dissolved	< 0.01	mg/L	ICP Analysis (Cr-D0030/05/13)
Copper Dissolved	0.02	mg/L	ICP Analysis (Cu-D0030/05/13)

Site: E206253 FRHC RICH LANDFILL WELL #4

From :88/07/18:0000 To :88/07/18:0000
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Iron Dissolved	25.3	mg/L	ICP Analysis (Fe-D0030/05/13)
Potassium Dissolved	3.2	mg/L	Auto. Flame Emmission (K--D1331/35/01)
Magnesium Dissolved	8.30	mg/L	ICP Analysis (Mg-D0030/05/13)
Manganese Dissolved	0.29	mg/L	ICP Analysis (Mn-D0030/05/13)
Molybdenum Dissolved	0.02	mg/L	ICP Analysis (Mo-D0030/05/13)
Nickel Dissolved	< 0.05	mg/L	ICP Analysis (Ni-D0030/05/13)
Lead Dissolved	< 0.1	mg/L	ICP Analysis (Pb-D0030/05/13)
Vanadium Dissolved	0.04	mg/L	ICP Analysis (V--D0030/05/13)
Zinc Dissolved	0.04	mg/L	ICP Analysis (Zn-D0030/05/13)
Nitrogen Amm.Diss(N)	3.87	mg/L	Automated Bertholot meth (11081351/35/01)
Nitrogen NO3+NO2 Dis	< 0.02	mg/L	Auto. Cadmium Reduction (11091350/35/01)
Nitrogen NO3 Diss(N)	?	mg/L	Calculated Result (1110CALC/--/--)
Not all component results available for Calculation			
Nitrogen NO2 Diss(N)	?	mg/L	Auto. Diazotization (11111354/35/01)
CHEMICAL INTERFERENCE			
Phosphorus Tot. Diss	0.069	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/35/01)

Lower Mainland - Waste Program ATTN: WALTON D G Sample 88005451

Site: E206253 FRHC RICH LANDFILL WELL #4

From :88/07/18:0000 To :88/07/18:0000
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Sodium Dissolved	40.0	mg/L	Auto. Flame Emmission (Na-D1331/35/01)
Chloride Dissolved	66.8	mg/L	Auto. mercuric thiocyan. (11041330/35/01)

ENVIRONMENTAL LABORATORY

Report for form 00409420

Lower Mainland - Waste Program ATTN: WALTON D G Sample # 88005241

RECEIVED
LOWER MAINLAND REGION
FILE NO.

Site: E100784 FRHC RICH LANDFILL

From : 88/07/14: 1304 To : 88/07/14: 1304
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	7.8	pH units	Automated pH Meter (00041220/01/01)
Residue Nonfilt.	11	mg/L	Grav; 9 cm Buchner, 105C (00081070/01/01)
Specific Conductance	4100	uS/cm	Cond. Meter Siebold (00111160/01/01)
Biochem. Oxygen Dem.	< 10	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Sulfide Total	< 0.5	mg/L	Titr. Iodine (01251410/03/08)
Hardness Dissolved	579	mg/L	Calculated Result (1107CALC/--/--)
Sulfate Dissolved	29.1	mg/L	Auto Methyl Thymol Blue (11211400/01/01)
Mercury	0.00007	mg/L	HNO3/H2SO4 Dig: Man. C. V. (Hg-T0310/06/28)
Calcium	154	mg/L	HNO3 Dig: ICP Analysis (Ca-T0040/05/02)
Cadmium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cd-T0040/05/02)
Cobalt	< 0.1	mg/L	HNO3 Dig: ICP Analysis (Co-T0040/05/02)
Chromium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cr-T0040/05/02)
Copper	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cu-T0040/05/02)
Iron	1.72	mg/L	HNO3 Dig: ICP Analysis (Fe-T0040/05/02)

Site: E100784 FRHC RICH LANDFILL

From : 88/07/14: 1304 To : 88/07/14: 1304
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Magnesium	61.2	mg/L	HNO3 Dig: ICP Analysis (Mg-T0040/05/02)
Manganese	0.71	mg/L	HNO3 Dig: ICP Analysis (Mn-T0040/05/02)
Molybdenum	0.04	mg/L	HNO3 Dig: ICP Analysis (Mo-T0040/05/02)
Nickel	< 0.05	mg/L	HNO3 Dig: ICP Analysis (Ni-T0040/05/02)
Lead	< 0.1	mg/L	HNO3 Dig: ICP Analysis (Pb-T0040/05/02)
Vanadium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (V--T0040/05/02)
Zinc	0.01	mg/L	HNO3 Dig: ICP Analysis (Zn-T0040/05/02)
Boron Dissolved	1.89	mg/L	ICP Analysis (B--D0030/05/13)
Barium Dissolved	0.26	mg/L	ICP Analysis (Ba-D0030/05/13)
Calcium Dissolved	147	mg/L	ICP Analysis (Ca-D0030/05/13)
Cadmium Dissolved	< 0.01	mg/L	ICP Analysis (Cd-D0030/05/13)
Cobalt Dissolved	< 0.1	mg/L	ICP Analysis (Co-D0030/05/13)
Chromium Dissolved	< 0.01	mg/L	ICP Analysis (Cr-D0030/05/13)
Copper Dissolved	< 0.01	mg/L	ICP Analysis (Cu-D0030/05/13)

Site: E100784 FRHC RICH LANDFILL

From :88/07/14:1304 To :88/07/14:1304
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Iron Dissolved	0.10	mg/L	ICP Analysis (Fe-D0030/05/13)
Potassium Dissolved	45.5	mg/L	Auto. Flame Emmission (K--D1331/01/01)
Magnesium Dissolved	51.4	mg/L	ICP Analysis (Mg-D0030/05/13)
Manganese Dissolved	0.64	mg/L	ICP Analysis (Mn-D0030/05/13)
Molybdenum Dissolved	0.04	mg/L	ICP Analysis (Mo-D0030/05/13)
Nickel Dissolved	< 0.05	mg/L	ICP Analysis (Ni-D0030/05/13)
Lead Dissolved	< 0.1	mg/L	ICP Analysis (Pb-D0030/05/13)
Vanadium Dissolved	< 0.01	mg/L	ICP Analysis (V--D0030/05/13)
Zinc Dissolved	0.01	mg/L	ICP Analysis (Zn-D0030/05/13)
Nitrogen Amm. Diss(N)	0.930	mg/L	Automated Bertholot meth (11081351/01/01)
Nitrogen NO3+NO2 Dis	0.96	mg/L	Auto. Cadmium Reduction (11091350/01/01)
Nitrogen NO3 Diss(N)	0.88	mg/L	Calculated Result (1110CALC/--/--)
Nitrogen NO2 Diss(N)	0.083	mg/L	Auto. Diazotization (11111354/01/01)
Phosphorus Tot. Diss	0.021	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/01/01)

ENVIRONMENTAL LABORATORY
Report for form 00409420
Lower Mainland - Waste Program ATTN: WALTON D G Sample 88005241

Site: E100784 FRHC RICH LANDFILL

From :88/07/14:1304 To :88/07/14:1304
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Sodium Dissolved	486	mg/L	Auto. Flame Emmission (Na-D1331/01/01)
Chloride Dissolved	610	mg/L	Auto. mercuric thiocyan. (11041330/01/01)

ENVIRONMENTAL LABORATORY

Report for form 00409425

Lower Mainland - Waste Program ATTN: WALTON D G Sample 88005238

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1988
LOWER MAINLAND REGION
FILE NO.

Site: E105878 FRHC RICH LANDFILL #4

From :88/07/14:1225 To :88/07/14:1225
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	6.8	pH units	Automated pH Meter (00041220/01/01)
Residue Nonfilt.	26	mg/L	Gravi 9 cm Buchner, 105C (00081070/01/01)
Specific Conductance	358	uS/cm	Cond. Meter Siebold (00111160/01/01)
Biochem. Oxygen Dem.	< 10	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Hardness Dissolved	125	mg/L	Calculated Result (1107CALC/--/--)
Sulfate Dissolved	11.5	mg/L	Auto Methyl Thymol Blue (11211400/01/01)
Mercury	0.00008	mg/L	HNO3/H2SO4 Dig:Man. C.V. (Hg-T0310/06/28)
Calcium	36.0	mg/L	HNO3 Dig: ICP Analysis (Ca-T0040/05/02)
Cadmium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cd-T0040/05/02)
Cobalt	< 0.1	mg/L	HNO3 Dig: ICP Analysis (Co-T0040/05/02)
Chromium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cr-T0040/05/02)
Copper	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cu-T0040/05/02)
Iron	10.0	mg/L	HNO3 Dig: ICP Analysis (Fe-T0040/05/02)
Magnesium	11.5	mg/L	HNO3 Dig: ICP Analysis (Mg-T0040/05/02)

Site: E105878 FRHC RICH LANDFILL #4

From :88/07/14:1225 To :88/07/14:1225
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Manganese	1.65	mg/L	HNO3 Dig: ICP Analysis (Mn-T0040/05/02)
Molybdenum	0.01	mg/L	HNO3 Dig: ICP Analysis (Mo-T0040/05/02)
Nickel	0.05	mg/L	HNO3 Dig: ICP Analysis (Ni-T0040/05/02)
Lead	< 0.1	mg/L	HNO3 Dig: ICP Analysis (Pb-T0040/05/02)
Vanadium	0.02	mg/L	HNO3 Dig: ICP Analysis (V--T0040/05/02)
Zinc	0.02	mg/L	HNO3 Dig: ICP Analysis (Zn-T0040/05/02)
Boron Dissolved	0.08	mg/L	ICP Analysis (B--D0030/05/13)
Barium Dissolved	0.12	mg/L	ICP Analysis (Ba--D0030/05/13)
Calcium Dissolved	32.6	mg/L	ICP Analysis (Ca-D0030/05/13)
Cadmium Dissolved	< 0.01	mg/L	ICP Analysis (Cd-D0030/05/13)
Cobalt Dissolved	< 0.1	mg/L	ICP Analysis (Co-D0030/05/13)
Chromium Dissolved	< 0.01	mg/L	ICP Analysis (Cr-D0030/05/13)
Copper Dissolved	< 0.01	mg/L	ICP Analysis (Cu-D0030/05/13)
Iron Dissolved	7.27	mg/L	ICP Analysis (Fe-D0030/05/13)

Site: E105878 FRHC RICH LANDFILL #4

From : 88/07/14: 1225 To : 88/07/14: 1225
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Potassium Dissolved	8.8	mg/L	Auto. Flame Emmission (K--D1331/01/01)
Magnesium Dissolved	10.7	mg/L	ICP Analysis (Mg-D0030/05/13)
Manganese Dissolved	1.54	mg/L	ICP Analysis (Mn-D0030/05/13)
Molybdenum Dissolved	< 0.01	mg/L	ICP Analysis (Mo-D0030/05/13)
Nickel Dissolved	< 0.05	mg/L	ICP Analysis (Ni-D0030/05/13)
Lead Dissolved	< 0.1	mg/L	ICP Analysis (Pb-D0030/05/13)
Vanadium Dissolved	0.01	mg/L	ICP Analysis (V--D0030/05/13)
Zinc Dissolved	0.02	mg/L	ICP Analysis (Zn-D0030/05/13)
Nitrogen Amm.Diss(N)	0.429	mg/L	Automated Bertholot meth (11081351/01/01)
Nitrogen NO3+NO2 Dis	0.04	mg/L	Auto. Cadmium Reduction (11091350/01/01)
Nitrogen NO3 Diss(N)	< 0.02	mg/L	Calculated Result (1110CALC/--/--)
Nitrogen NO2 Diss(N)	0.028	mg/L	Auto. Diazotization (11111354/01/01)
Phosphorus Tot. Diss	0.192	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/01/01)
Sodium Dissolved	24.3	mg/L	Auto. Flame Emmission (Na-D1331/01/01)

Lower Mainland - Waste Program ATTN: WALTON D G Sample 88005238

Site: E105878 FRHC RICH LANDFILL #4

From : 88/07/14: 1225 To : 88/07/14: 1225
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Chloride Dissolved	35.5	mg/L	Auto. mercuric thiocyan. (11041330/01/01)

Site: E105880 FRHC RICH LANDFILL #5

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OCT 13 1988
LOWER MAINLAND REGION

From : 88/07/14: 1130 To : 88/07/14: 1130
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Barcode/Medium/Preservation)
pH	7.1	pH units	Automated pH Meter (00041220/01/01)
Residue Nonfilt.	42	mg/L	Gravi 9 cm Buchner, 105C (00081070/01/01)
Specific Conductance	680	uS/cm	Cond. Meter Siebold (00111160/01/01)
Biochem. Oxygen Dem.	< 10	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Hardness Dissolved	130	mg/L	Calculated Result (1107CALC/--/--)
Sulfate Dissolved	1.8	mg/L	Auto Methyl Thymol Blue (11211400/01/01)
Mercury	0.00066	mg/L	HNO3/H2SO4 Dig:Man. C.V. (Hg-T0310/06/28)
Calcium	32.8	mg/L	HNO3 Dig: ICP Analysis (Ca-T0040/05/02)
Cadmium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cd-T0040/05/02)
Cobalt	< 0.1	mg/L	HNO3 Dig: ICP Analysis (Co-T0040/05/02)
Chromium	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cr-T0040/05/02)
Copper	< 0.01	mg/L	HNO3 Dig: ICP Analysis (Cu-T0040/05/02)
Iron	19.5	mg/L	HNO3 Dig: ICP Analysis (Fe-T0040/05/02)
Magnesium	15.0	mg/L	HNO3 Dig: ICP Analysis (Mg-T0040/05/02)

ENVIRONMENTAL LABORATORY

Report for form 00409426

Lower Mainland - Waste Program ATTN: WALTON D G Sample B8005242

Site: E105860 FRHC RICH LANDFILL #5

From :88/07/14:1130 To :88/07/14:1130
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Manganese	2.09	mg/L	HNO3 Dig: ICP Analysis (Mn-T0040/05/02)
Molybdenum	0.05	mg/L	HNO3 Dig: ICP Analysis (Mo-T0040/05/02)
Nickel	< 0.05	mg/L	HNO3 Dig: ICP Analysis (Ni-T0040/05/02)
Lead	< 0.1	mg/L	HNO3 Dig: ICP Analysis (Pb-T0040/05/02)
Vanadium	0.01	mg/L	HNO3 Dig: ICP Analysis (V--T0040/05/02)
Zinc	0.02	mg/L	HNO3 Dig: ICP Analysis (Zn-T0040/05/02)
Boron Dissolved	0.07	mg/L	ICP Analysis (B--D0030/05/13)
Barium Dissolved	0.13	mg/L	ICP Analysis (Ba-D0030/05/13)
Calcium Dissolved	31.2	mg/L	ICP Analysis (Ca-D0030/05/13)
Cadmium Dissolved	< 0.01	mg/L	ICP Analysis (Cd-D0030/05/13)
Cobalt Dissolved	< 0.1	mg/L	ICP Analysis (Co-D0030/05/13)
Chromium Dissolved	< 0.01	mg/L	ICP Analysis (Cr-D0030/05/13)
Copper Dissolved	< 0.01	mg/L	ICP Analysis (Cu-D0030/05/13)
Iron Dissolved	4.92	mg/L	ICP Analysis (Fe-D0030/05/13)

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Report for form 00409426

Lower Mainland - Waste Program ATTN: WALTON D G Sample 88005242

Site: E105880 FRHC RICH LANDFILL #5

From :88/07/14:1130 To :88/07/14:1130
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Potassium Dissolved	4.3	mg/L	Auto. Flame Emmission (K--D1331/01/01)
Magnesium Dissolved	12.6	mg/L	ICP Analysis (Mg-D0030/05/13)
Manganese Dissolved	1.66	mg/L	ICP Analysis (Mn-D0030/05/13)
Molybdenum Dissolved	0.02	mg/L	ICP Analysis (Mo-D0030/05/13)
Nickel Dissolved	< 0.05	mg/L	ICP Analysis (Ni-D0030/05/13)
Lead Dissolved	< 0.1	mg/L	ICP Analysis (Pb-D0030/05/13)
Vanadium Dissolved	< 0.01	mg/L	ICP Analysis (V--D0030/05/13)
Zinc Dissolved	0.01	mg/L	ICP Analysis (Zn-D0030/05/13)
Nitrogen Amm. Diss(N)	0.195	mg/L	Automated Bertholot meth (11081351/01/01)
Nitrogen NO3+NO2 Dis	< 0.02	mg/L	Auto. Cadmium Reduction (11091350/01/01)
Nitrogen NO3 Diss(N)	< 0.02	mg/L	Calculated Result (1110CALC/--/--)
Nitrogen NO2 Diss(N)	< 0.005	mg/L	Auto. Diazotization (11111354/01/01)
Phosphorus Tot. Diss	0.021	mg/L	Dig. Auto. Ascorbic Acid (P--D1390/01/01)
Sodium Dissolved	79.5	mg/L	Auto. Flame Emmission (Na-D1331/01/01)

ENVIRONMENTAL LABORATORY

Report for form 00409426

Lower Mainland - Waste Program ATTN: WALTON D G Sample 88005242

Site: E105880 FRHC RICH LANDFILL #5

From : 88/07/14: 1130 To : 88/07/14: 1130
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Chloride Dissolved	102	mg/L	Auto. mercuric thiocyan. (11041330/01/01)

ENVIRONMENTAL LABORATORY

Report for form 00052956

Lower Mainland - Waste Program ATTN: WALTON D G Sample 88005359

Site: E100784 FRHC RICH LANDFILL

RECEIVED
AUG 11 1988
LOWER MAINLAND REGION
TRF NO

From :88/07/14:1305 To :88/07/14:1305
Depth Range : 0.0 0.0 Tide :
Sample State: Fresh Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Bio. LT50:Rainbow Tr			Fish Bio/96hr/Vol Basis (04596000/00/00)

1. AT 100% CONC. THE SAMPLE WAS NON-TOXIC TO RBT AFTER 96 HOURS OF EXPOSURE.
2. 2 CONCENTRATIONS WERE TESTED.

The cost of this special analysis was $ 165.60

ENVIRONMENTAL LABORATORY

Report for form 00032476

Lower Mainland - Waste Program ATTN: WALTON D G Sample 87000701

Site: E206252 FRHC RICH LANDFILL WELL #3

RECEIVED
JUN 19 1987
LOWER MAINLAND REGION

From : 87/04/09: 0920 To : 87/04/09: 0920
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	5.4	pH units	Automated pH Meter (00041220/35/01)
Residue Nonfilt.	200	mg/L	Gravi 9 cm Buchner, 105C (00081070/35/01)
Conductance Specific	350	uS/cm	Cond. Meter Siebold (00111160/35/01)
Biochem. Oxygen Dem.	24	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Hardness Dissolved	106	mg/L	Calculated Result (1107CALC/--/--)
Sulfate Dissolved	16.9	mg/L	Auto Methyl Thymol Blue (11211400/35/01)
Mercury	0.00008	mg/L	HNO3/H2SO4 Dig: Man. C.V. (Hg-T0310/06/28)
Aluminum Dissolved	1.04	mg/L	ICP Analysis (Al-D0030/05/13)
Arsenic Dissolved	< 0.30	mg/L	ICP Analysis (As-D0030/05/13)
Boron Dissolved	0.05	mg/L	ICP Analysis (B--D0030/05/13)
Barium Dissolved	0.10	mg/L	ICP Analysis (Ba-D0030/05/13)
Calcium Dissolved	23.1	mg/L	ICP Analysis (Ca-D0030/05/13)
Cadmium Dissolved	< 0.01	mg/L	ICP Analysis (Cd-D0030/05/13)
Cobalt Dissolved	< 0.1	mg/L	ICP Analysis (Co-D0030/05/13)

ENVIRONMENTAL LABORATORY

Report for form 00032476

Lower Mainland - Waste Program ATTN: WALTON D G Sample B7000701

Site: E206252 FRHC RICH LANDFILL WELL #3

From :87/04/09:0920 To :87/04/09:0920
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Chromium Dissolved	< 0.01	mg/L	ICP Analysis (Cr-D0030/05/13)
Copper Dissolved	< 0.01	mg/L	ICP Analysis (Cu-D0030/05/13)
Iron Dissolved	5.13	mg/L	ICP Analysis (Fe-D0030/05/13)
Potassium Dissolved	3.7	mg/L	Auto. Flame Emmission (K--D1331/35/01)
Magnesium Dissolved	11.8	mg/L	ICP Analysis (Mg-D0030/05/13)
Manganese Dissolved	0.17	mg/L	ICP Analysis (Mn-D0030/05/13)
Molybdenum Dissolved	< 0.01	mg/L	ICP Analysis (Mo-D0030/05/13)
Nickel Dissolved	< 0.05	mg/L	ICP Analysis (Ni-D0030/05/13)
Lead Dissolved	< 0.1	mg/L	ICP Analysis (Pb-D0030/05/13)
Vanadium Dissolved	< 0.01	mg/L	ICP Analysis (V--D0030/05/13)
Zinc Dissolved	0.05	mg/L	ICP Analysis (Zn-D0030/05/13)
Nitrogen Amm. Diss(N)	3.64	mg/L	Automated Bertholot meth (1109135I/35/01)
Nitrogen NO3 Diss(N)	?	mg/L	Calculated Result (1110CALC/--/--)
Not all component results available for Calculation			
Phosphorus Tot. Diss	1.73	mg/L	Dig. Auto. Ascorbic Acid (P--D1390/35/01)

Site: E206252 FRHC RICH LANDFILL WELL #3

From :87/04/09:0920 To :87/04/09:0920
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Sodium Dissolved	21.9	mg/L	Auto. Flame Emmission (Na-D1331/35/01)
Chloride Dissolved	52.5	mg/L	Auto. mercuric thiocyan. (11041330/35/01)
Nitrogen NO3+NO2 Dis			Special Analysis (1109CLSP/35/01)
.03 MG/L			
The cost of this special analysis was $	18.00		
Nitrogen NO2 Diss(N)			Special Analysis (1111CLSP/35/01)
.025 MG/L			
The cost of this special analysis was $	18.00		

ENVIRONMENTAL LABORATORY

Report for form 00032477

Lower Mainland - Waste Program ATTN: WALTON D G Sample 87000700

RECEIVED
JAN 19 1987
LOWER MAINLAND REGION
FILE No.

Site: E206253 FRHC RICH LANDFILL WELL #4

From : 87/04/09: 0905 To : 87/04/09: 0905
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	5.5	pH units	Automated pH Meter (00041220/35/01)
Residue Nonfilt.	72	mg/L	Gravi 9 cm Buchner, 105C (00081070/35/01)
Conductance Specific	435	uS/cm	Cond. Meter Siebold (00111160/35/01)
Biochem. Oxygen Dem.	< 10	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Hardness Dissolved	94.8	mg/L	Calculated Result (1107CALC/--/--)
Sulfate Dissolved	6.9	mg/L	Auto Methyl Thymol Blue (11211400/35/01)
Mercury	0.00009	mg/L	HNO3/H2SO4 Dig: Man. C.V. (Hg-T0310/06/28)
Aluminum Dissolved	0.55	mg/L	ICP Analysis (Al-D0030/05/13)
Arsenic Dissolved	< 0.30	mg/L	ICP Analysis (As-D0030/05/13)
Boron Dissolved	0.16	mg/L	ICP Analysis (B--D0030/05/13)
Barium Dissolved	0.11	mg/L	ICP Analysis (Ba-D0030/05/13)
Calcium Dissolved	23.5	mg/L	ICP Analysis (Ca-D0030/05/13)
Cadmium Dissolved	< 0.01	mg/L	ICP Analysis (Cd-D0030/05/13)
Cobalt Dissolved	< 0.1	mg/L	ICP Analysis (Co-D0030/05/13)

ENVIRONMENTAL LABORATORY

Report for form 00032477

Lower Mainland - Waste Program ATTN: WALTON D G Sample 87000700

Site: E206253 FRHC RICH LANDFILL WELL #4

From :87/04/09:0905 To :87/04/09:0905
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Chromium Dissolved	< 0.01	mg/L	ICP Analysis (Cr--D0030/05/13)
Copper Dissolved	< 0.01	mg/L	ICP Analysis (Cu-D0030/05/13)
Iron Dissolved	16.9	mg/L	ICP Analysis (Fe-D0030/05/13)
Potassium Dissolved	3.3	mg/L	Auto. Flame Emmission (K--D1331/35/01)
Magnesium Dissolved	8.77	mg/L	ICP Analysis (Mg-D0030/05/13)
Manganese Dissolved	0.32	mg/L	ICP Analysis (Mn-D0030/05/13)
Molybdenum Dissolved	< 0.01	mg/L	ICP Analysis (Mo--D0030/05/13)
Nickel Dissolved	< 0.05	mg/L	ICP Analysis (Ni-D0030/05/13)
Lead Dissolved	< 0.1	mg/L	ICP Analysis (Pb-D0030/05/13)
Vanadium Dissolved	0.03	mg/L	ICP Analysis (V--D0030/05/13)
Zinc Dissolved	0.04	mg/L	ICP Analysis (Zn--D0030/05/13)
Nitrogen Amm.Diss(N)	3.78	mg/L	Automated Bertholot meth (11081351/35/01)
Nitrogen NO3 Diss(N)	?	mg/L	Calculated Result (1110CALC/--/--)
Not all component results available for Calculation			
Phosphorus Tot. Diss	0.047	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/35/01)

Site: E206253 FRHC RICH LANDFILL WELL #4

From :87/04/09:0905 To :87/04/09:0905
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Spercode/Medium/Pres'n)
Sodium Dissolved	38.0	mg/L	Auto. Flame Emmission (Na-D1331/35/01)
Chloride Dissolved	86.5	mg/L	Auto. mercuric thiocyan. (11041330/35/01)
Nitrogen NO3+NO2 Dis			Special Analysis (1109CLSP/35/01)
.03 MG/L			
The cost of this special analysis was $	18.00		
Nitrogen NO2 Diss(N)			Special Analysis (1111CLSP/35/01)
0.026 MG/L			
The cost of this special analysis was $	18.00		

ENVIRONMENTAL LABORATORY

Report for form 00032478

Lower Mainland - Waste Program ATTN: WALTON D G Sample 87000699

Site: E206254 FRHC RICH LANDFILL WELL #6

RECEIVED MAY 28 1987

From : 87/04/09: 0815 To : 87/04/09: 0815
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	6.1	pH units	Automated pH Meter (00041220/35/01)
Residue Nonfilt.	8	mg/L	Grav; 9 cm Buchner, 105C (00081070/35/01)
Conductance Specific	108	uS/cm	Cond. Meter Siebold (00111160/35/01)
Biochem. Oxygen Dem.	< 10	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Hardness Dissolved	39.9	mg/L	Calculated Result (1107CALC/---/---)
Sulfate Dissolved	10.8	mg/L	Auto Methyl Thymol Blue (11211400/35/01)
Mercury	0.00006	mg/L	HNO3/H2SO4 Dig: Man. C. V. (Hg-T0310/06/28)
Aluminum Dissolved	0.06	mg/L	ICP Analysis (Al-D0030/05/13)
Arsenic Dissolved	< 0.30	mg/L	ICP Analysis (As-D0030/05/13)
Boron Dissolved	0.01	mg/L	ICP Analysis (B--D0030/05/13)
Barium Dissolved	0.07	mg/L	ICP Analysis (Ba-D0030/05/13)
Calcium Dissolved	7.41	mg/L	ICP Analysis (Ca-D0030/05/13)
Cadmium Dissolved	< 0.01	mg/L	ICP Analysis (Cd-D0030/05/13)
Cobalt Dissolved	< 0.1	mg/L	ICP Analysis (Co-D0030/05/13)

Site: E206254 FRHC RICH LANDFILL WELL #6

From :87/04/09:0815 To :87/04/09:0815
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Chromium Dissolved	< 0.01	mg/L	ICP Analysis (Cr-D0030/05/13)
Copper Dissolved	< 0.01	mg/L	ICP Analysis (Cu-D0030/05/13)
Iron Dissolved	5.10	mg/L	ICP Analysis (Fe-D0030/05/13)
Potassium Dissolved	0.2	mg/L	Auto. Flame Emmission (K--D1331/35/01)
Magnesium Dissolved	5.19	mg/L	ICP Analysis (Mg-D0030/05/13)
Manganese Dissolved	0.32	mg/L	ICP Analysis (Mn-D0030/05/13)
Molybdenum Dissolved	< 0.01	mg/L	ICP Analysis (Mo-D0030/05/13)
Nickel Dissolved	< 0.05	mg/L	ICP Analysis (Ni-D0030/05/13)
Lead Dissolved	< 0.1	mg/L	ICP Analysis (Pb-D0030/05/13)
Vanadium Dissolved	< 0.01	mg/L	ICP Analysis (V--D0030/05/13)
Zinc Dissolved	0.03	mg/L	ICP Analysis (Zn-D0030/05/13)
Nitrogen Amm. Diss(N)	0.033	mg/L	Automated Bertholot meth (11081351/35/01)
Nitrogen NO3+NO2 Dis	0.05	mg/L	Auto. Cadmium Reduction (11091350/35/01)
Nitrogen NO3 Diss(N)	0.05	mg/L	Calculated Result (1110CALC/--/--)

Lower Mainland - Waste Program ATTN: WALTON D G Sample 87000699

Site: E206254 FRHC RICH LANDFILL WELL #6

From :87/04/09:0815 To :87/04/09:0815
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Nitrogen NO2 Diss(N)	< 0.005	mg/L	Auto. Diazotization (11111354/35/01)
Phosphorus Tot. Diss	0.010	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/35/01)
Sodium Dissolved	3.3	mg/L	Auto. Flame Emmission (Na-D1331/35/01)
Chloride Dissolved	1.2	mg/L	Auto. mercuric thiocyan. (11041330/35/01)

ENVIRONMENTAL LABORATORY
Report for form 00032475

Lower Mainland - Waste Program ATTN: WALTON D G Sample B7000698

Site: E206255 FRHC RICH LANDFILL WELL #7

RECEIVED
JUN 1987
LOWER MAINLAND REGION
FILES

From :87/04/09:0840 To :87/04/09:0840
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	6.3	pH units	Automated pH Meter (00041220/35/01)
Residue Nonfilt.	177	mg/L	Grav; 9 cm Buchner, 105C (00081070/35/01)
Conductance Specific	3700	uS/cm	Cond. Meter Siebold (00111160/35/01)
Biochem. Oxygen Dem.	12	mg/L	Seeded Dil. Nit. Inh. 5 Day (01151110/02/01)
Hardness Dissolved	580	mg/L	Calculated Result (1107CALC/--/--)
Sulfate Dissolved	?	mg/L	Auto Methyl Thymol Blue (11211400/35/01)
CHEMICAL INTERFERENCE			
Mercury	0.00008	mg/L	HNO3/H2SO4 Dig:Man. C.V. (Hg-T0310/06/28)
Aluminum Dissolved	0.24	mg/L	ICP Analysis (Al-D0030/05/13)
Arsenic Dissolved	< 0.30	mg/L	ICP Analysis (As-D0030/05/13)
Boron Dissolved	0.32	mg/L	ICP Analysis (B--D0030/05/13)
Barium Dissolved	0.64	mg/L	ICP Analysis (Ba-D0030/05/13)
Calcium Dissolved	116	mg/L	ICP Analysis (Ca-D0030/05/13)
Cadmium Dissolved	< 0.01	mg/L	ICP Analysis (Cd-D0030/05/13)
Cobalt Dissolved	< 0.1	mg/L	ICP Analysis (Co-D0030/05/13)

ENVIRONMENTAL LABORATORY

Report for form 00032475

Lower Mainland - Waste Program ATTN: WALTON D G Sample 87000698

Site: E206255 FRHC RICH LANDFILL WELL #7

From : 87/04/09: 0840 To : 87/04/09: 0840
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Chromium Dissolved	< 0.01	mg/L	ICP Analysis (Cr-D0030/05/13)
Copper Dissolved	< 0.01	mg/L	ICP Analysis (Cu-D0030/05/13)
Iron Dissolved	102	mg/L	ICP Analysis (Fe-D0030/05/13)
Potassium Dissolved	2.7	mg/L	Auto. Flame Emmission (K--D1331/35/01)
Magnesium Dissolved	70.5	mg/L	ICP Analysis (Mg-D0030/05/13)
Manganese Dissolved	2.36	mg/L	ICP Analysis (Mn-D0030/05/13)
Molybdenum Dissolved	< 0.01	mg/L	ICP Analysis (Mo-D0030/05/13)
Nickel Dissolved	< 0.05	mg/L	ICP Analysis (Ni-D0030/05/13)
Lead Dissolved	< 0.1	mg/L	ICP Analysis (Pb-D0030/05/13)
Vanadium Dissolved	0.02	mg/L	ICP Analysis (V--D0030/05/13)
Zinc Dissolved	0.01	mg/L	ICP Analysis (Zn-D0030/05/13)
Nitrogen Amm. Diss(N)	1.42	mg/L	Automated Bertholot meth (11081351/35/01)
Nitrogen NO3+NO2 Dis	0.06	mg/L	Auto. Cadmium Reduction (11091350/35/01)
Nitrogen NO3 Diss(N)	< 0.02	mg/L	Calculated Result (1110CALC/--/--)

ENVIRONMENTAL LABORATORY
Report for form 00032475

Lower Mainland - Waste Program ATTN: WALTON D G Sample 87000698

Site: E206255 FRHC RICH LANDFILL WELL #7

From :87/04/09:0840 To :87/04/09:0840
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
Nitrogen NO2 Diss(N)	0.054	mg/L	Auto. Diazotization (11111354/35/01)
Phosphorus Tot. Diss	0.007	mg/L	Dig.Auto.Ascorbic Acid (P--D1390/35/01)
Sodium Dissolved	448	mg/L	Auto. Flame Emmission (Na-D1331/35/01)
Chloride Dissolved	843	mg/L	Auto. mercuric thiocyan. (11041330/35/01)

ENVIRONMENTAL LABORATORY
Report for form 00006683

Lower Mainland - Waste Program ATTN: HENSEL, L.F.

From :85/05/13:0000 To :85/05/13:0000 Depth Range 0.0 0.0 Tide
Sample State Waste Water leachate Sample 85002019

Parameter Description	Analytical Technique		Result	Units
pH	pH Meter		6.9	pH units
Residue Nonfilt.	Grav 11CM Buchner 105C		62	mg/L
Conductance Specific	Cond.Meter Siebold	*	2140	uS/cm
Aluminum	N/H Dig:ICP Anal.		0.56	mg/L
Arsenic	N/H Dig:ICP Anal.	<	0.25	mg/L
Calcium	N/H Dig:ICP Anal.	*	92.5	mg/L
Cadmium	N/H Dig:ICP Anal.	<	0.01	mg/L
Cobalt	N/H Dig:ICP Anal.	<	0.1	mg/L
Chromium	N/H Dig:ICP Anal.		0.02	mg/L
Copper	N/H Dig:ICP Anal.	<	0.01	mg/L
Iron	N/H Dig:ICP Anal.	*	23.1	mg/L
Magnesium	N/H Dig:ICP Anal.	*	53.9	mg/L
Manganese	N/H Dig:ICP Anal.	*	6.13	mg/L
Molybdenum	N/H Dig:ICP Anal.		0.03	mg/L
Nickel	N/H Dig:ICP Anal.	<	0.05	mg/L
Lead	N/H Dig:ICP Anal.	<	0.1	mg/L
Vanadium	N/H Dig:ICP Anal.	<	0.01	mg/L
Zinc	N/H Dig:ICP Anal.		0.01	mg/L
Nitrogen Amm.Diss(N)	Automated Bertholot meth		1.93	mg/L

ENVIRONMENTAL LABORATORY
Report for form 00014594

Lower Mainland - Waste Program ATTN: HENSEL, L.F.

From :85/05/13:0000 To :85/05/13:0000 Depth Range 0.0 0.0 Tide
Sample State Fresh Water Nelson Rd ditch Sample 85002020

Parameter Description	Analytical Technique	Result	Units
pH	pH Meter	7.0	pH units
Residue Nonfilt.	Grav 11CM Buchner 105C	26	mg/L
Conductance Specific	Cond. Meter Siebold	268	umhos/cm
Aluminum	N/H Dig: ICP Anal.	0.71	mg/L
Arsenic	N/H Dig: ICP Anal.	< 0.25	mg/L
Calcium	N/H Dig: ICP Anal.	21.8	mg/L
Cadmium	N/H Dig: ICP Anal.	< 0.01	mg/L
Cobalt	N/H Dig: ICP Anal.	< 0.1	mg/L
Chromium	N/H Dig: ICP Anal.	0.01	mg/L
Copper	N/H Dig: ICP Anal.	< 0.01	mg/L
Iron	N/H Dig: ICP Anal.	12.0	mg/L
Magnesium	N/H Dig: ICP Anal.	6.96	mg/L
Manganese	N/H Dig: ICP Anal.	0.54	mg/L
Molybdenum	N/H Dig: ICP Anal.	< 0.01	mg/L
Nickel	N/H Dig: ICP Anal.	< 0.05	mg/L
Lead	N/H Dig: ICP Anal.	< 0.1	mg/L
Vanadium	N/H Dig: ICP Anal.	< 0.01	mg/L
Zinc	N/H Dig: ICP Anal.	0.02	mg/L
Nitrogen Amm. Diss(N)	Automated Bertholot meth	0.130	mg/L

R000276

EVS ENVIRONMENT CONSULTANTS

Our File: 9/158-03
W.O.: 950380

June 26, 1995

Mr. Brent Makelki
Analytical Service Laboratories Ltd.
1988 Triumph Street
Vancouver, B.C.
V5L 1K5

Dear Mr. Makelki:

Re: Toxicity Testing on the Sample Identified as F1132-5 (Collected June 7, 1995)

We have completed one (1) rainbow trout 96-h LC50 toxicity test on the sample identified as F1132-5, received on June 7, 1995. The 96-h LC50 value is expressed as the percent volume of sample per final volume (e.g., 56% LC50 = 56 mL sample per 100 mL total volume).

Standard toxicity test procedures were followed in accordance with EVS SOP numbers 1061-1 and 1063-1, which are based on A.P.H.A. Standard Methods, 18th Edition (1992) and Environment Canada's "Biological Test Method: Acute Lethality Test Using Rainbow Trout" EPS 1/RM/9 (1990).

Due to regional shortages in the availability of juvenile rainbow trout, we used seven fish, the minimum acceptable number of fish, per test concentration (Environment Canada, 1990), and ten fish in the negative control. This reduction in the number of fish has little effect on the 96-h LC50 calculation and helps conserve fish stocks.

The loading density in the control was above the maximum of 0.5 g/L specified by Environment Canada (1990). However, the loading density in the test concentrations was within limits.

The batch of fish used in testing this sample was acclimated for 10 days. A minimum of 14 days acclimation time is specified by Environment Canada (1990). However, the 96-h LC50 value of 45 mg/L for the reference toxicant (SDS) test performed on this batch of fish, was within the acceptable range of values (34 ± 12 mg/L) obtained by this laboratory in previous testing. Therefore, the reference toxicant test results indicate no difference in the relative sensitivity of the test fish.

The results, summarized on page two for your convenience, are based on data from the following pages.

● 195 Pemberton Avenue
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Tel: (604) 986-4331
Fax: (604) 662-8548
evs_consultants@mindlink.bc.ca

200 West Mercer Street
Suite 403
Seattle, WA 98119
Tel: (206) 217-9337
Fax: (206) 217-9343
evswa@halcyon.com

EVS ENVIRONMENT CONSULTANTS

Summary of Results:

Sample I.D.	Sample Date	96-h LC50 Value (% vol/vol)	96-h LC50 Value Determined By:
F1132-5	June 7, 1995	>100	Data Observation[1]

[1] No rainbow trout mortality was observed in any of the test concentrations.

Should you have any questions or comments, please do not hesitate to contact the undersigned at 986-4331.

Yours truly,

EVS ENVIRONMENT CONSULTANTS

Camille J. Merchant, B.Sc.
Biologist

Certified By:

QA/QC Committee:
Judy Crane, Ph.D.
Bettina Sander, M.Sc.
Patrick Allard, M.Sc.
Cathy McPherson, B.Sc.
Margot Daykin, B.Sc.

CJM/cjm

EVS CONSULTANTS

ACUTE TOXICITY TEST DATA SUMMARY

Client: ASL
EVS Project #: 9/158-03
EVS Work Order #: 950380

EVS Analysts: JJ, CJM, DMK, TLS
Test Type: 96-h LC50
Test Initiation Date: June 8, 1995

SAMPLE

Identification	F1132-5
Amount Received	40 L
Date Collected	June 7, 1995
Date Received	June 7, 1995
pH	7.9 - 8.1 after 30 minutes of aeration
Dissolved Oxygen (mg/L)	8.6 - 9.2 after 30 minutes of aeration
Conductivity (µmhos/cm)	1300
Other	

DILUTION AND CONTROL MEDIUM

Fresh Water (dechlorinated)	✓
Salt Water (Burrard Inlet)	
pH	6.7
Dissolved Oxygen (mg/L)	10.0
Conductivity (µmhos/cm)	10
Hardness (mg/L as $CaCO_3$)	13
Alkalinity (mg/L as $CaCO_3$)	5
Salinity (ppt)	
Other	

TEST SPECIES INFORMATION

Organism: Rainbow Trout *(Oncorhynchus mykiss)*
Source: Sun Valley Trout Farm
Collection Date/Batch: 052995a
Reference Toxicant: Sodium Dodecyl Sulphate
Current Reference Toxicant Result: LC50 value (mg/L) = 45
Laboratory Range For Reference Toxicant (mean ± 2SD): 34 ± 12 mg/L
Acclimation Time For Fish Used In Reference Toxicant: 10 days

TEST CONDITIONS

Temperature Range (°C)	14-16
pH Range	6.6-8.9
Dissolved Oxygen Range (mg/L)	8.2-10.1
Conductivity Range (µmhos/cm)	10-1300
Aeration (7.5 cc/min/L)	✓
Photoperiod (L:D h)	16:8
No. Organisms/Volume	~~9 @ 10/10 L~~ 10/15L in control; 7/15 in test concs
Loading Density (g/L)	~~@ 0.99~~ 0.64 in control, 0.45 in test concs
Acclimation Time (days)	10
Other	

Toxicity Test Results: The 96-h LC50 Value is 7100 % (vol/vol).

Certified By: Judy L Crane Date: June 23, 1995

h:\user\fish\datashts\acutelc.sum
Updated August 29, 1994

EVS CONSULTANTS

ACUTE LETHALITY TOXICITY TESTING DATA

SAMPLE I.D. F1132-5
DATE COLLECTED June 7, 1995
TEST DATE June 8, 1995 1430 h
NO. FISH/VOLUME ~~10/10 L~~ 7/15L ; 10/15L in Control
am

PROJECT NAME ASL
EVS PROJECT NO. 9/158-03
WORK ORDER NO. 950380
TEST SPECIES Rainbow Trout
BATCH # 052995a

CONC. % (vol/vol)	PERCENT SURVIVAL (1 to 96 hours)							DISSOLVED OXYGEN (mg/L)					TEMPERATURE (°C)					pH					COND. (µmhos/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
100				100	100	100	100	9.2	9.2	9.1	9.2	9.1	15	15.5	16	15	15.5	8.1	8.5	8.7	8.8	8.8	1300	1300
56				100	100	100	100	9.6	8.2	9.3	9.4	9.1	14.5	15.5	16	15	15.5	8.1	8.3	8.6	8.9	8.8	750	750
32				100	100	100	100	9.9	8.3	9.4	9.4	9.3	14.5	15	16	15	15.5	8.0	8.2	8.5	8.7	8.6	440	445
18				100	100	100	100	10.1	9.6	9.3	9.3	9.3	14.5	15	16	15	15.5	8.0	8.3	8.4	8.4	8.3	255	260
10				100	100	100	100	10.1	9.3	9.5	9.4	9.4	14.5	15	16	15	15.5	7.7	7.9	8.1	8.1	8.1	140	145
Control				100	100	100	100	10.0	9.5	9.2	9.1	9.3	14	15	16	15	15.5	6.7	6.6	6.9	7.0	7.1	10	15
Technician				DMK	JLS	JLS	JLS	ZJ	DMK	JLS	JLS	JLS	ZJ	DMK	JLS	JLS	JLS	ZJ	DMK	JLS	JLS	JLS	ZJ	JLS

SAMPLE DESCRIPTION cloudy, dark yellow/orange liquid.
COMMENTS

MEAN FISH LENGTH (mm) 79 RANGE 66-95
MEAN FISH WEIGHT (g) 0.96 RANGE 0.76-1.20

TEST SET UP BY ZJ
DATA VERIFIED BY Judy L Crane
DATE VERIFIED June 23, 1995

EVS CONSULTANTS

H:\user\fish\database\fish30.fm3
Updated September 6, 1994

EVS ENVIRONMENT CONSULTANTS

PE-06276

Our File: 9/158-03
W.O.: 950316

June 5, 1995

Mr. Brent Makelki
Analytical Service Laboratories Ltd.
1988 Triumph Street
Vancouver, B.C.
V5L 1K5

Dear Mr. Makelki:

Re: Toxicity Testing on the Sample Identified as E9347-1 (Collected May 9, 1995)

We have completed one (1) rainbow trout 96-h LC50 toxicity test on the sample identified as E9347-1, received on May 9, 1995. The 96-h LC50 value is expressed as the percent volume of sample per final volume (e.g., 56% LC50 = 56 mL sample per 100 mL total volume).

Standard toxicity test procedures were followed in accordance with EVS SOP numbers 1061-1 and 1063-1, which are based on A.P.H.A. Standard Methods, 18th Edition (1992) and Environment Canada's "Biological Test Method: Acute Lethality Test Using Rainbow Trout" EPS 1/RM/9 (1990).

The results, summarized below for your convenience, are based on data from the following pages.

Summary of Results:

Sample I.D.	Sample Date	96-h LC50 Value (% vol/vol)	96-h LC50 Value Determined By:
E9347-1	May 9, 1995	>100	Data Observation[1]

[1] No rainbow trout mortality was observed in any of the test concentrations.

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evswa@halcyon.com

1974 TWENTY YEARS 1994

Should you have any questions or comments, please do not hesitate to contact the undersigned at 986-4331.

Yours truly,

EVS ENVIRONMENT CONSULTANTS

Camille J. Merchant, B.Sc.
Biologist

Certified By:

QA/QC Committee:
Judy Crane, Ph.D.
Bettina Sander, M.Sc.
Patrick Allard, M.Sc.
Cathy McPherson, B.Sc.
Margot Daykin, B.Sc.

CJM/cjm

EVS CONSULTANTS
ACUTE TOXICITY TEST DATA SUMMARY

Client ASL
EVS Project # 9/158-03
EVS Work Order # 950316

EVS Analysts CJM ZLJ CPG MLB TLS
Test Type 96-h LC50
Test Initiation Date May 10, 1995

SAMPLE

Identification E93477-1
Amount Received 40 L
Date Collected May 9, 1995
Date Received May 9, 1995
pH 8.0 - 8.2 after 30 minutes of aeration
Dissolved Oxygen (mg/L) 8.7 ~~8.0~~ - 9.7 after 30 minutes of aeration
Conductivity (µmhos/cm) 1200
Other cm ~~temp=11a°C~~

DILUTION AND CONTROL MEDIUM

Fresh Water (dechlorinated) ✓
Salt Water (Burrard Inlet)
pH 6.7
Dissolved Oxygen (mg/L) 10.0
Conductivity (µmhos/cm) cm ~~10~~ 15
Hardness (mg/L as $CaCO_3$) 8
Alkalinity (mg/L as $CaCO_3$) 4
Salinity (ppt)
Other

TEST SPECIES INFORMATION

Organism: Rainbow Trout *(Oncorhynchus mykiss)*
Source: Sun Valley Trout Farm
Collection Date/Batch: 042095
Reference Toxicant: Sodium Dodecyl Sulphate
Current Reference Toxicant: LC50 value (mg/L) = 42
Laboratory Range For Reference Toxicant (mean ± 2SD) 34 ± 11 mg/L
Acclimation Time For Fish Used In Reference Toxicant: 20 days

TEST CONDITIONS

Temperature Range (°C) 15
pH Range 6.7-8.8
Dissolved Oxygen Range (mg/L) 9.0-10.2
Conductivity Range (µmhos/cm) 15-1200
Aeration (7.5 cc/min/L) ✓
Photoperiod (L:D h) 16:8
No. Organisms/Volume 10/10 L
Loading Density (g/L) 0.49
Acclimation Time (days) 20
Other

Toxicity Test Results The 96-h LC50 Value is >100 % (vol/vol).

Certified By: RJA **Date:** May 30/95

EVS CONSULTANTS

ACUTE LETHALITY TOXICITY TESTING DATA

SAMPLE I.D. E9347-1
DATE COLLECTED May 9, 1995
TEST DATE May 10, 1995
NO. FISH/VOLUME 10/10 L

PROJECT NAME ASL
EVS PROJECT NO. 9/158-03
WORK ORDER NO. 950316
TEST SPECIES Rainbow Trout
BATCH # 042095

CONC. % (vol/vol)	PERCENT SURVIVAL (1 to 96 hours)							DISSOLVED OXYGEN (mg/L)					TEMPERATURE (°C)					pH					COND. (µmhos/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
100				100	100	100	100	9.7	9.4	9.8	9.3	9.5	15	15	15	15	15	8.2	8.6	8.7	8.7	8.8	1200	1000
56				100	100	100	100	10.1	9.3	9.8	9.5	9.5	15	15	15	15	15	8.3	8.8	8.7	8.8	8.8	900	750
32				100	100	100	100	10.1	9.0	9.4	9.0	9.1	15	15	15	15	15	8.2	8.5	8.5	8.5	8.5	410	410
18				100	100	100	100	10.2	9.4	9.8	9.5	9.6	15	15	15	15	15	8.1	8.3	8.3	8.4	8.4	245	250
10				100	100	100	100	10.1	9.5	9.8	9.6	9.7	15	15	15	15	15	8.0	8.1	8.1	8.2	8.2	150	155
Control				100	100	100	100	10.0	9.4	9.9	9.4	9.5	15	15	15	15	15	6.7	6.8	6.9	7.1	7.1	15	20
Technician				ZJS	MB	JLS	JLS	ZJS	ZJS	MB CR	TLS	TLS	ZJS	ZJS	CR MB	TLS	TLS	ZJS	ZJS	CR MB	TLS	TLS	ZJS	TLS

SAMPLE DESCRIPTION Gold, clear
COMMENTS

MEAN FISH LENGTH (mm) 39 RANGE 35-45
MEAN FISH WEIGHT (g) 0.49 RANGE 0.38-0.75

TEST SET UP BY ZJS/CJM
DATA VERIFIED BY PJA
DATE VERIFIED May 30/95

EVS CONSULTANTS

H:\user\fish\databits\table90.fw3
Updated September 6, 1994

PE-06276

EVS ENVIRONMENT CONSULTANTS

Our File: 9/158-03
W.O.: 950252

May 15, 1995

Mr. Brent Makelki
ASL Analytical Service Laboratories Ltd.
1988 Triumph Street
Vancouver, B.C.
V5L 1K5

Dear Mr. Makelki:

Re: Toxicity Testing on the Sample Identified as E8844-1 (Collected April 19, 1995)

We have completed one (1) 96-h rainbow trout LC50 toxicity test on the sample identified as E8844-1, received April 19, 1995. The 96-h LC50 value is expressed as the percent volume of sample per final volume (e.g., 56% LC50 = 56 mL sample per 100 mL total volume).

Standard toxicity test procedures were followed in accordance with EVS SOP numbers 1061-1 and 1063-1, which are based on A.P.H.A. Standard Methods, 18th Edition (1992) and Environment Canada's "Biological Test Method: Acute Lethality Test Using Rainbow Trout" EPS 1/RM/9 (1990).

The results, summarized below for your convenience, are based on data from the following pages.

Summary of Results:

Sample I.D.	Sample Date	96-h LC50 Value (% vol/vol)	96-h LC50 Value Determined By:
E8844-1	April 19, 1995	>100	Data Observation[1]

[1] No rainbow trout mortality was observed in any of the test concentrations.

195 Pemberton Avenue
North Vancouver, B.C.
Canada V7P 2R4
Tel: (604) 986-4331
Fax: (604) 662-8548
evs_consultants@mindlink.bc.ca

200 West Mercer Street
Suite 403
Seattle, WA 98119
Tel: (206) 217-9337
Fax: (206) 217-9343
evswa@halcyon.com

TWENTY YEARS

Should you have any questions or comments, please do not hesitate to contact the undersigned at 986-4331.

Yours truly,

EVS ENVIRONMENT CONSULTANTS

Camille J. Merchant, B.Sc.
Biologist

Certified By:

QA/QC Committee:
Judy Crane, Ph.D.
Bettina Sander, M.Sc.
Patrick Allard, M.Sc.
Cathy McPherson, B.Sc.
Margot Daykin, B.Sc.

CJM/cjm

EVS CONSULTANTS

ACUTE TOXICITY TEST DATA SUMMARY

Client: ASL
EVS Project #: 91158-03
EVS Work Order #: 950252

EVS Analysts: CJM PLJ
Test Type: 96-h LC50
Test Initiation Date: April 20, 1995

SAMPLE

Identification: E8844-1
Amount Received: 40L
Date Collected: April 19/95
Date Received: April 19/95
pH: 7.8 - 8.0 after 30 minutes of aeration
Dissolved Oxygen (mg/L): 8.0 - 9.4 after 30 minutes of aeration
Conductivity (µmhos/cm): 1400
Other:

DILUTION AND CONTROL MEDIUM

Fresh Water (dechlorinated)	✓
Salt Water (Burrard Inlet)	
pH	6.8
Dissolved Oxygen (mg/L)	9.6
Conductivity (µmhos/cm)	15
Hardness (mg/L as $CaCO_3$)	8
Alkalinity (mg/L as $CaCO_3$)	4
Salinity (ppt)	
Other	

TEST SPECIES INFORMATION

Organism: Rainbow Trout *(Oncorhynchus mykiss)*
Source: ~~Spring~~ Sun Valley Trout Farm CYM
Collection Date/Batch: 033195
Reference Toxicant: Sodium Dodecyl Sulphate
Current Reference Toxicant Result: LC50 value (mg/L) = 34
Laboratory Range For Reference Toxicant (mean ± 2SD): 34 ± 14 mg/L
Acclimation Time For Fish Used In Reference Toxicant: 19 days

TEST CONDITIONS

Temperature Range (°C)	14.5-15
pH Range	6.8-8.7
Dissolved Oxygen Range (mg/L)	9.3-9.6
Conductivity Range (µmhos/cm)	15-1400
Aeration (7.5 cc/min/L)	✓
Photoperiod (L:D h)	16:8
No. Organisms/Volume	10/10 L
Loading Density (g/L)	0.49
Acclimation Time (days)	20
Other	

Toxicity Test Results: The 96-h LC50 Value is >100 % (vol/vol).

Certified By: [signature] Date: May 12, 1995

h:\user\fish\datashts\acutelc.sum
Updated August 29, 1994

EVS CONSULTANTS
ACUTE LETHALITY TOXICITY TESTING DATA

SAMPLE I.D. E 8844-1
DATE COLLECTED April 19/95
TEST DATE April 20, 1995 1715h
NO. FISH/VOLUME 10/10 L

PROJECT NAME ASL
EVS PROJECT NO. 9158-03
WORK ORDER NO. 950252
TEST SPECIES Rainbow Trout
BATCH # 033195

CONC. % (vol/vol)	PERCENT SURVIVAL (1 to 96 hours)							DISSOLVED OXYGEN (mg/L)					TEMPERATURE (°C)					pH					COND. (µmhos/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
100				100	100	100	①100	9.4	9.4	9.3	9.4	9.4	14.5	14.5	15	15	15	8.0	8.4	8.5	8.5	8.6	1400	1200
56				100	100	100	100	9.6	9.5	9.6	9.5	9.5	14.5	14.5	15	15	15	8.0	8.6	8.5	8.6	8.7	800	800
32				100	100	100	100	9.6	9.5	9.6	9.6	9.5	14.5	14.5	15	15	15	8.0	8.5	8.5	8.5	8.6	475	475
18				100	100	100	100	9.6	9.6	9.6	9.6	9.5	15	14.5	15	15	15	8.0	8.3	8.3	8.3	8.3	280	280
10				100	100	100	100	9.6	9.6	9.6	9.5	9.6	15	14.5	15	15	15	8.0	8.1	8.1	8.1	8.1	165	170
Control				100	100	100	100	9.6	9.6	9.6	9.6	9.6	15	14.5	15	15	15	6.8	6.9	6.8	6.9	7.0	15	20
Technician				PD	CMM	CMM	PD	PD	PD	CMM	CMM	PD	PD	PD	CMM	CMM	PD	PD	PD	CMM	CMM	PD	PD	PD

SAMPLE DESCRIPTION turbid, brown
COMMENTS ① one fish is swimming on its side

MEAN FISH LENGTH (mm) 38 RANGE 33-42
MEAN FISH WEIGHT (g) 0.49 RANGE 0.30-0.61

TEST SET UP BY PD
DATA VERIFIED BY Judy Crane
DATE VERIFIED May 12, 1995

EVS CONSULTANTS

(H:\user\lab\lasubm\table50.fw)
Updated September 4, 1994

PR-06276

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Fish Bioassay on: Final Discharge

780-95001

96-h LC50 %v/v: >100

SAMPLE Taken:	Jan. 17, 1995	**SAMPLE pH:**	7.6
SAMPLE Received:	Jan. 18, 1995	**SAMPLE Dissolved Oxygen (mg/L):**	9.1
Date Started:	Jan. 18, 1995	**SAMPLE Conductance (µmho/cm):**	1180
Time Started:	10:00		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	6.1	6.0	10.2	10.2	100	100	100	100
	100	7.6	7.8	9.3	10.2	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Fish:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to EPS 1 RM/13: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout", July 1990 and "British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish", November 1982.

TEST FISH Juvenile rainbow trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.33 ± 0.06 **Length (cm):** 3.2 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jan. 11, 1995
Tests gave 96-h LC50 of 16.8 mg/L (12.5, 20.3) and 16.1 mg/L (11.4, 19.5)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7	**Residual Chlorine (mg/L):**	< 0.002
EDTA Hardness (mg $CaCO_3$/L):	14	**Conductance (µmho/cm):**	22.7
Total Suspended Solids (mg/L):	1.3		

Other parameters available on request.

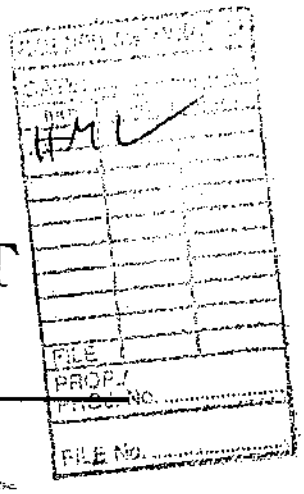
ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

1988 Triumph Street, Vancouver, B.C., Can V5L 1K5 FAX: (604) 253-6700 TEL: (604) 253-4188

analytical service laboratories ltd.

RECEIVED APR 7 1995



CHEMICAL ANALYSIS REPORT

PE-06276

Date: March 23, 1995

ASL File No. E7903

Report On: 952-1811 Water Analysis

Report To: **Golder Associates Ltd.**
500 - 4260 Still Creek Drive
Burnaby, BC
V5C 6C6

Attention: **Ms. Heather Matthews**

Received: March 8, 1995

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Brent A. Makelki, B.Sc.
Project Chemist

Joyce Chow, B.Sc.
Project Chemist

RESULTS OF ANALYSIS

File No. E7903

	437-01
	95 03 08
Bioassays[1]	
96 hour LC-50	100 %

[1]Subcontracted analyses - See the detailed E.V.S. report attached.

APPENDIX

RESULTS OF SUBCONTRACTED ANALYSES

EVS ENVIRONMENT CONSULTANTS

Our File: 9/158-03
W.O.: 950139

March 23, 1995

Mr. Brent Makelki
Analytical Service Laboratories Ltd.
1988 Triumph Street
Vancouver, B.C.
V5L 1K5

Dear Mr. Makelki:

Re: Toxicity Testing on the Sample Identified as E-7903 (Collected March 8, 1995)

We have completed one (1) 96-h rainbow trout LC50 toxicity test on the sample identified as E7903, received March 8, 1995. The 96-h LC50 value is expressed as the percent volume of sample per final volume (e.g., 56% LC50 = 56 mL sample per 100 mL total volume).

Standard toxicity test procedures were followed in accordance with A.P.H.A. Standard Methods, 18th Edition (1992) and Environment Canada's "Biological Test Method: Acute Lethality Test Using Rainbow Trout" EPS 1/RM/9 (1990). The 96-h LC50 value for this sample was calculated by interpolation, using angular-transformed mortalities and log-transformed concentrations. The approximate 95% confidence limits were calculated using the binomial method. All calculations were made using the EFFL computer program (IBM/AT Version 1.0) following procedures in Stephan (1977).

The results, summarized below for your convenience, are based on data from the following pages.

Summary of Results:

Sample I.D.	Sample Date	96-h LC50 Value (% vol/vol)	96-h LC50 Value Determined By:
E7903	March 8, 1995	≈100 (CL[1]: 32% and ∞)	Interpolation

[1] CL = Confidence Limits

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200 West Mercer Street
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Seattle, WA 98119
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Fax: (206) 217-9343
evswa@halcyon.com

1974 TWENTY YEARS 1994

Should you have any questions or comments, please do not hesitate to contact the undersigned at 986-4331.

Yours truly,

EVS ENVIRONMENT CONSULTANTS

Camille J. Merchant, B.Sc.
Biologist

Certified By:

QA/QC Committee:
Judy Crane, Ph.D.
Bettina Sander, M.Sc.
Patrick Allard, M.Sc.
Cathy McPherson, B.Sc.
Margot Daykin, B.Sc.

CJM/cjm

EVS CONSULTANTS
ACUTE TOXICITY TEST DATA SUMMARY

Client: ASL
EVS Project #: 9158-03
EVS Work Order #: 950139

EVS Analysts: CSM PLS CRL
Test Type: 96-h LC50
Test Initiation Date: Mar 13/95

SAMPLE

Identification: E-7903
Amount Received: 40L
Date Collected: Mar. 8, 1995
Date Received: Mar 8, 1995
pH: 7.9 - 8.1 after 30 minutes of aeration
Dissolved Oxygen (mg/L): 9.4 - 9.8 after 30 minutes of aeration
Conductivity (µmhos/cm): 1350
Other:

DILUTION AND CONTROL MEDIUM

Fresh Water (dechlorinated): ✓
Salt Water (Burrard Inlet):
pH: 6.9
Dissolved Oxygen (mg/L): 10.7
Conductivity (µmhos/cm): 15
Hardness (mg/L as $CaCO_3$): 10
Alkalinity (mg/L as $CaCO_3$): ~~qm~~ 84
Salinity (ppt):
Other:

TEST SPECIES INFORMATION

Organism: Rainbow Trout *(Oncorhynchus mykiss)*
Source: Sun Valley Trout Farm
Collection Date/Batch: 02 21 95
Reference Toxicant: Sodium Dodecyl Sulphate
Current Reference Toxicant Result: LC50 value (mg/L) = 30
Laboratory Range For Reference Toxicant (mean ± 2SD): 34 ± 14 mg/L
Acclimation Time For Fish Used In Reference Toxicant: 17 days

TEST CONDITIONS

Temperature Range (°C): 15
pH Range: 6.9-8.7
Dissolved Oxygen Range (mg/L): 9.1-10.2
Conductivity Range (µmhos/cm): 15-1350
Aeration (7.5 cc/min/L): ✓
Photoperiod (L:D h): 16:8
No. Organisms/Volume: 10/10 L
Loading Density (g/L): 0.36
Acclimation Time (days): ~~qm~~ 20 20
Other:

Toxicity Test Results: The 96-h LC50 Value is ≈100 % (vol/vol).

Certified By: Cathy McPherson **Date:** Mar 22/95

SAMPLE I.D. E-7903
DATE COLLECTED Mar 8/95
TEST DATE Mar 13/95 1100h
NO. FISH/VOLUME 10/10 L

EVS CONSULTANTS
ACUTE LETHALITY TOXICITY TESTING DATA

PROJECT NAME ASL
EVS PROJECT NO. 9158-03
WORK ORDER NO. 950139
TEST SPECIES Rainbow Trout
BATCH # 022/95

CONC. % (vol/vol)	PERCENT SURVIVAL (1 to 96 hours)							DISSOLVED OXYGEN (mg/L)					TEMPERATURE (°C)					pH					COND. (µmhos/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
100				90	80	80 ③	50	9.8	9.8	9.3	9.3	9.9	15	15	15	15	15	8.1	8.3	8.5	8.5	8.5	1350	1050
56				100 cpm 90	80	80 ③	70	10.0	9.7	9.4	9.3	9.8	15	15	15	15	15	8.1	8.6 ①	8.7	8.6	8.6	800	750
32				100	100	100	100	10.1	9.2	9.2	9.3	9.8	15	15	15	15	15	8.0	8.3	8.4	8.4	8.4	450	445
18				100	100	100	100	10.1	9.3	9.2	9.3	9.8	15	15	15	15	15	8.0	8.1	8.2	8.2	8.1	255	260
10				100	100	100	100	10.1	9.6	9.2	9.1	10.1	15	15	15	15	15	7.8	7.7	7.7	7.7	8.0	145	150
Control				100	100	100	100	10.2	9.9	9.7	9.6	10.1	15	15	15	15	15	6.9 pre	6.9	7.0	6.9	6.9	15	20
Technician				cpm	PD	cpm	cal	PD	cpm	PD	cpm	cal	PD	cpm	PD	cpm	cal	PD	cpm	PD	PD	cal	PD	cal

SAMPLE DESCRIPTION yellow-brown color, turbid ② Some particulate matter has settled to the tank bottom over time
COMMENTS ① value checked and verified ③ One fish lying on its side on the tank bottom.

MEAN FISH LENGTH (mm) 34 RANGE 26-39
MEAN FISH WEIGHT (g) 0.36 RANGE 0.16-0.52

TEST SET UP BY PLJ
DATA VERIFIED BY Cathy Mortimer
DATE VERIFIED Mar 22/95

EVS CONSULTANTS

H:\user\Gsh\data\bin\fish50.fw3
Updated September 6, 1994

LC50:STEPHEN IBM/AT VERS 1.0

Sample: 9/158-03 E-7903 950139 Mar.8/95

Conc	Number exposed	Number dead	Percent dead	Binomial prob(percent)
100.00	10	5	50.0	62.3047
56.00	10	3	30.0	17.1875
32.00	10	0	0.0	0.0977
18.00	10	0	0.0	0.0977
10.00	10	0	0.0	0.0977

*WARNING: no percent dead is greater then 65 *

The binom test shows that 32.000 and +infinity can be used as statistically sound at 95 conf since the actual conf level associated with these limits is 100.000

An approx LC50 is 100.000 % (vol/vol)

------RESULTS USING THE MOVING AVERAGE METHOD----------

span	g	lc50	95% conf limits
1	5.230069	100.000	+infinity

Probit warning:no convergence in 25 iterations

CdM Mar 22/95

1988 Triumph Street, Vancouver, B.C., Can V5L 1K5 FAX: (604) 253-6700 TEL: (604) 253-4188

analytical service laboratories ltd.

ASL

HMC

CHEMICAL ANALYSIS REPORT

PE-06276

Date: March 17, 1995

ASL File No. E7570

Report On: 952-1811 Water Analysis

Report To: **Golder Associates Ltd.**
500 - 4260 Still Creek Drive
Burnaby, BC
V5C 6C6

Attention: **Ms. Heather Mattheus**

Received: February 20, 1995

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Brent A. Makelki, B.Sc.
Project Chemist

Joyce Chow, B.Sc.
Project Chemist

REMARKS File No. E7570

The Bioassay analysis was subcontracted to EVS Consultants of N. Vancouver. Their report for this analysis is attached.

RESULTS OF ANALYSIS

File No. E7570

	0445-01
	95 02 20 10:30
Bioassays	
96 hour LC-50	Pass-100%

Remarks regarding the analyses appear at the beginning of this report.
Subcontracted analysis - see the EVS report attached for details.

APPENDIX

RESULTS OF SUBCONTRACTED ANALYSES

EVS ENVIRONMENT CONSULTANTS

Our File: 9/158-03
W.O.: 950077

March 6, 1995

Mr. Brent Makelki
Analytical Service Laboratories Ltd.
1988 Triumph Street
Vancouver, B.C.
V5L 1K5

Dear Mr. Makelki:

Re: Toxicity Testing on the Sample Identified as E7570-1 (Collected February 20, 1995)

We have completed one (1) 96-h rainbow trout LC50 toxicity test on the sample identified as E7570-1, received February 20, 1995. The 96-h LC50 value is expressed as the percent volume of sample per final volume (e.g., 56% LC50 = 56 mL sample per 100 mL total volume).

Standard toxicity test procedures were followed in accordance with A.P.H.A. Standard Methods, 18th Edition (1992) and Environment Canada's "Biological Test Method: Acute Lethality Test Using Rainbow Trout" EPS 1/RM/9 (1990).

The results, summarized below for your convenience, are based on data from the following pages.

Summary of Results:

Sample I.D.	Sample Date	96-h LC50 Value (% vol/vol)	96-h LC50 Value Determined By:
E7570-1	February 20, 1995	>100	Data Observation[1]

[1] Less than 50% rainbow trout mortality was observed in all of the test concentrations.

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Suite 403
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Tel: (206) 217-9337
Fax: (206) 217-9343
evswa@halcyon.com

TWENTY YEARS
1974

Should you have any questions or comments, please do not hesitate to contact the undersigned at 986-4331.

Yours truly,

EVS ENVIRONMENT CONSULTANTS

Camille J. Merchant, B.Sc.
Biologist

Certified By:

QA/QC Committee:
Judy Crane, Ph.D.
Bettina Sander, M.Sc.
Patrick Allard, M.Sc.
Cathy McPherson, B.Sc.
Margot Daykin, B.Sc.

CJM/cjm

EVS CONSULTANTS

ACUTE TOXICITY TEST DATA SUMMARY

Client: ASL
EVS Project #: 9158-03
EVS Work Order #: 9500077

EVS Analysts: CSM PLS EST LSS
Test Type: 96-h LC50
Test Initiation Date: Feb 21/95

SAMPLE

Identification	E 7570-1
Amount Received	20L
Date Collected	Feb 20/95
Date Received	Feb 20/95
pH	8.1 - 8.3 after 30 minutes of aeration
Dissolved Oxygen (mg/L)	9.5 - 9.9 after 11 minutes of aeration
Conductivity (µmhos/cm)	1200
Other	

DILUTION AND CONTROL MEDIUM

Fresh Water (dechlorinated)	✓
Salt Water (Burrard Inlet)	
pH	7.0
Dissolved Oxygen (mg/L)	10.1
Conductivity (µmhos/cm)	15
Hardness (mg/L as $CaCO_3$)	10
Alkalinity (mg/L as $CaCO_3$)	6
Salinity (ppt)	
Other	

TEST SPECIES INFORMATION

Organism: Rainbow Trout *(Oncorhynchus mykiss)*
Source: Sun Valley Trout Farm
Collection Date/Batch: 01 23 95
Reference Toxicant: Sodium Dodecyl Sulphate
Current Reference Toxicant Result: LC50 value (mg/L) = 38
Laboratory Range For Reference Toxicant (mean ± 2SD): 34 ~~38~~ ± 14 mg/L cmm
Acclimation Time For Fish Used In Reference Toxicant: 24 days

TEST CONDITIONS

Temperature Range (°C)	14.5-15
pH Range	6.9-8.8
Dissolved Oxygen Range (mg/L)	9.3-10.1
Conductivity Range (µmhos/cm)	15-1200
Aeration (7.5 cc/min/L)	✓
Photoperiod (L:D h)	16:8
No. Organisms/Volume	10/10 L
Loading Density (g/L)	0.43
Acclimation Time (days)	24
Other	

Toxicity Test Results: The 96-h LC50 Value is >100 % (vol/vol).

Certified By: Judy L Crane **Date:** March 3, 1995

h:\user\fish\datasht\acutelc.sum
Updated August 29, 1994

EVS CONSULTANTS

ACUTE LETHALITY TOXICITY TESTING DATA

SAMPLE I.D. E7570-1
DATE COLLECTED Feb 20/95
TEST DATE Feb 21/95 1500h
NO. FISH/VOLUME 10/10 L

PROJECT NAME ASL
EVS PROJECT NO. 9158-08
WORK ORDER NO. 950077
TEST SPECIES Rainbow Trout
BATCH # 012395

CONC. % (vol/vol)	PERCENT SURVIVAL (1 to 96 hours)							DISSOLVED OXYGEN (mg/L)					TEMPERATURE (°C)					pH					COND. (µmhos/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
100				80	80	80	80	9.9	9.8	9.7	9.7	7.8	15	15	15	15	15	8.3	8.5	8.7	8.8	8.8	1200	1000
56				100	100	100	100	10.0	9.8	9.6	9.6	9.8	15	15	15	15	15	8.3	8.7	8.7	8.7	8.7	650	650
32				100	100	100	100	10.1	9.8	9.7	9.7	9.8	14.5	15	15	15	15	8.3	8.5	8.5	8.5	8.6	395	395
18				100	100	100	100	10.1	9.8	9.7	9.8	9.6	14.5	15	15	15	15	8.2	8.3	8.3	8.2	8.3	230	240
10				100	100	100	100	10.1	9.7	9.4	9.4	9.3	14.5	15	15	15	15	8.0	7.9	7.8	7.8	7.9	140	150
Control				100	100	100	100	10.1	10.0	9.7	9.6	9.7	14.5	15	15	15	15	7.0	6.9	7.0	7.0	7.1	15	20
Technician				PJ	PJ	PJ	✓	CMM	PJ	PJ	PJ	2/21	CMM	PJ	PJ	PJ	✓	CMM	PJ	PJ	PJ	2/21	CMM	✓

SAMPLE DESCRIPTION Orange, textured
COMMENTS

MEAN FISH LENGTH (mm) 35 RANGE 29-40
MEAN FISH WEIGHT (g) 0.43 RANGE 0.28-0.60

TEST SET UP BY PJ/CJM
DATA VERIFIED BY
DATE VERIFIED March 3, 1995

EVS CONSULTANTS

H:\user\fish\datasht\Fishlc50.fw3
Updated September 6, 1994

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

PL-66276 Data

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94013

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Dec 13, 1994	SAMPLE pH:	7.5
SAMPLE RECEIVED:	Dec 13, 1994	SAMPLE D.O.:	7.9 mg/L
TEST STARTED:	Dec 14, 1994	SAMPLE CONDUCTANCE:	1840 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.5	8.2	8.7	9.4	100	100	100	100	100
				--- *CONTROL* ---				
6.5	7.0	10.3	10.2	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	7.0

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.44 ± 0.07 g	Length:	3.7 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 11.5 mg/L (9.2, 13.9) and 12.3 mg/L (8.0, 20.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7
EDTA hardness (mg $CaCO_3$/L):	14
Total suspended solids (mg/L):	1.3
Residual chlorine (mg/L):	< 0.002
Conductance (µmho/cm):	22.7

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94012

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Nov 29, 1994	SAMPLE pH:	7.4
SAMPLE RECEIVED:	Nov 29, 1994	SAMPLE D.O.:	9.7 mg/L
TEST STARTED:	Nov 30, 1994	SAMPLE CONDUCTANCE:	1575 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.5	8.0	9.9	10.3	100	100	100	100	100
				— CONTROL —				
6.6	6.5	10.2	10.3	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.44 ± 0.07 g	Length:	3.5 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 11.0 mg/L (8.0, 15.0) and 11.7 mg/L (8.0, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7
EDTA hardness (mg $CaCO_3$/L):	14
Total suspended solids (mg/L):	1.3
Residual chlorine (mg/L):	< 0.002
Conductance (µmho/cm):	22.7

Other parameters available on request.

ANALYST

JP

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94011

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Oct 19, 1994	SAMPLE pH:	7.3
SAMPLE RECEIVED:	Oct 19, 1994	SAMPLE D.O.:	5.1 mg/L
TEST STARTED:	Oct 19, 1994	SAMPLE CONDUCTANCE:	1890 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.5	8.1	8.3	10.2	100	100	100	100	100
				--- *CONTROL* ---				
6.2	5.9	10.2	10.4	0	100	100	100	100

COMMENTS: Fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.29 ± 0.05 g	Length:	3.1 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 11.0 mg/L (8.0, 15.0) and 11.0 mg/L (8.0, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7
EDTA hardness (mg $CaCO_3$/L):	14
Total suspended solids (mg/L):	1.3
Residual chlorine (mg/L):	< 0.002
Conductance (µmho/cm):	22.7

Other parameters available on request.

ANALYST

3

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens' *Methods for Calculating an LC50*" (ASTM STP 634, 1977)

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

PE-6276

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94010

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Sep 16, 1994	SAMPLE pH:	7.2
SAMPLE RECEIVED:	Sep 16, 1994	SAMPLE D.O.:	7.4 mg/L
TEST STARTED:	Sep 21, 1994	SAMPLE CONDUCTANCE:	1600 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.4	8.1	8.5	10.4	100	100	100	100	100
				--- *CONTROL* ---				
6.4	7.2	10.4	10.2	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.19 ± 0.03 g	Length:	2.7 ± 0.1 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 11.0 mg/L (8.0, 15.0) and 11.0 mg/L (8.0, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7
EDTA hardness (mg $CaCO_3$/L):	14
Total suspended solids (mg/L):	1.3
Residual chlorine (mg/L):	< 0.002
Conductance (µmho/cm):	22.7

Other parameters available on request.

ANALYST

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96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94009

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Aug 24, 1994	SAMPLE pH:	7.3
SAMPLE RECEIVED:	Aug 24, 1994	SAMPLE D.O.:	4.9 mg/L
TEST STARTED:	Aug 25, 1994	SAMPLE CONDUCTANCE:	1760 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.5	8.1	7.3	10.1	100	100	100	100	100
				-- CONTROL --				
6.2	6.0	10.2	9.9	0	100	100	100	100

COMMENTS: Sample was pre-aerated for 50 min. The test began at 1010hrs. Fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.44 ± 0.06 g	Length:	3.5 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 11.0 mg/L (8.0, 15.0) and 9.75 mg/L (5.00, 15.00).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7
EDTA hardness (mg $CaCO_3$/L):	14
Total suspended solids (mg/L):	1.3
Residual chlorine (mg/L):	< 0.002
Conductance (µmho/cm):	22.7

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

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96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94008

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Jul 06, 1994	SAMPLE pH:	7.3
SAMPLE RECEIVED:	Jul 06, 1994	SAMPLE D.O.:	8.0 mg/L
TEST STARTED:	Jul 07, 1994	SAMPLE CONDUCTANCE:	1790 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.4	8.0	8.6	10.0	100	100	100	100	100
				--- *CONTROL* ---				
6.2	6.1	10.4	10.0	0	100	100	100	100

COMMENTS: Fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.38 ± 0.09 g	Length:	3.5 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 11.0 mg/L (8.0, 15.0) and 10.3 mg/L (8.0, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7
EDTA hardness (mg $CaCO_3$/L):	14
Total suspended solids (mg/L):	1.3
Residual chlorine (mg/L):	< 0.002
Conductance (µmho/cm):	22.7

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94007

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Jun 22, 1994	SAMPLE pH:	7.6
SAMPLE RECEIVED:	Jun 22, 1994	SAMPLE D.O.:	12.4 mg/L
TEST STARTED:	Jun 23, 1994	SAMPLE CONDUCTANCE:	1840 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.7	8.0	10.8	10.3	100	100	100	100	100
				--- *CONTROL* ---				
6.0	5.9	10.4	10.0	0	100	100	100	100

COMMENTS: The sample was aerated for 2 hours. Fish appeared and behaved normally.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.45 ± 0.06 g	Length:	3.6 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 12.3 mg/L (8.0, 20.0) and 11.7 mg/L (8.0, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7
EDTA hardness (mg $CaCO_3$/L):	14
Total suspended solids (mg/L):	1.3
Residual chlorine (mg/L):	< 0.002
Conductance (µmho/cm):	22.7

Other parameters available on request.

ANALYST

AD.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

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BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94006

96-h LC50 (%v/v): >100

SAMPLE TAKEN:	May 25, 1994	SAMPLE pH:	7.2
SAMPLE RECEIVED:	May 25, 1994	SAMPLE D.O.:	6.9 mg/L
TEST STARTED:	May 26, 1994	SAMPLE CONDUCTANCE:	1930 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.4	8.1	8.8	10.2	100	100	100	100	100
				--- *CONTROL* ---				
6.7	6.3	10.4	10.2	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.31 ± 0.04 g	Length:	3.3 ± 0.1 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 12.3 mg/L (8.0, 20.0) and 11.7 mg/L (8.0, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7
EDTA hardness (mg $CaCO_3$/L):	14
Total suspended solids (mg/L):	1.3
Residual chlorine (mg/L):	< 0.002
Conductance (µmho/cm):	22.7

Other parameters available on request.

ANALYST

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

PE-06276

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94004

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Apr 07, 1994	SAMPLE pH:	7.4
SAMPLE RECEIVED:	Apr 07, 1994	SAMPLE D.O.:	6.9 mg/L
TEST STARTED:	Apr 08, 1994	SAMPLE CONDUCTANCE:	1500 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.5	8.1	8.4	9.9	100	100	100	100	100
				--- *CONTROL* ---				
6.0	6.0	10.2	10.0	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.94 ± 0.11 g	Length:	4.2 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT (*analytical grade phenol*)

These tests gave 96-h LC50 of 13.0 mg/L (8.0, 20.0) and 11.7 mg/L (8.0, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	7
EDTA hardness (mg $CaCO_3$/L):	14
Total suspended solids (mg/L):	1.3
Residual chlorine (mg/L):	< 0.002
Conductance (µmho/cm):	22.7

Other parameters available on request.

ANALYST

B

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

PE06274

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94003

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Mar 09, 1994	SAMPLE pH:	7.4
SAMPLE RECEIVED:	Mar 09, 1994	SAMPLE D.O.:	7.6 mg/L
TEST STARTED:	Mar 10, 1994	SAMPLE CONDUCTANCE:	1600 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.4	8.1	8.7	10.0	100	100	100	100	100
				--- *CONTROL* ---				
6.2	6.1	10.2	10.0	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.37 ± 0.05 g	Length:	3.5 ± 0.1 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 13.0 mg/L (8.0, 20.0) and 11.7 mg/L (8.0, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

JP

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94002

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Feb 17, 1994	SAMPLE pH:	7.4
SAMPLE RECEIVED:	Feb 17, 1994	SAMPLE D.O.:	7.2 mg/L
TEST STARTED:	Feb 18, 1994	SAMPLE CONDUCTANCE:	1680 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.4	8.1	7.7	9.9	100	100	100	100	100
				--- *CONTROL* ---				
6.1	6.1	10.2	10.0	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.52 ± .07 g	Length:	3.7 ± 0.1 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 9.23 mg/L (5.00, 15.00) and 8.66 mg/L (5.00, 15.00).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-94001

96-h LC50 (%v/v): >100

SAMPLE TAKEN:	Jan 06, 1994	SAMPLE pH:	7.6
SAMPLE RECEIVED:	Jan 06, 1994	SAMPLE D.O.:	9.1 mg/L
TEST STARTED:	Jan 07, 1994	SAMPLE CONDUCTANCE:	1600 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.6	8.7	10.0	10.2	100	100	100	100	100
				--- *CONTROL* ---				
6.1	6.1	10.2	10.2	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.36 ± .08 g	Length:	3.6 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 15.2 mg/L (10.0, 20.0) and 15.2 mg/L (10.0, 20.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93014

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Dec 16, 1993	SAMPLE pH:	7.3
SAMPLE RECEIVED:	Dec 16, 1993	SAMPLE D.O.:	7.0 mg/L
TEST STARTED:	Dec 17, 1993	SAMPLE CONDUCTANCE:	1650 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.5	8.2	8.6	10.0	100	100	100	100	100
				--- *CONTROL* ---				
6.2	6.2	10.2	10.2	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.36 ± .08 g	Length:	3.6 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 8.66 mg/L (5.00, 15.00) and 6.90 mg/L (5.00, 15.00).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

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BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93013

96-h LC50 (%v/v): >100

SAMPLE TAKEN:	Nov 26, 1993	SAMPLE pH:	7.2
SAMPLE RECEIVED:	Nov 26, 1993	SAMPLE D.O.:	9.4 mg/L
TEST STARTED:	Nov 27, 1993	SAMPLE CONDUCTANCE:	1980 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.3	8.3	10.2	9.6	100	100	100	100	100
				--- *CONTROL* ---				
6.5	6.5	10.2	9.0	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15.0 ± 1 (°C)		
Weight:	0.48 ± 0.03 g	Length:	3.7 ± 0.1 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 7.61 mg/L (5.00, 10.00) and 9.16 mg/L (5.00, 20.00).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634 1977).

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BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93012

96-h LC50 (%v/v): > 100

SAMPLE TAKEN:	Oct 27, 1993	SAMPLE pH:	7.3
SAMPLE RECEIVED:	Oct 27, 1993	SAMPLE D.O.:	7.6 mg/L
TEST STARTED:	Oct 28, 1993	SAMPLE CONDUCTANCE:	2300 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.4	7.8	10.0	10.2	100	100	100	100	100
				— CONTROL —				
6.1	6.3	10.2	10.2	0	100	100	100	100

COMMENTS: All test fish appeared and behaved normally compared to the controls throughout the bioassay.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15.0 ± 1 (°C)		
Weight:	0.32 ± 0.03 g	Length:	3.1 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 9.36 mg/L (6.50, 12.00) and 9.88 mg/L (8.70, 12.00).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977)

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BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93011

96-h LC50 (%v/v): >100

SAMPLE TAKEN:	Sep 30, 1993	SAMPLE pH:	7.4
SAMPLE RECEIVED:	Sep 30, 1993	SAMPLE D.O.:	9.3 mg/L
TEST STARTED:	Oct 01, 1993	SAMPLE CONDUCTANCE:	2400 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.5	8.4	9.8	10.2	100	100	100	100	100
				--- *CONTROL* ---				
5.7	7.0	10.0	10.2	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	20	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	1.08 ± 0.18 g	Length:	4.8 ± 0.3 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 8.93 mg/L (7.75, 10.24) and 7.32 mg/L (6.47, 8.33).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634. 1977).

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BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93010

96-h LC50 (%v/v): **> 100**

SAMPLE TAKEN:	Jul 14, 1993	SAMPLE pH:	7.2
SAMPLE RECEIVED:	Jul 14, 1993	SAMPLE D.O.:	7.5 mg/L
TEST STARTED:	Jul 15, 1993	SAMPLE CONDUCTANCE:	85 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
7.3	8.2	8.6	10.2	100	90	90	90	90
				-- *CONTROL* --				
6.4	6.3	10.2	10.2	0	100	100	100	100

COMMENTS: All surviving fish appeared and behaved normally compared to the control throughout the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.27 ± 0.02 g	Length:	3.3 ± 0.1 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 10.2 mg/L (8.7, 20.0) and 10.8 mg/L (8.7, 20.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93009

96-h LC50 (%v/v): >100

SAMPLE TAKEN:	Jun 30, 1993	SAMPLE pH:	7.4
SAMPLE RECEIVED:	Jun 30, 1993	SAMPLE D.O.:	7.7 mg/L
TEST STARTED:	Jun 30, 1993	SAMPLE CONDUCTANCE:	2250 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.6	8.3	9.5	10.2	100	100	100	100	100
				-- CONTROL --				
6.5	6.4	10.2	10.2	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.48 ± 0.06 g	Length:	3.8 ± 0.1 cm

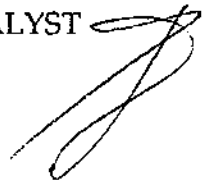
DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 10.2 mg/L (8.7, 12.0) and 8.70 mg/L (6.50, 15.00).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST 

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93008

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	May 26, 1993	SAMPLE pH:	7.8
SAMPLE RECEIVED:	May 26, 1993	SAMPLE D.O.:	9.2 mg/L
TEST STARTED:	May 27, 1993	SAMPLE CONDUCTANCE:	2200 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
8.0	8.2	10.2	10.2	100	100	100	100	100
				--- *CONTROL* ---				
6.8	6.5	10.2	10.2	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.47 ± 0.05 g	Length:	3.8 ± 0.1 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 8.70 mg/L (6.50, 12.00) and 9.63 mg/L (6.50, 12.00).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93007

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	May 20, 1993	SAMPLE pH:	7.5
SAMPLE RECEIVED:	May 20, 1993	SAMPLE D.O.:	6.0 mg/L
TEST STARTED:	May 21, 1993	SAMPLE CONDUCTANCE:	2500 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.6	8.4	7.0	10.2	100	100	100	100	100
7.5	8.0	9.1	10.2	56	100	100	100	100
7.5	7.8	9.5	10.2	32	100	100	100	100
7.5	7.7	10.2	10.2	18	100	100	100	100
7.5	7.4	10.2	10.2	10	100	100	100	100
				--- *CONTROL* ---				
7.0	6.5	10.2	10.2	0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.29 ± 0.05 g	Length:	2.9 ± 0.1 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 12.0 mg/L (8.7, 15.0) and 10.8 mg/L (8.7, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

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BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93006

96-h LC50 (%v/v): **< 100**

SAMPLE TAKEN:	May 18, 1993	SAMPLE pH:	7.6
SAMPLE RECEIVED:	May 18, 1993	SAMPLE D.O.:	6.0 mg/L
TEST STARTED:	May 19, 1993	SAMPLE CONDUCTANCE:	2550 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.7	8.4	7.7	10.2	100	100	60	0	0
				--- *CONTROL* ---				
6.6	6.7	10.2	10.2	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.29 ± 0.05 g	Length:	2.9 ± 0.1 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 12.0 mg/L (8.7, 15.0) and 10.8 mg/L (8.7, 15.0).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

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BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93005

96-h LC50 (%v/v): **> 100**

SAMPLE TAKEN:	Apr 26, 1993	SAMPLE pH:	7.6
SAMPLE RECEIVED:	Apr 26, 1993	SAMPLE D.O.:	8.2 mg/L
TEST STARTED:	Apr 26, 1993	SAMPLE CONDUCTANCE:	1600 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.8	8.3	10.2	10.2	100	100	100	100	100
				--- *CONTROL* ---				
6.4	6.6	10.2	10.2	0	100	100	100	100

COMMENTS: All fish behaved and appeared normally during the test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.44 ± 0.13 g	Length:	3.7 ± 0.3 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 9.63 mg/L (6.50, 12.00) and 8.70 mg/L (6.50, 12.00).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *Methods for Calculating an LC50* (ASTM STP 634 1977).

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93004

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Mar 24, 1993	SAMPLE pH:	7.5
SAMPLE RECEIVED:	Mar 24, 1993	SAMPLE D.O.:	10 mg/L
TEST STARTED:	Mar 25, 1993	SAMPLE CONDUCTANCE:	1700 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
7.6	7.8	10.2	10.2	100	100	100	100	80
				--- *CONTROL* ---				
6.4	6.6	10.2	10.2	0	100	100	100	100

COMMENTS: All surviving fish appeared normal at end of test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.33 ± .03 g	Length:	3.1 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 14.3 mg/L (12.0, 20.0) and 16.2 mg/L (14.4, 18.8).

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	14.5
EDTA hardness (mg $CaCO_3$/L):	21
Total suspended solids (mg/L):	< 1.0
Residual chlorine (mg/L):	< 0.01
Conductance (µmho/cm):	38

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93003

96-h LC50 (%v/v): >100

SAMPLE TAKEN:	Feb 14, 1993	SAMPLE pH:	7.7
SAMPLE RECEIVED:	Feb 14, 1993	SAMPLE D.O.:	7.9 mg/L
TEST STARTED:	Feb 15, 1993	SAMPLE CONDUCTANCE:	2120 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.9	7.8	9.0	10.2	100	90	90	70	70
				--- *CONTROL* ---				
6.7	6.8	10.2	10.2	0	100	100	100	100

COMMENTS: All surviving fish appeared normal at end of test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.46 ± 0.05 g	Length:	3.6 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 11.2 mg/L (8.7, 15.0) and 12.8 mg/L (11.4, 14.1).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

JP

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens, *"Methods for Calculating an LC50"* (ASTM STP 634 - 1977).

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93002

96-h LC50 (%v/v): **74.8 (56.0, 100.0)**

SAMPLE TAKEN:	Feb 01, 1993	SAMPLE pH:	7.6
SAMPLE RECEIVED:	Feb 01, 1993	SAMPLE D.O.:	8.2 mg/L
TEST STARTED:	Feb 02, 1993	SAMPLE CONDUCTANCE:	1700 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
7.6	8.3	9.4	10.0	100	100	80	50	0
7.6	8.2	10.1	10.2	56	100	100	100	100
7.6	8.1	10.2	10.2	32	100	100	100	100
7.6	8.0	10.2	10.2	18	100	100	100	100
7.5	8.0	10.2	10.2	10	100	100	100	100
				--- *CONTROL* ---				
6.8	6.6	10.2	10.2	0	100	100	100	100

COMMENTS: All surviving fish appeared normal at end of test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.37 ± 0.05 g	Length:	3.5 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 10.6 mg/L (8.7, 12.0) and 10.2 mg/L (8.7, 12.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977)

Fraser River Harbour Commission

BC RESEARCH VANCOUVER

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-93001

96-h LC50 (%v/v): **<100**

SAMPLE TAKEN:	Jan 28, 1993	SAMPLE pH:	7.5
SAMPLE RECEIVED:	Jan 28, 1993	SAMPLE D.O.:	8.0 mg/L
TEST STARTED:	Jan 29, 1993	SAMPLE CONDUCTANCE:	1150 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
7.6	8.3	10.2	10.2	100	100	60	0	0
				--- *CONTROL* ---				
6.6	6.7	10.2	10.2	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/13: *Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout/British Columbia Provincial Guidelines and Laboratory Procedures for Measuring Acute Lethal Toxicity of Liquid Effluents to Fish, November 1982.*

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.37 ± 0.05 g	Length:	3.5 ± 0.2 cm

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

These tests gave 96-h LC50 of 10.6 mg/L (8.7, 12.0) and 10.2 mg/L (8.7, 12.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

JP

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-92018

96-h LC50 (%v/v): >100

SAMPLE TAKEN:	Dec 02, 1992	SAMPLE pH:	7.6
SAMPLE RECEIVED:	Dec 02, 1992	SAMPLE D.O.:	8.4 mg/L
TEST STARTED:	Dec 03, 1992	SAMPLE CONDUCTANCE:	1900 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
7.6	8.5	9.2	10.0	100	100	100	100	100
				--- *CONTROL* ---				
7.2	6.8	10.2	10.2	0	100	100	100	100

COMMENTS: All fish appeared normal at end of test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/9: ACUTE LETHALITY TEST USING RAINBOW TROUT/British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING ACUTE LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November 1982.

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.30 ± 0.03 g	Length:	3.2 ± 0.1 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 8.14 mg/L (6.50, 20.00) and 12.3 mg/L (6.5, 20.00).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	2.75
EDTA hardness (mg $CaCO_3$/L):	4.95
Total suspended solids (mg/L):	<1
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	13.47

Other parameters available on request.

ANALYST

JP

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-92017

96-h LC50 (%v/v): >100

SAMPLE TAKEN:	Nov 25, 1992	SAMPLE pH:	7.7
SAMPLE RECEIVED:	Nov 25, 1992	SAMPLE D.O.:	9.3 mg/L
TEST STARTED:	Nov 26, 1992	SAMPLE CONDUCTANCE:	1950 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
7.8	8.5	10.2	10.1	100	100	100	100	100
				--- *CONTROL* ---				
6.7	6.7	10.2	10.2	0	100	100	100	100

COMMENTS: All fish appeared normal at end of test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	8	Test pH adjusted:	NO

Bioassay conducted according to EPS 1 RM/9: ACUTE LETHALITY TEST USING RAINBOW TROUT/British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING ACUTE LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November 1982.

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.30 ± 0.03 g	Length:	3.2 ± 0.1 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 8.14 mg/L (6.50, 20.00) and 12.3 mg/L (6.5, 20.00).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	2.75
EDTA hardness (mg $CaCO_3$/L):	4.95
Total suspended solids (mg/L):	<1
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	13.47

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *Methods for Calculating an LC50*" (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH

PE-6276

96-h Static LC50 Bioassay Results of #1 FINAL DISCHARGE

2-11-200-790-92016

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Aug 20, 1992	SAMPLE pH:	7.5
SAMPLE RECEIVED:	Aug 20, 1992	SAMPLE D.O.:	9.5 mg/L
TEST STARTED:	Aug 21, 1992	SAMPLE CONDUCTANCE:	3800 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
7.7	8.5	9.8	9.8	100	100	100	100	100
				--- *CONTROL* ---				
6.9	6.9	10.2	10.2	0	100	100	100	100

COMMENTS: All fish appeared normal at end of test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November 1982.

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.40 ± 0.6 g	Length:	3.7 ± 0.5 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 9.36 mg/L (6.50, 12.00) and 8.70 mg/L (6.50, 12.00).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

B

Fraser River Harbour Commission

BC RESEARCH

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-92015

96-h LC50 (%v/v): >100

SAMPLE TAKEN:	May 26, 1992	SAMPLE pH:	7.6
SAMPLE RECEIVED:	May 26, 1992	SAMPLE D.O.:	7.8 mg/L
TEST STARTED:	May 27, 1992	SAMPLE CONDUCTANCE:	2000 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.8	8.3	10.2	10.2	100	100	100	100	100
				--- *CONTROL* ---				
5.9	6.6	10.2	10.2	0	100	100	100	100

COMMENTS: All fish appeared normal at end of test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November 1982.

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.46 ± 0.06 g	Length:	3.7 ± 0.1 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 13.2 mg/L (11.5, 15.6) and 13.1 mg/L (11.5, 14.9).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

J

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC RESEARCH

96-h Static LC50 Bioassay Results of
SITE #3 - FINAL DISCHARGE

2-11-200-790-92012

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Feb 25, 1992	SAMPLE pH:	7.7
SAMPLE RECEIVED:	Feb 26, 1992	SAMPLE D.O.:	7.4 mg/L
TEST STARTED:	Feb 26, 1992	SAMPLE CONDUCTANCE:	1900 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
8.0	8.3	10.2	10.2	100	100	100	100	100
				--- *CONTROL* ---				
6.5	6.7	10.2	10.2	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH I, November 1982.

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.39 ± 0.07 g	Length:	3.5 ± 0.2 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 7.71 mg/L (6.50, 12.00) and 7.94 mg/L (6.50, 12.00).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

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BC RESEARCH

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-91008

96-h LC50 (%v/v): **> 100**

SAMPLE TAKEN:	Nov 13, 1991	SAMPLE pH:	7.7
SAMPLE RECEIVED:	Nov 13, 1991	SAMPLE D.O.:	7.4 mg/L
TEST STARTED:	Nov 14, 1991	SAMPLE CONDUCTANCE:	1410 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
8.0	8.5	10.2	10.2	100	100	100	100	100
				— *CONTROL* —				
6.6	6.8	10.2	10.2	0	100	100	100	100

COMMENTS: All fish behaved normally at end of test.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November 1982.

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.28 ± 0.06 g	Length:	3.1 ± 0.3 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 10.8 mg/L (8.7, 15.0) and 10.6 mg/L (8.7, 12.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

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BC RESEARCH

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-91006

96-h LC50 (%v/v): >100

SAMPLE TAKEN: Aug 27, 1991
SAMPLE RECEIVED: Aug 27, 1991
TEST STARTED: Aug 28, 1991

SAMPLE pH: 8.3
SAMPLE D.O.: 6.4 mg/L
SAMPLE CONDUCTANCE: 1800 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
8.2	8.6	10.2	10.2	100	100	100	100	100
				— *CONTROL* —				
6.2	6.7	10.2	10.2	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish: 10
Test volume (L): 10
Test temperature (°C): 15 ± 1
Test pH adjusted: NO

Bioassay conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November 1982.

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated: 15 ± 1 (°C)
Weight: 0.30 ± 0.08 g
Length: 3.3 ± 0.2 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 7.94 mg/L (6.50, 12.00) and 9.36 mg/L (6.50, 12.00).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	2.75
EDTA hardness (mg $CaCO_3$/L):	4.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	13.47

Other parameters available on request.

ANALYST

Patricia Keen

Fraser River Harbour Commission

BC RESEARCH

96-h Static LC50 Bioassay Results of FINAL DISCHARGE

2-11-200-790-91005

96-h LC50 (%v/v): > 100

SAMPLE TAKEN:	May 14, 1991	SAMPLE pH:	7.5
SAMPLE RECEIVED:	May 15, 1991	SAMPLE D.O.:	8.6 mg/L
TEST STARTED:	May 15, 1991	SAMPLE CONDUCTANCE:	1790 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
7.7	8.4	10.2	10.2	100	100	100	100	100
				— *CONTROL* —				
6.0	6.5	10.2	10.2	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	10	Test pH adjusted:	NO

Bioassay conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November 1982.

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.27 ± .02 g	Length:	3.18 ± .1 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 9.62 mg/L (6.50, 12.00) and 6.50 mg/L (4.90, 12.00).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	2.5
EDTA hardness (mg $CaCO_3$/L):	3.6
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.002
Conductance (µmho/cm):	27

Other parameters available on request.

ANALYST

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

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BC RESEARCH

2-11-200-790-91003

96-h STATIC LC50 BIOASSAY RESULTS OF FINAL DISCHARGE

SAMPLE TAKEN:	FEB-06-91	SAMPLE pH:	7.5	
SAMPLE RECEIVED:	FEB-06-91	SAMPLE D.O.:	8.0	mg/L
TEST STARTED:	FEB-07-91	SAMPLE CONDUCTANCE:	1870	umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h
7.6	8.6	9.4	10.2	100	100	100	100	100
6.1	6.3	10.2	10.2	0 CONTROL	100	100	100	100

96-h LC50 (%v/v): >100

TEST CONDITIONS

Number of fish: 10 Test temperature (C): 15 ± 1
Test volume (L): 10 Test pH adjusted: 0

TEST FISH Juvenile rainbow trout (Oncorhynchus mykiss)

Acclimated to temperature 15.0 (C)
Weight 0.27 ± 0.04 g Length 3.2 ± 0.1 cm

Duplicate reference toxicant (analytical grade phenol) bioassays were Bioassay conducted according to British Columbia PROVINCIAL GUIDELINES conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 8.70 mg/L (6.50, 12.00) and 8.14 mg/L (6.50, 12.00).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	2.5
EDTA hardness (mg CaCO3/L)	3.6
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	27

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Bioassay conducted according to British Columbia PROVINCIAL GUIDELINES AND LOBAROTARY PROCEDURES FOR MEASURING LEATHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

ANALYST B.C. RESEARCH

DB

FRASER RIVER HARBOUR COMMISSION

BC RESEARCH

2-11-200-790-91001

96-h STATIC LC50 BIOASSAY RESULTS OF FINAL DISCHAGE

SAMPLE TAKEN: Jan 22, 1991
SAMPLE RECEIVED: Jan 22, 1991
TEST STARTED: Jan 23, 1991

SAMPLE pH 7.4
SAMPLE D.O. 7.8 mg/L
SAMPLE CONDUCTANCE 2110 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.7	8.1	9.7	9.8	100.0	100	100	100	100	> 100
6.2	6.5	10.1	10.0	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10
Test volume (liters) 15.0
Test temperature (C) 15.0±1
Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Oncorhynchus mykiss)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.27 +/- 0.04 g Length 3.2 +/- 0.1 cm

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 8.70 mg/L (6.50, 12.00) and 8.14 mg/L (6.50, 12.00).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	2.5
EDTA hardness (mg CaCO3/L)	3.6
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	27

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM 1977).

ANALYST

B.C. RESEARCH

JP

HARBOUR COMMISION

2-41-100-791-89003

96-h STATIC LC50 BIOASSAY RESULTS OF
GRAB SAMPLE #1

SAMPLE TAKEN: Nov 17, 1989 SAMPLE pH 7.4
SAMPLE RECEIVED: Nov 17, 1989 SAMPLE D.O. 6.5 mg/L
TEST STARTED: Nov 17, 1989 SAMPLE CONDUCTANCE 7000 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.8	8.2	10.0	9.8	100.0	100	100	100	100	> 100
6.2	6.5	9.8	9.8	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10 Test temperature (C) 15.0
Test volume (liters) 4.0 Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.25 +/- 0.03 g Length 2.5 +/- 0.1 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 80.0 ug/L (70.0, 100.0) and 84.8 ug/L (81.3, 88.5)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	4.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	33

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST B.C. RESEARCH

FRASER RIVER HARBOUR COMMISSION

BC RESEARCH

2-11-200-790-90012

96-h STATIC LC50 BIOASSAY RESULTS OF
Site #1 Final Discharge

SAMPLE TAKEN: Nov 8, 1990
SAMPLE RECEIVED: Nov 8, 1990
TEST STARTED: Nov 9, 1990

SAMPLE pH 7.4
SAMPLE D.O. 6.2 mg/L
SAMPLE CONDUCTANCE 2600 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
6.1	6.3	10.0	10.0	100.0	90	90	90	90	> 100
7.7	8.3	10.0	10.0	0.0 CONTROL	100	100	90	90	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10
Test volume (liters) 4.0
Test temperature (C) 15.0±1
Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Oncorhynchus mykiss)

Acclimated to temperature 12.0 +/- 1 C.
Weight 0.32 +/- 0.05 g Length 3.5 +/- 0.2 cm

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 7.75 mg/L (6.84, 8.83) and 8.75 mg/L (7.65, 10.00).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	2.5
EDTA hardness (mg CaCO3/L)	3.6
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	27

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM 1977).

ANALYST

B.C. RESEARCH

J. Rickard

FRASER RIVER HARBOUR COMMISSION

2-11-200-790-90005

96-h STATIC LC50 BIOASSAY RESULTS OF
Final Discharge

SAMPLE TAKEN: Jul 18, 1990 SAMPLE pH 7.3
SAMPLE RECEIVED: Jul 18, 1990 SAMPLE D.O. 8.2 mg/L
TEST STARTED: Jul 19, 1990 SAMPLE CONDUCTANCE 6500 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.7	8.3	10.2	10.2	100.0	100	100	100	100	>100
6.3	6.9	10.2	10.2	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10 Test temperature (C) 15.0±1
Test volume (liters) 4.0 Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Oncorhynchus mykiss)

Acclimated to temperature 13.0 +/- 1 C.
Weight 0.14 +/- 0.03 g Length 2.8 +/- 0.1 cm

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 9.6 ug/L (8.3, 11.0) and 7.5 ug/L (6.5, 8.7).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	4.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	33

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM 1977).

ANALYST B.C. RESEARCH

FRASER RIVER HARBOUR COMMISSION

BC RESEARCH

2-11-200-790-90004

96-h STATIC LC50 BIOASSAY RESULTS OF FINAL DISCHARGE

SAMPLE TAKEN: May 29, 1990
SAMPLE RECEIVED: May 29, 1990
TEST STARTED: May 30, 1990

SAMPLE pH 7.8
SAMPLE D.O. 8.6 mg/L
SAMPLE CONDUCTANCE 5000 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.8	8.1	9.6	10.2	100.0	100	100	100	100	> 100
6.5	5.6	10.2	10.2	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10
Test volume (liters) 10.0
Test temperature (C) 15.0±1
Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Oncorhynchus mykiss)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.45 +/- 0.07 g Length 3.7 +/- 0.5 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 90.0 ug/L (80.0, 110.0) and 89.0 ug/L (83.5, 94.6).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	4.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	33

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM 1977).

ANALYST

B.C. RESEARCH

J Pickard

FRASER RIVER HARBOUR COMMISSION

BC RESEARCH

2-11-200-790-90002

96-h STATIC LC50 BIOASSAY RESULTS OF FINAL EFFLUENT

SAMPLE TAKEN: Apr 24, 1990
SAMPLE RECEIVED: Apr 25, 1990
TEST STARTED: Apr 26, 1990

SAMPLE pH 7.6
SAMPLE D.O. 10.2 mg/L
SAMPLE CONDUCTANCE 7000 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
8.1	8.3	10.2	10.0	100.0	100	100	100	100	> 100
6.3	6.5	10.2	10.0	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10
Test volume (liters) 4.0
Test temperature (C) 15.0±1
Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Oncorhynchus mykiss)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.34 +/- 0.05 g Length 3.2 +/- 0.2 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 78.3 ug/L (73.6, 82.7) and 73.1 ug/L (67.9, 78.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	4.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	33

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM 1977).

ANALYST

B.C. RESEARCH

RICHMOND LANDFILL

BC RESEARCH

2-11-200-790-90001

96-h STATIC LC50 BIOASSAY RESULTS OF GRAB #1

SAMPLE TAKEN: Feb 22, 1990
SAMPLE RECEIVED: Feb 22, 1990
TEST STARTED: Feb 23, 1990

SAMPLE pH 7.3
SAMPLE D.O. 7.1 mg/L
SAMPLE CONDUCTANCE 10800 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.3	7.9	9.8	10.0	100.0	100	100	100	100	> 100
6.3	6.5	10.2	10.0	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10
Test volume (liters) 4.0
Test temperature (C) 15.0
Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.34 +/- 0.03 g Length 3.3 +/- 0.2 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 93.0 ug/L (80.0, 100.0) and 91.2 ug/L (80.0, 100.0)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	4.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	33

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST

B.C. RESEARCH

RICHMOND LANDFILL

BC RESEARCH

2-11-200-790-90001

96-h STATIC LC50 BIOASSAY RESULTS OF
GRAB #1

SAMPLE TAKEN: Feb 22, 1990
SAMPLE RECEIVED: Feb 22, 1990
TEST STARTED: Feb 23, 1990

SAMPLE pH 7.3
SAMPLE D.O. 7.1 mg/L
SAMPLE CONDUCTANCE 10800 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.3	7.9	9.8	10.0	100.0	100	100	100	100	> 100
6.3	6.5	10.2	10.0	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10
Test volume (liters) 4.0
Test temperature (C) 15.0
Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.34 +/- 0.03 g Length 3.3 +/- 0.2 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 93.0 ug/L (80.0, 100.0) and 91.2 ug/L (80.0, 100.0)

DILUTION WATER (Vancouver dechlorinated tap water)

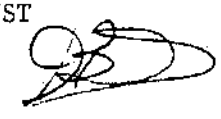
Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	4.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	33

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST

B.C. RESEARCH



RICHMOND LANDFILL

BC RESEARCH

2-41-100-813-89001

96-h STATIC LC50 BIOASSAY RESULTS OF
1

SAMPLE TAKEN: May 25, 1989
SAMPLE RECEIVED: May 25, 1989
TEST STARTED: May 26, 1989

SAMPLE pH 7.7
SAMPLE D.O. 6.6 mg/L
SAMPLE CONDUCTANCE 3100 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.8	8.4	9.8	10.0	100.0	100	100	100	100	> 100
6.6	6.7	9.8	10.0	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10
Test volume (liters) 4.0
Test temperature (C) 15.0
Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.36 +/- 0.08 g Length 3.3 +/- 0.3 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 72.3 ug/L (60.0, 90.0) and 74.8 ug/L (60.0, 100.0)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	4.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	33

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST

B.C. RESEARCH

HARBOUR COMMISION

BC RESEARCH

2-41-100-791-89001

96-h STATIC LC50 BIOASSAY RESULTS OF SAMPLE # 1

SAMPLE TAKEN: Feb 28, 1989
SAMPLE RECEIVED: Feb 28, 1989
TEST STARTED: Mar 2, 1989

SAMPLE pH 7.5
SAMPLE D.O. 8.0 mg/L
SAMPLE CONDUCTANCE 4200 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.7	8.3	10.0	10.0	100.0	100	100	100	100	> 100
6.3	6.5	10.0	10.2	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10
Test volume (liters) 4.0
Test temperature (C) 15.0
Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.20 +/- 0.02 g Length 3.0 +/- 0.2 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 84.9 ug/L (60.0, 90.0) and 76.5 ug/L (72.0, 80.8)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	4.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	33

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST

B.C. RESEARCH

RICHMOND LANDFILL

BC RESEARCH

2-41-100-790-10021

96-h STATIC LC50 BIOASSAY RESULTS OF FINAL EFFLUENT #3

SAMPLE TAKEN: Dec 14, 1988
SAMPLE RECEIVED: Dec 15, 1988
TEST STARTED: Dec 15, 1988

SAMPLE pH 7.4
SAMPLE D.O. 4.2 mg/L
SAMPLE CONDUCTANCE 7000 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.6	8.3	9.8	9.8	100.0	100	100	100	100	> 100
6.2	6.5	10.2	10.2	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10
Test volume (liters) 4.0
Test temperature (C) 15.0
Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.33 +/- 0.03 g Length 3.3 +/- 0.3 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 92.9 ug/L (88.4, 97.1) and 88.7 ug/L (80, 110)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	5.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	15

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST

B.C. RESEARCH

RECEIVED
JAN 23 1989
LOWER MAINLAND REGION
FILE No.

RICHMOND LANDFILL

BC RESEARCH

2-41-100-790-10017

96-h STATIC LC50 BIOASSAY RESULTS OF #3

SAMPLE TAKEN: Oct 19, 1988 SAMPLE pH 7.1
SAMPLE RECEIVED: Oct 19, 1988 SAMPLE D.O. 4.4 mg/L
TEST STARTED: Oct 20, 1988 SAMPLE CONDUCTANCE 4900 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.3	8.1	9.0	9.8	100.0	100	100	100	100	>100
6.3	6.5	10.0	10.0	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10 Test temperature (C) 15.0
Test volume (liters) 4.0 Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.50 +/- 0.10 g Length 4.0 +/- 0.3 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 107.5 ug/L (90, 120) and 91.2 ug/L (80.0, 120.0)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	5.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	15

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST B.C. RESEARCH

RICHMOND LANDFILL

2-41-100-790-10012

96-h STATIC LC50 BIOASSAY RESULTS OF
QUARTERLY GRAB SAMPLE

SAMPLE TAKEN: May 18, 1988 SAMPLE pH 7.6
SAMPLE RECEIVED: May 18, 1988 SAMPLE D.O. 6.8 mg/L
TEST STARTED: May 18, 1988 SAMPLE CONDUCTANCE 2000 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.6	8.8	10.0	9.4	100.0	100	100	100	100	>100
6.3	6.7	10.4	9.8	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10 Test temperature (C) 15.0
Test volume (liters) 4.0 Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)

Acclimated to temperature 15.0 +/- 1 C.
Weight 0.39 +/- 0.10 g Length 3.5 +/- 0.3 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 96.0 ug/L (90, 110) and 87.2 ug/L (80, 100)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	5.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	15

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST B.C. RESEARCH

RECEIVED
JUL 12 1988
LOWER MAINLAND REGION
FILE No.

RICHMOND LANDFILL

2-41-100-790-10008

96-h STATIC LC50 BIOASSAY RESULTS OF
#3

SAMPLE TAKEN: Mar 16, 1988 SAMPLE pH 7.7
SAMPLE RECEIVED: Mar 16, 1988 SAMPLE D.O. 9.2 mg/L
TEST STARTED: Mar 17, 1988 SAMPLE CONDUCTANCE 3100 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL				96-h
INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	CONC'N (%v/v)	24h	48h	72h	96h	LC50 (%v/v)
7.8	8.1	9.8	9.8	100.0	100	100	100	100	>100
6.2	6.5	9.8	9.8	0.0 CONTROL	100	100	100	100	

TEST CONDITIONS

Bioassays conducted according to British Columbia PROVINCIAL GUIDELINES AND LABORATORY PROCEDURES FOR MEASURING LETHAL TOXICITY OF LIQUID EFFLUENTS TO FISH, November, 1982.

Number of test fish 10 Test temperature (C) 15.0
Test volume (liters) 4.0 Test solution pH not adjusted

TEST FISH

Juvenile rainbow trout (Salmo gairdneri)
Acclimated to temperature 15.0 +/- 1 C.
Weight 0.25 +/- 0.05 g Length 2.7 +/- 0.3 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 80.0 ug/L (50.0, 100.0) and 71.5 ug/L (50.0, 90.0)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/L)	3.0
EDTA hardness (mg CaCO3/L)	5.0
Total suspended solids (mg/L)	<1.0
Residual chlorine (mg/L)	<0.002
Conductance (umho/cm)	15

Other parameters available on request.

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634, 1977).

ANALYST B.C. RESEARCH

RICHMOND LANDFILL

2-41-100-837-87019

96-h STATIC LC50 BIOASSAY RESULTS OF
#3

SAMPLE TAKEN: Nov 5, 1987
SAMPLE RECEIVED: Nov 5, 1987
TEST STARTED: Nov 6, 1987

SAMPLE pH 7.5
SAMPLE D.O. 7.5 mg/l
SAMPLE CONDUCTANCE 4500 umho/cm

THE 96-h LC50 FOR THIS SAMPLE WAS >100 %v/v

	INIT pH	FINAL pH	INIT DO mg/l	FINAL DO mg/l	TEST CONC %v/v	PERCENT SURVIVAL 24h	48h	72h	96h
SAMPLE	7.8	8.3	9.4	9.6	100.0	100	100	100	100
CONTROL	6.4	6.7	9.6	9.6		100	100	100	100

TEST CONDITIONS

Bioassays conducted according to STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER, 15th edition, 1980 APHA - AWWA - WPCF.

Number of test fish 10
Test volume (liters) 10.0
Test temperature (C) 15.0
Test solution pH not adjusted

TEST FISH

Juvenile Rainbow Trout (Salmo gairdneri)
Acclimated to temperature 15.0 +/- 1 C.
Weight 0.50 +/- 0.10 g Length 4.0 +/- 0.3 cm

Duplicate reference toxicant (sodium pentachlorophenate) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 values of 107.5 ug/l (90, 120) and 91.2 ug/l (80, 120)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/l)	3.0
EDTA hardness (mg CaCO3/l)	5.0
Total suspended solids (mg/l)	<1.0
Residual chlorine (mg/l)	0.002
Conductance (umho/cm)	18

Other parameters available on request.

96-h LC50 is the 96-h lethal concentration for 50% mortality. Synonyms are TLm96 and 96-h TL50 (median tolerance limit). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "Methods for Calculating an LC50" (ASTM STP 634. 1977).

ANALYST

B.C. RESEARCH

October 15, 1993
File No: 2-51-790

BC RESEARCH
B.C. Research Inc.
3650 Wesbrook Mall
Vancouver, B.C.
Canada V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

Mr. Dennis Barlow
Ministry of Environment
Waste Management Branch
15326 - 103A Avenue
Surrey, B.C.
V3R 7A2

RECEIVED
NOV 0 1 1993
LOWER MAINLAND REGION
FILE NO.

Dear Mr. Barlow:

Subject: Permit No. PE-6276

The attached tables contain the analytical and bioassay results for the third quarterly monitoring of the final discharge at the Fraser Port Richmond landfill site. I was advised by FRHC staff that there was no discharge in August due to the dry weather and repairs to the final pumps on west perimeter collection ditch, therefore there is no data for that month. The flow, temperature, and precipitation records for the months April to August are enclosed.

FIELD MEASUREMENTS

DATE	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
July 14, 1993	18.0	2.6
Sept. 30, 1993	18.5	10.7

Dean Chalcraft has informed me that there will be dredging from Nov.1 - 5 on the Mathers site, Northwest of the Ecowaste landfill. This may cause an impact on water levels in No. 7 Rd. Ditch but will not affect the discharge from the Richmond landfill site.

If you have any questions or comments please call me.

Yours truly,

BRITISH COLUMBIA RESEARCH INC.

J. Pickard
Biologist
Applied Biology Division

cc: *Mr. R. Pearce*
Mr. G. Hughes
Mr. Bill Tou

encls.

Province of
British Columbia

MINISTRY OF
ENVIRONMENT,
LANDS AND PARKS

BC Environment
LOWER MAINLAND REGION

Environmental Protection
15326 — 103A Avenue
Surrey, British Columbia
V3R 7A2
Telephone: (604) 582-5200
Facsimile: (604) 584-9751

PE06276

August 5, 1993

Fraser River Harbour Commission
505 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

Attention: Mr. T. Corsie, Manager of Operations

Dear Mr. Corsie:

Re: Waste Management Permit PE06276 - Fraser Port Landfill
Quarterly Monitoring Reports

I have received second quarter 1993 monitoring reports from B.C. Research Inc. on the effluent discharge, groundwater wells and surface waters pertaining to the Fraser Port Landfill. After reviewing the reports, I note that the following permit requirements were not satisfied. Status of the permit is therefore considered to be out of compliance.

- The final effluent was toxic on May 18, 1993 (96 hour LC_{50} <100%);
- Biochemical oxygen demand exceeded 30 mg/L on May 20 and May 26, 1993 (43 mg/L and 35 mg/L respectively).

Please advise me by August 31, 1993 of the action that has been taken or will be taken to ensure consistent compliance. Note that failure to comply with permit requirements is a violation of the Waste Management Act and violations may be subject to legal action. The Regional Waste Manager must be notified of any proposed bypasses or process modifications which may adversely affect the quality and/or quantity of the final effluent.

A report containing effluent quality and flow data for the final discharge is due 31 July 1993. Please call me (582-5276) if you have any questions.

Yours truly,

Dennis Barlow
Scientific/Technical Officer
Municipal Section

cc J. Pickard, B.C. Research Inc.

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BC RESEARCH
BRITISH COLUMBIA RESEARCH CORPORATION

3650 Wesbrook Mall
Vancouver, B.C.
Canada V6S 2L2
Fax: (604) 224-0540
Tel: (604) 224-4331

July 21, 1993
File No: 2-51-790

Mr. Dennis Barlow
Ministry of Environment
Waste Management Branch
15326 - 103A Avenue
Surrey, B.C.
V3R 7A2

RECEIVED
JUL 30 1993
LOWER MAINLAND REGION
FILE NO. .....

Dear Mr. Barlow:

Subject: Permit No. PE-6276

The attached tables contain the analytical and bioassay results for the second quarterly monitoring of the final discharge and results of the groundwater and surface waters monitoring at the Fraser Port Richmond landfill site for the first half of the year.

	FIELD MEASUREMENTS	
DATE	TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/L)
April 26, 1993	10.5	6.5
May 18, 1993	12.5	6.5
May 20, 1993	17.0	6.8
May 26, 1993	20.5	12.2
June 30, 1993	17.0	4.9

The Final Discharge bioassay sample taken on May 18th failed. I resampled on May 20th for toxicity and all the chemical analysis required on the quarterly report. This bioassay sample was nontoxic in all concentrations. The ammonia level of this sample was slightly elevated, 4.6 mgN/L, and this may have been the reason for the toxicity on May 18th.

The Harbour Commission has decided to monitor the flow and precipitation themselves using Inland Waters' instrument. Apparently FRHC staff encountered some difficulty and there are no records for this period. An appointment has been set with you for August and this will be discussed at that time.

I have sampled the north perimeter ditch (N.P.D.) at the site where Dean Chalcroft indicated there had been channelling through the berm and the results are enclosed. The only contaminant found was ammonia (20.9 mgN/L) which may have originated from the landfill or from the farmers field. In either event it does not show up in Site 5 (the outfall from Nelson Road ditch into the Fraser) or in No. 7 Road ditch.

The lead levels in the wells have been reduced since the December 1992 sampling in sites A, B, C, and D from 0.14, 0.26, 0.13, and 0.10 to 0.023, 0.008, 0.049, and 0.009, respectively.

Yours truly,
BRITISH COLUMBIA RESEARCH CORPORATION

Janet Pickard

J. Pickard
Biologist
Applied Biology Division

cc: *Mr. R. Pearce*
Mr. G. Hughes
Mr. Bill Tou
encls.

- BOD and TSS should be maintained as performance indicators of effluent treatment.
- SO_4 should be maintained, as less than two years have elapsed since levels exceeding permit limit were exhibited. However the limit of 250 mg/L is difficult to justify, and should be removed.
- Phosphorus (total dissolved) should be maintained, as P is added periodically in the treatment process.
- Na, Cl and K should be deleted from the monitoring program, as these parameters are associated with salt water infiltration and dredging, and do not serve as useful indicators.
- Pb, Cu and Zn should be deleted from Appendix 01-1, as no values causing concern have been noted. Total metals should be determined. and retained in App C-1 C-3 C-4 .03
- Hg should be deleted from all Appendices, as no values causing concern have ever been noted.

Evaluation of PE-6276 Monitoring Program

Parameter	App 01-1 Limit	Trend from 90-01	Recommendation
TSS	40 mg/L	3-30, variable	maintain
BOD	30 mg/L	<10-18 mg/L	maintain
Toxicity	Non-toxic	LC_{50} always >100%	LC_{50} > 100% in App 01-1
pH	6.5 - 8.5	6.9 - 8.4	maintain
Copper (diss)	0.2 mg/L	.001-.04, variable	delete from App 01-1, use total in App C-1, C-3, C-4
Lead (total)	0.05 mg/L	<.001-.003, var	delete from App 01-1
Mercury (total)	0.6 ug/L	<0.05 always	delete from all Apps
Zinc (total)	0.5 mg/L	.002-.11, var	delete from App 01-1
Iron (diss)	12.0 mg/L	0.1-2.4, var	delete from App 01-1, use total in App C-1, C-3, C-4
Manganese (diss)	3.3 mg/L	0.09-1.16, var	delete from App 01-1, use total in App C-1, C-3, C-4
Sulphate (diss)	250 mg/L	516 mg/L (90-01) steadily down to 7 mg/L (92-08)	delete from App 01-1
Phosphorus (diss)	—	0.012-0.098 mg/L, var	delete from App 01-1
Sodium	—	431-1460 mg/L, var	delete from all Apps
Potassium	—	23.5-67.5 mg/L, var	delete from all Apps
Chloride	—	100-2450 mg/L, var	delete from all Apps
Ammonia nitrogen	—	.013-8.1, var	add to App 01-1, specify <10 mg/l
Aluminum (total)	—	not measured	add to App C-1, C-3, C-4
Resin Acids	—	not measured	add to App C-1
Fatty Acids	—	not measured	add to App C-1
COD	—	not measured	add to App C-1, C-3, C-4
Acidity pH 8.3	—	not measured	add to App C-1, C-3, C-4

../7

RECOMMENDATIONS

It is recommended that the application for amendment proceed, authorizing operation of a woodwaste pile, with the following conditions to apply:

- Appendix 01(a) should read approximately "The sources of the effluent to which this appendix is applicable are (1) a closed municipal and demolition landfill operation and (2) a woodwaste storage facility with a maximum 115,000 tonnes of woodwaste in storage."
- Amend monitoring program to require records of weights of woodwaste hauled in and out, and held in storage. Records should be maintained for inspection.
- Amend monitoring program parameters as follows:

Parameter	Current App 01-1	Recommendation
TSS	40 mg/L	maintain
BOD	30 mg/L	maintain
Toxicity	Non-toxic to fish	replace with LC_{50} > 100% in App 01-1
pH	6.5 - 8.5	maintain
Copper (diss)	0.2 mg/L	delete from App 01-1, use total in App C-1, C-3, C-4
Lead (total)	0.05 mg/L	delete from App 01-1
Mercury (total)	0.6 ug/L	delete from all Apps
Zinc (total)	0.5 mg/L	delete from App 01-1
Iron (diss)	12.0 mg/L	delete from App 01-1, use total in App C-1, C-3, C-4
Manganese (diss)	3.3 mg/L	delete from App 01-1, use total in App C-1, C-3, C-4
Sulphate (diss)	250 mg/L	delete from App 01-1
Phosphorus (diss)	---	maintain
Potassium	---	delete from all Apps
Sodium	---	delete from all Apps
Chloride	---	delete from all Apps
Ammonia nitrogen	---	add to App 01-1, specify < 10 mg/L
Aluminum (total)	---	add to App C-1, C-3, C-4
Resin Acids	---	add to App C-1
Fatty Acids	---	add to App C-1
COD	---	add to App C-1, C-3, C-4
Acidity pH 8.3	---	add to App C-1, C-3, C-4

Dennis Barlow
Scientific/Technical Officer
Municipal Section

PE-6276: Environmental Impact

2 October 1992

Criteria	Rating	Rating Factor
Quantity of Discharge	1.0	Effluent Discharge > 500 m^3 per day
Quality of Receiving Environment in Relation to Ambient Water Quality Objectives	0.0	Ambient Water Quality Objectives Water Quality Objectives attained at 80% level or better
Dilution Capability and Sensitivity of	0.0	Initial Dilution > 2000:1
Actual or Intended Uses of Receiving Environment	3.0	High Fisheries Resource Value
Public Sensitivity	1.0	Low Sensitive Public
Potential and Actual Human Safety and Health	0.0	No Threat to Huiman Health Due to Contact with Discharged Effluent or Air Contaminants
Total	5.0	Low Environmental Impact.

Province of
British Columbia

BC Environment

Environmental Protection
Lower Mainland Region
15326 — 103A Avenue
Surrey
British Columbia
V3R 7A2
Telephone: (604) 584-8822
Fax: (604) 584-9751

PE-6276

October 8, 1991

Fraser River Harbour Commission
505 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

ATTENTION: Mr. T. Corsie, Manager of Operations
Captain A. Domas, Harbor Master

Gentlemen:

RE: Waste Management Permit PE-6276 - Richmond Landfill
Monitoring Data

Monitoring data for final effluent and receiving waters have been received in fulfillment of permit requirements for the third quarter of 1991.

Review of the report indicates that the data set is complete, and permit limits for final effluent have not been exceeded. The following points are noted regarding the data, which bear watching in the future:

1. pH values of the ditch sites are lower than the trend for the past three years.
2. Total Dissolved Phosphorus values of the ditches are elevated.
3. Ammonia values are reported as < 1.00 mg/L Nitrogen. A detection limit of 0.005 mg/L should be expected for water samples.

Status of the permit is considered to be in compliance at this time. The next monitoring report for final effluent, receiving water and groundwater is due December 31, 1991.

Yours truly,

Dennis Barlow
Scientific/Technical Officer
Municipal Section

cc Mr. A.E. Birkbeck
B.C. Research Corporation
3650 Wesbrook Mall
Vancouver, B.C.
V6S 2L2

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British Columbia
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I ON ENVIRONMENTAL INC.
B.C. LABORATORY SERVICES
Report for form 03008461

DUSTRIAL - LOWER MAINLAND(KHARE) ATTN: WOODBINE S B Sample 90005342

Site: NOSITE FRASER SURREY DOCKS S/W DRAIN NO. 1

RECEIVED
JUL 19 1990
LOWER MAINLAND REGION
FILE No.

From :90/07/05:0000 To :90/07/05:0000
Depth Range : 0.0 0.0 Tide :
Sample State: Waste Water
Sample Comment:

Parameter Description	Result	Units	Analytical Technique (Sparcode/Medium/Pres'n)
pH	5.5	pH units	Automated pH Meter (00041220/35/01)
Specific Conductance	7300	uS/cm	Cond. Meter Siebold (00111160/35/01)
Chemical Oxygen Dem.	11700	mg/L	K2Cr2O7 Dig:Titr. (01160500/04/05)
Acidity pH 8.3	492	mg/L	Auto. Potentiometric Titr (01311190/35/01)

Forintek Canada Corp.
6620 N.W. Marine Drive, Vancouver, B.C. V6T 1X2
Western Laboratory
Telephone (604) 224-3221
Telex 04-508552
Fax (604) 224-3225

FEED FAX THIS END

FAX
To: Ken Berrecloth
Dept: Fraser Surrey Docks
Fax No.: 581-7343
No. of Pages: 1
From: Bob Devlin
Date: Fri-July 13/90
Company: Forintek
Fax No.: 224-3221
Comments:

July 10, 1990

No. 39

RECEIVED
JUL 13 1990
LOWER MAINLAND REGION
FILE No.

Mr. Ken Berrecloth
Fraser Surrey Docks
11060 Elevator Road
Surrey, B.C.
V3V 2R7

Dear Ken:

The samples you recently sent to our laboratory have been analyzed with the following results:

SAMPLE/DESCRIPTION	CHEMICAL	
1. Hog Fuel leachage #2	< 1 ppm Copper Oxinate	MDC 10 ppb
2. "	< 1 ppm TCMTB	MDC 20 ppb.
3. "	< 1 ppm TCP/PCP	PCP MDC 0.1 ppb TCP MDC. 0.2 ppb

Yours truly,
FORINTEK CANADA CORP.

Wood Chemistry Technologist
Research and Development

CRD/bjd

Sept 1 1990
5 ppb PCP
~~15~~ ppb TCMTB
15 ppb Cu 8

** TOTAL PAGE
PAGE.002
JUL 12 '90 10:07

CANTEST

CanTest Ltd
Professional Analytical Services
Suite 200
1523 West 3rd Ave
Vancouver, BC
V6J 1J8
Fax: 604 731 2386
Tel: 604 734 7276

REPORT ON: Results of Testing

REPORTED TO: Fraser Surrey Docks
11060 Elevator Road
Surrey, B.C.
V3V 2R7

Attention: Ken Berrecloth

FILE NO: 3191-I

DATE: July 12, 1990

We have tested the sample of water submitted by you and report as follows:

SAMPLE IDENTIFICATION

DATE SUBMITTED: June 29, 1990
TYPE OF CONTAINER: Plastic

RESULTS OF TESTING:

CTL #	**3191**
CLIENT I.D.	**Hoy Fuel # 1 H**
pH (pH units)	6.35
Acidity to pH 8.3 as $CaCO_2$ (mg/L)	85.4
Chemical Oxygen Demand COD (mg/L)	808.

mg/L = milligrams per liter

METHODS OF TESTING:

The analyses were carried out in accordance with procedures described in "Laboratory Manual for the Chemical Analysis of Water, Wastewater, Sediments and Biological Materials (2nd Edition)" published by the Government of B.C., Ministry of Environment, Water Resources Services, 1976 and "Standard Methods for the Examination of Water and Wastewater" 16th Edition, 1985 and 15th Edition, 1980, published by the American Public Health Association.

CAN TEST LTD.

Don M. Enns, B.Sc., M.B.A.
Assistant Manager

DME/tt
C:FRSU3191

Province of British Columbia — Ministry of Environment

RECEIVED JUL 18

Collator: 9999-940

BIOASSAY LABORATORY

SHADED RECTANGLES TO BE FILLED IN BY SAMPLE SUBMITTOR

LOWER MAINLAND REGION

BIOASSAY RECORD 584-8820

SAMPLE NO:	COMPANY or SAMPLE LOCATION	ATTENTION
90 1165	FRASER SURREY DOCKS S/W DRAIN #1	SUE WOODBINE

DESCRIPTION AND AMOUNT OF SAMPLE AND CONTAINER (S)

SAMPLE

CONTAINER (S) TWO 5-GALLON PLASTIC COLLAPSIBLE CONTAINERS

COLLECTED BY	DATE	RECEIVED IN LABORATORY BY	DATE
S. WOODBINE	05 DAY | 07 MONTH | 90 YEAR	D. MOUL	06 DAY | 07 MONTH | 90 YEAR
WITNESS	TIME Hrs.	WITNESS S. VAN DERGEEST	TIME 1000 Hrs.

ANALYSIS REQUIRED
☐ 96 Hr LC50 ☑ 96 Hr LT50 ☐ Other
Specified Concentration (s) 100%

RECEIVED FROM Loomis

SAMPLE ☐ Legal ☐ Audit ☑ Routine

DILUTION WATER ☑ Fresh Water ☐ Salt Water

DILUTIONS MEASURED BY ☑ Weight ☑ Whole Sample ☐ Volume ☐ Active Ingredient

FISH SPECIES ☑ Rainbow Trout (*Oncorhynchus mykiss*) ☐ Other

ORIGINAL SAMPLE pH	Salinity	DILUTION WATER pH	Hardness Mg./l. $CaCO_3$	Salinity	BIOASSAY TEMPERATURE	FISH SIZE
5.09	4 ‰	/	/	/ ‰	14 ± 1 °C	☑ Weekly Average ☐ Actual

LOADING DENSITY	FORK LENGTH (Average)	RANGE	WEIGHT (Average)	RANGE
42 gm./l. Or ☐ See Below ☐ See Data Sheet	4.58 cm. ☐ See Data Sheet	4.0 cm. to 5.5 cm. ☐ See Data Sheet	0.85 gm. ☐ See Data Sheet	0.55 gm. to 1.38 gm. ☐ See Data Sheet

CONCENTRATION	TEST AMOUNT	START DATE	START pH	START D.O.	START Time	NO. FISH	CUMULATIVE MORTALITY AT TIME (HRS) 5min	24	48	72	96	FINAL pH	FINAL D.O.	Test vessel
CONTROL	0	6JUL90	6.02	11.6	1115	10	0	0	0	0	0	6.9	10.2	219
100%	20kg	6JUL90	5.1	0.4/aer	1245	10	10	/	/	/	/	5.05	0.4	20

Note: due to extremely low dissolved oxygen, the sample was initially aerated for the maximum time permitted. (2hrs.)

ANALYSIS RESULTS

sample conductivity 6000 µMOHS., control conductivity _____ µMOHS.

96 Hr. LC50 is _____ concentration.

96 Hr. LT50 is 5min at 100% concentration.

At 100% concentration the LT50 for this sample was less than 5minutes using Rainbow trout.

1 revised (07/89)

C. Buday
Analyst

12 JUL 90
DAY MONTH YEAR
Date

290
Man. Min. Conc. 2

Province of
British Columbia

Ministry of
Environment

ste Management
wer Mainland Region
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V3R 7A2
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December 27, 1990 PE-6276

Fraser River Harbour Commission
505 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

ATTENTION: Mr. T. Corsie, Manager of Operations
Captain A. Domas, Harbor Master

Dear Sirs:

RE: Waste Management Permit PE-6276 - Richmond Landfill Monitoring Data

Monitoring data for final effluent, receiving water and groundwater have been received in fulfillment of permit requirements for the fourth quarter of 1990.

Review of final effluent data indicates that permit limits have not been exceeded. There are no immediate concerns arising from the data. However, the following trends appear to have developed after comparing with historical data, and bear watching in the future:

1. Nitrate levels of the final discharge and receiving waters were elevated in comparison to the recent norm.
2. Mercury is being found in groundwater well #1 - West Site #3.
3. There is an increasing amount of Copper in the discharge.
4. Ammonia was unusually high in groundwater well #2 - West Site #4.

Status of the permit is considered to be in compliance at this time. The next monitoring report for final effluent, receiving water and groundwater is due March 31, 1991.

Yours truly,

Dennis Barlow
Scientific/Technical Officer
Municipal Section

cc Mr. A.E. Birkbeck
B.C. Research Corp.

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BC RESEARCH
BRITISH COLUMBIA RESEARCH CORPORATION

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RECEIVED
JUN 1 1 199
LOWER MAINLAND REGION
FILE No.

June 5, 1990
Our File: 2-51-790

Fraser River Harbour Commission
505-713 Columbia Street
New Westminster, B.C.
V3M 1B2

Attention: Mr. Tom Corsie, Manager of Operations
Captain Allan Domas, Harbour Master

Dear Mr. Corsie:

Re: Waste Management Permit PE6276-Richmond Landfill Monitoring Data

Following a letter received from the Ministry of Environment, Waste Management Branch, dated April 18, 1990 which indicated that the permit was out of compliance, a meeting was held at the Waste Management Branch in Surrey on May 8, 1990. Attendees at the meeting included:

Mr. Dennis Barlow	Waste Management
Captain Allan Domas	Fraser Port
Mr. Alex Birkbeck	B.C. Research
Mr. Lorrie Hunt	B.C. Research

At the meeting Mr. Barlow reviewed the reasons for his letter indicating non-compliance with the Permit PE-6276. These were as follows:

1. Over the past year analytical data has been consistently more than three months overdue.

2. The flow and temperature data was also several months late. In the last year data was reported 6 to 9 months after the recording had taken place.

3. Recent data for the final effluent showed that sulfate concentration exceeded the permit level of 250 mg/L.

Mr. Lorrie Hunt indicated that much of the problems concerning tardiness of the analytical data had arisen due to failure of the sub-contractor, Zenon Environmental Inc., to provide the analytical data within a promised 30-day delivery period. The samples had been collected at the mid point of each three month period and sent to Zenon with about six weeks available time frame to provide the analyses. Unfortunately, Zenon had moved laboratories in December 1989 from B.C. Research to Lake City, Burnaby. This move of premises caused a significant backlog of work which is apparently just returning to normal.

In regard to flow data Environment Canada, Inland Waters Directorate maintain the flow meter and make visits to the meter on an ad-hoc basis. Flow and temperature data are reprocessed by B.C. Research personnel to produce the units required by Waste Management. Usually this occurs with a short turn around (within a week). However, in the past it has been necessary to phone Inland Waters to get the raw data.

Another complicating problem that occurred during the early part of 1990 has involved the B.C. Research computer which refused to print out previously recorded data. This problem has now been resolved and new data is now logged into a personal computer system.

In regard to the deadline dates, Mr. Birkbeck specifically asked Mr. Barlow to list the dates that data became due. These are as follows:

1st Quarter	March 31
2nd Quarter	June 31
3rd Quarter	September 31
4th Quarter	December 31

Mr. Hunt pointed out that the sampling had historically been carried out at about the mid-point of each reporting period. When B.C. Research both collected the samples and carried out the analytical processes there had never been a problem. However, most analytical laboratories are currently encountering a heavy workload hence results were not available in time to meet the deadline dates. To resolve the problem it was agreed that in future samples would be collected during the first two weeks of each reporting period. This would allow the laboratory eight weeks for processing the samples. Nevertheless Zenon Environmental Inc. will be notified of the problem and their services terminated in the event that they do not provide the 30-day turnaround as contracted.

In regard to flow data it was agreed that Captain Domas would investigate the possibility of B.C. Research personnel servicing the flow meter and collecting the temperature and flow data. This could then be reported one month in arrears (i.e. data for January to March 31 to be available by April 30) and not at six month intervals as previously.

In regard to the overly high sulfate concentration the value obtained for the next set of samples would be available in May. In the event that this exceeds the permitted level additional consideration would be made. These would include:

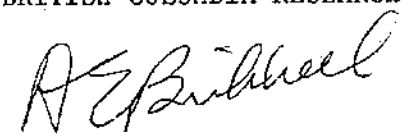
- A re-evaluation of the need to meet the 250 mg/L concentration.
- An examination of the causes of high sulfate content.
- The possible actions that may be adopted to reduce the sulfate level.

Captain Domas indicated that dredged sand fill was being deposited on more westerly locations which are known to have significant accumulations of gypsum wallboard in the landfilled material. This is a possible cause for the high sulfate values.

The meeting closed shortly before noon.

Yours truly,

BRITISH COLUMBIA RESEARCH CORPORATION



Alex E. Birkbeck
Senior Research Consultant
Waste Management Program
Applied Biology Division

AEB:amp

cc - Mr. G. Pettenuzzo, McQuarrie Hunter & Associates
Mr. Dennis Barlow, Waste Management Branch, Surrey
Mr. L. Hunt

Province of
British Columbia

Ministry of
Environment

Waste Management
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YOUR FILE

OUR FILE PE-6276

May 28, 1990

Port Manager
Fraser River Harbour Commission
505 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

ATTENTION: Mr. R. Pearce

Dear Sir:

RE: Waste Management Permit PE-6276 - Richmond Landfill
Monitoring Data

Flow and temperature data for the outfall at the Richmond Landfill site have been received. Review of the data indicates that permit conditions have been satisfied.

Confirmation of the Lead result from the first quarter 1990 report for effluent has been received. The value obtained (<0.01 mg/L) poses no concern at this time. As noted in previous correspondence, a detection limit of 0.01 mg/L will be required for all Lead analyses.

Status of the permit is considered to be in compliance, as outstanding data reports have been received. Please note that the next quarterly monitoring report, containing data for the effluent, groundwater and receiving waters, is due June 30, 1990.

Thank you for your co-operation.

Yours truly,

Dennis Barlow
Scientific/Technical Officer
Municipal Section

cc
Mr. A.E. Birkbeck
B.C. Research Corp.

Province of
British Columbia

Ministry of
Environment

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YOUR FILE

OUR FILE PE-6276

May 1, 1990

Fraser River Harbour Commission
505 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

ATTENTION: Mr. Tom Corsie

Dear Sir:

RE: Waste Management Permit PE-6276 - Richmond Landfill
Monitoring Data

Monitoring data of effluent and groundwater wells for the first quarter of 1990 were received April 30, 1990. After review of the data, I have the following comments:

1. The effluent monitoring report indicates that Sulfate (516 mg/L) exceeded the permit level (250 mg/L).

2. Report was due March 31, 1990.

Status of the permit remains out of compliance, pending receipt of outstanding first quarter 1990 data, and corrective action toward timely data submission as referenced in my letter of April 18, 1990.

Yours truly,

Dennis Barlow
Scientific/Technical Officer
Municipal Section

cc
Mr. A.E. Birkbeck
B.C. Research Corp.

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British Columbia

Ministry of
Environment

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YOUR FILE
OUR FILE PE-6276

April 18, 1990

Fraser River Harbour Commission
505 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

ATTENTION: Mr. Tom Corsie

Dear Sir:

RE: Waste Management Permit PE-6276 - Richmond Landfill
Monitoring Data

Monitoring data of effluent and groundwater wells for the fourth quarter of 1989 were received March 26, 1990. After review of the data, I have the following comments:

1. The effluent monitoring report indicates that Sulfate (253 mg/L) slightly exceeded the permit level (250 mg/L).

2. Report was due December 31, 1990.

The data received do not raise any specific concerns with leachate treatment and discharge at this time. However, the permit requires that sampling is undertaken quarterly, and monitoring reports for the sampling period are due at the end of that quarter. In view of the fact that data has consistently been more than 3 months overdue, and that first quarter 1990 data is now overdue, I must consider status of the permit to be out of compliance.

I have already expressed these concerns to B.C. Research, and I would appreciate your efforts toward corrective action.

Yours truly,

Dennis Barlow
Scientific/Technical Officer
Municipal Section

cc
Mr. A.E. Birkbeck
B.C. Research Corp.

Province of
British Columbia

Ministry of
Environment

Waste Management
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YOUR FILE

OUR FILE PE-6276

November 8, 1989

Fraser River Harbour Commission
505 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

ATTENTION: Mr. Tom Corsie

Dear Sir:

RE: Waste Management Permit PE-6276 - Richmond Landfill
Monitoring Data

Monitoring data of effluent and groundwater wells for the first three quarters of 1989 were received November 3, 1989. After review of the data, I have the following comments.

1. Monitoring data for groundwater wells is required once each six months under Appendix C-3 of the Permit. One report has been received for each of the 1988 and 1989 periods. I would anticipate a second report for 1989, due December 31, 1989.

2. The second quarter effluent monitoring report indicates that Total Suspended Solids (44 mg/L) slightly exceeded the permit level (40 mg/L).

3. The same report gave a Total Lead result of L0.1 mg/L. The information is not useful since the permit maximum is 0.05 mg/L. Please correspond to the analytical laboratory that a detection limit of 0.01 mg/L, as indicated on the previous report, is required.

4. Third quarter effluent and Site 4 monitoring results were due September 30, 1989. As the samples were collected August 17, 1989, please convey the results as they are made available to you.

The data received do not raise any specific concerns with leachate treatment and discharge at this time. However, the permit requires data submission by the end of each quarter in order that the discharge may be effectively administered.

Yours truly,

Dennis Barlow
Scientific/Technical Officer
Municipal Section

cc
Mr. A.E. Birkbeck
B.C. Research Corp.

Province of British Columbia

Ministry of Environment

Waste Management
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YOUR FILE

OUR FILE PE-6276

October 11, 1989

Fraser River Harbour Commission
505 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

ATTENTION: Mr. Tom Corsie

Dear Sir:

RE: Waste Management Permit PE-6276
RICHMOND LANDFILL

Final Effluent Flow and Temperature Reports for May and June, 1989 have been received. Review of the reports indicated that effluent flow did not exceed the upper limit of 10,000 cubic metres per day as specified by the permit.

As noted on the permit inspection form, monitoring data for effluent quality, groundwater and receiving water are outstanding. Status of the permit is therefore considered to be out of compliance. All monitoring reports are due at the end of each quarter (ie March 31, June 30, September 30, December 31), with the exception of groundwater monitoring reports, to be submitted every alternate quarter.

At this time, there are no concerns about onsite leachate containment and treatment which would constitute a compliance issue. Therefore, I anticipate that your prompt attention to submission of monitoring data will result in the permit being considered in compliance.

Yours truly,

Dennis Barlow
Scientific/Technical Officer
Municipal Section

cc
Mr. A.E. Birkbeck
B.C. Research Corp.
3650 Wesbrook Mall
Vancouver, B.C.
V6S 2L2

FRASER PORT

Our File:
Your File: PE2393

RECEIVED
FEB 14 1989
LOWER MAINLAND REGION
FILE No. PE-6276

February 8, 1989

Mr. Dennis Barlow
Waste Management Technician
Municipal Section
Ministry of Environment & Parks
15326 - 103A Avenue
Surrey, B.C.
V3R 7A2

Dear Mr. Barlow:

Re: Permit PE6276 - Richmond Landfill

In response to your letter of December 13, 1988, we have now had a response from B.C. Research pertaining to the questions you raised. I am attaching a copy of the letter, which is self-explanatory. If you have need of further information, please do not hesitate to contact Mr. Birkbeck directly.

Yours very truly,

FRASER RIVER HARBOUR COMMISSION

R.C. Pearce,
Port Manager and
Chief Executive Officer.

RCP/ff/waste.02
Encl.
cc Mr. A. Birkbeck

FRASER RIVER HARBOUR COMMISSION
JAN 2 4 1988

BC RESEARCH
BRITISH COLUMBIA RESEARCH CORPORATION
3650 Wesbrook Mall
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Phone (604) 224-4331

January 11, 1988
Our Ref: 2-51-790

Fraser River Harbour Commission
505 - 713 Columbia Street
New Westminster, B.C. V3M 1B2

Attention: Mr. R. Pearce, Port Manager

Subject: Letter from Mr. Dennis Barlow of Waste Management Branch

Dear Ric,

In regard to the question raised by Mr. Barlow concerning high values in sample station #4 for some parameters in the report for the third quarter of 1988, I have prepared a table (attached) which shows the average data for the nineteen (19) sample occasions since 1984.

The table shows the average value for each measured parameter, the standard deviation and the values obtained for the August sample collection. It can be seen that the high values implied in Mr. Barlow's letter refer to BOD_5 (5-day biochemical oxygen demand) iron, potassium, and possibly zinc. All the other values are at or below average. Indeed only BOD_5 and iron are unusually high.

Initially, I was going to suggest that the elevated values could be related to the flooding of the potato field with dredge water. However the data does not jibe with this suggestion. The dredge water contains high salt levels and one would expect a significant increase in the sodium, chloride and sulphate levels. Sodium and chloride levels would have increased as shown in our report concerning the flooding of the potato field. Soil sodium levels in the flooded areas of the potato field increased ten fold.

If the elevation of BOD_5 was associated with leachate leaking from the landfill there would be elevation in the ammonia nitrogen level. This is not the case. Similarly if the elevation of BOD_5 in sample #4 was associated with treated leachate from the lagoon area passing underground it also should show elevations of sodium and chloride. In any event lagoon effluent BOD_5 was extremely low at this time of the year. Lagoon effluent BOD_5 was 16 mg/L at the beginning of July and 12 mg/L on October 19th.

cont'd...2

Effluent from the 1st spray area contained 24 mg/L ammonia in July and 2.7 mg. in October. The implication is that a leak of lagoon effluent would not show an elevation of BOD_5 and if the north ditch was leaking it would show an elevation in ammonia.

I conclude that the increase in BOD_5 and iron is not associated with the landfill but is most likely caused by the use of hog fuel on the horticultural nursery north of the landfill. Leachate from hog fuel would cause increases in both BOD_5 and iron without causing any increase in the ammonia nitrogen level.

I should add that data for the fourth quarter sampling taken on November 19, 1988 show all parameters at values close to the average.

I trust that this will assist you to respond to Mr. Barlow. If you have any questions please phone me.

Yours truly,

BRITISH COLUMBIA RESEARCH CORPORATION

M. Wood Secretary

pp: Alex E. Birkbeck
Senior Research Consultant
Waste Management Program
Applied Biology Division

AEB:mw
attach. Table

Comparison of Average Data for Site 4 with Values Obtained for Samples on August 17, 1988

	No. of Cases	Average	Std. Dev.	Value for August 17, 1988
pH	---	---	---	6.1
Temp.	19	10.3	5.7	16.0
TSS	19	9.6	12.0	10.2
Ammonia	19	0.705	0.273	0.84
BOD_5	19	15.4	8.7	36.0
Oxygen	19	7.7	3.0	4.7
Nitrite	18	0.012	0.013	< 0.002
Nitrate	19	0.276	0.750	0.090
Copper	19	0.011	0.015	0.014
Iron	19	3.463	2.126	6.4
Manganese	19	2.015	1.781	1.24
Sodium	19	30.80	23.96	30.0
Potassium	19	10.4	18.8	19.0
Chloride	19	51.5	67.3	51.0
Sulfate	19	32.5	44.7	9.0
Phosphorus	19	0.277	0.292	0.81
Lead	19	0.0015	0.0012	0.002
Zinc	19	0.0202	0.0155	0.030
Mercury	19*	0.062	0.025	<0.05

* µg/L

BC RESEARCH Inc.

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RECEIVED
AUG - 1 2000
LOWER MAINLAND REGION
FILE NO. PE-06276

July 28, 2000.

Ms. P. Weber
Environmental Administrator
Fraser River Port Authority
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Second Quarter 2000 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the second quarter, 2000.

All parameters meet permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	June 13, 2000
Temperature (°C)	15.5
Dissolved Oxygen (mg/L)	5.8
5 day BOD (mg/L)	<10
NFR (mg/L)	2.3
Ammonia (mgN/L)	2.70
Nitrite (mgN/L)	0.099
Nitrate (mgN/L)	2.89
T D Phosphorous (mg/L)	0.086
Sulphate (mg/L)	14
COD (mg/L)	35
Acidity,pH 8.3 (mg/L)	<1
pH	8.3
Total Aluminum (mg/L)	0.02
Total Copper (mg/L)	0.006
Total Iron (mg/L)	0.72
Total Lead (mg/L)	0.005
Total Manganese (mg/L)	0.49
Total Zinc (mg/L)	<0.005
Total Cadmium (mg/L)	<0.0002
Total Mercury (mg/L)	<0.00005

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	June 13, 2000
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	<0.005
C18:0 Stearic	0.015
C18:1 Oleic	0.023
C18:3 Linolenic	0.017
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	April 12, 2000	May 10, 2000	June 13, 2000
LC50 (%)	>100	>100	>100
Temperature (°C)	18.0	13.0	15.5
Dissolved Oxygen (mg/L)	9.1	9.8	5.8

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E100784 (Final Discharge), 2000.

Date	April	May	June
1	3750	4400	4450
2	3550	4250	4100
3	3550	4300	3800
4	3650	4400	3800
5	3550	4350	3800
6	3500	4350	3800
7	3450	4350	4200
8	3350	4350	4550
9	3500	4350	5100
10	3650	5100	4800
11	3650	4400	4450
12	3750	4350	4300
13	4750	4350	4150
14	4400	4100	3800
15	4150	4050	3450
16	4300	3950	3200
17	4250	3800	4350
18	2350	4100	3800
19	3200	4100	3800
20	3650	4350	3950
21	3700	4350	4050
22	3950	4250	4250
23	3800	4100	3150
24	3850	4100	3200
25	4350	4050	3200
26	4300	4250	3200
27	4400	4600	2950
28	4350	4350	2900
29	4350	4250	3200
30	4350	4100	3200
31	-	4450	-

Table 5:
Analytical Results, Permit PE-6276, Surface Sites, June 13, 2000.

Parameter	E105877	E105876	E105878	E105880
Temperature (°C)	15.0	14.5	15.0	13.5
Dissolved Oxygen (mg/L)	2.9	3.1	4.1	4.8
Ammonia (mgN/L)	0.50	<0.5	2.20	<0.5
Nitrite (mgN/L)	0.047	0.139	0.060	0.045
Nitrate (mgN/L)	0.618	0.733	0.880	0.238
T D Phosphorous (mg/L)	0.411	0.716	0.264	0.491
Sulphate (mg/L)	22	17	31	15
COD (mg/L)	77	84	66	68
Acidity,pH 8.3 (mg/L)	14	17	15	12
pH	7.4	7.2	7.4	7.3
Total Aluminum (mg/L)	0.88	0.83	1.1	0.36
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	9.0	11	8.2	15
Total Lead (mg/L)	0.006	0.005	0.006	0.004
Total Manganese (mg/L)	0.35	0.43	0.51	0.71
Total Zinc (mg/L)	0.026	0.052	0.020	0.020

Table 6:
Analytical Results, Permit PE-6276, Groundwater Sites, June 13, 2000.

Parameter	E206252	E206253	E206254	E206255	N. Per Well
Ammonia (mgN/L)	<0.5	<0.5	<0.5	4.5	10.3
Nitrite (mgN/L)	0.005	0.035	0.008	0.008	0.015
Nitrate (mgN/L)	0.049	0.073	<0.020	<0.020	<0.020
T D Phosphorous (mg/L)	0.836	0.207	0.198	0.374	0.187
Sulphate (mg/L)	4.3	2.7	12	32	2.8
COD (mg/L)	74	143	68	88	108
Acidity, pH 8.3 (mg/L)	57	48	43	51	111
PH	7.1	6.7	7.1	7.3	6.7
Total Aluminum (mg/L)	0.06	0.18	0.10	0.04	0.10
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	0.45	7.2	22	7.7	7.7
Total Lead (mg/L)	<0.001	0.006	0.004	0.002	0.003
Total Manganese (mg/L)	0.09	0.16	2.8	3.7	3.4
Total Zinc (mg/L)	0.008	0.011	0.013	<0.005	0.008

Fraser River Port Authority

E100784

Rainbow Trout Bioassay

96-h LC50 %v/v: >100%

BC Research Inc.

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web http://bcresearch.com

BCRI Sample#: 20001480 — Report #: 2-11-200-790-00-004

Sample Taken	04/12/2000	Sample Temperature	15 °C
Sample Received	04/13/2000	Sample pH	7.9
Date Started	04/13/2000	Sample Dissolved Oxygen	8.7 mg/L
Time Started	10:42 AM	Sample Conductance	1172 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr
0	45	15.1	15.2	7.5	7.6	9.9	9.4	0	0	0	10
100	1172	15.0	15.5	7.9	8.4	8.9	9.0	10	10	20	20

Comments

By using O-Tolidine indicator, it was determined that no chlorine was present in the sample. All surviving fish appeared and behaved normally during the test, except for one moribund fish at 72 and 96 hours.

Test Conditions

Organisms per Replicate	10	Test Volume (L):	10
Rate of aeration	6.5 ml/min/L	Preaeration Time (minutes)	30

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (g)	0.37 ± 0.06	Length (cm):	3.4 ± 0.2

Duplicate Reference Toxicant: Phenol

Tests were conducted on: 04/10/2000

Tests gave a 96-h LC50 of 7.32 (5, 10) mg/L and 7 (5, 10) mg/L

Dilution Water: Vancouver Tapwater hardened and dechlorinated

EDTA Hardness	19.8 mg $CaCO_3$/L	Other parameters available on request

Test Method Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, July 1990 and May 1996 amendments.

Analyst **Verified By**

Fraser River Port Authority

E100784

Rainbow Trout Bioassay

96-h LC50 %v/v: >100%

BC Research Inc.

3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
ph. (604) 224-4331
fax (604) 224-0540
web http://bcresearch.com

BCRI Sample#: 20001860 Report #: 2-11-200-790-00-005

Date Started	05/11/2000	Sample Temperature	10.3 °C
Time Started	10:08 AM	Sample pH	7.7
Sample Taken	05/10/2000	Sample Dissolved Oxygen	7.0 mg/L
Sample Received	05/11/2000	Sample Conductance	1113 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr
0	43	15.0	15.0	7.6	7.4	10.1	9.1	0	0	0	0
100	1113	14.4	15.1	7.7	8.5	7.8	9.3	0	0	0	0

Comments

The fish showed signs of stress at test initiation, i.e., rapid gill movement. All fish appeared and behaved normally during the remainder of the test.
There was no chlorine in the sample as determined using O-Tolidine indicator.

Test Conditions

Organisms per Replicate	10	Test Volume (L):	10
Rate of aeration	6.5 ml/min/L	Preaeration Time (minutes)	30

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (g)	0.54 ± 0.1	Length (cm):	3.8 ± 0.2

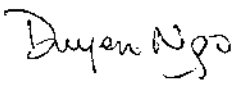
Duplicate Reference Toxicant: Phenol
Tests were conducted on: 05/02/2000
Tests gave a 96-h LC50 of 9.65 (8.34, 10.9) mg/L and 9.38 (8.12, 10.6) mg/L

Dilution Water: Vancouver Tapwater hardened and dechlorinated

EDTA Hardness	18.3 mg $CaCO_3$/L	Other parameters available on request

Test Method Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, July 1990 and May 1996 amendments.

Analyst **Verified By**



Fraser River Port Authority

E100784

Rainbow Trout Bioassay

96-h LC50 %v/v: >100%

BC Research Inc.

3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
ph. (604) 224-4331
fax (604) 224-0540
web http://bcresearch.com

BCRI Sample#: 20002340 — Report #: 2-11-200-790-00-006

Sample Taken	Jun. 13, 2000	Sample pH	7.6
Sample Received	Jun. 14, 2000	Sample Dissolved Oxygen	7.5 mg/L
Date Started	Jun. 14, 2000	Sample Temperature	14.5 °C
Time Started	12:04 PM	Sample Conductance	1138 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr
0	42	15.5	14.4	7.6	7.6	9.9	9.8	0	0	0	0
0	42	15.5	14.2	7.6	7.6	9.9	10.0	0	0	0	0
100	1138	14.6	14.2	7.7	8.5	7.9	10.0	0	0	0	0
100	1138	14.6	14.2	7.7	8.5	7.9	10.0	0	0	0	0

Comments

Some of the fish exhibited signs of stress (e.g. rapid gill movement) at test initiation. All fish appeared and behaved normally during the remainder of the test. There was no chlorine present in the sample (using O-Tolidine indicator). Due to the large size of the fish, the test was done in duplicate with five fish and 15L per aquaria.

Test Conditions

Organisms per Replicate	5	Test Volume (L):	30
Rate of aeration	6.5 ml/min/L	Preaeration Time (minutes)	30

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (g)	1.8 ± 0.33	Length (cm):	5.4 ± 0.3

Reference Toxicant: Phenol

Test was conducted on: 06/02/2000

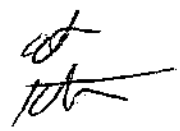
Test gave a 96-h LC50 of 8.69 (7, 10) mg/L

Dilution Water: Vancouver Tapwater hardened and dechlorinated

EDTA Hardness 17.6 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, July 1990 and May 1996 amendments.

Analyst **Verified By**



BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

April 27, 2000.

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

RECEIVED
MAY 0 1 2000
LOWER MAINLAND REGION
FILE NO. PE-06276

Dear Ms. Weber:

Subject: Permit PE-6276, First Quarter 2000, Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the first quarter, 2000. All results meet the permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt, Senior Technician

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	March 16, 2000
Temperature (°C)	10.0
Dissolved Oxygen (mg/L)	9.8
5 day BOD (mg/L)	<10
NFR (mg/L)	6.2
Ammonia (mgN/L)	6.6
Nitrate (mgN/L)	2.7
Nitrite (mgN/L)	0.261
T D Phosphorous (mg/L)	0.022
Sulphate (mg/L)	14
COD (mg/L)	36
Acidity,pH 8.3 (mg/L)	3.5
pH	8.3
Total Aluminum (mg/L)	0.010
Total Copper (mg/L)	0.010
Total Iron (mg/L)	2.5
Total Lead (mg/L)	0.004
Total Manganese (mg/L)	1.2
Total Zinc (mg/L)	<0.005

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	March 16, 2000
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	<0.005
C18:0 Stearic	0.024
C18:1 Oleic	0.030
C18:3 Linolenic	0.008
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	January 27, 2000	February 16, 2000	March 16, 2000
LC50 (%)	>100	>100	>100
Temperature (°C)	6.8	7.5	10.0
Dissolved Oxygen (mg/L)	9.8	7.8	9.8

Fraser River Port Authority

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #20000295 Report #2-11-200-790-00001

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken: Jan. 27,2000
SAMPLE Received: Jan. 28,2000
Date Started: Jan. 28,2000
Time Started: 14:43

SAMPLE pH: 8.7
SAMPLE Dissolved Oxygen (mg/L): 10.0
SAMPLE Conductance (µmho/cm): 794

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.4	9.9	8.6	100	100	100	100
	100	7.0	8.5	9.9	8.8	100	100	100	100

COMMENTS: At the start of the test the fish showed signs of stress, i.e. rapid gill movement and surfacing. All fish appeared and behaved normally during the remainder of the test.

TEST CONDITIONS:

Number of Organisms: 10
Test Volume (L): 15
Preaeration Time (min.): 30

Test Temperature (°C): 15 ± 1
Test pH Adjusted: 7.0

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.89 ± 0.09
Length (cm): 4.5 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jan. 242000
Tests gave 96-h LC50 of 11.4 mg/L (10.37, 12.53) and 10.8 mg/L (9.34, 12.48)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L): 18
EDTA Hardness (mg $CaCO_3$/L): 21.6
Total Suspended Solids (mg/L): 6
Other parameters available on request.

Residual Chlorine (mg/L): <0.001
Conductance (µmho/cm): 41

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Port Authority

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #20000607 Report #2-11-200-790-00002

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Feb. 16,2000	**SAMPLE pH:**	7.8
SAMPLE Received:	Feb. 17,2000	**SAMPLE Dissolved Oxygen (mg/L):**	11.3
Date Started:	Feb. 17,2000	**SAMPLE Conductance (µmho/cm):**	1268
Time Started:	13:57		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.4	10.0	9.4	100	100	100	100
	100	8.1	8.6	10.2	9.5	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	120		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.23 ± 0.03	**Length (cm):**	3.0 ± 0.1

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Feb. 17,2000

Tests gave 96-h LC50 of 13.91 mg/L (12.13, 17.63) and 11.88 mg/L (10.09, 14.56)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	18	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	18.4	**Conductance (µmho/cm):**	48
Total Suspended Solids (mg/L):	6		

Other parameters available on request.

ANALYST RW

VERIFIED BY Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

Fraser River Port Authority

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #20001014 Report #2-11-200-790-00003

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken: Mar. 16,2000
SAMPLE Received: Mar. 17,2000
Date Started: Mar. 17,2000
Time Started: 10:20

SAMPLE pH: 8.1
SAMPLE Dissolved Oxygen (mg/L): 10.4
SAMPLE Conductance (µmho/cm): 1089

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.6	7.5	9.9	9.2	100	100	100	100
	100	8.1	8.5	10.2	9.2	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms: 10
Test Volume (L): 10
Preaeration Time (min.): 30

Test Temperature (°C): 15 ± 1
Test pH Adjusted: No

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.42 ± 0.09
Length (cm): 3.5 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Feb. 172000
Tests gave 96-h LC50 of 13.91 mg/L (12.13, 17.63) and 11.88 mg/L (10.09, 14.56)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L): 18
EDTA Hardness (mg $CaCO_3$/L): 18.4
Total Suspended Solids (mg/L): 6
Other parameters available on request.

Residual Chlorine (mg/L): <0.001
Conductance (µmho/cm): 49

ANALYST **VERIFIED BY** Robyn Wood

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

February 8, 1999

RECEIVED
APR 13 1999
LOWER MAINLAND REGION
FILE NO. PE-06276

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Emergency 20" Discharge, January 14, 1999.

The attached tables contain analytical results and bioassay reports for a sample taken at the inlet to the 20" discharge pump at the FRHC Richmond Landfill site prior to an emergency discharge on January 14, 1999.

All results meet the requirements for the final effluent in Permit PE-6276 except for total suspended solids. The level found exceeded the permit level by 14 mg/L (54 mg/L vs. 40 mg/L). The sample did not exhibit any acute toxicity as measured by LC50 or Microtox™.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow,MELP

Table 1:
Analytical Results,Sample from the Inlet to the 20" Discharge Pump

Parameter	January 14, 1999
Temperature (^{o}C)	8.5
Dissolved Oxygen (mg/L)	8.9
5 day BOD (mg/L)	<10
NFR (mg/L)	54
Ammonia (mgN/L)	1.4
Nitrate (mgN/L)	0.071
Nitrite (mgN/L)	0.006
T D Phosphorous (mg/L)	0.014
Sulphate (mg/L)	14.6
COD (mg/L)	26
Acidity,pH 8.3 (mg/L)	7
pH	8.0
Total Aluminum (mg/L)	0.98
Total Copper (mg/L)	0.018
Total Iron (mg/L)	8.3
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	1.9
Total Zinc (mg/L)	0.012

Table 2:
Sample from the Inlet to the 20" Discharge Pump

Parameter	January 14, 1999
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	0.010
C16:0 Palmitic	0.120
C18:0 Stearic	0.026
C18:1 Oleic	<0.005
C18:3 Linolenic	<0.005
C18:2 Linoleic	0.012
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: 20" Discharge

BCRI Sample #990146 Report #2-11-200-790-99001

96-h LC50 %v/v:	>100	% Mortality in 100% Sample:	0

SAMPLE Taken:	Jan. 14, 1999	**SAMPLE pH:**	7.0
SAMPLE Received:	Jan. 15, 1999	**SAMPLE Dissolved Oxygen (mg/L):**	8.9
Date Started:	Jan. 15, 1999	**SAMPLE Conductance (µmho/cm):**	988
Time Started:	10:45		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.3	10.0	9.1	100	100	100	100
	100	7.1	8.6	9.5	9.2	100	100	100	100
	46	7.2	8.6	9.8	9.2	100	100	100	100
	22	7.3	8.2	10.0	9.2	100	100	100	100
	10	7.3	7.9	10.0	9.0	100	100	100	100

COMMENTS: The fish in the 100%v/v exhibited rapid gill and surfacing immediately. At 3 minutes, the fish showed loss of equilibrium. At 60 minutes, there were 7 fish swimming at the surface and 1 spiralling. All fish still had rapid gill movements. At 120 minutes, fish still had rapid gill movements, but mostly had recovered. During the rest of the test, all fish appeared and behaved normally.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.34 ± 0.06	**Length (cm):**	3.4 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*
Tests were conducted on: Jan. 4, 1999
Tests gave 96-h LC50 of 11.72 mg/L (10.52, 13.12) and 11.85 mg/L (10.26, 14.43)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	20	**Conductance (µmho/cm):**	44
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST Granger Jung by JP

VERIFIED BY Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are [illegible] LC50" (ASTM STP 634, 1977)

Acute Liquid Phase Microtox ™ Analyses for Fraser River Harbour Commission for 20" Discharge.

Acute liquid phase Microtox™ analysis was conducted on the sample, 20" Discharge, collected on January 14, 1999. The sample was received at BC Research on January 15, 1999. The analysis was performed in accordance with the Environment Canada Biological Test Method: "Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*)" EPS Report 1/RM/24 November 1992 The test methodology is briefly outlined below.

The Microtox™ test was performed on January 15, 1999. The solution was allowed to settle before testing commenced.

One vial of Microtox™ acute reagent was reconstituted in 1.0 mL of reconstitution water and allowed to thermally equilibrate for a minimum of 30 minutes prior to commencing the analysis. Microtox™ reagent lot ACV010-3 was used in this analysis.

Six serial dilutions of the sample were prepared using 2% saline diluent. Samples were salinity adjusted to 2%, using reagent grade NaCl. All solutions were thoroughly mixed and thermally equilibrated in the Microtox™ analyzer for a minimum of five minutes prior to analyses. Aliquots of 10 µL of reconstituted reagent were introduced into cuvettes for initial light intensity readings after 15 minutes. After reading initial light intensities, the reagent was exposed to serial dilutions of the samples (1.56 to 50%v/v). Light intensity readings were taken after five and fifteen minute exposure intervals.

A reference toxicant, reagent grade phenol, was run concurrently with the sample to assess the performance of the Microtox™ reagent and the precision of the results. The EC50 and 95% confidence intervals after a five minute exposure to phenol were 23.79 (20.80, 27.20) mg/L (Figure 3). This value was within 2 standard deviations of the previous mean EC50 value (20.57±1.66 mg/L) for this laboratory, as shown on the control chart (Figure 4).

The EC50 values and 95% confidence intervals for the 5 and 15 minute exposures were >50% (Figures 1 and 2). **Therefore, the sample did not exhibit any acute toxicity in the Microtox™ test.**

MICROTOX DATA REPORT

FILE NAME: 990115S1.K5

TEST DATE: 99/01/15
TEST TIME: 18:00
Approved by:

Investigator: KK
Sample Description: FRHC 20" Discharge
Procedure: BASIC
Initial Concentration : 50 %v/v
Test Time: 5 minutes

Osmotic Adjustment: 2% NaCl
Dilution Factor : 2
Concentration Units: %v/v

NUMBER	IO/IT	CONC.	GAMMA
1	113.94/106.65	1.5625	-0.00571*
2	112.56/106.73	3.1250	-0.01849*
3	99.93/ 93.09	6.2500	-0.00094*
4	131.01/120.49	12.5000	0.01193#
5	111.23/101.00	25.0000	0.02494#
6	102.46/ 90.97	50.0000	0.04823#

CONTROL IT/IO = 92.23/ 99.10
CORRECTION FACTOR = 0.9307

EC50 IS GREATER THAN HIGHEST CONCENTRATION

* Invalid data or controls

Figure 1. Fraser River Harbour Commission Acute Liquid Phase Microtox™ results for 20" Discharge (99/01/14) (5 minute exposure).

MICROTOX DATA REPORT

FILE NAME: 990115S1.K15

TEST DATE: 99/01/15
TEST TIME: 13:00
Investigator: KK
Approved by: AE
Sample Description: FRHC 20" Discharge
Procedure: BASIC
Osmotic Adjustment: 2% NaCl
Initial Concentration : 50 %v/v
Dilution Factor : 2
Test Time: 15 minutes
Concentration Units: %v/v

NUMBER	IO/IT	CONC.	GAMMA
1	113.94/103.16	1.5625	-0.03660*
2	112.56/104.71	3.1250	-0.06236*
3	99.93/ 92.16	6.2500	-0.05421*
4	131.01/119.05	12.5000	-0.04012*
5	111.23/100.94	25.0000	-0.03883*
6	102.46/ 96.16	50.0000	-0.07060*

CONTROL IT/IO = 86.44/ 99.10
CORRECTION FACTOR = 0.8723

EC50 IS GREATER THAN HIGHEST CONCENTRATION

* Invalid data or controls

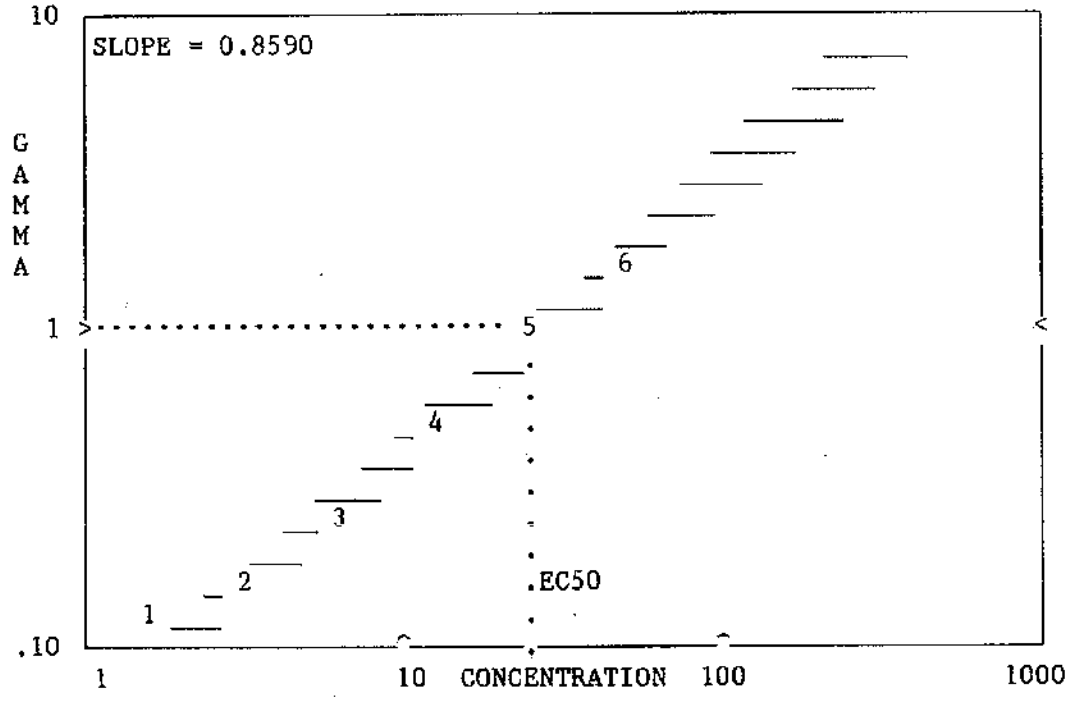
Figure 2. Fraser River Harbour Commission Acute Liquid Phase Microtox™ results for 20" Discharge (99/01/14) (5 minute exposure).

MICROTOX DATA REPORT

FILE NAME: 990115R2.K5 TEST DATE: 99/01/15
TEST TIME: 12:15
Investigator: KK Approved by:
Sample Description: Phenol Reference Toxicant (100 mg/L)
Procedure: BASIC Osmotic Adjustment: 2% NaCl
Initial Concentration : 50 mg/L Dilution Factor : 2
Test Time: 5 minutes Concentration Units: mg/L

NUMBER	IO/IT	CONC.	GAMMA
1	95.25/ 77.84	1.5625	0.09761#
2	91.24/ 68.93	3.1250	0.18731#
3	95.17/ 66.82	6.2500	0.27756#
4	98.83/ 56.51	12.5000	0.56874#
5	98.46/ 42.34	25.0000	1.08591#
6	101.96/ 31.51	50.0000	1.90247#

CONTROL IT/IO = 88.73/ 98.92
CORRECTION FACTOR = 0.8970



EC50 23.7865 (95% CONFIDENCE RANGE: 20.8014 TO 27.2000)

Used for calculations

Figure 3. Phenol Reference Toxicant results - January 15, 1999 (5 minute exposure).

Microtox

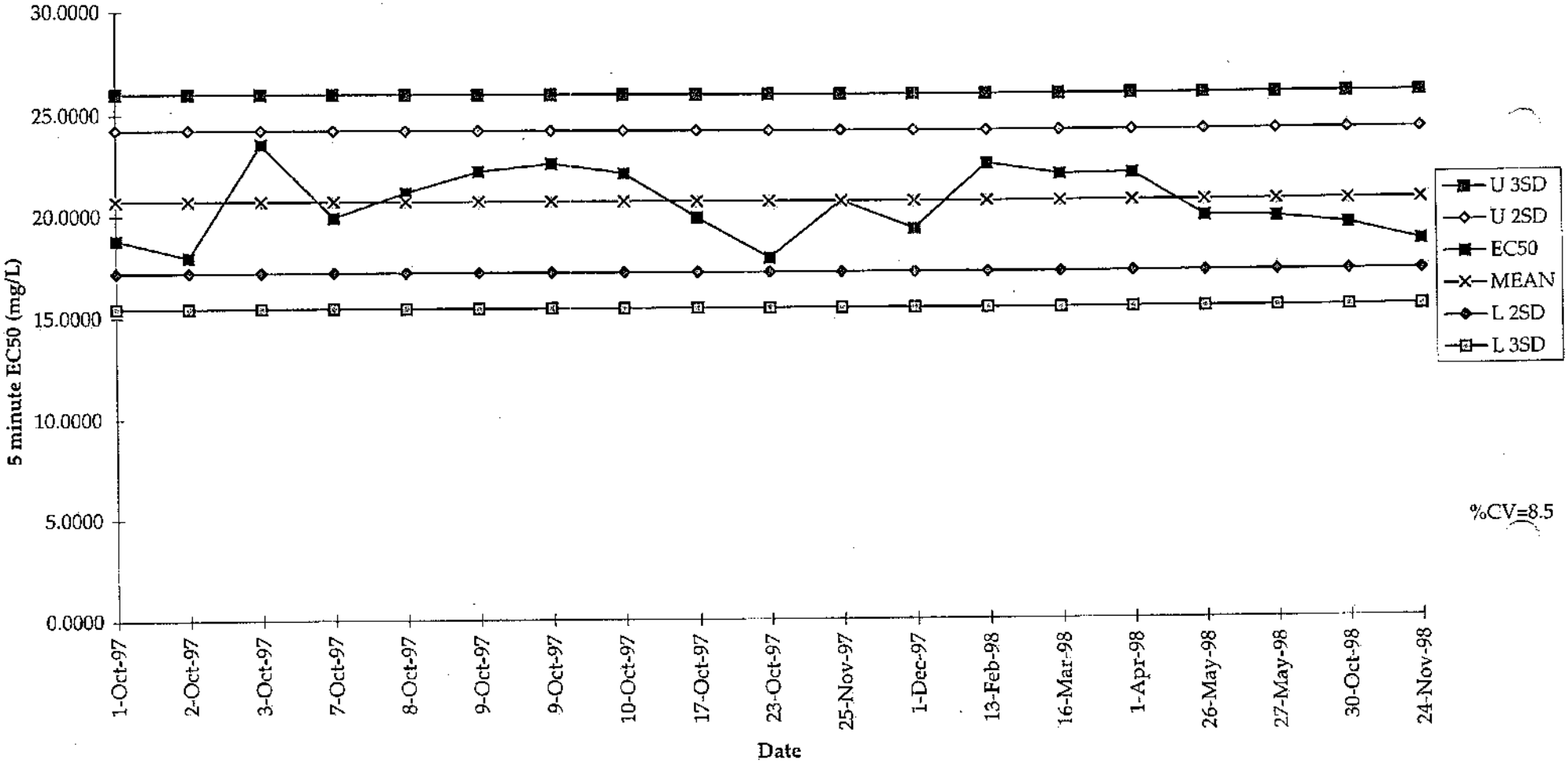


Figure 4. Reference Toxicant Control Chart for Phenol (5 Minute Exposure).

BCRI Acute Liquid Phase Microtox®

Client # & Name: 190 FRHC

Sample ID: 20" Discharge

BCRI #: 990146

Date Sampled: 99/01/14

Date Received: 99/01/15

Test Date & Time: 99/01/15 @ 13:15

Sample Description: pale yellow solution; allowed to settle before testing.

Sample pH: 7.0

Sample Salinity (‰): 1 ‰

Sample D.O. (mg/L) 6.8 @ 20.9°C

Osmotic Adjustment: 2 ‰ NaCl (0.5g in 25mL)

Acute Reagent Lot #: ACV010-3

Inoculation Time: 13:00

Microtox File Name: 990115S

Analyst: Karen Kinnel

Comments:
Reagent reconstituted @ 10:57 H.

BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

October 19, 1999

RECEIVED
OCT 22 1999
LOWER MAINLAND REGION
FILE NO. PE-06276

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Third Quarter 1998 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the third quarter, 1999. All results meet the permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	September 16, 1999
Temperature (°C)	16.5
Dissolved Oxygen (mg/L)	8.8
5 day BOD (mg/L)	<10
NFR (mg/L)	5
Ammonia (mgN/L)	0.48
Nitrate (mgN/L)	0.997
Nitrite (mgN/L)	0.086
T D Phosphorous (mg/L)	0.015
Sulphate (mg/L)	5.4
COD (mg/L)	33
Acidity,pH 8.3 (mg/L)	30
pH	7.54
Total Aluminum (mg/L)	<0.05
Total Copper (mg/L)	<0.020
Total Iron (mg/L)	2.0
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.07
Total Zinc (mg/L)	<0.020

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	September 16, 1999
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	0.016
C16:0 Palmitic	0.027
C18:0 Stearic	0.015
C18:1 Oleic	0.013
C18:3 Linolenic	<0.005
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	July 27, 1999	August 17, 1999	September 16, 1999
LC50 (%)	>100	>100	>100
Temperature (°C)	25.5	23.0	16.5
Dissolved Oxygen (mg/L)	13.4	8.3	8.8

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E1007844 (Final Discharge)

Date	July 1999	August 1999	September 1999
1	2550	2050	3050
2	2500	2100	2150
3	2300	2750	2350
4	1600	3150	2600
5	1275	3450	2950
6	850	3450	2750
7	550	3325	2350
8	350	3150	2500
9	200	3050	2550
10	150	2950	2500
11	1600	2750	2250
12	2150	2800	2500
13	3250	2775	2500
14	3800	2825	2350
15	4150	2850	2150
16	4500	2900	2000
17	4450	2975	1300
18	4950	2650	1150
19	5150	2600	1950
20	5800	2600	1750
21	5450	2600	650
22	5100	2600	200
23	4750	2600	150
24	4100	2600	250
25	2050	2525	850
26	2250	2100	1625
27	2550	2350	1750
28	2425	2600	950
29	2300	2950	600
30	2000	3050	400
31	1950	3100	-
max	5800	3450	3050
avg	2808	2781	1769

Fraser River Port Authority

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #992028 Report #2-11-200-790-99008

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken: Jul. 27, 1999
SAMPLE Received: Jul. 28, 1999
Date Started: Jul. 28, 1999
Time Started: 11:45

SAMPLE pH: 7.9
SAMPLE Dissolved Oxygen (mg/L): 13.5
SAMPLE Conductance (µmho/cm): 1268

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.4	10.3	9.6	100	100	100	100
	100	8.1	8.5	11.3	9.5	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms: 10
Test Volume (L): 10
Preaeration Time (min.): 120

Test Temperature (°C): 15 ± 1
Test pH Adjusted: No

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.35 ± 0.08

Length (cm): 3.3 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jul. 22, 1999
Tests gave 96-h LC50 of 15.03 mg/L (12.84, 18.65) and 17.2 mg/L (14.47, 21.78)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L): 23
EDTA Hardness (mg $CaCO_3$/L): 14.1
Total Suspended Solids (mg/L): 6
Other parameters available on request.

Residual Chlorine (mg/L): <0.001
Conductance (µmho/cm): 44

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277

SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY :

REPORT PERIOD: 1999 - 3rd quarter

Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		in	
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (ma)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in n/a	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	n/a	2nd & 4th quarters only
Surface water samples	14 parms	6276: C.3	per six months	per six months	n/a	n/a	2nd & 4th quarters only
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	in	

COMPLIANCE WITH MONITORING PROGRAM **IN**

OVERALL COMPLIANCE **IN**

SIGNATURE

BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Westbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

July 13, 1999.

RECEIVED
JUL 19 1999
LOWER MAINLAND REGION
FILE NO. PE-06276

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Second Quarter 1999 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the second quarter, 1999.

All parameters meet permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	June 29, 1999
Temperature (°C)	16.0
Dissolved Oxygen (mg/L)	5.8
5 day BOD (mg/L)	<10
NFR (mg/L)	5.8
Ammonia (mgN/L)	1.61
Nitrite (mgN/L)	0.054
Nitrate (mgN/L)	0.860
T D Phosphorous (mg/L)	0.028
Sulphate (mg/L)	7.0
COD (mg/L)	34
Acidity,pH 8.3 (mg/L)	5
pH	8.1
Total Aluminum (mg/L)	<0.10
Total Copper (mg/L)	<0.05
Total Iron (mg/L)	1.1
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.47
Total Zinc (mg/L)	<0.005
Total Cadmium (mg/L)	<0.0002
Total Mercury (mg/L)	<0.00005

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	June 29, 1999
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	0.056
C18:0 Stearic	0.043
C18:1 Oleic	0.049
C18:3 Linolenic	0.012
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	0.019
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	April 22, 1999	May 26, 1999	June 29, 1999
LC50 (%)	>100	>100	>100
Temperature (°C)	9.0	15.0	16.0
Dissolved Oxygen (mg/L)	5.8	8.6	5.8

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E100784 (Final Discharge), 1999.

Date	April	May	June
1	2600	3175	350
2	3175	3175	275
3	3800	2900	750
4	3450	2325	2350
5	3450	2800	4425
6	3450	1350	6400
7	3800	1150	6525
8	3800	750	4425
9	3450	750	3175
10	3250	1975	6525
11	3175	1975	3650
12	3650	1150	3800
13	3450	1050	3450
14	3250	750	3175
15	3200	900	2750
16	3175	550	2500
17	3175	400	2325
18	3050	400	2325
19	3175	250	2325
20	3175	350	2150
21	3250	750	2500
22	3175	2600	2625
23	3175	4750	2500
24	2600	5450	2600
25	2075	4100	2325
26	1600	2350	2150
27	1150	1350	2325
28	1350	550	2325
29	2800	475	2500
30	2600	425	2625
31	-	350	-

Table 5:
Analytical Results, Permit PE-6276, Surface Sites, June 29, 1999.

Parameter	E105877	E105876	E105878	E105880
Temperature (°C)	14.5	14.5	15.5	14.0
Dissolved Oxygen (mg/L)	6.4	6.2	3.2	4.4
Ammonia (mgN/L)	0.280	0.070	1.26	0.280
Nitrite (mgN/L)	0.030	0.019	0.041	0.040
Nitrate (mgN/L)	0.120	0.094	0.100	<0.020
T D Phosphorous (mg/L)	0.589	0.506	0.238	0.263
Sulphate (mg/L)	9.7	9.6	13.4	11.2
COD (mg/L)	63	44	21	39
Acidity,pH 8.3 (mg/L)	9	8	10	15
pH	7.4	7.3	7.3	7.3
Total Aluminum (mg/L)	0.46	0/71	0/36	0.23
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	3.0	2.5	5.5	14
Total Lead (mg/L)	<0.001	<0.001	<0.001	0.002
Total Manganese (mg/L)	0.10	0.07	0.41	0.73
Total Zinc (mg/L)	0.009	0.011	0.016	0.006

Table 6:
Analytical Results, Permit PE-6276, Groundwater Sites, June 29, 1999.

Parameter	E206252	E206253	E206254	E206255
Ammonia (mgN/L)	0.070	0.140	12.2	2.17
Nitrite (mgN/L)	0.029	0.039	0.107	0.037
Nitrate (mgN/L)	0.120	0.040	0.680	<0.020
T D Phosphorous (mg/L)	0.726	0.042	0.022	0.091
Sulphate (mg/L)	9.6	3.3	2.4	17.6
COD (mg/L)	222	216	128	289
Acidity, pH 8.3 (mg/L)	11	98	155	145
pH	7.0	6.2	7.0	6.4
Total Aluminum (mg/L)	0.21	0.27	0.21	0.20
Total Copper (mg/L)	<0.05	<0.05	0.08	<0.05
Total Iron (mg/L)	4.0	10	86	15
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.17	0.16	5.4	1.3
Total Zinc (mg/L)	<0.005	<0.005	<0.005	0.012

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #991146 Report #2-11-200-790-99005

96-h LC50 %v/v:	>100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Apr. 22, 1999	**SAMPLE pH:**	7.6
SAMPLE Received:	Apr. 22, 1999	**SAMPLE Dissolved Oxygen (mg/L):**	5.4
Date Started:	Apr. 22, 1999	**SAMPLE Conductance (µmho/cm):**	1080
Time Started:	12:28		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.4	10.0	9.1	100	100	100	100
	100	7.8	8.5	7.0	9.2	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	80		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.45 ± 0.11 **Length (cm):** 3.7 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Apr. 20, 1999
Tests gave 96-h LC50 of 8.05 mg/L (6.87, 9.33) and 9.22 mg/L (7.0, 13.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	20	**Conductance (µmho/cm):**	44
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

J. Graham

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: e100784

BCRI Sample #991372 Report #2-11-200-790-99006

96-h LC50 %v/v:	>100	% Mortality in 100% Sample:	0

SAMPLE Taken:	May. 13, 1999	**SAMPLE pH:**	7.7
SAMPLE Received:	May. 14, 1999	**SAMPLE Dissolved Oxygen (mg/L):**	8.4
Date Started:	May. 14, 1999	**SAMPLE Conductance (µmho/cm):**	1061
Time Started:	10:01		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.4	10.0	9.1	100	100	100	100
	100	7.8	8.5	8.8	9.2	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	12	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.52 ± 0.12	**Length (cm):**	3.9 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Apr. 20, 1999
Tests gave 96-h LC50 of 8.05 mg/L (6.87, 9.33) and 9.22 mg/L (7.0, 13.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	20.2	**Conductance (µmho/cm):**	53
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Duyen Ngo

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #991783 Report #2-11-200-790-99007

96-h LC50 %v/v:	>100	% Mortality in 100% Sample:	0

SAMPLE Taken:	Jun. 29, 1999	**SAMPLE pH:**	7.6
SAMPLE Received:	Jun. 30, 1999	**SAMPLE Dissolved Oxygen (mg/L):**	5.2
Date Started:	Jun. 30, 1999	**SAMPLE Conductance (µmho/cm):**	1112
Time Started:	12:55		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.4	10.2	9.3	100	100	100	100
	100	7.9	8.5	7.2	9.4	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	15	**Test pH Adjusted:**	No
Preaeration Time (min.):	80		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.73 ± 0.23	**Length (cm):**	4.0 ± 0.4

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jun. 9, 1999
Tests gave 96-h LC50 of 7.59 mg/L (5.0, 10.0) and 8.06 mg/L (7.06, 9.19)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	18.0	**Conductance (µmho/cm):**	43
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

April 7, 1999.

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

RECEIVED
APR 12 1999
LOWER MAINLAND REGION
FILE NO. PE-06276
Data

Dear Ms. Weber:

Subject: Permit PE-6276, First Quarter 1999, Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the first quarter, 1999. All results meet the permit requirements except for the February bioassay. Analytical results for the required follow up effluent sample (E100784) meet all permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time in March did the discharge exceed 10,000m^3/day. In January and February the discharge exceeded 10,00m^3/day on four days. The monthly averages were 9050m^3/day in January and 8750m^3/day in February.

Sincerely,

BCRI

L. J. Hunt, Senior Technician

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	March 2,1999
Temperature (°C)	4.0
Dissolved Oxygen (mg/L)	9.2
5 day BOD (mg/L)	20
NFR (mg/L)	16
Ammonia (mgN/L)	7.8
Nitrate (mgN/L)	0.84
Nitrite (mgN/L)	0.004
T D Phosphorous (mg/L)	0.012
Sulphate (mg/L)	12.6
COD (mg/L)	45
Acidity,pH 8.3 (mg/L)	8
pH	8.1
Total Aluminum (mg/L)	<0.05
Total Copper (mg/L)	0.016
Total Iron (mg/L)	3.5
Total Lead (mg/L)	0.004
Total Manganese (mg/L)	1.2
Total Zinc (mg/L)	0.003

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	March 2,1999
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	0.034
C18:0 Stearic	0.014
C18:1 Oleic	0.008
C18:3 Linolenic	<0.005
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	January 20,1999	February 24,1999	March 30,1999
LC50 (%)	>100	<100	>100
Temperature (°C)	7.0	8.0	9.0
Dissolved Oxygen (mg/L)	10.8	8.6	6.8

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E1007844 (Final Discharge)

Date	January 1999	February 1999	March 1999
1	8700	9050	9000
2	8400	8700	8750
3	8050	9650	8700
4	8300	8750	9250
5	8100	7100	8050
6	8250	9450	8100
7	8850	8700	7950
8	9150	8400	8050
9	8900	8100	4750
10	9050	8050	4100
11	8700	7950	1950
12	10,050	7900	5350
13	9800	7900	5100
14	9750	7850	7100
15	9650	8100	5900
16	9700	8050	5100
17	9750	6550	4550
18	9700	10,050	4500
19	9700	9550	4350
20	9300	9650	4250
21	9450	9650	4250
22	8950	10,000	4400
23	8900	10,150	4550
24	9050	9500	4550
25	9150	9000	4800
26	8850	8900	4550
27	8700	9250	4450
28	9900	9200	4200
29	9050	-	4150
30	8050	-	4100
31	8600	-	3550
	Avg 9048	8755	5561

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #990212 Report #2-11-200-790-99002

96-h LC50 %v/v:	>100	% Mortality in 100% Sample:	30

SAMPLE Taken:	Jan. 20, 1999	**SAMPLE pH:**	7.9
SAMPLE Received:	Jan. 21, 1999	**SAMPLE Dissolved Oxygen (mg/L):**	10.4
Date Started:	Jan. 21, 1999	**SAMPLE Conductance (µmho/cm):**	1128
Time Started:	13:15		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.4	10.0	9.3	100	100	100	100
	100	8.0	8.5	10.2	9.3	80	80	80	70

COMMENTS: During the test the fish showed signs of stress, i.e. swimming slowly and were twitchy. At the end of the test 4 fish had protruding eyes.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	85		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.36 ± 0.07	**Length (cm):**	3.4 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jan. 4, 1999
Tests gave 96-h LC50 of 11.72 mg/L (10.52, 13.12) and 11.85 mg/L (10.26, 14.43)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	43
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Janet Rickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

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96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #990523 Report #2-11-200-790-99003

96-h LC50 %v/v: <100	% Mortality in 100% Sample: 80

SAMPLE Taken: Feb. 24, 1999
SAMPLE Received: Feb. 25, 1999
Date Started: Feb. 25, 1999
Time Started: 14:20

SAMPLE pH: 8.0
SAMPLE Dissolved Oxygen (mg/L): 10.5
SAMPLE Conductance (µmho/cm): 961

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.5	9.9	9.2	100	100	100	100
	100	8.1	8.5	10.0	9.5	60	30	20	20

COMMENTS: All control fish appeared and behaved normally during the test. At 72 hours surviving fish had lost equilibrium. At 96 hours one fish was moribund and one fish was swimming erratically, swollen abdomen and bug eyed.

TEST CONDITIONS:

Number of Organisms: 10
Test Volume (L): 10
Preaeration Time (min.): 120

Test Temperature (°C): 15 ± 1
Test pH Adjusted: No

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.24 ± 0.06
Length (cm): 3.0 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Feb. 23, 1999
Tests gave 96-h LC50 of 9.5 mg/L (8.15, 10.98) and 9.77 mg/L (8.39, 11.34)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L): 17
EDTA Hardness (mg $CaCO_3$/L): 20
Total Suspended Solids (mg/L): <1
Other parameters available on request.

Residual Chlorine (mg/L): <0.001
Conductance (µmho/cm): 44

ANALYST **VERIFIED BY**

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

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96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #990891 Report #2-11-200-790-99004

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Mar. 30, 1999	**SAMPLE pH:**	7.7
SAMPLE Received:	Mar. 31, 1999	**SAMPLE Dissolved Oxygen (mg/L):**	7.5
Date Started:	Apr. 1, 1999	**SAMPLE Conductance (µmho/cm):**	1091
Time Started:	08:40		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.4	10.1	8.5	100	100	100	90
	100	7.9	8.5	7.9	9.0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.51 ± 0.11 **Length (cm):** 3.7 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Mar. 19, 1999
Tests gave 96-h LC50 of 9.82 mg/L (8.38, 11.57) and 8.37 mg/L (7.1, 9.76)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	20	**Conductance (µmho/cm):**	44
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST Granger Jung **VERIFIED BY** Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

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January 28, 1999

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

RECEIVED
FEB 01 1999
LOWER MAINLAND REGION
FILE NO. PE-06276

Dear Ms. Weber:

Subject: Permit PE-6276, Fourth Quarter 1998 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the fourth quarter, 1998.

Effluent discharge rates were calculated using Francis's formula. At no time during October did the discharge exceed 10,000m^3/day. In November and December the discharge exceeded 10,000m^3/day on seven days. The monthly averages were 7010m^3/day in November and 8970m^3/day in December.

Sincerely,

BCRI

L. J. Hunt
Senior Technician

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	December 18,1998
Temperature (°C)	2.0
Dissolved Oxygen (mg/L)	10.2
5 day BOD (mg/L)	13
NFR (mg/L)	24
Ammonia (mgN/L)	3.6
Nitrite (mgN/L)	0.099
Nitrate (mgN/L)	2.05
T D Phosphorous (mg/L)	0.008
Sulphate (mg/L)	11
COD (mg/L)	29
Acidity,pH 8.3 (mg/L)	1
pH	8.23
Total Aluminum (mg/L)	<0.05
Total Copper (mg/L)	<0.001
Total Iron (mg/L)	2.1
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.77
Total Zinc (mg/L)	<0.001

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	December 18,1998
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	0.100
C18:0 Stearic	0.047
C18:1 Oleic	0.023
C18:3 Linolenic	<0.007
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	October 29 ,1998	November 16,1998	December 18,1998
LC50 (%)	>100	>100	>100
Temperature (°C)	12.5	10.5	2.0
Dissolved Oxygen (mg/L)	6.5	8.7	10.2

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E1007844 (Final Discharge), 1998.

Date	October	November	December
1	750	2850	8850
2	1150	2100	8950
3	1350	5100	9250
4	2100	9250	9250
5	3225	9650	8850
6	4750	9250	9000
7	5100	7250	9750
8	4750	3800	9850
9	5400	2500	10600
10	5200	3400	9800
11	7250	4500	9250
12	8050	4750	9500
13	7950	4950	8950
14	8850	3800	8850
15	7250	6150	9250
16	8050	8050	8750
17	8250	8850	7150
18	8500	9650	7250
19	8250	8900	7700
20	6150	8050	7900
21	5100	7650	7600
22	2600	5800	7650
23	2550	3750	8850
24	2400	8800	10500
25	2250	9050	9650
26	2150	10100	10650
27	3250	11250	9150
28	4050	10950	9000
29	4350	10550	8750
30	3350	9650	8850
31	3450	-	8750

Avg = 4769 Avg = 7012 Avg = 8971

Table 5:
Analytical Results, Permit PE-6276, Surface Sites, December 18,1998.

Parameter	E105877	E105876	E105878	E105880
Temperature (°C)	4.0	4.0	4.0	2.5
Dissolved Oxygen (mg/L)	6.8	6.5	8.2	6.3
Ammonia (mgN/L)	1.2	<0.5	2.2	<0.5
Nitrite (mgN/L)	0.036	0.029	0.046	0.020
Nitrate (mgN/L)	0.516	0.552	0.349	0.073
T D Phosphorous (mg/L)	0.140	0.168	0.140	0.022
Sulphate (mg/L)	48	19	53	68
COD (mg/L)	82	53	110	76
Acidity,pH 8.3 (mg/L)	11	8	2	12
pH	7.50	7.64	8.14	7.75
Total Aluminum (mg/L)	1.1	0.60	0.70	1.2
Total Copper (mg/L)	0.006	0.007	0.004	0.045
Total Iron (mg/L)	8.5	9.9	7.2	5.3
Total Lead (mg/L)	<0.001	<0.001	<0.001	0.009
Total Manganese (mg/L)	0.42	0.36	0.53	1.7
Total Zinc (mg/L)	0.029	0.017	0.060	0.090
	✓	✓	✓	✓

Table 6:
Analytical Results, Permit PE-6276, Groundwater Sites, December 18,1998.

Parameter	E206252	E206253	E206254	E206255
Temperature (°C)	7.0	7.5	6.5	8.0
Ammonia (mgN/L)	<0.5	<0.5	7.8	2.9
Nitrite (mgN/L)	0.014	<0.020	0.031	<0.020
Nitrate (mgN/L)	0.077	0.027	0.047	<0.010
T D Phosphorous (mg/L)	0.010	0.028	0.012	0.660
Sulphate (mg/L)	14	16	1.6	3.1
COD (mg/L)	116	256	116	256
Acidity, pH 8.3 (mg/L)	3	15	2	12
pH	8.10	7.85	8.20	7.33
Total Aluminum (mg/L)	<0.05	0.25	<0.05	0.99
Total Copper (mg/L)	0.004	0.010	0.015	0.016
Total Iron (mg/L)	0.98	11	4.9	3.9
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.08	0.18	3.1	0.15
Total Zinc (mg/L)	0.001	0.008	0.001	0.017
	✓	✓	✓	✓

Fraser River Harbour Commission

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3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
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96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #983863 Report #2-11-200-790-98010

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken: Oct. 29, 1998
SAMPLE Received: Oct. 30, 1998
Date Started: Oct. 30, 1998
Time Started: 10:40

SAMPLE pH: 8.6
SAMPLE Dissolved Oxygen (mg/L): 9.7
SAMPLE Conductance (µmho/cm): 1108

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.4	10.0	9.4	100	100	100	100
	100	8.6	8.6	9.7	9.2	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms: 10
Test Volume (L): 12
Preaeration Time (min.): 30

Test Temperature (°C): 15 ± 1
Test pH Adjusted: No

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.44 ± 0.09
Length (cm): 3.6 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Oct. 26, 1998
Tests gave 96-h LC50 of 7.83 mg/L (5.0, 10.0) and 8.06 mg/L (7.0, 10.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L): 17
EDTA Hardness (mg $CaCO_3$/L): 16
Total Suspended Solids (mg/L): <1
Other parameters available on request.

Residual Chlorine (mg/L): <0.001
Conductance (µmho/cm): 43

ANALYST **VERIFIED BY** Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

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96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #984078 Report #2-11-200-790-98011

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken: Nov. 16, 1998
SAMPLE Received: Nov. 17, 1998
Date Started: Nov. 17, 1998
Time Started: 14:08

SAMPLE pH: 7.8
SAMPLE Dissolved Oxygen (mg/L): 7.6
SAMPLE Conductance (µmho/cm): 994

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.4	10.0	9.4	100	100	100	100
	100	7.8	8.5	8.2	9.3	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms: 10
Test Volume (L): 12
Preaeration Time (min.): 30

Test Temperature (°C): 15 ± 1
Test pH Adjusted: No

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.64 ± 0.11
Length (cm): 4.0 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Oct. 26, 1998
Tests gave 96-h LC50 of 7.83 mg/L (5.0, 10.0) and 8.06 mg/L (7.0, 10.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L): 17
EDTA Hardness (mg $CaCO_3$/L): 16
Total Suspended Solids (mg/L): <1
Other parameters available on request.

Residual Chlorine (mg/L): <0.001
Conductance (µmho/cm): 43

ANALYST

VERIFIED BY

Jane Rickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

Fraser River Harbour Commission

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96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #98 Report #2-11-200-790-98012

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Dec. 18, 1998	**SAMPLE pH:**	7.8
SAMPLE Received:	Dec. 18, 1998	**SAMPLE Dissolved Oxygen (mg/L):**	8.0
Date Started:	Dec. 18, 1998	**SAMPLE Conductance (µmho/cm):**	1069
Time Started:	11:50		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.3	10.2	9.3	100	100	100	100
	100	7.8	8.4	8.7	9.3	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	12	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.57 ± 0.11	**Length (cm):**	3.9 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Nov. 19, 1998

Tests gave 96-h LC50 of 9.18 mg/L (7.94, 10.4) and 9.56 mg/L (7.0, 13.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	43
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277

SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY :

REPORT PERIOD: 1998 - 3rd quarter

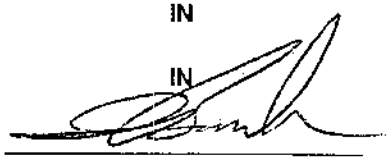
Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		in	
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (ma)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in n/a	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	n/a	2nd & 4th quarters only
Surface water samples	14 parms	6276: C.3	per six months	per six months	n/a	n/a	2nd & 4th quarters only
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	in	

COMPLIANCE WITH MONITORING PROGRAM IN

OVERALL COMPLIANCE IN

SIGNATURE



BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

October 21, 1998

RECEIVED
OCT 26 1998
LOWER MAINLAND REGION
FILE NO. PE-06276

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Third Quarter 1998 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the third quarter, 1998. All results meet the permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	September 9,1998
Temperature (°C)	21.0
Dissolved Oxygen (mg/L)	7.2
5 day BOD (mg/L)	<10
NFR (mg/L)	20
Ammonia (mgN/L)	<0.5
Nitrate (mgN/L)	1.17
Nitrite (mgN/L)	0.073
T D Phosphorous (mg/L)	0.012
Sulphate (mg/L)	4.4
COD (mg/L)	22
Acidity,pH 8.3 (mg/L)	18
pH	8.6
Total Aluminum (mg/L)	<0.05
Total Copper (mg/L)	<0.020
Total Iron (mg/L)	2.0
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.32
Total Zinc (mg/L)	<0.020

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	September 9,1998
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	0.016
C16:0 Palmitic	0.085
C18:0 Stearic	0.056
C18:1 Oleic	0.024
C18:3 Linolenic	<0.005
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	July 20,1998	August 20,1998	September 9,1998
LC50 (%)	>100	>100	>100
Temperature (°C)	23.0	23.0	21.0
Dissolved Oxygen (mg/L)	11.8	7.9	7.2

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E1007844 (Final Discharge)

Date	July 1998	August 1998	September 1998
1	1200	1150	400
2	750	550	550
3	3150	400	1350
4	2100	350	750
5	2050	400	900
6	950	2050	900
7	550	1800	750
8	400	1150	850
9	400	1600	800
10	250	1200	450
11	250	750	400
12	200	900	400
13	150	950	350
14	500	750	750
15	550	550	750
16	400	800	750
17	200	400	900
18	150	350	950
19	150	1350	750
20	150	400	700
21	100	1350	800
22	100	1250	1100
23	50	1550	1150
24	50	1350	1200
25	25	1250	900
26	25	1100	750
27	25	1050	800
28	150	1250	850
29	400	1300	750
30	450	700	650
31	550	550	-

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #982479 Report #2-11-200-790-98007

96-h LC50 %v/v:	>100	% Mortality in 100% Sample:	20

SAMPLE Taken:	Jul. 20, 1998	**SAMPLE pH:**	8.4
SAMPLE Received:	Jul. 21, 1998	**SAMPLE Dissolved Oxygen (mg/L):**	9.4
Date Started:	Jul. 21, 1998	**SAMPLE Conductance (µmho/cm):**	1030
Time Started:	12:30		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.6	7.4	10.2	9.3	100	100	100	100
	100	8.5	8.7	9.2	9.4	100	100	100	80

COMMENTS: All surviving fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.34 ± 0.05	**Length (cm):**	3.3 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jul. 21, 1998

Tests gave 96-h LC50 of 8.36 mg/L (7.37, 9.45) and 7.11 mg/L (6.0, 8.27)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	43
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

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3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
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96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #982799 Report #2-11-200-790-98008

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Aug. 20, 1998	**SAMPLE pH:**	7.7
SAMPLE Received:	Aug. 21, 1998	**SAMPLE Dissolved Oxygen (mg/L):**	8.2
Date Started:	Aug. 21, 1998	**SAMPLE Conductance (µmho/cm):**	1227
Time Started:	11:10		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.3	10.1	8.6	100	100	100	100
	100	7.8	8.5	8.4	9.0	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	15	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.64 ± 0.11 **Length (cm):** 4.0 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jul. 21, 1998
Tests gave 96-h LC50 of 8.36 mg/L (7.37, 9.45) and 7.11 mg/L (6.0, 8.27)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	43
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

Fraser River Harbour Commission

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3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

BCRI Sample #983034 Report #2-11-200-790-98009

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Sep. 9, 1998	**SAMPLE pH:**	8.6
SAMPLE Received:	Sep. 10, 1998	**SAMPLE Dissolved Oxygen (mg/L):**	8.7
Date Started:	Sep. 10, 1998	**SAMPLE Conductance (µmho/cm):**	1104
Time Started:	11:05		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.4	10.1	8.9	100	100	100	100
	100	8.6	8.6	8.9	9.0	100	100	100	100

COMMENTS: Fish displayed rapid gill movement at the start of the test. All fish appeared and behaved normally at 24 hours and during the remainder of the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	15	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments and BCRI SOP 1101-1.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.64 ± 0.12	**Length (cm):**	4.2 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Aug. 19, 1998
Tests gave 96-h LC50 of 7.92 mg/L (6.79, 9.13) and 7.92 mg/L (6.79, 9.13)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	43
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

BC RESEARCH Inc.

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Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

July 20, 1998.

RECEIVED
PE-06276

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Second Quarter 1998 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the second quarter, 1998.

All parameters meet permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	June 16, 1998
Temperature (^{O}C)	24.5
Dissolved Oxygen (mg/L)	16.8
5 day BOD (mg/L)	<10
NFR (mg/L)	4.5
Ammonia (mgN/L)	1.6
Nitrite (mgN/L)	0.128
Nitrate (mgN/L)	0.951
T D Phosphorous (mg/L)	0.014
Sulphate (mg/L)	3.1
COD (mg/L)	45
Acidity,pH 8.3 (mg/L)	<1
pH	8.4
Total Aluminum (mg/L)	<0.10
Total Copper (mg/L)	<0.05
Total Iron (mg/L)	1.0
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.31
Total Zinc (mg/L)	<0.005
Total Cadmium (mg/L)	<0.0002
Total Mercury (mg/L)	<0.00005

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	June 16, 1998
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	0.107
C18:0 Stearic	0.042
C18:1 Oleic	0.015
C18:3 Linolenic	0.015
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	April 28, 1998	May 26, 1998	June 16, 1998
LC50 (%)	>100	>100	>100
Temperature (°C)	20.0	14.5	24.5
Dissolved Oxygen (mg/L)	11.2	11.0	16.8

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E100784 (Final Discharge), 1998.

Date	April	May	June
1	7250	3450	2600
2	7350	2850	5100
3	6150	5150	6150
4	7250	5900	4750
5	5800	7650	4750
6	5850	8800	1550
7	7150	2050	900
8	7250	2100	600
9	4400	2150	1600
10	3450	2300	3200
11	4400	2100	3250
12	4550	2100	3050
13	5150	1950	3000
14	5300	2300	2850
15	5850	4400	2850
16	5700	4150	1150
17	5400	4400	1800
18	5150	4650	1350
19	4850	4350	750
20	4750	4350	900
21	4400	4350	1600
22	4250	4350	2150
23	4150	1150	1800
24	3950	750	900
25	3700	1200	3200
26	3650	3800	2850
27	3600	6150	4400
28	3500	4750	8850
29	3800	4350	8050
30	3450	2500	6500
31	-	2050	-

Table 5:
Analytical Results, Permit PE-6276, Surface Sites, June 16, 1998.

Parameter	E105877	E105876	E105878	E105880
Temperature (°C)	20.0	21.0	18.0	22.0
Dissolved Oxygen (mg/L)	3.2	3.2	4.1	2.8
Ammonia (mgN/L)	1.1	0.8	<0.5	<0.5
Nitrite (mgN/L)	0.033	0.017	0.009	0.007
Nitrate (mgN/L)	0.181	0.212	0.140	<0.010
T D Phosphorous (mg/L)	0.404	0.349	0.173	0.091
Sulphate (mg/L)	9.4	10	4.3	14
COD (mg/L)	78	54	26	40
Acidity,pH 8.3 (mg/L)	15	17	5	11
pH	7.7	7.6	7.8	7.7
Total Aluminum (mg/L)	0.30	0.38	0.25	0.44
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	7.1	12	7.4	13
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.22	0.34	0.22	0.45
Total Zinc (mg/L)	<0.005	<0.005	0.026	<0.005

Table 6:
Analytical Results, Permit PE-6276, Groundwater Sites, June 16, 1998.

Parameter	E206252	E206253	E206254	E206255
Ammonia (mgN/L)	<0.5	<0.5	6.7	4.6
Nitrite (mgN/L)	<0.010	<0.010	<0.010	<0.010
Nitrate (mgN/L)	0.013	0.336	0.340	<0.010
T D Phosphorous (mg/L)	0.114	0.039	0.142	0.846
Sulphate (mg/L)	1.1	<1.0	<1.0	2.1
COD (mg/L)	283	261	148	348
Acidity, pH 8.3 (mg/L)	67	81	61	60
pH	7.2	6.8	7.2	6.4
Total Aluminum (mg/L)	0.14	0.30	0.22	0.22
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	2.4	10	49	1.7
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.11	0.13	2.6	0.09
Total Zinc (mg/L)	<0.005	0.030	<0.005	0.100

Fraser River Harbour Commission

BC Research Inc.
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Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-98004

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Apr. 28, 1998	**SAMPLE pH:**	7.7
SAMPLE Received:	Apr. 29, 1998	**SAMPLE Dissolved Oxygen (mg/L):**	9.2
Date Started:	Apr. 29, 1998	**SAMPLE Conductance (µmho/cm):**	1250
Time Started:	11:20		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.3	7.1	9.9	9.5	100	100	100	100
	100	7.8	8.5	9.3	9.5	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	12	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.53 ± 0.12	**Length (cm):**	3.8 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Apr. 14, 1998
Tests gave 96-h LC50 of 9.56 mg/L (7.0, 13.0) and 8.72 mg/L (7.51, 9.98)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	43
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-98005

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	May. 26, 1998	**SAMPLE pH:**	8.0
SAMPLE Received:	May. 27, 1998	**SAMPLE Dissolved Oxygen (mg/L):**	9.4
Date Started:	May. 28, 1998	**SAMPLE Conductance (µmho/cm):**	1199
Time Started:	09:45		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.3	9.8	9.3	100	100	100	100
	100	8.0	8.4	9.5	9.3	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	15	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.73 ± 0.17 **Length (cm):** 4.2 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: May. 11, 1998
Tests gave 96-h LC50 of 8.36 mg/L (6.98, 9.86) and 7.6 mg/L (6.27, 9.11)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	43
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

Fraser River Harbour Commission

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96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-98006

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Jun. 16, 1998	**SAMPLE pH:**	8.1
SAMPLE Received:	Jun. 17, 1998	**SAMPLE Dissolved Oxygen (mg/L):**	12.4
Date Started:	Jun. 17, 1998	**SAMPLE Conductance (µmho/cm):**	1152
Time Started:	11:25		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.2	10.0	9.3	100	100	100	100
	100	8.2	8.5	11.0	9.2	100	100	100	100

COMMENTS: Fish immediately displayed rapid gill movement. After 30 minutes all fish appeared and behaved normally and remained thus, throughout the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	15	**Test pH Adjusted:**	No
Preaeration Time (min.):	120		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.70 ± 0.14	**Length (cm):**	4.2 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jun. 4, 1998
Tests gave 96-h LC50 of 9.46 mg/L (7.0, 13.0) and 10.0 mg/L (7.0, 13.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	43
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

April 29, 1998.

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

RECEIVED
MAY 05 1998
ENVIRONMENT, LANDS & PARKS
LOWER MAINLAND REGION
FILE No. PE-06276

Dear Ms. Weber:

Subject: Permit PE-6276, First Quarter 1998, Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the first quarter, 1998. All results meet the permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	March 25,1998
Temperature (°C)	14.5
Dissolved Oxygen (mg/L)	10.2
5 day BOD (mg/L)	<10
NFR (mg/L)	11
Ammonia (mgN/L)	6.4
Nitrate (mgN/L)	2.72
Nitrite (mgN/L)	0.110
T D Phosphorous (mg/L)	0.060
Sulphate (mg/L)	8.8
COD (mg/L)	39
Acidity,pH 8.3 (mg/L)	<1
pH	8.5
Total Aluminum (mg/L)	<0.05
Total Copper (mg/L)	<0.005
Total Iron (mg/L)	3.8
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	1.3
Total Zinc (mg/L)	0.023

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	March 25,1998
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	<0.005
C18:0 Stearic	<0.005
C18:1 Oleic	<0.005
C18:3 Linolenic	<0.005
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	January 29,1998	February 24,1998	March 25,1998
LC50 (%)	>100	>100	>100
Temperature (°C)	8.0	8.0	14.5
Dissolved Oxygen (mg/L)	9.5	7.6	10.2

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E1007844 (Final Discharge)

Date	January 1998	February 1998	March 1998
1	5900	9600	5100
2	6400	9000	6550
3	7150	8050	7250
4	7300	8100	6650
5	7250	8050	6700
6	7250	8050	6700
7	6550	8050	6250
8	6500	8050	5450
9	1800	8000	5750
10	1800	7850	6650
11	1350	7900	7100
12	800	8850	6950
13	750	8050	6950
14	7250	7800	7050
15	7650	7350	7000
16	7300	6550	7050
17	8050	6850	6850
18	7250	7250	5350
19	7950	7050	5100
20	8050	6900	5050
21	8100	6950	5100
22	9250	7450	5250
23	9650	5800	5050
24	8750	6100	4850
25	8850	6550	4800
26	8800	6500	5600
27	9350	5450	5750
28	9650	5400	5800
29	9650	-	5550
30	9650	-	5850
31	9500	-	5900

Fraser River Harbour Commission

BC Research Inc.
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Tel: (604) 224-4331
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96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-98001

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Jan. 29, 1998	**SAMPLE pH:**	7.7
SAMPLE Received:	Jan. 29, 1998	**SAMPLE Dissolved Oxygen (mg/L):**	7.8
Date Started:	Jan. 30, 1998	**SAMPLE Conductance (µmho/cm):**	1110
Time Started:	09:35		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.4	10.1	9.4	100	100	100	100
	100	7.8	8.4	8.3	9.4	100	100	100	100

COMMENTS: Fish appeared stressed, i.e. swimming slowly and not very reactive.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.34 ± 0.06 **Length (cm):** 3.5 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jan. 26, 1998
Tests gave 96-h LC50 of 11.52 mg/L (9.92, 13.92) and 11.14 mg/L (9.63, 13.24)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	20	**Conductance (µmho/cm):**	40
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY** Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

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96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-98003

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 10

SAMPLE Taken:	Mar. 25, 1998	**SAMPLE pH:**	8.3
SAMPLE Received:	Mar. 26, 1998	**SAMPLE Dissolved Oxygen (mg/L):**	9.3
Date Started:	Mar. 27, 1998	**SAMPLE Conductance (µmho/cm):**	1018
Time Started:	09:25		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.3	7.4	10.0	9.0	100	100	100	100
	100	8.3	8.5	9.4	8.7	100	100	100	90

COMMENTS: Fish were immediately stressed, i.e. rapid gill movement and quiescence at aquarium bottom. Surviving fish were stressed, i.e. 3 fish moribund or nearly so, while the others were slow swimming and twitching and displayed rapid gill movement.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.47 ± 0.12 **Length (cm):** 3.7 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Mar. 9, 1998
Tests gave 96-h LC50 of 9.71 mg/L (8.38, 11.06) and 7.83 mg/L (5.0, 10.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	20	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	24	**Conductance (µmho/cm):**	50
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

BCRI

January 29, 19978

RECEIVED
FEB - 3 '97
ENVIRONMENTAL LAND USE & FLOOD
LOWER MAINLAND REGION
FILE No.

PE-06276

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Fourth Quarter 1997 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the fourth quarter, 1997.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

The results for this quarter meet all permit requirements.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

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Value creation through innovation

PE-06276

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	November 13,1997
Temperature (°C)	7.5
Dissolved Oxygen (mg/L)	5.2
5 day BOD (mg/L)	<10
NFR (mg/L)	16
Ammonia (mgN/L)	4.8
Nitrite (mgN/L)	0.075
Nitrate (mgN/L)	0.728
T D Phosphorous (mg/L)	0.012
Sulphate (mg/L)	5.6
COD (mg/L)	33
Acidity,pH 8.3 (mg/L)	15
pH	8.1
Total Aluminum (mg/L)	0.054
Total Copper (mg/L)	0.006
Total Iron (mg/L)	3.0
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.99
Total Zinc (mg/L)	0.008

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	November 13,1997
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	0.052
C18:0 Stearic	0.032
C18:1 Oleic	0.012
C18:3 Linolenic	<0.005
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	October 20 ,1997	November 13,1997	December 9,1997
LC50 (%)	>100	>100	>100
Temperature (°C)	11.5	7.5	5.0
Dissolved Oxygen (mg/L)	7.4	5.2	6.1

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E1007844 (Final Discharge)

Date	October	November	December
1	5950	5900	5800
2	4250	5350	5800
3	4300	5300	6500
4	5900	5400	6700
5	3150	5350	4700
6	2400	5150	4700
7	3800	5200	8050
8	4350	5650	6150
9	4400	5500	4750
10	4050	5450	5100
11	3700	5400	6100
12	3800	3750	6350
13	3900	2600	6500
14	4450	3800	5100
15	4550	4300	7300
16	4750	4300	7250
17	5600	3200	6250
18	5750	3800	5250
19	6150	2600	5100
20	5800	2600	6400
21	4100	3450	5850
22	2500	4100	6800
23	2450	7250	6250
24	2350	6150	6250
25	2350	6250	6400
26	2350	4800	5900
27	3150	4700	3550
28	8850	4750	4350
29	8500	5400	4750
30	8800	5100	5800
31	7250	-	5800

Table 5:
Analytical Results, Permit PE-6276, Surface Sites, December 9,1997.

Parameter	E105877	E105876	E105878	E105880
Temperature (°C)	5.5	6.0	5.5	6.5
Dissolved Oxygen (mg/L)	4.4	4.6	3.8	3.8
Ammonia (mgN/L)	2.3	1.1	<0.5	0.6
Nitrite (mgN/L)	0.032	0.025	<0.002	0.024
Nitrate (mgN/L)	0.194	0.211	0.019	0.044
T D Phosphorous (mg/L)	0.186	0.172	0.076	0.354
Sulphate (mg/L)	32	20	3.7	11
COD (mg/L)	97	49	565	51
Acidity,pH 8.3 (mg/L)	39	32	38	24
pH	7.2	7.0	6.2	7.0
Total Aluminum (mg/L)	0.79	0.75	0.94	0.72
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	15	19	15	21
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.74	0.70	0.57	1.0
Total Zinc (mg/L)	<0.005	0.005	0.006	<0.005

Table 6:
Analytical Results, Permit PE-6276, Groundwater Sites, December 9,1997.

Parameter	E206252	E206253	E206254	E206255
Temperature (°C)	9.0	8.5	8.5	9.0
Ammonia (mgN/L)	<0.5	<0.5	11	4.0
Nitrite (mgN/L)	0.005	0.018	0.006	0.018
Nitrate (mgN/L)	<0.005	0.016	<0.005	0.029
T D Phosphorous (mg/L)	0.054	0.046	0.014	0.232
Sulphate (mg/L)	7.7	0.9	1.1	0.9
COD (mg/L)	190	282	131	282
Acidity, pH 8.3 (mg/L)	89	102	92	199
pH	6.8	6.3	7.2	5.9
Total Aluminum (mg/L)	0.07	0.37	<0.05	0.52
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	3.0	15	22	6.7
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.10	0.25	5.0	0.39
Total Zinc (mg/L)	<0.005	<0.005	<0.005	<0.005

Fraser River Harbour Commission

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96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-97012

96-h LC50 %v/v:	>100	% Mortality in 100% Sample:	0

SAMPLE Taken:	Dec. 9, 1997	**SAMPLE pH:**	7.6
SAMPLE Received:	Dec. 9, 1997	**SAMPLE Dissolved Oxygen (mg/L):**	6.0
Date Started:	Dec. 10, 1997	**SAMPLE Conductance (µmho/cm):**	1333
Time Started:	10:05		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.5	7.5	10.1	9.3	100	100	100	100
	100	7.7	8.5	7.0	9.4	100	100	100	100

COMMENTS: Fish were immediately stressed, i.e., rapid gill movement and swimming near the surface. All fish appeared and behaved normally at 24 hours and during the remainer of the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	35		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.26 ± 0.03	**Length (cm):**	3.3 ± 0.1

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Dec. 5, 1997
Tests gave 96-h LC50 of 14.45 mg/L (12.54, 18.09) and 13.55 mg/L (11.68, 16.83)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	20	**Conductance (µmho/cm):**	40
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

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96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-97011

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Nov. 13, 1997	**SAMPLE pH:**	7.7
SAMPLE Received:	Nov. 14, 1997	**SAMPLE Dissolved Oxygen (mg/L):**	5.3
Date Started:	Nov. 14, 1997	**SAMPLE Conductance (µmho/cm):**	1331
Time Started:	11:30		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.6	7.4	10.0	9.2	100	100	100	100
	100	7.9	8.6	7.3	9.2	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the first 48 hours of the test. Fish were stressed at the 72 and 96 hour observation time, i.e. slow to respond and 1 fish had protruding eyes .

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	90		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.28 ± 0.06 **Length (cm):** 3.2 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Nov. 4, 1997
Tests gave 96-h LC50 of 10.51 mg/L (9.06, 11.82) and 11.97 mg/L (10.0, 22.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	20	**Conductance (µmho/cm):**	40
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
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96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-97010

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Oct. 20, 1997	**SAMPLE pH:**	7.5
SAMPLE Received:	Oct. 21, 1997	**SAMPLE Dissolved Oxygen (mg/L):**	5.4
Date Started:	Oct. 22, 1997	**SAMPLE Conductance (µmho/cm):**	1286
Time Started:	09:35		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.4	7.1	10.1	8.9	100	100	100	100
	100	7.8	8.4	7.3	8.8	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	85		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.55 ± 0.10 **Length (cm):** 4.0 ± 0.4

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Sep. 23, 1997
Tests gave 96-h LC50 of 11.76 mg/L (10.29, 14.21) and 11.45 mg/L (9.94, 13.7)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	20	**Conductance (µmho/cm):**	33
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

BCRI

October 7, 1997

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

RECEIVED
OCT 16 1997
ENVIRONMENT, LANDS & PARKS
LOWER MAINLAND REGION
FILE No. PE-06276
Data

Dear Ms. Weber:

Subject: Permit PE-6276, Third Quarter Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the third quarter, 1997. All results meet the permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

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Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	September 15,1997
Temperature (^{O}C)	24.0
Dissolved Oxygen (mg/L)	12.4
5 day BOD (mg/L)	17
NFR (mg/L)	3.0
Ammonia (mgN/L)	4.4
Nitrate (mgN/L)	1.48
Nitrite (mgN/L)	0.228
T D Phosphorous (mg/L)	0.019
Sulphate (mg/L)	2.1
COD (mg/L)	28
Acidity,pH 8.3 (mg/L)	5
pH	8.2
Total Aluminum (mg/L)	<0.05
Total Copper (mg/L)	0.005
Total Iron (mg/L)	0.60
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.07
Total Zinc (mg/L)	0.002

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	September 15,1997
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	<0.005
C18:0 Stearic	<0.005
C18:1 Oleic	<0.005
C18:3 Linolenic	<0.005
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	July 14,1997	August 14,1997	September 15,1997
LC50 (%)	>100	>100	>100
Temperature (°C)	24.0	24.0	18.5
Dissolved Oxygen (mg/L)	12.4	6.5	11.5

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E1007844 (Final Discharge)

Date	July	August	September
1	400	1875	725
2	350	950	425
3	275	550	300
4	3800	400	2075
5	5200	1800	400
6	5250	1800	425
7	5800	3150	600
8	4750	2875	525
9	5800	2100	525
10	5400	2075	550
11	5350	1125	825
12	3050	500	325
13	2600	375	950
14	2150	225	1650
15	1575	400	2600
16	1500	750	1800
17	925	400	1575
18	1350	300	1475
19	225	150	350
20	75	550	400
21	2900	550	725
22	2900	575	725
23	4700	400	800
24	1800	1175	125
25	925	800	150
26	675	725	100
27	450	1350	50
28	400	1350	100
29	350	800	500
30	2325	475	2175
31	3775	725	-

Fraser River Harbour Commission

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96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-97007

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Jul. 14, 1997	**SAMPLE pH:**	7.9
SAMPLE Received:	Jul. 15, 1997	**SAMPLE Dissolved Oxygen (mg/L):**	11.8
Date Started:	Jul. 15, 1997	**SAMPLE Conductance (µmho/cm):**	970
Time Started:	14:24		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.6	7.2	10.2	9.9	100	100	100	100
	100	8.0	8.4	10.8	10	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	18	**Test pH Adjusted:**	No
Preaeration Time (min.):	124		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 1.06 ± 0.24 **Length (cm):** 4.7 ± 0.4

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jun. 19, 1997
Tests gave 96-h LC50 of 9.71 mg/L (8.38, 11.06) and 10.0 mg/L (7.0, 13.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	12	**Residual Chlorine (mg/L):**	<0.002
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	31
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977)

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96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-97008

96-h LC50 %v/v:	>100	% Mortality in 100% Sample:	0

SAMPLE Taken:	Aug. 14, 1997	**SAMPLE pH:**	7.5
SAMPLE Received:	Aug. 15, 1997	**SAMPLE Dissolved Oxygen (mg/L):**	6.9
Date Started:	Aug. 15, 1997	**SAMPLE Conductance (µmho/cm):**	870
Time Started:	10:20		

	TEST CONC'N	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
	(%v/v)	INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.6	7.3	10.1	9.5	100	100	100	100
	100	7.8	8.6	7.8	9.7	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	10	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.45 ± 0.09	**Length (cm):**	3.7 ± 0.2

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jul. 28, 1997

Tests gave 96-h LC50 of 10.83 mg/L (9.32, 12.81) and 10.51 mg/L (8.86, 12.75)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	12	**Residual Chlorine (mg/L):**	<0.002
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	31
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

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96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200-790-97009

96-h LC50 %v/v:	>100	% Mortality in 100% Sample:	0

SAMPLE Taken:	Sep. 15, 1997	**SAMPLE pH:**	8.1
SAMPLE Received:	Sep. 16, 1997	**SAMPLE Dissolved Oxygen (mg/L):**	11.4
Date Started:	Sep. 17, 1997	**SAMPLE Conductance (µmho/cm):**	1240
Time Started:	11:10		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.6	7.4	10.3	9.4	100	100	100	100
	100	8.2	8.6	10.9	9.3	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	15	**Test pH Adjusted:**	No
Preaeration Time (min.):	120		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.89 ± 0.21 **Length (cm):** 4.4 ± 0.4

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Sep. 2, 1997
Tests gave 96-h LC50 of 9.65 mg/L (8.34, 10.9) and 9.22 mg/L (7.0, 13.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	17	**Residual Chlorine (mg/L):**	<0.001
EDTA Hardness (mg $CaCO_3$/L):	20	**Conductance (µmho/cm):**	33
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY** Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

BCRI

August 28, 1997

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C, V3M 1B2

PE-06276

Dear Ms. Weber:

Subject: ***Permit PE-6276 Second Quarter 1997 Monitoring Results***

There was an error in the second quarter report. BOD and COD values were interchanged in table 1. This was confirmed by reviewing the analysts lab notes and repeating the COD analysis. The BOD analysis could not be repeated as no properly preserved sample was available.

A corrected cover letter and Table 1 are attached. Mr. D. Barlow has been informed by phone and the corrected pages will be sent to him.

I apologize for any inconvenience this error has caused.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc: Mr. D. Barlow

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2

Canada
Tel: (604) 224-4331
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BCRI

July 30, 1997

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Second Quarter 1997 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the second quarter, 1997.

The April bioassay failed. A sample for chemical analysis was then taken on April 18,1997. All parameters met permit requirements.

All other bioassays passed.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

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3650 Wesbrook Mall
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Value creation through innovation

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	April 18,1997	June 10,1997
Temperature (^{O}C)	9.5	-
Dissolved Oxygen (mg/L)	6.1	-
5 day BOD (mg/L)	<10	-
NFR (mg/L)	12	-
Ammonia (mgN/L)	8.8	-
Nitrite (mgN/L)	0.172	-
Nitrate (mgN/L)	2.86	
T D Phosphorous (mg/L)	0.025	-
Sulphate (mg/L)	19.4	-
COD (mg/L)	35	-
Acidity,pH 8.3 (mg/L)	33	-
pH	7.6	-
Total Aluminum (mg/L)	<0.05	-
Total Copper (mg/L)	0.007	-
Total Iron (mg/L)	5.40	-
Total Lead (mg/L)	<0.001	-
Total Manganese (mg/L)	1.30	-
Total Zinc (mg/L)	0.005	-
Total Cadmium (mg/L)	-	<0.001
Total Mercury (mg/L)	-	<0.00005

BCRI

July 30, 1997

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

PE-06276

Dear Ms. Weber:

Subject: Permit PE-6276, Second Quarter 1997 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the second quarter, 1997.

The April bioassay failed. A sample for chemical analysis was then taken on April 18,1997. The COD level (35 mg/L) exceeded the permit limit of 30.0 mg/L. All other parameters met permit requirements.

All other bioassays passed.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

RECEIVED
AUG 05 1997
LOWER MAINLAND REGION
FILE NO.

LJH/ljh

cc Mr. D. Barlow

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Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	April 18,1997	June 10,1997
Temperature (°C)	9.5	-
Dissolved Oxygen (mg/L)	6.1	-
5 day BOD (mg/L)	35	-
NFR (mg/L)	12	-
Ammonia (mgN/L)	8.8	-
Nitrite (mgN/L)	0.172	-
Nitrate (mgN/L)	2.86	
T D Phosphorous (mg/L)	0.025	-
Sulphate (mg/L)	19.4	-
COD (mg/L)	<10	-
Acidity,pH 8.3 (mg/L)	33	-
pH	7.6	-
Total Aluminum (mg/L)	<0.05	-
Total Copper (mg/L)	0.007	-
Total Iron (mg/L)	5.40	-
Total Lead (mg/L)	<0.001	-
Total Manganese (mg/L)	1.30	-
Total Zinc (mg/L)	0.005	-
Total Cadmium (mg/L)	-	<0.001
Total Mercury (mg/L)	-	<0.00005

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	April 18,1997
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	<0.005
C16:0 Palmitic	<0.005
C18:0 Stearic	<0.005
C18:1 Oleic	<0.005
C18:3 Linolenic	<0.005
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	April 15 ,1997	May 20,1997	June 4,1997
LC50 (%)	<100	>100	>100
Temperature (°C)	8.5	20.0	20.5
Dissolved Oxygen (mg/L)	11.0	18.4	12.9

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E100784 (Final Discharge)

Date	April	May	June
1	3400	3900	1575
2	4400	3650	2325
3	3175	3775	1750
4	3175	1600	1575
5	3150	2750	1500
6	2875	2500	1500
7	7425	2400	1575
8	8850	2175	5800
9	8850	2400	3175
10	6525	2625	3800
11	5450	3800	3800
12	5450	6275	1450
13	5800	5800	3175
14	5400	5200	3175
15	5800	5150	2600
16	6600	5150	2075
17	7400	5650	3175
18	7600	2425	2075
19	5800	3200	2875
20	3750	3950	1600
21	3175	4000	2075
22	2875	3200	1600
23	3800	1150	1650
24	4700	750	1600
25	4750	1600	1650
26	3650	3650	750
27	2500	2750	400
28	2075	2150	375
29	1975	1950	225
30	1975	1700	400
31	-	1575	-

Table 5:
Analytical Results, Permit PE-6276, Surface Sites, June 10,1997. E105878

Parameter	E105877	E105876	E206252	E105880
Temperature (°C)	19.0	18.5	18.0	14.0
Dissolved Oxygen (mg/L)	1.9	1.8	2.4	3.2
Ammonia (mgN/L)	1.2	1.1	0.8	<0.5
Nitrite (mgN/L)	0.033	0.041	0.019	0.017
Nitrate (mgN/L)	0.286	1.1	<0.01	0.045
T D Phosphorous (mg/L)	0.436	0.246	0.100	0.436
Sulphate (mg/L)	14.5	14.2	1.2	12.8
COD (mg/L)	60	53	477	43
Acidity,pH 8.3 (mg/L)	25.5	26.0	75.0	15.0
pH	6.8	7.0	6.4	7.2
Total Aluminum (mg/L)	0.25	0.18	1.3	0.25
Total Copper (mg/L)	0.005	0.005	0.008	0.005
Total Iron (mg/L)	11	13	59	15
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.49	0.55	1.6	1.1
Total Zinc (mg/L)	<0.005	<0.005	<0.005	<0.005

Table 6:
Analytical Results, Permit PE-6276, Groundwater Sites, June 10,1997.

Parameter	E206252	E206253	E206254	E206255
Temperature (°C)	14.0	13.0	16.5	16.0
Ammonia (mgN/L)	0.9	2.2	7.7	1.8
Nitrite (mgN/L)	0.016	0.012	0.062	0.055
Nitrate (mgN/L)	0.214	0.102	<0.01	<0.01
T D Phosphorous (mg/L)	0.154	0.052	0.034	0.020
Sulphate (mg/L)	1.8	1.4	1.5	29.8
COD (mg/L)	160	250	185	153
Acidity, pH 8.3 (mg/L)	125	128	198	181
pH	6.3	5.9	6.9	6.5
Total Aluminum (mg/L)	0.12	0.32	0.28	0.15
Total Copper (mg/L)	0.004	0.004	0.002	0.005
Total Iron (mg/L)	1.6	14	51	49
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.07	0.20	4.6	3.8
Total Zinc (mg/L)	<0.005	<0.005	<0.005	<0.005

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200- 790-97004

96-h LC50 %v/v:	<100

SAMPLE Taken:	Apr. 15, 1997	**SAMPLE pH:**	7.4
SAMPLE Received:	Apr. 16, 1997	**SAMPLE Dissolved Oxygen (mg/L):**	9.1
Date Started:	Apr. 16, 1997	**SAMPLE Conductance (µmho/cm):**	980
Time Started:	12:00		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	6.7	7.1	10.2	8.7	100	100	100	100
	100	7.6	8.1	9.4	9.3	40	10	10	0

COMMENTS:

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	15	**Test pH Adjusted:**	No
Preaeration Time (min.):	30		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13, July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.64 ± 0.15	**Length (cm):**	4.1 ± 0.4

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Apr. 8, 1997
Tests gave 96-h LC50 of 9.93 mg/L (8.57, 11.21) and 10.62 mg/L (7.0, 13.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	12	**Residual Chlorine (mg/L):**	<0.002
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	31
Total Suspended Solids (mg/L):	<1		

More information available on request.

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

2-11-200- 790-97005

96-h LC50 %v/v: >100

SAMPLE Taken:	May. 20, 1997	**SAMPLE pH:**	8.2
SAMPLE Received:	May. 21, 1997	**SAMPLE Dissolved Oxygen (mg/L):**	12.1
Date Started:	May. 21, 1997	**SAMPLE Conductance (µmho/cm):**	850
Time Started:	14:10		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.6	7.4	10.2	9.2	100	100	100	100
	100	8.3	8.5	11.3	9.0	100	100	100	100

COMMENTS: Fish appeared stressed during the test, i.e. swimming on the surface. At the end of the test one was starting to flip over and one on its back gasping.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	15	**Test pH Adjusted:**	No
Preaeration Time (min.):	120		

Bioassay conducted according to Biological Test Method:"Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13, July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C):	15 ± 1		
Weight (g):	0.68 ± 0.17	**Length (cm):**	4.1 ± 0.4

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: May. 8, 1997
Tests gave 96-h LC50 of 9.17 mg/L (7.81, 10.73) and 9.71 mg/L (8.38, 11.06)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	12	**Residual Chlorine (mg/L):**	<0.002
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	31
Total Suspended Solids (mg/L):	<1		

More information available on request.

ANALYST Karen J Kennie

VERIFIED BY Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634. 1977).

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

790-97006

96-h LC50 %v/v: >100	% Mortality in 100% Sample: 0

SAMPLE Taken:	Jun. 4, 1997	**SAMPLE pH:**	7.9
SAMPLE Received:	Jun. 5, 1997	**SAMPLE Dissolved Oxygen (mg/L):**	11.1
Date Started:	Jun. 5, 1997	**SAMPLE Conductance (µmho/cm):**	900
Time Started:	12:50		

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.7	7.5	10.2	9.4	100	100	100	100
	100	8.1	8.5	10.2	9.2	100	100	100	100

COMMENTS: All fish appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms:	10	**Test Temperature (°C):**	15 ± 1
Test Volume (L):	15	**Test pH Adjusted:**	No
Preaeration Time (min.):	120		

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13 July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.86 ± 0.22 **Length (cm):** 4.4 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: May. 8, 1997
Tests gave 96-h LC50 of 9.17 mg/L (7.81, 10.73) and 9.71 mg/L (8.38, 11.06)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L):	12	**Residual Chlorine (mg/L):**	<0.002
EDTA Hardness (mg $CaCO_3$/L):	16	**Conductance (µmho/cm):**	31
Total Suspended Solids (mg/L):	<1		

Other parameters available on request.

ANALYST **VERIFIED BY**

Patricia Keen

96-h $LC50$ is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

BCRI

April 25, 1997

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

RECEIVED
MAY - 5 1997
LOWER MAINLAND REGION
FILE NO. PE-06276
Data

Dear Ms. Weber:

Subject: Permit PE-6276, First Quarter Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the first quarter, 1997. All sampling and analysis in January was done by Golder Associates Ltd.

The January bioassay failed (LC50 60%). Those analytical results done for a sample taken at the same time met all permit requirements. A dissolved oxygen measurement was not made. COD was not determined.

A sample for chemical analysis was then taken on February 10,1997. The ammonia level (12.5 mgN/L) exceeded the permit limit of 10.0 mgN/L. All other parameters met permit requirements. A bioassay sample taken on February 28,1997 passed (LC50 >100).

A bioassay sample taken March 13,1997 failed. Analytical results for a sample take March 17,1997 met all permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2

Canada
Tel: (604) 224-4331
Fax: (604) 224-0540

USA
Tel: (360) 738-0958
Fax: (360) 733-3590

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	January 22,1997	February 10,1997	March 17,1997
Temperature (°C)	8.0	3.5	6.0
Dissolved Oxygen (mg/L)	-	9.4	9.2
5 day BOD (mg/L)	12	<10	19
NFR (mg/L)	12	18	11
Ammonia (mgN/L)	9.0	12.5	10.0
Nitrate (mgN/L)	0.911	0.675	1.30
Nitrite (mgN/L)	0.068	0.026	0.032
T D Phosphorous (mg/L)	0.012	<0.010	0.012
Sulphate (mg/L)	13	18	16
COD (mg/L)	-	50	47
Acidity,pH 8.3 (mg/L)	26	42	29
pH	7.7	7.7	7.7
Total Aluminum (mg/L)	0.045	<0.05	<0.05
Total Copper (mg/L)	0.002	<0.005	<0.005
Total Iron (mg/L)	2.99	5.80	5.40
Total Lead (mg/L)	<0.001	<0.001	<0.001
Total Manganese (mg/L)	1.75	1.90	1.50
Total Zinc (mg/L)	<0.005	<0.005	<0.005

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	January 22,1997	February 10,1997	March 17,1997
Fatty Acids (mg/l)			
C12:0 Lauric	<0.005	<0.005	<0.005
C14:0 Myristic	<0.005	<0.005	<0.005
C16:0 Palmitic	<0.005	0.059	<0.005
C18:0 Stearic	<0.005	0.032	<0.005
C18:1 Oleic	<0.005	<0.005	<0.005
C18:3 Linolenic	<0.005	<0.005	<0.005
C18:2 Linoleic	<0.005	<0.005	<0.005
C20:0 Arachidic	<0.005	<0.005	<0.005
C22:0 Behenic	<0.005	<0.005	<0.005
9,10 Epoxystearic	<0.005	<0.005	<0.005
9,10 Dichlorostearic	<0.005	<0.005	<0.005
Resin Acids (mg/L)			
Pimaric	<0.005	<0.005	<0.005
Sandaracopimaric	<0.005	<0.005	<0.005
Isopimaric	<0.005	<0.005	<0.005
Levopimaric/Palustric	<0.005	<0.005	<0.005
Dehydroabietic	<0.005	<0.005	<0.005
Abietic	<0.005	<0.005	<0.005
Neoabietic	<0.005	<0.005	<0.005
Chlorohydroabietic	<0.005	<0.005	<0.005
Dichlorohydroabietic	<0.005	<0.005	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	January 22,1997	February 28,1997	March 13,1997
LC50 (%)	60	>100	<100
Temperature (°C)	7.7	3.5	5.0
Dissolved Oxygen (mg/L)	-	8.4	10.2

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E1007844 (Final Discharge)

Date	January	February	March
1	7500	9250	6800
2	6370	9250	6350
3	5650	9000	7400
4	5790	8850	7700
5	5650	8650	8050
6	7770	8650	8050
7	5790	9150	7700
8	5800	8700	7900
9	5800	8450	7250
10	5290	9050	7350
11	5200	9850	8450
12	5100	7250	7550
13	5000	6900	7100
14	4950	8800	5950
15	4950	9550	6200
16	5400	9100	6350
17	5100	8650	8650
18	7250	8900	9350
19	8050	7250	8050
20	7250	7200	7300
21	7350	5800	7400
22	8400	4950	7250
23	8400	4750	7250
24	8400	6500	7350
25	8250	7850	7700
26	8350	7750	7800
27	9000	7900	7550
28	8950	7250	7550
29	9650	-	7350
30	9550	-	7250
31	8500	-	7200

EVS ENVIRONMENT CONSULTANTS

195 Pemberton Avenue
North Vancouver, BC
Canada V7P 2R4
Fax: (604) 662-8548
Tel: (604) 986-4331
evs_consultants@mindlink.bc.ca

FAX TRANSMITTAL SHEET

This message is intended only for the use of the individual or entity to which it is addressed and may contain information that is privileged, confidential and exempt from disclosure under applicable law. If you have received this communication in error, please notify us immediately by telephone (collect) and return the original transmission to us by mail, without making a copy. Thank you.

TO: ASL Analytical Services Lab
1988 Triumph St.
Vancouver, B.C.
V5L 1K5

ATTENTION: Mr. Brent Makelki

DATE: January 27, 1997

OUR FILE #: 9/158-03

FAX #: 253-6700

TEL #: 253-4188

SENT BY: Camille Merchant

 # OF PAGES: 1

RE: Interim Toxicity Testing Results

The rainbow trout 96-h LC50 toxicity testing results are as follows:

Sample I.D	Sample Date	96-h LC50 Value (% vol/vol)	# Deaths/Fish Exposed/Concentration
G8699-1	January 22, 1997	60	0/10 in 10%, 18% and 32%; 4/10 in 56%; 10/10 in 100% (vol/vol).

These results are subject to QA/QC review. A complete report will follow.
Should you have any questions please do not hesitate to contact me at 986-4331, or e-mail me at cmerchant@evs.wa.com.

Yours truly,

Camille Merchant

Camille Merchant

ORIGINAL: Sent by Mail [ ] Filed [X] Sent by Courier [ ] Held Pending Your Response [ ]

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784

790-97002

96-h LC50 %v/v: >100

SAMPLE Taken: Feb. 28, 1997
SAMPLE Received: Feb. 28, 1997
Date Started: Feb. 28, 1997
Time Started: 13:20

SAMPLE pH: 7.6
SAMPLE Dissolved Oxygen (mg/L): 10.8
SAMPLE Conductance (µmho/cm): 740

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	7.0	6.9	10.1	9.2	100	100	100	100
	100	7.9	8.3	10.4	9.2	100	100	100	80
	56	7.8	8.2	10.3	9.3	100	100	100	100
	32	7.6	7.7	10.2	9.4	100	100	100	100
	18	7.3	7.0	10.2	8.8	100	100	100	100
	10	7.0	6.9	10.2	9.0	100	100	100	100

COMMENTS: Surviving fish in the 100% concentration were stressed, i.e. all were twitchy and slow swimming, and two had lost their equilibrium. Three or four fish in the 56% concentration were dark pigmented and some displayed rapid gill movement after 24 hrs, but appeared and behaved normally during subsequent obrservations. All lower concentrations appeared and behaved normally during the test.

TEST CONDITIONS:

Number of Organisms: 10
Test Volume (L): 15
Preaeration Time (min.): 85

Test Temperature (°C): 15 ± 1
Test pH Adjusted: No

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13, July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.90 ± 0.18
Length (cm): 4.6 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Jan. 20, 1997
Tests gave 96-h LC50 of 9.18 mg/L (7.94, 10.4) and 10.34 mg/L (7.0, 13.0)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L): 14
EDTA Hardness (mg $CaCO_3$/L): 16
Total Suspended Solids (mg/L): <1
Other parameters available on request.

Residual Chlorine (mg/L): <0.002
Conductance (µmho/cm): 29

ANALYST **VERIFIED BY**

Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977).

Fraser River Harbour Commission

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC V6S 2L2
Tel: (604) 224-4331
Fax: (604) 224-0540

96-h LC50 Rainbow Trout Bioassay on: E100784 Richmond

2-11-263- 790-97003

96-h LC50 %v/v: <100

SAMPLE Taken: Mar. 13, 1997
SAMPLE Received: Mar. 13, 1997
Date Started: Mar. 13, 1997
Time Started: 17:00

SAMPLE pH: 7.3
SAMPLE Dissolved Oxygen (mg/L): 10.6
SAMPLE Conductance (µmho/cm): 710

	TEST CONC'N (%v/v)	pH		DISSOLVED OXYGEN		PERCENT SURVIVAL			
		INITIAL	FINAL	INITIAL (mg/L)	FINAL (mg/L)	24h	48h	72h	96h
Control	0	6.2	6.3	10.0	9.3	100	90	90	90
	100	8.0	7.7	10.4	9.6	0	0	0	0

COMMENTS:

TEST CONDITIONS:

Number of Organisms: 10
Test Volume (L): 10
Preaeration Time (min.): 120

Test Temperature (°C): 15 ± 1
Test pH Adjusted: No

Bioassay conducted according to Biological Test Method: "Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout" Report EPS 1/RM/13, July 1990 and May 1996 Amendments.

TEST ORGANISM Rainbow Trout *(Oncorhynchus mykiss)*

Acclimated (°C): 15 ± 1
Weight (g): 0.42 ± 0.11
Length (cm): 3.7 ± 0.3

DUPLICATE REFERENCE TOXICANT *(analytical grade phenol)*

Tests were conducted on: Mar. 4, 1997
Tests gave 96-h LC50 of 11.1 mg/L (9.93, 12.35) and 10.5 mg/L (9.06, 12.13)

DILUTION WATER (Vancouver dechlorinated hardened tap water)

Alkalinity (mg $CaCO_3$/L): 12
EDTA Hardness (mg $CaCO_3$/L): 16
Total Suspended Solids (mg/L): <1

Residual Chlorine (mg/L): <0.002
Conductance (µmho/cm): 31

More information available on request.

ANALYST Karen J Kennie

VERIFIED BY Janet Pickard

96-h LC50 is the 96-h median lethal concentration (i.e. that causing 50% mortality). The 95% confidence limits are in parentheses. Values are calculated by computer following C.E. Stephan "Methods for Calculating an LC50" (ASTM STP 634, 1977)

Golder Associates Ltd.

500 - 4260 Still Creek Drive
Burnaby, British Columbia, Canada V5C 6C6
Telephone (604) 298-6623
Fax (604) 298-5253

Golder Associates

E/97/0043
952-1811
Your File: PE-6276

January 9, 1997

B.C. Ministry of Environment
Environmental Protection
15326 - 103A Avenue
Surrey, B.C.
V3R 7A2

RECEIVED
JAN [illegible] 1997
LOWER MAINLAND REGION
FILE NO. PE-06276
Data

Attention: Mr. Dennis Barlow

RE: QUARTERLY MONITORING OF EFFLUENT DISCHARGE, FRASER PORT RICHMOND LANDFILL - FOURTH QUARTER 1996

Dear Sir:

Golder Associates Ltd. (Golder) has been retained by the Fraser River Harbour Commission (FRHC) to conduct Permit sampling at the closed landfill in Richmond, B.C. Permit PE-6276, issued by B.C. Environment under the provisions of the Waste Management Act, authorizes the FRHC to discharge effluent from the closed landfill to the Fraser River via the No. 7 Road ditch. Under the terms of the Permit, a grab sample of the effluent discharge must be taken once each month for toxicity analysis (96h LC_{50}) and once every three months for effluent chemistry analysis. Once every six months, samples from four wells around the perimeter of the site and four surface water samples from the perimeter ditch must be collected and analyzed. As well, a flow measuring device must record the effluent volume discharge once per day. This letter summarizes the results of monitoring in the fourth quarter of 1996.

Routine monitoring was conducted on October 15, November 1, and December 10, 1996. Effluent grab samples were submitted to EVS Environmental Consultants for toxicity analysis and to Analytical Service Laboratories Ltd. (ASL) for effluent chemistry analysis. Dissolved oxygen, temperature, pH, and conductivity of the effluent were measured in the field.

The following table summarizes the toxicity analysis and the measured field parameters for all samples collected during the fourth quarter of 1996. Copies of the original laboratory toxicity reports are attached.

		Field Parameters			
Date	**Trout Bioassay 96h LC50 % effluent**	**Dissolved Oxygen (mg/L)**	**Temperature °C**	**pH**	**Conductivity µS/cm**
October 15	>100	9.2	14.8	7.52	1256
November 1	>100	8.9	7.8	7.3	1248
December 10	>100	9.5	4.9	7.79	1180

The effluent chemistry sample was taken on October 15, 1996. The following table summarizes the results and limits for parameters stipulated in the Permit and the complete laboratory report containing all of the analysis results is attached.

	Discharge Limit-Permit PE-6276	**Effluent Chemistry October 15, 1996**
5-day Biochemical Oxygen Demand	30 mg/L	<5 mg/L
Total Suspended Solids	40 mg/L	7 mg/L
Ammonia Nitrogen	10 mg N/L	2.51 mg N/L

Note:
1) < = Less than the detection limit indicated.

Daily volume discharge was measured using a Steven's chart recorder and the daily volumes are reported in Table 1. The average monthly discharges were below the permitted discharge flow of 10,000 m^3/day.

We trust that the information contained in this letter satisfies the requirements of Fraser River Harbour Commission's Permit No. PE-6276.

Should you have any questions or comments, please do not hesitate to contact Don Livingstone at Golder's Burnaby office.

Yours very truly,

GOLDER ASSOCIATES LTD.
Environmental Division

D. R. Livingstone, P.Eng.
Environmental Engineer

B. H. Conlin, P.Eng.
Principal

DRL/BHC/vw/ggg
952-1811/7000

cc: FRHC, Ms. Pat Weber

J:\LET-97\JAN\NSB-1181.DOC

Table 1
Daily Flow Data for the 4th Quarter of 1996

October		November		December	
Date	Flow (m^3/day)	Date	Flow (m^3/day)	Date	Flow (m^3/day)
1-Oct	3180	1-Nov	6220	1-Dec	6884
2-Oct	3298	2-Nov	7957	2-Dec	8590
3-Oct	2075	3-Nov	8035	3-Dec	7645
4-Oct	2337	4-Nov	3911	4-Dec	8670
5-Oct	3418	5-Nov	3911	5-Dec	7645
6-Oct	3539	6-Nov	6148	6-Dec	7645
7-Oct	3479	7-Nov	8035	7-Dec	8035
8-Oct	2776	8-Nov	7645	8-Dec	7723
9-Oct	2947	9-Nov	3479	9-Dec	7262
10-Oct	2890	10-Nov	3786	10-Dec	7034
11-Oct	3180	11-Nov	3786	11-Dec	6660
12-Oct	3180	12-Nov	7262	12-Dec	7186
13-Oct	1922	13-Nov	7645	13-Dec	7262
14-Oct	4424	14-Nov	7491	14-Dec	6586
15-Oct	3724	15-Nov	2890	15-Dec	6884
16-Oct	4101	16-Nov	5648	16-Dec	6586
17-Oct	3662	17-Nov	5648	17-Dec	6513
18-Oct	4165	18-Nov	6075	18-Dec	6366
19-Oct	6148	19-Nov	7262	19-Dec	6513
20-Oct	3479	20-Nov	2609	20-Dec	7110
21-Oct	4424	21-Nov	4037	21-Dec	6884
22-Oct	4294	22-Nov	5437	22-Dec	6439
23-Oct	4956	23-Nov	3911	23-Dec	5648
24-Oct	5789	24-Nov	5648	24-Dec	5860
25-Oct	5437	25-Nov	2609	25-Dec	5789
26-Oct	7110	26-Nov	3786	26-Dec	6075
27-Oct	7568	27-Nov	7186	27-Dec	6075
28-Oct	8035	28-Nov	8430	28-Dec	6075
29-Oct	7414	29-Nov	8035	29-Dec	6075
30-Oct	7262	30-Nov	8114	30-Dec	7110
31-Oct	7262			31-Dec	7645
Monthly Average	4435		5755		6919
Permit Limit (Monthly Average)	10000		10000		10000
Maximum	8035		8430		8670
Minimum	1922		2609		5648

1988 Triumph Street, Vancouver, B.C., Canada V5L 1K5

analytical service laboratories ltd.

FAX: (604) 253-6700 TEL: (604) 253-4188

RECEIVED NOV 2 1 1996

CHEMICAL ANALYSIS REPORT

Date: October 31, 1996

ASL File No. G6054

Report On: 952-1811 Water Analysis

Report To: **Golder Associates Ltd.**
500 - 4260 Still Creek Drive
Burnaby, BC
V5C 6C6

Attention: **Mr. Bob Gauthier**

Received: October 15, 1996

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Brent A. Makelki, B.Sc.
Project Chemist

Joyce Chow. B.Sc.
Project Chemist

50 CANADA'S BEST MANAGED PRIVATE COMPANIES

REMARKS

File No. G6054

The 96 hour LC50 Bioassay analysis was subcontracted to E.V.S. Consultants of North Vancouver, B.C.. The E.V.S. report for this analyses is included in the appendix of this report.

RESULTS OF ANALYSIS - Water

File No. G6054

			1290-01 ✓ 96 10 15	1290-02 ✓ 96 10 15
Physical Tests				
Hardness		CaCO3	-	342
pH			-	7.71
Total Suspended Solids			-	7
Dissolved Anions				
Acidity		CaCO3	-	27.2
Sulphate	SO4		-	8.7
Nutrients				
Ammonia Nitrogen		N	-	2.51
Nitrate Nitrogen		N	-	3.85
Nitrite Nitrogen		N	-	0.090
Total Dissolved Phosphate		P	0.222	0.009
Total Metals				
Aluminum	T-Al		-	0.018
Calcium	T-Ca		-	83.1
Copper	T-Cu		-	0.002
Iron	T-Fe		-	0.98
Lead	T-Pb		-	<0.001
Magnesium	T-Mg		-	32.6
Manganese	T-Mn		-	0.261
Zinc	T-Zn		-	<0.005

Effluent
E100784

Log pond Exit

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS - Water

File No. G6054

1290-02

96 10 15

Resin and/or Fatty Acids	
Abietic Acid	<0.001
Arachidic Acid	<0.005
Behenic Acid	<0.005
Chlorodehydroabietic Acid	<0.001
Dehydroabietic Acid	<0.001
Dichlorodehydroabietic Acid	<0.001
Isopimaric Acid	<0.001
Lauric Acid	<0.005
Levopimaric Acid	<0.001
Lignoceric Acid	<0.005
Linoleic Acid	<0.005
Linolenic Acid	<0.005
Myristic Acid	<0.005
Neoabietic Acid	<0.001
Oleic Acid	<0.005
Palmitic Acid	<0.005
Pimaric Acid	<0.001
Sandaracopimaric Acid	<0.001
Stearic Acid	<0.005
Organic Parameters	
Biochem.Oxygen Demand-Tot BOD-5	<5
Chemical Oxygen Demand COD	44
Bioassays	
96 hour LC-50	> 100

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

Appendix 1 - METHODOLOGY File No. G6054

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows:

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

Metals in Water

This analysis is carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 19th Edition 1995 published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion or filtration (EPA Method 3005), followed by instrumental analysis by atomic absorption spectrophotometry (EPA Method 7000), inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010), and/or inductively coupled plasma - mass spectrometry (EPA Method 6020).

Resin and/or Fatty Acids in Water

This analysis is carried out in accordance with EPS and Pacific Environmental Institute Methods. The procedure involves extraction of the sample with dichlormethane. The extract is concentrated and derivatized. The methylated esters are analysed by capillary column gas chromatography with mass spectrometric detection.

APPENDIX

RESULTS OF SUBCONTRACTED ANALYSES

EVS ENVIRONMENT CONSULTANTS

Our File: 9/158-03
W.O.: 9600756

October 28, 1996

Mr. Brent Makelki
ASL Analytical Service Laboratories Ltd.
1988 Triumph Street
Vancouver, B.C.
V5L 1K5

Dear Mr. Makelki:

Re: Toxicity Testing on the Sample Identified as G6054-2 (Collected October 15, 1996)

We have completed one 96-h LC50 toxicity test with rainbow trout on the sample identified as G6054-2, received on October 16, 1996. Standard toxicity test procedures were followed in accordance with EVS SOP numbers 1061-1 and 1063-1, which are based on A.P.H.A. Standard Methods, 19th Edition (1995) and Environment Canada's "Biological Test Method: Acute Lethality Test Using Rainbow Trout" EPS 1/RM/9 (1990).

Summary of Results:

The results summarized below are based on the appended data. The 96-h LC50 value is expressed as the percent volume of sample per final volume (e.g., 56% LC50 = 56 mL sample per 100 mL total volume). As 100% survival was observed in all of the test concentrations, the 96-h LC50 value can be determined from data observation to be greater than the highest concentration tested (i.e., 100% [vol/vol]).

Sample I.D.	Sample Date	96-h LC50 Value (% vol/vol)
G6054-2	October 15, 1996	>100

195 Pemberton Avenue
North Vancouver, B.C.
Canada V7P 2R4
Tel: (604) 986-4331
Fax: (604) 662-8548
evs_consultants@mindlink.bc.ca

200 West Mercer Street
Suite 403
Seattle, WA 98119
Tel: (206) 217-9337
Fax: (206) 217-9343
evswa@halcyon.com

Should you have any questions or comments, please do not hesitate to contact the undersigned at 986-4331.

Yours truly,

EVS ENVIRONMENT CONSULTANTS

Camille Merchant

Camille J. Merchant, B.Sc.
Biologist

Certified By:

QA/QC Committee:
Cathy McPherson, B.Sc.
Patrick Allard, M.Sc.
Farida Bishay, B.Sc.
Margot Daykin, B.Sc.
Bettina Sander, M.Sc.
Erika Szenasy, M.Sc.

CJM/cjm

1988 Triumph Street, Vancouver, B.C., Ca V5L 1K5 FAX: (604) 253-6700 TEL: (604) 253-4188

analytical service laboratories ltd.

ASL

RECEIVED DEC 4 - 1996

CHEMICAL ANALYSIS REPORT

Date: November 22, 1996

ASL File No. G6679

Report On: 952-1811 Water Analysis

Report To: **Golder Associates Ltd.**
500 - 4260 Still Creek Drive
Burnaby, BC
V5C 6C6

Attention: **Mr. Don Livingstone**

Received: November 1, 1996

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Brent A. Makelki, B.Sc.
Project Chemist

Joyce Chow, B.Sc.
Project Chemist

REMARKS

File No. G6679

The metals detection limits for the samples "1366-01" and "1366-04" were increased due to the nature of these samples.

The sample "1366-04" was replicated for a number of parameters and the results for the replicate analyses are included in the Quality Control section of this report.

RESULTS OF ANALYSIS - Water File No. G6679

			1366-01	1366-02	1366-03	1366-04	1366-05
			96 11 01	96 11 01	96 11 01	96 11 01	96 11 01
Physical Tests							
Hardness		CaCO3	482	84.9	35.2	361	116
pH			5.83	5.69	5.90	6.38	6.58
Dissolved Anions							
Acidity (to pH 8.3)		CaCO3	119	161	9.8	89.5	23.4
Sulphate	SO4		24.2	<5	5.0	<5	31.7
Nutrients							
Ammonia Nitrogen		N	0.61	2.69	0.02	0.35	0.54
Nitrate Nitrogen		N	0.036	<0.005	0.011	0.009	0.760
Nitrite Nitrogen		N	0.008	0.024	0.003	0.064	0.037
Total Dissolved Phosphate		P	0.031	0.065	0.002	0.089	0.137
Total Metals							
Aluminum	T-Al		56.6	1.93	0.348	49.3	0.774
Arsenic	T-As		0.0389	0.0053	0.0015	0.0202	0.0026
Barium	T-Ba		0.80	0.05	0.03	0.70	0.06
Beryllium	T-Be		<0.02	<0.005	<0.005	<0.01	<0.005
Boron	T-B		0.4	0.2	<0.1	0.2	0.2
Cadmium	T-Cd		0.0076	0.0002	0.0002	0.0038	<0.0002
Calcium	T-Ca		107	19.3	6.29	102	29.5
Chromium	T-Cr		0.110	0.006	0.003	0.052	0.002
Cobalt	T-Co		<0.08	<0.02	<0.02	<0.04	<0.02
Copper	T-Cu		0.232	0.009	0.897	0.068	0.007
Iron	T-Fe		99.2	21.9	10.2	75.0	5.57
Lead	T-Pb		0.060	0.014	0.106	0.063	<0.001
Lithium	T-Li		<0.08	<0.02	<0.02	<0.04	<0.02
Magnesium	T-Mg		52.1	8.94	4.75	25.8	10.4
Manganese	T-Mn		1.93	0.210	0.197	2.15	0.375
Mercury	T-Hg		0.00013	0.00005	<0.00005	0.00016	<0.00005
Molybdenum	T-Mo		<0.1	<0.03	<0.03	<0.06	<0.03
Nickel	T-Ni		0.20	<0.02	<0.02	0.11	0.03
Selenium	T-Se		0.0049	0.0011	0.0008	0.0018	0.0008
Silver	T-Ag		0.0012	<0.0001	<0.0001	0.0004	<0.0001
Sodium	T-Na		11	35	3	96	20
Vanadium	T-V		0.2	0.04	<0.03	0.08	<0.03
Zinc	T-Zn		0.62	0.058	0.034	0.22	0.039
			MW-A	MW-B	MW-C	MW-D	Dup 2
			E206252	E206253	E206254	E206255	E105577

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS - Water

File No. G6679

			1366-06 ✓	1366-07 ✓	1366-08 ✓	1366-09
			96 11 01	96 11 01	96 11 01	96 11 01
Physical Tests						
Hardness		CaCO3	90.2	70.0	154	-
pH			6.53	5.88	6.95	-
Dissolved Anions						
Acidity (to pH 8.3)		CaCO3	25.3	21.4	8.2	-
Sulphate	SO4		18.1	18.7	97.1	-
Nutrients						
Ammonia Nitrogen		N	0.40	0.05	0.14	-
Nitrate Nitrogen		N	0.573	<0.005	0.114	-
Nitrite Nitrogen		N	0.030	0.017	0.034	-
Dissolved ortho-Phosphate		P	-	-	-	0.054
Total Dissolved Phosphate		P	0.127	0.032	0.007	-
Total Metals						
Aluminum	T-Al		0.652	0.578	0.701	-
Arsenic	T-As		0.0028	0.0047	0.0017	-
Barium	T-Ba		0.05	0.03	0.05	-
Beryllium	T-Be		<0.005	<0.005	<0.005	-
Boron	T-B		<0.1	<0.1	<0.1	-
Cadmium	T-Cd		<0.0002	<0.0002	0.0008	-
Calcium	T-Ca		22.0	18.5	43.6	-
Chromium	T-Cr		0.002	0.001	0.001	-
Cobalt	T-Co		<0.02	<0.02	<0.02	-
Copper	T-Cu		0.006	0.004	0.157	-
Iron	T-Fe		6.19	3.56	1.87	-
Lead	T-Pb		<0.001	0.003	0.025	-
Lithium	T-Li		<0.02	<0.02	<0.02	-
Magnesium	T-Mg		8.60	5.77	11.0	-
Manganese	T-Mn		0.378	0.461	0.106	-
Mercury	T-Hg		<0.00005	<0.00005	<0.00005	-
Molybdenum	T-Mo		<0.03	<0.03	<0.03	-
Nickel	T-Ni		<0.02	0.02	0.02	-
Selenium	T-Se		0.0006	0.0009	0.0008	-
Silver	T-Ag		<0.0001	<0.0001	<0.0001	-
Sodium	T-Na		16	10	20	-
Vanadium	T-V		<0.03	<0.03	<0.03	-
Zinc	T-Zn		0.028	0.015	0.229	-
			D.tub 3	D.tub 4	D.tub 5	
			E105876	E105878	E105880	

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS - Water

File No. G6679

		1366-01	1366-02	1366-03	1366-04	1366-05
		96 11 01	96 11 01	96 11 01	96 11 01	96 11 01
Organic Parameters						
Chemical Oxygen Demand	COD	1310	325	<20	756	90
		MW-A	MW-B	MW-C	MW-D	Ditch 2

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS - Water

File No. G6679

		1366-06	1366-07	1366-08
		96 11 01	96 11 01	96 11 01
Organic Parameters				
Chemical Oxygen Demand	COD	82	269	33

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

Appendix 1 - QUALITY CONTROL - Replicates

File No. G6679

Water			**1366-04**	**1366-04**
			96 11 01	QC # 76708
Physical Tests				
Hardness		CaCO3	361	360
pH			6.38	6.40
Dissolved Anions				
Acidity (to pH 8.3)		CaCO3	89.5	87.6
Nutrients				
Ammonia Nitrogen		N	0.350	0.360
Nitrate Nitrogen		N	0.009	0.009
Nitrite Nitrogen		N	0.064	0.064
Total Dissolved Phosphate		P	0.089	0.109
Total Metals				
Aluminum	T-Al		49.3	49.5
Arsenic	T-As		0.0202	0.0202
Barium	T-Ba		0.70	0.69
Beryllium	T-Be		<0.01	<0.01
Boron	T-B		0.2	<0.2
Cadmium	T-Cd		0.0038	0.0038
Calcium	T-Ca		102	102
Chromium	T-Cr		0.052	0.053
Cobalt	T-Co		<0.04	<0.04
Copper	T-Cu		0.068	0.070
Iron	T-Fe		75.0	74.8
Lead	T-Pb		0.063	0.064
Lithium	T-Li		<0.04	<0.04
Magnesium	T-Mg		25.8	25.8
Manganese	T-Mn		2.15	2.16
Mercury	T-Hg		0.00016	0.00015
Molybdenum	T-Mo		<0.06	<0.06
Nickel	T-Ni		0.11	0.10
Selenium	T-Se		0.0018	0.0026
Silver	T-Ag		0.0004	0.0005
Sodium	T-Na		96	96
Vanadium	T-V		0.08	0.09
Zinc	T-Zn		0.22	0.22

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

Appendix 2 - METHODOLOGY

File No. G6679

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows:

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

Metals in Water

This analysis is carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 19th Edition 1995 published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion or filtration (EPA Method 3005), followed by instrumental analysis by atomic absorption spectrophotometry (EPA Method 7000), inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010), and/or inductively coupled plasma - mass spectrometry (EPA Method 6020).

Mercury in Water

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" 19th Edition 1995 published by the American Public Health Association. A cold-oxidation procedure involving bromine monochloride is used, followed by instrumental analysis by cold-vapour atomic absorption spectrophotometry (CVAAS).

End of Report

CHEMICAL ANALYSIS REPORT

Date: December 20, 1996

ASL File No. G7771

Report On: 952-1811 Water Analysis

Report To: **Golder Associates Ltd.**
500 - 4260 Still Creek Drive
Burnaby, BC
V5C 6C6

Attention: **Ms. Nicole Bailey**

Received: December 10, 1996

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Joyce Chow, B.Sc.
Project Chemist

Brent A. Makelki, B.Sc.
Project Chemist

RESULTS OF ANALYSIS

File No. G7771

		1356-01	1356-02
		96 12 09	96 12 09
Nutrients			
Total Dissolved Phosphate	P	0.297	0.070
Bioassays			
96 hour LC-50[1]		>100%	-

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.
[1]Analysis performed by EVS Environment Consultants - See Appendix.

METHODOLOGY File No. G7771

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows:

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

End of Report

BRITISH COLUMBIA

January 21, 2000 File: PE-06276

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C. V3M 1B2

Attention: Pat Weber, Environmental Co-ordinator

Dear Madam:

Re: Waste Management Permit PE-06276

A monitoring report for final effluent, groundwater and surface water covering the fourth quarter of 1999 has been submitted on your behalf by BC Research Inc.

Review of the data determined that the report is complete, and effluent quality and quantity met permit requirements. Therefore the permit is considered to be in compliance with the monitoring and reporting requirements. Compliance with other permit requirements was not reviewed in this assessment.

The next quarterly monitoring report for effluent is due May 1, 2000. Please call me at 582-5276 if you have any questions.

Yours truly,

Dennis Barlow
Pollution Prevention Technician
Municipal Section

Ministry of Environment, Lands and Parks
BC Environment
Lower Mainland Region
Pollution Prevention
Mailing/Location Address:
10470 152 Street
SURREY BC V3R 0Y3
Telephone: (604) 582-5248
Facsimile: (604) 584-9751
or (604) 582-5335

PE-06276

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277 SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY : REPORT PERIOD: 1999 - 4th quarter

Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	n/a	
phosphate records	kg	6277: 2.5	per discharge	per inspection		n/a	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		in	
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (ma)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in n/a	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	n/a	2nd & 4th quarters only
Surface water samples	14 parms	6276: C.3	per six months	per six months	n/a	n/a	2nd & 4th quarters only
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	n/a	

COMPLIANCE WITH MONITORING PROGRAM IN

OVERALL COMPLIANCE IN

SIGNATURE

BRITISH COLUMBIA

November 16, 1999 File: PE-06276

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C. V3M 1B2

Attention: Pat Weber, Environmental Co-ordinator

Dear Madam:

Re: Waste Management Permit PE-06276

A monitoring report for final effluent covering the third quarter of 1999 has been submitted on your behalf by BC Research Inc.

Review of the data determined that the report is complete, and effluent quality and quantity met permit requirements. Therefore the permit is considered to be in compliance with the monitoring and reporting requirements. Compliance with other permit requirements was not reviewed in this assessment.

The next quarterly monitoring report for effluent, surface water and groundwater is due January 31, 2000. Please call me at 582-5276 if you have any questions.

Yours truly,

Dennis Barlow
Pollution Prevention Technician
Municipal Section

Ministry of Environment, Lands and Parks
Environment and Lands
Lower Mainland Region
Pollution Prevention
Mailing/Location Address:
10470 152 Street
SURREY BC V3R 0Y3
Telephone: (604) 582-5247
Facsimile: (604) 584-9751
or (604) 582-5335

MINISTRY OF ENVIRONMENT, LANDS AND PARKS
Lower Mainland Region

TELEPHONE CONTACT RECORD

Date of Call	October 20, 1999	File No.	MR-04922 PE-06276		
Name of Caller	Elson Hanson	Tel #	946-0111	Fax #	
Received by	E.H. Hanson Engineering Group Ltd.	Referred to			
Nature of Call	Richmond Landfill - landfill gas assessment				

Further Action Required **Yes** ☐ **No** ☑

Letter ☐ Phone call ☐ Other:

Comments	Caller advised E.H. Hanson has been commissioned by the GVRD to investigate opportunities for additional use of landfill gas (LFG) in the regional district. Requested a copy of the Landfill Gas Assessment for Ecowaste Industries Ltd. (Richmond Landfill). I agreed to send a copy. The adjacent closed landfill owned by Fraser River Harbour Commission (file PE-06276) provides LFG to the Lafarge Cement kiln. Production is waning. Peak production was 900 cfm 5-8 years ago, is now 250 cfm but may stay near current levels for several more years as gas from the 50 ha municipal garbage cell is spent but waste wood from the 250 ha area continues to decompose. Hanson is exploring the feasibility of tying in a line from the Richmond Landfill to augment the feed to Lafarge. We agreed that, although peak production of LFG from a DLC landfill would be expected to be lower than from a sanitary landfill, the gas would be produced over a much longer period of time. Collection and use for fuel may be feasible after the southern area of Richmond Landfill is closed in 2005, subject to assessment of monitoring data obtained in the interim.

(Signed) _____

FRASER PORT

FRASER RIVER PORT AUTHORITY
500 - 713 Columbia Street
New Westminster, B.C. V3M 1B2 Canada
Tel: 604.524.6655 • Fax: 604.524.1127
email: fraserport@frpa.com
www.fraserportauthority.com

ADMINISTRATION PORTUAIRE DU FLEUVES FRASER
713, rue Columbia, bureau 500
New Westminster (C.-B.) V3M 1B2 Canada
Tél: 604.524.6655 • Fax: 604.524.1127
courriel: fraserport@frpa.com
www.fraserportauthority.com

File: O32

RECEIVED
OCT 14 1999
LOWER MAINLAND REGION

pe-06276

October 8, 1999

Mr. Dennis Barlow
Solid Waste Officer
Ministry of Environment, Lands and Parks
Lower Mainland Region
10470 - 152nd Street
Surrey, BC V3R 0Y3

Dear Mr. Barlow:

Re: Emergency Bypass Manifold at our Fraser Richmond Site

As discussed with you previously, the Fraser River Port Authority wishes to advise you that we are proceeding with the installation of an Emergency Bypass Manifold at our Fraser Richmond site. In our previous on site meeting we demonstrated the need for this equipment to safeguard the millions of dollars in containment on the site. This manifold system will be fitted with lockable valves to ensure that they can only be operated by Port Authority staff. Our operating and procedures manual has been amended to include the procedures changes that you have requested to ensure the flows are monitored.

In the event you have any questions, please contact me at your convenience.

Yours very truly,

FRASER RIVER PORT AUTHORITY

Captain A.O. Domaas, PPM
Vice President, Operations

AOD/ll

cc: Mrs. Pat Weber
Fraser River Port Authority

Mr. Wayne Cooper
Fraser River Port Authority

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Canada

BRITISH COLUMBIA

July 28, 1999

File: PE-06276

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C. V3M 1B2

Attention: Pat Weber, Environmental Co-ordinator

Dear Madam:

Re: Waste Management Permit PE-06276

A monitoring report for final effluent, groundwater and surface water covering the second quarter of 1999 has been submitted on your behalf by BC Research Inc.

Review of the data determined that the report is complete, and effluent quality and quantity met permit requirements. Therefore the permit is considered to be in compliance with the monitoring and reporting requirements. Compliance with other permit requirements was not reviewed in this assessment.

The next quarterly monitoring report for effluent is due October 31, 1999. Please call me at 582-5276 if you have any questions.

Yours truly,

Dennis Barlow
Pollution Prevention Technician
Municipal Section

Ministry of Environment, Lands and Parks
Environment and Lands
Lower Mainland Region
Pollution Prevention
Mailing/Location Address:
10470 152 Street
SURREY BC V3R 0Y3
Telephone: (604) 582-5247
Facsimile: (604) 584-9751
or (604) 582-5335

(DP→ Ray, Alan, Hanna (fyi)
→ Ed, Jim JG, Dennis

NORTH FRASER HARBOUR COMMISSION

RECEIVED
JUN 0 1 1999
LOWER MAINLAND REGION
FILE NO. PE-06276

May 27, 1999

Mr. Doug Pope
Pollution Prevention Branch
Contaminated Sites Section
Parks - Lower Mainland Region
10470 152nd Street
Surrey, B.C.
V3R 0Y3

Dear Mr. Pope :

Re : **North Fraser Harbour Commission Land Use Planning Workshop**

We have now been informed that as of July 1st 1999, the North Fraser Harbour Commission will be transferred to the status of a Canadian Port Authority under the Canada Marine Act legislation (Bill C-9). In keeping with this legislation, the North Fraser Port Authority is required to develop a detailed land use plan for the real property it manages, holds or occupies within 12 months of issuing letters patent i.e., on or before July 1, 2000.

The start of the public involvement process surrounding the development of the Port North Fraser Land Use Plan first began in October 1998 with a community 'visioning' workshop in Richmond. This workshop helped to establish a vision and some of the planning principles behind the new Port Plan. Since October, the Commission has also established a series of working groups comprised of public, commercial and industrial representatives to offer feedback and advice on key plan elements, concepts and issues. In an effort to confirm and further refine the planning work that has been done to date, we invite you to participate in our second public land use planning workshop to be held at the Bonsor Centre in Burnaby on Tuesday, June 22, 1999, commencing at 7:30 pm.

2020 Airport Road, Richmond, British Columbia, Canada V7B 1C6
Telephone: (604) 273-1866 Fax: (604) 273-3772

To register for the workshop or obtain more information on the evening's session, please contact Gabriele Stein or Jennifer Jay at the Commission at (604) 273-1866. Thank you and we look forward to meeting with you on the 22nd of June.

Sincerely,

THE NORTH FRASER HARBOUR COMMISSION

George Colquhoun
CEO and General Manager

Encl. (2)

NORTH FRASER HARBOUR COMMISSION

LAND USE PLAN WORKSHOP
AGENDA

Tuesday, June 22, 1999
BONSOR RECREATION COMPLEX
6550 Bonsor Avenue, Burnaby
7:30 - 10:00 pm

Registration 7:15 pm sharp

7:30 pm	**INTRODUCTIONS/OPENING REMARKS**	Mr. Ken Maddison *NFHC Chair*
7:35 pm	**LAND USE PLAN UPDATE :** ***Why Plan Now? The Land Use Process and Major Planning Elements to Date***	NFHC Staff
8:00 pm	**AFFIRMING PRINCIPLES AND CONSTRUCTS:** ***Feedback/Review of Major Plan Concepts, Threats and Opportunities.*** Small Group Breakout Session.	Led by Session Facilitator
8:35 pm	**Break**	
8:45 pm	**WORKING WITH MAPS :** ***Planning the River.*** Small Group Session	
9:15 pm	**PLENARY SESSION/REPORT BACK:** ***Summarizing the Evening Discussions***	
9:45 pm	**CLOSING COMMENTS :** ***Wrap Up, Next Steps***	George Colquhoun *NFHC CEO/Manager*

North Fraser Harbour Commission
LAND USE PLAN WORKSHOP

Tuesday, June 22, 1999
Bonsor Recreation Complex
6550 Bonsor Avenue, Burnaby
7:30 - 10:00 pm

We would appreciate if you could let us know if you plan to attend so we can get a better idea of attendance numbers. Thank you! .

RSVP

☐ *Yes, I will be attending the meeting on June 22nd*

☐ *No, I will not be able to attend June 22nd*

Name : _____
Title : _____
Company : _____
Address: _____
Telephone: _____ Fax: _____

Please fax this form back to us by June 15, 1999 at (604) 273-3772

BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

April 28, 1999

RECEIVED
MAY - 4 1999
LOWER MAINLAND REGION
FILE NO. PE-06276

Ms. P. Weber
Environmental Administrator
Fraser River Harbour Commission
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Phosphate Addition to Aeration Lagoon.

Phosphate in the form of Na_3PO_4 is added to the leachate in the aeration lagoon to maintain the nitrogen:phosphorus:carbon ratio at levels suitable for bacterial growth. Each working day a 25Kg bag of Green Valley super phosphate is added at the legoon inlet.

Total dissolved phosphorus levels in the final discharge are typically in the ppb range indicating that phosphate is being added at a rate consistent with bacteria maintenance without any excess in the final discharge.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow, MELP

BRITISH COLUMBIA

April 20, 1999 File: PE-06276

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C. V3M 1B2

Attention: Pat Weber, Environmental Co-ordinator

Dear Madam:

Re: Waste Management Permit PE-06276

A monitoring report for final effluent covering the first quarter of 1999 has been submitted on your behalf by BC Research Inc.

Review of the data determined that the report is complete and permit requirements with respect to effluent flow have been met. However, the above referenced permit is **out of compliance** for the following reason(s):

1. Rainbow trout bioassay (LC_{50}) of the final effluent was reported to be less than 100%, in contravention of Appendix 01(C).

Compliance with other permit requirements was not reviewed in this assessment.

Please advise me in writing by **April 30, 1999** of the action that has been taken or will be taken to ensure consistent compliance with respect to effluent toxicity.

Failure to comply with permit requirements is a violation of the *Waste Management Act* and violations may be subject to legal action. This letter is without prejudice.

The next quarterly monitoring report for effluent is due May 1, 1999. Please call me at 582-5276 if you have any questions.

Yours truly,

Dennis Barlow
Pollution Prevention Technician
Municipal Section

Ministry of Environment, Lands and Parks
Environment and Lands
Lower Mainland Region
Pollution Prevention
Mailing/Location Address:
10470 152 Street
SURREY BC V3R 0Y3
Telephone: (604) 582-5247
Facsimile: (604) 584-9751
or (604) 582-5335

BRITISH COLUMBIA

April 13, 1999

Your File:
Our File: 76600-20/P2-Agri01

cc PE-06276 (i-k)

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, BC V3M1B2

Attention: Captain Tom Corsie, PPM
Director of Property Development

Dear: Mr. Corsie:

Re: Agri-Bulk Services Proposed Terminal at FRHC Site in Richmond

This is in response to your letter of March 17, 1999. We have received advice that enforcement of provincial requirements pursuant to a Waste Management Act Permit may not be possible regardless of agreements between the FRBC and the ministry.

Therefore, as proposed in your letter, you may wish to consult with federal authorities, such as Environment Canada and the Dept. of Fisheries & Oceans, with respect to establishing environmental protection requirements for the site. For your information, Environment Canada has developed stormwater best management practices (BMPs) that would be useful in the design of the facility.

Yours truly,

Ray Robb
Head, Industrial/Air Section
Lower Mainland Region

AKC/

cc: Doug Pope, A/Manager, Pollution Prevention, Lower Mainland Region
Harvey Maxwell, Head, Municipal Section
Mike Willcox, Planning and Assessment

JG JG
file

Ministry of Environment, Lands and Parks
Environment and Lands
Lower Mainland Region
Pollution Prevention
Mailing/Location Address:
10470 152 Street
SURREY BC V3R 0Y3
Telephone: (604) 582-5247
Facsimile: (604) 584-9751
or (604) 582-5335

RAM - SE attached draft response Alex I plan to assign this to Alex

FRASER PORT

RECEIVED
MAR 22 1999
LOWER MAINLAND REGION
FILE NO. 76600-20/PL-AGRI #1

File: G21 03 16

March 17, 1999

Mr. Raymond Robb, P.Eng.
Head, Industrial and Air Section
Assistant Regional Waste Manager
Ministry of Environment, Lands and Parks
10470 - 152nd Street
Surrey, B.C. V3R 0Y3

Dear Mr. Robb:

Re: Agri-Bulk Services Application for a Waste Management Permit

Further to our meeting of this morning regarding the FREMP application number 9812F114, Agri-Bulk Services Ltd. proposed transshipment terminal and storage facility, Richmond, B.C., we request confirmation from the Ministry with regard to the issuance of a Waste Management Permit. We have received an interim response from FREMP dated March 5, 1997, copy attached, which discusses the proposal by Powers Environmental Services on behalf of Agri-Bulk to obtain a Waste Management Permit to discharge wastewater and stormwater from areas considered to be "high level contaminated areas" and areas with "uncontaminated or low level contaminated" stormwater.

It will be a requirement of the lease agreement between Agri-Bulk Services and the Fraser River Harbour Commission (FRHC) that Agri-Bulk obtain a Waste Management Permit for all stormwater and wastewater treatment systems. A concern has been expressed to us from staff of the Department of Fisheries and Oceans, Canada (DFO) that the Ministry may not be willing to issue a Waste Management Permit to Agri-Bulk due to its proposed lease of federal land owned by the FRHC. The main concern of the Ministry appears to be one of jurisdiction and its ability to enforce its regulations onto Agri-Bulk Services, a prospective tenant of the FRHC.

We understand this concern and suggest a possible solution to this particular application may be for the FRHC and the Ministry to enter into an agreement whereby the FRHC agrees to the imposition of a Waste Management Permit for the Agri-Bulk development. Please accept this letter as our request for the Ministry to give consideration to whether or not it is in a position to issue a Waste Management Permit to Agri-Bulk Services. If the Ministry is not in a position to issue a Permit for the Agri-Bulk application, then we would propose to negotiate directly with DFO and Environment Canada in order to obtain confirmation on the guidelines for design and standards of effluent discharge.

FRASER RIVER HARBOUR COMMISSION
500 - 713 Columbia Street, New Westminster, British Columbia, Canada V3M 1B2 Telephone (604) 524-6655 Fax (604) 524-1127

If you wish to discuss this matter further, please do not hesitate to contact this office.

Yours truly,

FRASER RIVER HARBOUR COMMISSION

Captain Tom Corsie, PPM
Director of Property Development

cc Andrew Butt, Agri-Bulk Services
Tim Powers, Powers Environmental Services
Lee Nikl, DFO
Allen Domaas, FRHC
Jack Smith, Environment Canada

Fraser
River
Estuary
Management
FREMP Program

March 5, 1999

Fraser River Harbour Commission
500 – 713 Columbia Street
New Westminster, BC V3M 1B2

Faxs: 524-1127

Attn.: Pat Weber

RE: **FREMP 9812F114; Agri-Bulk Services Ltd.; Proposed Transshipment Terminal and Storage Facility, Richmond, BC – Fraser River**
INTERIM RESPONSE

Reference is made to the above subject application from Powers Environmental Services submitted on behalf of Agri-Bulk Services Ltd., dated November 30, 1998, received by the Fraser River Estuary Management Program (FREMP) Environmental Review Committee (ERC) on December 9, 1998 for coordinated environmental review. Reference is also made to the meeting between Agri-Bulk Services Ltd. (Agri-Bulk), their consultants and Department of Fisheries & Oceans (DFO), Environment Canada and Fraser River Harbour Commission (FRHC) held at FRHC offices in New Westminster on February 9, 1999.

Please note that this is an interim response only, and does not convey final recommendations or any form of approval to undertake works of any description, nor does it imply that such approval will or will not be forthcoming. The purpose of this letter is to request additional information which is required in order for the Fraser River Estuary Management Program (FREMP) Environmental Review Committee (ERC) to complete its review.

In brief, the ERC understands that Agri-Bulk is proposing to construct and operate a mini-bulk marine terminal facility in Richmond, BC located on the north shore of the main arm of the in Fraser River across from Tilbury Island. The proposed facility would handle such commodities as: fertilizers including solid urea, liquid urea ammonium nitrate (UAN 32), pure sulphur and 95% pure sulphur, ammonium sulphate, monoammonium phosphate, diammonium phosphate and potash; specialty agricultural products including malt (barley), alfalfa cubes and pellets, peas and lentils; wood pellets and gypsum.

As you are aware, the Fraser River estuary is known to support a variety of fish species and is important to all species of salmonids produced in the Fraser River Basin. The estuary is an important rearing and transitional zone for juvenile salmonids prior to entering marine waters. Contaminants allowed to enter or leach into the Fraser River may result in negative impacts to fish and/or fish habitat.

Based upon the information provided, the ERC understands that the subject site (Lot 2) is located on a portion of a now closed municipal landfill site owned by FRHC. The document entitled Environmental Assessment Screening Report – Proposed Fraser Richmond Agri-Bulk Terminal, Richmond, B.C prepared by Powers Environmental Services (Powers) for Agri-Bulk Services Ltd. (Agri-Bulk) dated December 1998 states that soil and groundwater contamination has been identified in the area proposed for the bulk terminal.

5945 Kathleen Avenue # 501 Burnaby BC V5H 4J7 • Phone: 775-5756 • Fax: 775-5198 • email: bi_fremp@istar.ca

P. Weber, FHPA
FREMP CPR # 9812F114I
05/03/99; page 2

The report provided, in part, a summary of the results of the soil sampling conducted by Golder Associates Ltd. (Golder) on behalf of FRHC, which indicates metal contamination and elevated levels of PAHs throughout the refuse layer of the FRHC site. Analysis of two soil samples from the refuse layer on Lot 2 indicated that cadmium and zinc concentrations slightly exceeded the provincial criteria for contaminated sites. As well, ethylbenzene and some PAHs exceeded the CCME soil criteria within the refuse layer of Lot 2.

Groundwater sampling, also conducted by Golder, shows metal contamination, elevated levels of some PAHs and resin and fatty acids, and slightly lowered pH levels at the subject site. The ERC notes that concentrations of aluminum, iron, manganese, selenium and zinc exceeded the CCME and/or CSR criteria for aquatic life. The report states that the concentrations of iron and manganese are "about two to three times higher in the shallow groundwater within the landfill material as compared to the deep groundwater within the Fraser River sands." As well, elevated concentrations of some PAHs, dehydroabietic acid and total resin acids above the standards were observed from monitoring wells sampling the shallow groundwater within the refuse layer, particularly from monitoring well MW98-3S.

It is the ERC's understanding that the FRHC operates a leachate collection and treatment system which collects most of the site's surface and groundwater from the refuse layer. The report states that "groundwater not captured in the leachate collection system will have a net flow toward the Fraser River." The ERC notes that groundwater seepage was observed on the foreshore of Lot 2 on the west side of the barge spit. The Powers report states that monitoring of the FRHC's leachate treatment system, conducted by BC Research from 1989 to 1992, indicated that high levels of ammonia are produced by the municipal landfill site. Moreover, a sample of sediments taken from the foreshore of Lot 2 "indicated that levels of aluminum and iron exceed relevant standards...(and) are likely due to groundwater leachate from former landfill operations". At this time, the proponent has provided insufficient information on the quality of the groundwater leachate and groundwater flux and direction from the subject site that may be adversely impacting the Fraser River.

As such, the proponent should conduct an assessment to clarify the groundwater leachate quality and determine the groundwater flux and direction through the subject area. If upon further sampling it is determined that the groundwater leachate from Lot 2 is adversely impacting the Fraser River then suitable remedial/management works will be required. Please note that the ERC would expect that any discharge of groundwater to the Fraser River would meet ambient water quality criteria in the pore water at the point of discharge.

Additionally, the proponent should conduct an environmental assessment of the sediments at the subject site in order to fully delineate the extent of contamination. Please note that further groundwater and sediment sampling and any subsequent remedial/management works must be conducted to the satisfaction of FREMP. As this proposal calls for permanent structures to be built in the area of suspected contamination, it is necessary that this construction does not preclude remediation if required. Therefore, the issue of who is responsible to conduct the above required sampling and subsequent remedial/management works, if necessary, is an issue to be worked out between FRHC and Agri-Bulk Services Ltd.

From the recent letter/report submitted to the ERC entitled Stormwater Management Plan for Agri-Bulk Services' Proposed Fraser Richmond Agri-Bulk Terminal prepared by Powers Environmental Services (Powers) dated February 19, 1999, the ERC understands that the proponent is proposing to collect, treat and discharge wastewater and stormwater to the Fraser River under an, as yet non-existent, BC MELP Waste Management Permit from the areas considered by the proponent to be "high level contaminated areas". Areas with "uncontaminated or low level contaminated" stormwater would be discharged directly to the Fraser River. Further, the ERC notes that there will be no washdown of facilities or equipment at the

subject site. The ERC has a number of comments and concerns based upon a review of this stormwater management plan proposal:

1) With respect to the proposed segregation of flows at the subject site, the ERC understands that the "high level contaminated areas" will be graded and curbed to prevent mixing of contaminated waters with uncontaminated waters from adjacent areas. Stormwater and wastewater in the "uncontaminated or low level contaminated" areas should be tested and analyzed before discharging to the Fraser River to ensure compliance with the ambient water quality criteria. As well, prior to any release of accumulated stormwater from the UAN storage tank area to the ground, samples of the stormwater should be tested and analysed to ensure that any contaminants are at acceptable levels. As such, contingency plans should be in place in the event that the wastewater and stormwater quality criteria are not met for any of the wastewater or stormwater flows.

2) The ERC understands that gypsum (calcium sulphate) will be stored in a covered open-sided storage area with a floor of compacted gypsum. As well, it is noted that the wastewater or stormwater from the gypsum storage area will not be directed to the treatment system, but allowed to filter into the surrounding area. Please note that gypsum can potentially produce hydrogen sulphide, which is toxic to fish and other aquatic organisms, under anaerobic conditions and where an organic carbon source exists. Further, if in the future Agri-Bulk vacates the property any gypsum must be removed from the site.

open 20,000 tonne + Settle tank

Please also note, contrary to what is stated in the report, gypsum having a neutral pH will not "serve to reduce or neutralize those adverse acidic qualities present in some of the various pollutants especially the metal exceedances" in the groundwater. For instance, the metal contaminants referred to in the Powers report may require far more alkaline conditions for precipitation to occur.

3) Powers has suggested that catchbasins would serve as "pre-settling basins" for the collected stormwater and wastewater. However, it is my understanding that catchbasins are not effectively designed for this function (with the possible exception of a new Stormceptor design which has not been proposed), and as such should not be relied on to remove solids from the stormwater and wastewater. However, to ensure proper operation of the catchbasins on-site they should be inspected and cleaned on a regular basis.

4) With respect to the proposed treatment system, please note that insufficient information was provided regarding how anticipated contaminants in the stormwater and wastewater will be treated. The design process for the treatment system should include, but is not limited to:

a) the detention period required for separation/settling;

b) the anticipated metals to be treated for;

c) the type of coagulants/flocculants to be used;

d) the type of chemical and/or biological inputs to be used;

e) where and how often will the contaminated sludge be disposed of;

f) contingency plan in the event that the wastewater and stormwater quality criteria are not met; and

g) anticipated effluent quality.

5) The proponent must ensure that the collection and treatment systems are adequately designed to handle the anticipated volume of stormwater and wastewater expected to require treatment. Given the sensitive receiving environment of the Fraser estuary, the tank design should be sufficient to handle the 50 or 100 year 24 hour storm events (88.8 or 96 mm). Similarly the 15 min storm magnitudes (11.2/12.3 mm) should also be considered when scaling the collection and treatment systems. From the report and attached engineering plans, the ERC notes that the total volume of rain in a 24 hour period is estimated to be 1049 m^3, and that the treatment tanks were claimed to hold twice the 24 hour volume of rain or 2098 m^3. However, the total tank dimensions are approximately 20m x 50m x 1.2m which is a volume of only 1200 m^3. Further, there is no mention as to what calendar years the referenced 24 hour rain is based on. Further, the report states that the proposed pumping station is to be designed to handle the 15 minute rain. However, it appears that the total volume from a 15 minute rain (81.1 L/second) exceeds the capacity of the proposed pumping station (66.2 L/second).

1/100 = 1/10

Very few details have been provided on treatment methods, their performance characteristics, etc. In fact, the report appears to give the impression that the treatment plant would be capable of multiple treatment modes simultaneously. This would not be consistent with the ERC's understanding of treatment systems which are typically optimized to treat specific contaminants of concern.

6) The report has quoted a total suspended solids (TSS) limit of "20 (e.g. sulphur) to 75 mg/L". However, TSS limits (such as those in the DFO/MELP Land Development Guidelines For The Protection Of Aquatic Habitat) are normally based on suspended geological material (i.e. inert weathered rock fragments) and not TSS in the form of elemental sulphur. The elemental sulphur is not inert and may undergo adverse reactions in the receiving environment including the potential formation of sulphuric acid or hydrogen sulphide gas. Accordingly, if the report means to suggest that the TSS limits are for sulphur, additional treatment will be required. The discharge water quality from the treatment system should address the following suspended solids standards, as non-sulphur material, of 25 mg/L, during dry periods, and 75 mg/L, during precipitation periods, over background levels. It should be noted that currently, 2 facilities are contending with the remediation of areas that have been historically contaminated by elemental sulphur.

7) With respect to the proposed monitoring plan, the ERC notes that the sampling location would be established in a manhole located on the barge spit. Please be advised that there may be a safety concern if this requires entry into a confined space, and that consideration should be given as to how the sample can be safely obtained. The ERC also notes that the location of this sampling site would be where the untreated stormwater pipe combines with the treated effluent pipe. Please note that in order to effectively sample the final effluent quality that would be discharging to the Fraser River the sample should be obtain where the two flows have been allowed to fully mix. Further, the core parameters to be measured should include metals of concern and nitrate.

With respect to the potential risk associated with storing and handling commodities, such as those mentioned above, and fuel on property adjacent to the Fraser River, the proponent must ensure that appropriate containment structures and contingency plans in the event of breach or accidental spill are in place. Please note that relying on the Fraser River to dilute the contaminant(s) in the case of a spill, as was suggested in the Environmental Assessment Screening report, is not acceptable to the ERC. With respect to the pipe conveyor system, the ERC understands from the meeting on February 9, 1999 that the system is fully enclosed by a flexible belt, and that all mobile conveyors, shiploaders and conveyor transfer stations are to be hooded or enclosed. However, there still exists the potential for accidental spills of materials, therefore the conveyor corridor should be fully contained i.e. installation of spill trays or paved and curbed.

You will note that the above comments are related primarily to water quality concerns. With regard to concerns related to physical fish habitat, please be advised that the ERC is still reviewing the recent letter/report submitted to the ERC entitled Stormwater Management Plan for Agri-Bulk Services' Proposed Fraser Richmond Agri-Bulk Terminal prepared by Powers Environmental Services (Powers) dated February 19, 1999. Upon this review, the ERC may be providing further comments on the subject proposal.

It must be made clear that the above constitutes the minimum information required by the ERC in order to continue a review of the subject proposal. Accordingly, it should also be made clear that during further review or a review of the above requested information, additional information may be requested or required.

Also please be advised that the intent of this letter is to request further information in order for the ERC to continue a review of the subject proposal. This letter does not constitute any form of approval by the ERC to commence the subject proposed works nor is it the intent of this letter to imply that any form of approval for the subject works is or is not forthcoming from the ERC.

Should you have any questions or require further information please do not hesitate to contact me at 775-5195.

Sincerely,

Environmental Review Committee

Per: Daria Hasselmann
Project Review Coordinator

cc: M. Willcox – BC MELP Surrey
A. Colodey – Environment Canada
B. Naito, DFO
B. Gowe – DFO CCG NWPA

March 2, 1999

Rec'd by mail
Apr 6/99 gb

Dennis Barlow
Solid Waste Officer
Ministry of Environment Lands and Parks
10470 - 152nd St.
Surrey, BC.
V3R 0Y3
Phone - (604) 582-5276

HIGH WATER LEVELS AT FRASER RICHMOND

Dear Sir:

As you are aware on January 14, 1999 the Fraser River Harbour Commission notified your department of a pending *"high water"* emergency situation at our Fraser Richmond site. The emergency developed primarily because of heavy precipitation, causing the water level in the perimeter ditches to rise beyond our current pumping capacity. The current pumps were chosen to meet the capacity of our current discharge permit level.

On January 14, 1999 the water level in the perimeter ditch was in danger of breaching the perimeter road which acts as a dike. A *"high water"* emergency was declared to prevent the possibility of dike failure which would result in contamination of adjoining property. FRHC outside operations staff commenced de-watering the perimeter ditch by following FRHC's "high water" emergency protocol which is designed to meet the requirements of Appendix B-1 to permit PE-6276 issued by Ministry of Environment, Lands and Parks (attached). This protocol requires that FRHC "20 inch Emergency Pump Operating Instructions" (attached) be followed and includes "Sampling Instructions" (attached) recommended by B.C. Research Inc. (BCRI). The samples were sent to BCRI for immediate analysis and the results indicated that the quality was within permissible parameters.

The following is the data you requested on January 15, 1999 during your on-site visit to our Fraser Richmond site:

1) Emergency Pump: - Direct discharge to Fraser River
   - Make - Cascade
   - Size - 20 inch
   - Capacity - 10,000 G.P.M.

2) Total Pumping Time:
   From Jan. 14, 1999 to Feb. 28, 1999 - 67 Hours

3) Total Quantaty Pumped:
   40,200,000 Gallons *or* 182,752 Cubic Meters

As of this date the water level in the perimeter ditch is still considered as *"high water"* and with any appreciable precipitation would result in a catastrophic emergency situation.

If you have any further questions do not hesitate to contact me at your convienience.

Wayne Herring-Cooper
Outside Operations Feild Supervisor
W. Herring-Cooper

MINISTRY OF ENVIRONMENT, LANDS AND PARKS
Environmental Protection

APPENDIX B-1

to Permit No. PE-6276

A. MAINTENANCE OF WORKS

The Permittee shall inspect the pollution control works regularly and maintain them in good working order. Notify the Regional Waste Manager of any malfunction of these works.

B. EMERGENCY PROCEDURES

1. In the event of an emergency which prevents the Permittee from complying with a requirement of the Permit that would otherwise be applicable, that requirement will be suspended for such time as the emergency exists or until otherwise directed by the Regional Waste Manager provided that:

   i The Permittee can demonstrate the exercise of due diligence in relation to the process, operation or event which has caused the emergency and that the emergency has occurred notwithstanding this exercise of due diligence.

   ii The Regional Waste Manager has been immediately notified of the emergency; and

   iii The Permittee is proceeding with due diligence to correct the emergency condition.

2. Notwithstanding, i, ii, and iii above, the Regional Waste Manager may require the Permittee to reduce or suspend operation to protect the environment while correcting the situation.

C. BYPASSES

The discharge of effluent which has bypassed the designated treatment works is prohibited unless the approval of the Director or the Regional Waste Manager is obtained and confirmed in writing.

D PROCESS MODIFICATIONS

The Permittee shall notify the Regional Waste Manager prior to implementing changes to any process that may adversely affect the quality and/or quantity of the discharge.

E. OPERATION OF STORAGE AND PROCESSING FACILITY

The Permittee shall operate the storage and processing facility in a manner satisfactory to the Regional Waste Manager. Controls may be specified which will reduce the generation of leachate or additional treatment works may be required. Records of wood residues and yard waste received, stored and processed on site, and removed from the site shall be maintained for inspection.

20" EMERGENCY PUMP OPERATING INSTRUCTIONS

1) Take Note of water height on gauge at South Pump House.
   - .90 on the gauge is equal to the lowest elevation of the perimeter road
   - High water level considered when water level exceeds .70 on the guage
   - Emergency level in effect when water level meets or exceeds .80 on the gauge

2) Obtain and record information on FRHC High Water Emergency form.

3) Shut down both sump pumps to prevent the water level from rising in the leachate treatment lagoons.

4) Shut down both pumps in the North Pump House, preventing lagoon water from being distributed onto sand mat which after filtration collects in the perimeter ditch.

5) Contact MELP (Dennis Barlow)(582-5276) advising of declared high water emergency.

6) Contact BCRI (Lori Hunt)(224-4331) advising of declared high water emergency and intent to sample.

7) Take water quality samples following sampling instructions as per BCRI recommendations.
   - Sampling kits are stored in the South Electrical Shed

8) Commence emergency de-watering of perimeter ditch.

9) Immediately send water quality samples to BCRI for analysis.

BCRI

SAMPLING INSTRUCTIONS-20" DISCHARGE-FRHC RICHMOND SITE

1. If possible, notify BCRI of intent to sample.

   Contact: L. J. Hunt-Ph/FAX 224-4331/0540, Home Ph: 591-3025.

2. Note date and time of sampling.

3. Measure and record dissolved oxygen and temperature.

   DO mg/L, Temp. °C

4. Rinse each of the 5 sample containers with sample water, fill and cap.

5. Send samples to BCRI immediately.

6. Curent MELP contact: Dick Roberts, Ph: 582-5200.

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
Canada
Tel: (604) 224-4331
Fax: (604) 224-0540
USA
Tel: (206)738-0958
Fax: (206) 733-3590

Value creation through innovation

BRITISH COLUMBIA

Ministry of Environment, Lands and Parks
POLLUTION PREVENTION PROGRAM

Permit No. PE-06276 / PA-06277
Date of Inspection Mar 25 / 99

PERMIT INSPECTION

Permittee Fraser River Harbour Commission
Location Fraser Port Landfill (closed)

A. SAMPLES TAKEN Yes ☐ NO ☑
Sources Sampled

B. OBSERVATIONS AND COMMENTS:
No changes noted since January 1999 inspection.
Pond of leachate in the north perimeter ditch is within 2-5 cm of the road.
Concern that leachate may flow over north perimeter dyke this season and in the future unless measures are taken to prevent this. Permittee has proposed a manifold which would result in a 2nd discharge location - this proposal is under assessment.

C. PERMIT COMPLIANCE IN ☑ OUT ☐
Based on Site Observations.
COMMENTS:

D. ACTION REQUIRED BY PERMITTEE: Ensure that leachate does not flow over north perimeter dyke.
Consider establishing a monitoring well between the north perimeter road and the agricultural drainage ditch at the lowest portion of the road.
Consider a plan with schedule to separate stormwater from leachate.
Comply with permit conditions.

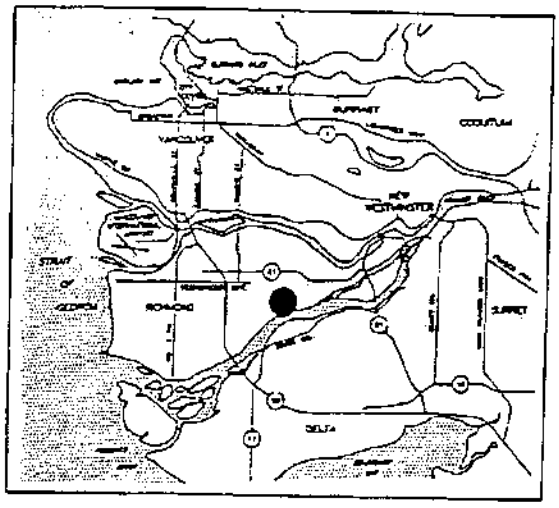
* Fax sent by mail

FRASER RICHMOND AGRI-BULK TERMINAL

Agri-Bulk Services Ltd. is proposing to develop a mini-bulk terminal on the Fraser River at the Fraser River Harbour Commission's (FRHC) Fraser Richmond port facility. The partnership that makes up Agri-Bulk Services Ltd. brings with it long established relationships with various sectors of the Canadian and international agricultural industry. It is the intention of the company to use the mini-bulk terminal to export agricultural commodities to markets where significant export opportunities exist.

Existing bulk commodity marine terminals in the lower mainland are predominantly designed and operated to service large tonnage volumes, usually involving millions of tons annually. Producers and exporters of commodities that move in smaller volumes, have tended to find themselves almost closed out of the ability to export through these lower mainland terminals, as their tonnages are not considered to be economically attractive. This situation has not prevented the export of these lesser volume commodities but has tended to see them diverted to mini-bulk terminals in the U.S. Pacific Northwest where terminals, similar to the one proposed, offer a viable alternative. The cost of exporting through these U.S. ports is significantly higher than would be the cost of exporting through Agri-Bulk's terminal. Agri-Bulk Services is confident that improved economics would result in Canadian-produced commodities being recaptured from U.S. ports and exported via its port facility.

While the intention of the proposed Agri-Bulk terminal is partly to recapture significant Canadian tonnage currently moving through the U.S. ports, at rates that would make these agri-products more competitive in the international markets, the terminal would also handle agri-products that have, to date, moved in only limited volumes due to the absence of suitable Canadian agri-bulk facilities. In order for exporters of smaller volumes to satisfy the

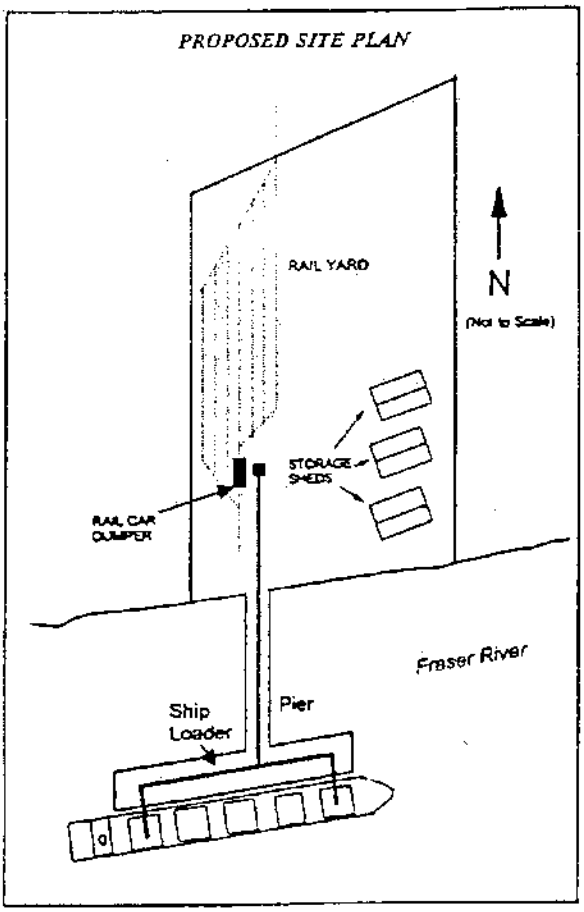


requirements of international customers, it is very important for them to have a regular and reliable outlet for their products such as the one envisioned by Agri-Bulk Services.

The Agri-Bulk terminal project would result in approximately 9 man-years of employment during its construction and, depending on export volumes, 15-25 full-time positions. Initial capital spending is expected to total $15 million, and expenditures for its operations are estimated at $3.5 million annually. It is expected that project construction and most storage and handling equipment would be provided by Canadian firms. Local equipment suppliers would be used for any external operations and maintenance services and, where possible, for initial equipment supply.

THE PROJECT

The proposed Agri-Bulk terminal is to be located on the north shore of the South Arm of the Fraser River at the FRHC's Fraser-Richmond port site development. This is



a now a closed land-fill site and is accessed from No.8 Road in the City of Richmond. Originally a natural peat bog, the Fraser Richmond port site was used from the 1950s to 1986 as a municipal landfill operation. In 1986, the landfill was closed, covered with sand and/or other soil materials, equipped with a wastewater control and treatment system and a methane gas collection system, and compacted/preloaded with dredged sand in preparation for port development. Since decommissioning as a landfill operation, the port site has been used for the storage and sale of dredged sand and also presently houses a wood waste recycling operation. The proposed mini-bulk facility is considered an excellent long-term use for a site that is not suitable for residential or agricultural development.

The Fraser Richmond port facility is zoned "Heavy Industrial' by the City of Richmond. Other riparian lands in the vicinity of the site are in industrial use as well. The site of the proposed Agri-Bulk terminal is well buffered from the agricultural lands to the north. While the upland portion of the site has low wildlife value, according to the Fraser River Estuary Management Programs' (FREMP) habitat classification system the shoreline along the agri-bulk terminal's proposed site is yellow-coded, (i.e., moderate productivity and diversity), with a primary designation of Port/Terminal use.

The Agri-Bulk terminal would handle up to 1.2 million metric tons of agricultural related products annually including products such as peas, lentils and wood pellets. Most commodities would be directly moved from railcars to the vessel using covered conveyor systems. Some commodity storage would also be provided. Marine facilities would consist of a dredged deep water berth. Public utilities such as power and water would be extended to the site.

The proposed Agri-Bulk terminal would be located on approximately 25 acres of land and 225 metres of shoreline on the south shore of the Fraser-Richmond site and would consist of:

- Deep-water berth.
- Paved asphalt or concrete traffic and dock areas.
- Single rail car dumper.
- Rail yard.
- Covered conveyor systems.
- Covered storage areas.
- Liquid storage tanks.
- Liquid rail car receiving system.
- Liquid ship loading manifolds.

- Office including ancillary buildings and an equipment maintenance facility.
- Wastewater control/treatment facilities

It is expected that rail traffic to the site would not exceed 12,000 rail cars per year with marine visits estimated at 60-70 vessels a year. No appreciable increase in truck traffic is anticipated.

Construction would begin as soon as equipment can be ordered which would be done immediately on receipt of regulatory approvals. Actual on-site construction is expected to take approximately three months. Start-up of the proposed Agri-Bulk terminal is scheduled for March 1999.

REGULATORY APPROVALS

The Fraser Richmond site presently is permitted under B.C. Waste Management Act permits for the operation of (i) a leachate control and treatment system and monitoring program, (ii) a methane gas collection system. In addition, FRHC has maintained a B.C. Waste Management Act restricted Landfill Permit, (i.e., dredge spoils). For the Agri-Bulk terminal, project approval would be acquired through the FREMP coordinated project review process. Specific authorizations and/or permits such as those required under the federal Fisheries Act, the Navigable Waters Protection Act (NWPA), etc. would be acquired in conjunction with FREMP's project review and approval.

In support of project approvals, Agri-Bulk Services Ltd. would conduct various environmental investigations to supplement previous environmental studies (and on-going monitoring programs) that have been undertaken at the Fraser Richmond site. These investigations would be presented in an Environmental Assessment document which would accompany the FREMP application. Impact mitigation measures resulting from the environmental assessment would be integrated into the proposed terminal's design, construction and operations.

POTENTIAL ENVIRONMENTAL ISSUES

- *Treatment of run-off and washdown water*
  All run-off and washdown water would be properly collected and treated on site to avoid the possibility of adverse impacts on marine organisms.

- *Fugitive dust emissions*
  The terminal would be designed with covered conveyors, covered storage (where applicable) and would use a shiploader trunk that would inhibit the potential for dust emissions of any kind.

- *Fish and wildlife habitat loss*
  Habitat losses would be minimized and, where impacted, would be replaced by habitat compensation areas along the port's shoreline.

+ sanitary facilities ?

POTENTIAL COMMUNITY ISSUES

- *Increased vehicular/truck traffic*
  It is anticipated that deliveries to the site would be by rail and not by road.

- *Noise*
  The Fraser Richmond port facility is near the La Farge Cement plant and across from the Tilbury Industrial Park. It is well buffered from any residential areas.

ENVIRONMENTAL MANAGEMENT

- Best Available Control Technology (BACT) would be integrated in facilities design including the use of covered conveyors and storage facilities to reduce nutrient enriched runoff from storage areas and minimize fugitive dust emissions.

- There are no surface water courses on the Fraser-Richmond port site. Impermeable asphalt and/or concrete surfaced storage areas would be constructed to prevent subsurface migration.

- Compensatory works would be constructed for any potential marine habitat losses.

- To decrease noise levels, the Agri-Bulk terminal would coordinate its efforts in the use of scheduling, routing, equipment selection, deflectors, barriers and berms to reduce noise in their operations.

- Any excavation or trenching of the landfill cover for the rail car dumper would be lined with a PVC curtain to prevent lateral migration of leachates from the site.

- Aquatic resources would be minimally affected by the terminal's operation. Residue and fugitive dust from ship loading activities would be mitigated by installation of extendable spouts on the ship loaders.

- Environmental monitoring programs for water and air quality and effectiveness of habitat compensation works, if required, would be instituted and maintained.

- ISO 14001 international environmental management systems standards would be used to plan, monitor and continually improve the Agri-Bulk terminal's competitive position and environmental performance. Internal environmental auditing would be undertaken on a scheduled basis.

PUBLIC INVOLVEMENT

Prior to and during FREMP project review, Agri-Bulk Services Ltd. would consult with all stakeholders, the public and relevant approving agencies to ensure all project issues are identified and addressed. It is expected that an open house would be held to present the project and solicit input from participants.

We welcome any questions or comments you may have on the proposed Agri-Bulk terminal project. Please take the opportunity to write your questions and/or comments in the space below and send them to:

Fraser River Harbour Commission
500 - 713 Columbia Street
New Westminster, B.C.
V3M 1B2

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277

SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY :

REPORT PERIOD: 1998 - 4th quarter

Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		in	
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (ma)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in n/a	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	in	2nd & 4th quarters only
Surface water samples	14 parms	6276: C.3	per six months	per six months	n/a	in	2nd & 4th quarters only
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	in	

COMPLIANCE WITH MONITORING PROGRAM IN

OVERALL COMPLIANCE IN

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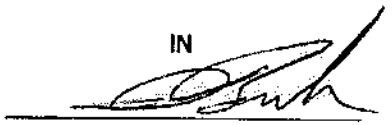


PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277

SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY :

Quarterly

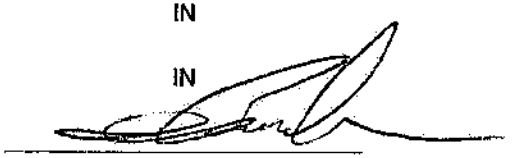
REPORT PERIOD: 1998 - 2nd quarter

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		in	
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (mo)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in n/a	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	in	
Surface water samples	14 parms	6276: C.3	per six months	per six months	n/a	in	
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	in	

COMPLIANCE WITH MONITORING PROGRAM IN

OVERALL COMPLIANCE IN

SIGNATURE



PE-06276

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277

SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY :

REPORT PERIOD: 1998 - 1st quarter

Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		in	
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (ma)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	In	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in in	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	in	
Surface water samples	14 parms	6276: C.3	per six months	per six months	n/a	in	
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	in	

COMPLIANCE WITH MONITORING PROGRAM IN

OVERALL COMPLIANCE IN

SIGNATURE

PE-06276

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277

SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY :

REPORT PERIOD: 1997-4th quarter

Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		in	
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (mo)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in in	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	in	
Surface water samples	14 parms	6276: C.3	per six months	per six months	n/a	in	
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	in	

COMPLIANCE WITH MONITORING PROGRAM **IN**

OVERALL COMPLIANCE **IN**

SIGNATURE _____

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277

SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY :

REPORT PERIOD: 1997-3rd quarter

Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		in	
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (ma)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in in	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	n/a	2nd, 4th quarters only
Surface water samples	14 parms	6276: C.3	per six months	per six months	n/a	n/a	2nd, 4th quarters only
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	in	

COMPLIANCE WITH MONITORING PROGRAM IN

OVERALL COMPLIANCE IN

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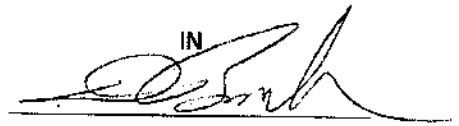


BRITISH COLUMBIA

August 19, 1997 File: PE-06276

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

Attention: Pat Weber, Environmental Co-ordinator

Dear Pat Weber:

Re: Waste Management Permit PE-06276: Fraser Port Richmond Landfill

The monitoring report for final effluent covering the second quarter of 1997 has been submitted on your behalf by BC Research Inc.

Review of the data determined that the above referenced permit is out of compliance for the following:

1. The bioassay (96 hour LC_{50}) conducted on the April 1997 sample found that the effluent was toxic to fish. The previous quarterly monitoring report indicated that the effluent was toxic in January 1997 and marginally toxic in March 1997.

2. The result for the 5-day BOD analysis conducted on the April 1997 effluent sample (35 mg/L) exceeded the maximum authorized by the referenced permit (30 mg/L).

Please advise me by **September 22, 1997** of the action that has been taken or will be taken to ensure consistent compliance. Compliance with other permit requirements was not reviewed in this assessment.

.../2

Ministry of Environment, Lands and Parks

Environment and Lands
Lower Mainland Region
Pollution Prevention

Mailing/Location Address:
10470 152 Street
SURREY BC V3R 0Y3

Telephone: (604) 582-5247
Facsimile: (604) 584-9751
or (604) 582-5335

Please note that failure to comply with permit requirements is a violation of the Waste Management Act and violations may be subject to legal action.

The next quarterly monitoring report, containing data for effluent, is due October 31, 1997.

Yours truly,

Dennis Barlow
Solid Waste Officer
Municipal Section

BRITISH COLUMBIA

May 5, 1997 File: PE-06276

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

Attention: Pat Weber, Environmental Co-ordinator

Dear Pat Weber:

Re: Waste Management Permit PE-06276: Fraser Port Richmond Landfill

The monitoring report for final effluent covering the first quarter of 1997 has been submitted on your behalf by BC Research Inc.

Review of the data determined that the above referenced permit is out of compliance for the following:

1. Dissolved Oxygen was not reported for the January 1997 sample;

2. The concentration Ammonia Nitrogen (12.5 mg/L) exceeded the authorized maximum of 10.0 mg/L in the February 1997 sample;

3. The bioassay (96 hour LC50) conducted on the January 1997 sample indicated that the effluent was toxic to fish. The bioassay conducted on the March 1997 sample indicated that the effluent was marginally toxic to fish.

Please advise me by **May 16, 1997** of the action that has been taken or will be taken to ensure consistent compliance. Compliance with other permit requirements was not reviewed in this assessment.

.../2

Ministry of Environment, Lands and Parks
Environment and Lands
Lower Mainland Region
Pollution Prevention
Mailing/Location Address:
15326 103A Avenue
Surrey BC V3R 7A2
Telephone: (604) 582-5247
Facsimile: (604) 584-9751
or (604) 582-5335

Please note that failure to comply with permit requirements is a violation of the Waste Management Act and violations may be subject to legal action.

The next quarterly monitoring report, containing data for effluent, groundwater and surface water, is due July 31, 1997.

Yours truly,

Dennis Barlow
Solid Waste Officer
Municipal Section

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277 SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY : REPORT PERIOD: 1997-2nd quarter

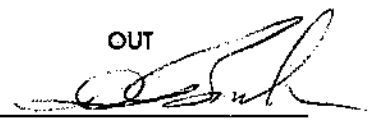
Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		in	
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (ma)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	out	Apr < 100%
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in in	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	n/a	2nd, 4th quarters only
Surface water sample	14 parms	6276: C.3	per six months	per six months	n/a	n/a	2nd, 4th quarters only
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	in	

COMPLIANCE WITH MONITORING PROGRAM OUT

OVERALL COMPLIANCE OUT

SIGNATURE



PE-06276 Data

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277 SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY : REPORT PERIOD: 1997-4th quarter

Quarterly

REQUIREMENT	UNITS	PERMIT SECTION	FREQUENCY MONITOR	FREQUENCY REPORT	LIMIT	IN/OUT	REASON
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per tox. sample	per quarter		out	missing Jan DO
temperature	C	6276: C.1.1	per tox. sample	per quarter		in	
flow	m3/d (mo)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	out	Jan 60%, Mar bl in
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter		in in	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	n/a	2nd, 4th quarters only
Surface water sample	14 parms	6276: C.3	per six months	per six months	n/a	n/a	2nd, 4th quarters only
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	in	

COMPLIANCE WITH MONITORING PROGRAM OUT

OVERALL COMPLIANCE OUT

SIGNATURE

BRITISH COLUMBIA

February 12, 1997 File: PE-06276

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

Attention: Pat Weber, Environmental Co-ordinator

Dear Pat Weber:

Re: Waste Management Permit PE-06276
Fraser Port Richmond Landfill

The monitoring report for final effluent, surface water and groundwater covering the fourth quarter of 1996 has been submitted on your behalf by Golder Associates Ltd. .

Review of the data determined that effluent quality and quantity have been within permit limits, and that the reports are complete. Therefore the permit is considered to be in compliance with the monitoring and reporting requirements. Compliance with other permit requirements was not reviewed in this assessment.

Future monitoring reports should provide reference to the site identifier in the ministry database in accordance with the list below. Reports for locations not recorded in the database should have the locations clearly identified.

Location	Site Identifier
Effluent	E100784
MW-A	E206252
MW-B	E206253
MW-C	E206254
MW-D	E206255
Surface 2	E105877
Surface 3	E105876
Surface 4	E105878
Surface 5	E105880

.../2

Ministry of Environment, Lands and Parks
Environment and Lands
Lower Mainland Region
Pollution Prevention
Mailing/Location Address:
15326 103A Avenue
Surrey BC V3R 7A2
Telephone: (604) 582-5247
Facsimile: (604) 584-9751
or (604) 582-5335

BRITISH COLUMBIA

October 29, 1996

File: PE-06276
PR-06277

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

Attention: Pat Weber, Environmental Co-ordinator

Dear Pat Weber:

Re: Waste Management Permit PE-06276
Fraser Port Richmond Landfill

The monitoring report for final effluent covering the third quarter of 1996 has been submitted on your behalf by Golder Associates Ltd. .

Review of the data determined that effluent quality and quantity have been within permit limits, and that the reports are complete. Therefore the permit is considered to be in compliance with the monitoring and reporting requirements. Compliance with other permit requirements was not reviewed in this assessment.

The next quarterly monitoring report, containing data for effluent, surface water, groundwater and effluent flow measurement, is due January 31, 1997.

If you have any questions, please call me at 582-5276.

Yours truly,

Dennis Barlow
Solid Waste Officer
Municipal Section

Ministry of Environment, Lands and Parks
BC Environment
Lower Mainland Region
Environmental Protection
Mailing/Location Address:
15326 103A Avenue
Surrey BC V3R 7A2
Telephone: (604) 582-5247
Facsimile: (604) 584-9751
or (604) 582-5335

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277 SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY : REPORT PERIOD 1996-3rd quarter

Quarterly

REQUIREMENT	UNITS	PERMIT SECTION	FREQUENCY		LIMIT	IN/OUT	REASON
			MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspectior	200,000	in	
phosphate records	kg	6277: 2.5	per discharge	per inspection		in	
dissolved oxygen	mg/L	6276: C.1.1	per toxicity samp	per quarter		in	
temperature	C	6276: C.1.1	per toxicity samp	per quarter		in	
flow	m3/d (ma	6276: C.1.3	per day	per quarter	10,000 (mon. avg.	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter	in	in	
Groundwater samp	14 parms	6276: C.2	per six months	per six month	n/a	n/a	2nd, 4th quarters only
Surface water samp	14 parms	6276: C.3	per six months	per six month	n/a	n/a	2nd, 4th quarters only
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspectior	0	in	

COMPLIANCE WITH MONITORING PROGRAM IN

OVERALL COMPLIANCE IN

SIGNATURE

PE-06276

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277
SOURCE: Fraser Port Richmond Landfill
REPORT FREQUENCY :
REPORT PERIOD 1996-2nd quarter
Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	*	next inspection
phosphate records	kg	6277: 2.5	per discharge	per inspection		*	next inspection
dissolved oxygen	mg/L	6276: C.1.1	per toxicity sample	per quarter		in	
temperature	C	6276: C.1.1	per toxicity sample	per quarter		in	
flow	m3/d (ma)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	in	
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	in	
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	in	
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter	in	in	
Groundwater samples	14 parms	6276: C.2	per six months	per six months		in	
Surface water samples	14 parms	6276: C.3	per six months	per six months		in	
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	*	next inspection

COMPLIANCE WITH MONITORING PROGRAM IN

OVERALL COMPLIANCE IN

SIGNATURE

Province of
British Columbia
MINISTRY OF
ENVIRONMENT,
LANDS AND PARKS

BC Environment
LOWER MAINLAND REGION

15326 103 A Avenue
Surrey
British Columbia
V3R 7A2
Telephone: (604) 582-5200
Facsimile: (604) 584-9751

File: PE-06276

May 1, 1996

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

Attention: Ms. Pat Weber, Environmental Co-ordinator

Dear Madam:

Re: Waste Management Permit PE-06276
Fraser Port Richmond Landfill

Thank you for the Fraser Port Richmond Landfill data submission covering the period from January 1, 1996 to March 31, 1996. The report was submitted on your behalf by Golder Associates Ltd.

I have reviewed the data, and have determined that the above referenced permit is out of compliance with respect to toxicity to fish, ammonia and total suspended solids. Please advise me by May 17, 1996 of the action that has been taken or will be taken to ensure consistent compliance. Compliance with other permit requirements was not reviewed in this assessment.

Please note that failure to comply with permit requirements is a violation of the Waste Management Act and violations may be subject to legal action.

The consultant has requested on your behalf that Environmental Protection accept analyses of groundwater for dissolved metals in the future. This is to confirm that analyses for total metals should continue for the discharge, groundwater and surface water, in accordance with permit requirements. Provision for analyses for dissolved metals in lieu of total metals may be considered within an application for permit amendment.

Should you have any questions, please call me at 582-5276.

Yours truly,

Dennis Barlow
Solid Waste Officer
Municipal Section

PERMIT COMPLIANCE CHECK SHEET

PERMIT NO: PE-06276, PR-06277 SOURCE: Fraser Port Richmond Landfill

REPORT FREQUENCY: REPORT PERIOD: 1996-1st quarter

Quarterly

REQUIREMENT	UNITS	PERMIT	FREQUENCY		LIMIT	IN/OUT	REASON
		SECTION	MONITOR	REPORT			
woodwaste records	m3	6276: B.E	all times	per inspection	200,000	*	next inspection
phosphate records	kg	6277: 2.5	per discharge	per inspection		*	next inspection
dissolved oxygen	mg/L	6276: C.1.1	per toxicity sample	per quarter		in	
temperature	C	6276: C.1.1	per toxicity sample	per quarter		in	
flow	m3/d (ma)	6276: C.1.3	per day	per quarter	10,000 (mon. avg.)	in	
BOD	mg/L	6276: 01(C)	per quarter	per quarter	30	in	
TSS	mg/L	6276: 01(C)	per quarter	per quarter	40	out	Feb 22: 44 mg/L
NH3	mg/L	6276: 01(C)	per quarter	per quarter	10	out	Feb 22: 11.2 mg/L
96 HR LC50	%	6276: 01(C)	per month	per quarter	100 (low limit)	out	Feb 22: 75%
Discharge samples	19 parms	6276: C.1.2	per quarter, and per LC50 failure	per quarter	in	in	
Groundwater samples	14 parms	6276: C.2	per six months	per six months	n/a	n/a	
Surface water samples	14 parms	6276: C.3	per six months	per six months	n/a	n/a	
Refuse discharge	tonnes/d	6277: 1.1	all times	per inspection	0	*	next inspection

COMPLIANCE WITH MONITORING PROGRAM OUT

OVERALL COMPLIANCE OUT

SIGNATURE

CALL FORM

Date:	May 1, 1996
Call Made by:	Dennis Barlow Municipal Section
Name:	Heather Matthews
Affiliation:	Golder Associates
Address:	
Telephone:	298-6623
File Number:	PE-06276
Regarding:	Richmond Landfill monitoring report - 1st quarter 1996

Comments/Discussion:

I noted that the February 1996 effluent sample was out of compliance with permit requirements (LC50 = 75%, TSS = 44 mg/L, NH3 = 11.2 mg/L) and asked what measures are being taken to remedy. HM advised sodium phosphate is being added to the lagoons to balance nutrients; this has been successful in the past in reducing NH3 content of effluent.

I advised I have asked FRHC for a copy of the log used to track these additions, however this information was not included in the report. I also asked for justification for the additions. HM will send the information requested.

The report asks EP to accept dissolved metals analyses for groundwater, and provides justification. I advised the permit requires total metals. The permittee may wish to perform both analyses, and provide the data to support a permit amendment.

HM advised FRHC does not wish a permit amendment at this time, however they are considering asking for a reduction in permitted flow. I said that could be considered, provided we get information on measures taken to reduce infiltration by precipitation, improve drainage and otherwise reduce flow of effluent.

Follow-up:

Letter to permittee: data non-compliance.

FRASER PORT

Our File: O22

June 7, 1995

Mr. Dennis Barlow
BC Ministry of Environment
15326 - 103A Avenue
Surrey, B.C. V3R 7A2

Dear Mr. Barlow:

Re: Emergency High Water Discharge of Perimeter Ditches at the Fraser Richmond Site

I am concerned with the Fraser River Harbour Commission's ability to handle extreme levels of rainfall on its Fraser Richmond site. On several occasions last winter, during extended periods of heavy rainfall (48 hours or longer), the Fraser Richmond pumping system was taxed to its limit. As more and more sand is removed in preparation for development, the site loses its ability to absorb and store runoff water which is then pumped over an extended period of time. The discharge of water and leachate is handled by the S/W pump station to the S/W sand filter and by the 20" direct discharge (to river) during emergency conditions. Both pumping systems depend on electrical service for operation. Electrical service in that sector of Richmond can and has failed on several occasions. If electrical failures occur during severe storms, it can leave the Fraser Richmond site in a critical state.

I have been exploring several ways of providing a failsafe method of handling high ditch levels during extreme precipitation periods and welcome your comments or suggestions with respect to our discharge permit. I have concluded that the simplest and most effective solution would be the installation of extreme high water overflow pipes, installed through the Perimeter Road dyke. I propose the installation of four 12' Ø steel pipes, discharge manifolds and split culverts (bank protection) at the N/W corner, discharging into the #7 Road ditch. These discharge pipes would be installed approximately 18" below (invert elevation) the road/dyke top. The pipe inlets would be capped with victaulic blind flanges which could be unbolted by Fraser River Harbour Commission staff, only in extenuating circumstances. In essence it becomes a direct discharge to the #7 Road ditch, similar to the use of the 20" pump but depends on gravity feed and not electricity. It is not intended to replace the 20" direct discharge pump but merely act as an independent backup.

la/cha/015.1

FRASER RIVER HARBOUR COMMISSION
500 - 713 Columbia Street, New Westminster, British Columbia, Canada V3M 1B2 Telephone (604) 524-6655 Fax (604) 524-1127

Province of
British Columbia

MINISTRY OF
ENVIRONMENT,
LANDS AND PARKS

BC Environment
LOWER MAINLAND REGION

Environmental Protection
15326 — 103A Avenue
Surrey, British Columbia
V3R 7A2
Telephone: (604) 582-5200
Facsimile: (604) 584-9751

November 23, 1995 File: PE-06276

Fraser River Harbour Commission
500 - 713 Columbia Street
New Westminster, BC V3M 1B2

Attention: Pat Weber, Environmental Administrator

Sir or Madam:

Re: Waste Management Permit PE-06276;
Proposed High Water Discharge

Thank you for your letter, dated November 7, 1995, in which you outlined your concern about an emergency situation from high water levels in ditches.

I have reviewed your information in terms of Permit PE-06276, and confirmed that there is no provision in the permit to construct bypass works for such an emergency. The emergency provisions of your permit set out required actions that you are to undertake in an emergency but do not allow for a "planned" emergency.

If you wish to construct works for bypassing some of the authorized treatment works, you may wish to apply for an amendment to your permit. Supporting information should be provided, plus a revised site plan showing the location of the bypass works. Processing of an application would determine the notification provisions required and possible additional monitoring necessary during such bypasses.

Enclosed are amendment application and site plan forms, plus instructions. An application fee of $100.00 would be applicable for a minor amendment.

If you have any questions or need assistance with an application, please contact either Dennis Barlow at 582-5276 or myself at 582-5270.

Yours truly,

H. G. Maxwell, P.Eng.
Head, Municipal Section

enc.

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British Columbia
Handle with care

FRASER PORT

Our File: (O22.01)

DB Please review & provide comments to me for a response Thanks H

RECEIVED
NOV 0 8 1995
LOWER MAINLAND REGION
FILE NO. PE-06276

November 7, 1995

Mr. Harvey Maxwell
Section Head, Municipal Waste Section
B.C. Ministry of Environment
15326 - 103A Avenue
Surrey, B.C. V3R 7A2

Dear Mr. Maxwell:

Re: Emergency High Water Discharge of Perimeter Ditches at Fraser Richmond Site

Since our letter to Mr. Dennis Barlow, dated June 7, 1995, signed by Mr. Dean Chalcraft, our management have been considering possible risks within our area of jurisdiction. As you are very familiar with our Fraser Richmond site and the rationale contained in the June 7, 1995 letter (attached for your perusal), we would like to reiterate our concern in a possible **EMERGENCY SITUATION**.

Mr. Barlow has advised in his response to Mr. Chalcraft that our existing permit does not provide for overflow pipes to control high ditch water levels during extreme precipitations or flooding periods. However, our permit does provide for a 20' discharge pump for emergency conditions through direct discharge via the emergency pump. Emergency conditions, such as extremely high ditch levels due to an unprecedented or unseasonable storm, would create a critical condition on our land. The ditch walls could be compromised if there was a power failure and our pump could not be operated. Needless to say, the situation would then be a major problem.

I want to reiterate that we have looked at all possible alternative measures. We have no doubt this is the most effective emergency risk management project that is tamper proof, and will be put into use by only our senior staff members, after confirmation with B.C.M.O.E. It is with the utmost urgency that we request you reconsider your decision, in light of the fact that this overflow pipe will be used **ONLY** when an emergency situation occurs of

.../2

FRASER RIVER HARBOUR COMMISSION
500 - 713 Columbia Street, New Westminster, British Columbia, Canada V3M 1B2 Telephone (604) 524-6655 Fax (604) 524-1127

extremely high flood waters and with no available hydro to the site. It cannot be overemphasized that this will not be used along with the 20' discharge pump, it will be a back up system ONLY in the above-noted scenario.

We look forward to your favourable comments.

Yours very truly,

FRASER RIVER HARBOUR COMMISSION

P. Weber

Pat Weber
Environmental Administrator

cc: Allen Domaas, Director of Operations, FRHC
Dean Chalcraft, Maintenance Administrator, FRHC

Attach.(1)

cg-weber\maxwell.ltr

Province of
British Columbia
MINISTRY OF
ENVIRONMENT,
LANDS AND PARKS

BC Environment
LOWER MAINLAND REGION

15326 103 A Avenue
Surrey
British Columbia
V3R 7A2
Telephone: (604) 582-5200
Facsimile: (604) 584-9751

Your File:
Our File: PE-06276

August 2, 1995

Fraser River Harbour Commission
500 - 713 Columbia St.
New Westminster, B.C.
V3M 1B2

Attention: D. Chalcraft, Maintenance Administrator

Sir or Madam:

Re: Waste Management Permit PE-06276

Thank you for your letters dated June 7, 1995 and July 27, 1995, and the information you provided at our meeting on June 20, 1995. The subject of the correspondence and the meeting was your proposal to install an emergency high water discharge system at the closed Fraser Richmond landfill site.

After careful consideration, Environmental Protection objects to the proposal, as it would provide a means for the leachate to bypass a portion of the authorized treatment works. Such a bypass would constitute a violation of Clause C, Appendix B of the referenced permit.

We acknowledge your efforts toward a plan for managing hydraulic overloads of the landfill site in the future. We encourage you to investigate other options such as providing backup pumps and increasing lagoon storage capacity. Your preferred options should be developed within the context of a comprehensive contingency plan for managing emergencies at the site.

Please do not hesitate to call me at 582-5276 if you have any questions.

Yours truly,

Dennis Barlow
Solid Waste Officer
Municipal Section

FRASER PORT

Our File: 022

RECEIVED
AUG - 1 1995
LOWER MAINLAND REGION
FILE NO. PE-06276

July 27, 1995

Mr. Dennis Barlow
B.C. Ministry of Environment
15326 - 103A Avenue
Surrey, BC V3R 7A2

Dear Mr. Barlow:

Re: Emergency High Water Discharge of Perimeter Ditches at the Fraser Richmond Site

Since our site visit on June 20, 1995, I have received no comment on our proposed installation of the emergency high water discharge system as discussed. Our window for construction is rapidly narrowing as we require a) dry weather for excavation of roadway b) warm conditions for the cementing of liner to pipe joins c) low ditch levels for construction and d) summer student help.

Please forward any comments or objections to the Fraser River Harbour Commission office as soon as possible as I would like to schedule construction for August 15, 1995. If there is no response by that time I will assume there is no objection to the project and I will proceed as scheduled. Construction will comply exactly as per the drawing submitted and installation as discussed at the June 20, 1995 site meeting.

Thank you for your co-operation.

Yours truly,

FRASER RIVER HARBOUR COMMISSION

Dean Chalcraft
Maintenance Administrator

data/home/white/barlo075.ltr

FRASER RIVER HARBOUR COMMISSION
500 - 713 Columbia Street, New Westminster, British Columbia, Canada V3M 1B2 Telephone (604) 524-6655 Fax (604) 524-1127

FRASER PORT

Our File: O22

RECEIVED
JUN 0 9 1995
LOWER MAINLAND REGION
FILE NO. PE-06216

June 7, 1995

Mr. Dennis Barlow
BC Ministry of Environment
15326 - 103A Avenue
Surrey, B.C. V3R 7A2

Dear Mr. Barlow:

Re: Emergency High Water Discharge of Perimeter Ditches at the Fraser Richmond Site

I am concerned with the Fraser River Harbour Commission's ability to handle extreme levels of rainfall on its Fraser Richmond site. On several occasions last winter, during extended periods of heavy rainfall (48 hours or longer), the Fraser Richmond pumping system was taxed to its limit. As more and more sand is removed in preparation for development, the site loses its ability to absorb and store runoff water which is then pumped over an extended period of time. The discharge of water and leachate is handled by the S/W pump station to the S/W sand filter and by the 20" direct discharge (to river) during emergency conditions. Both pumping systems depend on electrical service for operation. Electrical service in that sector of Richmond can and has failed on several occasions. If electrical failures occur during severe storms, it can leave the Fraser Richmond site in a critical state.

I have been exploring several ways of providing a failsafe method of handling high ditch levels during extreme precipitation periods and welcome your comments or suggestions with respect to our discharge permit. I have concluded that the simplest and most effective solution would be the installation of extreme high water overflow pipes, installed through the Perimeter Road dyke. I propose the installation of four 12' Ø steel pipes, discharge manifolds and split culverts (bank protection) at the N/W corner, discharging into the #7 Road ditch. These discharge pipes would be installed approximately 18" below (invert elevation) the road/dyke top. The pipe inlets would be capped with victaulic blind flanges which could be unbolted by Fraser River Harbour Commission staff, only in extenuating circumstances. In essence it becomes a direct discharge to the #7 Road ditch, similar to the use of the 20" pump but depends on gravity feed and not electricity. It is not intended to replace the 20" direct discharge pump but merely act as an independent backup.

FRASER RIVER HARBOUR COMMISSION
500 - 713 Columbia Street, New Westminster, British Columbia, Canada V3M 1B2 Telephone (604) 524-6655 Fax (604) 524-1127

I have enclosed a drawing of the proposal and look forward to your approval or comments. If you require further information or a site visit, please call me at this office. Thank you for your cooperation.

Yours truly,

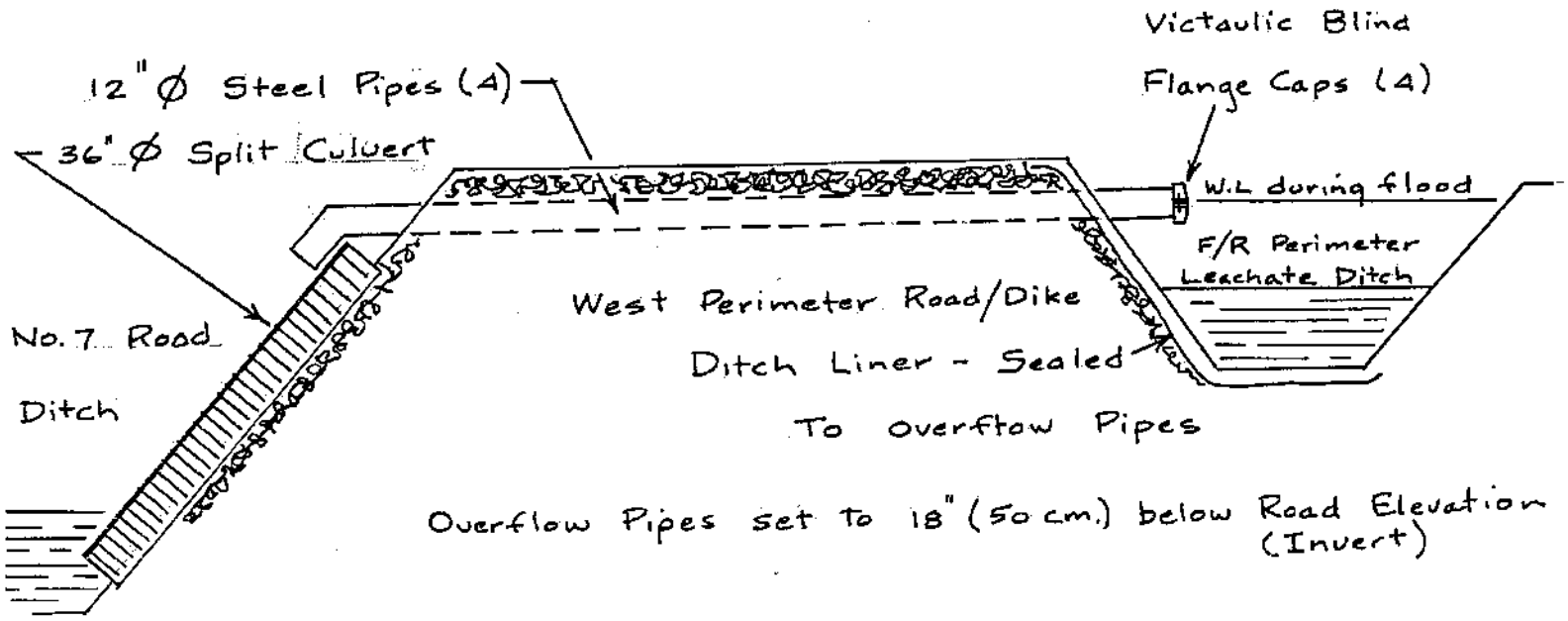
FRASER RIVER HARBOUR COMMISSION

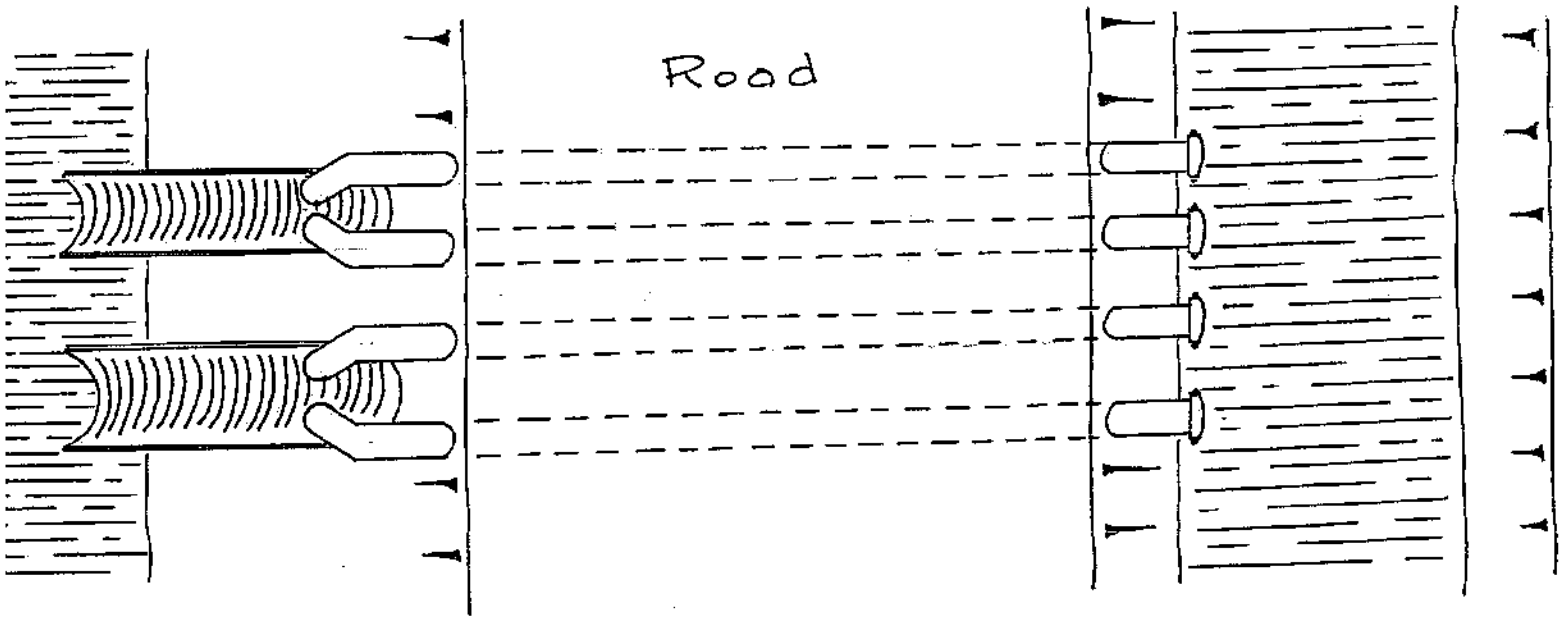
Dean Chalcraft

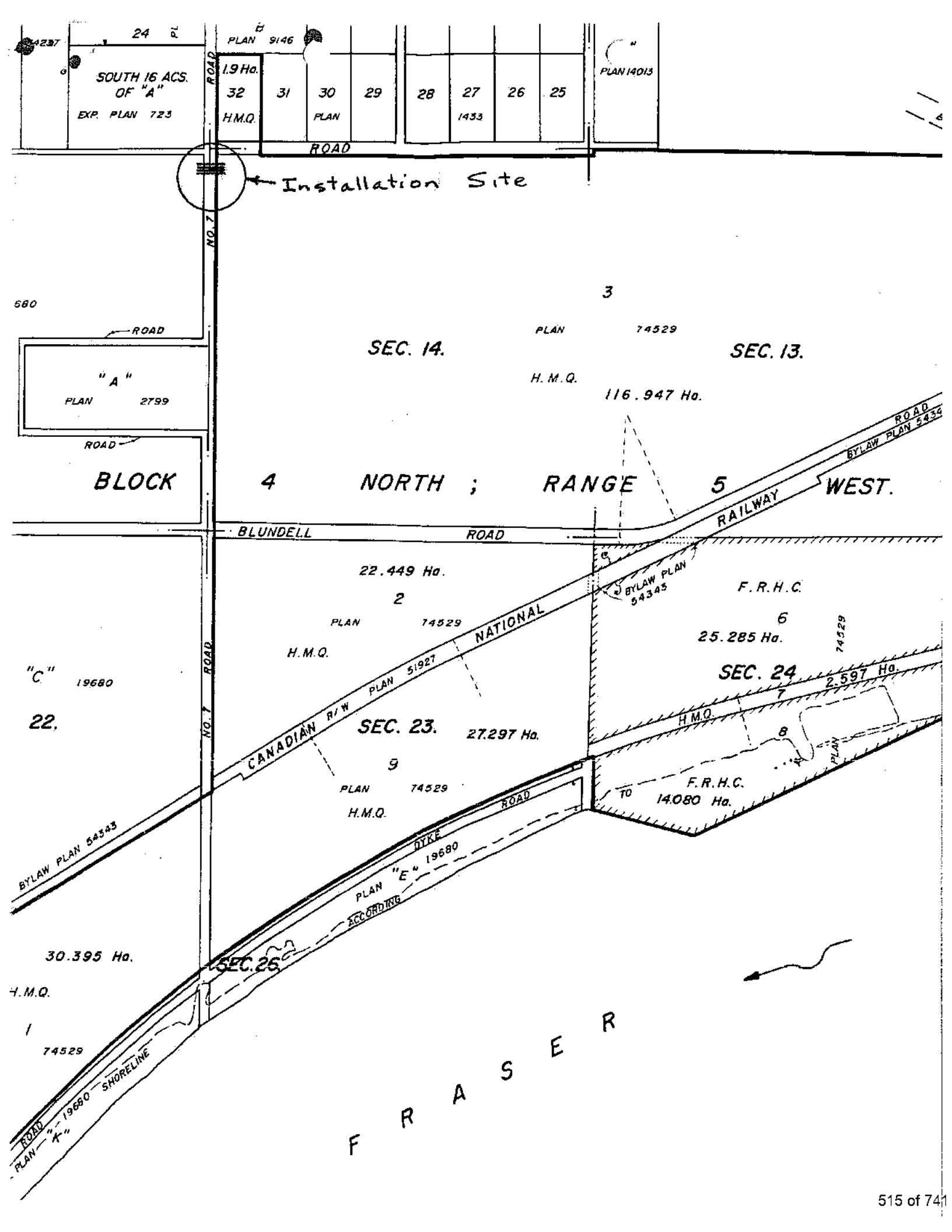
Dean Chalcraft
Maintenance Administrator

Encl.

la/cha/015.2


12" ∅ Steel Pipes (4)
36" ∅ Split Culvert
Victaulic Blind
Flange Caps (4)
W.L during flood
F/R Perimeter
Leachate Ditch
West Perimeter Road/Dike
Ditch Liner - Sealed
To overflow Pipes
No. 7 Road
Ditch
Overflow Pipes set to 18" (50 cm.) below Road Elevation
(Invert)


Road


24 PL
PLAN 9146
SOUTH 16 ACS. OF "A" EXP. PLAN 723
1.9 Ha.
32
H.M.Q.
31
30
PLAN
29
28
27
1433
26
25
PLAN 14013
ROAD
NO. 1 ROAD
Installation Site
560
ROAD
"A"
PLAN 2799
ROAD
3
PLAN 74529
SEC. 14.
SEC. 13.
H.M.Q.
116.947 Ha.
BLOCK 4 NORTH ; RANGE 5 WEST.
BLUNDELL ROAD
RAILWAY
ROAD
BYLAW PLAN 5434
22.449 Ha.
2
PLAN 74529
H.M.Q.
BYLAW PLAN 54345
F.R.H.C.
6
25.285 Ha.
74529
"C" 19680
22.
NATIONAL
CANADIAN R/W PLAN 51927
SEC. 23.
27.297 Ha.
SEC. 24
2.597 Ha.
7
H.M.Q.
8
PLAN
9
PLAN 74529
H.M.Q.
F.R.H.C.
TO
14.080 Ha.
ROAD
DYKE
PLAN "E" 19680
ACCORDING
BYLAW PLAN 54343
30.395 Ha.
SEC. 26
H.M.Q.
1
74529
ROAD
PLAN "A" 19680
SHORELINE
FRASER

FRASER PORT

Fraser River Harbour Commission
500 - 713 Columbia Street
New Westminster, B.C. V3M 1B2
Tel: (604) 524-6655
Fax: (604) 524-1127

PK 8276

FACSIMILE TRANSMISSION COVER SHEET

THIS MESSAGE IS INTENDED ONLY FOR THE USE OF THE INDIVIDUAL OR ENTITY TO WHICH IT IS ADDRESSED AND MAY CONTAIN INFORMATION THAT IS PRIVILEGED, CONFIDENTIAL AND EXEMPT FROM DISCLOSURE. IF YOU ARE NOT THE INTENDED RECIPIENT OR THE EMPLOYEE RESPONSIBLE FOR DELIVERING THE MESSAGE TO THE INTENDED RECIPIENT, YOU ARE NOTIFIED THAT ANY DISSEMINATION, DISTRIBUTION OR COPYING OF THIS COMMUNICATION IS STRICTLY PROHIBITED. IF YOU HAVE RECEIVED THIS COMMUNICATION IN ERROR, PLEASE NOTIFY US IMMEDIATELY BY TELEPHONE (COLLECT IF REQUIRED), AND RETURN THE ORIGINAL MESSAGE TO US BY MAIL OR ALTERNATIVELY, IMMEDIATELY DESTROY THIS MESSAGE.

DATE: June 22/95

TO: Dennis Barlow

FAX NO.: 584-9751

FROM: Dean Chalcraft

MESSAGE: Record of last year to date of Trisodium phosphate dispensing at F/R Leachate Lagoons. Also some recent responses from Golder to enquiries from FRHC staff

PAGES TO FOLLOW:

DISPENSING OF PHOSPHATE IN LAGOONS AT FRASER RICHMOND LEACHATE TREATMENT SYSTEM

JUNE 94	134 KG
JULY 94	147 KG
AUGUST 94	161 KG
SEPT 94	130 KG.
OCT 94	125 KG
NOV 94	123 KG.
DEC 94	115 KG
JAN 95	120 K.G.
FEB 95	98 KG
MAR 95	129 KG
APRIL 95	115 KG.
MAY 95	130 KG.
JUNE 95	134 KG.

TOTAL FOR 12 MONTH PERIOD 1701 KG OF SUPER TRIBLE PHOSPHATE DISPENSED

Golder Associates Ltd.

800 - 4260 Still Creek Drive
Burnaby, British Columbia, Canada V5C 6C6
Telephone (604) 298-6623
Fax (604) 298-5253

Golder Associates

E/95/0383
952-1811

June 5, 1995

Fraser River Harbour Commission
500 - 713 Columbia Street
New Westminster, B.C.
V3M 1B2

Attention: Ms. Pat Weber, Environmental Administrator

RE: FRASER/RICHMOND PUMP AND PHOSPHATE PROJECTS

Dear Ms. Weber:

Further to requests from Ms. Pat Weber and Mr. Dean Chalcraft of the Fraser River Harbour Commission (FRHC), Golder Associates Ltd. (Golder) has conducted a preliminary assessment of two concerns at the Fraser/Richmond landfill site: the source of the erosive material in the pump; and the required phosphate addition rates. Our findings and recommendations follow on these two topics.

1.0 SOLIDS ACCUMULATION IN FINAL PUMP

1.1 Assessment of Solids

In the past year, the FRHC has replaced the stainless steel shaft of the final pump at the south end of the perimeter ditch which pumps effluent to Sand Bed No. 2. During the recent replacement, a small amount of semi-solid material was recovered from a neoprene lip seal on the pump. Based on the appearance of the wear on the pump, FRHC personnel concluded that the semi-solid material was responsible for erosion of the pump shaft, and consequently obtained a sample for analysis. The sample was submitted by Golder to ASL Laboratories Ltd. for analysis of anions, cations, and total organic carbon. Only limited analyses could be conducted on the sample due to the small mass available (approximately 15 grams).

The results of the analyses, presented in Table 1, indicate that the material is likely primarily an iron carbonate/iron hydroxide precipitate. There are a variety of other elements that are present in the precipitate, many of which may have co-precipitated with

the iron. Iron, in the forms suspected in the effluent, precipitates in an oxidising environment at pHs that are near neutral and greater.

Having reviewed the analyses of the solids from the pump, a water sampling program was initiated to assess water quality at various locations along the treatment system. The sampling program was conducted on April 7, 1995. Field parameters measured included pH, electrical conductivity and temperature readings from a number of locations along the ditch prior to the effluent entering the pump. Water samples were obtained from four locations for anion and cation analyses. At the time of the sampling, water levels in the ditch were lower than previously observed at the site and were also notably more turbid (including visible suspended solids) than previously observed.

Water sampling of the influent to the pump and the water along the ditch indicated that there are relatively high concentrations of iron and calcium in the water which may be present in precipitates formed. The analyses indicated that the concentration of iron in the precipitate was about 10 times the concentration of calcium. The reverse was true in the water wherein the concentration of calcium was about 10 times that of iron. The pH data in the water supports an explanation of iron hydroxides and carbonates forming in both the ditch and the pump. However, the data from our grab sample chemical analyses is insufficient to conclusively determine the mechanism of formation and the effect may be transient - occurring more frequently under certain conditions.

1.1.1 Compost Discharge Impact Potential

FRHC personnel expressed concern that effluent run-off from the woodwaste composting operation located on part of the landfill site may be contributing to the solids problem. Solids build-up is reported to have been observed in the past, prior to commencement of the compost operation. In addition, organic acids typically provide a reducing environment that would increase the solubility of iron. Therefore, we conclude that woodwaste effluent is probably not contributing to the solids problem.

1.2 Possible Resolutions

Golder has identified four general methods that may be used to prevent the build up of solids in the pump, based on the presumption of an iron precipitate.

1. Decrease the pH or Eh of the effluent to increase the solubility of the iron.

By adding an acid or a reducing agent to the water, iron could be kept in solution; however, the pH of the effluent is near the ideal pH for biological activity and decreasing the pH may inhibit biological activity in Sand Bed No. 2. Furthermore, with the flow rate of the effluent, the cost of installation and operation of a suitable chemical addition

facility would almost certainly be prohibitive, especially when compared to the following two options.

2. ***Install solids removal facilities.***

To decrease the amount of solids reaching the pump, solids removal facilities such as a settlement basin could be added to the area around the final pump. A settlement basin would increase the amount of precipitate that could settle prior to entering the pump. The required settling time would need to be evaluated by a bench-scale test. As an example, if a one-hour settling time was required for an estimated flow of 5000 m^3/d, a settling basin would need to be at least 200 m^3 in volume. The pump intake should be installed near the surface of the water to limit the mass of solids entrained by pumping near the bottom of the basin. These measures would reduce, but not eliminate, the flow of solids to the pump.

3. ***Change the type of pump used for pumping the effluent to Sand Bed No.2.***

The pump presently used is likely not designed to handle water with a significant solids content. A pump that is designed for handling higher solids loads would be less likely to have erosion problems. This would require replacement of the pump. When solids are pumped to Sand Bed No. 2, the frequency of plugging of the sprinklers in the spray irrigation area and the relative cost of unplugging would need to be evaluated.

4. ***Review landfill leachate treatment options for discontinued use of Sand Bed No. 2 and, therefore, discontinued use of the final pump.***

The simplest solution to prevention of the problem is to stop using the pump. If it can be demonstrated that the existing treatment system, upstream of Sand Bed No. 2 is achieving sufficient treatment or that additional treatment facilities can be installed on the east side of the ditch, then Sand Bed No. 2 could be removed from service. The final pump would be replaced with a ditch and a weir on the east side of the canal. This option would obviously require additional assessment of the leachate treatment system to ensure that the treatment system upstream of Sand Bed No. 2 is capable of handling expected high concentration and high flow conditions. However, the advantages of pursuing this option have significant long-term cost savings potential.

The concern that phosphorus is a limiting nutrient in the aerated lagoons leads to the conclusion that better treatment may be possible upstream of Sand Bed No. 2. This supports the possibility that upstream changes may have a more significant impact on remedying the pump problems than efforts around the pump itself. In addition, there may be other upstream changes which can be made to limit the need for the second sand bed. For example, an assessment of methods to reduce the overall flow that is treated in the system may result in significant operational savings.

1.3 Summary

Unless iron is found to originate from a predominant source that can be removed from impacting the system, iron is likely to continue to be present in the effluent stream reaching the final pump. The precipitation of iron can only be avoided by costly chemical addition and Golder is of the opinion that prevention of iron precipitates will not be practical. Therefore, the options available to the FRHC relate to prevention of the effects on the pump or acceptance of the cost of maintenance of the pump. The most cost-effective short term measure would likely be excavation of a settling pond adjacent to the intake for the final pump, following an assessment of the settling rate of the suspended solids to determine an appropriate settling pond size.

In the long term, investigation of options to remove the final pump and Sand Bed No. 2 from service may provide the most significant cost savings. We recommend that, in conjunction with the phosphate addition suggested below, the FRHC review optimisation of other aspects of the treatment system to limit the overall cost of operation.

2.0 PHOSPHATE ADDITION RATE

2.1 Background

The leachate treatment system at the Fraser/Richmond landfill biologically treats a leachate that contains high levels of ammonia but very low levels of phosphorus. Phosphorus is an essential nutrient for biological growth and the lack of phosphorus in the treatment system may be a biologically limiting factor that limits the growth of biota in the treatment system. If biological growth is limited, it prevents the consumption of the ammonia from the leachate. The lack of sufficient phosphorus, therefore, may diminish the effectiveness of the treatment system. The intention of nutrient addition is to achieve optimal biological growth without the addition of excess.

Previous work by British Columbia Research Inc. (BCRI) had indicated that phosphate addition to the leachate treatment system was required. In the past, B.C. Research had suggested an addition rate of 7 kg/d of trisodium phosphate, which is equivalent to about 0.2 mg P/L effluent. The FRHC has since added trisodium phosphate at this rate. In a letter to the FRHC dated September 27, 1994, BCRI recommended an addition rate of 2 mg P/L effluent, ten times the previous amount. Due to the drastic increase recommended, the FRHC has not added phosphorus at this level. Golder was requested to assess the previously recommended addition rates and provide a further recommendation to the FRHC.

2.2 Measured Phosphorus Levels

The first quarterly sample of the effluent for complete water chemistry, conducted in April 1995 revealed that the phosphorus levels in the effluent were very low (about 4 µg/L). At this level the biological system is likely phosphorus limited, indicating that the present phosphorus addition rates are too low. Golder has reviewed the historical phosphorus levels in the effluent and the low phosphorus levels found in April 1995 are consistent with previous results.

2.3 Recommended Phosphorus Addition Strategy

It is evident from the phosphorus analyses on the effluent that the present system is likely phosphorus limited and additional phosphorus is required. The influent samples obtained by BCRI and reported in their letter of September 27, 1994 had a BOD/N/P ratio of about 1/2/0.001. Although there are "rules of thumb" for the addition of phosphorus to biological systems (for example, the basis of BCRIs addition rate would have been a BOD/N/P ratio of about 1/2/0.2), the cost effective method of determining the appropriate phosphorus addition rate is to gradually increase the rate and measure the difference between the influent and the effluent of the treatment system. When the phosphorus consumption stabilises, it is indicative of a balanced biological system.

Golder has reviewed the 2 mg P/L addition rate suggested by BCRI and consider that it is likely the highest addition rate that would have benefit. However, the cost of adding this much phosphorus to the system, ten times the present addition rate, likely outweighs the benefit in treatment, considering that the discharge presently meets permit levels. Therefore, for the first step in the evaluation, we would recommend that FRHC triple the present trisodium phosphate addition rate to approximately 20 kg/day, equivalent to about 0.6 mg P/L. After one month at this addition rate, Golder will obtain samples of the influent and effluent to compare the phosphorus levels.

If an excess of phosphorus is apparent, then the addition rate can be reduced. If phosphorus levels still appear to be biologically limiting then we would recommend that a cost-benefit analysis be conducted to correlate increase phosphorus addition cost with improvements in the lagoon treatment system. The increased addition of phosphorus should improve the operation of the front end of the leachate treatment system. Achieving better treatment in the front end may reduce the need for the final sand bed.

CLOSURE

If there are any questions or comments, or we can be of assistance in any way, please do not hesitate to contact either Don Livingstone or Brian Conlin at our Burnaby office.

Yours very truly,

GOLDER ASSOCIATES LTD.

D.R. Livingstone, P. Eng.
Project Manager

B.H. Conlin, P.Eng.
Principal - Environmental Division

DRL/BHC/tb
952-1811
Enclosures

J:\LET-95\JUN\DRL-1811.DOC

BCRI

January 20, 1995
File No: 2-51790

Mr. Dennis Barlow
Ministry of Environment
Waste Management Branch
15326 - 103A Avenue
Surrey, B.C.V3R 7A2

RECEIVED
JAN 25 1995
REGION
FILE NO. PE-06276

PE-06276

Dear Mr. Barlow:

Subject: Permit No. PE-6276

The attached tables contain the analytical and bioassay results for the fourth quarterly monitoring of the final discharge at the Fraser Port Richmond landfill site and the biannual monitoring of the surrounding surface and groundwater sites.

The flow and precipitation records for the months November and December are enclosed. During October it was necessary to reconstruct the stilling well and dock before the water level recorder could be remounted. The water level recorder was operational on November 4th. Since the monthly precipitation was 113.0mm and there was no dredging on site it is unlikely that the flow levels were out of compliance during this period.

The field measurements for the final discharge are as follows:

Date	Temperature (°C)	Dissolved Oxygen (mg/L)
October 19, 1994	12.0	4.7
November 29, 1994	5.5	10.2
December 13, 1994	3.0	8.0

If you have any questions or comments please call me at 224-4331.

Sincerely,

BCRI

Janet Pickard
Biologist
Environmental Sciences and Engineering

enclosure:

cc: Mr. R. Pearce
Mr. G. Hughes
Mr. Bill Tou

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
Canada
Tel: (604) 224-4331
Fax: (604) 224-0540
USA
Tel: (206)738-0958
Fax: (206) 733-3590

BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

July 27, 2001.

RECEIVED
AUG - 1 2001
LOWER MAINLAND REGION
FILE NO. PE-06276 Data

Ms. P. Weber
Manager, Environmental Services
Fraser River Port Authority
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Second Quarter 2001 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the second quarter, 2001.

All parameters meet permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day. On or around June 1, 2001 the flow recorder was vandalized. It was repaired and returned to service on June 7, 2001. Flows calculated for these days are based on levels observed manually and reported as less than the observed maximum.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	June 21, 2001
Temperature (^{O}C)	20.0
Dissolved Oxygen (mg/L)	5.9
5 day BOD (mg/L)	<10
NFR (mg/L)	3
Ammonia (mgN/L)	<1
Nitrite (mgN/L)	0.021
Nitrate (mgN/L)	0.116
T D Phosphorous (mg/L)	0.010
Sulphate (mg/L)	4
COD (mg/L)	33
Acidity,pH 8.3 (mg/L)	25
pH	7.66
Total Aluminum (mg/L)	<0.02
Total Copper (mg/L)	0.002
Total Iron (mg/L)	1.04
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.466
Total Zinc (mg/L)	<0.005
Total Cadmium (mg/L)	<0.0002
Total Mercury (mg/L)	<0.00005

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	June 21, 2001
Fatty Acids (mg/l)	
C12:0 Lauric	0.021
C14:0 Myristic	0.021
C16:0 Palmitic	0.057
C18:0 Stearic	0.034
C18:1/C18.3 Oleic/Linolenic	0.092
C18:2 Linoleic	0.131
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	April 9 2001	May 16, 2001	June 21, 2001
LC50 (%)	>100	>100	>100
Temperature (°C)	10.0	16.5	20.0
Dissolved Oxygen (mg/L)	10.4	11.0	5.9

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E100784 (Final Discharge), 2001.

Date	April	May	June
1	5450	2050	<3000
2	5050	1950	<2500
3	5450	1650	<2500
4	5800	3150	<750
5	4900	3800	<750
6	3450	2600	<750
7	3450	2050	1600
8	3200	1500	950
9	3200	1350	1150
10	3350	1250	1700
11	3200	1250	1350
12	3950	1250	400
13	3450	2050	250
14	3550	2150	750
15	3450	2350	950
16	3800	2450	1100
17	2600	2600	750
18	2200	2750	750
19	1850	2700	400
20	1700	2700	250
21	1750	2700	<100
22	1550	2850	250
23	2350	1950	750
24	3050	1650	950
25	3150	1350	1150
26	3300	1150	1050
27	3350	1150	950
28	3150	900	400
29	3450	850	1150
30	3200	3100	950
31	-	3050	-

flow recorder vandalized.

Table 5:
Analytical Results, Permit PE-6276, Surface Sites, June 21, 2001.

Parameter	E105877	E105876	E105878	E105880
Temperature (°C)	20.5	17.0	20.5	18.0
Dissolved Oxygen (mg/L)	2.3	2.9	7.4	4.3
Ammonia (mgN/L)	1.4	<1	7.1	<1
Nitrite (mgN/L)	0.066	0.168	0.385	0.022
Nitrate (mgN/L)	0.200	0.063	1.15	<0.02
T D Phosphorous (mg/L)	0.310	0.322	0.038	0.536
Sulphate (mg/L)	14	11	9.0	6.4
COD (mg/L)	55	73	73	55
Acidity,pH 8.3 (mg/L)	21	30	16	13
pH	7.41	7.17	7.65	7.57
Total Aluminum (mg/L)	0.26	0.27	0.10	0.25
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	10.7	11.7	3.19	7.84
Total Lead (mg/L)	0.001	<0.001	0.002	0.001
Total Manganese (mg/L)	0.400	0.371	0.216	0.475
Total Zinc (mg/L)	0.041	0.029	0.030	0.015

Table 6:
Analytical Results, Permit PE-6276, Groundwater Sites, June 21, 2001.

Parameter	E206252	E206253	E206254	E206255	N. Per Well
Ammonia (mgN/L)	1.1	2.8	14.4	<1	7.0
Nitrite (mgN/L)	0.046	0.062	0.002	0.002	0.410
Nitrate (mgN/L)	0.154	0.203	<0.02	0.207	<0.02
T D Phosphorous (mg/L)	0.224	0.316	<0.01	<0.01	0.036
Sulphate (mg/L)	11	14	2.2	172	9.2
COD (mg/L)	46	75	132	22	73
Acidity, pH 8.3 (mg/L)	16	21	303	29	18
pH	7.49	7.45	6.68	7.51	7.66
Total Aluminum (mg/L)	0.07	0.10	0.04	<0.02	0.04
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	4.82	6.90	23.5	0.21	1.89
Total Lead (mg/L)	0.001	0.002	0.002	0.002	0.001
Total Manganese (mg/L)	0.226	0.327	5.15	0.037	0.201
Total Zinc (mg/L)	0.022	0.032	0.128	0.008	0.015

Fraser River Port Authority
E100784

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
ph. (604) 224-4331
fax (604) 224-0540
web http://bcresearch.com

BCRI Sample#: 20011465 — Report #: 2-11-200-790-01-004

Sample Taken	Apr. 9, 2001 4:00 PM	Sample pH	7.9
Sample Received	Apr. 10, 2001	Sample Dissolved Oxygen	9.7 mg/L
Date Started	Apr. 10, 2001	Sample Temperature	9.3 °C
Time Started	12:05 PM	Sample Conductance	1161 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr
0	45	15.4	14.6	7.4	7.4	9.9	9.5	0	0	0	0
100	1166	14.4	14.4	7.9	8.6	9.8	9.6	0	18.2	27.3	27.3

Comments
No chlorine was detected using O-tolidine. There were 11 fish in the 100% and 10 fish in the control. At test termination, 1 fish was lethagic, had loss of equilibrium and darkened pigmentation. All other fish appeared and behaved normally during the test.

Test Conditions

Organisms per Replicate	11	Test Volume (L):	10
Rate of aeration	6.5 ml/min/L	Preaeration Time (minutes)	30

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (g)	0.37 ± 0.11	Length (cm):	3.6 ± 0.3

Reference Toxicant: Phenol
Test was conducted on: 03/27/2001
Test gave a 96-h LC50 of 9.44 (8.15, 10.72) mg/L

Dilution Water: Vancouver Tapwater hardened and dechlorinated

EDTA Hardness	20 mg $CaCO_3$/L	Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, July 1990 and May 1996 amendments.

Analyst — Verified By

Fraser River Port Authority

E100784

Rainbow Trout Bioassay

96-h LC50 %v/v: >100%

BC Research Inc.

3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
ph. (604) 224-4331
fax (604) 224-0540
web http://bcresearch.com

BCRI Sample#: 20012169 — Report #: 2-11-200-790-01-005

Sample Taken	May 16, 2001	Sample pH	7.8
Sample Received	May 17, 2001	Sample Dissolved Oxygen	9.7 mg/L
Date Started	May 17, 2001	Sample Temperature	13.5 °C
Time Started	2:25 PM	Sample Conductance	1016 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr
0	44	15.0	14.6	7.4	7.3	9.9	9.5	0	0	0	0
100	1016	14.6	14.5	7.8	8.4	9.7	9.5	0	0	0	0

Comments

All fish appeared and behaved normally during the test.

Test Conditions

Organisms per Replicate	10	Test Volume (L):	12
Rate of aeration	6.5 ml/min/L	Preaeration Time (minutes)	30

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (g)	0.42 ± 0.09	Length (cm):	3.8 ± 0.2

Reference Toxicant: Phenol

Test was conducted on: 05/06/2001

Test gave a 96-h LC50 of 11.4 (10.37, 12.53) mg/L

Dilution Water: Vancouver Tapwater hardened and dechlorinated

EDTA Hardness 18.5 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, July 1990 and May 1996 amendments.

Analyst **Verified By**

Fraser River Port Authority

E100784

Rainbow Trout Bioassay

96-h LC50 %v/v: >100%

BC Research Inc.

3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
ph. (604) 224-4331
fax (604) 224-0540
web http://bcresearch.com

BCRI Sample#: 20013201 Report #: 2-11-200-790-01-006

Sample Taken	Jun. 21, 2001 11:30 AM	Sample pH	7.7
Sample Received	Jun. 21, 2001	Sample Dissolved Oxygen	6.0 mg/L
Date Started	Jun. 21, 2001	Sample Temperature	21.8 °C
Time Started	3:40 PM	Sample Conductance	1060 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr
0	47	15.0	15.4	7.5	7.3	10.0	8.4	0	0	0	0
100	1044	14.9	15.4	7.8	8.3	7.5	9.1	0	0	0	0

Comments

All fish appeared and behaved normally during the test.

Test Conditions

Organisms per Replicate	10	Test Volume (L):	18
Rate of aeration	6.5 ml/min/L	Preaeration Time (minutes)	80

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (g)	1 ± 0.22	Length (cm):	4.6 ± 0.3

Reference Toxicant: Phenol

Test was conducted on: 05/30/2001

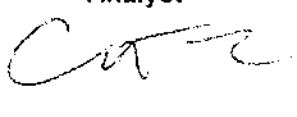
Test gave a 96-h LC50 of 10.51 (9.06, 11.82) mg/L

Dilution Water: Vancouver Tapwater hardened and dechlorinated

EDTA Hardness 19 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, July 1990 and May 1996 amendments.

Analyst **Verified By**



BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

RECEIVED
APR - 9 2001
LOWER MAINLAND REGION
FILE NO. PE-06276

April 6, 2001

Ms. P. Weber
Environmental Administrator
Fraser River Port Authority
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, First Quarter 2001 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRPA Richmond Landfill site in the first quarter, 2001. All results meet the permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Technical Services Representative

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	March 8, 2001
Temperature (°C)	7.5
Dissolved Oxygen (mg/L)	5.8
5 day BOD (mg/L)	<10
NFR (mg/L)	3.0
Ammonia (mgN/L)	2.5
Nitrate (mgN/L)	3.35
Nitrite (mgN/L)	0.066
T D Phosphorous (mg/L)	0.014
Sulphate (mg/L)	10
COD (mg/L)	39
Acidity,pH 8.3 (mg/L)	5
pH	8.15
Total Aluminum (mg/L)	0.006
Total Cadmium	<0.0002
Total Copper (mg/L)	0.008
Total Iron (mg/L)	0.76
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.265
Total Zinc (mg/L)	<0.005

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	March 8, 2001
Fatty Acids (mg/l)	
C12:0 Lauric	<0.005
C14:0 Myristic	0.015
C16:0 Palmitic	0.055
C18:0 Stearic	0.021
C18:1 Oleic	0.021
C18:3 Linolenic	0.021
C18:2 Linoleic	0.025
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	<0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	January 16, 2001	February 15, 2001	March 8, 2001
LC50 (%)	>100	>100	>100
Temperature (°C)	4.5	4.5	7.5
Dissolved Oxygen (mg/L)	5.2	7.4	5.8

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E1007844 (Final Discharge)

Date	January 2001	February 2001	March 2001
1	3050	5150	5250
2	2650	5250	4100
3	1950	5400	3200
4	1950	5250	3200
5	3800	4450	3250
6	5900	4400	3200
7	6550	3800	3800
8	6450	3650	4450
9	5450	3650	4400
10	5050	3650	3800
11	5050	4750	3150
12	5050	3850	2950
13	5050	3200	2450
14	4050	3200	2200
15	3450	3200	2700
16	3450	3050	2950
17	3750	3100	3150
18	3800	3100	5800
19	3750	4250	3800
20	5050	3800	3750
21	5400	3550	3650
22	5450	3050	3600
23	5650	3050	3750
24	5850	3050	3700
25	5850	3000	1250
26	5650	3050	1850
27	5150	4700	3150
28	5150	5100	3350
29	5150	-	3600
30	5150	-	3150
31	5150	-	4600

Fraser River Port Authority
E100784

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
ph. (604) 224-4331
fax (604) 224-0540
web http://bcresearch.com

BCRI Sample#: 20010267 Report #: 2-11-200-790-01-001

Sample Taken	Jan. 16, 2001	Sample pH	7.6
Sample Received	Jan. 17, 2001	Sample Dissolved Oxygen	5.2 mg/L
Date Started	Jan. 17, 2001	Sample Temperature	8.2 °C
Time Started	2:03 PM	Sample Conductance	1102 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr
0	44	14.7	14.9	7.4	7.4	10.0	9.5	0	0	0	0
100	1122	14.9	14.7	8.0	8.5	6.7	9.7	0	0	0	0

Comments
All fish appeared and behaved normally during the test.

Test Conditions

Organisms per Replicate	10	Test Volume (L):	12
Rate of aeration	6.5 ml/min/L	Preaeration Time (minutes)	30

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (g)	0.49 ± 0.11	Length (cm):	3.7 ± 0.2

Reference Toxicant: Phenol
Test was conducted on: 01/02/2001
Test gave a 96-h LC50 of 10.35 (8.89, 12.11) mg/L

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness 17.5 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, July 1990 and May 1996 amendments.

Analyst **Verified By**

Janet Pickard

Fraser River Port Authority

E100784

Rainbow Trout Bioassay

96-h LC50 %v/v: >100%

BC Research Inc.

3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
ph. (604) 224-4331
fax (604) 224-0540
web http://bcresearch.com

BCRI Sample#: 20010666			Report #: 2-11-200-790-01-002
Sample Taken	Feb. 15, 2001 5:00 PM	Sample pH	7.7
Sample Received	Feb. 16, 2001	Sample Dissolved Oxygen	8.3 mg/L
Date Started	Feb. 16, 2001	Sample Temperature	4.1 °C
Time Started	10:25 AM	Sample Conductance	1135 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr
0	46	15.0	15.5	7.6	7.4	10.1	9.4	0	0	0	0
100	1142	14.6	15.8	7.7	8.4	8.3	9.3	0	0	0	0

Comments

All fish appeared and behaved normally during the test.

Test Conditions

Organisms per Replicate	10	Test Volume (L):	15
Rate of aeration	6.5 ml/min/L	Preaeration Time (minutes)	30

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (g)	0.77 ± 0.16	Length (cm):	4.4 ± 0.3

Reference Toxicant: Phenol

Test was conducted on: 02/05/2001

Test gave a 96-h LC50 of 10.97 (9.03, 13.76) mg/L

Dilution Water: Vancouver Tapwater hardened and dechlorinated

EDTA Hardness	16 mg $CaCO_3$/L	Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, July 1990 and May 1996 amendments.

Analyst	Verified By
Karen Kinnee	Janet Pickard

Fraser River Port Authority
E100784

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

BC Research Inc.
3650 Wesbrook Mall
Vancouver, BC
Canada V6S 2L2
ph. (604) 224-4331
fax (604) 224-0540
web http://bcresearch.com

BCRI Sample#: 20010972 Report #: 2-11-200-790-01-003

Sample Taken	Mar. 8, 2001 1:00 PM	Sample pH	7.6
Sample Received	Mar. 9, 2001	Sample Dissolved Oxygen	5.6 mg/L
Date Started	Mar. 9, 2001	Sample Temperature	8.2 °C
Time Started	11:25 AM	Sample Conductance	1118 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr
0	47	15.7	14.4	7.4	7.4	10.0	9.8	0	0	0	0
100	1124	14.1	14.5	7.9	8.5	8.2	9.7	0	0	0	0

Comments
All fish appeared and behaved normally during the test.

Test Conditions

Organisms per Replicate	10	Test Volume (L):	20
Rate of aeration	6.5 ml/min/L	Preaeration Time (minutes)	60

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (g)	0.82 ± 0.16	Length (cm):	4.3 ± 0.3

Reference Toxicant: Phenol
Test was conducted on: 03/02/2001
Test gave a 96-h LC50 of 10.8 (9.42, 12.11) mg/L

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness 15.5 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, July 1990 and May 1996 amendments.

Analyst **Verified By**

BC RESEARCH Inc.

BC Research Inc., BC Research and Innovation Complex, 3650 Wesbrook Mall, Vancouver, BC, Canada V6S 2L2
Telephone: (604) 224-4331 • Facsimile: (604) 224-0540 • Email: bcri@bcr.bc.ca • Website: http://www.bcr.bc.ca

January 26, 2001.

RECEIVED
JAN 30 2001
LOWER MAINLAND REGION
FILE NO. PE-06276

Ms. P. Weber
Environmental Administrator
Fraser River Port Authority
500-713 Columbia Street
New Westminster, B.C. V3M 1B2

Dear Ms. Weber:

Subject: Permit PE-6276, Fourth Quarter 2000 Monitoring Results.

The attached tables contain analytical and flow results and bioassay reports for samples taken at the FRHC Richmond Landfill site in the fourth quarter, 2000.

All parameters meet permit requirements.

Effluent discharge rates were calculated using Francis's formula. At no time during the quarter did the discharge exceed 10,000m^3/day.

Sincerely,

BCRI

L. J. Hunt
Senior Technician

LJH/ljh

cc Mr. D. Barlow

Table 1:
Analytical Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	December 13, 2000
Temperature (^{O}C)	3.0
Dissolved Oxygen (mg/L)	5.8
5 day BOD (mg/L)	<10
NFR (mg/L)	3.0
Ammonia (mgN/L)	1.30
Nitrite (mgN/L)	0.033
Nitrate (mgN/L)	2.49
T D Phosphorous (mg/L)	<0.010
Sulphate (mg/L)	10
COD (mg/L)	26
Acidity,pH 8.3 (mg/L)	9
pH	8.07
Total Aluminum (mg/L)	<0.010
Total Copper (mg/L)	<0.010
Total Iron (mg/L)	0.81
Total Lead (mg/L)	<0.001
Total Manganese (mg/L)	0.36
Total Zinc (mg/L)	<0.005

Table 2:
Resin and Fatty Acid Results, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	December 13, 2000
Fatty Acids (mg/l)	
C12:0 Lauric	0.007
C14:0 Myristic	0.006
C16:0 Palmitic	0.017
C18:0 Stearic	0.008
C18:1 Oleic	0.010
C18:3 Linolenic	0.009
C18:2 Linoleic	<0.005
C20:0 Arachidic	<0.005
C22:0 Behenic	<0.005
9,10 Epoxystearic	<0.005
9,10 Dichlorostearic	<0.005
Resin Acids (mg/L)	
Pimaric	<0.005
Sandaracopimaric	<0.005
Isopimaric	<0.005
Levopimaric/Palustric	<0.005
Dehydroabietic	0.005
Abietic	<0.005
Neoabietic	<0.005
Chlorohydroabietic	<0.005
Dichlorohydroabietic	<0.005

Table 3:
Field Data, Bioassay Sample, Permit PE-6276, Site E100784 (Final Discharge)

Parameter	October 23, 2000	November 16, 2000	December 13, 2000
LC50 (%)	>100	>100	>100
Temperature (°C)	12.5	7.0	3.0
Dissolved Oxygen (mg/L)	8.2	5.5	5.8

Table 4:
Flow Data (m^3/day), Permit PE-6276, Site E100784 (Final Discharge), 2000.

Date	October	November	December
1	750	2500	4500
2	1150	2550	4350
3	250	2750	3400
4	5500	2850	3350
5	750	2850	3350
6	400	2050	3350
7	550	1500	3350
8	1050	1650	3150
9	1150	1850	2300
10	750	1600	2550
11	700	950	2650
12	400	1800	2750
13	950	1600	2600
14	1150	1150	1800
15	950	400	1750
16	800	750	2550
17	200	1800	3150
18	350	2150	3450
19	150	1650	4050
20	525	450	4950
21	750	850	4950
22	250	1350	5100
23	200	2150	5100
24	1350	2650	5800
25	1600	1800	5150
26	1600	1650	5050
27	3150	3150	5250
28	2050	4050	4750
29	1650	3950	4750
30	1650	4100	3800
31	1800	-	3300

Table 5:
Analytical Results, Permit PE-6276, Surface Sites, December 13, 2000.

Parameter	E105877	E105876	E105878	E105880
Temperature (°C)	3.0	3.0	1.5	3.0
Dissolved Oxygen (mg/L)	10.1	7.1	8.9	7.2
Ammonia (mgN/L)	1.5	<1	3.2	<1
Nitrite (mgN/L)	0.036	0.029	0.035	0.021
Nitrate (mgN/L)	0.142	0.158	0.091	0.109
T D Phosphorous (mg/L)	0.114	0.092	0.126	0.140
Sulphate (mg/L)	26	20	32	79
COD (mg/L)	67	49	204	41
Acidity,pH 8.3 (mg/L)	22	32	30	15
pH	7.24	7.06	7.44	7.25
Total Aluminum (mg/L)	0.49	0.65	0.64	0.75
Total Copper (mg/L)	0.019	<0.010	<0.010	0.010
Total Iron (mg/L)	16	20	12	12
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.72	0.63	0.74	0.74
Total Zinc (mg/L)	0.050	0.031	0.070	0.012

Table 6:
Analytical Results, Permit PE-6276, Groundwater Sites, December 13, 2000.

Parameter	E206252	E206253	E206254	E206255	N. Per. Well
Ammonia (mgN/L)	<0.5	<0.5	<0.5	4.5	10.3
Nitrite (mgN/L)	0.005	0.035	0.008	0.008	0.015
Nitrate (mgN/L)	0.049	0.073	<0.020	<0.020	<0.020
T D Phosphorous (mg/L)	0.836	0.207	0.198	0.374	0.187
Sulphate (mg/L)	4.3	2.7	12	32	2.8
COD (mg/L)	74	143	68	88	108
Acidity, pH 8.3 (mg/L)	57	48	43	51	111
PH	7.1	6.7	7.1	7.3	6.7
Total Aluminum (mg/L)	0.13	0.33	0.05	0.06	0.25
Total Copper (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Total Iron (mg/L)	1.2	7.8	30	0.39	10
Total Lead (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001
Total Manganese (mg/L)	0.10	0.20	5.5	2.3	2.6
Total Zinc (mg/L)	0.008	0.016	0.012	0.005	0.050

Table 6:
Analytical Results, Permit PE-6276, Groundwater Sites, December 13, 2000.

Parameter	E206252	E206253	E206254	E206255	N. Per Well
Ammonia (mgN/L)	<1	<1	13.5	<1	13.3
Nitrite (mgN/L)	0.010	0.026	0.006	<0.002	0.030
Nitrate (mgN/L)	0.117	0.011	0.031	0.068	<0.010
T D Phosphorous (mg/L)	0.036	0.040	<0.010	0.011	0.037
Sulphate (mg/L)	17	2.3	1.4	95	1.3
COD (mg/L)	776	184	115	59	149
Acidity, pH 8.3 (mg/L)	33	73	140	100	165
PH	7.07	6.48	7.11	7.09	6.63
Total Aluminum (mg/L)	0.06	0.18	0.10	0.04	0.10
Total Copper (mg/L)	<0.05	<0.05	<0.05	<0.05	<0.05
Total Iron (mg/L)	0.45	7.2	22	7.7	7.7
Total Lead (mg/L)	<0.001	0.006	0.004	0.002	0.003
Total Manganese (mg/L)	0.09	0.16	2.8	3.7	3.4
Total Zinc (mg/L)	0.008	0.011	0.013	<0.005	0.008

RECEIVED
FEB 23 2001
LOWER MAINLAND REGION
FILE NO.

Golder Associates Ltd.

#500 - 4260 Still Creek Drive
Burnaby, B.C., Canada V5C 6C6

Fax Access: 604-298-5253

RECEIVED
AUG - 1 1995
LOWER MAINLAND REGION

Golder Associates

Telephone: 604-298-6623

LETTER OF TRANSMITTAL

PE-06276
Data

TO Mr. Dennis Barlow
Environmental Protection
15326 - 103A Avenue
Surrey, B.C.

DATE July 31, 1995
JOB NO: 952-1811
ATTENTION Mr. Dennis Barlow
RE: Surface Water and Groundwater Sampling

_ WE ARE SENDING YOU _X_ Attached __ Under separate cover via ____ the following items:

THESE ARE TRANSMITTED as checked: __ For approval __ For your use __ For review and comment __ As requested

Please find enclosed a table summarizing the groundwater and surface water chemical results and the laboratory report for the same samples. This information should be appended to the 2nd Quarterly report for the Fraser Port Richmond Landfill.

1/

COPY TO _____

SIGNED: Heather Matthews

Fraser Port Richmond Landfill
Groundwater and Surface Water Chemical Results
Sample Date: July 9, 1995

Location		Surface-2	Surface-3	Surface-4	Surface-5	Well A	Well B	Well C	Well D
SCN		493-5	493-4	493-4	493-1	493-7	493-6	493-3	493-2
QAQC Code				LRep					
Field Measurements									
pH		5.75	6.29		6.42	6.06	5.9	5.7	6.01
conductivity (uS)		84	80		634	227	310	113	720
Temperature		18.3	18.3		18.6	15.1	14.5	11.6	11.8
Physical Tests									
Hardness	CaCO3	41	41.4	42.3	390	752	110	37.2	170
pH		7.03	7.03	7.04	6.95	6.36	6.21	6.1	6.56
Dissolved Anions									
Acidity	CaCO3	6.5	4.3	4.3	65.1	73.3	48.4	52.7	81.9
Sulphate	SO4	10.2	10.3	10.7	8.3	6.5	<10	10.8	<10
Nutrients									
Ammonia Nitrogen	N	0.054	0.049	0.051	1.48	1.64	4.31	0.045	0.92
Nitrate Nitrogen	N	0.323	0.34	0.32	0.008	0.099	0.303	<0.005	<0.005
Nitrite Nitrogen	N	0.008	0.011	0.011	0.003	0.025	0.033	0.004	0.007
Total Dissolved Phosphate	P	0.031	0.304	0.289	0.011	0.033	0.053	0.005	0.135
Total Metals									
Aluminum	T-Al	0.35	0.38	0.395	0.11	79	0.07	0.1	0.17
Calcium	T-Ca	12.2	12.3	12.6	89.7	172	26.9	6.37	36.3
Copper	T-Cu	0.002	0.003	0.003	<0.001	0.408	0.047	0.041	0.001
Iron	T-Fe	0.792	0.87	0.87	10.6	113	31.6	12.3	19.5
Lead	T-Pb	<0.001	<0.001	<0.001	<0.001	0.09	0.08	0.009	0.006
Magnesium	T-Mg	2.58	2.6	2.65	40.4	78.4	10.5	5.17	19.3
Manganese	T-Mn	0.026	0.024	0.023	4.85	2.21	0.259	0.17	0.361
Zinc	T-Zn	0.007	0.008	0.008	<0.005	0.66	0.094	<0.005	0.008
Organic Parameters									
Chemical Oxygen Demand	COD	<20	<20	<20	51	2120	846	<20	67

Note:
1) Results expressed as mg/L.
2) < = Less than the detection limit indicated.
3) The ditch at Surface-4 was dry so a sample was not collected.

CHEMICAL ANALYSIS REPORT

Date: July 27, 1995

ASL File No. F1919

Report On: 952-1811 Water Analysis

Report To: **Golder Associates Ltd.**
500 - 4260 Still Creek Drive
Burnaby, BC
V5C 6C6

Attention: **Ms. Heather Matthews**

Received: July 10, 1995

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

Brent A. Makelki, B.Sc.
Project Chemist

Joyce Chow, B.Sc.
Project Chemist

REMARKS File No. F1919

The Bioassay analysis was subcontracted to E.V.S. Consultants of North Vancouver B.C.. The E.V.S. report is attached in the appendix of this document.

RESULTS OF ANALYSIS File No. F1919

			Surf-5 493-1	Well D 493-2	Well C 493-3	Surf-3 493-4	493-4[1] LRep
			95 07 09	95 07 09	95 07 09	95 07 09	95 07 09
Physical Tests							
Hardness	CaCO3		390	170	37.2	41.4	42.3
pH			6.95	6.56	6.10	7.03	7.04
Dissolved Anions							
Acidity	CaCO3		65.1	81.9	52.7	4.3	4.3
Sulphate	SO4		8.3	<10	10.8	10.3	10.7
Nutrients							
Ammonia Nitrogen		N	1.48	0.920	0.045	0.049	0.051
Nitrate Nitrogen		N	0.008	<0.005	<0.005	0.340	0.320
Nitrite Nitrogen		N	0.003	0.007	0.004	0.011	0.011
Total Dissolved Phosphate		P	0.011	0.135	0.005	0.304	0.289
Total Metals							
Aluminum	T-Al		0.110	0.170	0.100	0.380	0.395
Calcium	T-Ca		89.7	36.3	6.37	12.3	12.6
Copper	T-Cu		<0.001	0.001	0.041	0.003	0.003
Iron	T-Fe		10.6	19.5	12.3	0.870	0.870
Lead	T-Pb		<0.001	0.006	0.009	<0.001	<0.001
Magnesium	T-Mg		40.4	19.3	5.17	2.60	2.65
Manganese	T-Mn		4.85	0.361	0.170	0.024	0.023
Zinc	T-Zn		<0.005	0.008	<0.005	0.008	0.008
Organic Parameters							
Chemical Oxygen Demand		COD	51	67	<20	<20	<20

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.
[1]LRep = Laboratory Replicate.

RESULTS OF ANALYSIS File No. F1919

			Surf-2 493-5	Well B 493-6	Well A 493-7	493-10
			95 07 09	95 07 09	95 07 09	95 07 09
Physical Tests						
Hardness	CaCO3		41.0	110	752	-
pH			7.03	6.21	6.36	-
Dissolved Anions						
Acidity	CaCO3		6.5	48.4	73.3	-
Sulphate	SO4		10.2	<10	6.5	-
Nutrients						
Ammonia Nitrogen		N	0.054	4.31	1.64	-
Nitrate Nitrogen		N	0.323	0.303	0.099	-
Nitrite Nitrogen		N	0.008	0.033	0.025	-
Total Dissolved Phosphate		P	0.031	0.053	0.033	-
Total Metals						
Aluminum	T-Al		0.350	0.070	79.0	-
Calcium	T-Ca		12.2	26.9	172	-
Copper	T-Cu		0.002	0.047	0.408	-
Iron	T-Fe		0.792	31.6	113	-
Lead	T-Pb		<0.001	0.080	0.090	-
Magnesium	T-Mg		2.58	10.5	78.4	-
Manganese	T-Mn		0.026	0.259	2.21	-
Zinc	T-Zn		0.007	0.094	0.660	-
Organic Parameters						
Chemical Oxygen Demand		COD	<20	846	2120	-
Bioassays						
96 hour LC-50			-	-	-	> 100 %

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

METHODOLOGY File No. F1919

Samples were analyzed by methods acceptable to the appropriate regulatory agency. Outlines of the methodologies utilized are as follows:

Conventional Parameters in Water

These analyses are carried out in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

Metals in Water

These analyses are carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 18th Edition published by the American Public Health Association, 1992. The procedures involve a variety of instrumental analyses including atomic emission spectrophotometry (ICP) and atomic absorption spectrophotometry (AA) to obtain the required detection limit for each element. Specific details are available on request.

End of Report

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

GROUNDWATER MONITORING (WELLS)

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

PE-6276 Dwa

SAMPLING SITES:

A
B
C
D

	A	B	C	D
Date	12/13/94	12/13/94	12/13/94	12/13/94
pH	6.1	5.6	6.1	6.4
Acidity pH 8.3 (mg CaCO3/L)	94.0	172.0	26.7	131.0
Ammonia (mgN/L)	0.11	2.67	0.04	0.89
Chemical Oxygen Demand (mg/L)	791	349	42	0
Nitrite Nitrogen (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Nitrate Nitrogen (mg/L)	0.083	0.049	0.140	0.007
Dissolved Sulfate (mg/L)	27	< 1	13	< 1
Total Dissolved Phosphorus (mg/L)	< 0.01	0.048	< 0.01	< 0.01
Total Aluminum (mg/L)	0.09	0.27	0.05	0.04
Total Copper (mg/L)	0.0017	0.0023	0.020	< 0.0005
Total Lead (mg/L)	< 0.001	0.003	0.011	0.001
Total Iron (mg/L)	0.62	9.1	2.2	12
Total Manganese (mg/L)	0.051	0.14	0.10	0.59
Total Zinc (mg/L)	0.010	0.026	0.061	0.018

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

GROUNDWATER MONITORING (WELLS)

WASTE MANAGEMENT BRANCH, PERMIT NO: PE-6276

SAMPLING SITES:

A
B
C
D

	A	B	C	D
Date	06/22/94	06/22/94	06/22/94	06/22/94
pH	5.8	5.3	5.4	6.0
Acidity pH 8.3 (mg CaCO3/L)	107.0	412.0	47.0	134.0
Ammonia (mgN/L)	1.33	4.13	0.03	1.26
Chemical Oxygen Demand (mg/L)	58	356	21	71
Nitrite Nitrogen (mg/L)	< 0.050	< 0.050	< 0.050	< 0.050
Nitrate Nitrogen (mg/L)	0.195	< 0.050	< 0.050	0.100
Dissolved Sulfate (mg/L)	5.0	< 1.0	7.0	< 1.0
Total Dissolved Phosphorus (mg/L)	0.550	0.120	0.030	0.260
Total Aluminum (mg/L)	< 0.10	0.38	< 0.10	< 0.10
Total Copper (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Total Lead (mg/L)	0.001	0.054	0.006	0.014
Total Iron (mg/L)	0.35	18.00	0.43	13.00
Total Manganese (mg/L)	0.06	0.22	0.07	0.30
Total Zinc (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

GROUNDWATER MONITORING (WELLS)

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

1	A
2	B
3	C
4	D

	A	B	C	D
Date	12/16/93	12/16/93	12/16/93	12/16/93
pH	5.6	5.3	5.8	6.3
Acidity pH 8.3 (mg CaCO3/L)	150	266	10	125
Ammonia (mgN/L)	0.38	4.40	< 0.002	1.45
Chemical Oxygen Demand (mg/L)	1044	749	13	65
Nitrite Nitrogen (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Nitrate Nitrogen (mg/L)	1.15	0.44	0.51	0.65
Dissolved Sulfate (mg/L)	55.0	11.0	14.0	1.0
Total Dissolved Phosphorus (mg/L)	0.112	0.008	< 0.005	0.132
Total Aluminum (mg/L)	6.90	1.10	0.10	< 0.10
Total Copper (mg/L)	< 0.05	< 0.05	< 0.05	< 0.05
Total Lead (mg/L)	0.080	0.100	0.041	0.010
Total Iron (mg/L)	9.6	19.	2.4	34.00
Total Manganese (mg/L)	0.19	0.20	0.05	0.52
Total Zinc (mg/L)	0.04	< 0.02	< 0.02	< 0.02

LEACHATE TREATMENT MONITORING AT RICHMOND LANDFILL
FOR FRASER RIVER HARBOUR COMMISSION (FRHC)

GROUNDWATER MONITORING (WELLS)

WASTE MANAGEMENT BRANCH, PERMIT NO. PE-6276

SAMPLING SITES:

A
B
C
D

	A	B	C	D
Date	05/26/93	05/26/93	05/26/93	05/26/93
pH	5.7	5.2	5.3	6.1
Acidity pH 8.3 (mg CaCO3/L)	126	313	48	116
Ammonia (mgN/L)	1.20	3.90	0.29	0.81
Chemical Oxygen Demand (mg/L)	2445	330	40	70
Nitrite Nitrogen (mg/L)	< 0.002	< 0.002	< 0.002	< 0.002
Nitrate Nitrogen (mg/L)	0.110	< 0.05	< 0.05	< 0.05
Dissolved Sulfate (mg/L)	2	3	6	< 1.0
Total Dissolved Phosphorus (mg/L)	0.040	0.118	0.060	0.165
Total Aluminum (mg/L)	37	1.6	0.48	0.10
Total Copper (mg/L)	0.17	< 0.05	0.15	< 0.05
Total Lead (mg/L)	0.023	0.008	0.049	0.009
Total Iron (mg/L)	55	25	9.2	22
Total Manganese (mg/L)	1.00	0.28	0.22	0.25
Total Zinc (mg/L)	0.21	< 0.04	0.05	< 0.04

PE6276
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: **	10,000	Copper, Dissolved, mg/L:	0.2	Lead, Total, mg/L:	0.05
Susp. Solids, mg/L: **	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: **	30 ✓	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Ammonia - Nitrogen, mg/L: **	10 ✓	Sulphate, Dissolved, mg/L: *	250		

Date (1992)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
92/01/01	691																	IN	
92/01/02	1469																	IN	
92/01/03	950																	IN	
92/01/04	1210																	IN	
92/01/05	1037																	IN	
92/01/06	605																	IN	
92/01/07	518																	IN	
92/01/08	432																	IN	
92/01/09	691																	IN	
92/01/10	1210																	IN	
92/01/11	1123																	IN	
92/01/12	778																	IN	
92/01/13	691																	IN	
92/01/14	518																	IN	
92/01/15	432																	IN	
92/01/16	605																	IN	
92/01/17	605																	IN	
92/01/18	605																	IN	
92/01/19	518																	IN	
92/01/20	778																	IN	
92/01/21	4147																	IN	
92/01/22	6480																	IN	
92/01/23	7776																	IN	
92/01/24	7517																	IN	
92/01/25	4666																	IN	
92/01/26	1728																	IN	
92/01/27	1814																	IN	
92/01/28	2333																	IN	
92/01/29	4320																	IN	
92/01/30	5098																	IN	
92/01/31	5702																	IN	

PE6276
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: ** 10000
Susp. Solids, mg/L: ** 40
BOD5, mg/L: ** 30
Ammonia - Nitrogen, mg/L: ** 10

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3
Sulphate, Dissolved, mg/L: * 250

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1992)	Discharge	Parameter *																	
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
92/02/01	4147																	IN	
92/02/02	3110																	IN	
92/02/03	2074																	IN	
92/02/04	1642																	IN	
92/02/05	1382																	IN	
92/02/06	1037																	IN	
92/02/07	1296																	IN	
92/02/08	1123																	IN	
92/02/09	1123																	IN	
92/02/10	1037																	IN	
92/02/11	1555																	IN	
92/02/12	1901																	IN	
92/02/13	3283																	IN	
92/02/14	2851																	IN	
92/02/15	4234																	IN	
92/02/16	2419																	IN	
92/02/17	2678																	IN	
92/02/18	2074																	IN	
92/02/19	1814																	IN	
92/02/20	1814																	IN	
92/02/21	2074																	IN	
92/02/22	2592																	IN	
92/02/23	1642																	IN	
92/02/24	1469																	IN	
92/02/25	950	15	13	4.4	<0.010	2.27	929	67	0.002	0.3	0.87	30	431	0.021	<0.001	<0.05	0.02	IN	
92/02/26	864																	IN	
92/02/27	950																	IN	
92/02/28	778																	IN	
92/02/29	864																	IN	

PE6276
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: 10000
Susp. Solids, mg/L: ** 40
BOD5, mg/L: ** 30
Ammonia - Nitrogen, mg/L: ** 10

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3
Sulphate, Dissolved, mg/L: * 250

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1992)	Discharge	Parameter *																		
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
92/03/01	950																	IN	
92/03/02	1037																	IN	
92/03/03	3110																	IN	
92/03/04	5184																	IN	
92/03/05	5616																	IN	
92/03/06	6394																	IN	
92/03/07	8208																	IN	
92/03/08	8381																	IN	
92/03/09	8122																	IN	
92/03/10	8122																	IN	
92/03/11	8208																	IN	
92/03/12	7949																	IN	
92/03/13	7258																	IN	
92/03/14	5616																	IN	
92/03/15	5530																	IN	
92/03/16	5443																	IN	
92/03/17	5184																	IN	
92/03/18	5098																	IN	
92/03/19	6566																	IN	
92/03/20	6998																	IN	
92/03/21	6998																	IN	
92/03/22	5357																	IN	
92/03/23	4579																	IN	
92/03/24	4579																	IN	
92/03/25	4061																	IN	
92/03/26	4061																	IN	
92/03/27	5098																	IN	
92/03/28	4752																	IN	
92/03/29	3974																	IN	
92/03/30	3715																	IN	
92/03/31	3888																	IN	

PE6276
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: **	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: **	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: **	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Ammonia - Nitrogen, mg/L: **	10	Sulphate, Dissolved, mg/L: *	250		

Date (1992)	Discharge	Parameter *																	
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
92/04/01	3888																	IN	
92/04/02	4061																	IN	
92/04/03	4666																	IN	
92/04/04	4925																	IN	
92/04/05	4406																	IN	
92/04/06	4406																	IN	
92/04/07	4406																	IN	
92/04/08	3024																	IN	
92/04/09	3456																	IN	
92/04/10	4234																	IN	
92/04/11	4493																	IN	
92/04/12	4925																	IN	
92/04/13	5357																	IN	
92/04/14	5875																	IN	
92/04/15	6826																	IN	
92/04/16	7258																	IN	
92/04/17	10109																	OUT	Flow above limit
92/04/18	10627																	OUT	Flow above limit
92/04/19	12182																	OUT	Flow above limit
92/04/20	15638																	OUT	Flow above limit
92/04/21	17453																	OUT	Flow above limit
92/04/22	19094																	OUT	Flow above limit
92/04/23	21514																	OUT	Flow above limit
92/04/24	13651																	OUT	Flow above limit
92/04/25	3542																	IN	
92/04/26	3802																	IN	
92/04/27	3802																	IN	
92/04/28	4838																	IN	
92/04/29	6307																	IN	
92/04/30	6221																	IN	

PE6276
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: 10000
Susp. Solids, mg/L: ** 40
BOD5, mg/L: ** 30
Ammonia - Nitrogen, mg/L: ** 10

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3
Sulphate, Dissolved, mg/L: * 250

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1992)	Discharge	Parameter *																	
		TSS	BOD5	NH3-N	NO2-	NO3-	Cl-	SO4=	Cu Diss.	Fe Diss.	Mn Diss.	K Diss.	Na Diss.	P Total	Pb Total	Hg Total	Zn Total	Compliance	Comment
(YY/MM/DD)	m3/d	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L		
92/05/01	6221																	IN	
92/05/02	6480																	IN	
92/05/03	6307																	IN	
92/05/04	4234																	IN	
92/05/05	3456																	IN	
92/05/06	4061																	IN	
92/05/07	3024																	IN	
92/05/08	3370																	IN	
92/05/09	3974																	IN	
92/05/10	4666																	IN	
91/05/11	3802																	IN	
92/05/12	2765																	IN	
92/05/13	3715																	IN	
92/05/14	3802																	IN	
92/05/15	2938																	IN	
92/05/16	2938																	IN	
92/05/17	3024																	IN	
92/05/18	2678																	IN	
92/05/19	2756																	IN	
92/05/20	3110																	IN	
92/05/21	2506																	IN	
92/05/22	2678																	IN	
92/05/23	1814																	IN	
92/05/24	1642																	IN	
92/05/25	1555																	IN	
92/05/26	1123	4	13	1.44	0.158	1.23	1180	22	<0.050	0.3	0.86	41	709	0.021	0.002	<0.05	0.002	IN	
92/05/27	605																	IN	
92/05/28	518																	IN	
92/05/29	1642																	IN	
92/05/30	2506																	IN	
92/05/31	2074																	IN	

PE6276
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: **	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: **	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: **	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Ammonia - Nitrogen, mg/L: **	10	Sulphate, Dissolved, mg/L: *	250		

Date (1992)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
92/06/01	1987																	IN	
92/06/02	1382																	IN	
92/06/03	1123																	IN	
92/06/04	2074																	IN	
92/06/05	1469																	IN	
92/06/06	2074																	IN	
92/06/07	1901																	IN	
92/06/08	3629																	IN	
92/06/09	4234																	IN	
92/06/10	1296																	IN	
92/06/11	1469																	IN	
92/06/12	2678																	IN	
92/06/13	5789																	IN	
92/06/14	5702																	IN	
92/06/15	5875																	IN	
92/06/16	7430																	IN	
92/06/17	11491																	OUT	Flow above limit
92/06/18	16630																	OUT	Flow above limit
92/06/19	19267																	OUT	Flow above limit
92/06/20	17453																	OUT	Flow above limit
92/06/21	18144																	OUT	Flow above limit
92/06/22	19699																	OUT	Flow above limit
92/06/23	20131																	OUT	Flow above limit
92/06/24	21773																	OUT	Flow above limit
92/06/25	18835																	OUT	Flow above limit
92/06/26	19354																	OUT	Flow above limit
92/06/27	19699																	OUT	Flow above limit
92/06/28	20131																	OUT	Flow above limit
92/06/29	22896																	OUT	Flow above limit
92/06/30	22810																	OUT	Flow above limit[6]

PE6276
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: **	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: **	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: **	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Ammonia - Nitrogen, mg/L: **	10	Sulphate, Dissolved, mg/L: *	250		

Date (1992)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
92/07/01	24710																	OUT	Flow above limit
92/07/02	24797																	OUT	Flow above limit
92/07/03	26784																	OUT	Flow above limit
92/07/04	25747																	OUT	Flow above limit
92/07/05	28858																	OUT	Flow above limit
92/07/06	17626																	OUT	Flow above limit
92/07/07	3715																	IN	
92/07/08	2756																	IN	
92/07/09	1814																	IN	
92/07/10	1728																	IN	
92/07/11	2333																	IN	
92/07/12	2246																	IN	
92/07/13	2851																	IN	
92/07/14	3024																	IN	
92/07/15	1728																	IN	
92/07/16	2160																	IN	
92/07/17	1987																	IN	
92/07/18	1296																	IN	
92/07/19	1296																	IN	
92/07/20	1123																	IN	
92/07/21	1296																	IN	
92/07/22	1642																	IN	
92/07/23	1382																	IN	
92/07/24	1469																	IN	
92/07/25	1469																	IN	
92/07/26	1555																	IN	
92/07/27	1296																	IN	
92/07/28	1123																	IN	
92/07/29	1123																	IN	
92/07/30	1469																	IN	
92/07/31	1210																	IN	

PE6276	Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Fraser River	Susp. Solids, mg/L: **	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
Harbour Commission	BOD5, mg/L: **	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Main Arm	Ammonia - Nitrogen, mg/L: **	10	Sulphate, Dissolved, mg/L: *	250		

		Parameter *																	
Date (1992) (YY/MM/DD)	Discharge m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
92/08/01	1037																	IN	
92/08/02	1210																	IN	
92/08/03	1123																	IN	
92/08/04	1210																	IN	
92/08/05	1037																	IN	
92/08/06	1469																	IN	
92/08/07	1728																	IN	
92/08/08	2074																	IN	
92/08/09	1814																	IN	
92/08/10	1123																	IN	
92/08/11	1123																	IN	
92/08/12	1382																	IN	
92/08/13	1296																	IN	
92/08/14	1210																	IN	
92/08/15	950																	IN	
92/08/16	778																	IN	
92/08/17	778																	IN	
92/08/18	864																	IN	
92/08/19	950																	IN	
92/08/20	950	11	13	0.13	<0.010	0.70	1510	7	<0.050	0.4	0.81	44	759	0.042	<0.001	<0.05	0.003	IN	
92/08/21	950																	IN	
92/08/22	950																	IN	
92/08/23	950																	IN	
92/08/24	1037																	IN	
92/08/25	1037																	IN	
92/08/26	950																	IN	
92/08/27	1123																	IN	
92/08/28	1210																	IN	
92/08/29	1555																	IN	
92/08/30	1469																	IN	
92/08/31	1555																	IN	

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Fraser River
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Main Arm

Discharge, m3/d: **	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: **	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: **	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Ammonia - Nitrogen, mg/L: **	10	Sulphate, Dissolved, mg/L: *	250		

		Parameter *																	
Date (1992) (YY/MM/DD)	Discharge m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
92/09/01	2506																	IN	
92/09/02	1037																	IN	
92/09/03	1123																	IN	
92/09/04	1123																	IN	
92/09/05	1037																	IN	
92/09/06	864																	IN	
92/09/07	1123																	IN	
92/09/08	2765																	IN	
92/09/09	1728																	IN	
92/09/10	1382																	IN	
92/09/11	1123																	IN	
92/09/12	950																	IN	
92/09/13	864																	IN	
92/09/14	778																	IN	
92/09/15	778																	IN	
92/09/16	864																	IN	
92/09/17	864																	IN	
92/09/18	864																	IN	
92/09/19	864																	IN	
92/09/20	1037																	IN	
92/09/21	1382																	IN	
92/09/22	1987																	IN	
92/09/23	1814																	IN	
92/09/24	2074																	IN	
92/09/25	1469																	IN	
92/09/26	1382																	IN	
92/09/27	1469																	IN	
92/09/28	1642																	IN	
92/09/29	1901																	IN	
92/09/30	1642																	IN	

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Discharge, m3/d: ** 10000
Susp. Solids, mg/L: ** 40
BOD5, mg/L: ** 30
Ammonia - Nitrogen, mg/L: ** 10

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3
Sulphate, Dissolved, mg/L: * 250

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1992)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
92/10/01	1555																	IN	
92/10/02	2765																	IN	
92/10/03	5270																	IN	
92/10/04	6566																	IN	
92/10/05	6998																	IN	
92/10/06	8035																	IN	
92/10/07	7776																	IN	
92/10/08	8381																	IN	
92/10/09	8035																	IN	
92/10/10	9245																	IN	
92/10/11	9936																	IN	
92/10/12	10627																	OUT	Flow above limit
92/10/13	4666																	IN	
92/10/14	864																	IN	
92/10/15	778																	IN	
92/10/16	950																	IN	
92/10/17	950																	IN	
92/10/18	1037																	IN	
92/10/19	1296																	IN	
92/10/20	1642																	IN	
92/10/21	1642																	IN	
92/10/22	2678																	IN	
92/10/23	4147																	IN	
92/10/24	3888																	IN	
92/10/25	2419																	IN	
92/10/26	3370																	IN	
92/10/27	3370																	IN	
92/10/28	2246																	IN	
92/10/29	2592																	IN	
92/10/30	3197																	IN	
92/10/31	2851																	IN	

PE6276	Discharge, m3/d: **	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Fraser River	Susp. Solids, mg/L: **	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
Harbour Commission	BOD5, mg/L: **	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Main Arm	Ammonia - Nitrogen, mg/L: **	10	Sulphate, Dissolved, mg/L: *	250		

		Parameter *																	
Date (1992)	Discharge	TSS	BOD5	NH3-N	NO2-	NO3-	Cl-	SO4=	Cu Diss.	Fe Diss.	Mn Diss.	K Diss.	Na Diss.	P Total	Pb Total	Hg Total	Zn Total	Compliance	Comment
(YY/MM/DD)	m3/d	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L		
92/11/01	2592																	IN	
92/11/02	2592																	IN	
2/11/03	2938																	IN	
92/11/04	4838																	IN	
92/11/05	3888																	IN	
92/11/06	3629																	IN	
92/11/07	3542																	IN	
92/11/08	2938																	IN	
92/11/09	3370																	IN	
92/11/10	4666																	IN	
92/11/11	4493																	IN	
92/11/12	4493																	IN	
92/11/13	4406																	IN	
92/11/14	4493																	IN	
92/11/15	4493																	IN	
92/11/16	3715																	IN	
2/11/17	2506																	IN	
92/11/18	4320																	IN	
92/11/19	4925																	IN	
92/11/20	4493																	IN	
92/11/21	5443																	IN	
92/11/22	4493																	IN	
92/11/23	4320																	IN	
92/11/24	4320																	IN	
92/11/25	4234																	IN	
92/11/26	4320																	IN	
92/11/27	4838																	IN	
92/11/28	4147																	IN	
92/11/29	4493																	IN	
92/11/30	4234																	IN	

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Fraser River
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Main Arm

Discharge, m3/d: ** 10000
Susp. Solids, mg/L: ** 40
BOD5, mg/L: ** 30
Ammonia - Nitrogen, mg/L: ** 10

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3
Sulphate, Dissolved, mg/L: * 250

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1992)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
92/12/01	3888																	IN	
92/12/02	4061	8	20	1.96	<0.020	1.40	***	15.7	<0.05†	3.20†	1.40†	***	***	0.04	<0.10	***	<0.04	IN	
92/12/03	3802																	IN	
92/12/04	4061																	IN	
92/12/05	5098																	IN	
92/12/06	5443																	IN	
92/12/07	4234																	IN	
92/12/08	6134																	IN	
92/12/09	5530																	IN	
92/12/10	5616																	IN	
92/12/11	4406																	IN	
92/12/12	950																	IN	
92/12/13	864																	IN	
92/12/14	778																	IN	
92/12/15	778																	IN	
92/12/16	3802																	IN	
92/12/17	3715																	IN	
92/12/18	5530																	IN	
92/12/19	5184																	IN	
92/12/20	7949																	IN	
92/12/21	6826																	IN	
92/12/22	6480																	IN	
92/12/23	6394																	IN	
92/12/24	5875																	IN	
92/12/25	6221																	IN	
92/12/26	6394																	IN	
92/12/27	5875																	IN	
92/12/28	5184																	IN	
92/12/29	5011																	IN	
92/12/30	5098																	IN	
92/12/31	4579																	IN	

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Date (1992) (YY/MM/DD)	Discharge m3/d	Loadings TSS kg/d	BOD5 kg/d	NH3-N kg/d	NO2- kg/d	NO3- kg/d	Cl- kg/d	SO4= kg/d	Cu Diss. kg/d	Fe Diss. kg/d	Mn Diss. kg/d	K Diss. kg/d	Na Diss. kg/d	P Total kg/d	Pb Total kg/d	Hg Total kg/d	Zn Total kg/d
92/02/25	950	14.25	12.35	4.180	0.0950	2.157	882.6	63.65	0.0019	0.2850	0.8265	28.50	409.5	0.0200	0.0010	5E-05	0.019
92/05/26	1123	4.492	14.60	1.617	0.1774	1.381	1325	24.71	0.0562	0.3369	0.9658	46.04	796.2	0.0236	0.0022	6E-05	0.0022
92/08/20	950	10.45	12.35	0.1235	0.0095	0.6650	1435	6.650	0.0475	0.3800	0.7695	41.80	721.1	0.0399	0.0010	5E-05	0.0029
92/12/02	4061	32.49	81.22	7.960	0.0812	5.685	***	63.76	0.2031†	13.00†	5.685†	***	***	0.1624	0.4061	***	0.1624
Maximum	28858	32.49	81.22	7.960	0.1774	5.685	1435	63.76	0.0562	0.3800	0.9658	46.04	796.2	0.1624	0.4061	6E-05	0.1624
Minimum	432	4.492	12.35	0.1235	0.0095	0.6650	882.6	6.650	0.0019	0.2850	0.7695	28.50	409.5	0.0200	0.0010	5E-05	0.0022
Mean	4371	15.42	30.13	3.470	0.0908	2.472	1214	39.69	0.0352	0.3340	0.8539	38.78	642.2	0.0615	0.1026	5E-05	0.0466
Std. Dev.	4919	12.07	34.08	3.430	0.0689	2.227	292.3	28.69	0.0291	0.0476	0.1010	9.15	205.1	0.0679	0.2024	5E-06	0.0776
Maximum x Maximum		432.9	577.2	127.0	4.560	65.51	43576	1933	<1.443	11.54	25.11	1270	21903	1.212	< 2.886	<0.0014	<1.154
Minimum x Minimum		1.728	4.320	0.0562	<0.0043	0.3024	401.3	3.024	0.0009	0.1296	0.3499	12.96	186.2	0.0432	<0.0004	<2E-05	0.0009
Mean x Mean		41.53	48.08	8.666	<0.2186	6.120	5273	122.1	<0.1661	1.457	3.701	167.6	2767	0.1355	<0.1137	<0.0002	<0.0699

Note: < values included in calculations

* Permitted levels and monitoring parameters as required before October 27, 1992 amendment.

** Permitted levels as of October 27, 1992 amendment.

*** Monitoring of these parameters is no longer required as of October 27, 1992 amendment.

† Total metals analyzed, as required by October 27, 1992 amendment. The total metal results were not included in summary calculations.

Additional parameters to be monitored as of October 27, 1992, are given below.

Date (1992) (YY/MM/DD)	Discharge m3/d	Loadings COD kg/d	Al Total kg/d	Acidity pH 8.3 kg/d	Resin Acids kg/d	Fatty Acids kg/d
92/12/02	4061	223	0.4061	154.3	0.0203	0.0203

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Main Arm

Discharge, m3/d: **	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: **	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: **	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Ammonia - Nitrogen, mg/L: **	10	Sulphate, Dissolved, mg/L: *	250		

Date (1992)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
Maximum	28858	15	20	4.40	0.158	2.27	1510	67	<0.050	0.4	0.87	44	759	0.042	<0.10	<0.05	<0.04	OUT	Flow above limit
Minimum	432	4	13	0.13	<0.010	0.70	929	7	0.002	0.3	0.81	30	431	0.021	<0.001	<0.05	0.002	IN	
Mean	4371	10	15	1.98	<0.050	1.40	1206	28	<0.02	0.3	0.85	38.3	633	0.031	<0.03	<0.05	<0.02	IN	
Std. Dev.	4919	5	4	1.79	0.072	0.65	291.4	27	0.02	0.1	0.03	7.4	177	0.012	0.05	0	0.02		
Maximum x Maximum																			
Minimum x Minimum																			
Mean x Mean																			

Note: < values included in calculations

* Permitted levels and monitoring parameters as required before October 27, 1992 amendment.

** Permitted levels as of October 27, 1992 amendment.

*** Monitoring of these parameters is no longer required as of October 27, 1992 amendment.

, Total metals analyzed, as required by October 27, 1992 amendment. The total metal results were not included in summary calculations.

Additional parameters to be monitored as of October 27, 1992, are given below.

Date (1992)	Discharge	Parameter				
(YY/MM/DD)	m3/d	COD mg/L	Al Total mg/L	Acidity pH 8.3 mg/L	Resin Acids mg/L	Fatty Acids mg/L
92/12/02	4061	55	<0.10	38	<0.005	<0.005

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Harbour Commission
Main Arm

Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																	
		TSS	BOD5	NH3-N	NO2-	NO3-	Cl-	SO4=	Cu Diss.	Fe Diss.	Mn Diss.	K Diss.	Na Diss.	P Total	Pb Total	Hg Total	Zn Total	Compliance	Comment
(YY/MM/DD)	m3/d	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L		
91/01/01	0																	IN	Effluent was frozen.
91/01/02	0																	IN	No flow data was
91/01/03	0																	IN	available from
91/01/04	0																	IN	Jan 1 to Jan 14
91/01/05	0																	IN	
91/01/06	0																	IN	
91/01/07	0																	IN	
91/01/08	0																	IN	
91/01/09	0																	IN	
91/01/10	0																	IN	
91/01/11	0																	IN	
91/01/12	0																	IN	
91/01/13	0																	IN	
91/01/14	0																	IN	
91/01/15	2592																	IN	
91/01/16	2592																	IN	
91/01/17	3024																	IN	
91/01/18	2851																	IN	
91/01/19	2592																	IN	
91/01/20	1037																	IN	
91/01/21	691																	IN	
91/01/22	432																	IN	
91/01/23	346																	IN	
91/01/24	259																	IN	
91/01/25	259																	IN	
91/01/26	173																	IN	
91/01/27	173																	IN	
91/01/28	259																	IN	
91/01/29	173																	IN	
91/01/30	172																	IN	
91/01/31	346																	IN	

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Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																	
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
91/02/01	518																	IN	
91/02/02	432																	IN	
91/02/03	346																	IN	
91/02/04	432																	IN	
91/02/05	259																	IN	
91/02/06	259	30	< 10	0.6	0.023	0.17	636	25.1	0.001	1.5	0.65	23.5	456	0.065	< 0.01	< 0.05	0.04	IN	
91/02/07	259																	IN	
91/02/08	518																	IN	
91/02/09	346																	IN	
91/02/10	346																	IN	
91/02/11	346																	IN	
91/02/12	605																	IN	
91/02/13	432																	IN	
91/02/14	518																	IN	
91/02/15	432																	IN	
91/02/16	605																	IN	
91/02/17	950																	IN	
91/02/18	864																	IN	
91/02/19	1382																	IN	
91/02/20	950																	IN	
91/02/21	1037																	IN	
91/02/22	864																	IN	
91/02/23	778																	IN	
91/02/24	1037																	IN	
91/02/25	950																	IN	
91/02/26	1037																	IN	
91/02/27	1123																	IN	
91/02/28	1382																	IN	

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Main Arm

Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

Date (1991)	Discharge	Parameter *																Compliance	Comment
		TSS	BOD5	NH3-N	NO2-	NO3-	Cl-	SO4=	Cu Diss.	Fe Diss.	Mn Diss.	K Diss.	Na Diss.	P Total	Pb Total	Hg Total	Zn Total		
(YY/MM/DD)	m3/d	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L		
91/03/01	1555																	IN	
91/03/02	2592																	IN	
91/03/03	2765																	IN	
91/03/04	950																	IN	
91/03/05	950																	IN	
91/03/06	950																	IN	
91/03/07	691																	IN	
91/03/08	864																	IN	
91/03/09	605																	IN	
91/03/10	691																	IN	
91/03/11	864																	IN	
91/03/12	1037																	IN	
91/03/13	691																	IN	
91/03/14	691																	IN	
91/03/15	864																	IN	
91/03/16	778																	IN	
91/03/17	864																	IN	
91/03/18	950																	IN	
91/03/19	1469																	IN	
91/03/20	1123																	IN	
91/03/21	1382																	IN	
91/03/22	1037																	IN	
91/03/23	1210																	IN	
91/03/24	1469																	IN	
91/03/25	1382																	IN	
91/03/26	1037																	IN	
91/03/27	864																	IN	
91/03/28	778																	IN	
91/03/29	778																	IN	
91/03/30	864																	IN	
91/03/31	864																	IN	3

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Main Arm

Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/04/01	950																	IN	
91/04/02	691																	IN	
91/04/03	1123																	IN	
91/04/04	864																	IN	
91/04/05	1296																	IN	
91/04/06	1555																	IN	
91/04/07	950																	IN	
91/04/08	950																	IN	
91/04/09	1814																	IN	
91/04/10	1642																	IN	
91/04/11	1210																	IN	
91/04/12	1037																	IN	
91/04/13	950																	IN	
91/04/14	778																	IN	
91/04/15	605																	IN	
91/04/16	605																	IN	
91/04/17	518																	IN	
91/04/18	2333																	IN	
91/04/19	3888																	IN	
91/04/20	4406																	IN	
91/04/21	4406																	IN	
91/04/22	4320																	IN	
91/04/23	4320																	IN	
91/04/24	4234																	IN	
91/04/25	4406																	IN	
91/04/26	4406																	IN	
91/04/27	4666																	IN	
91/04/28	5270																	IN	
91/04/29	3456																	IN	
91/04/[illegible]	2592																	IN	

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Fraser River
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Main Arm

Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																	
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
91/05/01	2160																	IN	
91/05/02	605																	IN	
91/05/03	778																	IN	
91/05/04	691																	IN	
91/05/05	778																	IN	
91/05/06	1123																	IN	
91/05/07	2592																	IN	
91/05/08	4147																	IN	
91/05/09	4838																	IN	
91/05/10	6653																	IN	
91/05/11	6653																	IN	
91/05/12	6566																	IN	
91/05/13	8122																	IN	
91/05/14	7171	11	< 10	4.54	0.143	1.28	676	37.1	0.004	0.3	0.79	38	526	0.017	0.001	< 0.05	0.012	IN	
91/05/15	2851																	IN	
91/05/16	3110																	IN	
91/05/17	3024																	IN	
91/05/18	2678																	IN	
91/05/19	2678																	IN	
91/05/20	3024																	IN	
91/05/21	2765																	IN	
91/05/22	1901																	IN	
91/05/23	2333																	IN	
91/05/24	3024																	IN	
91/05/25	2938																	IN	
91/05/26	2938																	IN	
91/05/27	3542																	IN	
91/05/28	2938																	IN	
91/05/29	3110																	IN	
91/05/30	2419																	IN	5
91/05/31	2246																	IN	

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Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/06/01	3283																	IN	
91/06/02	4838																	IN	
91/06/03	3715																	IN	
91/06/04	1987																	IN	
91/06/05	1901																	IN	
91/06/06	1728																	IN	
91/06/07	1814																	IN	
91/06/08	1814																	IN	
91/06/09	2246																	IN	
91/06/10	2419																	IN	
91/06/11	1728																	IN	
91/06/12	2160																	IN	
91/06/13	3110																	IN	
91/06/14	4061																	IN	
91/06/15	5184																	IN	
91/06/16	9158																	IN	
91/06/17	10454																	OUT	
91/06/18	11837																	OUT	Flow data from
91/06/19	13738																	OUT	June to October, 1991
91/06/20	9763																	IN	was not reliable, or
91/06/21	9590																	IN	not available since
91/06/22	12960																	OUT	debris from beaver
91/06/23	13738																	OUT	dams had caused the
91/06/24	14429																	OUT	weir gauges to
91/06/25	14602																	OUT	malfunction.
91/06/26	14688																	OUT	
91/06/27	14774																	OUT	
91/06/28	14774																	OUT	
91/06/29	14429																	OUT	
91/06/30	14170																	OUT	
91/08/27		3	<10	<1	<0.01	<0.01	699	11	<0.05	1.4	0.11	29	570	0.098	<0.001	<0.05	0.002	IN	

'E6276
'raser River
larbour Commission
lain Arm

Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

		Parameter *																	
ate (1991)	Discharge	TSS	BOD5	NH3-N	NO2-	NO3-	Cl-	SO4=	Cu Diss.	Fe Diss.	Mn Diss.	K Diss.	Na Diss.	P Total	Pb Total	Hg Total	Zn Total	Compliance	Comment
(Y/MM/DD)	m3/d	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L		
1/11/01	173																	IN	
1/11/02	173																	IN	
1/11/03	0																	IN	
1/11/04	259																	IN	
1/11/05	259																	IN	
1/11/06	173																	IN	
1/11/07	173																	IN	
1/11/08	259																	IN	
1/11/09	259																	IN	
1/11/10	173																	IN	
1/11/11	518																	IN	
1/11/12	518																	IN	
1/11/13	346	10	18	0.27	< 0.025	0.05	566	22	0.003	1.1	1.10	28	431	0.055	0.001	< 0.05	0.006	IN	
1/11/14	346																	IN	
1/11/15	259																	IN	
1/11/16	346																	IN	
1/11/17	259																	IN	
1/11/18	259																	IN	
1/11/19	691																	IN	
1/11/20	518																	IN	
1/11/21	432																	IN	
1/11/22	346																	IN	
1/11/23	346																	IN	
1/11/24	518																	IN	
1/11/25	432																	IN	
1/11/26	346																	IN	
1/11/27	346																	IN	
1/11/28	346																	IN	
1/11/29	173																	IN	
1/11/30	86																	IN	

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Harbour Commission
Main Arm

Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1991)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
91/12/01	173																	IN	
91/12/02	173																	IN	
91/12/03	259																	IN	
91/12/04	259																	IN	
91/12/05	432																	IN	
91/12/06	432																	IN	
91/12/07	346																	IN	
91/12/08	346																	IN	
91/12/09	346																	IN	
91/12/10	86																	IN	
91/12/11	0																	IN	
91/12/12	86																	IN	
91/12/13	86																	IN	
91/12/14	86																	IN	
91/12/15	86																	IN	
91/12/16	86																	IN	
91/12/17	0																	IN	
91/12/18	259																	IN	
91/12/19	605																	IN	
91/12/20	950																	IN	
91/12/21	691																	IN	
91/12/22	432																	IN	
91/12/23	518																	IN	
91/12/24	432																	IN	
91/12/25	346																	IN	
91/12/26	346																	IN	
91/12/27	346																	IN	
91/12/28	432																	IN	
91/12/29	432																	IN	
91/12/30	432																	IN	8
91/12/31	605																	IN	

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Main Arm

Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

		Parameter *																	
Date (1991) (YY/MM/DD)	Discharge m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
Maximum	14774	30	18	4.54	0.143	1.28	699	37.1	0.004	1.5	1.10	38.0	570	0.098	< 0.01	< 0.05	0.040	OUT	Flow above limit
Minimum	0	3	< 10	0.27	< 0.01	< 0.01	566	11.0	0.001	0.3	0.11	23.5	431	0.017	< 0.001	< 0.05	0.002	IN	
Mean	2049	14	< 12	< 1.61	< 0.083	< 0.50	644	23.8	< 0.003	1.1	0.66	29.6	496	0.059	< 0.003	< 0.05	0.015	IN	
Std. Dev.	3194	12	4	1.98	0.085	0.68	58	10.7	0.002	0.5	0.41	6.1	64	0.033	0.005	0	0.017		
Maximum x Maximum																			
Minimum x Minimum																			
Mean x Mean																			

Note: < values included in calculations

* Permitted levels and monitoring parameters as required before October 27, 1992 amendment.

Please see December 1992 data sheet for October 27, 1992 amended permitted levels and monitoring parameter requirements.

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Main Arm

Date (1991) (YY/MM/DD)	Discharge m3/d	Loadings TSS kg/d	BOD5 kg/d	NH3-N kg/d	NO2- kg/d	NO3- kg/d	Cl- kg/d	SO4= kg/d	Cu Diss. kg/d	Fe Diss. kg/d	Mn Diss. kg/d	K Diss. kg/d	Na Diss. kg/d	P Total kg/d	Pb Total kg/d	Hg Total kg/d	Zn Total kg/d
91/02/06	259	7.770	2.590	0.1554	0.0060	0.0440	164.7	6.501	0.0003	0.3885	0.1684	6.087	118.1	0.0168	0.0026	1.3E-05	0.0104
91/05/14	7171	78.88	71.71	32.56	1.025	9.179	4848	266.0	0.0287	2.151	5.665	272.5	3772	0.1219	0.0072	0.0004	0.0861
91/11/13	346	3.460	6.228	0.0934	0.0087	0.0173	195.8	7.612	0.0010	0.3806	0.3806	9.688	149.1	0.0190	0.0003	1.7E-05	0.0021
Maximum	14774	78.88	71.71	32.56	1.025	9.179	4848	266.0	0.0287	2.151	5.665	272.5	3772	0.1219	0.0072	0.0004	0.0861
Minimum	0	3.460	2.590	0.0934	0.0060	0.0173	164.7	6.501	0.0003	0.3806	0.1684	6.087	118	0.0168	0.0003	1.3E-05	0.0021
Mean	2049	30.04	26.84	10.94	0.3467	3.080	1736	93.39	0.0100	0.9735	2.071	96.09	1346	0.0526	0.0034	0.0001	0.0328
Std. Dev.	3194	42.36	38.90	18.72	0.5878	5.282	2695	149.5	0.0162	1.020	3.114	152.8	2101	0.0600	0.0035	0.0002	0.0463
Maximum x Maximum		443.2	265.9	67.07	2.113	18.91	10327	548.1	0.0591	22.16	16.25	561.4	8421	1.448	< 1.477	<0.0007	0.5910
Minimum x Minimum		0	* 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean x Mean		27.66	<24.58	<3.298	<0.1700	<1.024	1320	48.76	<0.0061	2.202	1.357	60.69	1016	0.1204	<0.0061	<0.0001	0.0307

Note: < values included in calculations

* Permitted levels and monitoring parameters as required before October 27, 1992 amendment.

Please see December 1992 data sheet for October 27, 1992 amended permitted levels and monitoring parameter requirements.

PE6276 Discharge, m3/d: * 10000 Copper, Dissolved, mg/L: * 0.2 Lead, Total, mg/L: * 0.05
Fraser River Susp. Solids, mg/L: * 40 Iron, Dissolved, mg/L: * 12 Mercury, Total, µg/L: * 0.6
Harbour Commission BOD5, mg/L: * 30 Manganese, Dissolved, mg/L: * 3.3 Zinc, Total, mg/L: * 0.5
Main Arm Sulphate, Dissolved, mg/L: * 250

Date (1990)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
90/01/01	2851																	IN	
90/01/02	2592																	IN	
90/01/03	3456																	IN	
0/01/04	3715																	IN	
90/01/05	5098																	IN	
90/01/06	5011																	IN	
90/01/07	5098																	IN	
90/01/08	4147																	IN	
90/01/09	4406																	IN	
90/01/10	3715																	IN	
90/01/11	3802																	IN	
90/01/12	4061																	IN	
90/01/13	4752																	IN	
90/01/14	4406																	IN	
90/01/15	4147																	IN	
90/01/16	3715																	IN	
90/01/17	4666																	IN	
)0/01/18	4579																	IN	
90/01/19	4579																	IN	
90/01/20	4493																	IN	
90/01/21	4925																	IN	
90/01/22	4061																	IN	
90/01/23	2678																	IN	
90/01/24	3974																	IN	
90/01/25	4838																	IN	
90/01/26	4752																	IN	
90/01/27	5270																	IN	
90/01/28	5443																	IN	
90/01/29	4666																	IN	
90/01/30	4752																	IN	1
90/01/31	5357																	IN	

PE6276
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

Date (1990)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
90/02/01	6134																	IN	
90/02/02	6048																	IN	
90/02/03	5270																	IN	
90/02/04	2419																	IN	
90/02/05	2074																	IN	
90/02/06	2160																	IN	
90/02/07	3715																	IN	
90/02/08	4493																	IN	
90/02/09	6307																	IN	
90/02/10	6307																	IN	
90/02/11	5184																	IN	
90/02/12	4147																	IN	
90/02/13	3802																	IN	
90/02/14	4579																	IN	
90/02/15	4752																	IN	
90/02/16	5011																	IN	
90/02/17	4752																	IN	
90/02/18	4925																	IN	
90/02/19	4925																	IN	
90/02/20	6134																	IN	
90/02/21	4925																	IN	
90/02/22	3283	16	< 10	2.67	0.047	1.28	100	516	0.01	2.4	3.30	67.5	1000	0.014	< 0.1	< 0.05	0.06	OUT	Sulphate above limit
90/02/23	2592																	IN	
90/02/24	1901																	IN	
90/02/25	1382																	IN	
90/02/26	950																	IN	
90/02/27	778																	IN	
90/02/28	1296																	IN	

PE3278
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1990) (YY/MM/DD)	Discharge m3/d	Parameter * TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
90/03/01	3456																	IN	
90/03/02	4320																	IN	
90/03/03	4925																	IN	
90/03/04	5184																	IN	
90/03/05	5357																	IN	
90/03/06	5789																	IN	
90/03/07	6134																	IN	
90/03/08	2765																	IN	
90/03/09	2074																	IN	
90/03/10	1814																	IN	
90/03/11	1469																	IN	
90/03/12	1123																	IN	
90/03/13	1037																	IN	
90/03/14	1210																	IN	
90/03/15	864																	IN	
90/03/16	864																	IN	
90/03/17	1469																	IN	
90/03/18	1814																	IN	
90/03/19	1728																	IN	
90/03/20	2333																	IN	
90/03/21	3802																	IN	
90/03/22	4147																	IN	
90/03/23	4234																	IN	
90/03/24	4234																	IN	
90/03/25	2592																	IN	
90/03/26	1469																	IN	
90/03/27	950																	IN	
90/03/28	864																	IN	
90/03/29	864																	IN	
90/03/30	1123																	IN	
90/03/31	950																	IN	

PE6276
Fraser River
Harbour Commission
Main Arm

Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

Date (1990)	Discharge	Parameter *																Compliance	Comment
		TSS	BOD5	NH3-N	NO2-	NO3-	Cl-	SO4=	Cu Diss.	Fe Diss.	Mn Diss.	K Diss.	Na Diss.	P Total	Pb Total	Hg Total	Zn Total		
(YY/MM/DD)	m3/d	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L		
90/04/01	864																	IN	
90/04/02	864																	IN	
90/04/03	1296																	IN	
90/04/04	3197																	IN	
90/04/05	3974																	IN	
90/04/06	2938																	IN	
90/04/07	2678																	IN	
90/04/08	2506																	IN	
90/04/09	2765																	IN	
90/04/10	2074																	IN	
90/04/11	1123																	IN	
90/04/12	950																	IN	
90/04/13	864																	IN	
90/04/14	950																	IN	
90/04/15	778																	IN	
90/04/16	778																	IN	
90/04/17	864																	IN	
90/04/18	691																	IN	
90/04/19	1987																	IN	
90/04/20	2506																	IN	
90/04/21	3888																	IN	
90/04/22	5011																	IN	
90/04/23	4925																	IN	
90/04/24	3629																	IN	
90/04/25	2506																	IN	
90/04/26	2074																	IN	
90/04/27	2074																	IN	
90/04/28	2419																	IN	
90/04/29	1555																	IN	
90/04/30	1382																	IN	

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Discharge, m3/d: * 40000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

		Parameter *																	
Date (1990) (YY/MM/DD)	Discharge m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
90/05/01	1037																	IN	
90/05/02	1123																	IN	
90/05/03	864																	IN	
90/05/04	778																	IN	
90/05/05	605																	IN	
90/05/06	518																	IN	
90/05/07	432																	IN	
90/05/08	1469																	IN	
90/05/09	2765																	IN	
90/05/10	2938																	IN	
90/05/11	3456																	IN	
90/05/12	3456																	IN	
90/05/13	3802																	IN	
90/05/14	3456																	IN	
90/05/15	3283																	IN	
90/05/16	3283																	IN	
90/05/17	3197																	IN	
90/05/18	3283																	IN	
90/05/19	3197																	IN	
90/05/20	3370																	IN	
90/05/21	3197																	IN	
90/05/22	3197																	IN	
90/05/23	3110																	IN	
90/05/24	3110																	IN	
90/05/25	3110																	IN	
90/05/26	3110																	IN	
90/05/27	3197																	IN	
90/05/28	3024																	IN	
90/05/29	3024	10	14	8.10	0.047	1.28	1880	143	0.03	0.1	1.16	55	1110	0.012	0.003	< 0.05	0.022	IN	
90/05/30	2333																	IN	
90/05/31	4061																	IN	

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Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

		Parameter *																	
Date (1990) (YY/MM/DD)	Discharge m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
90/06/01	3456																	IN	
90/06/02	3197																	IN	
90/06/03	3715																	IN	
90/06/04	3370																	IN	
90/06/05	3197																	IN	
90/06/06	3542																	IN	
90/06/07	3370																	IN	
90/06/08	3715																	IN	
90/06/09	4925																	IN	
90/06/10	6394																	IN	
90/06/11	7430																	IN	
90/06/12	8122																	IN	
90/06/13	8122																	IN	
90/06/14	5789																	IN	
90/06/15	5270																	IN	
90/06/16	5270																	IN	
90/06/17	5270																	IN	
90/06/18	5184																	IN	
90/06/19	6739																	IN	
90/06/20	5789																	IN	
90/06/21	5443																	IN	
90/06/22	5530																	IN	
90/06/23	5702																	IN	
90/06/24	5962																	IN	
90/06/25	7776																	IN	
90/06/26	8554																	IN	
90/06/27	6394																	IN	
90/06/28	4061																	IN	
90/06/29	4493																	IN	
90/06/30	5098																	IN	

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Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

		Parameter *																	
Date (1990) (YY/MM/DD)	Discharge m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
90/07	2809																	IN	Average monthly flows
90/07/18		6	< 10	0.44	1.1	1.80	2450	122	0.04	0.1	0.09	30.6	1460	0.017	0.003	< 0.05	0.009	IN	for July, Aug, & Sept
90/08	1948																	IN	since daily flows
90/09	1889																	IN	were not available

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Discharge, m3/d: 1000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1990)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
90/10/01	691																	IN	
90/10/02	605																	IN	
90/10/03	778																	IN	
90/10/04	1123																	IN	
90/10/05	950																	IN	
90/10/06	950																	IN	
90/10/07	864																	IN	
90/10/08	778																	IN	
90/10/09	950																	IN	
90/10/10	1123																	IN	
90/10/11	564																	IN	
90/10/12	950																	IN	
90/10/13	691																	IN	
90/10/14	778																	IN	
90/10/15	691																	IN	
90/10/16	518																	IN	
90/10/17	432																	IN	
90/10/18	346																	IN	
90/10/19	346																	IN	
90/10/20	346																	IN	
90/10/21	778																	IN	
90/10/22	691																	IN	
90/10/23	778																	IN	
90/10/24	518																	IN	
90/10/25	778																	IN	
90/10/26	950																	IN	
90/10/27	864																	IN	
90/10/28	864																	IN	
90/10/29	950																	IN	
90/10/30	1037																	IN	
90/10/31	864																	IN	

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Discharge, m3/d: *	10000	Copper, Dissolved, mg/L: *	0.2	Lead, Total, mg/L: *	0.05
Susp. Solids, mg/L: *	40	Iron, Dissolved, mg/L: *	12	Mercury, Total, µg/L: *	0.6
BOD5, mg/L: *	30	Manganese, Dissolved, mg/L: *	3.3	Zinc, Total, mg/L: *	0.5
Sulphate, Dissolved, mg/L: *	250				

		Parameter *																	
Date (1990) (YY/MM/DD)	Discharge m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
90/11/01	778																	IN	
90/11/02	864																	IN	
90/11/03	1123																	IN	
90/11/04	1469																	IN	
90/11/05	3283																	IN	
90/11/06	2851																	IN	
90/11/07	3715	14	< 10	0.57	0.036	1.21	1160	68.5	0.04	0.7	0.52	32.6	712	0.012	0.002	< 0.05	0.11	IN	
90/11/08	2678																	IN	
90/11/09	3110																	IN	
90/11/10	3802																	IN	
90/11/11	2851																	IN	
90/11/12	2160																	IN	
90/11/13	3456																	IN	
90/11/14	2938																	IN	
90/11/15	2419																	IN	
90/11/16	2765																	IN	
90/11/17	2678																	IN	
90/11/18	2246																	IN	
90/11/19	2592																	IN	
90/11/20	3283																	IN	
90/11/21	5357																	IN	
90/11/22	5530																	IN	
90/11/23	6307																	IN	
90/11/24	5875																	IN	
90/11/25	3974																	IN	
90/11/26	2938																	IN	
90/11/27	5357																	IN	
90/11/28	6221																	IN	
90/11/29	6998																	IN	
90/11/30	6480																	IN	

PE6273 — Discharge, m3/d: 10000 — Copper, Dissolved, mg/L: * 0.2 — Lead, Total, mg/L: * 0.05
Fraser River — Susp. Solids, mg/L: * 40 — Iron, Dissolved, mg/L: * 12 — Mercury, Total, µg/L: * 0.6
Harbour Commission — BOD5, mg/L: * 30 — Manganese, Dissolved, mg/L: * 3.3 — Zinc, Total, mg/L: * 0.5
Main Arm — Sulphate, Dissolved, mg/L: * 250

Date (1990)	Discharge	Parameter *																Compliance	Comment
(YY/MM/DD)	m3/d	TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L		
90/12/01	6566																	IN	
90/12/02	3197																	IN	
90/12/03	518																	IN	
90/12/04	4234																	IN	
90/12/05	3629																	IN	
90/12/06	4579																	IN	
90/12/07	4579																	IN	
90/12/08	5616																	IN	
90/12/09	5702																	IN	
90/12/10	4925																	IN	
90/12/11	4925																	IN	
90/12/12	5875																	IN	
90/12/13	6394																	IN	
90/12/14	6394																	IN	
90/12/15	6566																	IN	
90/12/16	6221																	IN	
90/12/17	6480																	IN	
90/12/18	5270																	IN	
90/12/19	5011																	IN	
90/12/20	0																	IN	Effluent was frozen.
90/12/21	0																	IN	No flow data was
90/12/22	0																	IN	available from
90/12/23	0																	IN	December 20th on.
90/12/24	0																	IN	
90/12/25	0																	IN	
90/12/26	0																	IN	
90/12/27	0																	IN	
90/12/28	0																	IN	
90/12/29	0																	IN	
90/12/30	0																	IN	
90/12/31	0																	IN	

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Discharge, m3/d: * 10000
Susp. Solids, mg/L: * 40
BOD5, mg/L: * 30
Sulphate, Dissolved, mg/L: * 250

Copper, Dissolved, mg/L: * 0.2
Iron, Dissolved, mg/L: * 12
Manganese, Dissolved, mg/L: * 3.3

Lead, Total, mg/L: * 0.05
Mercury, Total, µg/L: * 0.6
Zinc, Total, mg/L: * 0.5

Date (1990) (YY/MM/DD)	Discharge m3/d	Parameter * TSS mg/L	BOD5 mg/L	NH3-N mg/L	NO2- mg/L	NO3- mg/L	Cl- mg/L	SO4= mg/L	Cu Diss. mg/L	Fe Diss. mg/L	Mn Diss. mg/L	K Diss. mg/L	Na Diss. mg/L	P Total mg/L	Pb Total mg/L	Hg Total µg/L	Zn Total mg/L	Compliance	Comment
Maximum	8554	16	14	8.10	1.1	1.80	2450	516	0.04	2.4	3.30	67.5	1460	0.017	< 0.1	< 0.05	0.11	OUT	Sulphate above limit
Minimum	0	6	< 10	0.44	0.036	1.21	100	68.5	0.01	0.1	0.09	30.6	712	0.012	0.002	< 0.05	0.01	IN	
Mean	3130	12	< 11	2.95	0.308	1.39	1398	212	0.03	0.8	1.27	46.4	1071	0.014	< 0.03	< 0.05	0.05	IN	
Std. Dev.	2001	4	2	3.59	0.528	0.27	1013	205	0.01	1.1	1.42	17.9	309	0.002	0.05	0	0.05		
Maximum x Maximum																			
Minimum x Minimum																			
Mean x Mean																			

Note: < values included in calculations

* Permitted levels and monitoring parameters as required before October 27, 1992 amendment.

Please see December 1992 data sheet for October 27, 1992 amended permitted levels and monitoring parameter requirements.

Fraser River
Harbour Commission
Main Arm

Date (1990) (YY/MM/DD)	Discharge m3/d	Loadings TSS kg/d	BOD5 kg/d	NH3-N kg/d	NO2- kg/d	NO3- kg/d	Cl- kg/d	SO4= kg/d	Cu Diss. kg/d	Fe Diss. kg/d	Mn Diss. kg/d	K Diss. kg/d	Na Diss. kg/d	P Total kg/d	Pb Total kg/d	Hg Total kg/d	Zn Total kg/d
90/02/22	3283	52.53	32.83	8.766	0.1543	4.202	328.3	1694	0.0328	7.879	10.83	221.6	3283	0.0460	0.3283	0.0002	0.1970
90/05/29	3024	30.24	42.34	24.49	0.1421	3.871	5685	432.4	0.0907	0.302	3.508	166.3	3357	0.0363	0.0091	0.0002	0.0665
90/11/06	2851	52.01	37.15	2.118	0.1337	4.495	4309	254.5	0.1486	2.601	1.932	121.1	2645	0.0446	0.0074	0.0002	0.4087
Maximum	8554	52.53	42.34	24.49	0.1543	4.495	5685	1694	0.1486	7.879	10.83	221.6	3357	0.0460	0.3283	0.0002	0.4087
Minimum	0	30.24	32.83	2.118	0.1337	3.871	328.3	254.5	0.0328	0.302	1.932	121.1	2645	0.0363	0.0074	0.0002	0.0665
Mean	3130	44.93	37.44	11.79	0.1434	4.189	3441	793.6	0.0907	3.594	5.425	169.7	3095	0.0423	0.1149	0.0002	0.2241
Std. Dev.	2001	12.72	4.760	11.49	0.0103	0.3124	2782	784.8	0.0579	3.885	4.750	50.33	391.3	0.0052	0.1848	0.0000	0.1727
Maximum x Maximum		136.9	119.8	69.29	9.409	15.40	20957	4414	0.3422	20.53	28.23	577.4	12489	0.1454	0.8554	0.0004	0.9409
Minimum x Minimum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean x Mean		36.00	34.43	9.219	0.9626	4.359	4375	664.8	0.0939	2.582	3.968	145.3	3351	0.0430	0.0939	0.0002	0.1573

Note: < values included in calculations

* Permitted levels and monitoring parameters as required before October 27, 1992 amendment.

Please see December 1992 data sheet for October 27, 1992 amended permitted levels and monitoring parameter requirements.

ENVIRONMENTAL IMPACT OF COMPOSTING HEMLOCK/BALSAM AT FRASER PORT RICHMOND

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EXECUTIVE SUMMARY

The Composting Operation

Augustine Trucking Ltd. have provided and transported woodwaste materials to horticultural operations in the lower Fraser valley and in Washington state for several years. The company proposes to carry out composting of Hemlock/Balsam (hembal) bark at the Fraser Port Richmond site.

B.C. Research has considered environmental changes that may occur at the Fraser Port site due to operation of the composting system.

The composting operation will be carried out on an area of land approximately 52 acres in size and located near the northern boundary of the Fraser Port site, between the existing lagoon waste water treatment plant and the closed municipal landfill area.

Hembal bark will be obtained from the Western Whitewood Division of Interfor at Queensborough. The bark will originate from the merchandising section of the Interfor operation and will constitute hemlock/balsam processed bark from the debarking process only.

Saw dust and other wood waste from the sawmill, which potentially contain anti-sap stain chemicals, will not be used in the composting system.

The projected volumes of hembal bark arriving at the Fraser Port site will be in the order of 150 units/day (850 m^3/day). These will be composted in windrows. Each windrow will be approximately 8 meters high and 16 meters wide. The space between each windrow will be about 6 meters to enable vehicle access for processing and fire control purposes. The overall land area involved in the composting project will be about 51.7 acres (20.92 hectares)

Leachate Production and Treatment

Precipitation onto the composting bark during the composting process will produce leachate. It is expected that the leachate type produced will be highly coloured, have high oxygen demand, and will be toxic to fish at 100% concentration. Such leachate will also contain iron, manganese and possibly aluminum.

Since the proposed site is positioned between the existing leachate treatment plant and the closed municipal landfill area, the leachate produced can be readily collected and pumped into the existing leachate treatment system.

During the winter and springtime months when about 0.9 meter of precipitation falls on the site, leachate flow from the 20.2 ha municipal solid waste site will be 900 m^3/day. A similar volume of leachate will be derived from the composting site. This potentially increases the leachate flow into the lagoon and may reduce the residence time in the lagoon. However, the existing collection system for the municipal waste site extends about 100 meters east of the end of the municipal site and will also collect leachate from the proposed composting site. The combined leachate flow from these two sites will not exceed 2000 m^3/day and the retention time in the lagoons should not fall below 30 days.

Under the present manner of operation of the existing leachate control system, a large fraction of the leachate from the perimeter collection ditches does not pass to the aeration lagoons and only receives treatment by spray irrigation on the second spray area. Hence it is extremely important to make sure that little or none of the composting hembal bark leachate escapes into the north ditch. For this reason, it may be necessary to carry out minor modifications to the existing ditches and drainage collection system to minimize loss of leachate to the ditch system and to make certain that the hembal bark leachate is directed into the existing lagoons.

Leachate Quality

The proposed composting process yields some change in the characteristics of the wood waste. The fraction of nutrients in composted samples increases marginally but is very low.

Analysis of leachate produced from new hembal bark and from composted hembal bark shows that, although there has been a change in the chemical make-up of the leachates produced, both the new bark and the composted bark continue to produce strong leachate. Test leachates showed that the new hembal bark leachate will kill all exposed fish at 10% concentration, whereas the 96-h LC50 for leachate from the composted bark was 81%.

Both leachates had high oxygen demand (210 mg/L BOD_5 for new hembal bark, 322 mg/L BOD_5 for composted material). Based on this new information and information found in the literature, it is predicted that the biological oxygen demand of leachate pumped into the lagoon will be approximately 1500 kg/day.

Oxygen is supplied to the lagoon system by means of mechanical aeration units having a capability of providing some 2000 kg oxygen/day. It is concluded that the additional leachate entering the system from the composting operation will not lead to an oxygen deficient situation in the lagoons.

Previous treatability studies carried out by B.C. Research and others have shown that the biochemical oxygen demand of leachate from hembal bark can be reduced (at 85 to 90% effect) by aerobic digestion in aerated lagoons, provided the retention time in the lagoon exceeds ten days. This is the basic mode of operation of the present system.

Leachate Toxicity

It has been well established that the toxicity of leachate from the Fraser Port Richmond site is primarily due to the concentration of ammonia nitrogen in the leachate. Provided that ammonia nitrogen can be maintained below 10 mg/L, treated leachate is non-toxic to rainbow trout.

Hembal bark leachate from the composting operation will also contain toxic resin acids derived from the bark. Such resin acids may have some inhibitory effect on the ability of the nitrifying organisms to convert the toxic ammonia nitrogen into the non-toxic nitrate form. However, tests carried out in this study showed negligible impact of hembal bark leachate on the respiration rate of aerobic organisms, which suggests that the nitrification reaction was not inhibited. Toxicity due to the presence of resin acids will readily be removed in aeration lagoons.

Nitrogen Utilisation

It is expected that the increased addition to the lagoons of organic substances deficient in nitrogen will lead to a reduction of ammonia nitrogen content in the lagoon effluent. This is caused by utilisation of nitrogen in bacterial cell matter in the lagoons.

CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the composting process will lead to production of coloured, toxic leachate having high oxygen demand but being deficient in nitrogen content.

The additional oxygen demand will lead to an incoming leachate quality similar to that used in design test work for the existing lagoons. Oxygen supply and retention time in the lagoons will be sufficient to provide continued effective removal of biochemical and chemical oxygen demand. The final effluent should remain non-toxic to fish.

Although the composting will cause increases in the iron and manganese content (and possibly aluminum) of the incoming leachate, aeration will reduce these levels in the effluent and maintain their concentration within the permitted limits. Some minor engineering of the north perimeter collection ditch may be necessary.

1.0 INTRODUCTION

1.1 Objectives

To review a proposed composting process and predict whether it will impact on the character of leachate produced at the Fraser Port Richmond site.

To determine if the leachate can be effectively collected in the leachate collection system at the Fraser Port Richmond site and whether the existing leachate treatment system will be capable of maintaining the effluent quality within the limits of the pollution control permit.

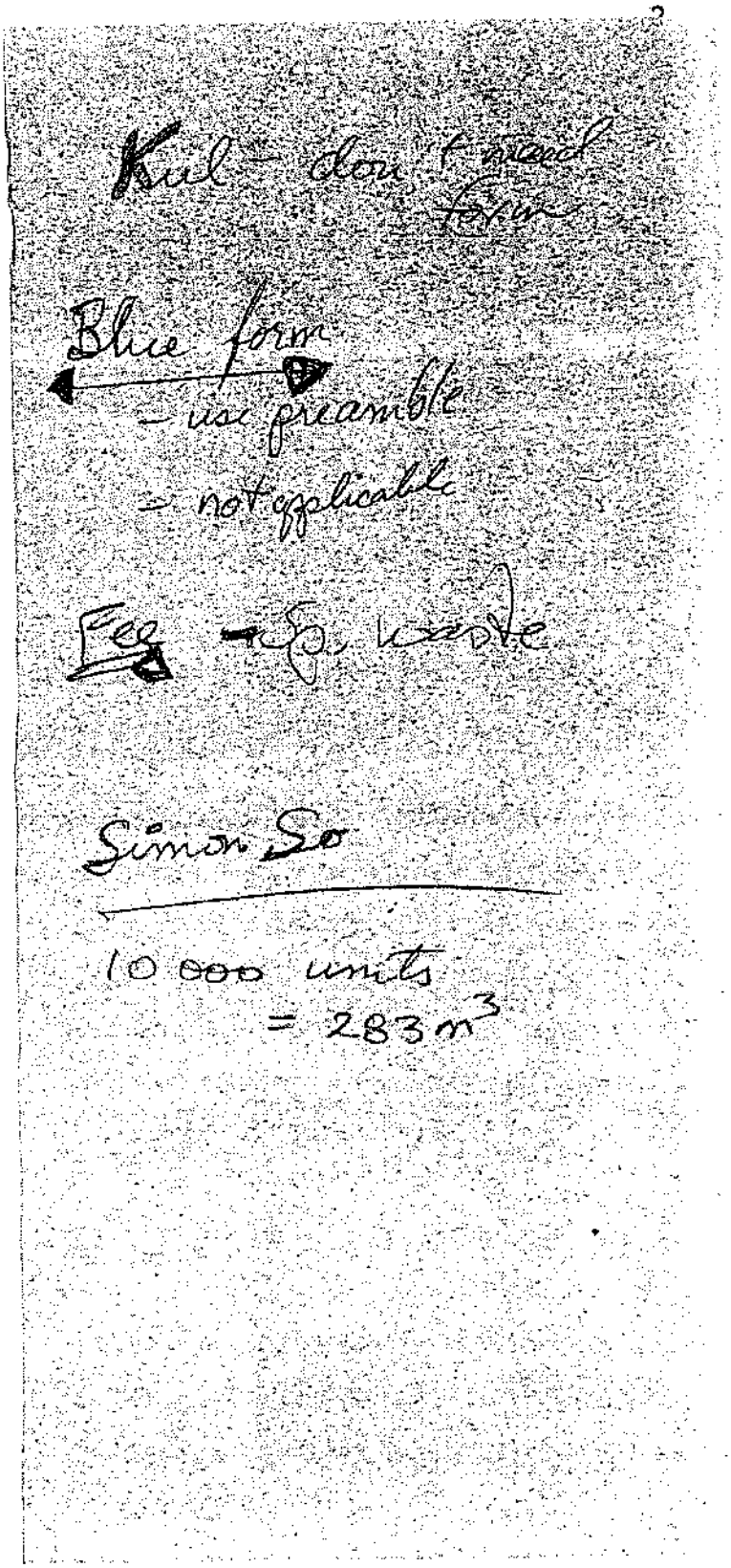
To determine if there are any unacceptable environmental effects likely to be caused by the composting process.

1.2 Background

Augustine Trucking Ltd. has been disposing of hembal bark materials on behalf of forest industry companies, in the lower mainland of British Columbia, for the past thirty years. In recent years the company has been using a form of composting for the treatment of bark from hemlock/balsam (hembal) processing plants to produce material suitable for replacement of peat in horticultural operations.

The company proposes to expand this operation and process the hembal bark from the Western Whitewood Division of INTERFOR, at Queensborough on Lulu Island. The composting operation will be carried out on the Fraser River Harbour Commission property known as Fraser Port Richmond.

As hembal bark is known to produce leachate when contacted with natural precipitation there is some potential that the leachate produced by the proposed composting



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of species from a sawmill near the

Bark and size-reduced hog fuel was piled approximately 8 m (25 feet) high. Two piles were on the property, with an estimated volume of 283 m^3 (10,000 volumetric units of

200 cft). The total site area was 1.5 acre. The content of one of the piles, the composting pile, was said to be characteristic for the materials to be composted at the Richmond site.

Hog fuel was received on the site and, after some self heating, aerated and piled onto large piles. The material would stay in piles for approximately 13 months. Afterwards, the material was turned and sieved and then repiled to cure. Three stages of the process were inspected: the receiving pile, the aerated material after one year, and the finished product.

2.2.1 Receiving Pile

Material was piled up with a backhoe and was well mixed. The inspected material came from the Interfor mill and was approximately 3 weeks old. Some self heating was evident, as temperatures read 35°C. Samples were taken for a modified leaching assessment, a nutrient and metal scan, pH and salinity.

2.2.2 One Year Old Material

Immediately before the site visit took place, the side of the pile was removed with a backhoe to expose the face of the pile. Removed material was placed close by for inspection. The top 3 m of the pile was brown in colour and wood material was still visible. The bottom of the pile was black in colour and compacted. Some material was removed by hand and the temperature of the pile was taken. The inside temperature read 85°C. Loose material ranged in temperature from 35°C to 65°C. The freshly opened face emitted steam but no odours were detected in the vicinity of the pile. The black material itself emitted a slight burnt odour. Samples were taken for a modified leaching assessment, a nutrient and metal scan, pH and salinity.

2.2.3 Cured Material

Material cured for one month after aeration and sieving, was black in colour, and did not have a distinct burnt smell. Some steam emitted from the pile. Under the surface, the pile showed characteristic patterns of fungal growth. However, the odour, typical for a well-cured, rich compost was not detected.

Samples were taken for a modified leaching assessment, a nutrient and metal scan, pH and salinity.

2.3 Visit to the Mill Site

Mr. Birkbeck and Dr. Timmenga visited the Interfor Sawmill in Queensborough. This mill is a computerised saw mill. The operation is physically separated in two parts. The merchandiser debarker is situated on the waterfront, the mill is located in the middle of the property. Logs are received at the waterfront from the storage areas in the Fraser River. They are fed into the debarker, sorted according to diameter and stored in the yard. Bark is hogged and transported by conveyor belt to a hopper situated away from the sawmill. The material is then loaded into trucks and removed from the property. This debarking system and bark handling system is set-up so that no wood or sawdust from the mill may enter it at any point.

Sorted logs are fed into the sawmill with a conveyor belt. The logs are automatically measured and turned, then cut. Each shift is using only one diameter class of logs. Boards are cut, graded and sprayed with the anti-sapstain chemical NP1. Sawdust from the mill is collected in a hopper for transport to a particle board mill, chips made from reject material is collected in a batch for transport to a pulpmill. Contaminated sawdust (NP1) is collected in barrels for removal and destruction. Both the chip and sawdust conveyors are separate from the bark conveyor. Traces of NP1 may be found in the chips and sawdust because treated lumber may be sent to the remanufacturing line for reprocessing.

The visit to the sawmill site satisfies us that no wood preservative from the mill will enter the debarking system at any time. Therefore it is not necessary to analyze the bark for wood preservatives.

2.4 The Pollution Control Permit PE6276

The currently applicable pollution control permit #PE6276 was last amended on February 1, 1984. This permit describes the site as "the Richmond Landfill Site" and the point of discharge as the Fraser River via No. 7 Road Ditch.

The permit allows a discharge of effluent up to 10,000 m^3/day (based on a monthly average). The acceptable characteristics of the discharge are presented in Table 1.

It should be noted that the permit does not cite a maximum concentration for ammonia-nitrogen, the pollutant which is known to contribute a significant portion of the toxicity to the leachate. However Appendix C-1 of the permit lists parameters to be measured in the final discharge and Appendix C-4 lists other parameters to be measured in the final discharge and in samples collected from the receiving waters in the general environment of the landfill. This list includes, chloride, nitrite, nitrate, ammonia-nitrogen, sodium, potassium and total phosphorus.

It should be noted that Appendix B-1 of the permit states in item D: "The permittee shall notify the Regional Waste Manager prior to implementing any change to any process that may affect the quantity and/or quality of the discharge."

TABLE 1

CHARACTERISTICS OF AN ACCEPTABLE EFFLUENT DISCHARGE AS DESCRIBED IN PERMIT PE6276

Non-Filterable Residue (Total Suspended Solids)	40 mg/L
5-day Biochemical Oxygen Demand	30 mg/L
pH	6.5 to 8.5
Copper (dissolved)	0.2 mg/L
Iron (dissolved)	12 mg/L
Manganese (dissolved)	3.3 mg/L
Lead (total)	0.05 mg/L
Zinc (total)	0.5 mg/L
Mercury (total)	0.0006 mg/L
Sulphate (dissolved)	250 mg/L
Toxicity	Non-toxic to fish

2.5 Background Water Quality at Fraser Port

Although samples are collected at quarterly and monthly intervals from the leachate treatment plant at Fraser Port, to satisfy the requirements of B.C. Environment and Environment Canada, several characteristics of the leachates entering the lagoon system were not available. For this reason samples of the leachates, or effluents, were collected from the following sites during the first week of January 1992.

- raw leachate from sample site #8
- raw leachate from sample site #9
- raw leachate from the collection ditch on the north perimeter
- lagoon effluent
- feed to the second spray area
- final effluent.

The samples were analyzed using standard protocols for:

- pH
- five-day biochemical oxygen demand (BOD_5)
- chemical oxygen demand (COD)
- ammonia nitrogen
- total phosphorus
- sulphate
- sulphide
- toxicity to rainbow trout
- metals
- resin acids

2.6 Characteristics of the Hembal Bark and Leachate

During a visit to the site in Pitt Meadows where the composting process is currently being done, samples of both the raw hembal bark and the partly composted and completely composted materials were collected. In addition, samples of the leachate accumulating on the site were collected.

To determine if there were any differences in the quality of leachate produced by old and new hembal bark, samples of each material were placed into 20 L containers which were then filled with Vancouver tap water. The containers were allowed to stand over the weekend and the water drained off on the following Monday. The two samples of leachate produced were analyzed and tested for toxicity to rainbow trout.

2.7 Inhibition of Nitrification

One of the potential problems that may be caused by the compost leachate is the inhibition of the nitrification process. Demonstration that the leachate inhibits (or does not inhibit) the nitrification reactions in the aerated lagoon system is difficult in the

given time frame of the test program. However a simple laboratory test using activated sludge organisms from a pilot-scale waste water treatment system, presently treating domestic sewage, was carried out.

In this test a sample of activated sludge was mixed with samples of:

- raw sewage
- raw leachate from fresh hembal bark
- raw leachate from composted hembal bark.

Each sample was aerated so that the concentration of dissolved oxygen in the sample exceeded 6 mg/L. The mixture was placed in a sealed bottle (a BOD test bottle) and the dissolved oxygen level in the mixed solution continuously monitored by means of a YSI dissolved oxygen electrode inserted into the bottle. Mixing of the liquid contents was done by means of a magnetic stirrer.

The concentration of activated sludge solids in the undiluted activated sludge sample was assayed and from the two measurements the rate of oxygen utilisation per unit of activated sludge solids calculated.

The test activated sludge contained 3150 mg/L mixed liquor suspended solids (MLSS). When mixed with an equal volume of sewage the oxygen uptake rate was 19.2 mg/L/hr. The rates observed, when diluting the activated sludge with leachate, were 12 and 15 mg/L/hr for the leachates from fresh hembal bark and composted hembal bark respectively. The test implies that the leachates do not have any major inhibitory effect on the aerobic organisms and that biodegradation is likely to proceed normally. However, if one considers the BOD_5 concentration in the leachates from fresh and composted hembal bark and the Pitt Meadows leachate sample, removal rates in the order of 12 mg/L/hr would reduce 210 mg/L to less than 30 mg/L in 15 h, 322 to less than 30 mg/L in 24 h, and 1600 to less than 30 mg/L in 130 h. These approximations would apply to an activated sludge system only and would suggest that for a system

operating with an MLSS concentration above 1500 mg/L, the BOD_5 concentration of the effluent (30 mg/L BOD_5) allowed by the permit would be obtained in a retention time of between 1 and 5.5 days.

2.8 Discussions With Fraser River Harbour Commission Staff

Formal presentation of this document to Fraser River Harbour Commission staff will be made by the proponents of the composting operation. It is expected that B.C. Research personnel will be called upon to clarify any concerns of the Commission. In addition B.C. Research will review the document with the FRHC, Manager of Operations and Environmental Control Officer prior to the annual review of leachate treatment plant performance made to Environment Canada, Environmental Protection Service.

3.0 FINDINGS

3.1 The Fraser Port Site

The Fraser River Harbour commission is the owner of the Fraser Port site formally known as Richmond Landfill. The 265 hectare site is located along the south arm of the Fraser river adjacent to an agricultural drainage ditch running south beside No. 7 Road (see Figure 1).

Municipal, industrial, and demolition wastes have been deposited in the landfill between the years 1956 and 1987 inclusive. The municipal wastes were confined to an area known as the "50 acre" (20.2 ha) site which is situated west of the No 8 Road entrance (see Figure 2).

3.1.1 Leachate Control and Collection System

The site is surrounded by a dike and access roadway along the south side and by ditches along the east,west, and north sides. The ditches were constructed to collect leachate

from the site and prevent its migration to surface waters and onto the farm lands north and east of the site. Loss of leachate into the Fraser River is prevented by the dike and compacted roadway along the south side of the site.

3.1.2 Leachate Treatment

The Fraser River Harbour Commission constructed a leachate treatment system designed by Public Works Canada and based on treatment technology provided by B.C. Research. The treatment system, first installed in 1982, consisted of an aerated lagoon with a capacity of 21,000 m^3 and a 200 m by 100 m spray irrigation area. Since then the treatment system has been monitored by B. C. Research as required by B.C. Environment and Environment Canada, Environmental Protection Service. It should be pointed out that this treatment system was installed following court action under the Fisheries Act in which the Commission, Richmond Landfill Ltd., and the City of Richmond were defendants.

Modifications and expansions to the treatment system have been carried out, so that the aerated lagoon capacity is presently 63,500 m^3. A second spray irrigation area increased the filtration area from 2,000 m^2 to 6000 m^2. In 1986 a change in the collection system allowed segregation of the leachate from the old municipal landfill area (20.2 hectare) and separate treatment in the aeration lagoons. In this manner the leachate containing high concentrations of ammonia nitrogen has about 30-days retention in the lagoons regardless of the time of year, and a substantially longer retention time in the summer to maximize the conversion of the toxic ammonia to non-toxic nitrate-nitrogen or nitrogen. The lagoon effluent is then sprayed onto the first spray area and the runoff, combined with leachates from the rest of the site, is resprayed onto the second spray area.

The final treated leachate is aerated as it cascades down the discharge channel into No. 7 Road ditch.

3.1.3 Oxygen Supply and Nutrients

Oxygen is supplied to the aeration lagoons by means of floating mechanical aerators of the "AIRE O_2" type[1]. These units inject air through a turbine thereby providing a plume of fine bubbles some 15 meters long. In addition to providing aeration they cause effective mixing of the lagoon contents. The system has twenty units available however regular maintenance is required, hence all the units are not active all the time. The potential oxygen transfer to the lagoons is in the order of 2000 kg oxygen/day.

Because most landfill leachates are phosphorus deficient and biotreatment is more effective with optimised phosphorus levels, chemical addition of trisodium phosphate is practised.

3.1.4 Monitoring the Performance of the System

Regular monitoring of the leachate, groundwater, final discharge, and receiving waters in surrounding areas has been carried out by B.C. Research since 1982 (see Figure 2). Reports have been submitted to B.C. Environment and Environment Canada.

The B.C. Environment permit requires quarterly monitoring of the final discharge, and other receiving surface waters in the local environment of the discharge and where leachate was known to leave the site prior to the installation of the collection ditches (see Figure 3). Assays of the surface waters are made for pH, temperature and dissolved oxygen content, biochemical oxygen demand, non-filterable residue, nitrite, nitrate, ammonia, total phosphorus, chloride and sulphate. Samples are also analyzed for the metals, lead, copper, zinc, mercury, iron, manganese, sodium, and potassium.

The temperature and flow rate of the final discharge is continuously recorded by instruments installed and monitored by Inland Waters Canada. In addition, the

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[1]Supplied by Aeration Industries Inc., 1107 Hazeltine Boulevard, Chaska, MN, 55318, U.S.A.

precipitation data accumulated by Environment Canada Atmospheric Environment Service monitoring station at the Vancouver Airport is collected for inclusion in reports to the Commission.

In addition to surface water monitoring, B.C. Environment requires monitoring of the water quality in groundwater wells on the west and east sides of the site. Environment Canada also requires monitoring of the actual treatment system at monthly intervals during the rainy season.

Bioassays using rainbow trout are carried out as required by both regulatory agencies on the final discharge only.

In the monitoring done for Environment Canada samples of the incoming leachate, the lagoon effluent, and the final discharge are assayed for both biochemical and chemical oxygen demand, pH, temperature, dissolved oxygen, sulphide, ammonia, non-filterable residue and organic carbon.

A summary of the treatment system's performance is presented in Table 3. Historically water flow rates have been measured as high as 10,000 m^3/day but the norm is now in the order of 7,000 to 8,000 m^3/day during the winter period.

3.1.5 Characteristics of Leachates and Effluents from the Fraser Port Site

Table 1 shows the concentrations of various parameters cited in Permit PE 6276 for the various sample sites in the environment of the landfill. Additional data describing the leachate treatment plant performance is presented in recent reports prepared for the Fraser River Harbour Commission (7) (8). Leachate entering the lagoons from sample points 8 and 9 is approximately neutral (pH 6.9 to 7.4) and has significant chemical oxygen demand. However only the recently collected sample from Site #9, the south Lagoon ditch, showed high content, at 280 mg/L BOD_5 (see Table 4). Samples collected over the three years between 1988 and 1990 record this stream to have a biochemical

oxygen demand between 10 and 61 mg/L (average 28 mg/L) and a chemical oxygen demand average of 216 mg/L. Samples collected in 1991 show values of BOD_5 between 14 mg/L and 206 mg/L.

The recent higher values (206 mg/L and 280 mg/L BOD_5) obtained for the sample collected in November 1991 and on January 4, 1992 is elevated due to introduction of leachate from a hog fuel waste pile at the Fraser Surrey Docks. The practice of adding this leachate (in amounts of about 20 m^3/day) commenced in December 1991. It has been proposed to move this old hog fuel from the Fraser Surrey Docks to the Richmond site (see Section 3.1.6).

The data in Table 3 show that ammonia nitrogen concentrations are high (average 75 mg N/L) in incoming leachate from the municipal site (#8 sample point on Figure 2), and are lower in the lagoon discharge (average 18.8 mg N/L) and are reduced to <1.7 mg N/L in the final effluent. It should be noted that leachate taken from the north perimeter ditch (Table 4) contained 29 mg N/L ammonia nitrogen.

The implication of this relatively high value for ammonia nitrogen in perimeter ditch water is that the underdrain system, installed parallel to and south of the north ditch, does not collect all of the leachate from the municipal landfill area.

In regard to the leachate treatment the concentrations of all the measured parameters present in the final discharge are well below those specified in the permit. The highest value for iron in the final leachate was 4.8 mg/L in November 1989, a value well below the permit level of 12 mg/L. Indeed, except for the occasional presence of high concentrations of sulphate, originating from dredge waters, the operation of the system has been in compliance with the permit for several years. The final effluent is very low in ammonia nitrogen and is non-toxic to rainbow trout. Other data show that all the parameters defined in the permit are within compliance concentrations.

Metal concentrations in the receiving waters are shown in Appendix Table A-2.

3.1.6 Hog Fuel From Fraser Surrey Docks

In a letter to Ms. Pat Weber, Environmental Control Officer for Fraser River Harbour Commission, B.C. Research commented on the feasibility of placing a large amount of old hog fuel on the site immediately south of the aeration lagoons. It is our understanding that this hog fuel, stored on the Fraser Surrey Docks (FSD), has now been distributed to other users and will not be sent to Fraser Port Richmond. However calculations presented in this report include the possibility that the area south of the aeration lagoons could potentially be used for storage of woodwaste.

4.0 LEACHATE, CHARACTERISTICS, VOLUME AND TREATMENT

A major potential problem that may arise due to the storage of wastewood in any form on the Fraser Port Richmond site is the generation of leachate. Such leachate may be different from the leachate currently produced by materials landfilled at the site. Differences may occur in strength, volume and biodegradable character. Some indication of each of these measures must be defined in order to assess whether the leachate will have any impact on the quality of the discharge from the existing treatment plant. The following sections attempt to define the characteristics and volumes of leachates that may arise from the proposed composting process. The feasibility of treating the leachate is presented in the discussion Section 6.3.

4.1 Characteristics of the Hembal Bark

Table 2 shows the chemical breakdown of the hogged hembal bark material. Metal concentrations are shown in Appendix Table A-1. Concentrations of resin and fatty acids found in the Hembal bark leachate are presented in Appendix Table A-3.

The hembal bark tends to lose some carbon content during the aging or composting process and undergoes minor changes in phosphorus and nitrogen content. The total nitrogen content is low and increases from 1.8 mg/g to 2.4 mg/g after composting

(Table 2). Regardless of age the hembal bark produces leachate having high oxygen demand and may contain high concentrations of iron, and manganese as suggested from Table A-1.

4.2 Leachate Characteristics

It is difficult to precisely define the quality of the leachate that will be fed into the lagoon system when the composting area is completely full. However some concept of the leachate characteristics can be drawn from the data presented in Table 4. The leachate sent to the lagoons will be a combination of leachate from Municipal Site 8, South Lagoon ditch and hembal bark leachate. In the worst scenario, leachate would compare to that collected from the Pitt Meadows site. The latter shows dissolved chemical oxygen demand of 5499 mg/L, and total BOD_5 was >1500 gm/L.

The leachates, produced by standing hembal bark samples in water over the weekend, showed dissolved chemical oxygen demands of 961 and 1098 mg/L and biochemical oxygen demands of 210 and 322 mg/L respectively.

Calculation of the dissolved BOD_5 for the Pitt Meadows site sample, based on ratios of dissolved COD/BOD for the old hembal and new hembal samples, suggest that the actual BOD_5 was about 1600 mg/L.

Table 2 shows the carbon, sulphur, nitrogen and phosphorus content of the hembal bark samples. The data suggest that leachate from the composting hembal bark will not contain very high levels of ammonia-nitrogen or phosphorus nutrients. Based on the carbon contents of the leachate samples, phosphorus content of the hembal bark leachate will not exceed 1.07 mg/L and is more likely to be in the order of 0.1 mg/L. Both nitrogen and sulphur levels will be low.

The latter will probably exist as sulfide or mercaptan in the leachate since it will most likely be in a reduced form due to the high oxygen demand of the leachate. However

analysis of the old and new hembal bark leachate showed 30 and 37 mg/L sulphate. This probably originates from salt water saturation of logs before processing.

The net effect of mixing hog fuel leachate with the flow from the municipal site will be an increase in carbonaceous content. Both the ammonia-nitrogen content and the phosphorus levels will remain much the same.

Appendix Table A-1 shows the metals present in the hembal bark and in the compost. The data suggest that leachate from this material may contain elevated levels of calcium, iron, magnesium, aluminum, sodium, potassium and manganese.

Of these metals those of concern, cited in the pollution control permit, are iron and manganese. Aluminum which is not cited on the permit could show at higher concentration in the leachates at the site. The bark contains silts and clays resulting from the storage of logs in the Fraser River. The silts and clays may explain high aluminum levels; therefore aluminum may not be in a soluble form.

Appendix Table A-2 shows that aluminum levels are below 0.1 mg/L at all sample stations at the Fraser Port site.

Concentrations of resin acids in leachates at the Fraser Port site are presented in Appendix Table A-4. The data show that these substances could not be detected in any of the leachates or effluents. Appendix Table A-3 shows both resin acids and fatty acids were detected in leachate from hembal bark.

In general both resin acids and fatty acids are low in comparison to some bark leachates such as from cedar. There is some change in the concentrations of resin and fatty acids due to the composting (or aging) process. Higher concentrations of fatty acids are present in the aged hembal compost.

Regardless of age the hembal bark will produce a leachate having high oxygen demand, and containing high concentrations of iron and manganese. It will be toxic to fish. However, leachate from the aged hembal bark is less toxic than that from fresh hembal bark (Appendix B1).

4.3 Potential Volumes of Leachate

One of the most important impacts that may occur to the waste treatment plant is the possibility of an increase in leachate volume sent to the plant. Such an increase would lead to a reduction in the retention time in the lagoons and potentially an inferior effluent quality. Regardless of the areas used for the storage and/or composting of hembal bark, additional wastewater or leachate flows cannot occur until there is a change in the engineering of the feed system to the plant. Under the present method of operation there are two pumps which feed liquid to the plant. The Municipal pump station No. 8 (shown as Number 8 on Figure 2) feeds liquids collected from an arrangement of perforated pipes buried between the 20 hectare municipal site and the north perimeter ditch. No. 9 pump station (shown as Number 9 on Figure 2) collects leachates from the south and east sides of the lagoon treatment system via an open ditch.

It is concluded that there will be no increase in leachate flow until it becomes necessary to collect leachates that may escape into the north ditch. The entire leachate collection system relies on horizontal movement of leachate towards the perimeter ditches. Leachate passes downwards through the fill until it reaches an impermeable barrier formed by compression of peat layers and an underlying clay silt material. The leachate then moves towards the perimeter ditches. Although it will not be necessary to site the proposed composting operation on a prepared impermeable area it will be necessary to arrange the operation so that all of the leachate is collected and pumped into the treatment system.

If this is done then the leachates fed into the treatment plant will include:

- leachate from the 50 acre municipal site
- leachate from the composting site
- leachate from the area south of the lagoons where it is proposed to store hembal bark presently at the Fraser Surrey Docks.

4.3.1 Maximum Leachate Volume Based on Precipitation

Calculations presented in Appendix C show that the maximum possible average daily leachate flow from the site is 42.8 m^3/hectare. These calculations are made from the total precipitation on the site between November 1 and April 30. If one assumes that the maximum area available for strong leachate production is:

20 (municipal area) + 21 (composting area) + 4 (area south of lagoon) = 45 hectares

Then the maximum average daily flow during the winter period will be 1926 m^3/day.

It should be noted that no account has been made for the loss of leachate volume due to evapotranspiration. Evapotranspiration is high in the summer but is negligible during the winter. However, biological heat production in an active composting operation will produce substantial evaporation.

4.4 Collection and Routing To the Treatment System

As previously mentioned in Section 4.3 leachate is pumped to the treatment system by means of pumps sited at stations 8 and 9 (see Figure 2). It is expected that the ditch leading to pump station 9 will collect all of the leachate that is passing through sub-soils in a westerly direction. However leachate moving northwards will pass, in the main, into the north perimeter collection ditch. Some of the leachate will be collected by the underground perforated pipe system running west-east from pump station 8. A simple method to collect leachate passing into the north collection ditch would be to install a pipe within this ditch from points A to B (Figure 4). This pipe would allow flows from

the east section of the site to pass towards the second spray area. The leachate from the ditch between A and B and not contained by the pipe, would then be diverted to pump station 8. For very high leachate flows an overflow arrangement could be made.

5.0 AIR POLLUTION CONCERNS

5.1 Odours

The presence of sulfide in the municipal leachate and the south lagoon ditch causes some odours due to hydrogen sulfide. The south lagoon ditch samples also contain relatively high levels of sulphate (65 mg/L).

Odours from the landfill area and from sites where hembal bark have been stored or landfilled are usually associated with the rotten-egg smell of hydrogen sulfide. The problem has existed at the Fraser Port Richmond site for several years and is primarily associated with the reduction of dissolved sulphates derived from gypsum wallboard waste in the landfilled demolition material. Parts of the site are known to contain large amounts of landfilled wallboard waste. High concentrations of hydrogen sulfide have been measured in gas samples at bore hole stations both by E.H. Hanson and Associates and B.C. Research (6). Ground gas samples show significant levels in the area proposed for the composting site. These are also reflected in sulfide levels measured in samples of leachate collected from Station 9. Figure 6 shows areas where odours can be expected.

There are two factors likely to yield increased levels of hydrogen sulfide, both in the leachate and in the landfill gases. These are, the overall reduction/oxidation potential and the pH. The reduction/oxidation potential is a measure of the oxidation state of the groundwater system. When there is a large demand for oxygen by organic pollutants the reduction/oxidation potential will fall. At a measurable point (i.e. when the groundwater becomes anaerobic) any sulphates in the ground water will be converted to sulfides. An increase in sulfide content would then occur.

The hembal bark leachate will tend to lower the pH of the landfill leachate. However this tendency will be buffered by the high calcium and sodium content of leachates from the municipal site and the south east drainage ditch. Tests carried out for this study showed that mixing the hembal bark leachate with the municipal waste leachate actually increased the pH of the mixture.

The presence of free (ionic) iron will also tend to control sulfide odours. This iron will combine with sulfide and form insoluble iron sulfide. Any sulfide produced is rapidly oxidised in the aeration lagoons and/or precipitated as the insoluble iron salt in the first lagoon. It is concluded that although there may be some increase in sulfide odour it is unlikely to be severe.

A major factor controlling hydrogen sulfide products from the composting site itself will be the presence of compost. Compost filter systems are commonly used in waste management for the control of odours. B.C. Research demonstrated at the Coquitlam Landfill that a 1 m deep layer of sand mixed with hog fuel would reduce hydrogen sulfide gas concentrations from about 200 ppm to non-detectable levels. The compost filter systems are now used for odour control at chemical plants, paper mills, municipal composting operations and landfills.

Other odours at the site may be expected to be pine/resin odours associated with hembal bark. These odours are unlikely to cause annoyance to any residents near to the site. It should be noted that the nearest residences are those on No. 7 Road just south of Westminster Highway and roughly 2 km from the proposed composting operation. People in these residences in the past have indicated that sulfide odours from the landfill(s) occur from time to time.

5.2 Dust

Air pollution monitoring permits in the Greater Vancouver Regional District are policed by the GVRD. As the hembal bark to be composted is in a hogged form and **IS NOT SAWDUST** the problem of fugitive dust is expected to be negligible.

In any event, the material must be kept damp in order to promote the composting process. This damping will be done with leachate from the treatment lagoons.

5.3 Fire Protection

When a composting process, similar to the Pitt Meadows operation, is fully operational there will be some 6.5 million m^3 of hembal bark on the site. Examination of the composting operation at Pitt Meadows showed that compost temperature could increase to 85°C. The fire potential is real, however it is expected that temperature in the compost will be controlled below 65°C. Temperatures above 70°C will kill the composting organisms. To prevent the possibility of fires careful temperature control must be observed, and the temperature would be controlled by turning the compost.

Rapid building of high piles will cause the entrapment of heat from biological activity. The exposure of an active chip or hog pile to oxygen can cause a fire. Through slowly building a pile or windrow of <20' high, temperature monitoring, aeration for cooling purposes and spray irrigation, fire potential can be significantly lowered.

Additional fire protection must be arranged. It is expected that this would be derived from the lagoons.

6.0 DISCUSSION

6.1 The Proposed Composting Operation

The proposed composting operation will be carried out with hembal bark produced by the merchandising line at the Western Whitewood Division of Interfor in Queensborough.

Composting has been practised for several years by Augustine Trucking Ltd. on another site. Observations made at this site suggested that the current practice may be a combination of biological self-heating, compaction and charring of carbonaceous materials. Fresh material was self-heating within 3 weeks and temperatures of approximately 35°C were measured. After aeration (once) and storage in a large pile (from 15 m high reduced to 8 m in 13 months) the bottom half of the pile was heavily compacted. In the undisturbed face, temperatures of 85°C were measured.

This finished product was black in colour and contained typical fungal growth. After aeration through screening, biological activity again took place during the curing stage. Extended curing may be needed to completely stabilize the compost.

When the composting operation at the Fraser Port Richmond site is fully operational, some 21 hectares of the landfill will be covered with hembal bark. A total volume of 6.5 million m^3 of hembal bark will be present on the Richmond site in various states of stabilization.

The composting process in windrows will demand careful management to ensure adequate stabilization and to avoid fire situations. Composting is an aerobic biological process, where bacteria, and fungi degrade organic matter and stabilize nutrients. Therefore, for aerobic composting to take place, an ample supply of oxygen should be available. Oxygen can be supplied through frequent mixing or through forced-air aeration. Both techniques have been used in composting of bark products. Because temperatures above 65°C must be prevented in order for the bacterial processes to

continue, careful temperature monitoring should take place. When windrow temperatures reach 65°C, aeration for cooling purposes must take place. Such a practice will also reduce the fire hazard.

The composting of hembal bark at the Pitt Meadows site required about 14 months to mature, during which time, leachate was produced. To speed-up the composting process, nutrients could be supplied. Added nutrients will also increase the nutrient value of the finished compost. It is advisable to experiment with the management practices and nutrient additions in a pilot scale operation. The careful management of nutrient additions in conjunction with effective composting will limit nutrient losses into produced leachate. Again this must be determined in pilot operation before expansion of nutrient addition of the site.

The completed compost is very low in nutrient content and will probably have a greater value in the horticulture industry as a replacement for peat rather than a provider of nutrients, which is the conventional agricultural value of compost.

6.2 The Potential for Toxic Leachate

Regardless of the state of the hembal bark on the Fraser Port Richmond site, precipitation will lead to the production of leachate comparable in characteristics to other wood waste leachate described in the literature. This leachate will be highly coloured and toxic to fish. It will have high oxygen demand and will contain significant concentrations of iron and manganese. Although the concentrations of resin acids will be relatively low due to the type of wood waste, resin acids will be present and degradation of the wood waste will lead to the presence of fatty acids in the leachate.

6.3 Projected Impact of Leachate on Present Leachate Quality and Quantity

Regardless of the amount of hembal bark used or the area occupied by hembal bark there will be no net increase in the leachate volumes generated from the entire Fraser

Port Richmond site. However, it is expected that the current leachate quality will change due to leachate from the hembal bark. In the current situation the 5-day biochemical oxygen demand produced at the site is low. The average value for BOD_5 during the years 1988-1990 was 38 mg/L for incoming leachate at pump station #8 and <28 mg/L for pump station #9. Leachate from the composting site could conceivably show BOD_5 concentrations of 1000 mg/L. Similar BOD_5 concentrations may be anticipated from the area south of the aerated lagoon system where it has been proposed to place hog fuel from the Fraser Surrey Docks. This material actually originates from the Fletcher-Challenge Mill at Fraser Mills and is several years old. The waste was used as a source for test leachates in tests described by Birkbeck et. al. (1990). It is difficult to project what the combined leachate BOD_5 concentration will be, however it is unlikely to exceed a value given by:

$$x = \frac{aBOD_5 \times A + bBOD_5 \times B + cBOD_5 \times C}{a + b + c}$$

where A = leachate volume from municipal site
$aBOD_5$ = BOD_5 in leachate from municipal site
B = leachate volume from composting site
$bBOD_5$= BOD_5 in leachate from composting site
C = leachate volume from south of lagoons (FSD wastewood)
$cBOD_5$ = BOD_5 in leachate from FSD hembal bark

Feeding in the available data for these values we get:

$$x = \frac{38 \times 20 + 1000 \times 21 + 500 \times 4}{45}$$

= 528 mg/L when $bBOD_5$ = 1000 mg/L

x = 808 mg/L when $bBOD_5$ = 1600 mg/L

There are several studies in the literature which suggest that the 5-day biochemical oxygen demand of hembal bark leachate can be effectively reduced by aerobic biological treatment. Combinations of anaerobic and aerobic treatment have also been demonstrated to be effective.

In some of the earlier studies Thomas in CPAR report 393-2 (1) showed that the BOD_5 from Fir/Balsam leachate could be reduced from 2080 mg/L to 170 mg/L (92% reduction) in ten days aeration. Similar ten day aeration of leachate from Balsam/Douglas Fir and Hemlock/Douglas Fir gave 96 and 87% reduction of leachate BOD_5. In all three cases toxicity was removed.

Birkbeck and Walden (4) in tests carried out during the design stages of the existing treatment system at Fraser Port, showed 68.4% reduction of BOD_5 for a retention time of 10 days in a system operating under plug flow conditions. However, influent BOD_5 values were low (190 mg/L) and were derived from a mixture of municipal waste and woodwaste leachate.

Birkbeck and Reil (3) showed that 95% reduction of BOD_5 from Hemlock/Balsam hog leachate was possible in a sequencing-batch aeration system when operating at 5 days retention. A flow-through system obtained 97% reduction. Influent BOD_5 concentrations to these test systems were about 550 mg/L BOD_5 derived from woodwaste alone.

It may be concluded that the carbonaceous substrates produced during the leaching of hembal bark are readily biodegradable. However, for treatment in a lagoon type system, retention times well in excess of ten days are desirable (e.g. 20 to 30 days). For the treatment system at Fraser Port the leachate volume accrued, from all of the areas likely to produce strong leachate (the 20 ha Municipal site, the 21 ha compost site and the FSD hog storage site), is unlikely to exceed 2000 m^3/day. For this flow rate the retention time will be in the order of 30 days. Removal of biochemical oxygen demand should exceed 90% and is likely to be about 95%. For 90% reduction of leachate containing 528 to 808 mg/L BOD_5 the lagoon treated effluent quality will be 52.8 and 80.8 mg/L. For 95%

reduction, effluent quality would be 26.4 and 40.4 mg/L BOD_5. As the treated leachate from the lagoon is further diluted with leachate having lower BOD_5 and is sprayed twice onto sand areas it is reasonable to forecast that the final discharge BOD_5 will be within the 30 mg/L required in the permit. However, the situation will need careful monitoring and care must be taken to limit discharges of leachates from the auxiliary pump station.

Removal of ammonia nitrogen is also a concern. The leachate from the municipal site contains 60 to 86 mg N/L whereas leachate from Site 9 only contains on average 23 mg/L ammonia nitrogen.

Any additional leachate collected from the new composting area will have ammonia nitrogen concentrations in the same order. Biological degradation of the leachate from the compost will demand additional nutrients so that ammonia levels in the lagoon effluent may be expected to decline. The literature suggests that the ratios of BOD_5:N:P needed for effective biotreatment is 100:5:1.

For leachate which may range from 550 to 800 mg/L BOD_5 the nutrients needed for cell production will range from 25 to 40 mg/L of nitrogen and 5 to 8 mg/L of phosphorus. Because the lagoon effluent contains on average 20 mg/L ammonia nitrogen, the additional carbonaceous BOD_5 may lead to an effluent containing much lower ammonia nitrogen. Indeed the system may be nitrogen deficient and additional nitrogen may be required to sufficiently lower the BOD_5.

Phosphorus levels must be maintained in order to effect BOD removal.

6.3.1 Oxygen Requirements

Oxygen is supplied to the system by means of pontoon mounted Aire-O_2 surface aerators capable of introducing in excess of 2000 kg oxygen/day. For the predicted leachate

BOD_5 of 808 mg/L and for a flow rate of 2000 m^3/day and 95% reduction in oxygen demand the oxygen requirement will be in the order of 1535 kg oxygen/day.

Some oxygen will be provided by virtue of the lagoon surface. For temperate latitudes this is about 27 kg oxygen/hectare surface area. For the 4 hectare lagoon surface, oxygen transfer through the surface will be 108 kg oxygen/day. At this time, this oxygen transfer is adequate to maintain the effluent quality within the permit limits. This was demonstrated in operational tests carried out in the fall of 1991.

It is concluded that about 75% of the aeration capacity must be operated to maintain adequate oxygen supply.

6.4 The Capability of the Treatment System To Maintain the Current Effluent Quality

It is expected that the leachate from the composting hembal bark will increase the 5-day biochemical oxygen demand. However provided that the treatment system is maintained, including operation of floating aerators and continuous provision of phosphorus nutrients, the impact on the treated effluent quality will be minimal. An increase in effluent BOD_5 is expected and this potential must be monitored. It is suggested that an increased frequency of monitoring is warranted. Indeed we would expect Environment Canada to request a return to bi-weekly or even weekly monitoring of the treatment system until such time that it is demonstrated the system can adequately treat the new leachate. Ammonia-nitrogen concentrations may be reduced to such a low concentration that it is no longer likely to cause the toxicity associated with the effluent. BOD_5 may become the greater concern. Presently the monitoring done at the request of Environment Canada is performed at monthly intervals throughout the winter.

7.0 CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the existing leachate treatment system at the Fraser Port Richmond will be capable of treating leachates from the proposed composting site in addition to those from the existing site and the hembal bark leachate from Fraser Surrey Docks. The limiting criteria listed in the pollution control permit for an acceptable effluent discharge should be adhered to at all times.

Operation of aeration units will be mandatory to maintain adequate dissolved oxygen levels. Additional phosphorus nutrients may be necessary. Some minor redesign of the leachate collection system may be necessary to ensure that all of the hembal bark leachate is directed into the aeration lagoons.

It is recommended that more frequent monitoring of the leachate treatment system, utilising the sample points presently monitored at request of Environment Canada, should commence as soon as additional wastes are deposited on the site. The monitoring should be done bi-weekly.

In addition to the monitoring, a program must be established which will continuously measure temperatures within the composting windrows. Such a program will define when compost requires turning for optimum biological action, and will minimise the possibility of fires on the site.

LIST OF REFERENCES

1. Econotech Services Ltd. 1977. Consequences of Leaching from Pulp and Paper Mill Landfill Operations. CPAR Project Report 363-2. Fisheries and Environment Canada, Environmental Protection Service, Ottawa.

2. Birkbeck, A.E. 1990. Treatment of Landfill and Woodwaste Leachate. Research Poster Display presented at Globe 90, Conference, March 19-23, 1990, Vancouver, B.C.

3. Birkbeck, A.E., R. Hunter and D.D. Reil. 1990. Biological Treatment of Hog Fuel Leachate. Paper presented at British Columbia Water Waste Association Proceedings, April 1990, Victoria, B.C.

4. Birkbeck, A.E., and C.C. Walden. 1979. Treatability Studies on Leachates from the Richmond Landfill. Prepared for Richmond Landfill Ltd. by B.C. Research, Vancouver, B.C.

5. Birkbeck, A.E., R. Vos and C.C. Walden. 1979. Evaluation of Landfill Beds as Anaerobic Treatment Systems for Landfill Leachates. CPAR Project Report 732 Fisheries and Environment Canada, Environment Protection Service, Ottawa.

6. E.H. Hanson Associates Ltd. 1985. Report on Methane Hazards and Control at the Richmond Landfill Site. E.H. Hanson and Associates, Delta.

7. Birkbeck, A.E., Pickard, J. and B. Bennett. 1991. Review of Monitoring Data from the Fraser Port Richmond Site. B.C. Research, Vancouver.

8. Birkbeck, A.E. and J. Pickard. 1992. Review of Monitoring Data From Fraser Port Richmond for 1991. B.C. Research, Vancouver.

TABLE 2

CHARACTERISTICS OF HEMLOCK/BALSAM SAMPLES
(% DRY WEIGHT)

	CARBON	SULPHUR	PHOSPHORUS	NITROGEN
New Hog	55.0	0.17	0.0133	0.1795*
Medium Hog	55.0	0.12	0.0140	0.2205
14 Month Old Hog	49.6	0.11	0.0227	0.2376

* equivalent to 1,795 $\mu g/g$.

TABLE 3

SUMMARY OF TREATMENT SYSTEM PERFORMANCE (1991)

	MUNICIPAL LEACHATE	SOUTH DRAINAGE DITCH	LAGOON EFFLUENT	FINAL DISCHARGE	NO. OF DATA
pH	6.2 to 7.1	6.4 to 7.2	7.2 to 8.3	7.5 to 8.2	7
Total Suspended Solids (mg/L)	6.4	14.4	6.3	15.8	7
BOD_5	26	51	<18	<11	7
COD	211	244	128	70	7
TOC	62.5	69.4	43.5	<16.7	7
Ammonia	75	18	<18.8	<1.7	7
Dissolved Oxygen	<1.2	<1.1	5.9	7.8	7
Sulfide	<2.9	<2.0	<0.5	<0.5	7
Temperature (°C)	13.6	12.1	8.1	7.6	7
96-h LC50 Bioassay % v/v				>100	5
Flow m^3/day for the year of 1990				3083	

TABLE 4

CHARACTERISTICS OF LEACHATE FROM HEMLOCK/BALSAM BARK
HOG FUEL AND LEACHATES FROM VARIOUS SITES OF FRASER PORT, RICHMOND

		OXYGEN DEMAND (mg/L)		DISSOLVED ORGANIC CARBON	TOTAL PHOSPHORUS	AMMONIA	SULPHATE	SULFIDE
SAMPLE LOCATION	pH	CHEMICAL (mg/L)	BIOCHEMICAL (mg/L)	(mg/L)	(mg P/L)	(mg N/L)	(mg SO_4/L)	(mg S/L)
Municipal Site #8	6.9	230	29	-	-	75	50	<0.05
South Lagoon Ditch #9	7.4	384	280	-	-	7.1	65	4.8
Lagoon Effluent #2	8.0	153	<10	-	-	30	61	<0.05
Final Effluent #3	7.8	72	<10	-	-	2.1	41	<0.05
New Hemlock Bark Leachate	5.7	1260 (961)	210	345	0.08*	1.1*	37	-
Old Hemlock Bark Leachate	5.2	1863 (1098)	322	370	0.09*	1.5*	30	-
Pitt Meadows Site Leachate		7757 (5469)	>1,500	2,330	1.07*	11.1*	79	-
North Perimeter Ditch	6.9	67	<10	-		27	7.6	<0.05

Data in parenthesis represents value for a filtered sample.
* Calculated from ratios of C:N:P shown in Table 1 and dissolved carbon content.

TABLE 5

TOXICITY OF LEACHATE FROM HEMLOCK/BALSAM HOGFUEL AND VARIOUS SITES AT FRASER PORT RICHMOND

SAMPLE LOCATION	pH	CONDUCTANCE µs/cm	DISSOLVED* OXYGEN mg/L	TOXICITY 96-h LC50 %
Municipal site #8	6.9	2,500		15.9
South Lagoon Ditch #9	6.9	1,300		>49 <65
North Perimeter Ditch	6.9	1,175		39.6
Lagoon Effluent	6.9	1,650		26.6
New H/B Hog Leachate	5.7	900	9.0	<10
Old H/B Hog Leachate	5.2	340	8.4	81

* Initial dissolved oxygen at start of bioassay test.

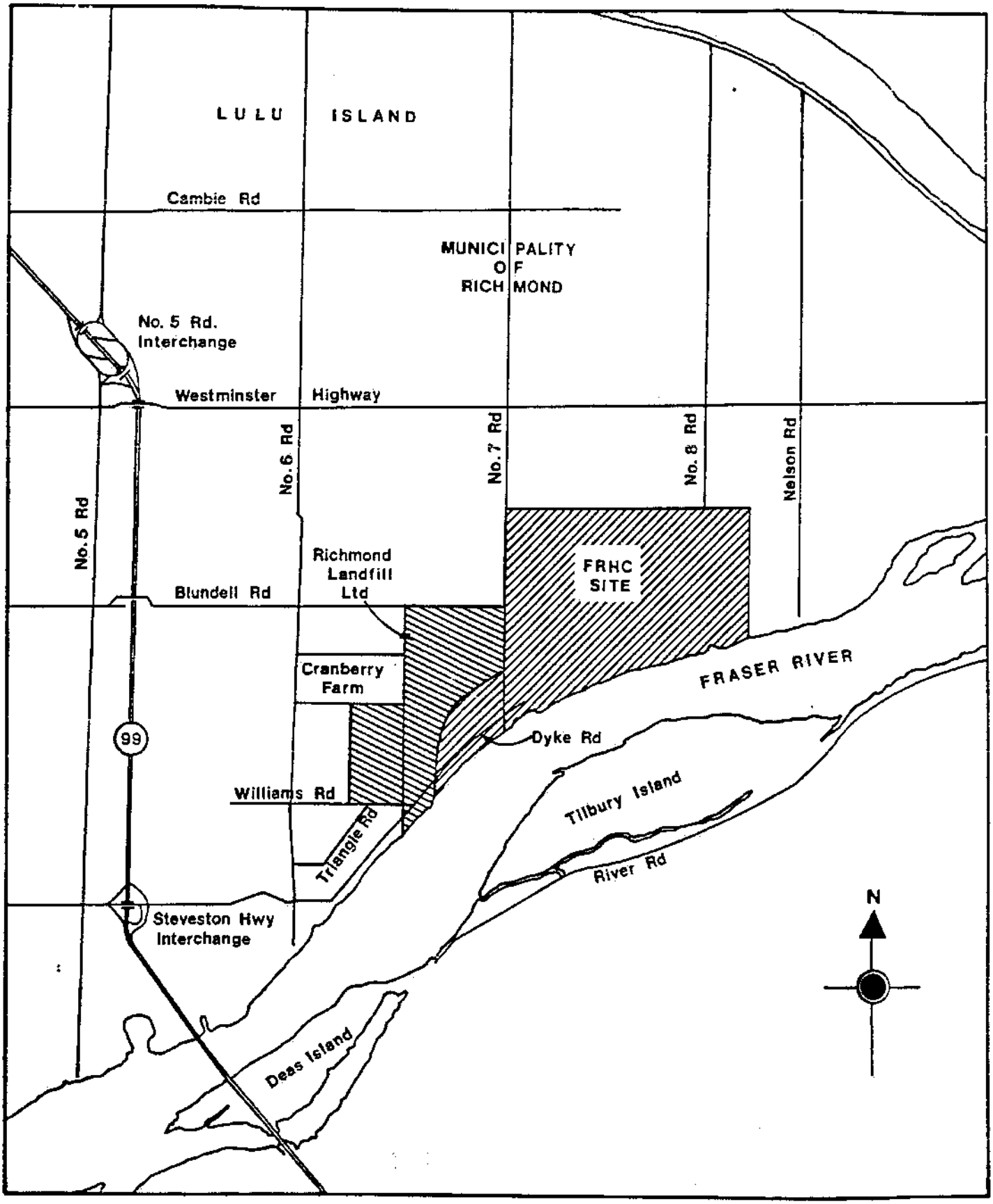
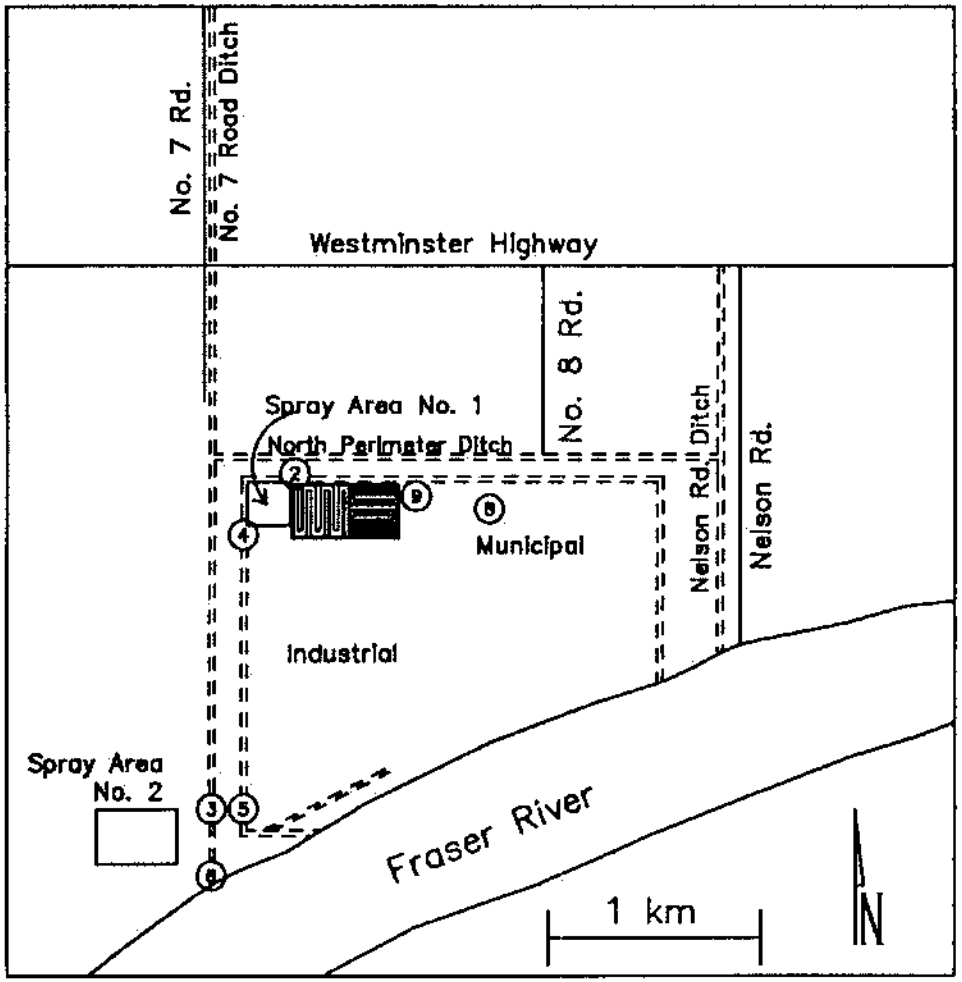


FIGURE 1 - Fraser Port Richmond
Location Map

Figure 2. Fraser Port Richmond
Showing Location of Sampling Sites



Monthly Sampling Sites

2 Lagoon Effluent
3 Final Effluent
4 First Sand Filter Effluent
5 Application to Second Sand Filter
6 No.7 Road Ditch at Outfall to Fraser
8 Municipal Site
9 South Lagoon Ditch

Figure 4. Fraser Port Richmond Showing Location of Proposed Composting Site

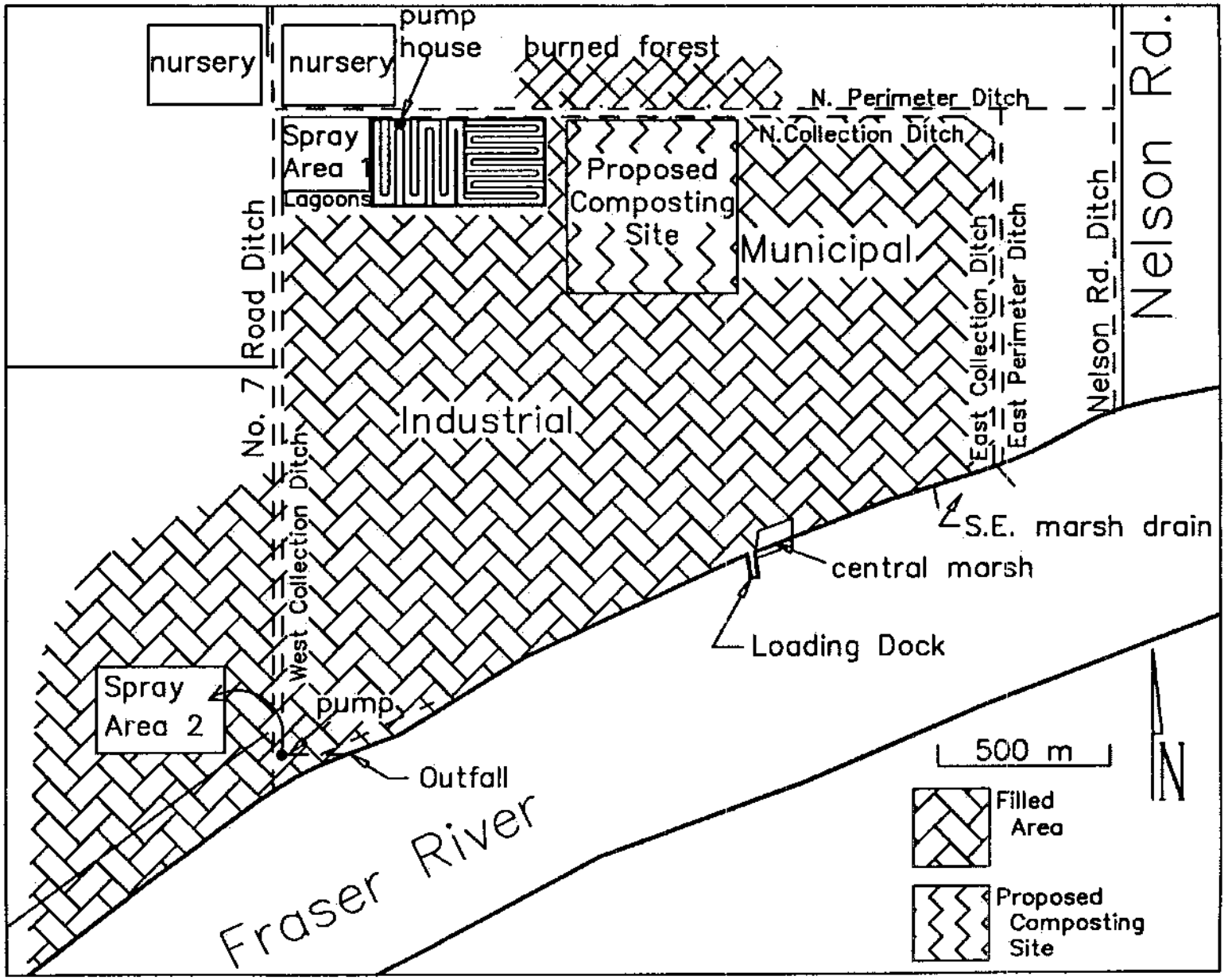


Figure 3. Plan of Fraser Port Richmond,
Showing Permit Surface Water Sampling Sites

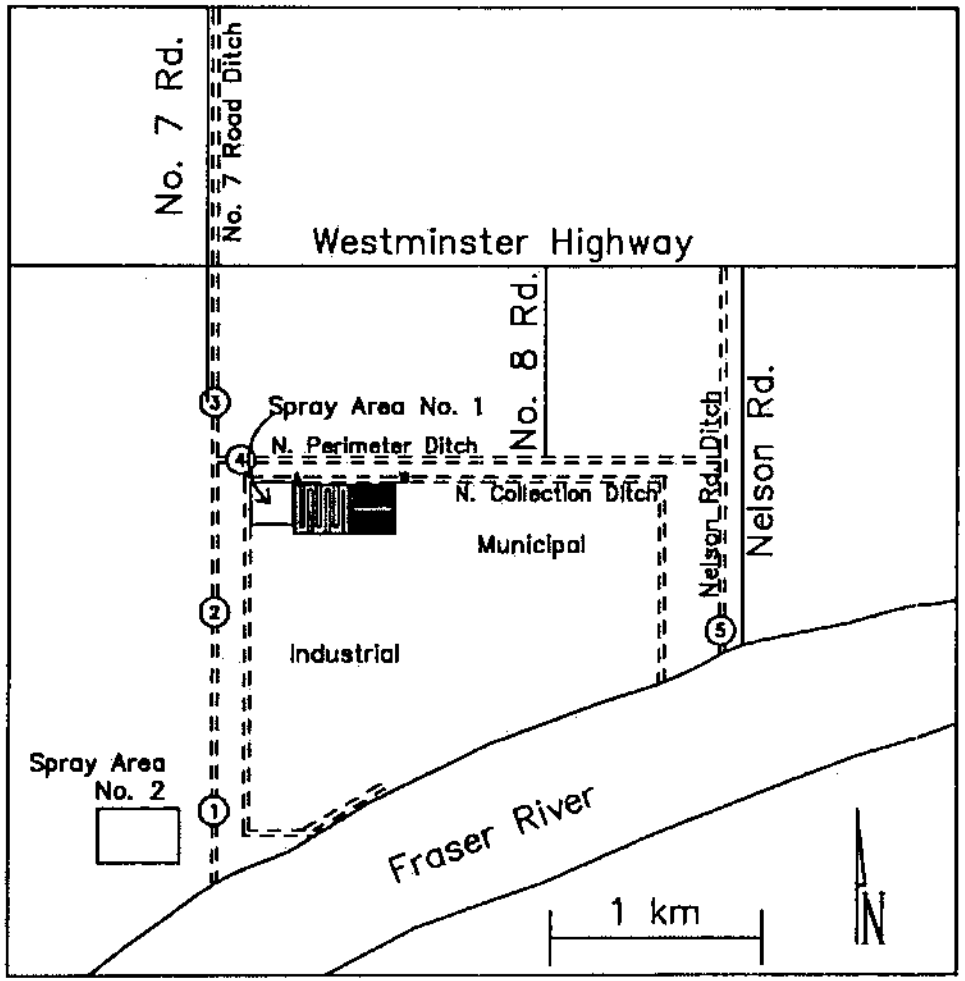


Figure 5 Activated Sludge Oxygen Uptake

Using Sewage or Leachate Substrate

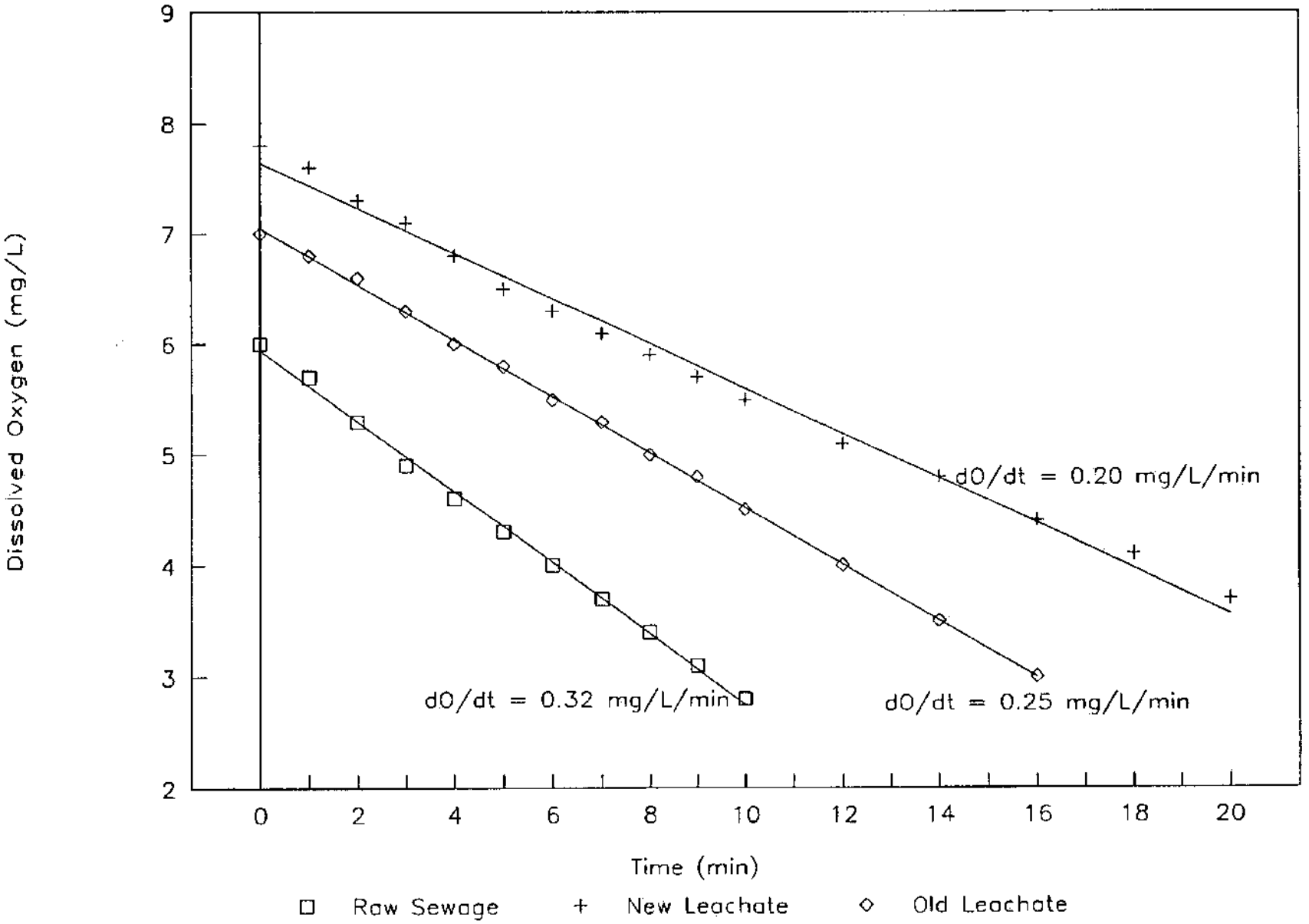
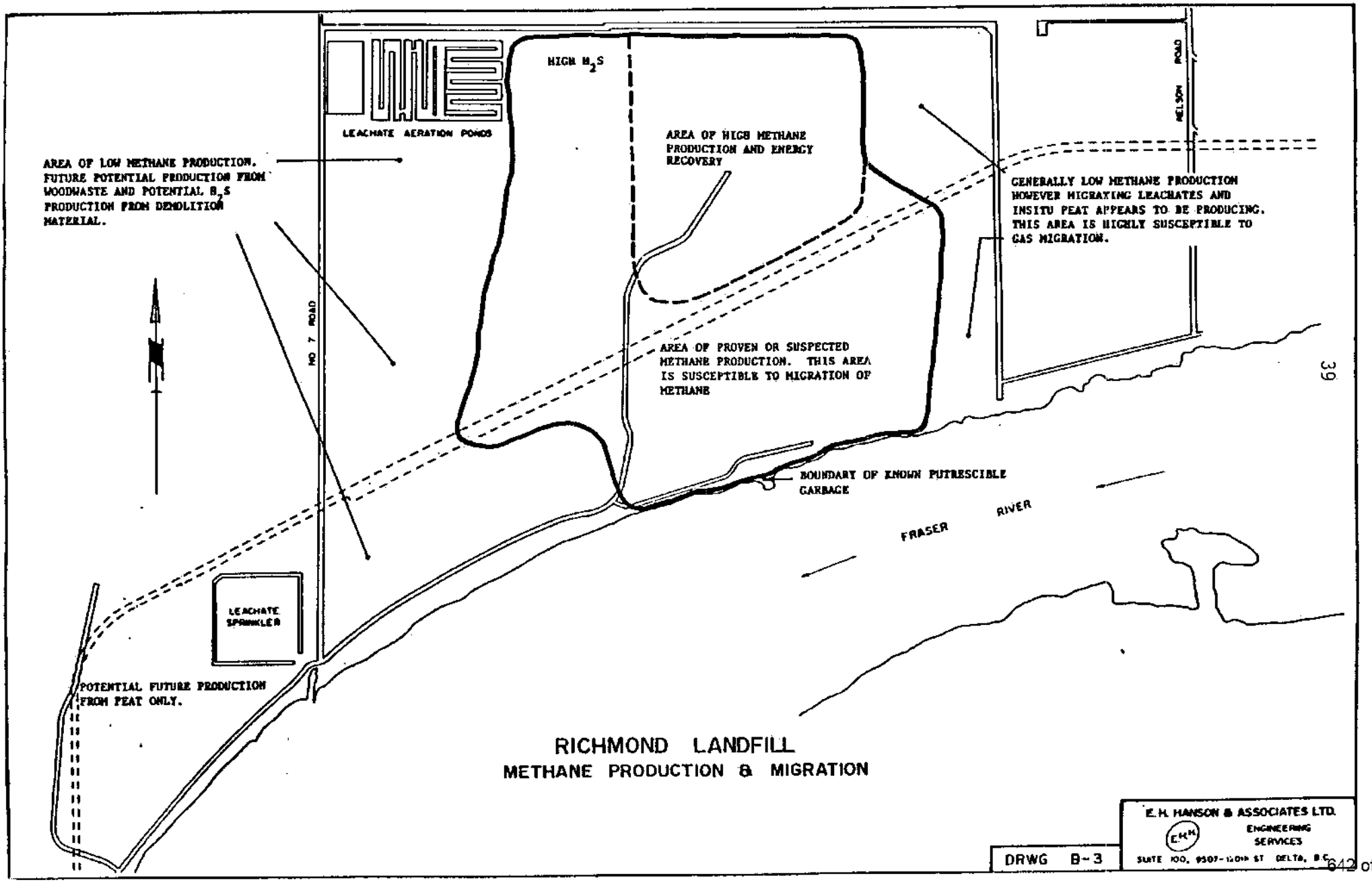


FIGURE 6

Methane Production and Hydrogen Sulfide (H_2S)
at Fraser Port, Richmond
(From E.H. Hanson 1985)



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METHANE PRODUCTION & MIGRATION

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SUITE 100, 9507-120th ST DELTA, B.C.

DRWG B-3

APPENDIX A-1

Metal Content of Hemlock/Balsam Hog Fuel, by ICP Scan and Flame Atomic Absorption

APPENDIX TABLE A-1

METAL CONTENT OF HEMLOCK/BALSAM HOG FUEL BY ICP SCAN AND FLAME ATOMIC ABSORPTION

ELEMENT	#1 FRESH HOG	#2 PARTLY AGED HOG	#3 FINAL PRODUCT
Arsenic	<5	<5	<5
Tin	<25	<25	<25
Selenium	<5	<5	<5
Molybdenum	<2	<2	<2
Zinc	16	16	21
Antimony	<5	<5	<5
Lead	<5	<5	<5
Cadmium	<2.5	<2.5	<2.5
Nickel	5.4	3.9	4.0
Beryllium	<2	<2	<2
Cobalt	4.9	4.3	6.9
Boron	11	7.2	11
Manganese	246	198	267
Iron	1,967	2,655	4,353
Chromium	5.4	5.8	8.4
Vanadium	3.9	5.3	8.9
Calcium	5,900	5,794	6,925
Copper	5.9	7.7	8.9
Silver	<5	<5	<5
Titanium	0.69	121	182
Magnesium	1,033	869	1,335
Aluminum	934	1,110	1,929
Strontium	22	19	25
Barium	17	16	22
Sodium	983	483	841
Potassium	492	410	643

All values in $\mu g/g$.

APPENDIX A-2

Concentrations of Metals in Various Leachate Samples at Fraser Port Richmond

APPENDIX TABLE A-2

CONCENTRATIONS OF METALS IN VARIOUS LEACHATE SAMPLES AT FRASER PORT RICHMOND

ELEMENT	#8 SITE	#9 SITE	ND	#5 PUMP	#3 PUMP	#2 LAGOON
Arsenic	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Selenium	0.14	<0.10	<0.10	<0.10	<0.10	<0.10
Molybdenum	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Zinc	<0.05*	<0.05	<0.05	<0.05	<0.05	<0.05
Antimony	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Lead	<0.10*	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	<0.05*	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Beryllium	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Cobalt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	3.9	2.2	<1.0	1.2	<1.0	1.8
Manganese	1.0*	1.0	3.1	1.8	0.76	0.53/0.54
Iron	2.3*	1-6/1-6	12/12	5.2	1-7/1-6	0.68/0.70
Chromium	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Vanadium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Calcium	440*	380	104	140	106	316
Copper	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Titanium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Magnesium	45	37	32	46	59	45
Aluminum	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Strontium	2.9	2.3	0.75	1.2	0.89	1.9
Barium	0.68*	0.57	0.32	0.32	0.22	0.37
Sodium	315*	255	129	396	502	238
Potassium	96	54	29	36	30	54

All values in mg/L.
* Determined by Flame Atomic Absorption.
#8 - Municipal Site
#9 - South Lagoon Ditch
ND - North Perimeter Ditch
#5 Pump - Feed to 2nd Spray Area
#2 Lagoon - Lagoon discharge
#3 Lagoon - Final Discharge

APPENDIX A-3

Concentrations of Resin and Fatty Acids in Three Samples of Leachate From Hembal Bark Leachates

To: Alex Birkbeck

January 9, 1992

From: Fragrance Chen

2-51-442

Re: Results of resin acids analysis in three water samples received on January 6, 1992.

Analysis:

A surrogate standard (N-heptadecanoic acid) was added to the sample and the sample was extracted with methyl-tert butyl ether at pH9. A performance standard (N-tricosanic acid) was added to the extract and the extract was methylated with diazomethane. Concentration of resin and fatty acids in the methylated extract was measured using a Hewlett Packard Model 5880 gas chromatograph equipped with a flame ionization detector and a 30M x 0.32mm DB5 capillary column.

Results:

Compounds	Concentration (mg/L) Leachate off hog pile Jan3/92	New Leachate Jan6/92	Old Leachate Jan6/92
Oleic Acid	<0.005	0.270	0.235
Linoleic Acid	0.059	0.663	0.558
Pimaric Acid	<0.005	<0.005	<0.005
Sandaracopimaric Acid	<0.005	0.088	0.028
9,10-Epoxy Stearic Acid	<0.005	<0.005	<0.005
Isopimaric Acid	0.076	0.182	0.097
Palustric Acid	0.047	0.029	<0.005
Dehydroabietic Acid	0.249	1.02	0.721
Abietic Acid	0.052	0.345	0.028
Neoabietic Acid	<0.005	0.021	<0.005
9,10-Dichlorostearic Acid	0.046	0.140	0.053
Chlorodehydroabietic Acid	<0.005	<0.005	<0.005
Dichlorodehydroabietic Acid	<0.005	<0.005	<0.005
Lauric Acid	<0.005	0.065	0.038
Myristic Acid	<0.005	0.050	0.040
Palmitac Acid	0.090	0.300	0.264
Stearic Acid	0.033	0.082	0.088
Arachidic Acid	<0.005	0.067	0.227
Behenic Acid	<0.005	<0.005	<0.005
Lionoceric Acid	0.860	0.296	1.50

APPENDIX A-4

Resin Acids in Fraser Port Leachate Samples

To: Alex Birkbeck January 9, 1992

From: Fragrance Chen 2-51-442

Re: Results of resin acids analysis in three water samples received on January 2, 1992.

Analysis:

A surrogate standard (N-heptadecanoic acid) was added to the sample and the sample was extracted with methyl-tert butyl ether at pH9. A performance standard (N-tricosanic acid) was added to the extract and the extract was methylated with diazomethane. Concentration of resin and fatty acids in the methylated extract was measured using a Hewlett Packard Model 5880 gas chromatograph equipped with a flame ionization detector and a 30M x 0.32mm DB5 capillary column.

Results:

Compounds	Concentration (mg/L) FRHC #9 Jan2/92	FRHC North Ditch Jan2/92	FRHC Final Jan2/92
Oleic Acid	<0.005	<0.005	<0.005
Linoleic Acid	<0.005	<0.005	<0.005
Pimaric Acid	<0.005	<0.005	<0.005
Sandaracopimaric Acid	<0.005	<0.005	<0.005
9,10-Epoxy Stearic Acid	<0.005	<0.005	<0.005
Isopimaric Acid	<0.005	<0.005	<0.005
Palustric Acid	<0.005	<0.005	<0.005
Dehydroabietic Acid	<0.005	<0.005	<0.005
Abietic Acid	<0.005	<0.005	<0.005
Neoabietic Acid	<0.005	<0.005	<0.005
9,10-Dichlorostearic Acid	<0.005	<0.005	<0.005
Chlorodehydroabietic Acid	<0.005	<0.005	<0.005
Dichlorodehydroabietic Acid	<0.005	<0.005	<0.005

APPENDIX B-1

Bioassay Data for Hembal Bark Leachates

Augustine Trucking

BC RESEARCH

96-h Static LC50 Bioassay Results of OLD HOG LEACHATE

2-11-200-442-92001

96-h LC50 (%v/v): **81 (65, 100)**

SAMPLE TAKEN:	Unknown	SAMPLE pH:	5.2
SAMPLE RECEIVED:	Jan 09, 1992	SAMPLE D.O.:	1.5 mg/L
TEST STARTED:	Jan 14, 1992	SAMPLE CONDUCTANCE:	340 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
5.3	6.1	8.4	9.4	100	100	0	0	0
5.5	6.5	8.8	9.6	65	100	100	100	100
5.6	6.6	9.3	9.8	49	100	100	100	100
5.6	6.6	9.7	10.0	32	100	100	100	100
5.7	6.7	10.0	10.2	10	100	100	100	100
				— *CONTROL* —				
6.1	6.3	10.2	10.2	0	100	100	100	100

COMMENTS: All surviving fish appeared normal.

TEST CONDITIONS

Number of fish:	5	Test temperature (°C):	15 ± 1
Test volume (L):	1	Test pH adjusted:	NO

Bioassay conducted according to STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER, 17th edition, APHA (1989) and U.S. EPA (1985).

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.25 ± 0.03 g	Length:	2.7 ± 0.1 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 12.0 mg/L (8.7, 15.0) and 12.9 mg/L (8.7, 15.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

B

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Augustine Trucking

BC RESEARCH

96-h Static LC50 Bioassay Results of NEW HOG LEACHATE

2-11-200-442-92002

96-h LC50 (%v/v): **<10**

SAMPLE TAKEN:	Unknown	SAMPLE pH:	5.7
SAMPLE RECEIVED:	Jan 09, 1992	SAMPLE D.O.:	1.9 mg/L
TEST STARTED:	Jan 14, 1992	SAMPLE CONDUCTANCE:	900 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
5.9	6.5	9.0	7.0	100	0	0	0	0
6.3	6.7	9.2	8.2	65	0	0	0	0
6.6	6.8	9.6	8.3	49	0	0	0	0
6.8	6.9	9.8	9.6	32	0	0	0	0
6.8	6.9	10.0	10.2	10	60	20	20	20
				--- *CONTROL* ---				
6.1	6.3	10.2	10.2	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish:	5	Test temperature (°C):	15 ± 1
Test volume (L):	1	Test pH adjusted:	NO

Bioassay conducted according to STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER, 17th edition, APHA (1989) and U.S. EPA (1985).

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.25 ± 0.03 g	Length:	2.7 ± 0.1 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 12.0 mg/L (8.7, 15.0) and 12.9 mg/L (8.7, 15.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

B

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

APPENDIX B-2

Bioassay Data For Fraser Port Richmond Leachates and Effluents

Augustine Trucking

BC RESEARCH

96-h Static LC50 Bioassay Results of NORTH PERIMETER COLLECTION DITCH

2-11-200-442-92005

96-h LC50 (%v/v): **39.6 (32.0, 49.0)**

SAMPLE TAKEN:	Jan 06, 1992	SAMPLE pH:	6.5
SAMPLE RECEIVED:	Jan 06, 1992	SAMPLE D.O.:	7.5 mg/L
TEST STARTED:	Jan 06, 1992	SAMPLE CONDUCTANCE:	1175 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
6.9	7.7	10.2	10.2	49	0	0	0	0
6.9	7.7	10.2	10.2	32	100	100	100	100
6.9	7.7	10.2	10.2	20	100	90	90	90
7.0	7.0	10.2	9.7	10	100	100	100	100
				--- *CONTROL* ---				
7.0	6.9	10.2	10.0	0	100	100	100	100

COMMENTS: The fish in 32% concentration showed signs of distress.

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	8	Test pH adjusted:	NO

Bioassay conducted according to STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER, 17th edition, APHA (1989) and U.S. EPA (1985).

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.34 ± 0.07 g	Length:	3.6 ± 0.2 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 10.2 mg/L (9.0, 11.4) and 7.3 mg/L (4.9, 12.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

JP

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Augustine Trucking

BC RESEARCH

96-h Static LC50 Bioassay Results of
SITE 8 - MUNICIPAL SITE

2-11-200-442-92006

96-h LC50 (%v/v): **15.9 (10.0, 24.0)**

SAMPLE TAKEN:	Jan 06, 1992	SAMPLE pH:	6.6
SAMPLE RECEIVED:	Jan 06, 1992	SAMPLE D.O.:	2.0 mg/L
TEST STARTED:	Jan 06, 1992	SAMPLE CONDUCTANCE:	2500 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
6.8	8.0	8.5	10.2	49	0	0	0	0
6.9	7.9	9.8	10.2	32	0	0	0	0
6.9	7.8	10.2	10.2	24	0	0	0	0
7.0	8.0	10.2	9.8	15	80	70	60	60
7.0	7.9	10.2	10.0	10	100	100	100	100
				--- *CONTROL* ---				
7.0	6.9	10.2	10.0	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	8	Test pH adjusted:	NO

Bioassay conducted according to STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER, 17th edition, APHA (1989) and U.S. EPA (1985).

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.34 ± 0.07 g	Length:	3.6 ± 0.2 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 10.2 mg/L (9.0, 11.4) and 7.3 mg/L (4.9, 12.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

J

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens, *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Augustine Trucking

BC RESEARCH

96-h Static LC50 Bioassay Results of
SITE 9 - SOUTH LAGOON DITCH

2-11-200-442-92007

96-h LC50 (%v/v): **>49<65 (32, 65)**

SAMPLE TAKEN:	Jan 06, 1992	SAMPLE pH:	6.8
SAMPLE RECEIVED:	Jan 06, 1992	SAMPLE D.O.:	7.3 mg/L
TEST STARTED:	Jan 06, 1992	SAMPLE CONDUCTANCE:	1300 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
6.9	8.1	10.2	9.3	49	80	70	70	70
6.8	7.9	10.2	10.2	32	100	100	100	100
7.1	7.4	10.2	10.2	10	100	100	100	100
				— *CONTROL* —				
7.0	6.9	10.2	10.0	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	8	Test pH adjusted:	NO

Bioassay conducted according to STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER, 17th edition, APHA (1989) and U.S. EPA (1985).

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.34 ± 0.07 g	Length:	3.6 ± 0.2 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 10.2 mg/L (9.0, 11.4) and 7.3 mg/L (4.9, 12.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

3

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

Augustine Trucking

BC RESEARCH

96-h Static LC50 Bioassay Results of SITE 2 - LAGOON EFFLUENT

2-11-200-442-92003

96-h LC50 (%v/v): **26.6 (20.0, 32.0)**

SAMPLE TAKEN:	Jan 06, 1992	SAMPLE pH:	7.7
SAMPLE RECEIVED:	Jan 06, 1992	SAMPLE D.O.:	9.5 mg/L
TEST STARTED:	Jan 06, 1992	SAMPLE CONDUCTANCE:	1650 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.7	7.7	10.2	10.2	100	0	0	0	0
7.8	8.0	10.2	10.2	49	0	0	0	0
7.6	8.1	10.2	10.2	32	70	70	10	10
7.7	7.6	10.2	10.2	20	100	100	100	100
7.4	7.5	10.2	10.2	10	100	100	100	100
				--- *CONTROL* ---				
7.0	6.9	10.2	10.0	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	8	Test pH adjusted:	NO

Bioassay conducted according to STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER, 17th edition, APHA (1989) and U.S. EPA (1985).

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.34 ± 0.07 g	Length:	3.6 ± 0.2 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 10.2 mg/L (9.0, 11.4) and 7.3 mg/L (4.9, 12.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

B

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens *"Methods for Calculating an LC50"* (ASTM STP 634, 1977).

Augustine Trucking

BC RESEARCH

96-h Static LC50 Bioassay Results of SITE 3 - FINAL EFFLUENT

2-11-200-442-92004

96-h LC50 (%v/v): **>100**

SAMPLE TAKEN:	Jan 06, 1992	SAMPLE pH:	7.4
SAMPLE RECEIVED:	Jan 06, 1992	SAMPLE D.O.:	9.2 mg/L
TEST STARTED:	Jan 06, 1992	SAMPLE CONDUCTANCE:	1900 umho/cm

pH		DISSOLVED OXYGEN		TEST	PERCENT SURVIVAL			
		INITIAL	FINAL	CONC'N				
INITIAL	FINAL	(mg/L)	(mg/L)	(%v/v)	24h	48h	72h	96h
7.6	8.3	10.2	9.8	100	100	100	100	100
				— *CONTROL* —				
7.0	6.9	10.2	10.0	0	100	100	100	100

COMMENTS:

TEST CONDITIONS

Number of fish:	10	Test temperature (°C):	15 ± 1
Test volume (L):	8	Test pH adjusted:	NO

Bioassay conducted according to STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTE WATER, 17th edition, APHA (1989) and U.S. EPA (1985).

TEST FISH Juvenile rainbow trout (*Oncorhynchus mykiss*)

Acclimated:	15 ± 1 (°C)		
Weight:	0.34 ± 0.07 g	Length:	3.6 ± 0.2 cm

REFERENCE TOXICANT

Duplicate reference toxicant (analytical grade phenol) bioassays were conducted in order to test the tolerance of the fish stock. These tests gave 96-h LC50 of 10.2 mg/L (9.0, 11.4) and 7.3 mg/L (4.9, 12.0).

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg $CaCO_3$/L):	19.2
EDTA hardness (mg $CaCO_3$/L):	22.1
Total suspended solids (mg/L):	<1.0
Residual chlorine (mg/L):	<0.01
Conductance (µmho/cm):	35

Other parameters available on request.

ANALYST

J

96-h LC50 is the 96-h median lethal concentration (ie. that causing 50% mortality). The 95% confidence limits are in parentheses. Values were calculated by computer following C.E. Stephens "*Methods for Calculating an LC50*" (ASTM STP 634, 1977).

APPENDIX C

Calculation of Maximum Average Leachate Production From Precipitation Onto the Fraser Port Richmond Site

APPENDIX C

CALCULATION OF MAXIMUM AVERAGE LEACHATE PRODUCTION FROM PRECIPITATION ONTO THE FRASER PORT RICHMOND SITE

In this calculation leachate production is assumed to be derived as 100% of the average daily precipitation during the late fall, winter and early springtime months between November 1 and April 30. The calculation is based on the average precipitation recorded at Vancouver Airport and occurring during the years 1988, 1989 and 1990.

Total Precipitation (mm)

1988	742.6
1989	707.1
1990	877.6
Average	775.8

Average daily precipitation = $\frac{775.8 \text{ mm}}{181 \text{ days}} = 4.28 \text{ mm/day}$

Maximum volume of leachate possible

$$= 10{,}000 \ (m^2) \times \frac{1(m)}{1000 \ (mm)} \times 4.28 \ (mm) \ m^3/day$$

$$= 42.8 \ m^3/day/hectare$$

Rec'd Jan 13/94

File: PR06277

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APPENDIX A LANDFILL REFUSE AREAS

APPENDIX B TOPOGRAPHICAL MAP - ELEVATIONS

APPENDIX C CHRONOLOGY OF PRE-LOADING

APPENDIX D PROPOSED FINAL ELEVATIONS
1994
1997
2000

I INTRODUCTION

In September 1986, the Landfill operating at the Fraser River Harbour Commission site known as Fraser Richmond closed operation, bringing to an end some 26 years of solid waste landfilling on the 265-hectare site. The landfill, portions of which were originally owned by the Municipality of Richmond, will be developed by the present owners, the Fraser River Harbour Commission (FRHC), into a port site and industrial park.

Site Geology and Landfill Materials

The basic geologic stratigraphy of the site is that of a peat bog. The zero to 5m layer of peat covers a 1m to 7.5m clay layer which is, in turn, underlaid by 31m to 37m of silty sands. The types of landfilled refuse varies over the site roughly as shown in Appendix A. To maintain the integrity of the compacted peat bog layer and prevent mechanical failure, the entire site received a mattress fill of waste wood/hog fuel to a minimum of 2m in thickness. About 40 per cent of the landfill area on the west side was used for demolition and non-putrescible industrial wastes. a special 20-hectare area was reserved for municipal garbage which was placed in 2 lifts of total depth about 12m (37 ft.). The balance of the site on the east side was filled with wood waste (hog fuel etc.).

The site is presently under development, the entire eastern section has been preloaded with some 15m river sand. As the pre-load is removed, a layer remains. This layer of sand acts as a cover for the landfill and as the foundation material for future development. Future services (ie. water, sewer, and power) will be placed in this layer.

II PRESENT/FUTURE ELEVATIONS

The present elevations are as shown on the topographic map attached as Appendix B.

The chronology of preloading is as shown on site plan attached as Appendix C.

The final elevations for the entire site are as projected on the map attached as Appendix D, with the exception of the 20 hectare Municipal Garbage Area (MGA) which is the final evaluation.

III SLOPES AND GRADING

The slopes for the entire site are 3:1 and the grading is as per the topographic map attached as Appendix B.

IV TYPE AND DEPTH OF MATERIALS USED FOR FINAL COVER

Richmond Landfill Ltd., the current operator of the landfill site was contracted to provide a 60 cm layer of dredged Fraser River sand as part of the completion of their contract. The present depth of materials for the majority of the site are as per topographic map Appendix B.

The 50 acre MGA has received an initial 0.6 m sand cover over the refuse, plus a second lift of sand (0.6m deep), bringing the total depth of sand cover to 1.2m. The sand covering was followed by a 0.3m - 0.9m depth of amended top soil consisting of sand, peat, and silty clays. This final covering was seeded with an agriculture mixture of Buckerfield clover mix, to establish vegetation growth. This covering, without an impermeable barrier, allows for high moisture infiltration and hence for a high refuse moisture content. This promotes accelerated rates of decomposition of biodegradable garbage as moisture content is a critical environmental parameter for microbial growth.

V MAINTENANCE OF COVER

The majority of the site is presently being preloaded on a continual basis, and will continue to be for some time to come. As the pre-load is removed a final sand layer of 1.5 - 3.0 will remain. The MGA site is stabilized with a final cover and is naturally re-vegetating itself. There is no surface water ponding and/or channelling as the surface water percolates through to the perimeter ditches.

VI VEGETATIVE COVER

As above, the MGA site has received vegetative cover. The north and east quadrants have natural vegetation, as well as the side slopes of the perimeter ditches. The westerly property boundary, adjacent to Ecowaste has some tree growth. Future plans for the site are not finalized, however, as the site is developed open areas will be developed as lawns and fields.

VII FUGITIVE DUST CONTROL

Dust control is maintained by the root system from the natural vegetative cover, as described in Section VI, and by water on the north west spray area. Dust from the land during the dry months will be a problem until the site is fully developed. Given the industrial and agricultural nature of the surrounding properties this should not pose a serious problem.

VIII MANAGEMENT OF LEACHATE AND LANDFILL GASES

Leachate Production and Containment

The compressed peat beneath the landfill material, in combination with the clay layer, provide an impermeable barrier which prevents vertical migration of leachate into groundwater.

Due to the 1.2m annual precipitation and because the water table is at or near the surface most of the year, large volumes of leachate are formed. These leachates originally spilled in an uncontrolled manner into agricultural drainage ditches on the east, north and west sides of the site, eventually finding their way into the Fraser River, either via the agricultural ditches or the river foreshore.

The leachates vary in characteristics, depending upon the waste origin, but generally are odoriferous, due to sulphide content, highly coloured, contain a high level of dissolved solids, oxygen-demanding organics and ammonia nitrogen.

Leachate Containment

To contain the leachates, new collection ditches were engineered on the east, north and west sides. These ditches were lined with a 30 mil PVC membrane and keyed into the clay layer, this was then protected by a crushed 3 1/2" minus rock cover.

Aerial photography using infra-red and colour film suggest that these containment ditches have prevented further loss of leachate into agricultural lands.

All perimeter ditches were cleaned out this year and the sand filters scarified every two months. An additional lift of sand will be placed in 1994 to stabilize sprinkler pipes and increase filter activity.

Foreshore Seeps

Aerial photography of the landfill perimeter showed the presence of minor escapes of leachate along the river foreshore. These seeps are close to the marsh areas, installed for mitigation of the dock facilities, constructed on the south east corner of the port site. Geotechnical investigations carried out by Golder and Associates in the early 1980s, following compaction of the land adjacent to the foreshore, suggested that the total losses of leachates to the river via the foreshore was about 64m3/day. The seeps identified in the mid 1980s have been monitored since the beginning of 1988. The seeps were designated centre marsh drain and south east drain. Analyses of samples collected from these seeps shows that the ammonia content is almost invariably less than 7.5mg/1. Indeed the samples from the south east drain have usually contained less than 1 mg/1 ammonia nitrogen. Bioassay analyses have shown that the seeps are occasionally toxic having 96h LC 50 values about 65%. The oxygen demand of these seeps has been low and in general they are not considered a major environmental problem.

It is the Commission's intention to continue monitoring these seeps and should the problem deteriorate, action will be taken to ameliorate it. A possible action would involve diverting the seeps through an engineered marsh system installed in an upland situation.

Leachate Treatment

A leachate treatment system was constructed consisting of 6 aerated lagoons, each 200m long, 15m wide and of average depth 1m, providing 2-day retention at 8,800m^3/day flow, Leachate was pumped by a means of 2-4050 L/min (900 gpm) pumps. A diesel-operated pump was used as a standby and to lower water levels in the collection ditches during extremely wet weather, which was directed to a storage area, prior to receiving treatment as described below.

Aeration was provided by 9 Aire o_2 (aeration Industries Inc.) aerators, providing approximately 200 kg of oxygen per day by 4 aerators working with an additional one for backup, and some circulation of lagoon contents. The lagoon effluent was spray-irrigated onto a 200m x 100m sand area by conventional spray irrigation equipment. In the winter of 1982/83, a 3.6-hectare surge lagoon was constructed on the east side of the aeration lagoons. This was later converted into another series of serpentine lagoons and a new surge lagoon was constructed south of the old one. Additional aeration was installed so that the total lagoon capacity of 63600m^3 was aerated with 20 5 HP units.

After treatment in the lagoons this leachate is sprayed into a sand filter. this treated leachate is directed south to a second filter. The treated leachate was allowed to combine with weak leachate from the demolition area in the west ditch. The combined leachate was the resprayed onto a 40,000m^2 sand filters. Both sand filters were fitted with trench drains. The final effluent passes over a broad, crested weir into No. 7 Road ditch. The flow and temperature at the weir is continuously recorded by B.C. Research.

A further modification implemented in April 1986 was the segregation of leachate from the municipal waste area. To achieve this, new collection ditches were installed on the north side of the Municipal Garbage Area within the north ditch No. 8. 6" perforated drain pipes were installed at a 12' depth by 2' wide basically above the clay layer and backfilled with 1 1/2" drain rock for the full length of the fifty (50) acres.

This "French Drain" intercepts the groundwater, (approximately 2000m^3/day during wet weather), from the waste area to the lagoon system. All the other leachates are now treated by only spray irrigation on the larger spray area. This modification ensures that the strong leachate from the MGA receives a minimum of 30 days' retention in the aerated lagoons. To augment phosphorous levels, continuous addition of a phosphate solution was initiated in 1986.

Environmental Monitoring and Treatment Plant Performance

As part of the Provincial pollution control permit, the final discharge and agricultural ditches in the immediate environment of the landfill are monitored at quarterly intervals. Groundwater wells on the east and west sides of the landfill are monitored at 6-month intervals. In addition, bio-assay testing is conducted monthly, by B.C. Research.

Gas Extraction System

On the 50 acre MGA site E.H. Hanson & Associates has installed a methane gas extraction system. This system consists of approximately 1 extraction well per acre connected by a series of laterals to an exhaust fan. The gas is then compressed. The blower system transports the landfill gas through a main line to Canada LaFarge who purchases the gas from approximately April to November. Gas extraction is effective in preventing gas migration, and aids in re-vegetation.

Future gas extraction will be addressed once production is reduced to make it viable to consider alternative extraction methods, such as, vent with bio filters or vent and flare.

IX SURFACE DRAINAGE & INTERCEPTION OF GROUNDWATER

Surface water drainage and interception of groundwater from the Municipal Garbage Area is collected, lagooned, sprayed onto the first sand bed and then discharged to the perimeter ditch.

The perimeter ditch also receives surface water and is then sprayed onto a second sand bed. The effluent from the second spray area is then discharge to No. 7 Road ditch, which discharges to the Fraser River.

X. PROPOSED FUTURE USE

The future use of Fraser Richmond will be an overall intermodal terminal site.

1. The acreage north of the CNR track Right of Way, will be an industrial park for uses auxiliary to water - oriented commerce.

2. The acreage south of the CNR track Right of Way will be a marine terminal site and dock area.

3. The 50 acre Municipal Garbage Area site will be an open space landscaped area. The development of this area will be in conjunction with the Municipality of Richmond. The Fraser River Harbour Commission intends to dedicate this area to the City of Richmond.

DRAFT

ANALYSIS OF

SEDIMENT SAMPLES

ON BEHALF OF

THE FRASER RIVER HARBOUR

COMMISSION

Reported To:

Ministry of Environment
Water Management Branch
Victoria, B.C.

Report By:

ASL Analytical Service Laboratories Ltd.
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March 27, 1992

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March 27, 1992
File No: 1650C

Mr. L. G. Swain, P.Eng
Ministry of Environment
Waste Management Branch
810 Blanchard St.
Victoria, B.C.
V8V 1X5

Dear Les,

Re: Analysis of Sediment Samples on Behalf of the Fraser River Harbour Commission

Enclosed are two (2) copies of our above referenced draft report, including analytical methodology, discussion, sample results and quality assurance data.

The report includes some discussion on the methods of analysis used and the data produced. Although the intent is not to interpret the data, we feel our discussion will point out some important facts, particularly regarding analytical concerns.

We trust this report meets with your requirements and completes our assignment at this time. If you require any additional information, please call.

We would like to thank yourself and Doug for the opportunity to work with you on this most interesting study.

Yours truly,

ASL ANALYTICAL SERVICE LABORATORIES LTD.
per:

R. W. Deverall
Senior Partner

Helen Macdonald
Project Chemist

RWD/HM/ch

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1.0 INTRODUCTION

The Fraser River Harbour Commission, in collaboration with the Ministry of Environment has undertaken a survey to determine the relationship between various physical and chemical parameters in six sites of the Fraser River Estuary. The primary focus was on analysis for physical parameters, total metals, acid volatile sulfide, extractable metals (released during AVS measurement) and dioxins/furans. In addition, we prepared sediment extracts for testing by the B.C. Environment Toxicity Lab. This data will be reported under separate cover by the Toxicity Lab.

This report covers the analytical methodology used in analyzing the samples, analysis data and corresponding Quality Assurance information. Where appropriate, we have also provided discussions on the analytical data to clarify the information presented.

2.0 ANALYTICAL METHODOLOGY

2.1 Sample Preparation and Storage

ASL provided sample containers prepared in a manner suitable to the parameters being analysed. Glass jars were acid washed, solvent rinsed and baked in an oven at 250 °C. The lids were teflon lined to ensure good contamination control was maintained.

When the samples were received at the laboratory they were catalogued against field submission forms (designed in collaboration with the sampler) and kept cool until analysed.

Prior to analysis, the samples were prepared in a clean environment dedicated to this project. Sediment samples were blended and subsampled to ensure representative portions were taken for analysis.

2.2 Sediment Analysis

All methods employed by ASL use state-of-the-art equipment and instrumentation for preparation and analyses of samples. We incorporate a high degree of quality assurance in all testing procedures to ensure only credible data is produced.

Metals

These analyses are carried out using procedures that are consistent with the requirements of the appropriate regulatory agencies and adapted from U.S. Environmental Protection Agency Method 3050 (Publ. # SW-846, 3rd ed., Washington, DC 20460).

After an initial preparation (blending, homogenizing, etc.), a representative portion is removed and digested using a combination of nitric and hydrochloric acids. The resulting extract is bulked to volume with deionized/distilled water and analysed as follows:

Cd, Pb - determined in the extract by direct flame atomic absorption spectrophotometry.

Se - determined in the extract by hydride generation atomic absorption spectrophotometry.

Hg - determined in the extract by cold vapour atomic absorption spectrophotometry.

Al, Sb, As, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, Zn - determined in the extract using inductively coupled plasma (ICP) emission spectrometry.

NOTE: Aluminum, chromium, iron, and manganese are often associated, to some extent, with the silicate matrix of the sediment. Because of this the recoveries of these elements may be low using the specified digestion. From an environmental standpoint this is not a problem since the "available" metals are usually the fraction of concern.

Acid Volatile Sulfide and SEM Metals

This analysis was carried out in accordance with the method described by the Final Report, Development of An Analytical Method of The Determination of Acid Volatile Sulfide (AVS) in Sediment, Environmental Protection Agency No. 68-03-3534, submitted to U.S. EPA by Battelle, December 1990. Hydrochloric acid, 6.0 N HCl, is added to the sediment samples. The hydrogen sulfide (H_2S) produced is carried into two sodium hydroxide (NaOH) sulfide traps by purified nitrogen gas. The acid volatile sulfide absorbed in the NaOH is then determined colourimetrically. The extract produced from the addition of 6.0 N HCl is then analyzed for simultaneous extracted metals (SEM) using the same instrumental methods as for total metals.

Dioxins/Furans

Subsamples of the sediment were sent to Axys Analytical (formerly Seakem) for analysis.

This method is based on that of Wright State University, Dayton, Ohio and determines the concentration of polychlorinated dibenzo-p-dioxins and dibenzofurans. The sample is spiked with 13C labelled standards and soxhlet extracted. The extract is then put through a series of chromatographic cleanup steps prior to analysis by GC/MS.

Moisture

Moisture is determined gravimetrically after drying the sample for twelve hours at 103°C.

Particle Size Distribution

After oven drying particle size distribution is determined by the use of standard sieves for the sand and silt fractions and the pipette method for the clay fraction (method in Walton, 1978. For Fisheries and Environment Canada, Ottawa).

Loss On Ignition (Total Volatile Residue)

Loss on ignition is determined by ignition of oven dried material in a muffle furnace at 550°C, with the loss of weight determined gravimetrically.

Total Organic Carbon

After removal of inorganic carbon, organic carbon is determined in the sample using a Leco Induction Furnace.

Toxicity Test Leachates

This analysis is carried out using a modified extraction procedure outlined by the B.C. Ministry of Environment and Parks (Waste Management Act - Special Waste Regulation, February 18, 1988 - B.C. Reg. 63/88 OC 268/88). The resulting extracts were forwarded to the Aquatic Toxicity Laboratory - Attn: Graham Van Aggelen for subsequent testing.

2.3 Quality Assurance/Quality Control Methods

The U.S. EPA define Quality Assurance (QA) as "the total program for assuring the reliability of monitoring data". Quality Control (QC) is limited to "the routine application of procedures for controlling the measurement process". QC is primarily concerned with the tools of the measurement system. Reagents of the highest quality and checked for purity, strength, deterioration with time, and contamination. Class A volumetric glassware is thoroughly cleaned and calibrated when necessary. Balances are frequently checked with certified weights and records kept. All instruments are calibrated on a routine basis, with the maintenance of appropriate standards and operation logs on performance.

The QA program includes the analysis of quality assurance samples to define the precision and accuracy of the method for the type of sample under investigation. For trace analyses, the following quality assurance samples are commonly employed:

- Method Blank - usually distilled water with added reagents, which is carried through the entire analysis as a check on laboratory contamination (also called a reagent blank).

- Duplicate - a homogenous sample is split either in the field or in the laboratory with the duplicate presented to the analyst as an additional sample to check for precision. If more than two splits are analysed the term replicate is normally used.

- Check Standard - a procedure is standardized with calibration standards prior to analysing the samples. The analytical response to the standards should be checked by frequently analysing one or more standards along with the samples. The check standards should be prepared independently of the calibration standards.

- Surrogate Compounds - are used when gas chromatography/mass spectrometry procedures are employed. The surrogate standards are deuterium labelled compounds that are added to the samples prior to the extraction. They can be quantified independently of the authentic compounds. In this way quality assurance is provided for each sample.

- Spike - a known amount of analyte is added to a sample to provide information on matrix effects and apparent accuracy. Internal Standards are also used in this manner.

- Standard Reference Material - a material that contains a known concentration of the analyte in question. Based upon reliable documentation of the analyte concentration, a reference material is certified by agencies such as the National Bureau of Standards and the National Research Council.

The use of such QA samples for the proposed subject was extensive. The following table summarizes the laboratory QC.

QUALITY CONTROL SUMMARY

	No. of Samples	Blanks	Duplicates	SRMS	Spikes	%QC
Total Metals	36	2	12	3	-	47
AVS	36	2	5	-	3	28
SEM Metals	36	2	5	-	2	25
Dioxin/Furan	9	-	1	-	9	111

3.0 RESULTS AND DISCUSSION

All data is provided in the attached appendices divided according to analysis class (Total Metals, SEM Metals, etc.).

The sediment samples analyzed can be classified as primarily sand and silt fractions with very little coarse or extraneous material.

None of the samples had unusual characteristics that caused technical difficulties with any of the test methods. Analysis results were reviewed by us for AVS and SEM metals however, no known previous data exists for comparisons.

The Quality Assurance data indicates good control for all methods and procedures used. Aluminum, chromium and iron all yielded low recoveries using the specified digestion method. This was expected (and well documented in literature) since the full recovery of these elements requires that the sample is completely decomposed during preparation. The more appropriate digestion for this study was the strong acid (aqua regia) since the fraction released is the one of environmental concern. Contamination control, precision and accuracy were acceptable for all parameters analyzed.

4.0 REFERENCES

Department of Civil Engineering, University of Delaware 1990. Final Report, Development of an Analytical Method of the Determination of Acid Volatile Sulfide (AVS) in Sediment. Report submitted to the U.S. Environmental Protection Agency by Battelle. Contract No. 68-03-3534.

Tanner, C. and R. Jackson. 1947. Nomographs of Sedimentation Times for Soil Particles under Gravitational or Centrifugal Acceleration. Soil Sciences SOC. Proc. 12:60-65.

Tetra Tech. 1986. Analytical Methods for U.S. EPA Priority Pollutants and 301(h) Pesticides in Estuarine and Marine Sediments. Report prepared for the U.S. Environmental Protection Agency. Contract No. 68-01-6938.

Tyler, W.S. 1980. Soil Analysis. handbook No. 53.

U.S. EPA. 1986. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods. SW-846, 3rd Ed., Washington, DC 20460.

APPENDIX 1

Total Metals and Physical Tests Data

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Annacis Channel A1	Annacis Channel A1 Dup.	Annacis Channel A2	Annacis Channel A3
Physical Tests						
Loss On Ignition		%	2.30	-	2.40	2.40
Moisture		%	35.9	-	36.2	34.9
Total Organic Carbon		C %	0.88	-	0.83	0.80
Total Metals						
Aluminum	T-Al	%	2.52	2.78	2.47	2.47
Antimony	T-Sb		<25	<25	<25	<25
Arsenic	T-As		<25	<25	<25	<25
Cadmium	T-Cd		0.16	0.16	0.10	0.11
Calcium	T-Ca	%	1.14	1.29	1.24	1.25
Chromium	T-Cr		63.9	69.2	66.3	66.4
Cobalt	T-Co		18.8	20.5	19.3	20.3
Copper	T-Cu		40.1	43.4	40.0	40.7
Iron	T-Fe	%	3.80	3.88	3.77	3.69
Lead	T-Pb		8.6	8.5	8.4	7.8
Magnesium	T-Mg	%	1.35	1.54	1.52	1.55
Manganese	T-Mn		653	669	680	664
Mercury	T-Hg		0.050	0.057	0.053	0.048
Molybdenum	T-Mo		<5.0	<5.0	<5.0	<5.0
Nickel	T-Ni		60.1	63.6	66.9	69.4
Selenium	T-Se		0.28	0.22	0.27	0.26
Zinc	T-Zn		90.9	102	97.5	96.4

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Annacis Channel A4	Annacis Channel A5
Physical Tests				
Loss On Ignition		%	2.70	2.60
Moisture		%	38.4	33.2
Total Organic Carbon		C %	0.99	0.87
Total Metals				
Aluminum	T-Al	%	2.50	2.56
Antimony	T-Sb		<25	<25
Arsenic	T-As		<25	<25
Cadmium	T-Cd		0.15	0.11
Calcium	T-Ca	%	1.20	1.29
Chromium	T-Cr		65.2	65.6
Cobalt	T-Co		20.8	19.8
Copper	T-Cu		45.1	42.2
Iron	T-Fe	%	3.85	3.69
Lead	T-Pb		8.8	8.4
Magnesium	T-Mg	%	1.53	1.48
Manganese	T-Mn		688	692
Mercury	T-Hg		0.052	0.048
Molybdenum	T-Mo		<5.0	<5.0
Nickel	T-Ni		66.3	62.7
Selenium	T-Se		0.29	0.30
Zinc	T-Zn		103	99.3

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Blind Channel B1	Blind Channel B1 Dup.	Blind Channel B2	Blind Channel B3
Physical Tests						
Loss On Ignition		%	2.70	-	2.70	2.80
Moisture		%	39.6	-	39.8	41.9
Total Organic Carbon		C %	0.95	-	0.94	0.97
Total Metals						
Aluminum	T-Al	%	3.04	3.22	2.74	2.60
Antimony	T-Sb		<25	<25	<25	<25
Arsenic	T-As		<25	<25	<25	<25
Cadmium	T-Cd		<0.10	0.14	0.15	0.16
Calcium	T-Ca	%	1.30	1.37	1.14	1.05
Chromium	T-Cr		70.8	73.2	64.8	66.3
Cobalt	T-Co		23.3	22.2	22.8	22.0
Copper	T-Cu		48.4	48.6	47.4	49.6
Iron	T-Fe	%	4.37	4.23	4.16	4.15
Lead	T-Pb		10.9	11.1	11.1	10.7
Magnesium	T-Mg	%	1.51	1.55	1.45	1.47
Manganese	T-Mn		781	814	763	771
Mercury	T-Hg		0.056	0.053	0.056	0.056
Molybdenum	T-Mo		<5.0	<5.0	<5.0	<5.0
Nickel	T-Ni		68.0	72.3	68.3	67.4
Selenium	T-Se		0.34	0.35	0.36	0.34
Zinc	T-Zn		127	133	131	132

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Blind Channel B4	Blind Channel B5
Physical Tests				
Loss On Ignition		%	2.80	2.80
Moisture		%	41.3	40.5
Total Organic Carbon	C	%	0.96	0.94
Total Metals				
Aluminum	T-Al	%	2.47	2.62
Antimony	T-Sb		<25	<25
Arsenic	T-As		<25	<25
Cadmium	T-Cd		0.19	0.17
Calcium	T-Ca	%	1.06	1.07
Chromium	T-Cr		62.0	63.1
Cobalt	T-Co		21.4	22.7
Copper	T-Cu		49.2	48.2
Iron	T-Fe	%	4.02	4.27
Lead	T-Pb		11.3	10.9
Magnesium	T-Mg	%	1.40	1.48
Manganese	T-Mn		802	782
Mercury	T-Hg		0.056	0.055
Molybdenum	T-Mo		<5.0	<5.0
Nickel	T-Ni		67.4	65.4
Selenium	T-Se		0.29	0.29
Zinc	T-Zn		134	132

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Ewen Slough E1	Ewen Slough E1 Dup.	Ewen Slough E2	Ewen Slough E3
Physical Tests						
Loss On Ignition		%	2.50	-	3.40	4.40
Moisture		%	31.0	-	35.2	40.6
Total Organic Carbon	C	%	0.82	-	1.23	1.71
Total Metals						
Aluminum	T-Al	%	1.87	2.01	2.12	2.35
Antimony	T-Sb		<25	<25	<25	<25
Arsenic	T-As		<25	<25	<25	<25
Cadmium	T-Cd		0.14	0.13	0.21	0.22
Calcium	T-Ca	%	0.813	0.899	0.910	0.931
Chromium	T-Cr		48.8	52.8	53.7	56.0
Cobalt	T-Co		16.9	15.7	16.9	18.1
Copper	T-Cu		34.8	34.8	39.4	44.4
Iron	T-Fe	%	3.11	3.18	3.41	3.61
Lead	T-Pb		7.7	8.3	8.1	8.4
Magnesium	T-Mg	%	1.15	1.23	1.26	1.35
Manganese	T-Mn		461	495	546	583
Mercury	T-Hg		0.048	0.045	0.049	0.051
Molybdenum	T-Mo		<5.0	<5.0	<5.0	<5.0
Nickel	T-Ni		46.4	48.4	49.6	54.8
Selenium	T-Se		0.26	0.07	0.26	0.31
Zinc	T-Zn		80.9	78.2	85.4	91.0

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Ewen Slough E4	Ewen Slough E5
Physical Tests				
Loss On Ignition		%	3.30	5.60
Moisture		%	37.8	35.2
Total Organic Carbon		C %	1.16	0.82
Total Metals				
Aluminum	T-Al	%	2.14	2.50
Antimony	T-Sb		<25	<25
Arsenic	T-As		<25	<25
Cadmium	T-Cd		0.20	0.22
Calcium	T-Ca	%	0.912	1.21
Chromium	T-Cr		55.9	60.2
Cobalt	T-Co		18.0	20.0
Copper	T-Cu		45.9	42.8
Iron	T-Fe	%	3.66	3.83
Lead	T-Pb		9.3	8.2
Magnesium	T-Mg	%	1.38	1.44
Manganese	T-Mn		608	615
Mercury	T-Hg		0.052	0.070
Molybdenum	T-Mo		<5.0	<5.0
Nickel	T-Ni		53.1	55.6
Selenium	T-Se		0.28	0.32
Zinc	T-Zn		92.3	92.7

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Barnston Island L1	Barnston Island L1 Dup.	Barnston Island L2	Barnston Island L3
Physical Tests						
Loss On Ignition		%	2.90	-	2.80	2.50
Moisture		%	35.5	-	34.8	32.5
Total Organic Carbon		C %	0.97	-	0.81	0.81
Total Metals						
Aluminum	T-Al	%	1.98	2.38	2.13	2.15
Antimony	T-Sb		<25	<25	<25	<25
Arsenic	T-As		<25	<25	<25	<25
Cadmium	T-Cd		0.21	0.21	0.15	0.17
Calcium	T-Ca	%	0.972	1.10	1.04	1.08
Chromium	T-Cr		54.4	61.0	61.2	64.0
Cobalt	T-Co		17.3	17.6	18.1	18.9
Copper	T-Cu		36.2	37.4	40.4	37.6
Iron	T-Fe	%	3.39	3.47	3.65	3.68
Lead	T-Pb		6.8	6.8	7.3	7.2
Magnesium	T-Mg	%	1.23	1.26	1.45	1.39
Manganese	T-Mn		699	739	737	720
Mercury	T-Hg		0.041	0.051	0.050	0.052
Molybdenum	T-Mo		<5.0	<5.0	<5.0	<5.0
Nickel	T-Ni		53.3	55.6	63.8	60.8
Selenium	T-Se		0.30	0.21	0.29	0.27
Zinc	T-Zn		84.1	90.0	88.8	90.7

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Barnston Island L4	Barnston Island L5
Physical Tests				
Loss On Ignition		%	2.70	2.50
Moisture		%	31.7	31.2
Total Organic Carbon		C %	0.82	0.84
Total Metals				
Aluminum	T-Al	%	1.84	1.92
Antimony	T-Sb		<25	<25
Arsenic	T-As		<25	<25
Cadmium	T-Cd		0.18	0.19
Calcium	T-Ca	%	0.946	0.953
Chromium	T-Cr		51.0	53.3
Cobalt	T-Co		16.0	15.8
Copper	T-Cu		32.0	31.8
Iron	T-Fe	%	3.18	3.18
Lead	T-Pb		6.3	5.9
Magnesium	T-Mg	%	1.12	1.15
Manganese	T-Mn		683	639
Mercury	T-Hg		0.040	0.046
Molybdenum	T-Mo		<5.0	<5.0
Nickel	T-Ni		46.9	47.2
Selenium	T-Se		0.23	0.21
Zinc	T-Zn		80.7	81.0

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Macdonald Slough M1	Macdonald Slough M1 Dup.	Macdonald Slough M2	Macdonald Slough M3
Physical Tests						
Loss On Ignition		%	3.50	-	3.40	3.60
Moisture		%	35.1	-	35.2	35.5
Total Organic Carbon	C	%	1.18	-	1.15	1.19
Total Metals						
Aluminum	T-Al	%	2.47	2.45	2.32	2.36
Antimony	T-Sb		<25	<25	<25	<25
Arsenic	T-As		<25	<25	<25	<25
Cadmium	T-Cd		0.25	0.21	0.18	0.22
Calcium	T-Ca	%	0.960	1.02	1.00	1.03
Chromium	T-Cr		65.7	65.3	61.2	61.7
Cobalt	T-Co		19.7	18.5	17.2	18.4
Copper	T-Cu		44.2	43.9	39.6	42.9
Iron	T-Fe	%	3.85	3.78	3.59	3.82
Lead	T-Pb		10.7	10.0	10.6	10.9
Magnesium	T-Mg	%	1.44	1.44	1.33	1.38
Manganese	T-Mn		494	486	469	493
Mercury	T-Hg		0.088	0.052	0.056	0.057
Molybdenum	T-Mo		<5.0	<5.0	<5.0	<5.0
Nickel	T-Ni		60.0	59.2	53.3	55.7
Selenium	T-Se		0.27	0.22	0.23	0.28
Zinc	T-Zn		107	105	98.7	108

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Macdonald Slough M4	Macdonald Slough M5
Physical Tests				
Loss On Ignition		%	3.60	3.60
Moisture		%	36.4	35.4
Total Organi Carbon		C %	1.18	1.19
Total Metals				
Aluminum	T-Al	%	2.45	2.37
Antimony	T-Sb		<25	<25
Arsenic	T-As		<25	<25
Cadmium	T-Cd		0.23	0.20
Calcium	T-Ca	%	0.981	1.01
Chromium	T-Cr		64.7	60.0
Cobalt	T-Co		18.8	19.6
Copper	T-Cu		45.3	43.7
Iron	T-Fe	%	3.93	3.86
Lead	T-Pb		10.5	10.1
Magnesium	T-Mg	%	1.53	1.47
Manganese	T-Mn		480	478
Mercury	T-Hg		0.058	0.056
Molybdenum	T-Mo		<5.0	<5.0
Nickel	T-Ni		58.8	58.1
Selenium	T-Se		0.31	0.35
Zinc	T-Zn		102	100

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Sapperton S1	Sapperton S1 Dup.	Sapperton S2	Sapperton S3
Physical Tests						
Loss On Ignition		%	1.80	-	2.60	2.20
Moisture		%	25.2	-	29.3	29.5
Total Organic Carbon		C %	0.56	-	0.84	0.72
Total Metals						
Aluminum	T-Al	%	2.04	1.97	2.16	2.31
Antimony	T-Sb		<25	<25	<25	<25
Arsenic	T-As		<25	<25	<25	<25
Cadmium	T-Cd		<0.10	0.17	0.14	0.19
Calcium	T-Ca	%	1.07	1.07	1.11	1.24
Chromium	T-Cr		53.7	52.3	58.5	58.7
Cobalt	T-Co		15.6	14.1	16.7	17.2
Copper	T-Cu		29.5	28.0	34.3	36.0
Iron	T-Fe	%	3.05	3.02	3.18	3.46
Lead	T-Pb		5.1	5.4	6.1	6.7
Magnesium	T-Mg	%	1.10	1.05	1.18	1.22
Manganese	T-Mn		562	543	585	635
Mercury	T-Hg		0.035	0.037	0.051	0.051
Molybdenum	T-Mo		<5.0	<5.0	<5.0	<5.0
Nickel	T-Ni		46.7	45.4	51.7	54.8
Selenium	T-Se		0.24	0.07	0.26	0.22
Zinc	T-Zn		73.7	71.0	76.9	81.5

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			Sapperton S4	Sapperton S5
Physical Tests				
Loss On Ignition		%	2.00	2.40
Moisture		%	28.3	32.0
Total Organic Carbon		C %	0.67	0.92
Total Metals				
Aluminum	T-Al	%	2.11	2.10
Antimony	T-Sb		<25	<25
Arsenic	T-As		<25	<25
Cadmium	T-Cd		0.19	0.18
Calcium	T-Ca	%	1.22	1.07
Chromium	T-Cr		57.6	57.5
Cobalt	T-Co		17.2	17.5
Copper	T-Cu		35.5	33.1
Iron	T-Fe	%	3.35	3.42
Lead	T-Pb		6.8	6.2
Magnesium	T-Mg	%	1.19	1.20
Manganese	T-Mn		583	665
Mercury	T-Hg		0.041	0.044
Molybdenum	T-Mo		<5.0	<5.0
Nickel	T-Ni		50.0	52.0
Selenium	T-Se		0.27	0.33
Zinc	T-Zn		81.9	80.4

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			LGS-1	LGS-1 Dup.	LGS-2	LGS-2 Dup.
Total Metals						
Aluminum	T-Al	%	2.37	2.59	2.73	2.56
Antimony	T-Sb		<25	<25	180	190
Arsenic	T-As		<25	<25	195	207
Cadmium	T-Cd		0.23	0.22	2.43	2.43
Calcium	T-Ca	%	0.472	0.460	1.18	1.17
Chromium	T-Cr		59.7	62.8	77.9	73.8
Cobalt	T-Co		11.4	13.1	16.7	17.8
Copper	T-Cu		17.3	17.1	470	463
Iron	T-Fe	%	3.09	3.16	4.34	4.26
Lead	T-Pb		20.9	20.3	407	405
Magnesium	T-Mg	%	1.26	1.24	1.17	1.09
Manganese	T-Mn		230	222	358	354
Mercury	T-Hg		0.161	0.178	4.70	4.50
Molybdenum	T-Mo		<5.0	<5.0	12.8	11.5
Nickel	T-Ni		55.8	56.9	41.3	42.0
Selenium	T-Se		0.50	0.47	0.90	0.97
Zinc	T-Zn		118	112	943	931

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			LGS-3	LGS-3 Dup.
Total Metals				
Aluminum	T-Al	%	2.66	2.66
Antimony	T-Sb		175	180
Arsenic	T-As		195	197
Cadmium	T-Cd		2.50	2.43
Calcium	T-Ca	%	1.24	1.27
Chromium	T-Cr		75.6	73.1
Cobalt	T-Co		18.1	18.8
Copper	T-Cu		471	478
Iron	T-Fe	%	4.43	4.58
Lead	T-Pb		408	408
Magnesium	T-Mg	%	1.19	1.20
Manganese	T-Mn		370	365
Mercury	T-Hg		4.80	4.70
Molybdenum	T-Mo		12.0	11.9
Nickel	T-Ni		42.4	42.0
Selenium	T-Se		0.95	0.99
Zinc	T-Zn		850	840

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter			DGW-1	DGW-1 Dup.	DGW-2	DGW-2 Dup.
Total Metals						
Aluminum	T-Al	%	2.49	2.27	2.67	2.87
Antimony	T-Sb		<25	<25	165	166
Arsenic	T-As		<25	<25	200	198
Cadmium	T-Cd		0.33	0.25	2.39	2.49
Calcium	T-Ca	%	0.458	0.451	1.21	1.22
Chromium	T-Cr		60.4	57.8	73.7	78.0
Cobalt	T-Co		11.7	11.7	18.2	18.5
Copper	T-Cu		18.5	16.2	449	460
Iron	T-Fe	%	3.20	3.16	4.37	4.59
Lead	T-Pb		19.3	20.6	392	391
Magnesium	T-Mg	%	1.28	1.25	1.15	1.18
Manganese	T-Mn		229	228	369	370
Mercury	T-Hg		0.191	0.189	4.60	4.70
Molybdenum	T-Mo		<5.0	<5.0	13.1	13.8
Nickel	T-Ni		54.8	55.7	41.0	42.5
Selenium	T-Se		0.47	0.45	0.95	0.98
Zinc	T-Zn		117	114	829	850

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		DGW-3	DGW-3 Dup.
Total Metals			
Aluminum	T-Al	2.55	2.71
Antimony	T-Sb	<25	<25
Arsenic	T-As	<25	<25
Cadmium	T-Cd	0.29	0.29
Calcium	T-Ca	0.455	0.475
Chromium	T-Cr	63.0	66.3
Cobalt	T-Co	12.9	13.5
Copper	T-Cu	19.0	17.2
Iron	T-Fe	3.17	3.43
Lead	T-Pb	20.8	20.3
Magnesium	T-Mg	1.27	1.30
Manganese	T-Mn	230	234
Mercury	T-Hg	0.213	0.203
Molybdenum	T-Mo	<5.0	<5.0
Nickel	T-Ni	53.8	58.4
Selenium	T-Se	0.49	0.49
Zinc	T-Zn	122	126

Results are expressed as milligrams per dry kilogram except where noted.
% = Percent, dry weight basis.
Dup. = Duplicate.

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APPENDIX 2

Total Metals Quality Control Data

RESULTS OF ANALYSIS - QC Data

File No. 1650C

Parameter			Digestion Blank 1	Digestion Blank 2
Total Metals				
Aluminum	T-Al	%	<0.005	<0.005
Antimony	T-Sb		<25	<25
Arsenic	T-As		<25	<25
Cadmium	T-Cd		<0.10	<0.10
Calcium	T-Ca	%	<0.005	<0.005
Chromium	T-Cr		<2.0	<2.0
Cobalt	T-Co		<2.0	<2.0
Copper	T-Cu		<1.0	<1.0
Iron	T-Fe	%	<0.005	<0.005
Lead	T-Pb		<2.0	<2.0
Magnesium	T-Mg	%	<0.005	<0.005
Manganese	T-Mn		<0.10	<0.10
Mercury	T-Hg		<0.005	<0.005
Molybdenum	T-Mo		<0.2	<0.2
Nickel	T-Ni		<2.0	<2.0
Selenium	T-Se		<0.05	<0.05
Zinc	T-Zn		<1.0	<1.0

Results are expressed as milligrams per dry kilogram of sample except where otherwise indicated.
% = Percent.

RESULTS OF ANALYSIS - QC Data

File No. 1650C

Parameter		MESS-1 (Found)	MESS-1 Certified Value	BCSS-1 (Found)	BCSS-1 Certified Value
Total Metals					
Aluminum	T-Al %	2.19	5.84 ± 0.20	2.52	6.26 ± 0.22
Antimony	T-Sb	<25	0.73 ± 0.08	<25	0.59 ± 0.06
Arsenic	T-As	<25	10.6 ± 1.2	<25	11.1 ± 1.4
Cadmium	T-Cd	0.60	0.59 ± 0.10	0.23	0.25 ± 0.04
Calcium	T-Ca %	0.280	0.48 ± 0.05	0.470	0.54 ± 0.05
Chromium	T-Cr	36.6	71. ± 11.	65.1	123. ± 14.
Cobalt	T-Co	12.7	10.8 ± 1.9	10.6	11.4 ± 2.1
Copper	T-Cu	23.8	25.1 ± 3.8	17.0	18.5 ± 2.7
Iron	T-Fe %	2.76	3.05 ± 0.17	3.22	3.29 ± 0.10
Lead	T-Pb	29.3	34.0 ± 6.1	20.5	22.7 ± 3.4
Magnesium	T-Mg %	0.710	0.87 ± 0.05	1.20	1.47 ± 0.14
Manganese	T-Mn	403	513. ± 25.	219	229. ± 15.
Molybdenum	T-Mo	<0.2	-	<0.2	-
Nickel	T-Ni	26.0	29.5 ± 2.7	52.4	55.3 ± 3.6
Selenium	T-Se	0.030	0.34 ± 0.06	0.038	0.43 ± 0.06
Zinc	T-Zn	189	191. ± 17.	115	119. ± 12.0

Parameter		BEST-1 (Found)	BEST-1 Certified Value
Mercury	T-Hg	0.090	0.092 ± 0.009

Results are expressed as milligrams per dry kilogram of sample except where otherwise indicated.
% = Percent.

APPENDIX 3

Acid Volatile Sulphide and Extractable Metals Data

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Annacis Channel A1	Annacis Channel A2	Annacis Channel A3	Annacis Channel A4
Extractable Metals					
Aluminum	Al	2100	2150	2120	2150
Antimony	Sb	<15	<15	<15	<15
Arsenic	As	<15	<15	<15	<15
Cadmium	Cd	<0.5	<0.5	<0.5	<0.5
Calcium	Ca	3460	3720	3570	3930
Chromium	Cr	3.9	3.1	6.7	5.6
Cobalt	Co	3.6	3.8	3.9	4.0
Copper	Cu	13.2	17.1	15.6	37.0
Iron	Fe	4060	4280	5040	5080
Lead	Pb	6.4	5.3	8.6	8.3
Magnesium	Mg	2060	2200	2290	2190
Manganese	Mn	188	206	211	219
Mercury	Hg	<0.025	<0.025	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0	<5.0	<5.0
Nickel	Ni	11.1	11.7	19.0	14.6
Selenium	Se	<0.2	<0.2	<0.2	<0.2
Zinc	Zn	18.6	18.4	63.4	51.3
Inorganic Parameters					
Acid Volatile Sulphide		6.23	6.18	14.3	5.67

Results are expressed as milligrams per dry kilogram.
Dup. = Duplicate.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Annacis Channel A5	Annacis Channel A5 Dup.
Extractable Metals			
Aluminum	Al	1930	2020
Antimony	Sb	<15	<15
Arsenic	As	<15	<15
Cadmium	Cd	<0.5	<0.5
Calcium	Ca	3610	3350
Chromium	Cr	3.3	3.5
Cobalt	Co	3.4	3.6
Copper	Cu	11.4	12.5
Iron	Fe	4590	4930
Lead	Pb	5.2	6.4
Magnesium	Mg	2050	2220
Manganese	Mn	196	204
Mercury	Hg	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0
Nickel	Ni	10.4	10.5
Selenium	Se	<0.2	<0.2
Zinc	Zn	19.1	15.2
Inorganic Parameters			
Acid Volatile Sulphide		13.4	13.4

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Blind Channel B1	Blind Channel B2	Blind Channel B3	Blind Channel B4
Extractable Metals					
Aluminum	Al	2380	2260	2270	2130
Antimony	Sb	<15	<15	<15	<15
Arsenic	As	<15	<15	<15	<15
Cadmium	Cd	<0.5	<0.5	<0.5	<0.5
Calcium	Ca	3930	3690	3600	3670
Chromium	Cr	4.6	3.5	4.0	4.7
Cobalt	Co	4.3	4.4	4.2	4.0
Copper	Cu	15.1	13.7	14.4	18.6
Iron	Fe	5670	5410	5440	5160
Lead	Pb	5.6	8.1	7.2	9.0
Magnesium	Mg	2450	2270	2210	2080
Manganese	Mn	233	224	230	248
Mercury	Hg	<0.025	<0.025	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0	<5.0	<5.0
Nickel	Ni	12.6	11.0	11.1	11.4
Selenium	Se	<0.2	<0.2	<0.2	<0.2
Zinc	Zn	25.9	26.9	27.7	31.5
Inorganic Parameters					
Acid Volatile Sulphide		7.94	11.7	2.58	2.66

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Blind Channel B5	Blind Channel B5 Dup.
Extractable Metals			
Aluminum	Al	2310	2390
Antimony	Sb	<15	<15
Arsenic	As	<15	<15
Cadmium	Cd	<0.5	<0.5
Calcium	Ca	3850	3620
Chromium	Cr	3.2	3.5
Cobalt	Co	4.5	4.5
Copper	Cu	15.0	15.1
Iron	Fe	5980	6200
Lead	Pb	10.4	10.4
Magnesium	Mg	2350	2450
Manganese	Mn	254	243
Mercury	Hg	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0
Nickel	Ni	11.5	11.7
Selenium	Se	<0.2	<0.2
Zinc	Zn	32.0	30.3
Inorganic Parameters			
Acid Volatile Sulphide		3.51	4.27

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Ewen Slough E1	Ewen Slough E2	Ewen Slough E3	Ewen Slough E4
Extractable Metals					
Aluminum	Al	1420	1610	1690	1700
Antimony	Sb	<15	<15	<15	<15
Arsenic	As	<15	<15	<15	<15
Cadmium	Cd	<0.5	<0.5	<0.5	<0.5
Calcium	Ca	2660	3040	3130	2980
Chromium	Cr	2.2	1.9	2.2	6.3
Cobalt	Co	2.6	3.3	2.7	2.6
Copper	Cu	9.1	10.2	22.7	13.4
Iron	Fe	4220	4270	4720	4220
Lead	Pb	7.8	7.7	9.3	7.8
Magnesium	Mg	1820	2010	2070	2050
Manganese	Mn	103	131	152	139
Mercury	Hg	<0.025	<0.025	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0	<5.0	<5.0
Nickel	Ni	6.5	6.5	8.6	8.1
Selenium	Se	<0.2	<0.2	<0.2	<0.2
Zinc	Zn	12.8	13.2	21.2	15.0
Inorganic Parameters					
Acid Volatile Sulphide		145	58.6	54.2	36.3

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Ewen Slough E5	Ewen Slough E5 Dup.
Extractable Metals			
Aluminum	Al	1580	1600
Antimony	Sb	<15	<15
Arsenic	As	<15	<15
Cadmium	Cd	<0.5	<0.5
Calcium	Ca	2960	3120
Chromium	Cr	2.4	2.4
Cobalt	Co	2.8	2.7
Copper	Cu	9.5	10.0
Iron	Fe	3820	3820
Lead	Pb	8.6	7.7
Magnesium	Mg	2160	2170
Manganese	Mn	120	121
Mercury	Hg	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0
Nickel	Ni	6.5	6.5
Selenium	Se	<0.2	<0.2
Zinc	Zn	11.6	12.2
Inorganic Parameters			
Acid Volatile Sulphide		72.0	68.9

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Barnston Island L1	Barnston Island L2	Barnston Island L3	Barnston Island L4
Extractable Metals					
Aluminum	Al	1510	1620	1480	1380
Antimony	Sb	<15	<15	<15	<15
Arsenic	As	<15	<15	<15	<15
Cadmium	Cd	<0.5	<0.5	<0.5	<0.5
Calcium	Ca	3060	3440	3270	3030
Chromium	Cr	3.5	3.3	3.4	3.1
Cobalt	Co	2.8	3.2	3.0	2.5
Copper	Cu	8.2	9.3	7.7	6.8
Iron	Fe	3270	3530	3260	2860
Lead	Pb	3.9	5.8	4.5	3.7
Magnesium	Mg	1490	1750	1560	1370
Manganese	Mn	201	198	187	203
Mercury	Hg	<0.025	<0.025	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0	<5.0	<5.0
Nickel	Ni	7.3	9.5	7.8	5.9
Selenium	Se	<0.2	<0.2	<0.2	<0.2
Zinc	Zn	12.3	11.7	10.9	11.5
Inorganic Parameters					
Acid Volatile Sulphide		0.71	1.66	1.41	0.59

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - Sediment/Soil

File No. 1650C

Parameter		Barnston Island L5	Barnston Island L5 Dup.
Extractable Metals			
Aluminum	Al	1410	1630
Antimony	Sb	<15	<15
Arsenic	As	<15	<15
Cadmium	Cd	<0.5	<0.5
Calcium	Ca	3090	2910
Chromium	Cr	2.8	4.2
Cobalt	Co	2.6	41.6
Copper	Cu	10.1	13.0
Iron	Fe	2930	3790
Lead	Pb	5.4	3.3
Magnesium	Mg	1440	1640
Manganese	Mn	182	180
Mercury	Hg	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0
Nickel	Ni	7.3	26.3
Selenium	Se	<0.2	<0.2
Zinc	Zn	20.6	13.4
Inorganic Parameters			
Acid Volatile Sulphide		2.24	3.43

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Macdonald Slough M1	Macdonald Slough M2	Macdonald Slough M3	Macdonald Slough M4
Extractable Metals					
Aluminum	Al	2020	1680	1630	1990
Antimony	Sb	<15	<15	<15	<15
Arsenic	As	<15	<15	<15	<15
Cadmium	Cd	<0.5	<0.5	<0.5	<0.5
Calcium	Ca	3120	3000	2540	3110
Chromium	Cr	4.4	4.9	5.2	7.4
Cobalt	Co	3.0	2.2	2.2	2.7
Copper	Cu	12.2	9.8	9.3	11.6
Iron	Fe	4070	3220	3290	3770
Lead	Pb	6.8	3.8	6.9	7.0
Magnesium	Mg	2580	2080	2040	2370
Manganese	Mn	73.3	65.6	64.9	71.5
Mercury	Hg	<0.025	<0.025	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0	<5.0	<5.0
Nickel	Ni	8.5	7.4	7.4	10.5
Selenium	Se	<0.2	<0.2	<0.2	<0.2
Zinc	Zn	18.6	15.8	15.7	16.9
Inorganic Parameters					
Acid Volatile Sulphide		135	110	116	263

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Macdonald Slough M5	Macdonald Slough M5 Dup.
Extractable Metals			
Aluminum	Al	2090	2130
Antimony	Sb	<15	<15
Arsenic	As	<15	<15
Cadmium	Cd	<0.5	<0.5
Calcium	Ca	3350	2660
Chromium	Cr	8.5	8.8
Cobalt	Co	2.9	3.0
Copper	Cu	11.5	12.4
Iron	Fe	3830	3510
Lead	Pb	6.8	6.5
Magnesium	Mg	2480	2580
Manganese	Mn	72.7	76.7
Mercury	Hg	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0
Nickel	Ni	11.9	12.3
Selenium	Se	<0.2	<0.2
Zinc	Zn	16.5	17.1
Inorganic Parameters			
Acid Volatile Sulphide		152	167

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Parameter		Sapperton S1	Sapperton S2	Sapperton S3	Sapperton S4	Sapperton S5
Extractable Metals						
Aluminum	Al	1370	1860	1870	1770	1860
Antimony	Sb	<15	<15	<15	<15	<15
Arsenic	As	<15	<15	<15	<15	<15
Cadmium	Cd	<0.5	<0.5	<0.5	<0.5	<0.5
Calcium	Ca	2300	3330	2990	3290	3900
Chromium	Cr	5.6	8.7	4.2	4.1	4.5
Cobalt	Co	2.3	4.0	13.6	3.1	4.0
Copper	Cu	6.7	13.7	10.9	9.4	13.9
Iron	Fe	2490	3350	3270	3150	3910
Lead	Pb	2.9	4.5	3.4	3.6	3.4
Magnesium	Mg	1330	1970	1960	1960	1800
Manganese	Mn	133	160	161	161	189
Mercury	Hg	<0.025	<0.025	<0.025	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0	<5.0	<5.0	<5.0
Nickel	Ni	8.0	13.2	15.8	8.9	10.9
Selenium	Se	<0.2	<0.2	<0.2	<0.2	<0.2
Zinc	Zn	9.87	16.4	12.1	13.0	15.0
Inorganic Parameters						
Acid Volatile Sulphide		3.06	14.6	10.1	10.7	10.6

Results are expressed as milligrams per dry kilogram.

APPENDIX 4

Acid Volatile Sulfide and Extractable Metals Quality Control Data

RESULTS OF ANALYSIS - QC Data

File No. 1650C

Parameter		SEM Blank 1	SEM Blank 2
Extractable Metals			
Aluminum	Al	<25	<25
Antimony	Sb	<15	<15
Arsenic	As	<15	<15
Cadmium	Cd	<0.5	<0.5
Calcium	Ca	<2.5	<2.5
Chromium	Cr	<2.5	<2.5
Cobalt	Co	<2.5	<2.5
Copper	Cu	<1.5	<1.5
Iron	Fe	<1.5	<1.5
Lead	Pb	<2.5	<2.5
Magnesium	Mg	<2.5	<2.5
Manganese	Mn	<0.25	<0.25
Mercury	Hg	<0.025	<0.025
Molybdenum	Mo	<5.0	<5.0
Nickel	Ni	<2.5	<2.5
Selenium	Se	<0.2	<0.2
Zinc	Zn	<1.5	<1.5
Inorganic Parameters			
Acid Volatile Sulphide		<1.0	<1.0

Results are expressed as milligrams per dry kilogram.

RESULTS OF ANALYSIS - QA Data File No. 1650C

Aqueous Spike	Spike Amount (mg/L)	Found (mg/L)	Percent Recovery
Cadmium	0.39	0.35	90.0
Cobalt	0.39	0.35	90.0
Copper	0.39	0.27	69.0
Iron	0.39	0.34	87.2
Lead	0.39	0.37	94.9
Nickel	0.39	0.36	92.3
Zinc	0.39	0.45	115.
Mercury	0.00079	0.00083	105.
Selenium	0.00079	0.00070	88.6

Spike into Sample "Blind Channel, B1".

	Spike Amount (mg/L)	Found (mg/L)	Percent Recovery
Cadmium	0.39	0.38	97.4
Cobalt	0.39	0.24	61.5
Copper	0.39	0.33	84.6
Iron	0.39	-	-
Lead	0.39	0.39	100.
Nickel	0.39	0.28	71.8
Zinc	0.39	0.27	69.2
Mercury	0.00079	0.00050	63.3
Selenium	0.00079	0.00071	89.8

Results are expressed as milligrams per litre in the extract.
< = Less than detection limit indicated.

Acid Volatile Sulphide
Quality Assurance
Data

RESULTS OF ANALYSIS - QA Data

File No. 1650C

Spike into Sample		Spike Amount (ug)	Found (ug)	Percent Recovery
Annacis Channel	A5	50.0	46.5	93.
Blind Channel	B2	40.0	33.6	84.
Blind Channel	B3	20.0	15.0	75.

Results are expressed as micrograms (ug) of Sulphide.

APPENDIX 5

**Total and SEM
Metals + AVS
Coverted
to
m moles/Kg**

Results of Analysis- Sediment/Soil File No. 1650C

		Annacis Channel A1 a+b	Annacis Channel A1 Dup.	Annacis Channel A2 a+b	Annacis Channel A3 a+b	Annacis Channel A4 a+b	Annacis Channel A5 a+b	Annacis Channel A5 Dup.	Blind Channel B1 a+b	Blind Channel B1 Dup.
Total Metals (mmoles/kg)										
Aluminum	T-Al	933.97	1030.33	915.44	915.44	926.56	948.80	-	1126.70	1193.41
Antimony	T-Sb	<	<	<	<	<	<	-	<	<
Arsenic	T-As	<	<	<	<	<	<	-	<	<
Cadmium	T-Cd	0.0014	0.0014	0.0009	0.0010	0.0013	0.0010	-	0.0000	0.0012
Calcium	T-Ca	284.43	321.86	309.38	311.88	299.40	321.86	-	324.35	341.82
Chromium	T-Cr	1.2289	1.3309	1.2751	1.2770	1.2539	1.2816	-	1.3616	1.4078
Cobalt	T-Co	0.3190	0.3479	0.3275	0.3445	0.3529	0.3360	-	0.3954	0.3767
Copper	T-Cu	0.6310	0.6830	0.6295	0.6405	0.7097	0.6641	-	0.7617	0.7648
Iron	T-Fe	680.43	694.76	675.06	660.73	689.38	660.73	-	782.50	757.43
Lead	T-Pb	0.0415	0.0410	0.0405	0.0376	0.0425	0.0405	-	0.0526	0.0536
Magnesium	T-Mg	555.44	633.61	625.39	637.73	629.50	608.93	-	621.27	637.73
Manganese	T-Mn	11.886	12.177	12.378	12.086	12.523	12.596	-	14.216	14.817
Mercury	T-Hg	3.2554	3.3352	3.3900	3.3102	3.4299	3.4498	-	3.8935	4.0580
Molybdenum	T-Mo	0.0005	0.0006	0.0006	0.0005	0.0005	0.0005	-	0.0006	0.0006
Nickel	T-Ni	<	<	<	<	<	<	-	<	<
Selenium	T-Se	0.0035	0.0028	0.0034	0.0033	0.0037	0.0038	-	0.0043	0.0044
Zinc	T-Zn	1.3903	1.5601	1.4913	1.4745	1.5754	1.5188	-	1.9425	2.0343
Extractable Metals (mmoles/kg)										
Aluminum	Al	77.83	-	79.68	78.57	79.68	71.53	74.87	88.21	-
Antimony	Sb	<	-	<	<	<	<	<	<	-
Arsenic	As	<	-	<	<	<	<	<	<	-
Cadmium	Cd	<	-	<	<	<	<	<	<	-
Calcium	Ca	86.33	-	92.81	89.07	98.05	90.07	83.58	98.05	-
Chromium	Cr	0.0750	-	0.0595	0.1289	0.1077	0.0635	0.0673	0.0885	-
Cobalt	Co	0.0611	-	0.0645	0.0662	0.0679	0.0577	0.0611	0.0730	-
Copper	Cu	0.2077	-	0.2691	0.2455	0.5823	0.1794	0.1967	0.2376	-
Iron	Fe	72.70	-	76.64	90.25	90.96	82.19	88.28	101.53	-
Lead	Pb	<	-	<	<	<	<	<	<	-
Magnesium	Mg	84.76	-	90.52	94.22	90.10	84.34	91.34	100.80	-
Manganese	Mn	3.422	-	3.750	3.841	3.986	3.568	3.713	4.241	-
Mercury	Hg	<	-	<	<	<	<	<	<	-
Molybdenum	Mo	<	-	<	<	<	<	<	<	-
Nickel	Ni	0.1891	-	0.1993	0.3237	0.2467	0.1772	0.1789	0.2147	-
Selenium	Se	<	-	<	<	<	<	<	<	-
Zinc	Zn	0.2845	-	0.2814	0.9697	0.7846	0.2921	0.2325	0.3961	-
Total Sum of Extractable Metals		325.853	-	344.276	357.685	364.583	332.471	342.515	393.843	-
Acid Volatile Sulphide		0.1938	-	0.1922	0.4447	0.1763	0.4167	0.4167	0.2469	-

Results are expressed in mmoles/kg

Results of Analysis- Sediment/Soil File No. 1650C

		Blind Channel B2 a+b	Blind Channel B3 a+b	Blind Channel B4 a+b	Blind Channel B5 a+b	Blind Channel B5 Dup.	Ewen Slough E1 a+b	Ewen Slough E1 Dup.	Ewen Slough E2 a+b	Ewen Slough E3 a+b
Total Metals (mmoles/kg)										
Aluminum	T-Al	1015.51	963.62	915.44	971.03	-	693.07	744.95	785.72	870.97
Antimony	T-Sb	<	<	<	<	-	<	<	<	<
Arsenic	T-As	<	<	<	<	-	<	<	<	<
Cadmium	T-Cd	0.0013	0.0014	0.0017	0.0015	-	0.0012	0.0012	0.0019	0.0020
Calcium	T-Ca	284.43	261.98	264.47	266.97	-	202.84	224.30	227.05	232.29
Chromium	T-Cr	1.2462	1.2751	1.1924	1.2136	-	0.9385	1.0155	1.0328	1.0770
Cobalt	T-Co	0.3869	0.3733	0.3631	0.3852	-	0.2868	0.2664	0.2868	0.3071
Copper	T-Cu	0.7459	0.7805	0.7742	0.7585	-	0.5476	0.5476	0.6200	0.6987
Iron	T-Fe	744.89	743.10	719.82	764.59	-	556.88	569.41	610.60	646.41
Lead	T-Pb	0.0536	0.0516	0.0545	0.0526	-	0.0372	0.0401	0.0391	0.0405
Magnesium	T-Mg	596.59	604.81	576.01	608.93	-	473.15	506.07	518.41	555.44
Manganese	T-Mn	13.888	14.034	14.598	14.234	-	8.391	9.010	9.938	10.612
Mercury	T-Hg	3.8038	3.8437	3.9982	3.8985	-	2.2982	2.4677	2.7220	2.9064
Molybdenum	T-Mo	0.0006	0.0006	0.0006	0.0006	-	0.0005	0.0005	0.0005	0.0005
Nickel	T-Ni	<	<	<	<	-	<	<	<	<
Selenium	T-Se	0.0046	0.0043	0.0037	0.0037	-	0.0033	0.0009	0.0033	0.0039
Zinc	T-Zn	2.0037	2.0190	2.0496	2.0190	-	1.2374	1.1961	1.3062	1.3919
Extractable Metals (mmoles/kg)										
Aluminum	Al	83.76	84.13	78.94	85.61	88.58	52.63	-	59.67	62.64
Antimony	Sb	<	<	<	<	<	<	-	<	<
Arsenic	As	<	<	<	0.0374	<	<	-	<	<
Cadmium	Cd	<	<	<	<	<	<	-	<	<
Calcium	Ca	92.07	89.82	91.57	96.06	90.32	66.37	-	75.85	78.09
Chromium	Cr	0.0673	0.0769	0.0904	0.0615	0.0673	0.0423	-	0.0365	0.0423
Cobalt	Co	0.0747	0.0713	0.0679	0.0764	0.0764	0.0441	-	0.0560	0.0458
Copper	Cu	0.2156	0.2266	0.2927	0.2360	0.2376	0.1432	-	0.1605	0.3572
Iron	Fe	96.87	97.41	92.40	107.08	111.02	75.56	-	76.46	84.52
Lead	Pb	<	<	<	<	<	<	-	<	<
Magnesium	Mg	93.40	90.93	85.58	96.69	100.80	74.88	-	82.70	85.17
Manganese	Mn	4.077	4.187	4.514	4.623	4.423	1.875	-	2.385	2.767
Mercury	Hg	<	<	<	<	<	<	-	<	<
Molybdenum	Mo	<	<	<	<	<	<	-	<	<
Nickel	Ni	0.1874	0.1891	0.1942	0.1959	0.1993	0.1107	-	0.1107	0.1465
Selenium	Se	<	<	<	<	<	<	-	<	<
Zinc	Zn	0.4114	0.4237	0.4818	0.4894	0.4634	0.1958	-	0.2019	0.3243
Total Sum of Extractable Metals		371.129	367.463	354.125	391.158	396.186	271.852	-	297.627	314.096
Acid Volatile Sulphide		0.3539	0.0802	0.0827	0.1092	0.1328	4.5095	-	1.8225	1.5856

Results are expressed in mmoles/kg

Results of Analysis- Sediment/Soil File No. 1650C

		Ewen Slough E4 a+b	Ewen Slough E5 a+b	Ewen Slough E5 Dup.	Barnston Island L1 a+b	Barnston Island L1 Dup.	Barnston Island L2 a+b	Barnston Island L3 a+b	Barnston Island L4 a+b	Barnston Island L5 a+b
Total Metals (mmoles/kg)										
Aluminum	T-Al	793.13	926.56	-	733.84	882.08	789.43	796.84	681.95	711.60
Antimony	T-Sb	<	<	-	<	<	<	<	<	<
Arsenic	T-As	<	<	-	<	<	<	<	<	<
Cadmium	T-Cd	0.0018	0.0020	-	0.0019	0.0019	0.0013	0.0015	0.0016	0.0017
Calcium	T-Ca	227.54	301.90	-	242.51	274.45	259.48	269.46	236.03	237.77
Chromium	T-Cr	1.0751	1.1578	-	1.0462	1.1732	1.1770	1.2309	0.9808	1.0251
Cobalt	T-Co	0.3054	0.3394	-	0.2936	0.2986	0.3071	0.3207	0.2715	0.2681
Copper	T-Cu	0.7223	0.6735	-	0.5697	0.5886	0.6358	0.5917	0.5036	0.5004
Iron	T-Fe	655.36	685.80	-	607.02	621.34	653.57	658.94	569.41	569.41
Lead	T-Pb	0.0449	0.0396	-	0.0328	0.0328	0.0352	0.0347	0.0304	0.0285
Magnesium	T-Mg	567.78	592.47	-	506.07	516.41	596.59	571.90	460.81	473.15
Manganese	T-Mn	11.067	11.194	-	12.723	13.452	13.415	13.106	12.432	11.631
Mercury	T-Hg	3.0311	3.0660	-	3.4847	3.6841	3.6742	3.5894	3.4050	3.1856
Molybdenum	T-Mo	0.0005	0.0007	-	0.0004	0.0005	0.0005	0.0005	0.0004	0.0005
Nickel	T-Ni	<	<	-	<	<	<	<	<	<
Selenium	T-Se	0.0035	0.0041	-	0.0038	0.0027	0.0037	0.0034	0.0029	0.0027
Zinc	T-Zn	1.4117	1.4179	-	1.2863	1.3766	1.3582	1.3873	1.2343	1.2389
Extractable Metals (mmoles/kg)										
Aluminum	Al	63.01	58.56	59.30	55.96	-	60.04	54.85	51.15	52.26
Antimony	Sb	<	<	<	<	-	<	<	<	<
Arsenic	As	<	<	<	<	-	<	<	<	<
Cadmium	Cd	<	<	<	<	-	<	<	<	<
Calcium	Ca	74.35	73.65	77.84	76.35	-	85.83	81.59	75.60	77.10
Chromium	Cr	0.1212	0.0462	0.0462	0.0573	-	0.0635	0.0654	0.0596	0.0539
Cobalt	Co	0.0441	0.0475	0.0458	0.0475	-	0.0543	0.0509	0.0424	0.0441
Copper	Cu	0.2109	0.1495	0.1574	0.1290	-	0.1464	0.1212	0.1070	0.1589
Iron	Fe	75.56	68.40	68.40	58.55	-	63.21	58.37	51.21	52.46
Lead	Pb	<	<	<	<	-	<	<	<	<
Magnesium	Mg	84.34	88.87	89.28	51.30	-	72.00	64.18	56.37	59.25
Manganese	Mn	2.530	2.184	2.202	3.659	-	3.604	3.404	3.695	3.313
Mercury	Hg	<	<	<	<	-	<	<	<	<
Molybdenum	Mo	<	<	<	<	-	<	<	<	<
Nickel	Ni	0.1360	0.1107	0.1107	0.1244	-	0.1618	0.1329	0.1005	0.1244
Selenium	Se	<	<	<	<	-	<	<	<	<
Zinc	Zn	0.2294	0.1774	0.1866	0.1881	-	0.1790	0.1667	0.1759	0.3151
Total Sum of Extractable Metals		300.539	292.398	297.576	256.384	-	285.288	262.938	238.504	245.075
Acid Volatile Sulphide		1.1289	2.2392	2.1428	0.0221	-	0.0516	0.0439	0.0183	0.0697

Results are expressed in mmoles/kg

Results of Analysis- Sediment/Soil File No. 1650C

		Barnston Island L5 Dup.	Macdon. Slough M1 a+b	Macdon. Slough M1 Dup.	Macdon. Slough M2 a+b	Macdon. Slough M3 a+b	Macdon. Slough M4 a+b	Macdon. Slough M5 a+b	Macdon. Slough M5 Dup.	Sapperton S1 a+b
Total Metals (mmoles/kg)										
Aluminum	T-Al	0.00	915.44	908.03	859.85	874.67	908.03	878.38	-	756.07
Antimony	T-Sb	<	<	<	<	<	<	<	-	<
Arsenic	T-As	<	<	<	<	<	<	<	-	<
Cadmium	T-Cd	0.0000	0.0022	0.0019	0.0016	0.0020	0.0020	0.0018	-	<
Calcium	T-Ca	0.00	239.52	254.49	249.50	256.99	244.76	252.00	-	266.97
Chromium	T-Cr	0.0000	1.2636	1.2559	1.1770	1.1866	1.2443	1.1539	-	1.0328
Cobalt	T-Co	0.0000	0.3343	0.3139	0.2919	0.3122	0.3190	0.3326	-	0.2647
Copper	T-Cu	0.0000	0.6956	0.6908	0.6232	0.6751	0.7129	0.6877	-	0.4642
Iron	T-Fe	0.00	689.38	676.85	642.83	684.01	703.71	691.17	-	546.13
Lead	T-Pb	0.0000	0.0516	0.0483	0.0512	0.0526	0.0507	0.0487	-	0.0246
Magnesium	T-Mg	0.00	592.47	592.47	547.21	567.78	629.50	604.81	-	452.58
Manganese	T-Mn	0.000	8.992	8.846	8.537	8.974	8.737	8.701	-	10.230
Mercury	T-Hg	0.0000	2.4627	2.4229	2.3381	2.4577	2.3929	2.3830	-	2.8017
Molybdenum	T-Mo	0.0000	0.0009	0.0005	0.0006	0.0006	0.0006	0.0006	-	0.0004
Nickel	T-Ni	0.0000	<	<	<	<	<	<	-	<
Selenium	T-Se	0.0000	0.0034	0.0028	0.0029	0.0035	0.0039	0.0044	-	0.0030
Zinc	T-Zn	0.0000	1.6366	1.6060	1.5096	1.6519	1.5601	1.5295	-	1.1273
Extractable Metals (mmoles/kg)										
Aluminum	Al	60.41	74.87	-	62.26	60.41	73.75	77.46	78.94	50.78
Antimony	Sb	<	<	-	<	<	<	<	<	<
Arsenic	As	<	<	-	<	<	<	<	<	<
Cadmium	Cd	<	<	-	<	<	<	<	<	<
Calcium	Ca	72.60	77.84	-	74.85	63.37	77.59	83.58	66.37	57.39
Chromium	Cr	0.0808	0.0846	-	0.0942	0.1000	0.1423	0.1635	0.1692	0.1077
Cobalt	Co	0.7059	0.0509	-	0.0373	0.0373	0.0458	0.0492	0.0509	0.0390
Copper	Cu	0.2046	0.1920	-	0.1542	0.1464	0.1825	0.1810	0.1951	0.1054
Iron	Fe	67.86	72.88	-	57.66	58.91	67.51	68.58	62.85	44.59
Lead	Pb	<	<	-	<	<	<	<	<	<
Magnesium	Mg	67.48	106.15	-	85.58	83.93	97.51	102.04	106.15	54.72
Manganese	Mn	3.276	1.334	-	1.194	1.181	1.301	1.323	1.396	2.421
Mercury	Hg	<	<	-	<	<	<	<	<	<
Molybdenum	Mo	<	<	-	<	<	<	<	<	<
Nickel	Ni	0.4480	0.1448	-	0.1261	0.1261	0.1789	0.2027	0.2095	0.1363
Selenium	Se	<	<	-	<	<	<	<	<	<
Zinc	Zn	0.2050	0.2845	-	0.2417	0.2401	0.2585	0.2524	0.2615	0.1510
Total Sum of Extractable Metals		273.277	333.830	-	282.199	268.460	318.475	333.832	316.594	210.428
Acid Volatile Sulphide		0.1067	4.1985	-	3.4210	3.6076	8.1793	4.7272	5.1937	0.0950

Results are expressed in mmoles/kg

Results of Analysis- Sediment/Soil File No. 16500

		Sapperton S1 a+b Dup.	Sapperton S2 a+b	Sapperton S3	Sapperton S4 a+b	Sapperton S4 Dup.	Sapperton S5 a+b
Total Metals (mmoles/kg)							
Aluminum	T-Al	730.13	800.55	856.14	782.02	-	778.31
Antimony	T-Sb	<	<	<	<	-	<
Arsenic	T-As	<	<	<	<	-	<
Cadmium	T-Cd	0.0015	0.0012	0.0017	0.0017	-	0.0016
Calcium	T-Ca	266.97	276.95	309.38	304.39	-	266.97
Chromium	T-Cr	1.0058	1.1251	1.1289	1.1078	-	1.1059
Cobalt	T-Co	0.2393	0.2834	0.2919	0.2919	-	0.2969
Copper	T-Cu	0.4406	0.5398	0.5665	0.5587	-	0.5209
Iron	T-Fe	540.76	569.41	619.55	599.65	-	612.39
Lead	T-Pb	0.0261	0.0294	0.0323	0.0328	-	0.0299
Magnesium	T-Mg	432.01	485.50	501.95	489.61	-	493.73
Manganese	T-Mn	9.884	10.648	11.558	10.612	-	12.105
Mercury	T-Hg	2.7070	2.9164	3.1657	2.9064	-	3.3152
Molybdenum	T-Mo	0.0004	0.0005	0.0005	0.0004	-	0.0005
Nickel	T-Ni	<	<	<	<	-	<
Selenium	T-Se	0.0009	0.0033	0.0028	0.0034	-	0.0042
Zinc	T-Zn	1.0860	1.1762	1.2466	1.2527	-	1.2297
Extractable Metals (mmoles/kg)							
Aluminum	Al	-	68.94	69.31	65.60	-	68.94
Antimony	Sb	-	<	<	<	-	<
Arsenic	As	-	<	<	<	-	<
Cadmium	Cd	-	<	<	<	-	<
Calcium	Ca	-	83.08	74.60	82.09	-	97.31
Chromium	Cr	-	0.1673	0.0808	0.0789	-	0.0865
Cobalt	Co	-	0.0679	0.2308	0.0526	-	0.0679
Copper	Cu	-	0.2156	0.1715	0.1479	-	0.2187
Iron	Fe	-	59.99	58.55	56.40	-	70.01
Lead	Pb	-	<	<	<	-	0.0164
Magnesium	Mg	-	81.05	80.64	80.64	-	74.06
Manganese	Mn	-	2.912	2.931	2.931	-	3.440
Mercury	Hg	-	<	<	<	-	<
Molybdenum	Mo	-	<	<	<	-	<
Nickel	Ni	-	0.2249	0.2692	0.1516	-	1.8569
Selenium	Se	-	<	<	<	-	<
Zinc	Zn	-	0.2508	0.1851	0.1988	-	0.2294
Total Sum of Extractable Metals		-	296.897	286.970	268.293	-	316.229
Acid Volatile Sulphide		-	0.4541	0.3141	0.3328	-	0.330

Results are expressed in mmoles/kg

APPENDIX 6

Dioxin/Furan Data

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd. **Our File: 2510**

Sample ID: 1650-1 Annacis Channel (A1) **Axys ID: 2510-27**

Sample Weight: 10.62 g dry **Date: March 25, 1992**

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T_4CDD - Total	4.3	0.2	T_4CDF - Total	5.4	0.2
2,3,7,8	ND	0.2	2,3,7,8	1.6	0.2
P_5CDD - Total	3.3	0.4	P_5CDF - Total	3.0	0.2
1,2,3,7,8	ND	0.4	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H_6CDD - Total	18	0.5			
1,2,3,4,7,8	ND	0.5	H_6CDF - Total	10	0.4
1,2,3,6,7,8	2.6	0.5	1,2,3,4,7,8	ND	0.4
1,2,3,7,8,9	1.7	0.5	1,2,3,6,7,8	ND	0.4
			2,3,4,6,7,8	ND	0.4
H_7CDD - Total	54	0.5	1,2,3,7,8,9	ND	0.4
1,2,3,4,6,7,8	24	0.5			
			H_7CDF - Total	18	0.4
O_8CDD	160	0.5	1,2,3,4,6,7,8	ND	0.4
			1,2,3,4,7,8,9	7.0	0.4
			O_8CDF	9.2	0.5

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery (%)

^{13}C-T_4CDD:	80
^{13}C-T_4CDF:	82
^{13}C-P_5CDD:	92
^{13}C-H_6CDD:	57
^{13}C-H_7CDD:	75
^{13}C-O_8CDD:	72

B.C. Ministry of Environment TEQ = 1.4 pg/g

Environment Canada TEQ = 1.1 pg/g

Approved by: M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd.

Our File: 2510

Sample ID: 1650-3 Annacis Channel (A3)

Axys ID: 2510-28

Sample Weight: 10.33 g dry

Date: March 25, 1992

Dioxins	Concentration pg/g	(SDL)
T_4CDD - Total	2.6	0.2
2,3,7,8	ND	0.2
P_5CDD - Total	0.9	0.3
1,2,3,7,8	ND	0.3
H_6CDD - Total	12	0.6
1,2,3,4,7,8	ND	0.6
1,2,3,6,7,8	1.7	0.6
1,2,3,7,8,9	NDR(1.3)	0.6
H_7CDD - Total	57	0.5
1,2,3,4,6,7,8	26	0.5
O_8CDD	290	0.4

Furans	Concentration pg/g	(SDL)
T_4CDF - Total	3.4	0.2
2,3,7,8	1.3	0.2
P_5CDF - Total	1.7	0.2
1,2,3,7,8	ND	0.2
2,3,4,7,8	ND	0.2
H_6CDF - Total	7.6	0.4
1,2,3,4,7,8	ND	0.4
1,2,3,6,7,8	ND	0.4
2,3,4,6,7,8	ND	0.4
1,2,3,7,8,9	ND	0.4
H_7CDF - Total	11	0.5
1,2,3,4,6,7,8	4.4	0.5
1,2,3,4,7,8,9	ND	0.5
O_8CDF	5.5	0.4

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery	(%)
^{13}C-T_4CDD:	83
^{13}C-T_4CDF:	89
^{13}C-P_5CDD:	70
^{13}C-H_6CDD:	73
^{13}C-H_7CDD:	83
^{13}C-O_8CDD:	80

B.C. Ministry of Environment TEQ = 1.3 pg/g

Environment Canada TEQ = 0.8 pg/g

Approved by: M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd. Our File: 2510

Sample ID: 1650-5 Annacis Channel (A5) Axys ID: 2510-29

Sample Weight: 9.81 g dry Date: March 25, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T_4CDD - Total	1.7	0.2	T_4CDF - Total	4.6	0.2
2,3,7,8	ND	0.2	2,3,7,8	1.6	0.2
P_5CDD - Total	1.3	0.2	P_5CDF - Total	3.0	0.2
1,2,3,7,8	ND	0.2	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H_6CDD - Total	19	0.5			
1,2,3,4,7,8	ND	0.5	H_6CDF - Total	12	0.5
1,2,3,6,7,8	2.3	0.5	1,2,3,4,7,8	ND	0.5
1,2,3,7,8,9	1.6	0.5	1,2,3,6,7,8	ND	0.5
			2,3,4,6,7,8	ND	0.5
H_7CDD - Total	50	0.4	1,2,3,7,8,9	ND	0.5
1,2,3,4,6,7,8	20	0.4			
			H_7CDF - Total	16	0.5
O_8CDD	150	0.3	1,2,3,4,6,7,8	6.5	0.5
			1,2,3,4,7,8,9	ND	0.5
			O_8CDF	7.4	0.5

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery	(%)
^{13}C-T_4CDD:	75
^{13}C-T_4CDF:	87
^{13}C-P_5CDD:	81
^{13}C-H_6CDD:	62
^{13}C-H_7CDD:	75
^{13}C-O_8CDD:	66

B.C. Ministry of Environment TEQ = 1.3 pg/g

Environment Canada TEQ = 0.9 pg/g

Approved by: M.C. Hamilton
M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd. **Our File: 2510**

Sample ID: 1650-21 Macdonald Slough (M1) **Axys ID: 2510-30**

Sample Weight: 10.16 g dry **Date: March 25, 1992**

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T_4CDD - Total	4.7	0.2	T_4CDF - Total	9.4	0.2
2,3,7,8	ND	0.2	2,3,7,8	2.6	0.2
P_5CDD - Total	4.4	0.4	P_5CDF - Total	1.1	0.2
1,2,3,7,8	ND	0.4	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H_6CDD - Total	41	0.7			
1,2,3,4,7,8	ND	0.7	H_6CDF - Total	41	0.5
1,2,3,6,7,8	6.8	0.7	1,2,3,4,7,8	0.7	0.5
1,2,3,7,8,9	2.6	0.7	1,2,3,6,7,8	NDR(0.7)	0.5
			2,3,4,6,7,8	NDR(0.7)	0.5
H_7CDD - Total	140	0.6	1,2,3,7,8,9	ND	0.5
1,2,3,4,6,7,8	63	0.6			
			H_7CDF - Total	91	0.5
O_8CDD	500	0.6	1,2,3,4,6,7,8	28	0.5
			1,2,3,4,7,8,9	1.0	0.5
			O_8CDF	59	0.5

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery (%)

^{13}C-T_4CDD:	72
^{13}C-T_4CDF:	77
^{13}C-P_5CDD:	60
^{13}C-H_6CDD:	61
^{13}C-H_7CDD:	77
^{13}C-O_8CDD:	63

B.C. Ministry of Environment TEQ = 3.1 pg/g

Environment Canada TEQ = 2.7 pg/g

Approved by: M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd.

Our File: 2510

Sample ID: 1650-23 Macdonald Slough (M3)

Axys ID: 2510-31

Sample Weight: 9.96 g dry

Date: March 25, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T_4CDD - Total	5.3	0.2	T_4CDF - Total	10	0.2
2,3,7,8	ND	0.2	2,3,7,8	3.0	0.2
P_5CDD - Total	7.7	0.2	P_5CDF - Total	11	0.3
1,2,3,7,8	0.5	0.2	1,2,3,7,8	ND	0.3
			2,3,4,7,8	ND	0.3
H_6CDD - Total	38	0.5			
1,2,3,4,7,8	ND	0.5	H_6CDF - Total	38	0.4
1,2,3,6,7,8	7.7	0.5	1,2,3,4,7,8	0.9	0.4
1,2,3,7,8,9	2.3	0.5	1,2,3,6,7,8	0.7	0.4
			2,3,4,6,7,8	0.8	0.4
H_7CDD - Total	100	0.5	1,2,3,7,8,9	ND	0.4
1,2,3,4,6,7,8	50	0.5			
			H_7CDF - Total	78	0.4
O_8CDD	280	0.5	1,2,3,4,6,7,8	29	0.4
			1,2,3,4,7,8,9	1.2	0.4
			O_8CDF	31	0.5

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery	(%)
^{13}C-T_4CDD:	96
^{13}C-T_4CDF:	97
^{13}C-P_5CDD:	87
^{13}C-H_6CDD:	67
^{13}C-H_7CDD:	91
^{13}C-O_8CDD:	90

B.C. Ministry of Environment TEQ = 3.1 pg/g

Environment Canada TEQ = 2.9 pg/g

Approved by: M.C. Hamilton

M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd. Our File: 2510

Sample ID: 1650-25 Macdonald Slough (M5) Axys ID: 2510-32

Sample Weight: 10.06 g dry Date: March 25, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T_4CDD - Total	4.4	0.2	T_4CDF - Total	7.0	0.2
2,3,7,8	ND	0.2	2,3,7,8	2.5	0.2
P_5CDD - Total	1.8	0.6	P_5CDF - Total	8.6	0.2
1,2,3,7,8	ND	0.6	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H_6CDD - Total	38	0.6			
1,2,3,4,7,8	ND	0.6	H_6CDF - Total	24	0.5
1,2,3,6,7,8	5.0	0.6	1,2,3,4,7,8	ND	0.5
1,2,3,7,8,9	2.4	0.6	1,2,3,6,7,8	ND	0.5
			2,3,4,6,7,8	ND	0.5
H_7CDD - Total	100	0.6	1,2,3,7,8,9	ND	0.5
1,2,3,4,6,7,8	46	0.6			
			H_7CDF - Total	42	0.5
O_8CDD	370	0.4	1,2,3,4,6,7,8	15	0.5
			1,2,3,4,7,8,9	0.7	0.5
			O_8CDF	17	0.4

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery	(%)
^{13}C-T_4CDD:	77
^{13}C-T_4CDF:	80
^{13}C-P_5CDD:	67
^{13}C-H_6CDD:	65
^{13}C-H_7CDD:	71
^{13}C-O_8CDD:	73

B.C. Ministry of Environment TEQ = 2.4 pg/g

Environment Canada TEQ = 1.9 pg/g

Approved by: M.C. Hamilton

M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd.

Our File: 2510

Sample ID: 1650-26 Sapperton (S1)

Axys ID: 2510-33

Sample Weight: 11.31 g dry

Date: March 25, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T_4CDD - Total	4.9	0.2	T_4CDF - Total	3.8	0.2
2,3,7,8	ND	0.2	2,3,7,8	1.2	0.2
P_5CDD - Total	2.8	0.2	P_5CDF - Total	1.7	0.2
1,2,3,7,8	ND	0.2	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H_6CDD - Total	11	0.3			
1,2,3,4,7,8	ND	0.3	H_6CDF - Total	5.2	0.3
1,2,3,6,7,8	1.3	0.3	1,2,3,4,7,8	ND	0.3
1,2,3,7,8,9	1.2	0.3	1,2,3,6,7,8	ND	0.3
			2,3,4,6,7,8	ND	0.3
H_7CDD - Total	24	0.2	1,2,3,7,8,9	ND	0.3
1,2,3,4,6,7,8	10	0.2			
			H_7CDF - Total	7.8	0.2
O_8CDD	81	0.2	1,2,3,4,6,7,8	3.1	0.2
			1,2,3,4,7,8,9	ND	0.2
			O_8CDF	3.7	0.2

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery	(%)
^{13}C-T_4CDD:	84
^{13}C-T_4CDF:	89
^{13}C-P_5CDD:	67
^{13}C-H_6CDD:	74
^{13}C-H_7CDD:	79
^{13}C-O_8CDD:	76

B.C. Ministry of Environment TEQ = 0.8 pg/g

Environment Canada TEQ = 0.5 pg/g

Approved by: M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd. **Our File:** 2510

Sample ID: 1650-28 Sapperton (S3) **Axys ID:** 2510-34

Sample Weight: 11.14 g dry **Date:** March 25, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T_4CDD - Total	1.8	0.2	T_4CDF - Total	3.8	0.2
2,3,7,8	ND	0.2	2,3,7,8	1.3	0.2
P_5CDD - Total	ND	0.4	P_5CDF - Total	1.0	0.2
1,2,3,7,8	ND	0.4	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H_6CDD - Total	9.4	0.6			
1,2,3,4,7,8	ND	0.6	H_6CDF - Total	3.7	0.5
1,2,3,6,7,8	1.4	0.6	1,2,3,4,7,8	ND	0.5
1,2,3,7,8,9	NDR(1.0)	0.6	1,2,3,6,7,8	ND	0.5
			2,3,4,6,7,8	ND	0.5
H_7CDD - Total	23	0.8	1,2,3,7,8,9	ND	0.5
1,2,3,4,6,7,8	9.1	0.8			
			H_7CDF - Total	4.0	0.6
O_8CDD	89	0.8	1,2,3,4,6,7,8	NDR(2.2)	0.6
			1,2,3,4,7,8,9	ND	0.6
			O_8CDF	2.4	0.7

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery (%)

^{13}C-T_4CDD:	70
^{13}C-T_4CDF:	77
^{13}C-P_5CDD:	56
^{13}C-H_6CDD:	65
^{13}C-H_7CDD:	70
^{13}C-O_8CDD:	60

B.C. Ministry of Environment TEQ = 0.9 pg/g

Environment Canada TEQ = 0.4 pg/g

Approved by: M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd. | Our File: 2510

Sample ID: 1650-30 Sapperton (S5) | Axys ID: 2510-35A

Sample Weight: 10.18 g dry | Date: March 25, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T_4CDD - Total	1.2	0.2	T_4CDF - Total	3.6	0.07
2,3,7,8	ND	0.2	2,3,7,8	1.4	0.07
P_5CDD - Total	ND	0.3	P_5CDF - Total	4.0	0.2
1,2,3,7,8	ND	0.3	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H_6CDD - Total	17	0.5			
1,2,3,4,7,8	ND	0.5	H_6CDF - Total	34	0.3
1,2,3,6,7,8	3.1	0.5	1,2,3,4,7,8	0.7	0.3
1,2,3,7,8,9	1.8	0.5	1,2,3,6,7,8	0.6	0.3
			2,3,4,6,7,8	0.5	0.3
H_7CDD - Total	46	0.5	1,2,3,7,8,9	ND	0.3
1,2,3,4,6,7,8	24	0.5			
			H_7CDF - Total	83	0.4
O_8CDD	160	0.4	1,2,3,4,6,7,8	28	0.4
			1,2,3,4,7,8,9	0.6	0.4
			O_8CDF	34	0.4

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery (%)

^{13}C-T_4CDD:	71
^{13}C-T_4CDF:	75
^{13}C-P_5CDD:	66
^{13}C-H_6CDD:	55
^{13}C-H_7CDD:	60
^{13}C-O_8CDD:	58

B.C. Ministry of Environment TEQ = 1.8 pg/g

Environment Canada TEQ = 1.5 pg/g

Approved by: M. Coreen Hamilton
A. Dale Hoover

ANALYSIS REPORT

POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

HIGH RESOLUTION GC/MS

Client: ASL Ltd.

Our File: 2510

Sample ID: 1650-30 Duplicate Sapperton (S5)

Axys ID: 2510-35B

Sample Weight: 10.34 g dry

Date: March 25, 1992

Dioxins	Concentration pg/g	(SDL)	Furans	Concentration pg/g	(SDL)
T_4CDD - Total	1.1	0.2	T_4CDF - Total	3.0	0.2
2,3,7,8	ND	0.2	2,3,7,8	1.3	0.2
P_5CDD - Total	ND	0.3	P_5CDF - Total	4.4	0.2
1,2,3,7,8	ND	0.3	1,2,3,7,8	ND	0.2
			2,3,4,7,8	ND	0.2
H_6CDD - Total	16	0.5			
1,2,3,4,7,8	ND	0.5	H_6CDF - Total	37	0.4
1,2,3,6,7,8	2.3	0.5	1,2,3,4,7,8	0.5	0.4
1,2,3,7,8,9	1.3	0.5	1,2,3,6,7,8	ND	0.4
			2,3,4,6,7,8	0.5	0.4
H_7CDD - Total	42	0.4	1,2,3,7,8,9	0.6	0.4
1,2,3,4,6,7,8	25	0.4			
			H_7CDF - Total	93	0.4
O_8CDD	150	0.4	1,2,3,4,6,7,8	30	0.4
			1,2,3,4,7,8,9	0.7	0.4
			O_8CDF	43	0.4

ND = Not detected
SDL = Sample Detection Limit
NDR = Peak detected but did not meet quantification criteria

Surrogate Standard Recovery	(%)
^{13}C-T_4CDD:	72
^{13}C-T_4CDF:	85
^{13}C-P_5CDD:	68
^{13}C-H_6CDD:	64
^{13}C-H_7CDD:	77
^{13}C-O_8CDD:	65

B.C. Ministry of Environment TEQ = 1.6 pg/g

Environment Canada TEQ = 1.4 pg/g

Approved by: M. Coreen Hamilton
A. Dale Hoover

APPENDIX 7

Particle Size Data

RESULTS OF ANALYSIS - Sediment/Soil File No. 1650C

Sample Identification	Gravel (>2.00mm)	Sand (2.00mm -0.063mm)	Silt (0.063mm -4um)	Clay (<4um)
Annacis Channel A1	0.0	17.5	69.5	13.0
Annacis Channel A2	0.0	20.2	67.5	12.3
Annacis Channel A3	0.0	19.3	63.7	17.0
Annacis Channel A4	0.0	15.5	71.0	13.5
Annacis Channel A5	0.0	20.8	66.5	12.7
Blind Channel B1	0.0	3.8	75.0	21.2
Blind Channel B2	0.0	2.8	75.4	21.8
Blind Channel B3	0.0	2.9	75.2	21.9
Blind Channel B4	0.0	3.0	74.4	22.6
Blind Channel B5	0.0	2.6	75.8	21.6
Ewen Slough E1	0.0	38.2	50.4	11.4
Ewen Slough E2	0.0	25.4	63.2	11.4
Ewen Slough E3	0.0	25.6	60.5	13.9
Ewen Slough E4	0.0	21.6	63.2	15.2
Ewen Slough E5	0.0	11.7	72.7	15.6
Barnston Island L1	0.0	41.0	47.3	11.7
Barnston Island L2	0.0	28.2	59.6	12.2
Barnston Island L3	0.0	42.6	46.7	10.7
Barnston Island L4	0.0	51.8	38.7	9.5
Barnston Island L5	0.0	51.6	38.8	9.6
Macdonald Slough M1	0.0	22.2	59.1	18.7
Macdonald Slough M2	0.0	29.9	54.2	15.9
Macdonald Slough M3	0.0	27.3	56.8	15.9
Macdonald Slough M4	0.0	19.2	61.9	18.9
Macdonald Slough M5	0.0	19.5	62.0	18.5
Sapperton S1	0.0	63.2	30.7	6.1
Sapperton S2	0.0	49.0	41.7	9.3
Sapperton S3	0.0	44.4	47.0	8.6
Sapperton S4	0.0	45.6	45.1	9.3
Sapperton S5	0.0	51.6	39.2	9.2

Results are expressed as percent.