020407

CURRAGH RESOURCES INC.

FARO, YUKON

WATER LICENSE Y-IN85-05AL

1987 ANNUAL REPORT

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1. SURFACE WATER QUALITY DATA

The complete set of water quality data is presented in tabular form in Appendix 1. Summary statistics are presented for each month and for the year.

1.1. Summary

Table 1 presents a summary of effluent water quality data along with effluent standards from Curragh Resources Inc.'s water licence. Site locations are indicated on Figure 1.

Cyanide, ammonia, lead and copper effluent standards were exceeded on occasion at the Cross Valley Dam decant (X5). Of these, cyanide was considered to be potentially the most serious and efforts were made to reduce the levels and to develop an emergency treatment system. The seepage from the Cross Valley Dam was within effluent standards for all parameters with the exception of cyanide. Zinc concentration, which had been a problem in previous years, was well within effluent standards at both sites.

1.2. Methods

Samples were collected and preserved for analysis as indicated in Schedule C of Curragh Resources Inc.'s water licence. Temperature was measured with a thermometer in the field and pH was measured in the mine assay lab as soon as possible following sample collection. Samples were then shipped to commercial laboratories for analysis as follows:

- Cyanide and ammonia: Ecotech Labs, Kamloops, B.C.
- Other parameters: Bondar-Clegg and Co.Ltd., Whitehorse, Yukon

Results were reported monthly to the Yukon Territory Water Board.

1.3. Ammonia

Ammonia concentration at X5 fluctuated about the effluent standard of 1.00 mg/L from April to the end of the year, reaching a peak of 1.7 mg/L in December (Figure 2).

1.3.1. Sources of Ammonia

Ammonia entered the system from the following sources:

- Pit water (X22), average ammonia concentration 4.3 mg/L, range <0.01 to 16.3 mg/L.

FIGURE 1

CURRAGH RESOURCES INC.

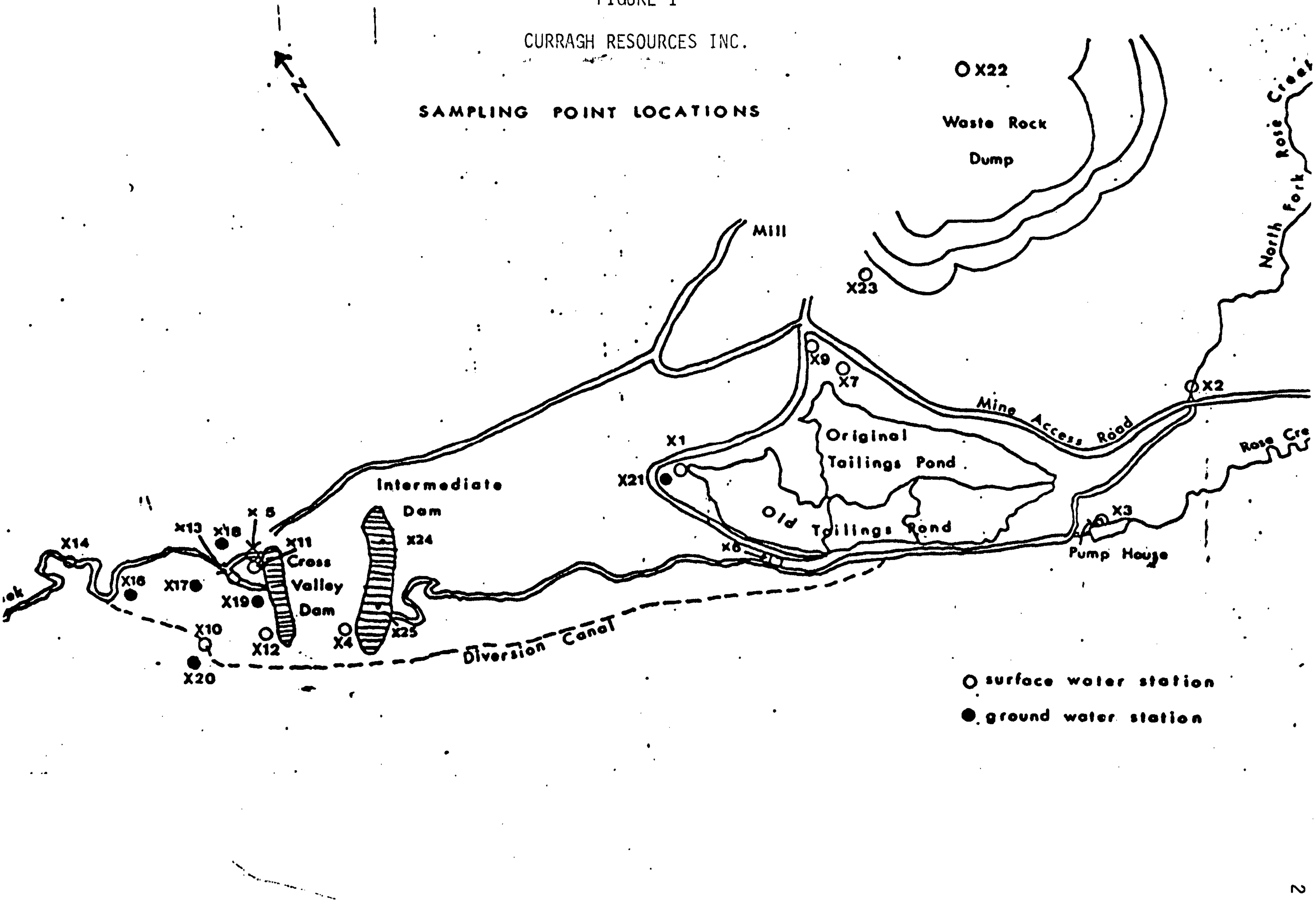


TABLE 1: SUMMARY OF EFFLUENT WATER QUALITY
Contaminant concentrations in mg/L, pH in pH units

A. Site X5: Decant from Cross Valley Dam

Parameter	Effluent Standard	Year Average	Number of Samples	Standard Deviation	Range
Ammonia	1.00	0.94	52	0.33	<0.01-1.70
Cyanide	0.05	0.05	47	0.04	<0.01-0.17
Lead	0.20	0.11	52	0.07	0.03-0.25
Zinc	0.50	0.16	52	0.07	0.06-0.30
Copper	0.20	0.05	52	0.04	<0.01-0.23
pH	>6.5	7.93	52	0.23	7.61-8.71
Suspended Solids	15.0	1	52	1	< 1 - 4

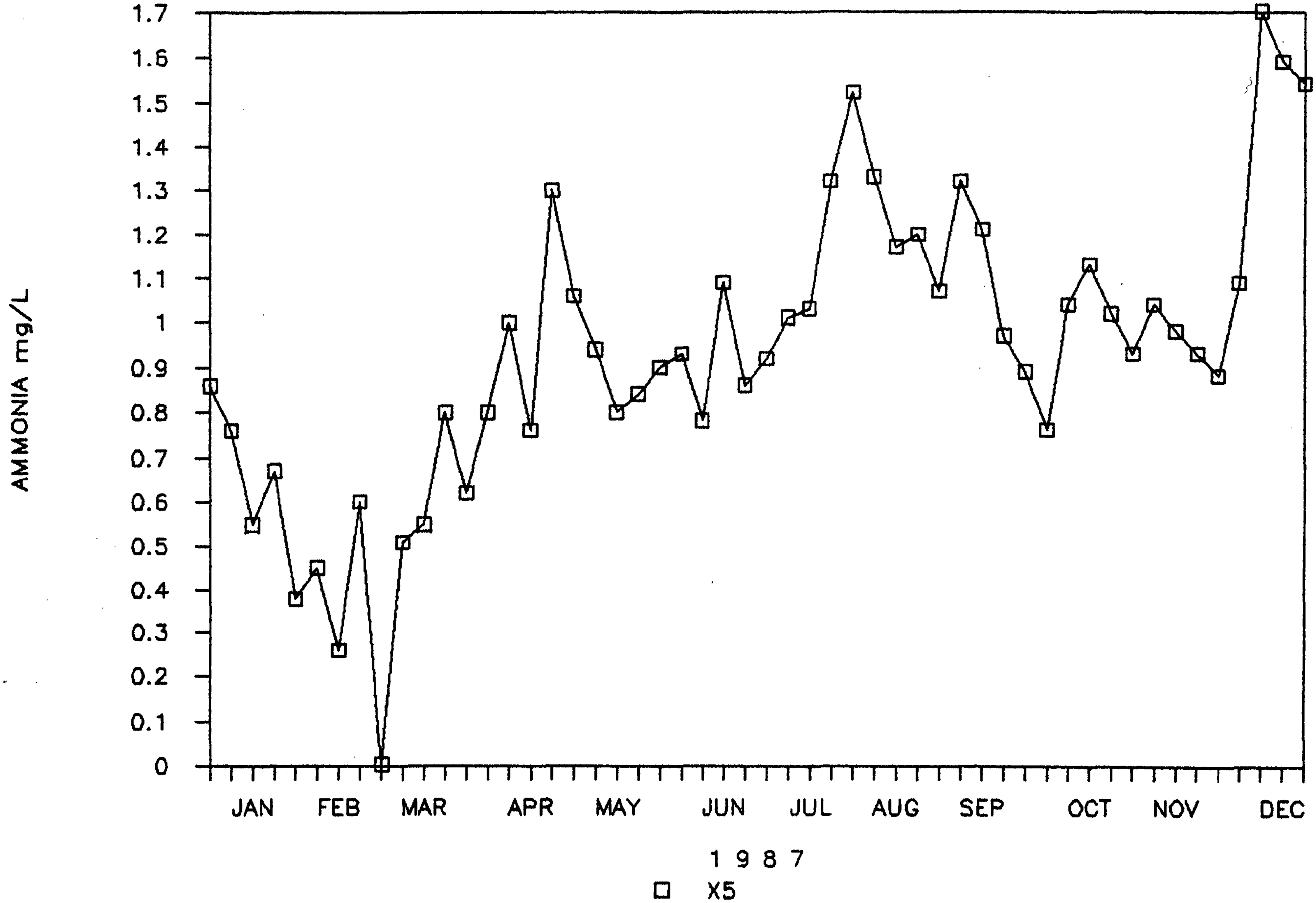
B. X13: Seepage from Cross Valley Dam

Parameter	Effluent Standard	Year Average	Number of Samples	Standard Deviation	Range
Ammonia	1.00	0.52	52	0.21	<0.01-0.97
Cyanide	0.05	0.05	15	0.04	<0.01-0.15
Lead	0.20	0.01	52	0.01	0.00-0.05
Zinc	0.50	0.01	52	0.01	<0.01-0.07
Copper	0.20	0.01	52	0.01	<0.01-0.09
pH	>6.5	7.66	52	0.26	7.23-8.78
Suspended Solids	15.0	2	52	1	< 1 - 4

FIGURE 2

AMMONIA AT X5, CROSS VALLEY DAM DECANT

CURRAGH RESOURCES INC. – FARO MINESITE



- Tailings line (X9), average ammonia concentration 1.08 mg/L, range 0.27 to 2.9 mg/L.

Ammonia is in residues from explosives used in the pit; there is no ammonia addition in the mill. Ammonia concentration in the pit water was erratic, showing no seasonal trend. The much lower concentrations in the tailings line also showed no seasonal trend. The apparent rise in the ammonia at X5 over the year may indicate a decrease in residence time in the pond system with increases in tailings solids volume. The pond would be expected to decrease in efficiency under winter conditions, as ammonia breaks down through oxidation.

1.3.2. Impact on Rose Creek

Ammonia levels at the downstream site (X14) ranged from <0.01 to 0.76 mg/L, averaging 0.43 mg/L. Background levels (at X2) were as high as 0.4 mg/L, with an average of 0.19 mg/L and similar ammonia concentrations were found at the pumphouse pond (X3) and the diversion canal (X10) (Figure 3). Toxicity of ammonia depends on the concentration of free ammonia, which varies greatly with pH. Fish toxicity studies have indicated that ammonia should not adversely affect fish in receiving waters with pH below 8 and ammonia less than 1 mg/L (Sawyer and McCarty 1978).

1.4. Cyanide

Cyanide concentrations at the tailings line (X9), the Intermediate Dam (X4) and the Cross Valley Dam (X5) are shown in Figure 4, Figure 5 and Figure 6, respectively. Levels at all three sites were high in the early spring. Split sampling with the Water Resources Division of Northern Affairs subsequently showed that this was due more to analytical problems than to true increases in cyanide.

However, in late summer, levels began to rise again. The levels of cyanide addition in the mill were reduced, with good results for December. Bench scale treatability tests were initiated, as it was felt that the mine should have an emergency cyanide treatment facility at the Intermediate Dam. The frequency of bioassays at X5 was increased to one per month as cyanide analyses are unreliable at low levels.

1.4.1. Impact on Rose Creek

Cyanide levels in Rose Creek are plotted on Figure 7. During the first half of the year, cyanide levels at the downstream site did not rise above the detection limit (with the exception of March, for which analytical errors are suspected). However, from July on, cyanide was present at the downstream site.

FIGURE 3

AMMONIA AT ROSE CREEK SITES

CURRAGH RESOURCES INC. – FARO MINESITE

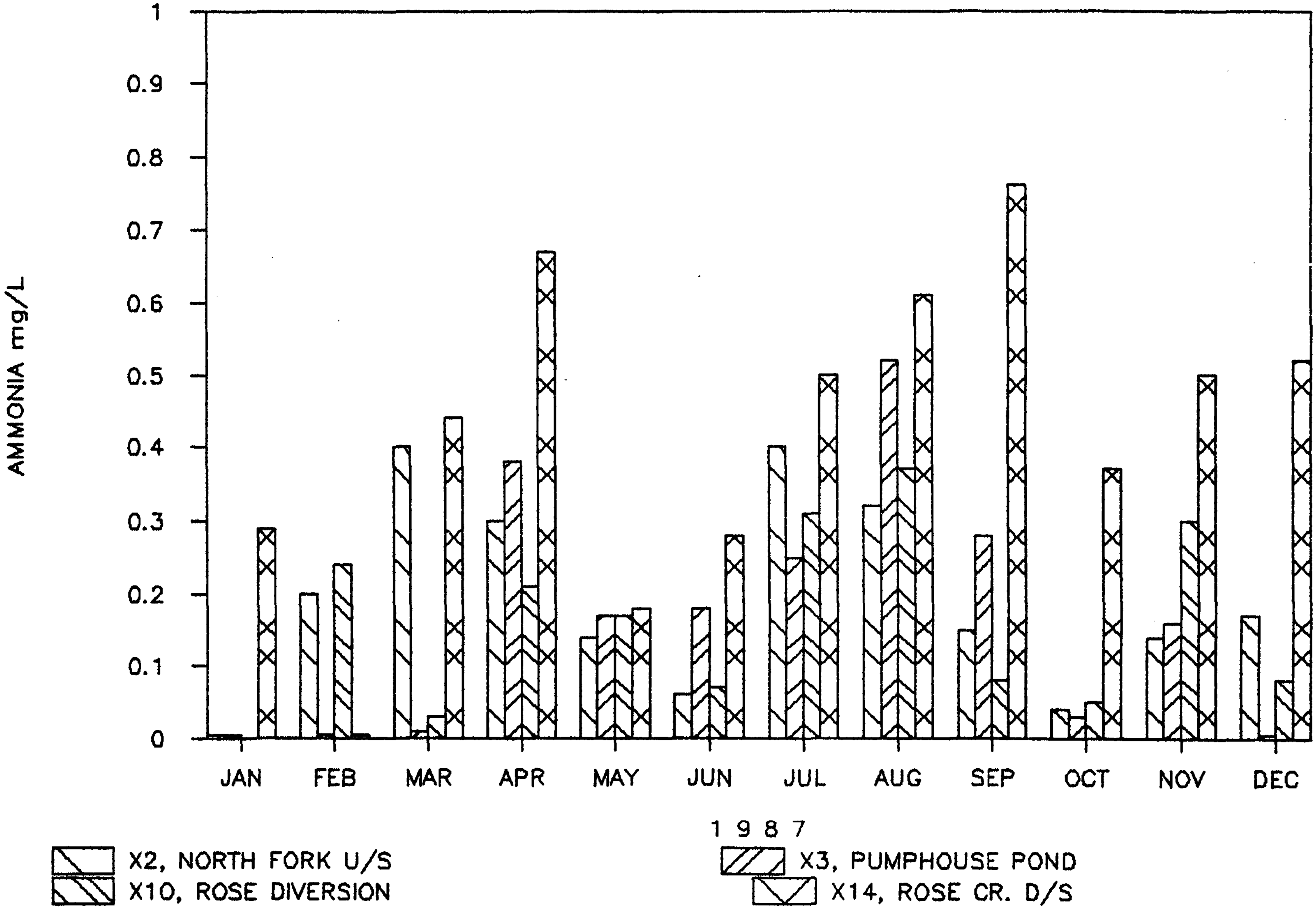


FIGURE 4

CYANIDE AT X9, TAILINGS LINE

CURRAGH RESOURCES, INC. – FARO MINESITE

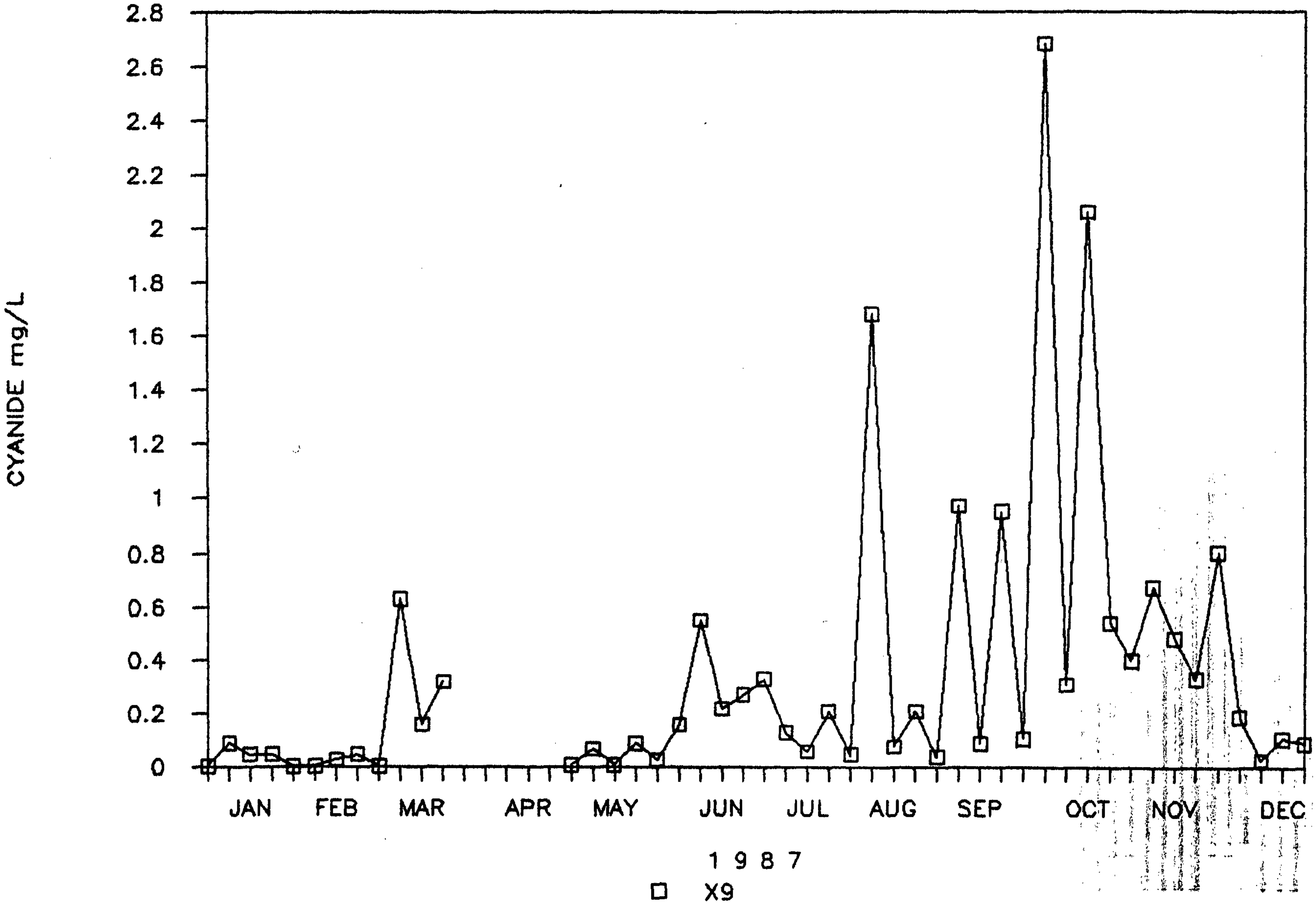


FIGURE 5

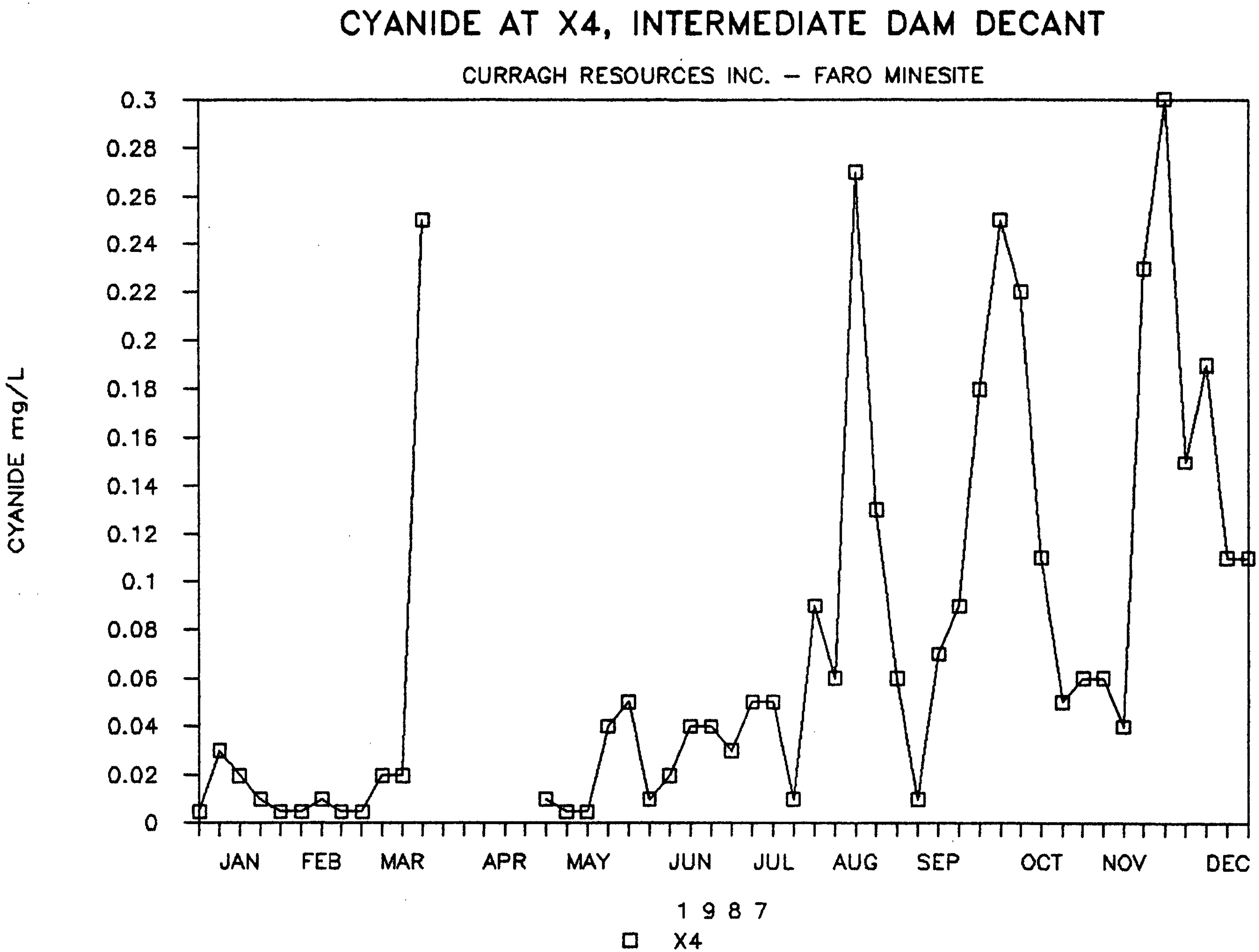

CYANIDE AT X4, INTERMEDIATE DAM DECANT
CURRAGH RESOURCES INC. – FARO MINESITE
CYANIDE mg/L
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1 9 8 7
X4

FIGURE 6

CYANIDE AT X5, CROSS VALLEY DAM DECANT

CURRAGH RESOURCES INC. – FARO MINESITE

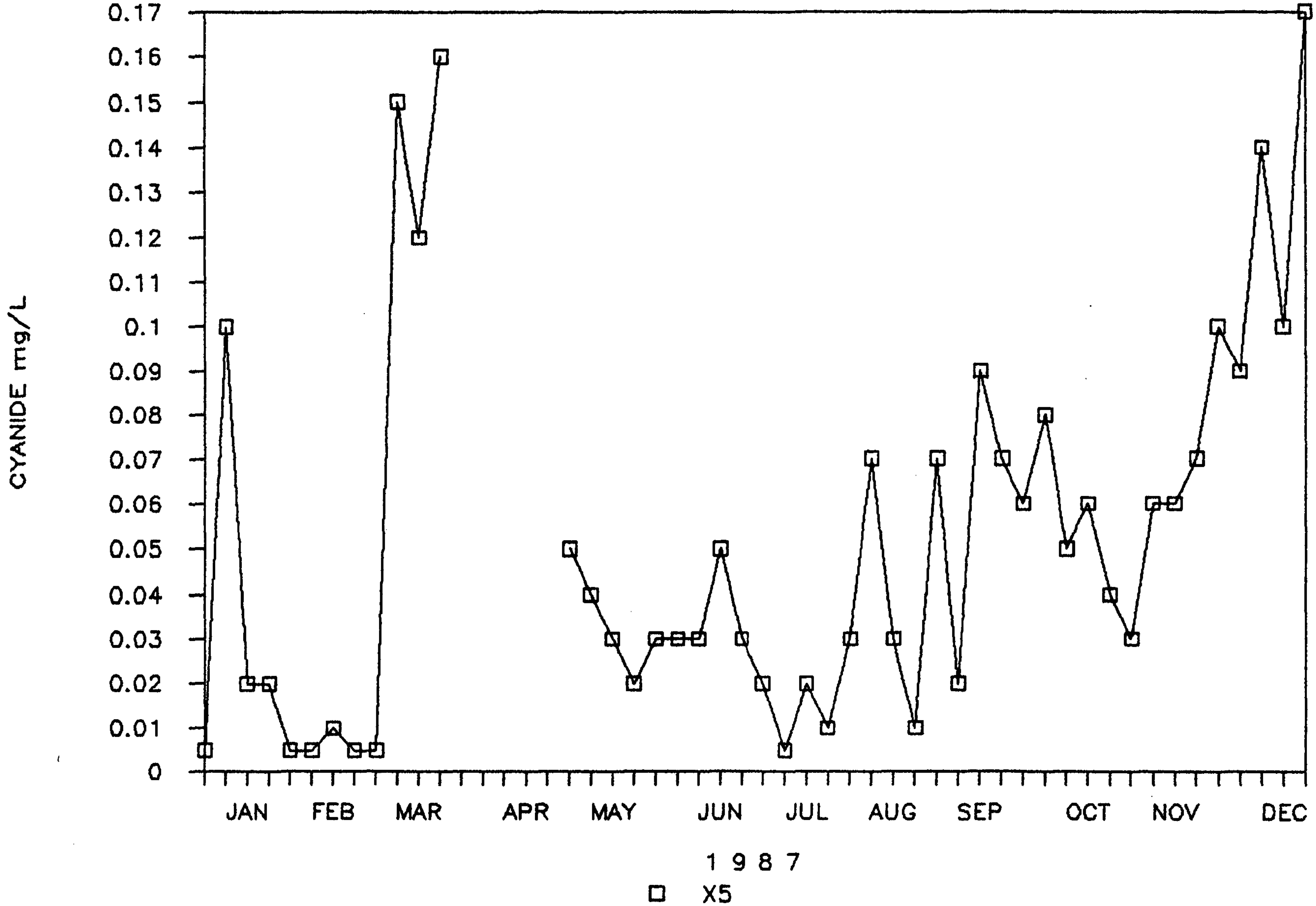
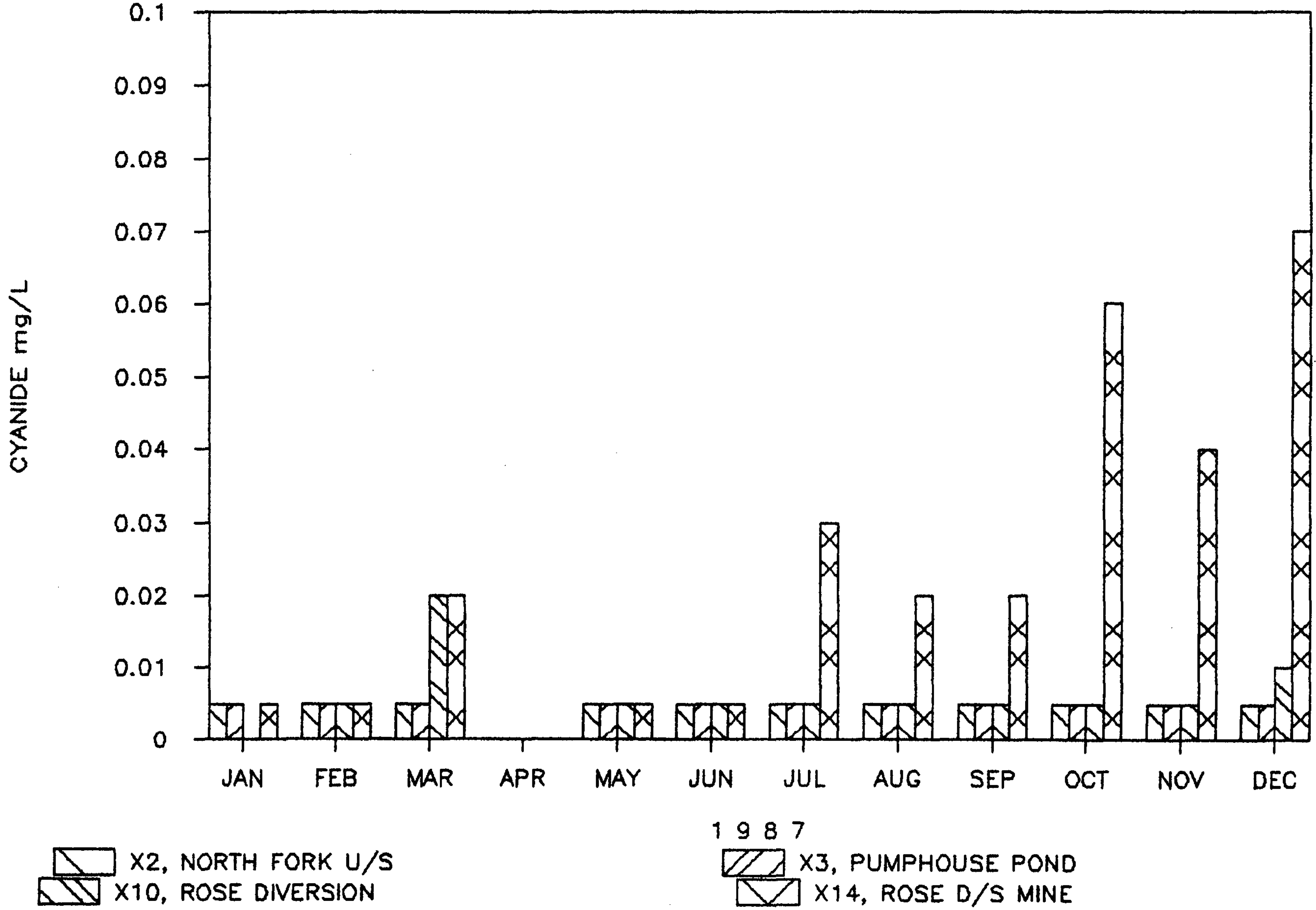


FIGURE 7

CYANIDE AT ROSE CREEK STATIONS

CURRAGH RESOURCES INC. – FARO MINESITE



Most toxicity data relates to free cyanide concentration, which may be a small proportion of the total cyanide measured at the downstream site. A comparison of total and weak acid dissociable (closer to free cyanide) levels at X5 was performed in late 1987 and 1988 to assess toxicity of the effluent. In 12 samples from X5, the mean ratio of weak acid dissociable to total cyanide was 0.40, with a range of 0.14 to 0.66. Applying this ratio to the receiving water data indicates that free cyanide concentrations in Rose Creek in late 1987 were probably not acutely toxic (confirmed by bioassay results), but may have been within the range of chronic toxicity to fish (Anon. 1987).

1.5. Lead

Lead concentration in the effluent exceeded the standard on four occasions during the summer. Levels were generally low in winter and spring, rose in the summer and dropped again in December (Figure 8).

1.5.1. Sources of Lead

Lead entered the impoundment from the following sources:

- Tailings line (X9), average lead concentration 0.16 mg/L, range <0.01 to 1.9 mg/L.
- Old tailings dam decant (X1), average lead concentration 0.65 mg/L, range <0.01 to 10.6 mg/L.
- Pit water (X22), average lead concentration .12 mg/L, range <0.01 to 0.49 mg/L.

Levels were erratic in all sources. A high proportion of lead in water is usually bound to particulates (Moore and Ramamoorthy 1984); it is probable that most of the lead entered the tailings impoundment in particles of tailings or soil.

1.5.2. Impact on Rose Creek

The highest lead level in the creek was recorded upstream of the mine in the North Fork (X2) during freshet, coinciding with a high suspended solids concentration (Figure 9). Lead concentrations downstream of the mine (X14) were in the range 0.02 to 0.07 mg/L, well below the toxic threshold (Moore and Ramamoorthy 1984) and below the chronic toxicity concentration of total lead for most fish studies (Anon. 1987).

1.6. Zinc

There was a marked improvement in zinc concentration in the

FIGURE 8

LEAD AT X5, CROSS VALLEY DAM DECANT

CURRAGH RESOURCES INC. – FARO MINESITE

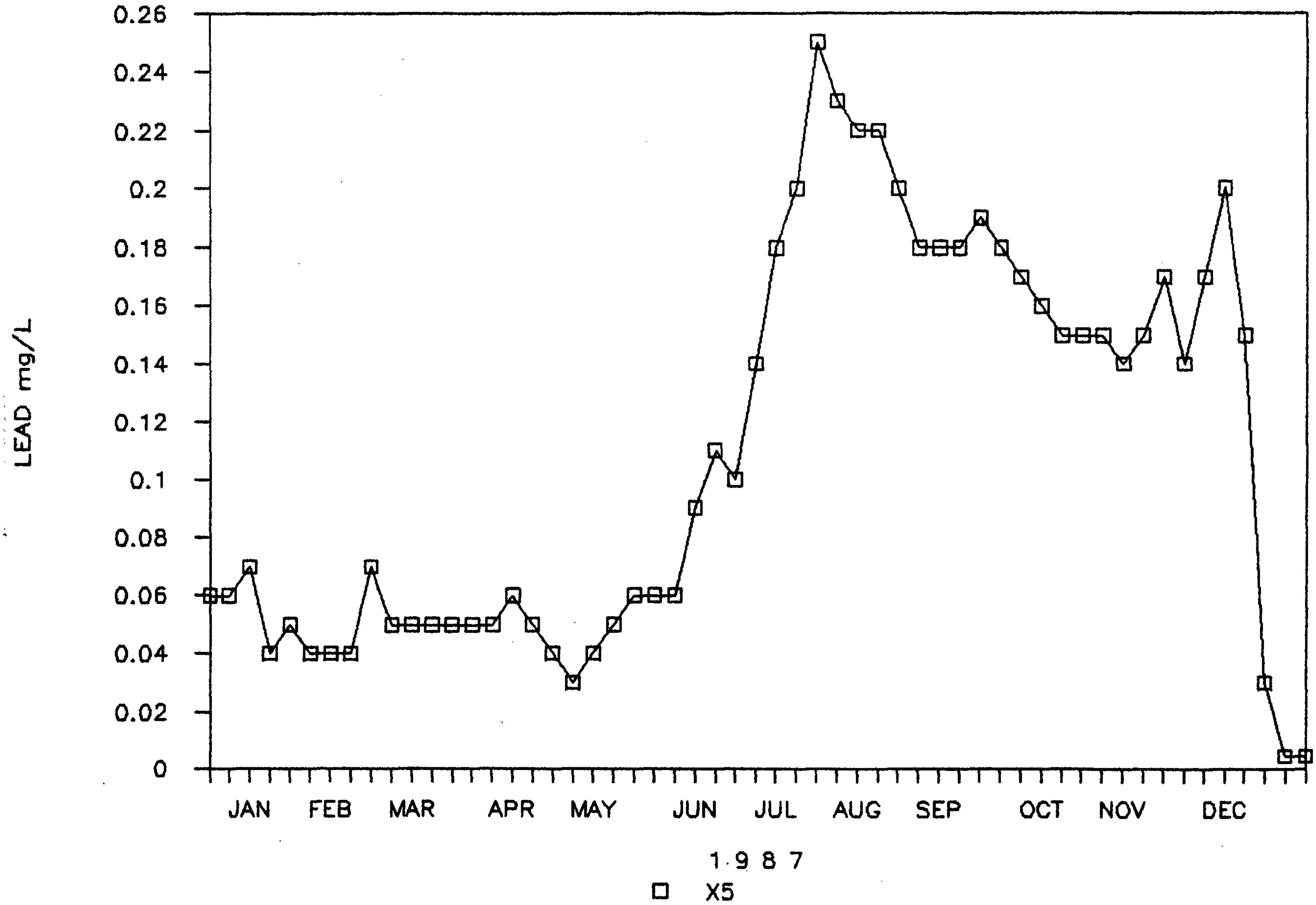
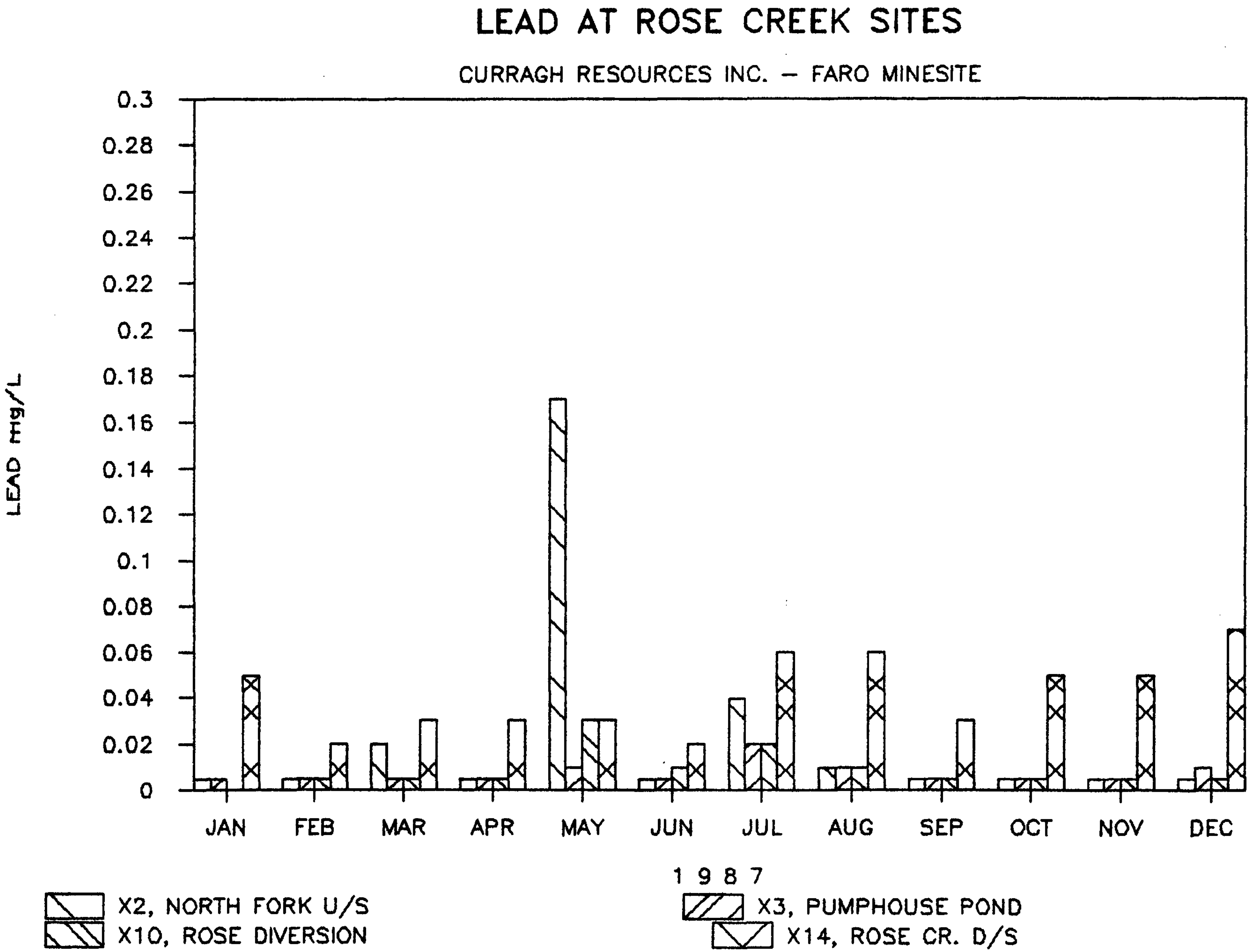


FIGURE 9


LEAD AT ROSE CREEK SITES
CURRAGH RESOURCES INC. – FARO MINESITE
LEAD mg/L
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1 9 8 7
X2, NORTH FORK U/S
X3, PUMPHOUSE POND
X10, ROSE DIVERSION
X14, ROSE CR. D/S

effluent in 1987. Zinc exceeded effluent standards during periods of 1985 and 1986 when pit water was being pumped to the tailings ponds but no lime was being added through milling or water treatment. The mill was in operation throughout 1987 and the tailings were sufficiently alkaline (average pH value of 9.53 at X9) to precipitate most of the zinc. Zinc concentration was well below the effluent standard throughout the year.

1.6.1. Sources of Zinc

Sources of zinc to the tailings impoundment were:

- Pit water (X22): moderate flow (average 62 L/s), average zinc concentration 28 mg/L, range 1 to 111 mg/L.

- Seep from waste dumps (X23): very low flow (3 L/s on September 28), average zinc concentration 25 mg/L, range 9 to 45 mg/L.

- Decant from old tailings (X1): moderate to low flow (average 50 L/s, September to November), average zinc concentration 41 mg/L, range 1 to 75 mg/L.

Zinc concentrations at these three sites are plotted in Figure 10, Figure 11 and Figure 12. Peak zinc input to the impoundment occurred during May and June, with increased concentrations in all three sources. However, zinc levels in the effluent remained low (Figure 13).

The tailings line (X9) was not a significant source of zinc in water, with only .08 mg/L zinc average.

1.6.2. Impact on Rose Creek

Zinc concentrations in Rose Creek are presented in Figure 14. Downstream zinc levels (X14) ranged from .03 to .12 mg/L and did not greatly differ from levels in the North Fork, which ranged from .02 to .10 mg/L. Although these levels are not likely to be acutely toxic, chronic toxicity to fish may begin about 0.07 mg/L (Anon. 1987).

Potential sources of zinc to the North Fork are: a) natural (zinc levels in the soils are high in the area) b) water pumped to the Faro Creek diversion upstream of the pit and c) groundwater from the Zone 2 Pit area.

Zinc concentrations at X3 (pumphouse pond) rose sharply in February and steadily declined to low levels by June.
This presumably resulted from groundwater movement from the old tailings pond area. There was, however, no observable impact on Rose Creek downstream of this location (X10 and X14).

FIGURE 10

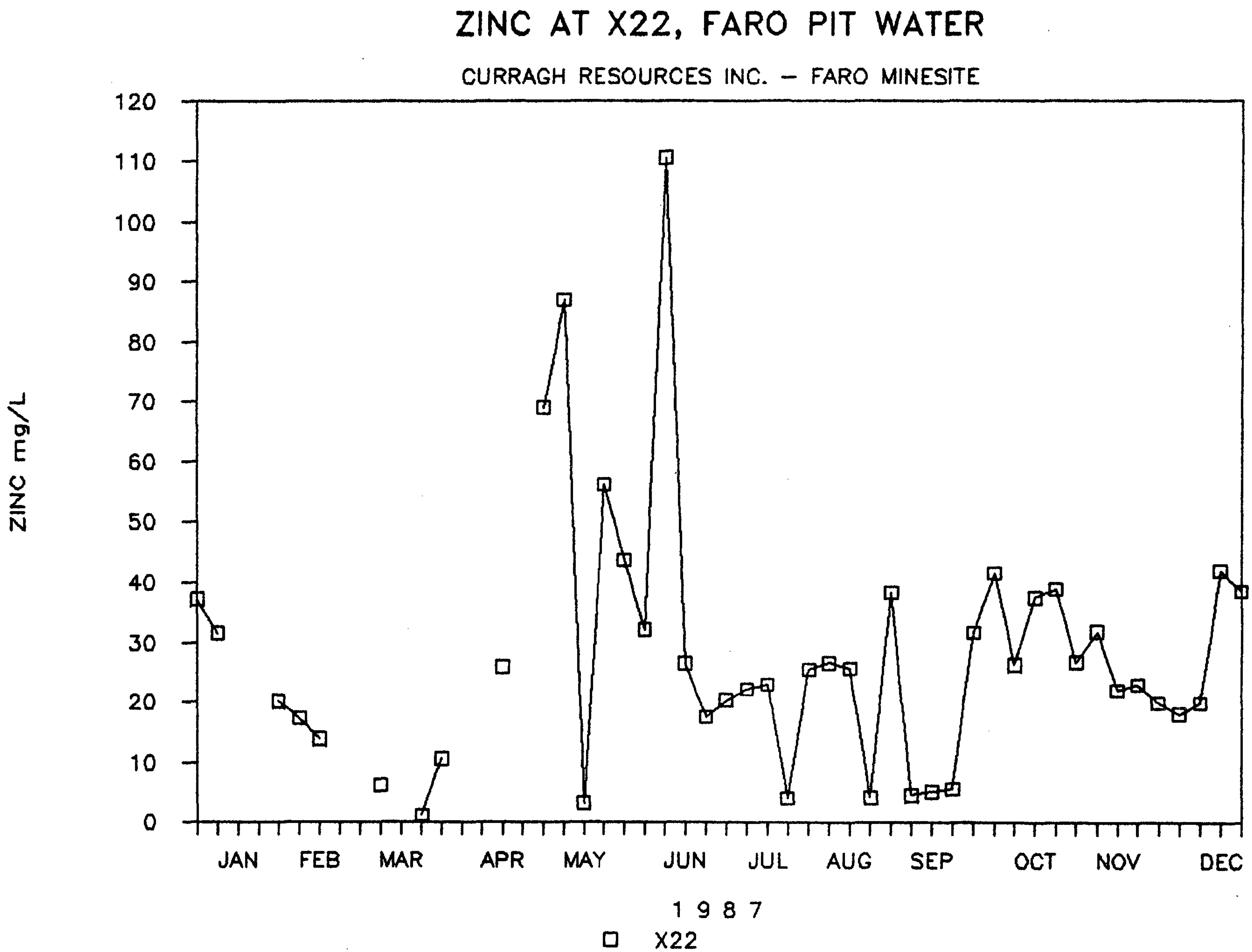

ZINC AT X22, FARO PIT WATER
CURRAGH RESOURCES INC. – FARO MINESITE
ZINC mg/L
120
110
100
90
80
70
60
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1 9 8 7
X22

FIGURE 11

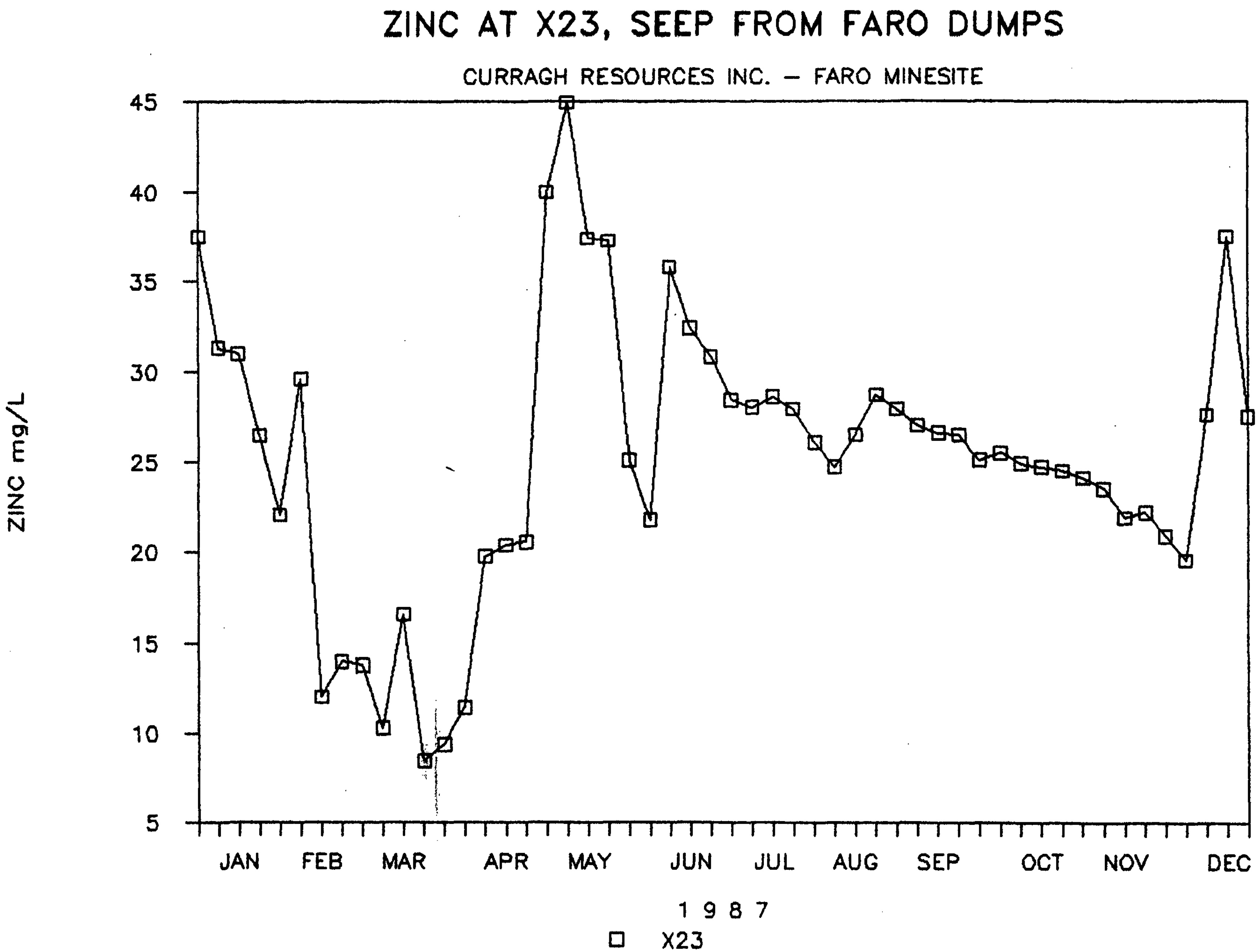

ZINC AT X23, SEEP FROM FARO DUMPS
CURRAGH RESOURCES INC. – FARO MINESITE
ZINC mg/L
45
40
35
30
25
20
15
10
5
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1 9 8 7
X23

FIGURE 13

ZINC AT X5, CROSS VALLEY DAM DECANT

CURRAGH RESOURCES INC. – FARO MINESITE

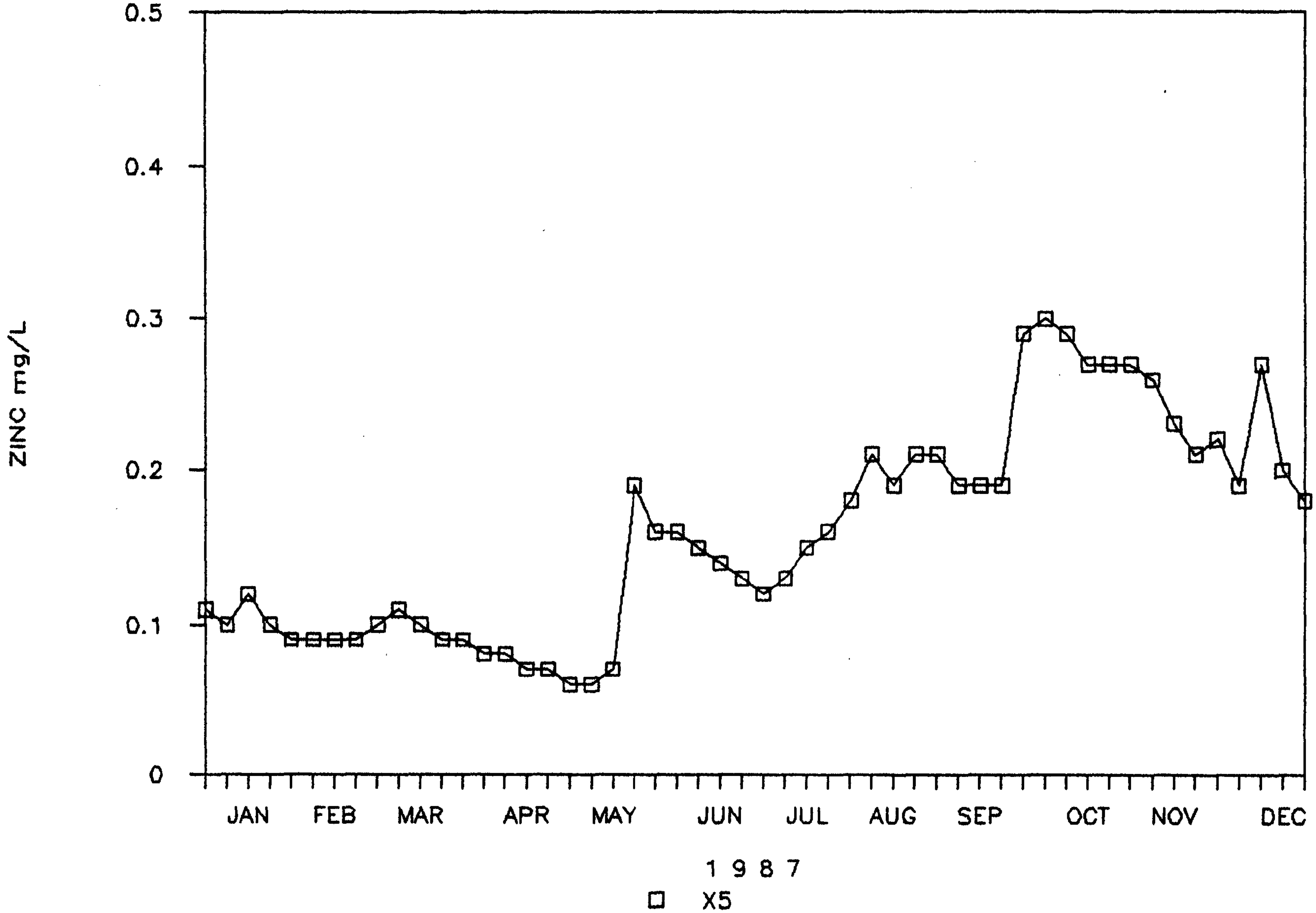
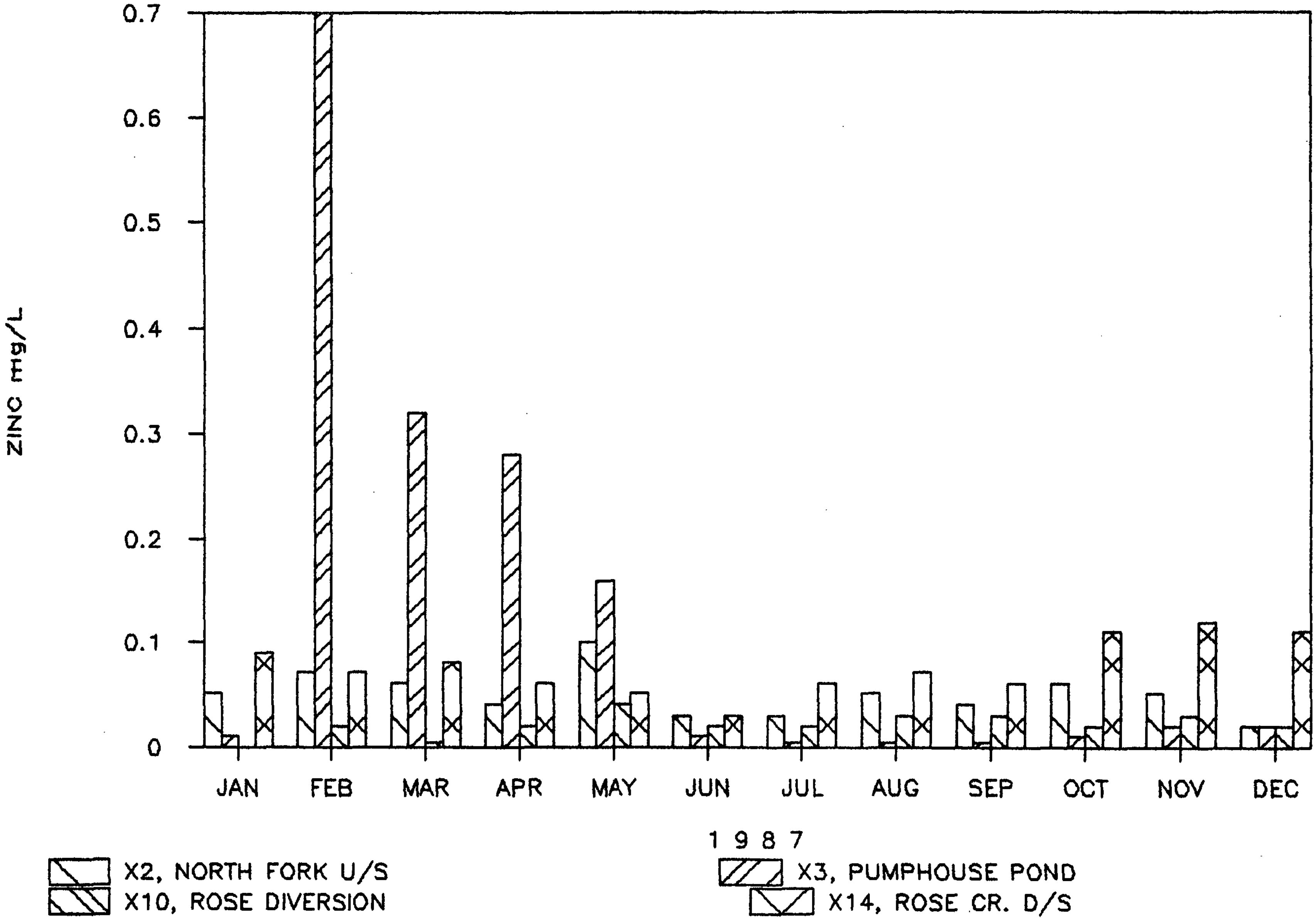


FIGURE 14

ZINC AT ROSE CREEK STATIONS

CURRAGH RESOURCES INC. – FARO MINESITE



1.7. Copper

Copper levels were well below the effluent standard of 0.20 mg/L for most of the year (Figure 15). However, levels increased during the fall and winter, exceeding the standard on one occasion. Copper forms complexes with both cyanide and ammonia (Moore and Ramamoorthy 1984), both of which were in higher than normal concentration in the effluent during this period.

1.7.1. Sources of Copper

Copper is a component of the ore and is added in the mill process in the form of copper sulphate. Addition is closely monitored as excess addition adversely affects processing. Copper entered the impoundment with the tailings (X9) and was not found in appreciable concentrations in the other inflows to the system (X23, X22, X1).

As can be seen in Figure 16, copper concentration in the tailings line was erratic, with particularly high levels occurring in August and October. Concentrations were elevated at X5 in September and December, lag periods of one month and two months respectively.

1.7.2. Impact on Rose Creek

Copper levels in Rose Creek are plotted on Figure 17. Copper at the downstream site (X14) reached a peak of 0.07 when the effluent levels were high. Copper at this concentration may be acutely toxic to juveniles or have sublethal effects (Anon. 1987). Toxicity is highly variable and depends in part on the form copper is in, with ionic copper and copper hydroxides being more toxic than complex forms (Moore and Ramamoorthy 1984).

1.8. pH

pH was well above the effluent standard minimum of 6.5 units. All inputs to the system, including the seep from the dumps (X23) were within the neutral range.

1.9. Suspended Solids

Suspended solids levels were consistently very low and well within effluent standards. The system's long residence time ensures adequate settling of solids. As Figure 18 illustrates, elevated levels of suspended solids occurred in Rose Creek upstream and downstream of the minesite during freshet. The creek was clear at other times.

FIGURE 15

COPPER AT X5, CROSS VALLEY DAM DECANT

CURRAGH RESOURCES INC. – FARO MINESITE

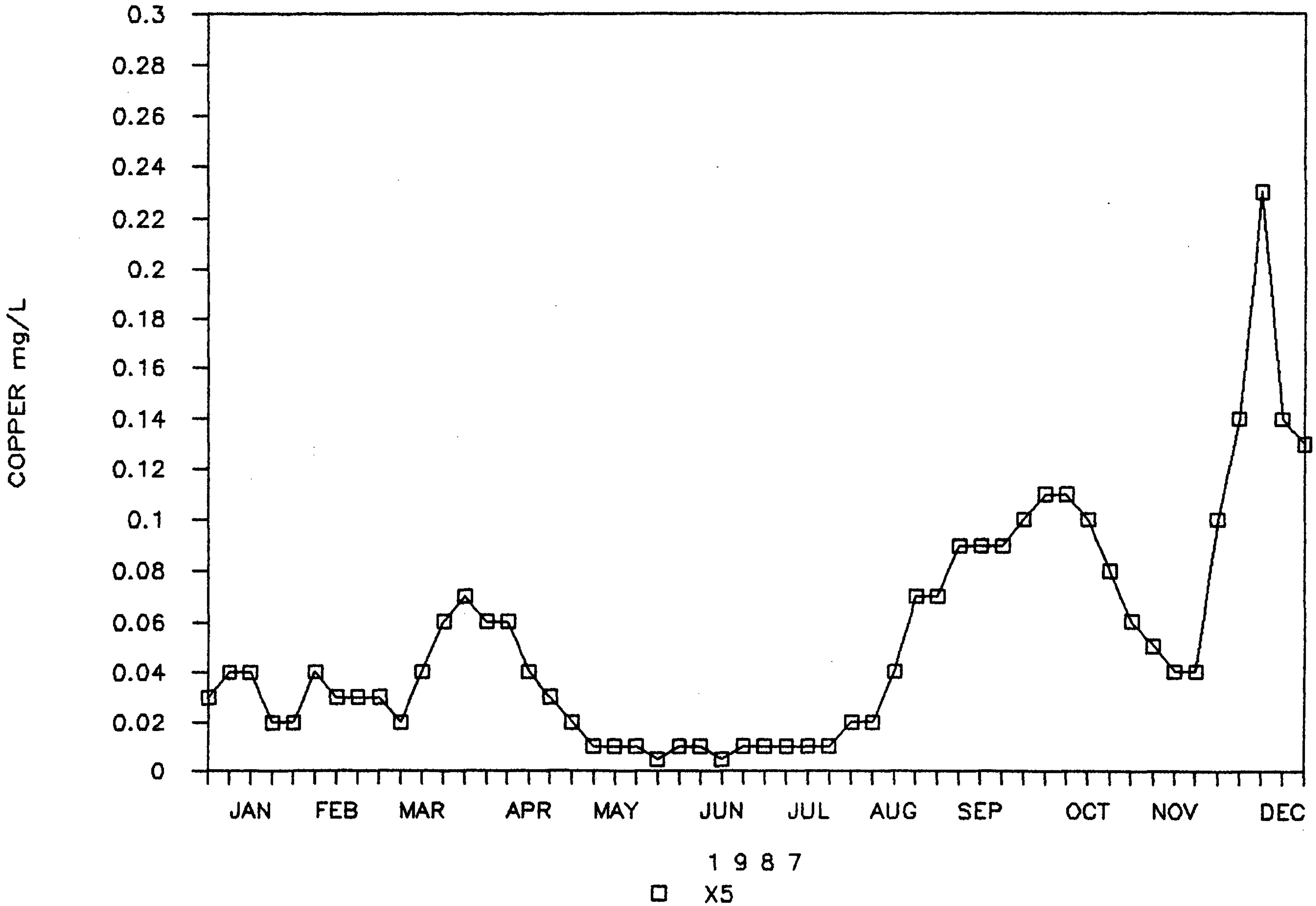


FIGURE 16

COPPER AT X9, TAILINGS LINE

CURRAGH RESOURCES INC. – FARO MINESITE

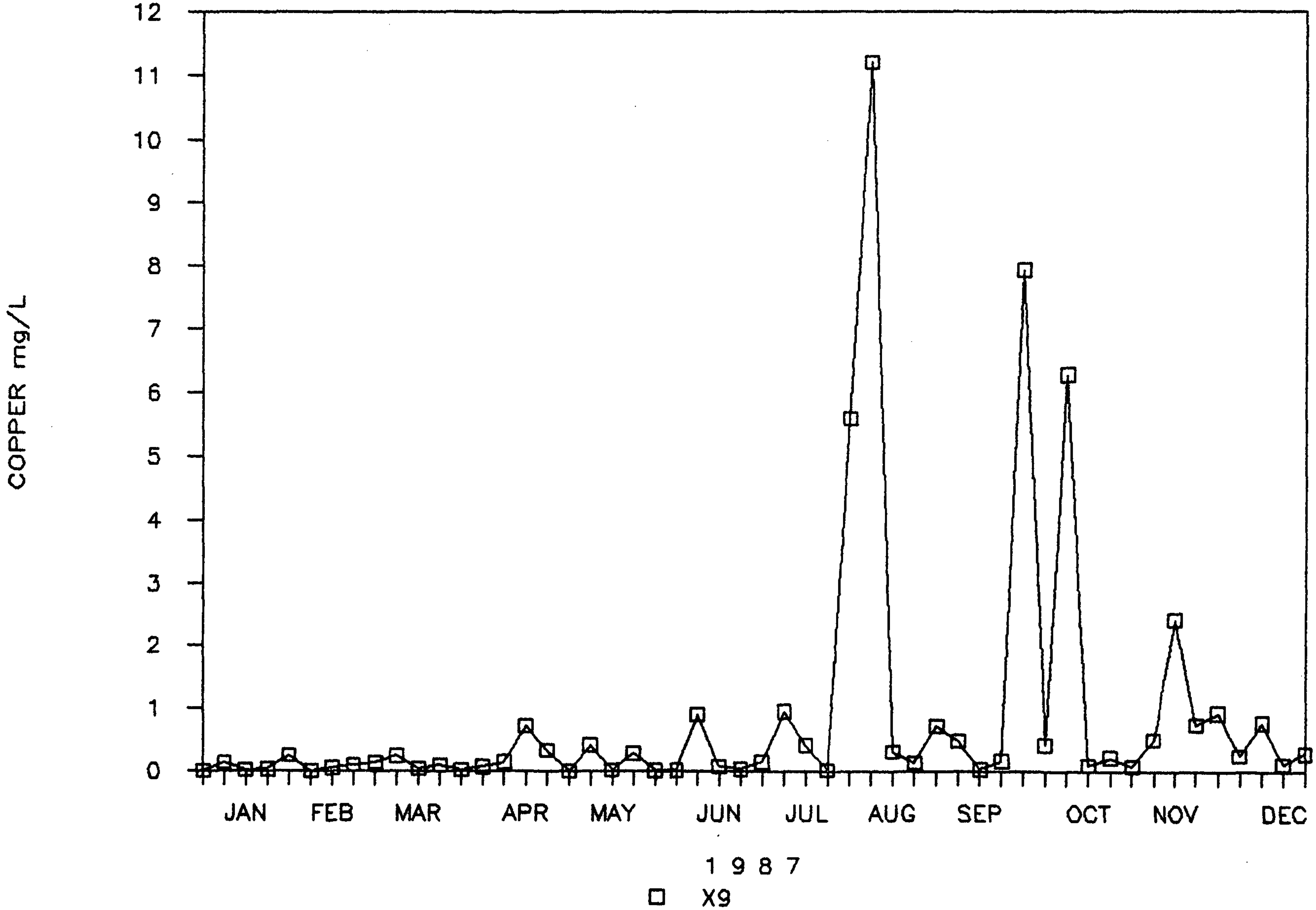


FIGURE 17

COPPER AT ROSE CREEK SITES

CURRAGH RESOURCES INC. – FARO MINESITE

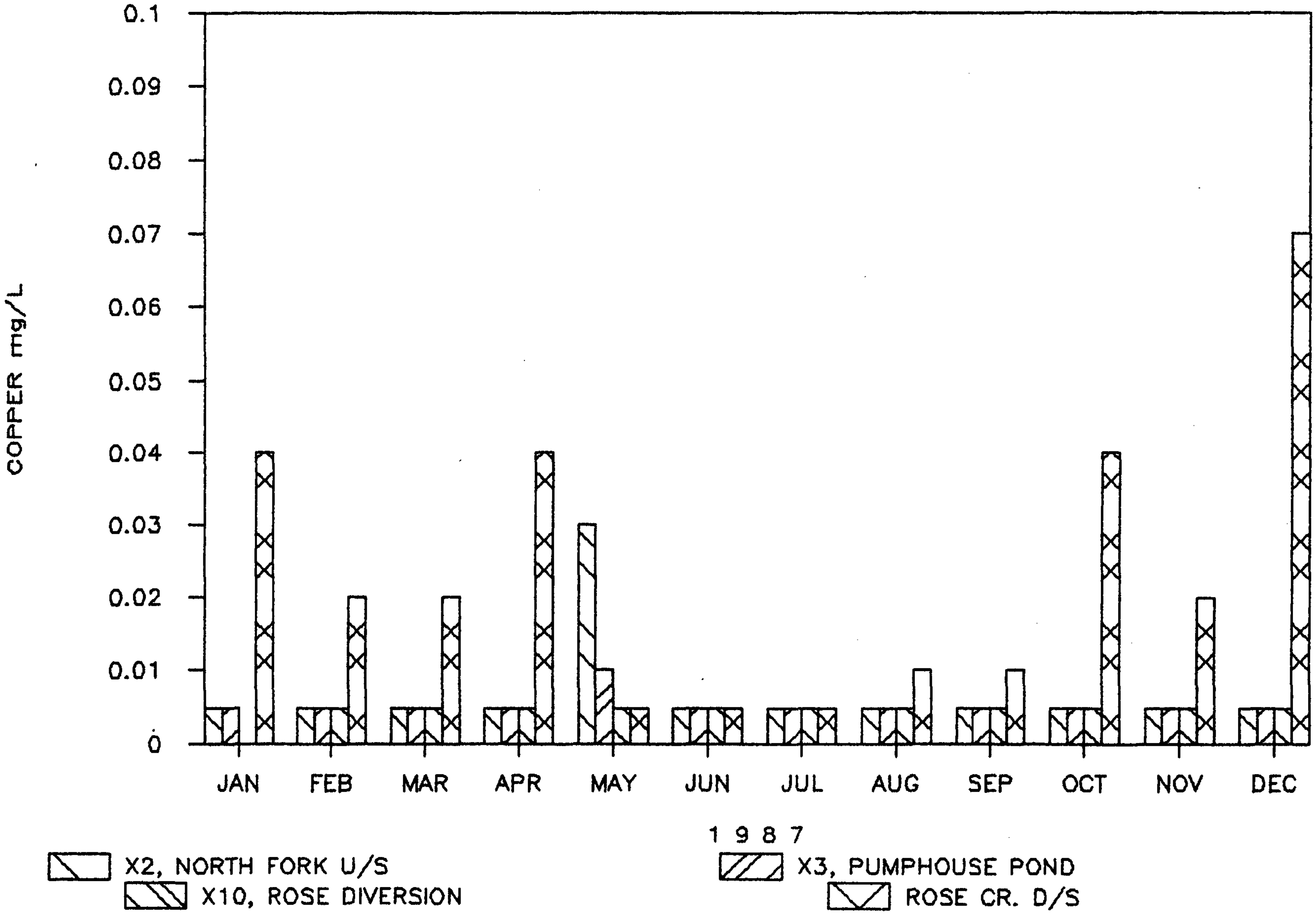
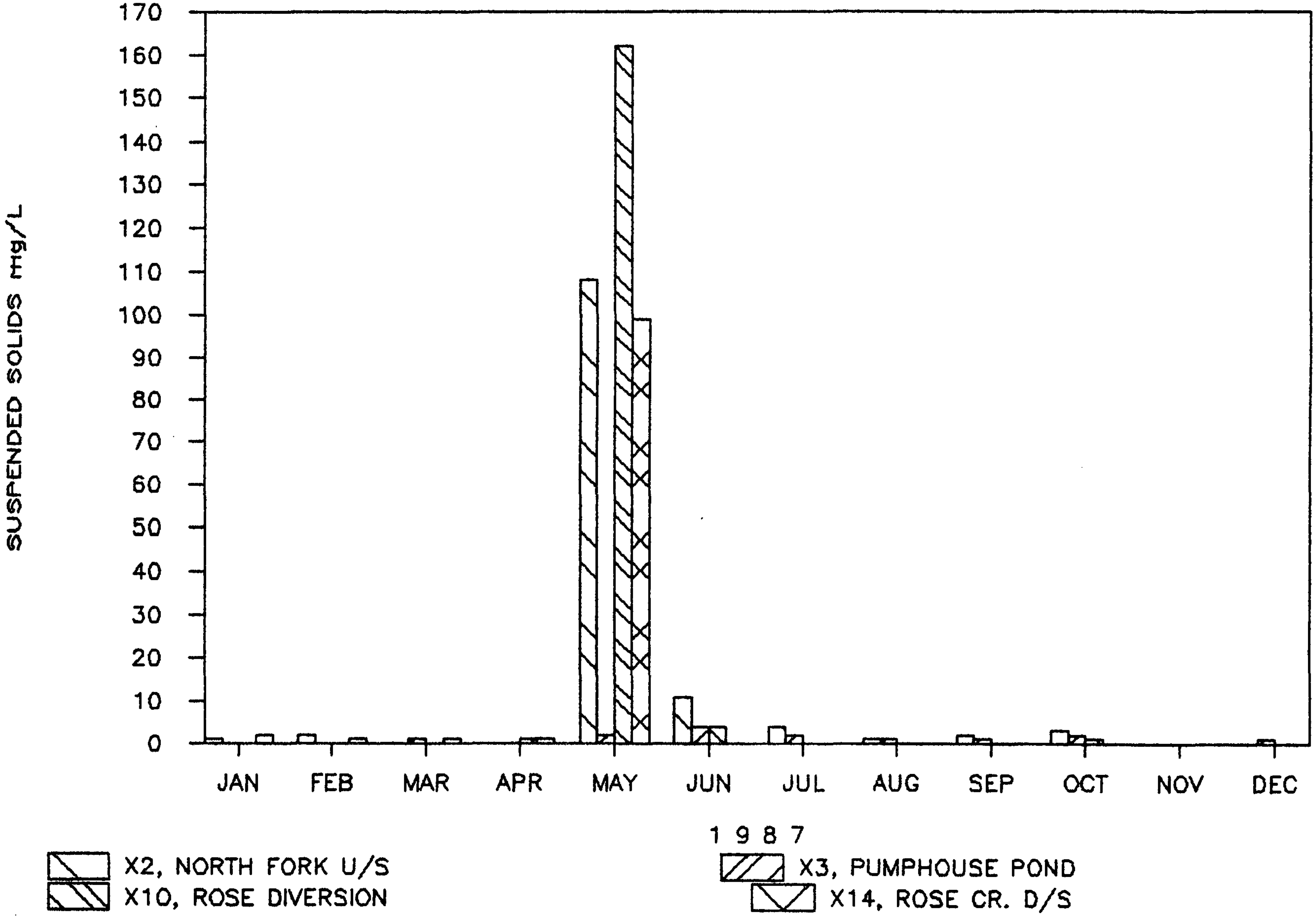


FIGURE 18

SUSPENDED SOLIDS AT ROSE CREEK SITES

CURRAGH RESOURCES INC. – FARO MINESITE



1.10. Flow Data

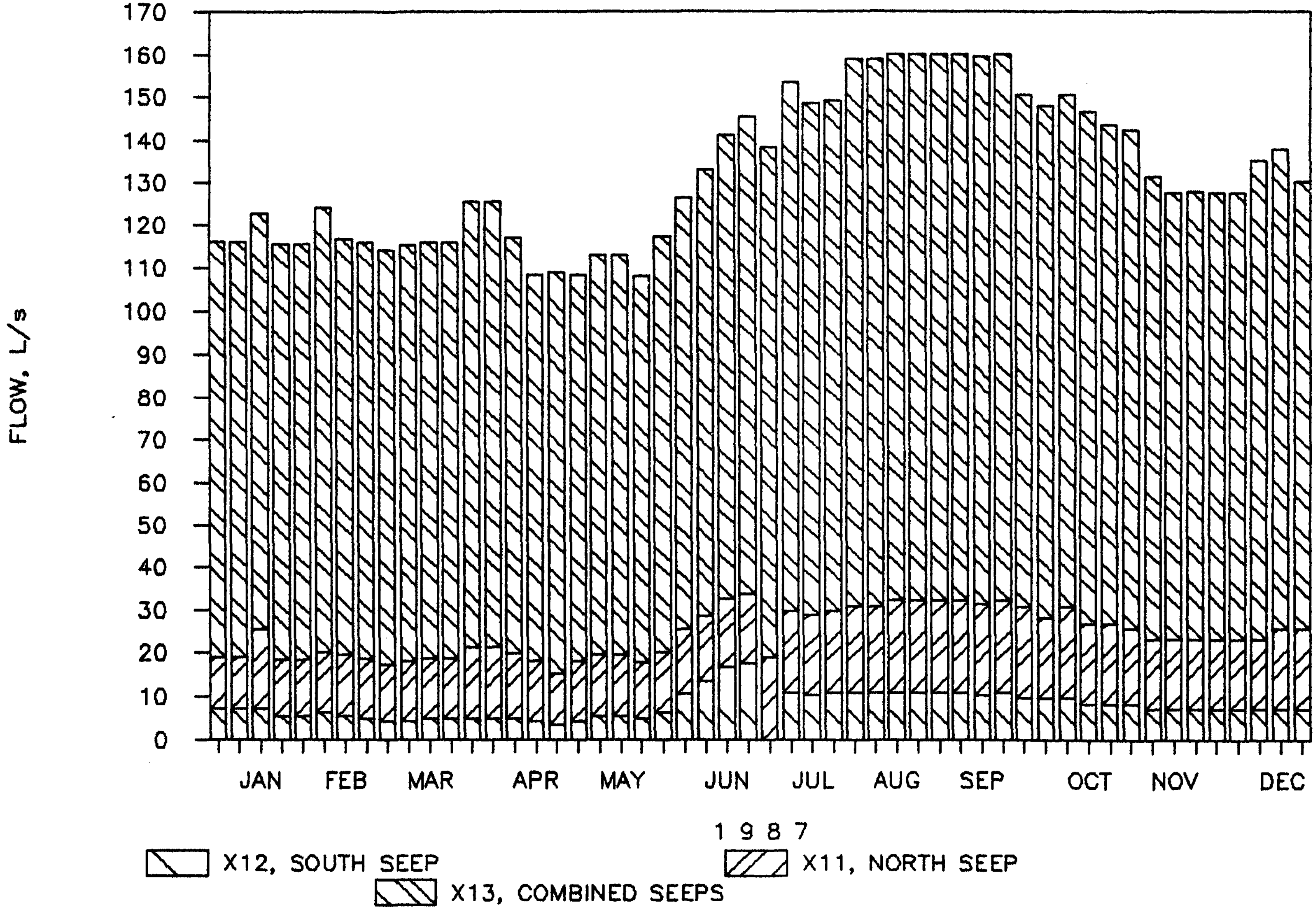
Weekly readings of the weirs at sites X11, X12 and X13 (seeps from the Cross Valley Dam) indicate that seepage did not alter greatly over the year (Figure 19). There was some increase in all flows during the summer. The seeps from the north and south toes of the dam form a small proportion of the total seepage flow from the face of the dam.

Readings of weirs at inflows to the tailings impoundment (Figure 20) indicate that the greatest proportion of water flow to the system is from the tailings line. This inflow is a fairly constant amount--the two low points on the graph were during mill shutdowns.

FIGURE 19

SEEPS FROM CROSS VALLEY DAM

CURRAGH RESOURCES INC. – FARO MINESITE



2. GROUNDWATER DATA

Results from groundwater monitoring are presented in Appendix 3. Licence site locations are shown on Figure 1 and the locations of all groundwater sites are described in Appendix 3.

2.1. Interpretation of Results

The samples indicated that the tailings system had little impact on downstream groundwater quality in 1987. Water quality remained good in groundwater samples downstream of the Cross Valley Dam (X16, X17 and X18), with very low levels of metals and with pH values above 7. Groundwater quality at these downstream sites was similar to that at the upstream site (P81-09), with the exception of slightly higher sulphate and sodium levels in some samples. The upstream site is located at the location recommended for background groundwater quality by Steffen, Robertson and Kirsten (1986).

Copper, zinc and lead levels were low and pH remained neutral to basic in the samples from the Cross Valley and Intermediate Dams. Manganese, sodium and sulphate were slightly elevated in several of these samples.

Water quality at X21, by the old tailings decant, was comparable to previous years, with slightly lowered pH and elevated sulphate, zinc and manganese in the 10 m sample only. Most of the samples from wells in the original and old tailings ponds were neutral to basic with fairly low sulphates and metals. Water from K10, located in the north part of the original tailings pond, was slightly acidic (pH 6.23) and somewhat high in zinc (2.34 mg/L). The zinc concentration was comparable to the last sample taken (October, 1984, zinc 1.60 mg/L and no pH recorded).

Low pH values and high metals were found in two samples from the old tailings area (sites 83-3A and 83-3B). Samples have never been taken from these two piezometers as they have been dry during all sampling attempts since their installation. Mr. Newt Cornish, who conducted the fall sampling, noted that inflow to these wells was extremely slow and that samples were taken from stagnant water in the wells. He recommended that the holes be evacuated in the spring of 1988 and samples be taken after a period of about two days to determine if the low pH, high metal content water in these samples was representative of tailings pore water quality at this location or if the results were an artifact of sampling.

3. BIOASSAYS

Bioassay lab reports are presented in Appendix 2 and summarized in Table 2. The lethal concentration was greater than 100 % for all tests. There were no mortalities at X13, the seepage from the Cross Valley Dam. Mortalities occurred during the last 48 hours in samples from the final decant (X5) for May, September and December.

TABLE 2: BIOASSAY RESULTS, X5 AND X13

X5 = Decant of Cross Valley Dam

X13 = Combined seepage from Cross Valley Dam

There were no mortalities in the controls.

Month	Site	96-h LC50	Percent Survival			
			24 h	48 h	72 h	96 h
May	X5	>100 %	100	100	60	60
May	X13	>100 %	100	100	100	100
August	X5	>100 %	100	100	100	100
Sept.	X5	>100 %	100	100	100	80
Sept.	X13	>100 %	100	100	100	100
November	X5	>100 %	100	100	100	100
December	X5	>100 %	100	100	80	70
December	X13	>100 %	100	100	100	100

4. PHYSICAL MONITORING

The report entitled 1987 Performance Monitoring of the Down Valley Tailings Project, Faro Mine, prepared by Golder Associates, is included as Appendix 4.

This report presents and reviews data from the 1987 monitoring program (Schedule C of the Water Licence). The data reviewed include observations of thermistors, slope indicators and piezometers on the dams, flow data and observations from a field inspection by Mr. H.G. Gilchrist of Golder Associates.

The report's conclusion is that "the elements of construction constituting the tailings storage and creek diversion systems are continuing to perform well." The report contains recommendations for further monitoring.

5. FRESH WATER CONSUMPTION

5.1. Water Supply

Curragh Resources Inc. extracts fresh water from Rose Creek primarily to supply the requirements of its mill. Within the mill, the principal water uses are for grinding (33%), flotation (42%), and dewatering.

Curragh's fresh water supply system consists of:

- a water supply reservoir;
- a pumphouse pond and pumphouse;
- groundwater wells (PW3, PW4, PW5, PW6);
- North Fork Rose Creek Diversion;
- a supply line from the pumphouse to the mill.

The main source of fresh water is the water supply reservoir which supplies water to the pumphouse year round. Reservoir capacity is recharged from the Rose Creek drainage basin. The water supply is supplemented by the North Fork of Rose Creek and groundwater wells adjacent to the pumphouse ponds during the winter months.

5.2. Consumption

The average daily water requirement for the mill during 1987 was 29,900 m^3/day.

Table 2 summarizes the fresh water consumption for the mill during 1987. The total water consumption is composed of a fixed component associated with the daily milling operation and a variable component dependent upon the volume of ore feed to the mill. Hence, the relationship between ore feed and total water consumption is not linear.

Water licence limit: 15,380,000 m^3/year.

Water consumption is based on mill water meter readings. Meter calibration has indicated that readings are 10 to 15 percent lower than actual usage. Based on these results, actual water usage is estimated at 12,400,000 m^3/year. Water consumption at the Faro mine site, however, was within both the daily and yearly water licence limits for 1987.

TABLE 2: MILL FRESH WATER CONSUMPTION

MONTH	ORE FEED TONNES	WATER CONSUMPTION (m3)
JANUARY	380,756	910,007
FEBRUARY	331,666	929,600
MARCH	331,788	857,060
APRIL	411,698	873,240
MAY	347,698	830,145
JUNE	374,084	890,400
JULY	373,133	984,720
AUGUST	417,419	973,770
SEPTEMBER	371,419	896,840
OCTOBER	386,452	912,430
NOVEMBER	399,345	870,770
DECEMBER	414,062	871,530
TOTAL	4,539,394	10,800,512

6. PIT WATER PUMPING

During 1987, pit water pumping was carried out from Zone I, II, and JB Phase (Zone III).

Zone I: Zone I was pumped from January to March using a 300 h.p. turbine pump and a 140 h.p. Flygt pump. The average discharge was 0.114 m3/sec.

Zone I was pumped from April to December using two 140 h.p. Flygt pumps. The average discharge varied between 0.051 m3/sec. to 0.063 m3/sec.

Zone II: Zone II was pumped from mid-June to the end of October using a 140 h.p. Flygt pump. The average discharge was 0.032 m3/sec.

JB Phase: The JB phase of Zone III was pumped from September to December using a 140 h.p. Flygt pump. The average discharge was 0.035 m3/sec.

Total pit water pumped for the year was 2,991,250 cubic meters. All pit water discharge was pumped to the tailings impoundment.

As in previous years, water was pumped to the Faro Creek diversion channel from the Faro Valley about 1 km downstream of the point of diversion. The discharge was about 0.010 m^3/sec.

However, it was discovered in October that the zinc concentration in this water was above the effluent standard and pumping was immediately stopped.

7. TAILINGS FACILITY WATER BALANCE

1. Water Discharged to the Tailings Pond.	VOLUME (m3)
- Pit water pumped to tailings	2,991,300
- Mill tailings discharge	10,800,500
TOTAL	13,791,800

2. Water Discharged from Tailings Pond.	VOLUME (m3)
- Decant at Cross Valley Dam (X5)	10,512,000
- Cross Valley Dam Seepage (X13)	3,416,400
TOTAL	13,928,400

8. MAINTENANCE WORK

8.1. Jobs Completed

1. The diversion canal backslope thermal liner was graded to reduce erosion.

2. A detailed profile survey was completed for the diversion canal dyke.

3. A crack survey strip chart was completed for the fresh water supply dam.

4. The surface of the fresh water supply dam was graded to obliterate the surface cracks.

5. Faro Creek diversion ditch:
   Installed two weirs in diversion channel
   - weir (1) opposite Faro Valley waste plug
   - weir (2) placed 900 m downstream of weir (1) immediately prior to steepening of diversion channel gradient.

   Flows were measured at these weirs in September to determine seepage losses through diversion ditch dyke walls. Recorded flows were:

   Faro Creek 0.163 m^3/s

Weir (1) 0.106 m^3/s
Weir (2) 0.081 m^3/s

Channel losses were:

Faro Creek to Weir (1) 0.057 m^3/s
Weir (1) to Weir (2) 0.025 m^3/s

The Faro diversion channel was lined with TG-Blue liner beginning below Weir (1) and extending 670 m downstream. The liner was installed to reduce ditch flow losses and to reduce inflows into Zone 2.

6. An interceptor ditch was installed on bench 4030 of the main pit to direct water to the JB pit. The ditch was installed to reduce inflows into Zone 2 and was an abandonment measure for Zone 2.

7. A horizontal drain was constructed at the 3800 foot elevation to channel overflow from the Zone 2 pit so that it may be collected and pumped to the tailings impoundment.

8. Upper Intermediate Dam (Plug Dam)

   During the winter, the tailings discharge spreads out across the intermediate disposal area. The flow is slow and considerable glaciation of the slurry occurs. Much of this glaciated material does not melt during the warm period and this results in a loss of volume for solids disposal.

   A dam was constructed in the upper portion of the intermediate disposal area so that the tailings could be deposited in deep water and thus avoid glaciation. The dam construction had to be suspended due to heavy frost in late fall, but construction will resume again in the summer in order to complete the southern portion of the dam. It is anticipated that this dam will be adequate for winter disposal for at least four years.

   Construction period: Late September to early November

   Construction method: Glacial till (sizing less than 0.3 m). Built by pushing till in place with a cat.

8.2. Jobs to be Done During 1988

1. Armour the erosion channel 50 meters downstream from Goodall Creek.

2. Excavate the granular cap in the ramp opposite the rock quarry, backfill and compact, restore bedding and finally replace rip rap.

3. Clean out the channel bottom pilot channel.

4. Excavate cracks occuring at sta. 2 + 100, backfill and compact with glacial till, dress with gravel.

5. Redirect the Rose Creek flow to go via the 1974 route just upstream of the automatic gauging station.

6. Install a flexible apron downstream of the weirs opposite the Cross Valley Dam.

7. Read the piezometers located on the Fresh Water Dam monthly, Nov./87 - Apr./88, and bi-weekly as the reservoir fills.

8. Maintain a record of the water level during winter for the Fresh Water Dam.

9. Read thermistors located on the Fresh Water Dam.

10. Record qualitative observations on the Fresh Water Dam.

11. The source of high zinc loading to the pumping pond in the Faro Valley will be isolated. The indicated source is seepage through a section of the Faro Creek diversion dyke which probably has a high sulphide composition. The material will be excavated and replaced with till so that pumping can resume.

12. An interceptor ditch will be installed immediately north to north-east of Zone 2 to further reduce drainage into this area.

9. WASTE ROCK DEPOSITION

Plans for the development of the Zone Two Dump were developed in house and reviewed by Dr. Andrew Robertson of Steffen, Robertson and Kirsten Engineering Consultants Ltd., Vancouver. Plans were submitted to the Yukon Territory Water Board in December and approval to proceed with the dump was received early in 1988.

Waste rock was separated by its acid generating potential. Most of the non acid generating calc-silicate rock was used in the construction of the North Fork causeway. Potentially acid generating high sulphide waste was placed in a separate sulphide waste dump.

10. ASSESSMENT OF ELIMINATION OF 1000 IGPM SPILL

P.A. Harder and Associates of Victoria, B.C. prepared an assessment of the impact of winter flow reduction on the Rose Creek diversion canal (Appendix 5). This assessment is based on observations and fish sampling data collected during May, 1987. Mr. Harder concludes that the proposed flow reductions would have a relatively minor impact to existing fish production capabilities in Rose Creek between the effluent discharge and the North Fork haul road crossing. This is due to the relatively low over-winter habitat capabilities in the affected portion of Rose Creek.

11. WATER CONSERVATION

11.1. Reduction in Primary Consumption

In August, low-volume sprays were installed on two of three of the zinc cleaner banks for an estimated reduction of 350 USGPM. These sprays use only about one-third of the water of a conventional spray for the same froth breaking action. Applied on all cleaner and rougher banks, a further 600 USGPM might be saved.

11.2. Internal Re-cycle

Two 10 X 8 SRL pumps were used for recycle of lead and zinc clarifier overflows from February to May. The system was shut down after periods of high suspended solids in the clarifier overflows. Once levels above 300 ppm were reached, severe plugging problems occurred in the sprays of the zinc cleaning circuit, where the water was used. The water was also used on the zinc rougher and first cleaner sprays with equal lack of success.

We are now (February, 1988) making the modifications to exchange the duties of the thickeners and the clarifiers to produce a clean overflow suitable for recycle. The original (ex-1982) flowsheet routed the large thickener overflows to the smaller clarifiers in addition to the filtrate and the scrubber water. This resulted in a much higher rising current velocity in the clarifier than the thickener, the opposite of normal practice. After the zinc system exchange is complete, results will be evaluated before lead system modifications proceed. The existing lead and zinc thickener overflow pumps would then be available for recycle duty.

Recycle of crusher scrubber water to #1 and #2 cyclone feed pumps was practised for the first six months of 1987, but was discontinued with the freshet and has since not been operable. New pumps will be required to reactivate this system, together with some kind of metering arrangement for the addition rate.

Recovery of vacuum pump seal water and compressor cooling water was attempted by piping to the clarifier overflow recycle pumps. Although this water was clean, it became contaminated with overflow solids and these flows were eventually redirected to their original locations. Recycle will be attempted again when the clarifier overflow clarity problem has been solved.

11.3. External Re-cycle

Laboratory testwork to assess the effect of external (and internal) recycle on metallurgical results from bench scale tests has been postponed due to shortage of metallurgical and assay lab personnel.

Testwork to establish the effect of recycle on Vangorda metallurgy has been included in the test program being conducted at Lakefield Research. This will be conducted near the end of the program (July/August), when base-level metallurgical test conditions have been properly established.

REFERENCES

Anon. 1987. Canadian Water Quality Guidelines. Task Force on Water Quality Guidelines of the Canadian Council of Resource and Environment Ministers. Environment Canada, Ottawa.

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Sawyer, C.N. and P.L. McCarty 1978. Chemistry for Environmental Engineering. Third Edition. McGraw-Hill Book Company, Toronto.

Steffen Robertson and Kirsten, 1986. Studies Related to Evaluation of Alternative Abandonment Measures for Faro Mine Tailings.

APPENDIX 1

SURFACE WATER QUALITY MONITORING PROGRAM RESULTS

List of Surface Water Sample Site Numbers and Locations

Site	Description in Water Licence
X1	Old tailings pond decant
X2	North Fork of Rose Creek at road bridge
X3	Rose Creek at freshwater pumphouse
X4	Intermediate dam decant
X5	Cross Valley dam decant
X6	Seepage from old tailings pond
X7	Minewater at road crossing
X8	At diversion of Faro Creek
X9	Tailings line to tailings pond
X10	Rose Creek diversion canal below wiers (sic)
X11	Seepage from north toe of Cross Valley dam
X12	Seepage from south toe of Cross Valley dam
X13	Combined seepage flows downstream from the culvert and upstream of the confluence with the decant
X14	Rose Creek after mixing downstream of the diversion canal confluence
X22	Discharge from Faro #1 Pit pumps
X23	Pit drainage at toe of waste dumps

Notes on the treatment of data:

- The detection limit for most parameters is taken as 0.01 mg/L for surface water quality data, as results for most parameters have been rounded to two significant figures.
- Sample results reported as less than the detection limit were entered in the database as 0.0049 and thus appear as 0.00.
- Statistics were calculated using 0.0049 (half way between the detection limit and zero).
- Parameters with results reported as a different number of significant figures were treated in a similar manner.
- Blanks represent missing data.

FOR SAMPLE SITE: X1 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
07-Jan-87	0.32	0.00	0.19	56.80	0.01	8.75	30.0	1205	7.11	57		1
15-Jan-87												
20-Jan-87												
28-Jan-87												
MLY AVG	0.32	0.00	0.19	56.80	0.01	8.75	30.0	1205	7.11	57		1
03-Feb-87												
10-Feb-87												
17-Feb-87												
24-Feb-87												
MLY AVG												
03-Mar-87												
10-Mar-87												
17-Mar-87												
24-Mar-87												
MLY AVG												
01-Apr-87												
07-Apr-87												
14-Apr-87												
20-Apr-87												
28-Apr-87												
MLY AVG												
05-May-87	9.53	0.01	0.37	36.25	0.02	7.05	19.4	859	6.66	1610		0
12-May-87	3.92	0.06	10.62	14.55	0.02	14.00	21.5	1120	6.45	1410		1
19-May-87	6.35	0.03	0.05	3.04	0.00	9.40	0.2	963	6.94	2370		5
26-May-87	3.26	0.05	0.65	68.30	0.03	8.05	17.6	904	6.63	668		5
MLY AVG	5.77	0.04	2.92	30.54	0.02	9.63	14.7	962	6.67	1515		3
04-Jun-87	1.40	0.10	6.03	37.00	0.01	6.80	47.0	853	6.75	119		7
11-Jun-87	1.75	0.15	0.11	44.20	0.01	9.25	30.0	1020	6.48	117		8
16-Jun-87	2.10	0.11	0.13	60.30	0.00	8.95	30.0	1093	6.65	90		8
26-Jun-87												
30-Jun-87												
MLY AVG	1.75	0.12	2.09	47.17	0.01	8.33	35.7	989	6.63	109		8
06-Jul-87	3.03	0.06	0.36	38.50	0.02	6.85	28.0	947	6.95	52		12
13-Jul-87	1.63	0.07	0.36	1.00	0.06	1.06	124.0	443	7.82	187		12
20-Jul-87	1.78	0.05	0.46	30.00	0.04	6.10	34.5	866	7.24	86		10
28-Jul-87	4.96	0.10	0.17	29.30	0.01	6.74	28.5	810	7.05	29		14
MLY AVG	2.85	0.07	0.34	24.70	0.03	5.19	53.8	767	7.27	89		12

FOR SAMPLE SITE: X1 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
04-Aug-87	1.87	0.07	0.20	32.10	0.00	6.50	26.5	887	6.84	43		10
11-Aug-87	3.81	0.19	0.18	29.30	0.40	6.90	32.0	874	6.86	64		6
18-Aug-87	1.99	0.15	0.11	43.80	0.00	8.00	37.0	1165	6.80	38		8
25-Aug-87	1.33	0.15	0.10	58.00	0.00	9.12	37.0	1305	6.50	41		8
MLY AVG	2.25	0.14	0.15	40.80	0.10	7.63	33.1	1058	6.75	47		8
01-Sep-87	0.91	0.04	0.05	58.70	0.00	9.67	36.0	1370	6.77	95	39.7	4
08-Sep-87	1.48	0.03	0.04	39.40	0.00	7.81	36.0	1035	6.79	33	50.0	5
15-Sep-87	0.99	0.06	0.06	51.00	0.00	8.80	34.0	1225	6.55	72	55.0	7
21-Sep-87	1.50	0.09	0.09	38.40	0.00	7.00	36.0	930	6.86	67	70.5	0
MLY AVG	1.22	0.06	0.06	46.88	0.00	8.32	35.5	1140	6.74	67	53.8	4
02-Oct-87	2.86	0.07	0.00	31.00	0.02	7.40	36.5	948	7.03	790	18.7	2
06-Oct-87	3.04	0.07	0.00	35.60	0.01	6.60	32.5	863	6.88	1520	77.5	1
13-Oct-87	5.84	1.82	0.02	52.20	0.09	9.52	43.5	1260	7.30	4480	48.5	0
20-Oct-87	1.96	0.15	0.00	55.80	0.00	9.20	36.0	1275	7.08	3350	55.8	2
27-Oct-87	1.51	0.07	0.00	45.00	0.01	7.50	35.0	977	7.01	8420	42.2	3
MLY AVG	3.04	0.44	0.01	43.92	0.03	8.04	36.7	1065	7.06	3712	48.5	2
03-Nov-87	2.04	0.18	0.03	74.50	0.00	8.93	37.0	1440	6.87	60	77.5	0
10-Nov-87	4.16	0.11	0.00	61.00	0.00	6.92	27.0	936	6.55	2970	55.8	1
17-Nov-87	2.97	0.08	0.00	67.80	0.00	7.02	25.0	990	6.78	70		0
24-Nov-87	1.15	0.31	0.02	35.60	0.01	7.23	19.0	766	6.50	4990	8.5	1
MLY AVG	2.58	0.17	0.01	59.73	0.01	7.53	27.0	1033	6.68	2023	47.3	1
01-Dec-87	5.04	0.04	0.00	24.00	0.00	4.39	18.5	536	6.77	2270		1
09-Dec-87												
15-Dec-87	2.60	0.01	0.16	38.40	0.10	7.20	14.0	962	6.48	89		0
23-Dec-87	3.05	0.09	0.90	28.50	0.07	5.34	10.1	891	6.94	6150		2
30-Dec-87	3.13	0.02	0.10	22.00	0.01	5.13	18.4	910	6.62	371		0
MLY AVG	3.46	0.04	0.29	28.23	0.05	5.52	15.3	825	6.70	2220		1

YEARLY SUMMARY:

	AMMONIA	CYANIDE	LEAD	ZINC	COPPER	MANGANESE	SODIUM	SULFATE	pH	SUSPSOLIDS	FLOWRATE	TEMP
YEAR MIN	0.32	0.00	0.00	1.00	0.00	1.06	0.2	443	6.45	29	8.5	0
YEAR MAX	9.53	1.82	10.62	74.50	0.40	14.00	124.0	1440	7.82	8420	77.5	14
# ANALYSES	33	33	33	33	33	33	33	33	33	33	12	33
YEAR AVG	2.83	0.14	0.65	40.65	0.03	7.55	31.4	989	6.83	1296	50.0	4
YEAR STD DEV	1.85	0.30	2.04	17.34	0.07	2.06	19.0	212	0.28	2040	20.2	4

FOR SAMPLE SITE: X2 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
15-Jan-87	0.00	0.00	0.00	0.05	0.00	0.11	3.1	11	7.54	1		2
10-Feb-87	0.20	0.00	0.00	0.07	0.00	0.13	3.3	15	7.20	2		1
10-Mar-87	0.40	0.00	0.02	0.06	0.00	0.14	3.6	16	7.22	0		1
07-Apr-87	0.30		0.00	0.04	0.00	0.12	3.4	18	7.41	0		1
12-May-87	0.14	0.00	0.17	0.10	0.03	0.11	0.8	3	7.31	108		0
11-Jun-87	0.06	0.00	0.00	0.03	0.00	0.02	1.1	5	7.79	11		3
13-Jul-87	0.40	0.00	0.04	0.03	0.00	0.03	1.7	8	7.83	4		7
11-Aug-87	0.32	0.00	0.01	0.05	0.00	0.03	1.7	11	7.74	1		5
08-Sep-87	0.15	0.00	0.00	0.04	0.00	0.03	2.3	7	7.61	2		1
06-Oct-87	0.04	0.00	0.00	0.06	0.00	0.07	2.5	14	8.21	3	492.0	0
10-Nov-87	0.14	0.00	0.00	0.05	0.00	0.07	2.6	15	7.39	0		1
09-Dec-87	0.17	0.00	0.00	0.02	0.00	0.05	2.8	19	7.30	0		1

YEARLY SUMMARY:

YEAR MIN	0.00	0.00	0.00	0.02	0.00	0.02	0.8	3	7.20	0	492.0	0
YEAR MAX	0.40	0.00	0.17	0.10	0.03	0.14	3.6	19	8.21	108	492.0	7
# ANALYSES	12	11	12	12	12	12	12	12	12	12	1	12
YEAR AVG	0.19	0.00	0.02	0.05	0.01	0.08	2.4	12	7.55	11	492.0	2
YEAR STD DEV	0.13	0.00	0.05	0.02	0.01	0.04	0.9	5	0.29	29	0.0	2

FOR SAMPLE SITE: X3 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
15-Jan-87	0.00	0.00	0.00	0.01	0.00	0.04	2.0	12	7.73	0		2
10-Feb-87	0.00	0.00	0.00	0.71	0.00	0.54	2.1	33	7.25	0		2
10-Mar-87	0.01	0.00	0.00	0.32	0.00	0.12	2.0	16	7.58	1		2
07-Apr-87	0.38		0.00	0.28	0.00	0.10	2.4	15	7.68	0		3
12-May-87	0.17	0.00	0.01	0.16	0.01	0.03	2.0	14	7.51	2		2
11-Jun-87	0.18	0.00	0.00	0.01	0.00	0.01	0.1	2	7.84	4		5
13-Jul-87	0.25	0.00	0.02	0.00	0.00	0.01	1.2	6	7.93	2		10
11-Aug-87	0.52	0.00	0.01	0.00	0.00	0.02	1.1	8	7.82	1		8
08-Sep-87	0.28	0.00	0.00	0.00	0.00	0.01	1.9	11	7.68	1		4
06-Oct-87	0.03	0.00	0.00	0.01	0.00	0.02	2.0	11	8.18	2	473.0	2
10-Nov-87	0.16	0.00	0.00	0.02	0.00	0.03	2.3	17	7.78	0		1
09-Dec-87	0.00	0.00	0.01	0.02	0.00	0.03	2.4	19	7.39	1		0

YEARLY SUMMARY:

YEAR MIN	0.00	0.00	0.00	0.00	0.00	0.01	0.1	2	7.25	0	473.0	0
YEAR MAX	0.52	0.00	0.02	0.71	0.01	0.54	2.4	33	8.18	4	473.0	10
# ANALYSES	12	11	12	12	12	12	12	12	12	12	1	12
YEAR AVG	0.17	0.00	0.01	0.13	0.01	0.08	1.8	14	7.70	1	473.0	3
YEAR STD DEV	0.16	0.00	0.00	0.21	0.00	0.14	0.6	7	0.24	1	0.0	3

FOR SAMPLE SITE: X4 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
07-Jan-87	0.25	0.00	0.22	0.16	0.01	0.78	70.0	682	8.27	4		3
15-Jan-87	0.74	0.03	0.00	0.16	0.02	0.97	70.0	631	8.15	4		1
20-Jan-87	0.60	0.02	0.09	0.22	0.00	1.06	71.0	593	8.06	4		2
28-Jan-87	0.90	0.01	0.18	0.18	0.01	1.13	70.0	667	8.30	2		2
MLY AVG	0.62	0.02	0.12	0.18	0.01	0.99	70.3	643	8.20	4		2
03-Feb-87	0.68	0.00	0.09	0.08	0.05	0.81	74.0	995	8.56	2		2
10-Feb-87	0.66	0.00	0.03	0.08	0.03	0.65	80.0	1010	8.38	3		2
17-Feb-87	0.47	0.01	0.06	0.08	0.00	0.80	79.0	906	8.32	5		2
24-Feb-87	0.59	0.00	0.06	0.12	0.00	1.01	82.0	823	7.93	5		2
MLY AVG	0.60	0.01	0.06	0.09	0.02	0.82	78.8	934	8.30	4		2
03-Mar-87	0.53	0.00	0.10	0.16	0.01	1.06	77.5	738	7.97	2		2
10-Mar-87	0.63	0.02	0.11	0.19	0.06	1.08	89.0	789	8.35	2		2
17-Mar-87	0.89	0.02	0.02	0.04	0.14	0.67	87.0	914	8.61	1		2
24-Mar-87	0.81	0.25	0.06	0.04	0.12	0.34	99.0	1045	8.67	9		2
MLY AVG	0.72	0.07	0.07	0.11	0.08	0.79	88.1	872	8.40	4		2
01-Apr-87	0.82		0.04	0.05	0.07	0.46	103.0	871	8.35	6		2
07-Apr-87	0.92		0.10	0.05	0.01	0.50	99.0	800	8.28	19		3
14-Apr-87	0.77		0.10	0.08	0.02	0.58	98.0	716	8.15	2		3
20-Apr-87	1.25		0.07	0.07	0.00	0.64	98.0	617	7.99	2		3
28-Apr-87	1.45		0.08	0.06	0.00	0.58	100.0	556	8.14	2		3
MLY AVG	1.04		0.08	0.06	0.02	0.55	99.6	712	8.18	6		3
05-May-87	1.17	0.01	0.02	0.04	0.00	0.57	99.0	500	8.17	9		3
12-May-87	1.09	0.00	0.07	0.08	0.01	0.81	93.0	459	7.89	4		4
19-May-87	0.88	0.00	0.15	0.65	0.01	0.11	84.0	419	7.85	4		5
26-May-87	1.16	0.04	0.17	0.28	0.01	1.05	85.0	417	7.95	5		7
MLY AVG	1.08	0.01	0.10	0.26	0.01	0.64	90.3	449	7.97	6		5
04-Jun-87	0.95	0.05	0.10	0.07	0.00	1.04	82.0	386	7.93	1		10
11-Jun-87	0.90	0.01	0.12	0.10	0.00	1.00	85.0	386	7.97	4		10
16-Jun-87	0.87	0.02	0.15	0.11	0.01	0.90	89.0	357	7.95	16		10
26-Jun-87	1.28	0.04	0.26	0.15	0.01	1.01	92.0	358	7.87	8		11
30-Jun-87	1.43	0.04	0.23	0.19	0.00	1.80	92.0	346	7.87	4		14
MLY AVG	1.09	0.03	0.17	0.12	0.01	1.15	88.0	367	7.92	7		11
06-Jul-87	1.20	0.03	0.29	0.18	0.00	1.17	89.0	326	7.95	2		14
13-Jul-87	1.10	0.05	0.33	0.30	0.01	1.44	88.0	339	7.74	3		14
20-Jul-87	1.13	0.05	0.30	0.23	0.01	1.25	100.0	336	8.88	8		15
28-Jul-87	1.23	0.01	0.32	0.16	0.03	1.31	106.0	350	7.83	2		15
MLY AVG	1.17	0.04	0.31	0.22	0.01	1.29	95.8	338	8.10	4		15

FOR SAMPLE SITE: X4 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
04-Aug-87	1.11	0.09	0.35	0.23	0.06	1.33	106.0	361	7.89	8		14
11-Aug-87	1.34	0.06	0.28	0.22	0.09	1.32	109.0	355	7.92	3		13
18-Aug-87	1.55	0.27	0.28	0.31	0.19	1.19	124.0	373	7.91	18		12
25-Aug-87	1.27	0.13	0.25	0.31	0.13	1.13	122.0	385	7.97	20		12
MLY AVG	1.32	0.14	0.29	0.27	0.12	1.24	115.3	369	7.92	12		13
01-Sep-87	1.23	0.06	0.20	0.22	0.09	1.02	120.0	398	8.06	8		9
08-Sep-87	1.19	0.01	0.17	0.14	0.13	0.86	153.0	439	7.93	19		10
15-Sep-87	1.07	0.07	0.23	0.27	0.08	1.01	143.0	430	7.98	13		8
21-Sep-87	1.02	0.09	0.17	0.17	0.10	0.98	135.0	418	8.04	8		6
MLY AVG	1.13	0.06	0.19	0.20	0.10	0.97	137.8	421	8.00	12		8
02-Oct-87	1.16	0.18	0.34	0.70	0.23	1.25	120.0	429	7.92	14		6
06-Oct-87	0.93	0.25	0.18	0.31	0.15	1.24	110.0	407	7.81	24		5
13-Oct-87	0.84	0.22	0.16	0.30	0.13	1.45	100.0	409	8.20	7		3
20-Oct-87	1.04	0.11	0.21	0.27	0.07	1.47	95.0	398	8.18	40		3
27-Oct-87	1.13	0.05	0.18	0.31	0.02	1.43	88.0	382	8.10	13		1
MLY AVG	1.02	0.16	0.21	0.38	0.12	1.37	102.6	405	8.04	20		4
03-Nov-87	0.86	0.06	0.19	0.17	0.02	1.13	84.0	356	8.20	17		2
10-Nov-87	0.97	0.06	0.11	0.18	0.01	1.41	89.0	364	8.43	8		1
17-Nov-87	0.89	0.04	0.23	0.24	0.04	1.48	90.0	379	7.37	17		1
24-Nov-87	0.86	0.23	0.24	0.23	0.30	1.68	94.0	397	8.02	10		1
MLY AVG	0.90	0.10	0.19	0.21	0.09	1.43	89.3	374	8.01	13		1
01-Dec-87	0.97	0.30	0.27	0.25	0.34	1.66	86.0	365	7.92	12		1
09-Dec-87	1.02	0.15	0.15	0.27	0.27	1.88	77.0	368	7.84	5		1
15-Dec-87	1.31	0.19	0.25	0.79	0.30	2.03	51.8	490	7.89	14		1
23-Dec-87	1.30	0.11	0.15	0.17	0.08	1.42	78.0	401	8.24	5		1
30-Dec-87	1.29	0.11	0.25	0.18	0.08	1.29	113.0	405	8.01	7		1
MLY AVG	1.18	0.17	0.21	0.33	0.21	1.66	81.2	406	7.98	9		1

YEARLY SUMMARY:

YEAR MIN	0.25	0.00	0.00	0.04	0.00	0.11	51.8	326	7.37	1		1
YEAR MAX	1.55	0.30	0.35	0.79	0.34	2.03	153.0	1045	8.88	40		15
# ANALYSES	52	47	52	52	52	52	52	52	52	52	0	52
YEAR AVG	0.99	0.08	0.17	0.20	0.07	1.08	94.6	520	8.08	8		5
YEAR STD DEV	0.27	0.08	0.09	0.15	0.09	0.39	18.9	206	0.26	7		5

FOR SAMPLE SITE: X5 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
07-Jan-87	0.86	0.00	0.06	0.11	0.03	0.92	68.0	628	8.03	0		4
15-Jan-87	0.76	0.10	0.06	0.10	0.04	1.10	68.0	629	7.93	0		1
20-Jan-87	0.55	0.02	0.07	0.12	0.04	1.07	67.0	639	7.95	2		1
28-Jan-87	0.67	0.02	0.04	0.10	0.02	1.12	67.0	624	7.95	2		1
MLY AVG	0.71	0.04	0.06	0.11	0.03	1.05	67.5	630	7.97	1		2
03-Feb-87	0.38	0.00	0.05	0.09	0.02	1.22	69.0	659	7.95	0		2
10-Feb-87	0.45	0.00	0.04	0.09	0.04	1.01	71.0	728	8.01	1		1
17-Feb-87	0.26	0.01	0.04	0.09	0.03	1.05	69.0	758	7.93	0		1
24-Feb-87	0.60	0.00	0.04	0.09	0.03	1.11	75.0	779	7.84	2		2
MLY AVG	0.42	0.01	0.04	0.09	0.03	1.10	71.0	731	7.93	1		2
03-Mar-87	0.00	0.00	0.07	0.10	0.03	1.11	70.5	770	7.77	1		1
10-Mar-87	0.51	0.15	0.05	0.11	0.02	1.17	74.0	767	7.73	2		2
17-Mar-87	0.55	0.12	0.05	0.10	0.04	1.10	80.0	778	7.77	2		2
24-Mar-87	0.80	0.16	0.05	0.09	0.06	1.05	80.0	823	7.73	1		2
MLY AVG	0.47	0.11	0.06	0.10	0.04	1.11	76.1	785	7.75	2		2
01-Apr-87	0.62		0.05	0.09	0.07	0.99	89.0	827	7.61	1		2
07-Apr-87	0.80		0.05	0.08	0.06	0.87	89.0	847	7.62	1		2
14-Apr-87	1.00		0.05	0.08	0.06	0.87	90.0	821	7.66	1		1
20-Apr-87	0.76		0.06	0.07	0.04	0.83	92.0	765	7.67	2		2
28-Apr-87	1.30		0.05	0.07	0.03	0.79	92.0	738	7.66	1		1
MLY AVG	0.90		0.05	0.08	0.05	0.87	90.4	800	7.64	1		2
05-May-87	1.06	0.05	0.04	0.06	0.02	0.72	95.0	663	7.80	3		2
12-May-87	0.94	0.04	0.03	0.06	0.01	0.81	94.0	615	7.74	2		2
19-May-87	0.80	0.03	0.04	0.07	0.01	0.85	91.0	554	7.72	1		4
26-May-87	0.84	0.02	0.05	0.19	0.01	0.92	88.0	531	7.82	0		5
MLY AVG	0.91	0.04	0.04	0.10	0.01	0.83	92.0	591	7.77	2		3
04-Jun-87	0.90	0.03	0.06	0.16	0.00	1.07	81.0	468	7.80	1		8
11-Jun-87	0.93	0.03	0.06	0.16	0.01	1.00	83.0	426	7.94	1		10
16-Jun-87	0.78	0.03	0.06	0.15	0.01	1.00	82.0	420	7.89	0		10
26-Jun-87	1.09	0.05	0.09	0.14	0.00	1.12	88.0	419	7.78	0		11
30-Jun-87	0.86	0.03	0.11	0.13	0.01	1.10	86.0	393	7.80	2		12
MLY AVG	0.91	0.03	0.08	0.15	0.01	1.06	84.0	425	7.84	1		10
06-Jul-87	0.92	0.02	0.10	0.12	0.01	1.18	85.0	379	7.85	0		12
13-Jul-87	1.01	0.00	0.14	0.13	0.01	1.15	84.0	370	7.73	1		13
20-Jul-87	1.03	0.02	0.18	0.15	0.01	1.14	85.0	351	8.71	1		13
28-Jul-87	1.32	0.01	0.20	0.16	0.01	1.38	87.0	334	8.18	1		15
MLY AVG	1.07	0.01	0.16	0.14	0.01	1.21	85.3	359	8.12	1		13

FOR SAMPLE SITE: X5 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
04-Aug-87	1.52	0.03	0.25	0.18	0.02	1.38	93.0	343	7.82	1		15
11-Aug-87	1.33	0.07	0.23	0.21	0.02	1.39	95.0	361	7.92	1		13
18-Aug-87	1.17	0.03	0.22	0.19	0.04	1.38	100.0	344	7.94	1		13
25-Aug-87	1.20	0.01	0.22	0.21	0.07	1.35	100.0	360	8.06	1		12
MLY AVG	1.31	0.04	0.23	0.20	0.04	1.38	97.0	352	7.94	1		13
01-Sep-87	1.07	0.07	0.20	0.21	0.07	1.29	98.0	377	7.95	0		11
08-Sep-87	1.32	0.02	0.18	0.19	0.09	1.26	100.0	389	7.85	2		10
15-Sep-87	1.21	0.09	0.18	0.19	0.09	1.27	116.0	399	7.99	1		8
21-Sep-87	0.97	0.07	0.18	0.19	0.09	1.23	118.0	386	8.00	0		7
MLY AVG	1.14	0.06	0.19	0.20	0.09	1.26	108.0	388	7.95	1		9
02-Oct-87	0.89	0.06	0.19	0.29	0.10	1.22	121.0	405	7.99	2		6
06-Oct-87	0.76	0.08	0.18	0.30	0.11	1.23	118.0	399	7.99	2		5
13-Oct-87	1.04	0.05	0.17	0.29	0.11	1.28	117.0	399	8.30	2	635.2	4
20-Oct-87	1.13	0.06	0.16	0.27	0.10	1.32	110.0	398	8.19	1		3
27-Oct-87	1.02	0.04	0.15	0.27	0.08	1.36	104.0	386	8.15	1		2
MLY AVG	0.97	0.06	0.17	0.28	0.10	1.28	114.0	397	8.12	2	635.2	4
03-Nov-87	0.93	0.03	0.15	0.27	0.06	1.35	101.0	398	8.05	4		2
10-Nov-87	1.04	0.06	0.15	0.26	0.05	1.36	100.0	360	8.52	1		1
17-Nov-87	0.98	0.06	0.14	0.23	0.04	1.40	95.0	390	8.53	1		1
24-Nov-87	0.93	0.07	0.15	0.21	0.04	1.44	96.0	385	7.92	1		2
MLY AVG	0.97	0.06	0.15	0.24	0.05	1.39	98.0	383	8.26	2		2
01-Dec-87	0.88	0.10	0.17	0.22	0.10	1.47	95.0	368	7.96	2		1
09-Dec-87	1.09	0.09	0.14	0.19	0.14	1.50	93.0	392	7.63	2		4
15-Dec-87	1.70	0.14	0.17	0.27	0.23	1.63	103.0	471	7.83	1		1
23-Dec-87	1.59	0.10	0.20	0.20	0.14	1.42	99.0	371	8.23	2		-1
30-Dec-87	1.54	0.17	0.15	0.18	0.13	1.43	98.0	310	7.92	1		1
MLY AVG	1.36	0.12	0.17	0.21	0.15	1.49	97.6	382	7.91	2		1

YEARLY SUMMARY:

YEAR MIN	0.00	0.00	0.03	0.06	0.00	0.72	67.0	310	7.61	0	635.2	-1
YEAR MAX	1.70	0.17	0.25	0.30	0.23	1.63	121.0	847	8.71	4	635.2	15
# ANALYSES	52	47	52	52	52	52	52	52	52	52	1	52
YEAR AVG	0.94	0.05	0.11	0.16	0.05	1.17	90.6	517	7.93	1	635.2	5
YEAR STD DEV	0.33	0.04	0.07	0.07	0.04	0.21	14.0	172	0.23	1	0.0	5

FOR SAMPLE SITE: X6 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
15-Jan-87	1.17	0.00	0.00	0.14	0.00	9.60	59.0	240	7.24	26		3
10-Feb-87	0.58	0.00	0.00	0.21	0.00	10.40	61.0	273	7.12	40		2
10-Mar-87	0.76	0.00	0.00	0.22	0.00	13.45	71.0	379	6.96	64		2
07-Apr-87	1.48		0.00	0.27	0.00	13.10	69.0	280	6.93	27		3
12-May-87	0.92	0.00	0.00	0.57	0.08	13.90	72.0	404	6.86	57		2
11-Jun-87	0.88	0.01	0.00	0.30	0.02	13.10	68.0	385	6.73	58		3
13-Jul-87											0.0	
11-Aug-87											0.0	
08-Sep-87											0.0	
06-Oct-87											0.0	
10-Nov-87											0.0	
09-Dec-87											0.0	

YEARLY SUMMARY:

YEAR MIN	0.58	0.00	0.00	0.14	0.00	9.60	59.0	240	6.73	26	0.0	2
YEAR MAX	1.48	0.01	0.00	0.57	0.08	13.90	72.0	404	7.24	64	0.0	3
# ANALYSES	6	5	6	6	6	6	6	6	6	6	6	6
YEAR AVG	0.97	0.01	0.00	0.29	0.02	12.26	66.7	327	6.97	45	0.0	3
YEAR STD DEV	0.29	0.00	0.00	0.14	0.03	1.64	4.9	64	0.17	15	0.0	1

FOR SAMPLE SITE: X7 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
15-Jan-87	0.40	0.00	7.32	43.00	0.18	7.57	2.7	800	7.08	448		2
10-Feb-87	0.50	0.00	0.22	17.00	0.01	7.41	24.0	1060	7.36	102		1
10-Mar-87	1.32	0.00	0.90	12.20	0.02	6.93	23.5	803	7.57	26		2
07-Apr-87	4.27		0.19	9.75	0.05	4.32	20.8	591	7.54	50		2
12-May-87	7.65	0.01	0.59	3.60	0.03	8.20	19.5	897	6.87	323		6
11-Jun-87	1.69	0.00	0.78	47.00	0.01	6.50	22.5	817	6.82	249		5
13-Jul-87	1.63	0.02	0.23	27.95	0.00	4.98	20.5	783	6.99	266		2
11-Aug-87	2.13	0.00	0.03	39.10	0.00	5.50	34.5	951	7.13	94		7
08-Sep-87	1.08	0.00	0.06	36.50	0.00	5.25	25.5	847	7.14	58	70.5	3
06-Oct-87	3.19	0.03	0.86	57.80	0.03	7.18	36.5	1090	7.23	134	49.0	2
10-Nov-87	4.16	0.01	0.00	65.80	0.03	5.25	21.0	864	7.20	185		1
09-Dec-87	8.74	0.02	0.11	18.40	0.01	2.69	21.0	403	7.43	32		1

YEARLY SUMMARY:

YEAR MIN	0.40	0.00	0.00	3.60	0.00	2.69	2.7	403	6.82	26	49.0	1
YEAR MAX	8.74	0.03	7.32	65.80	0.18	8.20	36.5	1090	7.57	448	70.5	7
# ANALYSES	12	11	12	12	12	12	12	12	12	12	2	12
YEAR AVG	3.06	0.01	0.94	31.51	0.03	5.98	22.7	826	7.20	164	59.8	3
YEAR STD DEV	2.60	0.01	1.95	19.02	0.05	1.53	8.0	179	0.23	127	10.7	2

FOR SAMPLE SITE: X9 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
07-Jan-87	0.32	0.00	0.12	0.03	0.00	0.04	94.0	153	9.06	128000	504.7	10
15-Jan-87	0.89	0.09	0.06	0.09	0.14	0.02	108.0	142	9.40	192000	504.7	8
20-Jan-87	0.41	0.05	0.44	0.12	0.03	0.04	72.0	135	8.97	153000	504.7	11
28-Jan-87	0.71	0.05	0.59	0.43	0.04	0.04	43.0	1590	9.01	224000	504.7	11
MLY AVG	0.58	0.05	0.30	0.17	0.05	0.04	79.3	505	9.11	174250	504.7	10
03-Feb-87	1.26	0.00	0.21	0.07	0.26	0.00	310.0	1850	10.70	158000	504.7	12
10-Feb-87	0.52	0.00	0.04	0.03	0.01	0.03	154.0	325	9.10	164000	504.7	12
17-Feb-87	0.61	0.03	0.08	0.03	0.06	0.03	93.0	212	9.05	132000	504.7	11
24-Feb-87	0.65	0.05	0.11	0.06	0.11	0.04	105.0	226	8.98	188000	504.7	11
MLY AVG	0.76	0.02	0.11	0.05	0.11	0.03	165.5	653	9.46	160500	504.7	12
03-Mar-87	0.45	0.00	0.08	0.03	0.14	0.04	106.0	190	8.86	131000	340.7	9
10-Mar-87	0.94	0.63	0.07	0.04	0.25	0.00	119.0	1675	10.03	209000	340.7	12
17-Mar-87	0.85	0.16	0.52	0.18	0.05	0.00	66.5	1560	11.19	150000	340.7	12
24-Mar-87	1.40	0.32	0.06	0.03	0.10	0.00	276.0	550	9.66	236000	340.7	12
MLY AVG	0.91	0.28	0.18	0.07	0.14	0.01	141.9	994	9.94	181500	340.7	11
01-Apr-87	0.78		0.07	0.03	0.03	0.02	97.0	159	9.22	185000	340.7	11
07-Apr-87	0.70		0.04	0.02	0.08	0.03	111.0	265	8.79	200000	340.7	12
14-Apr-87	0.89		0.05	0.03	0.15	0.01	160.0	260	9.26	151000	340.7	11
20-Apr-87	0.78		0.06	0.04	0.73	0.00	82.0	156	9.99	72300	340.7	11
28-Apr-87	2.02		0.07	0.08	0.34	0.01	178.0	135	8.75	80000	340.7	11
MLY AVG	1.03		0.06	0.04	0.27	0.01	125.6	195	9.20	137660	340.7	11
05-May-87	0.37	0.01	0.13	0.02	0.00	0.00	12.0	40	10.92	6700	133.3	8
12-May-87	0.80	0.07	0.13	0.47	0.42	0.01	138.0	194	9.36	194000	340.6	11
19-May-87	0.95	0.01	0.06	0.02	0.03	0.00	80.0	212	8.90	178000	340.0	14
26-May-87	1.15	0.09	0.21	0.16	0.29	0.02	83.0	172	9.03	110000	340.7	13
MLY AVG	0.82	0.05	0.13	0.17	0.19	0.01	78.3	155	9.55	122175	288.7	12
04-Jun-87	0.84	0.03	0.05	0.06	0.02	0.01	135.0	184	9.06	279000	340.7	14
11-Jun-87	0.96	0.16	0.07	0.02	0.02	0.02	230.0	363	9.24	241000	340.7	14
16-Jun-87	1.59	0.55	0.13	0.02	0.90	0.03	186.0	323	8.90	242000	340.7	14
26-Jun-87	2.84	0.22	0.16	0.05	0.09	0.01	93.0	125	10.09	190000	340.7	15
30-Jun-87	0.77	0.27	0.11	0.04	0.04	0.02	140.0	124	9.42	240000	340.7	18
MLY AVG	1.40	0.25	0.10	0.04	0.21	0.02	156.8	224	9.34	238400	340.7	15
06-Jul-87	0.87	0.33	0.05	0.10	0.16	0.00	104.0	119	9.48	140000	340.7	17
13-Jul-87	1.33	0.13	0.12	0.06	0.95	0.01	116.0	173	9.46	170000	340.7	17
20-Jul-87	1.19	0.06	0.14	0.02	0.42	0.01	220.0	235	10.36	271000	340.7	18
28-Jul-87	0.94	0.21	0.11	0.02	0.03	0.00	183.0	180	9.69	150000	340.7	18
MLY AVG	1.08	0.18	0.11	0.05	0.39	0.01	155.8	177	9.75	182750	340.7	18

FOR SAMPLE SITE: X9 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
04-Aug-87	1.25	0.05	0.14	0.06	5.60	0.02	118.0	288	9.61	140000	340.7	18
11-Aug-87	2.38	1.68	0.06	0.02	11.20	0.01	202.0	390	9.42	260000	340.7	16
18-Aug-87	1.16	0.08	0.07	0.03	0.32	0.02	129.0	123	9.05	206000	340.7	18
25-Aug-87	0.77	0.21	0.23	0.06	0.14	0.00	144.0	191	9.39	180000	340.7	17
MLY AVG	1.39	0.51	0.13	0.04	4.32	0.01	148.3	248	9.37	196500	340.7	17
01-Sep-87	1.08	0.04	0.14	0.07	0.73	0.03	203.0	336	9.10	257000	340.7	15
08-Sep-87	0.58	0.97	0.20	0.10	0.50	0.02	163.0	216	9.10	269000	340.7	15
15-Sep-87	0.27	0.09	0.49	0.42	0.04	0.02	159.0	122	10.15	31300	113.7	11
21-Sep-87	0.69	0.95	0.11	0.12	0.17	0.00	80.0	151	9.41	182000	340.7	13
MLY AVG	0.66	0.51	0.24	0.18	0.36	0.02	151.3	206	9.44	184825	284.0	14
02-Oct-87	2.85	0.11	0.12	0.09	7.93	0.00	199.0	279	9.45	208000	340.0	13
06-Oct-87	0.88	2.68	1.86	0.48	0.43	0.00	83.0	48	12.22	117000	340.0	10
13-Oct-87	2.06	0.31	0.07	0.12	6.28	0.00	165.0	229	10.30	250000	340.0	9
20-Oct-87	0.80	2.06	0.05	0.02	0.10	0.00	109.0	147	9.97	310000	340.0	12
27-Oct-87	0.80	0.54	0.05	0.00	0.23	0.00	115.0	140	9.78	169000	340.0	10
MLY AVG	1.48	1.14	0.43	0.14	2.99	0.00	134.2	169	10.34	210800	340.0	11
03-Nov-87	1.26	0.40	0.06	0.01	0.09	0.00	136.0	142	9.90	235000	340.0	10
10-Nov-87	1.43	0.67	0.07	0.00	0.51	0.00	160.0	238	9.41	275000	340.0	10
17-Nov-87	1.47	0.48	0.04	0.00	2.42	0.00	137.0	346	8.50	359000	340.0	9
24-Nov-87	1.02	0.33	0.00	0.00	0.74	0.00	39.0	370	9.21	226000	340.0	9
MLY AVG	1.30	0.47	0.04	0.01	0.94	0.00	118.0	274	9.26	273750	340.0	10
01-Dec-87	1.43	0.80	0.01	0.02	0.93	0.00	93.0	129	10.16	259000	340.0	9
09-Dec-87	2.33	0.19	0.06	0.01	0.26	0.01	128.0	213	9.29	266000	340.0	9
15-Dec-87	0.76	0.03	0.05	0.04	0.77	0.06	329.0	962	9.70	227000	340.0	8
23-Dec-87	1.58	0.11	0.05	0.05	0.13	0.02	106.0	151	9.58	27500	340.0	9
30-Dec-87	0.74	0.09	0.05	0.05	0.29	0.01	113.0	240	9.16	83300	340.0	9
MLY AVG	1.37	0.24	0.04	0.03	0.48	0.02	153.8	339	9.58	172560	340.0	9

YEARLY SUMMARY:

	AMMONIA	CYANIDE	LEAD	ZINC	COPPER	MANGANESE	SODIUM	SULFATE	pH	SUSPSOLIDS	FLOWRATE	TEMP
YEAR MIN	0.27	0.00	0.00	0.00	0.00	0.00	12.0	40	8.50	6700	113.7	8
YEAR MAX	2.85	2.68	1.86	0.48	11.20	0.06	329.0	1850	12.22	359000	504.7	18
# ANALYSES	52	47	52	52	52	52	52	52	52	52	52	52
YEAR AVG	1.08	0.35	0.16	0.08	0.88	0.02	134.7	336	9.53	186579	357.4	12
YEAR STD DEV	0.58	0.54	0.27	0.11	2.11	0.01	62.0	410	0.67	72000	75.4	3

FOR SAMPLE SITE: X10 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
15-Jan-87												
10-Feb-87	0.24	0.00	0.00	0.02	0.00	0.00	1.8	19	8.06	0		3
10-Mar-87	0.03	0.02	0.00	0.00	0.00	0.00	1.9	18	8.01	0		2
07-Apr-87	0.21		0.00	0.02	0.00	0.00	1.8	16	7.97	1		3
12-May-87	0.17	0.00	0.03	0.04	0.00	0.04	0.8	3	7.72	162		0
11-Jun-87	0.07	0.00	0.01	0.02	0.00	0.02	0.1	0	8.08	4		4
13-Jul-87	0.31	0.00	0.02	0.02	0.00	0.02	1.5	6	8.21	0		9
11-Aug-87	0.37	0.00	0.01	0.03	0.00	0.02	1.5	13	8.19	0		6
08-Sep-87	0.08	0.00	0.00	0.03	0.00	0.02	2.1	9	7.80	0		2
06-Oct-87	0.05	0.00	0.00	0.02	0.00	0.02	2.1	13	8.38	1	1231.0	0
10-Nov-87	0.30	0.00	0.00	0.03	0.00	0.02	2.3	16	7.62	0		0
09-Dec-87	0.08	0.01	0.00	0.02	0.00	0.01	2.4	22	8.07	0		0

YEARLY SUMMARY:

YEAR MIN	0.03	0.00	0.00	0.00	0.00	0.00	0.1	0	7.62	0	1231.0	0
YEAR MAX	0.37	0.02	0.03	0.04	0.00	0.04	2.4	22	8.38	162	1231.0	9
# ANALYSES	11	10	11	11	11	11	11	11	11	11	1	11
YEAR AVG	0.17	0.01	0.01	0.02	0.00	0.02	1.7	12	8.01	15	1231.0	3
YEAR STD DEV	0.11	0.00	0.01	0.01	0.00	0.01	0.7	7	0.21	46	0.0	3

FOR SAMPLE SITE: X11 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
07-Jan-87	0.24	0.00	0.00	0.00	0.00	2.46	63.0	496	7.53	1	11.7	5
15-Jan-87	0.60	0.05	0.00	0.01	0.00	2.77	62.0	474	7.58	2	11.7	3
20-Jan-87	0.60	0.03	0.00	0.01	0.00	2.98	63.0	494	7.45	3	13.8	4
28-Jan-87	0.40	0.02	0.00	0.01	0.00	3.19	63.0	506	7.55	1	12.8	3
MLY AVG	0.46	0.03	0.00	0.01	0.00	2.85	62.8	493	7.53	2	12.5	4
03-Feb-87	1.32	0.04	0.00	0.00	0.00	3.22	60.0	511	7.65	2	12.8	2
10-Feb-87	0.37	0.08	0.00	0.00	0.00	3.14	62.5	526	7.52	1	13.8	4
17-Feb-87	0.18	0.09	0.00	0.00	0.00	3.53	61.0	546	7.49	1	13.8	4
24-Feb-87	0.54	0.00	0.00	0.01	0.00	3.82	65.0	555	7.44	2	13.8	3
MLY AVG	0.60	0.05	0.00	0.01	0.00	3.43	62.1	535	7.53	2	13.6	3
03-Mar-87	0.29	0.02	0.02	0.02	0.00	4.10	62.0	572	7.55	2	12.8	2
10-Mar-87	0.44	0.09	0.00	0.00	0.00	4.32	65.0	589	7.50	3	13.8	3
17-Mar-87	0.59	0.01	0.00	0.02	0.00	4.30	64.5	599	7.59	4	13.8	3
24-Mar-87	0.63	0.00	0.00	0.01	0.00	4.22	67.0	625	7.55	2	13.8	3
MLY AVG	0.49	0.03	0.01	0.01	0.00	4.24	64.6	596	7.55	3	13.6	3
01-Apr-87	0.40		0.00	0.00	0.00	4.22	68.0	621	7.68	3	16.2	3
07-Apr-87	0.91		0.00	0.00	0.00	4.80	67.0	652	7.63	5	16.2	3
14-Apr-87	0.54		0.00	0.02	0.00	4.84	69.0	677	7.46	2	15.0	3
20-Apr-87	0.65		0.00	0.00	0.00	4.98	68.0	670	7.62	3	13.8	3
28-Apr-87	0.32		0.00	0.00	0.00	5.10	69.0	678	7.42	2	11.7	2
MLY AVG	0.56		0.00	0.01	0.00	4.79	68.2	660	7.56	3	14.6	3
05-May-87	0.56		0.00	0.00	0.00	5.15	70.0	688	7.60	4	13.8	2
12-May-87	0.68		0.00	0.00	0.00	5.15	72.0	695	7.70	7	13.8	2
19-May-87	0.79		0.00	0.02	0.00	4.92	69.0	664	7.69	5	13.8	2
26-May-87	0.66		0.00	0.00	0.00	5.10	70.0	693	7.52	2	12.8	2
MLY AVG	0.67		0.00	0.01	0.00	5.08	70.3	685	7.63	5	13.6	2
04-Jun-87	0.78		0.00	0.00	0.00	5.10	70.0	670	7.47	6	13.8	3
11-Jun-87			0.00	0.02	0.00	4.40	73.0	663	7.56	5	15.0	3
16-Jun-87	0.71		0.00	0.00	0.00	4.50	71.0	653	7.63	5	15.0	3
26-Jun-87	0.84		0.00	0.00	0.01	4.68	79.0	651	7.58	5	16.2	3
30-Jun-87	0.86		0.00	0.00	0.00	4.56	74.0	624	7.50	5	16.2	3
MLY AVG	0.80		0.00	0.01	0.01	4.65	73.4	652	7.55	5	15.2	3
06-Jul-87	0.73		0.00	0.00	0.00	4.15	78.0	609	7.61	2	18.7	3
13-Jul-87	0.74		0.03	0.05	0.00	4.09	80.0	595	7.49	4	18.7	3
20-Jul-87	0.87		0.03	0.01	0.00	3.78	78.0	553	8.74	5	18.7	4
28-Jul-87	0.80		0.02	0.00	0.00	4.17	78.0	567	7.59	4	18.7	5
MLY AVG	0.79		0.02	0.02	0.00	4.05	78.5	581	7.86	4	18.7	4

FOR SAMPLE SITE: X11 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
04-Aug-87	0.97		0.04	0.02	0.00	4.30	78.0	548	7.92	2	20.0	4
11-Aug-87	0.94		0.01	0.00	0.00	3.96	80.0	513	7.59	2	20.0	5
18-Aug-87	1.11		0.03	0.02	0.00	4.10	79.0	531	7.68	3	21.2	5
25-Aug-87	0.94		0.02	0.04	0.00	4.17	79.0	538	7.75	3	21.2	6
MLY AVG	0.99		0.03	0.02	0.00	4.13	79.0	533	7.74	3	20.6	5
01-Sep-87	0.87		0.00	0.00	0.00	3.93	80.0	526	7.57	2	21.2	5
08-Sep-87	0.97		0.00	0.01	0.00	3.99	82.0	512	7.41	4	21.2	6
15-Sep-87	0.88		0.00	0.00	0.00	4.13	84.0	512	7.59	3	21.2	6
21-Sep-87	0.84		0.00	0.00	0.00	4.03	82.0	486	7.37	3	21.2	6
MLY AVG	0.89		0.00	0.01	0.00	4.02	82.0	509	7.49	3	21.2	6
02-Oct-87	1.03		0.00	0.00	0.00	4.13	85.0	495	7.62	3	21.2	7
06-Oct-87	0.84		0.00	0.00	0.00	4.11	85.0	493	7.54	3	18.7	5
13-Oct-87	0.98		0.00	0.00	0.00	4.10	85.0	499	8.00	3	21.2	6
20-Oct-87	1.05		0.00	0.00	0.00	4.17	84.0	460	7.78	3	18.7	7
27-Oct-87	0.93		0.00	0.00	0.00	4.19	83.0	459	7.84	4	18.7	6
MLY AVG	0.97		0.00	0.00	0.00	4.14	84.4	481	7.76	3	19.7	6
03-Nov-87	1.51		0.00	0.02	0.00	4.08	84.0	484	7.62	5	17.5	6
10-Nov-87	0.91		0.00	0.01	0.00	4.00	81.0	474	7.64	3	16.2	5
17-Nov-87	1.03		0.00	0.00	0.00	4.12	82.0	467	7.15	3	16.2	4
24-Nov-87	0.82		0.00	0.00	0.00	4.10	79.0	485	7.46	3	16.2	5
MLY AVG	1.07		0.00	0.01	0.00	4.08	81.5	478	7.47	4	16.5	5
01-Dec-87	0.79		0.00	0.00	0.01	4.02	79.0	471	7.62	4	16.2	4
09-Dec-87	1.33		0.00	0.01	0.00	3.90	79.0	474	7.63	4	16.2	4
15-Dec-87	1.15	0.11	0.02	0.85	0.07	4.23	65.5	697	7.78	2	16.2	3
23-Dec-87	1.12	0.12	0.10	0.04	0.00	3.49	83.0	483	8.01	1	18.7	4
30-Dec-87	1.06	0.16	0.05	0.04	0.01	3.54	81.1	480	7.67	3	18.7	3
MLY AVG	1.09	0.13	0.04	0.19	0.02	3.84	77.5	521	7.74	3	17.2	4

YEARLY SUMMARY:

YEAR MIN	0.18	0.00	0.00	0.00	0.00	2.46	60.0	459	7.15	1	11.7	2
YEAR MAX	1.51	0.16	0.10	0.85	0.07	5.15	85.0	697	8.74	7	21.2	7
# ANALYSES	51	15	52	52	52	52	52	52	52	52	52	52
YEAR AVG	0.79	0.06	0.01	0.03	0.01	4.13	73.9	562	7.62	3	16.4	4
YEAR STD DEV	0.28	0.05	0.02	0.12	0.01	0.59	7.9	78	0.22	1	3.0	1

FOR SAMPLE SITE: X12 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
07-Jan-87	0.00	0.00	0.00	0.00	0.00	0.51	33.5	281	7.69	1	7.2	3
15-Jan-87	0.37	0.00	0.00	0.00	0.00	0.60	34.5	293	7.79	2	7.2	1
20-Jan-87	0.22	0.00	0.00	0.01	0.00	0.65	35.5	322	7.64	2	7.2	2
28-Jan-87	0.46	0.00	0.00	0.00	0.00	0.62	36.0	339	7.76	2	5.5	2
MLY AVG	0.26	0.00	0.00	0.01	0.00	0.60	34.9	309	7.72	2	6.8	2
03-Feb-87	0.15	0.00	0.00	0.00	0.00	0.62	37.5	357	7.76	1	5.5	2
10-Feb-87	0.14	0.00	0.00	0.00	0.00	0.63	39.5	375	7.56	1	6.3	3
17-Feb-87	0.00	0.00	0.00	0.00	0.00	0.67	40.0	394	7.70	1	5.5	2
24-Feb-87	0.25	0.00	0.00	0.00	0.00	0.72	40.5	415	7.49	2	4.8	3
MLY AVG	0.14	0.00	0.00	0.00	0.00	0.66	39.4	385	7.63	1	5.5	3
03-Mar-87	0.00	0.00	0.03	0.02	0.00	0.76	41.5	427	7.72	1	4.2	2
10-Mar-87	0.00	0.00	0.00	0.00	0.00	0.80	42.0	449	7.73	2	4.2	2
17-Mar-87	0.09	0.00	0.00	0.01	0.00	0.83	43.0	463	7.80	2	4.8	2
24-Mar-87	0.34	0.00	0.00	0.00	0.00	0.84	45.5	481	7.75	0	4.8	3
MLY AVG	0.11	0.00	0.01	0.01	0.00	0.81	43.0	455	7.75	1	4.5	2
01-Apr-87	0.15		0.00	0.00	0.00	0.82	47.0	489	7.99	1	4.8	3
07-Apr-87	0.25		0.00	0.00	0.00	0.87	48.5	521	7.86	0	4.8	3
14-Apr-87	0.24		0.00	0.00	0.02	0.91	48.0	543	7.80	0	4.8	3
20-Apr-87	0.16		0.00	0.00	0.00	0.99	49.5	548	7.74	1	4.2	3
28-Apr-87	0.17		0.00	0.00	0.01	1.06	51.0	559	8.05	1	3.5	2
MLY AVG	0.19	ERR	0.00	0.00	0.01	0.93	48.8	532	7.89	1	4.4	3
05-May-87	0.13	0.00	0.00	0.01	0.00	1.05	47.5	544	7.77	3	4.2	2
12-May-87	0.19	0.00	0.00	0.00	0.00	0.97	49.0	564	8.08	1	5.5	3
19-May-87	0.23	0.00	0.00	0.00	0.00	1.04	47.5	542	7.77	10	5.5	4
26-May-87	0.65	0.00	0.00	0.00	0.00	1.06	52.0	605	7.67	0	4.8	4
MLY AVG	0.30	0.00	0.00	0.01	0.00	1.03	49.0	564	7.82	4	5.0	3
04-Jun-87	0.26	0.00	0.00	0.00	0.00	0.97	53.0	575	7.66	0	6.3	4
11-Jun-87	0.31	0.00	0.00	0.00	0.00	1.04	51.0	570	7.71	1	10.5	3
16-Jun-87	0.56	0.00	0.00	0.00	0.00	0.95	48.0	536	7.77	0	13.5	4
26-Jun-87	0.56	0.00	0.00	0.00	0.00	1.06	47.0	470	7.67	0	16.5	2
30-Jun-87	0.26	0.00	0.00	0.00	0.00	1.05	45.0	413	7.68	1	17.5	4
MLY AVG	0.39	0.00	0.00	0.00	0.00	1.01	48.8	513	7.70	0	12.9	3
06-Jul-87	0.26	0.00	0.00	0.00	0.00	1.02	39.5	328	7.91	0		2
13-Jul-87	0.29	0.00	0.02	0.00	0.00	0.95	37.0	295	7.65	0	11.0	3
20-Jul-87	0.31	0.00	0.06	0.00	0.00	0.91	34.0	253	8.97	2	10.3	3
28-Jul-87	0.45	0.00	0.02	0.00	0.00	0.85	34.5	253	7.79	0	11.0	3
MLY AVG	0.33	0.00	0.03	0.00	0.00	0.93	36.3	282	8.08	1	10.8	3

FOR SAMPLE SITE: X12 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
04-Aug-87	0.66	0.00	0.04	0.01	0.00	0.88	33.5	234	7.89	0	11.0	3
11-Aug-87	0.45	0.00	0.02	0.00	0.00	0.90	32.5	216	7.87	0	11.0	2
18-Aug-87	0.62	0.00	0.01	0.06	0.00	1.02	36.0	239	7.67	0	11.0	3
25-Aug-87	0.44	0.00	0.01	0.00	0.00	1.14	37.5	246	7.79	1	11.0	3
MLY AVG	0.54	0.00	0.02	0.02	0.00	0.99	34.9	234	7.81	0	11.0	3
01-Sep-87	0.27	0.00	0.00	0.00	0.00	1.20	41.0	240	7.85	0	11.0	3
08-Sep-87	0.35	0.02	0.00	0.00	0.00	1.25	38.0	239	7.58	0	11.0	3
15-Sep-87	0.60	0.00	0.00	0.00	0.00	1.22	37.0	224	7.62	0	10.3	3
21-Sep-87	0.26	0.00	0.00	0.00	0.00	1.31	38.0	233	7.51	0	11.0	3
MLY AVG	0.37	0.01	0.00	0.00	0.00	1.25	38.5	234	7.64	0	10.8	3
02-Oct-87	0.20	0.00	0.00	0.00	0.00	1.28	39.0	251	7.62	1	9.7	5
06-Oct-87	0.22	0.00	0.00	0.00	0.00	1.30	39.0	247	7.74	1	9.7	2
13-Oct-87	0.25	0.00	0.00	0.00	0.00	1.32	40.0	233	8.10	0	9.7	2
20-Oct-87	0.35	0.00	0.00	0.00	0.00	1.32	41.0	251	8.04	0	8.3	3
27-Oct-87	0.25	0.00	0.00	0.00	0.00	1.21	41.0	253	8.74	0	8.3	3
MLY AVG	0.25	0.00	0.00	0.00	0.00	1.29	40.0	247	8.05	0	9.1	3
03-Nov-87	0.40	0.00	0.00	0.00	0.00	1.13	41.0	223	7.67	0	8.3	2
10-Nov-87	0.35	0.00	0.00	0.00	0.00	1.01	39.0	217	7.61	0	7.0	3
17-Nov-87	0.19	0.00	0.00	0.00	0.00	1.10	41.0	252	7.21	0	7.0	2
24-Nov-87	0.33	0.00	0.00	0.00	0.00	1.00	40.5	258	7.64	0	7.0	3
MLY AVG	0.32	0.00	0.00	0.00	0.00	1.06	40.4	238	7.53	0	7.3	3
01-Dec-87	0.23	0.00	0.00	0.00	0.00	1.08	40.0	275	7.88	0	7.0	2
09-Dec-87	0.11	0.01	0.00	0.01	0.00	0.96	42.0	268	7.75	0	7.0	2
15-Dec-87	0.14	0.00	0.02	0.00	0.06	0.93	40.7	230	7.67	1	7.0	3
23-Dec-87	0.22	0.00	0.05	0.04	0.00	0.92	39.1	297	8.17	0	7.0	2
30-Dec-87	0.26	0.00	0.05	0.04	0.01	0.86	32.8	300	7.84	0	7.0	1
MLY AVG	0.19	0.01	0.03	0.02	0.02	0.95	38.9	274	7.86	0	7.0	2

YEARLY SUMMARY:

YEAR MIN	0.00	0.00	0.00	0.00	0.00	0.51	32.5	216	7.21	0	3.5	1
YEAR MAX	0.66	0.02	0.06	0.06	0.06	1.32	53.0	605	8.97	10	17.5	5
# ANALYSES	52	47	52	52	52	52	52	52	52	52	51	52
YEAR AVG	0.28	0.01	0.01	0.01	0.01	0.96	41.3	358	7.80	1	7.9	3
YEAR STD DEV	0.16	0.00	0.01	0.01	0.01	0.20	5.4	126	0.27	2	3.1	1

FOR SAMPLE SITE: X13 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
07-Jan-87	0.00	0.02	0.00	0.02	0.00	2.42	55.0	434	7.51	1	97.3	5
15-Jan-87	0.47	0.03	0.00	0.02	0.00	2.66	58.0	441	7.69	1	97.3	2
20-Jan-87	0.20	0.02	0.00	0.02	0.00	2.76	59.0	461	7.52	2	97.3	3
28-Jan-87	0.37	0.04	0.00	0.01	0.00	2.90	60.0	450	7.54	2	97.3	3
MLY AVG	0.26	0.03	0.00	0.02	0.00	2.69	58.0	447	7.57	2	97.3	3
03-Feb-87	0.30	0.04	0.00	0.01	0.00	2.96	57.5	481	7.51	2	97.3	2
10-Feb-87	0.19	0.02	0.00	0.00	0.00	2.81	59.5	475	7.42	2	104.0	3
17-Feb-87	0.00	0.02	0.00	0.01	0.00	3.12	58.0	501	7.46	1	97.3	3
24-Feb-87	0.33	0.05	0.00	0.01	0.00	3.32	61.0	515	7.49	4	97.3	3
MLY AVG	0.21	0.03	0.00	0.01	0.00	3.05	59.0	493	7.47	2	99.0	3
03-Mar-87	0.05	0.00	0.03	0.02	0.00	3.30	60.5	511	7.56	2	97.3	1
10-Mar-87	0.26	0.09	0.00	0.00	0.00	3.53	61.0	549	7.51	2	97.3	2
17-Mar-87	0.57	0.00	0.00	0.01	0.00	3.58	63.0	553	7.59	2	97.3	3
24-Mar-87	0.69	0.00	0.00	0.00	0.00	3.63	64.0	570	7.56	1	97.3	4
MLY AVG	0.39	0.03	0.01	0.01	0.00	3.51	62.1	546	7.56	2	97.3	3
01-Apr-87	0.30		0.00	0.00	0.00	3.72	65.0	556	8.03	2	104.5	3
07-Apr-87	0.83		0.00	0.00	0.00	4.69	67.0	608	7.53	1	104.5	4
14-Apr-87	0.25		0.00	0.02	0.01	4.00	67.0	616	7.52	2	97.3	3
20-Apr-87	0.44		0.00	0.00	0.00	4.10	67.0	621	7.54	1	90.5	3
28-Apr-87	0.30		0.00	0.02	0.00	4.20	67.0	637	7.80	2	93.8	2
MLY AVG	0.42		0.00	0.01	0.01	4.14	66.6	608	7.68	2	98.1	3
05-May-87	0.38		0.00	0.01	0.00	4.50	67.0	636	7.66	4	90.5	2
12-May-87	0.41		0.00	0.00	0.00	4.26	67.0	656	7.86	3	93.8	3
19-May-87	0.45		0.00	0.01	0.01	4.06	68.5	623	7.58	3	93.8	4
26-May-87	0.55		0.00	0.00	0.00	4.25	68.0	667	7.47	2	90.5	3
MLY AVG	0.45		0.00	0.01	0.01	4.27	67.6	646	7.64	3	92.2	3
04-Jun-87	0.45		0.00	0.00	0.00	4.20	70.0	655	7.49	3	97.3	3
11-Jun-87	0.51		0.00	0.00	0.00	3.85	69.0	657	7.53	2	101.0	3
16-Jun-87	0.46		0.00	0.00	0.00	3.60	67.0	654	7.53	2	104.5	4
26-Jun-87	0.53		0.00	0.00	0.00	3.82	69.0	637	7.59	2	108.2	3
30-Jun-87	0.47		0.00	0.02	0.00	3.98	69.0	631	7.56	3	111.8	5
MLY AVG	0.48		0.00	0.01	0.00	3.89	68.8	647	7.54	2	104.6	4
06-Jul-87	0.47		0.00	0.01	0.00	3.72	67.0	604	7.91	2	119.5	3
13-Jul-87	0.47		0.02	0.03	0.00	3.93	68.0	537	7.47	3	123.7	3
20-Jul-87	0.53		0.03	0.01	0.00	3.05	60.0	488	8.78	2	119.5	3
28-Jul-87	0.57		0.02	0.01	0.00	3.72	67.5	540	7.67	2	119.5	4
MLY AVG	0.51		0.02	0.02	0.00	3.61	65.6	542	7.96	2	120.6	3

FOR SAMPLE SITE: X13 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
04-Aug-87	0.68		0.05	0.02	0.00	3.63	66.0	542	7.68	2	127.7	3
11-Aug-87	0.74		0.02	0.00	0.00	3.33	63.0	488	7.83	2	127.7	3
18-Aug-87	0.80		0.01	0.00	0.00	3.73	70.0	512	7.56	2	127.7	3
25-Aug-87	0.70		0.02	0.02	0.00	3.80	70.0	523	7.70	2	127.7	5
MLY AVG	0.73		0.03	0.01	0.00	3.62	67.3	516	7.69	2	127.7	4
01-Sep-87	0.71		0.00	0.00	0.00	3.69	70.0	533	7.60	3	127.7	4
08-Sep-87	0.97		0.00	0.02	0.00	3.66	70.0	512	7.39	3	127.7	5
15-Sep-87	0.70		0.00	0.01	0.00	3.67	71.0	517	7.50	4	127.7	4
21-Sep-87	0.65		0.00	0.00	0.00	3.73	72.0	487	7.61	2	127.7	4
MLY AVG	0.76		0.00	0.01	0.00	3.69	70.8	512	7.53	3	127.7	4
02-Oct-87	0.69		0.00	0.00	0.00	3.88	72.0	526	7.57	1	119.5	5
06-Oct-87	0.56		0.00	0.00	0.00	3.71	72.0	504	7.68	4	119.5	4
13-Oct-87	0.74		0.00	0.01	0.00	3.68	72.0	520	7.90	2	119.5	3
20-Oct-87	0.75		0.00	0.00	0.00	3.73	74.0	499	7.73	3	119.5	5
27-Oct-87	0.70		0.00	0.00	0.00	3.73	74.0	484	8.51	2	116.2	4
MLY AVG	0.69		0.00	0.01	0.00	3.75	72.8	507	7.88	2	118.8	4
03-Nov-87	0.74		0.00	0.00	0.00	3.42	70.0	492	7.59	4	116.2	4
10-Nov-87	0.65		0.00	0.01	0.00	3.85	75.0	495	7.63	2	108.2	4
17-Nov-87	0.63		0.00	0.00	0.00	3.63	72.0	475	7.23	2	104.5	3
24-Nov-87	0.75		0.00	0.00	0.00	3.69	75.0	480	7.48	3	104.6	4
MLY AVG	0.69		0.00	0.01	0.00	3.65	73.0	486	7.48	3	108.4	4
01-Dec-87	0.68		0.00	0.01	0.00	3.67	74.0	467	7.88	3	104.5	4
09-Dec-87	0.53		0.00	0.01	0.00	3.79	76.0	469	7.68	2	104.5	3
15-Dec-87	0.67	0.10	0.01	0.02	0.09	3.84	53.1	490	7.66	3	111.8	3
23-Dec-87	0.73	0.15	0.05	0.07	0.00	3.22	82.0	483	8.15	1	111.8	3
30-Dec-87	0.72	0.12	0.05	0.04	0.00	3.14	80.2	625	7.80	2	104.5	3
MLY AVG	0.67	0.12	0.02	0.03	0.02	3.53	73.1	507	7.83	2	107.4	3

YEARLY SUMMARY:

	AMMONIA	CYANIDE	LEAD	ZINC	COPPER	MANGANESE	SODIUM	SULFATE	pH	SUSPSOLIDS	FLOWRATE	TEMP
YEAR MIN	0.00	0.00	0.00	0.00	0.00	2.42	53.1	434	7.23	1	90.5	1
YEAR MAX	0.97	0.15	0.05	0.07	0.09	4.69	82.0	667	8.78	4	127.7	5
# ANALYSES	52	15	52	52	52	52	52	52	52	52	52	52
YEAR AVG	0.52	0.05	0.01	0.01	0.01	3.63	67.3	540	7.66	2	108.2	3
YEAR STD DEV	0.21	0.04	0.01	0.01	0.01	0.45	6.1	67	0.26	1	12.1	1

FOR SAMPLE SITE: X14 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
15-Jan-87	0.29	0.00	0.05	0.09	0.04	1.23	63.0	567	7.67	2		2
10-Feb-87	0.00	0.00	0.02	0.07	0.02	19.10	57.0	549	7.60	1		1
10-Mar-87	0.44	0.02	0.03	0.08	0.02	2.08	63.0	646	7.65	1		1
07-Apr-87	0.67		0.03	0.06	0.04	1.81	82.0	762	7.93	1		2
12-May-87	0.18	0.00	0.03	0.05	0.00	0.36	14.5	108	7.65	99		2
11-Jun-87	0.28	0.00	0.02	0.03	0.00	0.33	9.7	71	7.85	5		4
13-Jul-87	0.50	0.03	0.06	0.06	0.00	0.62	25.0	123	8.00	1		10
11-Aug-87	0.61	0.02	0.06	0.07	0.01	0.70	33.0	131	7.99	0		8
08-Sep-87	0.76	0.02	0.03	0.06	0.01	0.49	28.0	109	7.99	1		3
06-Oct-87	0.37	0.06	0.05	0.11	0.04	0.82	43.0	184	8.21	1	2003.0	1
10-Nov-87	0.50	0.04	0.05	0.12	0.02	1.06	49.0	229	7.85	2		1
09-Dec-87	0.52	0.07	0.07	0.11	0.07	1.68	66.0	329	7.86	2		1

YEARLY SUMMARY:

YEAR MIN	0.00	0.00	0.02	0.03	0.00	0.33	9.7	71	7.60	0	2003.0	1
YEAR MAX	0.76	0.07	0.07	0.12	0.07	19.10	82.0	762	8.21	99	2003.0	10
# ANALYSES	12	11	12	12	12	12	12	12	12	12	1	12
YEAR AVG	0.43	0.03	0.04	0.08	0.02	2.52	44.4	317	7.85	10	2003.0	3
YEAR STD DEV	0.21	0.02	0.02	0.03	0.02	5.03	21.7	236	0.18	27	0.0	3

FOR SAMPLE SITE: X22 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
07-Jan-87	0.18	0.01	0.03	37.20	0.00	2.86	16.0	532	7.26	4	128.8	2
15-Jan-87	0.29	0.00	0.02	31.60	0.00	2.49	15.0	487	6.97	5	128.8	1
20-Jan-87											0.0	
28-Jan-87											0.0	
MLY AVG	0.24	0.01	0.03	34.40	0.00	2.68	15.5	510	7.12	5	64.4	2
03-Feb-87	1.65	0.00	0.04	20.20	0.00	1.68	13.5	391	7.09	16	45.5	1
10-Feb-87	1.33	0.00	0.05	17.30	0.00	1.99	15.0	399	6.95	22	45.5	2
17-Feb-87	4.97	0.00	0.08	14.00	0.00	1.63	14.1	352	7.22	25	91.0	1
24-Feb-87											0.0	
MLY AVG	2.65	0.00	0.06	17.17	0.00	1.77	14.2	381	7.09	21	45.5	1
03-Mar-87											0.0	
10-Mar-87	6.26	0.01	0.23	6.25	0.00	0.67	15.7	259	7.40	13	45.5	2
17-Mar-87											0.0	
24-Mar-87	11.60	0.05	0.10	1.28	0.00	0.54	22.3	279	7.21	324	45.5	4
MLY AVG	8.93	0.03	0.17	3.77	0.00	0.61	19.0	269	7.31	169	22.8	3
01-Apr-87	6.38		0.49	10.70	0.02	1.22	16.0	351	7.55	216	45.5	3
07-Apr-87											0.0	
14-Apr-87											0.0	
20-Apr-87	0.77		0.10	26.00	0.01	1.60	9.0	398	7.37	8	45.5	3
28-Apr-87											0.0	
MLY AVG	3.58		0.30	18.35	0.02	1.41	12.5	375	7.46	112	18.2	3
05-May-87	16.30	0.01	0.26	69.00	0.05	4.25	16.5	642	7.22	57	45.5	4
12-May-87	3.54	0.00	0.13	87.00	0.11	5.45	15.4	677	7.61	48	45.5	4
19-May-87	7.21	0.01	0.06	3.26	0.06	5.20	14.5	656	6.68	1670	45.5	4
26-May-87	4.44	0.00	0.15	56.20	0.05	4.20	11.9	609	6.96	38	45.5	5
MLY AVG	7.87	0.01	0.15	53.87	0.07	4.78	14.6	646	7.12	453	45.5	4
04-Jun-87	1.87	0.00	0.04	43.80	0.01	2.70	14.8	426	7.19	82	91.0	5
11-Jun-87	2.67	0.01	0.45	32.20	0.01	2.06	19.1	449	7.23	101	91.0	6
16-Jun-87	2.60	0.02	0.10	110.50	0.93	8.30	38.5	1485	6.95	113	36.3	6
26-Jun-87	1.10	0.00	0.02	26.50	0.00	1.71	13.4	325	7.48	57	127.3	5
30-Jun-87	9.39	0.00	0.13	17.50	0.00	1.27	24.0	351	7.07	24	127.3	10
MLY AVG	3.53	0.01	0.15	46.10	0.19	3.21	22.0	607	7.18	75	94.6	6
06-Jul-87	4.45	0.02	0.06	20.30	0.00	1.50	24.0	344	7.41	17	91.0	8
13-Jul-87	3.33	0.00	0.23	22.20	0.01	1.60	22.5	391	7.03	42	91.0	7
20-Jul-87	2.61	0.00	0.11	23.00	0.00	1.64	24.5	380	7.10	15	81.8	9
28-Jul-87	0.19	0.00	0.02	4.14	0.00	0.02	3.6	201	7.91	1	22.8	8
MLY AVG	2.65	0.01	0.11	17.41	0.01	1.19	18.7	329	7.36	19	71.7	8

FOR SAMPLE SITE: X22 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
04-Aug-87	2.78	0.01	0.12	25.50	0.00	2.30	37.0	491	7.68	8	81.8	9
11-Aug-87	9.81	0.07	0.05	26.60	0.00	2.20	37.5	450	7.56	2	91.0	7
18-Aug-87	4.64	0.00	0.05	25.70	0.00	1.98	37.5	430	7.29	9	110.7	7
25-Aug-87	0.18	0.00	0.02	4.31	0.00	0.02	3.2	187	7.92	11	81.8	10
MLY AVG	4.35	0.02	0.06	20.53	0.00	1.63	28.8	390	7.61	8	91.3	8
01-Sep-87	3.40	0.00	0.07	38.30	0.00	3.24	44.0	588	7.26	7	97.0	6
08-Sep-87	0.18	0.08	0.01	4.69	0.00	0.02	3.8	182	7.47	2	51.7	5
15-Sep-87	0.00	0.00	0.00	5.26	0.00	0.07	3.8	202	7.45	7	51.7	2
21-Sep-87	0.25	0.00	0.00	5.70	0.00	0.06	3.8	204	7.41	1	51.7	3
MLY AVG	0.96	0.02	0.02	13.49	0.00	0.85	13.9	294	7.40	4	63.0	4
02-Oct-87	4.98	0.01	0.10	31.70	0.00	2.53	43.5	539	6.98	7	97.0	7
06-Oct-87	6.75	0.01	0.22	41.60	0.00	3.29	47.5	616	7.19	10		5
13-Oct-87	5.92	0.00	0.20	26.40	0.01	2.29	39.0	505	7.50	26	119.8	4
20-Oct-87	2.54	0.01	0.06	37.40	0.00	2.20	25.5	479	7.50	15		4
27-Oct-87	2.27	0.00	0.09	38.88	0.01	2.02	22.0	426	7.70	16	81.8	3
MLY AVG	4.49	0.01	0.13	35.20	0.01	2.47	35.5	513	7.37	15	99.5	5
03-Nov-87	1.81	0.00	0.06	26.70	0.01	1.34	15.5	353	7.02	17	81.8	2
10-Nov-87	6.45	0.03	0.05	31.80	0.01	1.54	18.5	359	7.45	48	81.8	3
17-Nov-87	4.44	0.03	0.14	22.00	0.01	1.18	18.0	345	6.92	28	81.8	1
24-Nov-87	0.64	0.01	0.06	23.00	0.00	0.80	6.8	253	7.13	11	81.8	2
MLY AVG	3.34	0.02	0.08	25.88	0.01	1.22	14.7	328	7.13	26	81.8	2
01-Dec-87	8.99	0.04	0.18	19.90	0.01	1.08	16.5	314	7.37	26		2
09-Dec-87	11.90	0.03	0.07	18.00	0.01	0.95	20.0	298	7.22	25		3
15-Dec-87	1.52	0.00	0.03	19.90	0.11	0.79	3.8	385	6.98	19		1
23-Dec-87	5.16	0.00	0.25	42.00	0.01	8.35	33.5	1110	6.94	22		3
30-Dec-87	9.71	0.00	0.40	38.50	0.03	5.78	31.8	1020	6.88	89		1
MLY AVG	7.46	0.02	0.19	27.66	0.03	3.39	21.1	625	7.08	36		2
YEARLY SUMMARY:												
YEAR MIN	0.00	0.00	0.00	1.28	0.00	0.02	3.2	182	6.68	1	0.0	1
YEAR MAX	16.30	0.08	0.49	110.50	0.93	8.35	47.5	1485	7.92	1670	128.8	10
# ANALYSES	44	42	44	44	44	44	44	44	44	44	45	44
YEAR AVG	4.26	0.01	0.12	28.04	0.04	2.24	20.3	457	7.27	75	62.4	4
YEAR STD DEV	3.71	0.02	0.11	21.14	0.14	1.91	11.9	245	0.28	250	39.4	3

FOR SAMPLE SITE: X23 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
07-Jan-87	0.25	0.01	0.03	37.50	0.02	8.31	29.0	1190	7.26	5		4
15-Jan-87	0.77	0.00	0.00	31.30	0.02	11.30	34.0	1250	6.97	2		1
20-Jan-87	0.56	0.01	0.00	31.00	0.02	8.95	29.5	1055	6.77	2		3
28-Jan-87	0.56	0.00	0.02	26.50	0.02	9.18	29.0	1115	7.00	3		2
MLY AVG	0.54	0.01	0.01	31.58	0.02	9.44	30.4	1153	7.00	3		3
03-Feb-87	0.55	0.00	0.01	22.10	0.01	7.33	24.5	1010	7.01	3		3
10-Feb-87	0.56	0.00	0.01	29.60	0.00	10.30	33.5	1145	6.96	2		2
17-Feb-87	5.56	0.01	0.02	12.00	0.00	2.60	16.4	547	6.95	2		3
24-Feb-87	1.76	0.01	0.02	14.00	0.01	3.80	16.9	641	6.77	4		3
MLY AVG	2.11	0.01	0.02	19.43	0.01	6.01	22.8	836	6.92	3		3
03-Mar-87	0.58	0.00	0.02	13.80	0.10	4.02	15.5	644	7.34	3		1
10-Mar-87	3.23	0.02	0.00	10.30	0.00	2.88	17.3	522	7.31	2		1
17-Mar-87	1.47	0.01	0.00	16.60	0.00	6.87	22.5	837	7.16	10		4
24-Mar-87	4.26	0.00	0.03	8.50	0.00	1.98	14.4	415	7.07	4		4
MLY AVG	2.39	0.01	0.01	12.30	0.03	3.94	17.4	605	7.22	5		3
01-Apr-87	9.80		0.05	9.40	0.01	2.31	19.8	487	7.57	14		2
07-Apr-87	4.46		0.02	11.40	0.07	3.45	15.4	546	7.03	5		
14-Apr-87	7.90		0.05	19.80	0.02	3.86	20.0	605	6.83	4		2
20-Apr-87	5.62		0.04	20.40	0.02	3.40	18.0	559	6.88	4		3
28-Apr-87	2.46		0.08	20.60	0.04	8.60	16.5	566	7.46	3		2
MLY AVG	6.05		0.05	16.32	0.03	4.32	17.9	553	7.15	6		2
05-May-87	13.30	0.02	0.13	40.00	0.02	4.70	18.7	782	7.36	13		3
12-May-87	7.36	0.02	0.09	44.90	0.01	5.05	20.0	784	7.52	13		2
19-May-87	8.50	0.01	0.20	37.40	0.04	4.56	19.5	749	6.74	148		3
26-May-87	3.32	0.00	0.10	37.30	0.01	4.63	14.7	738	6.77	11		4
MLY AVG	8.12	0.01	0.13	39.90	0.02	4.74	18.2	763	7.10	46		3
04-Jun-87	1.89	0.00	0.03	25.10	0.00	4.74	19.6	748	7.14	6		5
11-Jun-87	1.39	0.00	0.05	21.80	0.01	4.75	22.0	796	7.00	3		3
16-Jun-87	1.90	0.00	0.13	35.80	0.03	5.20	27.0	1040	6.11	38		4
26-Jun-87	1.26	0.00	0.01	32.40	0.00	10.70	33.5	1400	7.05	2		3
30-Jun-87	0.95	0.00	0.01	30.80	0.01	11.50	33.5	1385	6.88	2		5
MLY AVG	1.48	0.00	0.05	29.18	0.01	7.38	27.1	1074	6.84	10		4
06-Jul-87	0.78	0.00	0.01	28.40	0.01	10.60	34.5	1380	7.31	1		5
13-Jul-87	0.81	0.00	0.03	28.00	0.01	11.95	36.0	1440	7.13	2		4
20-Jul-87	0.79	0.00	0.03	28.60	0.00	11.70	37.0	1410	8.40	2		5
28-Jul-87	0.75	0.00	0.03	27.90	0.00	12.25	37.5	1470	7.16	1		5
MLY AVG	0.78	0.00	0.03	28.23	0.01	11.63	36.3	1425	7.50	2		5

FOR SAMPLE SITE: X23 FARO MINESITE

DATE OF SAMPLE	AMMONIA (mg/l)	CYANIDE (mg/l)	LEAD (mg/l)	ZINC (mg/l)	COPPER (mg/l)	MANGANESE (mg/l)	SODIUM (mg/l)	SULFATE (mg/l)	pH	SUSPSOLIDS (mg/l)	FLOWRATE (l/s)	TEMP (deg C)
04-Aug-87	0.95	0.00	0.05	26.10	0.00	11.00	34.0	1385	7.10	3		3
11-Aug-87	0.97	0.00	0.02	24.70	0.00	9.95	34.0	1360	7.12	1		3
18-Aug-87	0.89	0.00	0.02	26.50	0.00	11.25	39.0	1435	7.06	1		3
25-Aug-87	0.76	0.02	0.05	28.70	0.01	11.85	41.5	1510	7.08	3		4
MLY AVG	0.89	0.01	0.04	26.50	0.01	11.01	37.1	1423	7.09	2		3
01-Sep-87	0.83	0.02	0.01	27.90	0.00	11.50	41.5	1505	7.08	1		3
08-Sep-87	0.70	0.01	0.01	27.00	0.00	12.15	41.0	1505	6.94	2		3
15-Sep-87	0.67	0.00	0.01	26.60	0.00	12.35	42.0	1510	6.87	3		3
21-Sep-87	0.84	0.00	0.00	26.50	0.00	12.45	42.0	1485	7.06	1		3
MLY AVG	0.76	0.01	0.01	27.00	0.00	12.11	41.6	1501	6.99	2		3
02-Oct-87	0.63	0.00	0.00	25.10	0.00	12.70	41.5	1470	7.00	2		3
06-Oct-87	0.67	0.03	0.00	25.50	0.00	15.30	42.0	1500	7.32	1		2
13-Oct-87	0.76	0.00	0.01	24.90	0.00	12.70	41.5	1500	7.40	1		3
20-Oct-87	0.78	0.01	0.00	24.70	0.00	13.15	42.0	1485	7.63	2		3
27-Oct-87	0.78	0.02	0.00	24.50	0.00	13.00	42.0	1480	7.91	3		3
MLY AVG	0.72	0.01	0.01	24.94	0.00	13.37	41.8	1487	7.45	2		3
03-Nov-87	0.74	0.00	0.00	24.10	0.00	12.75	43.0	1490	7.39	2		2
10-Nov-87	1.29	0.00	0.00	23.50	0.00	13.10	42.0	1480	7.50	1		3
17-Nov-87	0.76	0.00	0.00	21.90	0.00	13.00	40.5	1470	7.07	3		1
24-Nov-87	0.85	0.00	0.00	22.20	0.00	13.15	40.5	1350	7.24	2		2
MLY AVG	0.91	0.00	0.00	22.93	0.00	13.00	41.5	1448	7.30	2		2
01-Dec-87	0.80	0.01	0.01	20.90	0.01	13.00	39.5	1465	7.26	2		2
09-Dec-87	0.50	0.00	0.01	19.60	0.01	12.75	40.5	1455	7.35	3		3
15-Dec-87	0.85	0.01	0.12	27.60	0.11	13.00	34.3	1830	7.64	3		1
23-Dec-87	0.78	0.00	0.15	37.50	0.02	12.80	33.3	1550	7.78	0	0.0	2
30-Dec-87	0.61	0.00	0.15	27.50	0.02	12.60	28.7	1740	7.33	5		2
MLY AVG	0.71	0.01	0.09	26.62	0.03	12.83	35.3	1608	7.47	3	0.0	2
YEARLY SUMMARY:												
YEAR MIN	0.25	0.00	0.00	8.50	0.00	1.98	14.4	415	6.11	0	0.0	1
YEAR MAX	13.30	0.03	0.20	44.90	0.11	15.30	43.0	1830	8.40	148	0.0	5
# ANALYSES	52	47	52	52	52	52	52	52	52	52	1	51
YEAR AVG	2.13	0.01	0.04	25.32	0.02	9.17	30.6	1158	7.17	7	0.0	3
YEAR STD DEV	2.74	0.01	0.05	7.82	0.02	3.88	9.8	391	0.35	21	0.0	1

APPENDIX 2

BIOASSAY RESULTS

CURRAGH RESOURCES

2-41-100-077-87003

96-h STATIC LC50 BIOASSAY RESULTS OF
X5

SAMPLE TAKEN: ~~UNKNOWN~~ Apr 28
SAMPLE RECEIVED: May 1, 1987
TEST STARTED: May 4, 1987

SAMPLE pH 7.2
SAMPLE D.O. 7.4 mg/l
SAMPLE CONDUCTANCE 1000 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	7.2	7.5	9.4	9.6	100.0	100	100	60	60
CONTROL	6.1	6.2	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 0.22 +/- 0.03 g Length 3.2 +/- 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 100 ug/l (90, 110) and 100 ug/l (70, 110)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/l)	0.8
EDTA hardness (mg CaCO3/l)	4.3
Total suspended solids (mg/l)	2.9
Residual chlorine (mg/l)	0.001
Conductance (umho/cm)	23

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

SB

CURRAGH RESOURCES

2-41-100-077-87004

96-h STATIC LC50 BIOASSAY RESULTS OF
X13

SAMPLE TAKEN:	~~UNKNOWN~~ Apr 28	SAMPLE pH	7.3
SAMPLE RECEIVED:	May 1, 1987	SAMPLE D.O.	6.2 mg/l
TEST STARTED:	May 4, 1987	SAMPLE CONDUCTANCE	1300 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	7.3	7.5	9.4	9.6	100.0	100	100	100	100
CONTROL	6.1	6.2	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 temperature (C)	15.0
Test volume (liters)	10.0	Test solution pH not adjusted	

TEST FISH

Juvenile Rainbow Trout (Salmo gairdneri)
Acclimated to temperature 15.0 +/- 1 C.
Weight 0.22 +/- 0.03 g Length 3.2 +/- 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 100 ug/l (90, 110) and 100 ug/l (70, 110)

DILUTION WATER (Vancouver dechlorinated tap water)

Alkalinity (mg CaCO3/l)	0.8
EDTA hardness (mg CaCO3/l)	4.3
Total suspended solids (mg/l)	2.9
Residual chlorine (mg/l)	0.001
Conductance (umho/cm)	23

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

CURRAGH RESOURCES

2-41-100-077-87007

96-h STATIC LC50 BIOASSAY RESULTS OF
X5

SAMPLE TAKEN: ~~UNKNOWN~~ 31/7/87 DW
SAMPLE RECEIVED: Aug 5, 1987
TEST STARTED: Aug 6, 1987

SAMPLE pH 7.8
SAMPLE D.O. 8.5 mg/l
SAMPLE CONDUCTANCE 500 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	7.9	9.6	9.6	100.0	100	100	100	100
CONTROL	6.1	6.3	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) 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 0.25 +/- 0.03 g Length 3.2 +/- 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 85.9 ug/l (81.9, 89.7) 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)	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 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

CURRAGH RESOURCES

Z-41-100-077-87008

96-h STATIC LC50 BIOASSAY RESULTS OF
X5

SAMPLE TAKEN: UNKNOWN
SAMPLE RECEIVED: Sep 25, 1987
TEST STARTED: Sep 26, 1987

SAMPLE pH 7.0
SAMPLE D.O. 7.6 mg/l
SAMPLE CONDUCTANCE 600 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	8.0	8.0	9.0	9.6	100.0	100	100	100	80
CONTROL	7.0	7.2	9.4	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)	15

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

CURRAGH RESOURCES

2-41-100-077-87009

96-h STATIC LC50 BIOASSAY RESULTS OF
X13

SAMPLE TAKEN:	UNKNOWN	SAMPLE pH	7.0
SAMPLE RECEIVED:	Sep 25, 1987	SAMPLE D.O.	6.2 mg/l
TEST STARTED:	Sep 25, 1987	SAMPLE CONDUCTANCE	600 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	8.0	8.3	9.6	9.6	100.0	100	100	100	100
CONTROL	7.0	7.2	9.4	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 temperature (C)	15.0
Test volume (liters)	10.0	Test solution pH not adjusted	

TEST FISH

Juvenile Rainbow Trout (Salmo gairdneri)
Acclimated to temperature 15.0 +/- 1 C.
Weight 0.60 +/- 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)	15

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

JB

CURRAGH RESOURCES

2-41-100-077-87010

96-h STATIC LC50 BIOASSAY RESULTS OF
X6

SAMPLE TAKEN: UNKNOWN
SAMPLE RECEIVED: Nov 30, 1987
TEST STARTED: Dec 1, 1987

SAMPLE pH 7.6
SAMPLE D.O. 8.8 mg/l
SAMPLE CONDUCTANCE 550 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	7.6	7.5	9.4	9.4	100.0	100	100	100	100
CONTROL	6.1	6.2	9.8	10.2		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)	15

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

CURRAGH RESOURCES

2-41-100-077-87011

96-h STATIC LC50 BIOASSAY RESULTS OF
X5

SAMPLE TAKEN: UNKNOWN
SAMPLE RECEIVED: Dec 18, 1987
TEST STARTED: Dec 19, 1987

SAMPLE pH 7.8
SAMPLE D.O. 8.4 mg/l
SAMPLE CONDUCTANCE 650 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	8.0	8.3	10.0	9.8	100.0	100	100	80	70
CONTROL	6.1	6.5	10.0	9.8		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 0.49 +/- 0.1 g Length 3.8 +/- 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 88.3 ug/l (83.7, 92.7) and 86.7 ug/l (80.0, 100.0)

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 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

CURRAGH RESOURCES

2-41-100-077-87012

96-h STATIC LC50 BIOASSAY RESULTS OF
X 13

SAMPLE TAKEN: UNKNOWN
SAMPLE RECEIVED: Dec 18, 1987
TEST STARTED: Dec 19, 1987

SAMPLE pH 7.4
SAMPLE D.O. 5.7 mg/l
SAMPLE CONDUCTANCE 1700 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	7.9	8.2	9.6	9.6	100.0	100	100	100	100
CONTROL	6.1	6.5	10.0	9.8		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)	15

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

APPENDIX 3

GROUNDWATER MONITORING PROGRAM RESULTS

A. LICENCE GROUNDWATER SAMPLE SITES

SITE	LOCATION	DATE	PH	CU mg/L	PB mg/L	ZN mg/L	MN mg/L	NA mg/L	SO4 mg/L
X16A	BY ROSE CREEK, DOWNSTREAM	09-Jun-87	7.45	0.008	0.011	0.045	0.208	3.4	46
X16A	OF CROSS VALLEY DAM	01-Oct-87	7.16	0.002	0.032	0.087	0.305	2.8	118
	A - 5 M								
X16B	B - 30 M	09-Jun-87	7.75	0.005	0.006	0.021	0.008	3.5	9
X16B		01-Oct-87	7.87	0.000	0.007	0.014	0.005	4.0	21
X17A	DOWNSTREAM OF	09-Jun-87	7.70	0.004	0.005	0.016	0.005	4.0	14
X17A	CROSS VALLEY DAM	01-Oct-87	7.83	0.000	0.005	0.020	0.007	4.6	26
	A - 5 M								
X17B	B - 20 M	09-Jun-87	7.76	0.004	0.006	0.013	0.147	3.3	20
X17B		01-Oct-87	7.75	0.000	0.000	0.009	0.132	3.2	25
X18B	NORTH OF CROSS	10-Jun-87	7.03	0.004	0.000	0.026	0.424	35.5	281
X18B	VALLEY DAM, B - 20 M	01-Oct-87	7.54	0.002	0.011	0.024	0.284	25.0	188
X21A	BY OLD TAILINGS POND	10-Jun-87	6.68	0.004	0.000	1.550	28.500	92.0	1175
	DECANT, A - 10 M								
X21B	B - 27 M	10-Jun-87	7.54	0.003	0.007	0.021	0.660	13.1	127
X21C	C - 40 M	10-Jun-87	7.09	0.004	0.000	0.219	8.850	28.0	444
X24A	INTERMEDIATE DAM, NORTH	01-Oct-87	7.66	0.004	0.000	0.024	3.200	98.0	474
	A - SHALLOW								
X24B	B - DEEP	01-Oct-87	7.37	0.003	0.000	0.022	1.900	87.0	532
X25A		09-Jun-87	7.56	0.004	0.000	0.310	2.830	78.0	718
X25A	INTERMEDIATE DAM, SOUTH	01-Oct-87	7.36	0.003	0.000	0.026	0.185	14.1	224
	A - SHALLOW								
X25B	B - DEEP	09-Jun-87	7.49	0.014	0.007	0.013	3.050	74.0	753
X25B		01-Oct-87	7.56	0.000	0.000	0.010	0.610	4.4	81

B. ADDITIONAL GROUNDWATER SAMPLE SITES

SITE	LOCATION	DATE	PH	CU mg/L	PB mg/L	ZN mg/L	MN mg/L	NA mg/L	SO4 mg/L
P81-09	NORTH OF PUMPHOUSE POND	09-Jun-87	7.59	0.023	0.007	0.030	0.010	3.6	11
P81-09		01-Oct-87	7.54	0.005	0.019	0.073	0.017	2.6	23
CVDC 4S	CROSS VALLEY DAM CREST NORTH	01-Oct-87	7.20	0.003	0.000	0.023	4.220	69.0	495
CVDC 4D	S - SHALLOW, D - DEEP	01-Oct-87	7.68	0.000	0.005	0.046	0.036	9.1	215
CVDC 7S	CROSS VALLEY DAM CREST MID	01-Oct-87	7.56	0.002	0.000	0.016	4.510	56.0	314
CVDC 7D	S - SHALLOW, D - DEEP	01-Oct-87	7.46	0.003	0.000	0.022	4.400	83.0	617
CVDC 9S	CROSS VALLEY DAM CREST SOUTH	01-Oct-87	7.77	0.000	0.000	0.028	0.040	8.6	78
CVDC 9D	S - SHALLOW, D - DEEP	01-Oct-87	7.70	0.002	0.000	0.017	0.078	17.4	163
CVDT 1	CROSS VALLEY DAM TOE NORTH	01-Oct-87	7.90	0.002	0.000	0.011	3.920	84.0	456
CVDT 2	CROSS VALLEY DAM TOE SOUTH	01-Oct-87	7.11	0.003	0.000	0.016	2.220	68.0	417
ID 4S	INTERMEDIATE DAM MID	01-Oct-87	7.31	0.006	0.000	0.044	6.750	67.0	487
ID 4D	S - SHALLOW, D - DEEP	01-Oct-87	7.71	0.004	0.000	0.017	0.083	71.0	609
81-04D	OLD TAILINGS DAM, DEEP	01-Oct-87	6.85	0.003	0.023	0.072	12.400	100.0	335
83-2B	ORIGINAL TAILINGS POND	01-Oct-87	9.22	0.002	0.009	0.009	0.008	38.0	37
83-2C	ORIGINAL TAILINGS POND	01-Oct-87	7.57	0.009	0.027	0.074	0.072	175.0	506
83-3A	OLD TAILINGS POND	01-Oct-87	5.42	0.011	0.400	165.000	35.100	195.0	1940
83-3B	OLD TAILINGS POND	01-Oct-87	3.15	0.710	1.700	52.500	14.900	263.0	1670
83-4B	OLD TAILINGS POND	01-Oct-87	7.53	0.008	0.117	0.790	0.175	91.0	116
K10	ORIGINAL TAILINGS POND	01-Oct-87	6.23	0.006	0.137	2.340	0.670	28.0	
K12	ORIGINAL TAILINGS POND	01-Oct-87	7.06	0.002	0.044	0.355	0.092	48.0	119

APPENDIX 4

1987 PERFORMANCE MONITORING OF THE

DOWN VALLEY TAILINGS PROJECT, FARO MINE

PREPARED BY GOLDER ASSOCIATES

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

Report to
CURRAGH RESOURCES LIMITED
On The
1987 PERFORMANCE MONITORING
Of The
DOWN VALLEY TAILINGS PROJECT
FARO MINE
Faro, Yukon Territory

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March 1988 872-2407

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Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

March 15, 1988 Ref. No. 872-2407

Curragh Resources Limited
117 Industrial Road
Whitehorse, Yukon Territory
Y1A 2T8

Attention: Mr. H.M. Visagie

RE: 1986 PERFORMANCE MONITORING OF THE
DOWN VALLEY TAILINGS DAM

Dear Sir:

We are pleased to provide this report on the geotechnical and thermal performance of the Down Valley Tailings Project during 1987. Our conclusion is that the elements of construction constituting the tailings storage and creek diversion systems are continuing to perform well. The reduced monitoring intensity recommended in 1986 can be carried forward with only minor exceptions.

The contribution of Curragh Resources staff and your independent consultant, Mr. N.G. Cornish are gratefully acknowledged.

We look forward to a continuing involvement with the assessment of the Down Valley Project, and to Curragh Resources maintaining a keen interest in the project.

Yours very truly
GOLDER ASSOCIATES

B. Leach.

B. Leach, P. Eng.

H.G. Gilchrist, P. Eng.

PROFESSIONAL ENGINEER
H.G. GILCHRIST
YUKON TERRITORIES

BL:HGG:kk

1.0 INTRODUCTION

The Curragh Resources' Faro Mine (formerly Cyprus Anvil) Down Valley Tailings Project consists of three major components - the Diversion Canal, the Intermediate Dam and the Cross Valley Dam. An extensive geotechnical monitoring program was initiated December, 1981, and is continuing on an ongoing basis. This report presents an assessment of the results of this program up to the end of 1987. The monitoring data reviewed in this report is presented in the accompanying data volume prepared by Mr. N.G. Cornish, P. Eng., (formerly an employee of Cyprus Anvil Mining Corporation) and now a consultant to Curragh Resources.

2.0 1987 MONITORING PROGRAM

The program of monitoring the Down Valley Tailings Project facilities during 1987 consisted of the following:

- Owner observation of thermistors, slope indicators, and piezometers along the diversion canal in September/October.
- Owner observation of thermistors and piezometers in the Cross Valley and Intermediate Dams in October.
- Owner observation of stream flows in the diversion canal and at the toe of the Cross Valley Dam.
- A field inspection by Mr. H.G. Gilchrist of Golder Associates during the period of September 29 to October 2, 1987.

A plan of the project layout and the monitoring locations is presented in Figure 1 of this report. It is also noted that Mr. Cornish was intimately involved with Curragh Resources personnel in their assumption of responsibility for obtaining the 1987 field performance data.

3.0 DIVERSION CANAL

3.1 Canal Dyke

3.1.1 Thermal Regime

The thermal regime observed in September 1987 is summarized in Table 1. Examination of the data presented in Table 1 indicates that general warming trend observed in previous years has abated along significant sections of the canal dyke. Of the fifteen thermistor strings monitored along the canal dyke, eight of these thermistor strings, although still thawed along their entire depth, were recording temperatures somewhat colder than those observed in 1986. Five of the thermistor strings indicated warmer conditions than 1986, and the remaining two strings indicated thermal regimes essentially unchanged from 1986. The mean monthly temperatures recorded at Faro Airport during 1987 were almost identical to those recorded during 1986. Consequently, it is considered that the recording of temperatures lower than those observed in 1986 in certain thermistor strings may be due to instrument drift in the monitoring unit.

Between chainages 0+000 to 1+705 (CD17) the thermal regime is consistently cooler than 1986, indicating that canal seepage may be minimal along this reach of the diversion canal. Between chainage 2+900 (CD28) and 3+130(CD30) the thermal regime is consistently warmer than 1986 indicating that canal seepage may be continuing to significantly impact the thermal regime along this reach of canal.

From chainage 1+705 to 2+900, the changes in the thermal regime compared to 1986 are variable. Thermistor strings CD20, CD26 and CD27 are slightly colder, CD19 and CD24 are generally warmer, and CD21 and CD25 are similar to the temperatures observed in 1986. This variation in thermal regime probably reflects the differences in soil conditions and hence impact of canal seepage along this reach of the diversion canal.

3.1.2 Piezometers

With the exception of the deep (11.3 metres) piezometer at CD4, all the piezometers along the canal dyke indicate that water levels have dropped relative to 1986 elevations. The decrease in water levels was typically in the range of 0.1 to 0.5 metres. However, at piezometers CD19, CD21 and CD29 decreases in water levels were 0.84, 2.36 and 0.84 metres respectively. It is considered that the generally lower water levels observed in October 1987 compared with 1986 may be due to climatic differences between these years. Total precipitation records for Faro Airport are presented in Table 6. Examination of the data presented in Table 6 indicates that whilst precipitation from April to October 1987 was 313.8 mm compared with 282.9 mm in 1986, the precipitation during the period August to October was 120.5 mm and 145.8 mm respectively. Accordingly, the generally lower water levels may be influenced by the lower precipitation during August to October in 1987. The three piezometers that displayed significant decreases in water level are located in areas where the thermal regime in 1987 was either warmer or similar to that in 1986. Accordingly, it may be possible that the decrease in water levels is due to a change in the groundwater flow regime in these areas, consequent upon a change in the thermal regime. The thermal regime adjustment could include that occurring beneath the spoil piles because that would affect seepage conditions.

The apparent increase in water level of 0.63 metres in the deeper piezometer at CD4 may be a response to regional groundwater flow conditions in the valley side, whereas the response of the other shallower piezometers is dominated by the operation of the canal.

3.1.3 Ground Movements

No ground survey of ground movement stations was undertaken in 1987. Three inclinometers designated CD15, CD19, CD21 and CD29 were monitored, and a survey of canal dyke elevations between chainage 2+100 and 2+550 was undertaken. The horizontal inclinometer movements are summarized on Table 2.

Inclinometer CD15 indicated a movement of approximately 1 mm away from the canal compared with a total movement of 17 mm towards it during the period 1984 to 1986.

Inclinometers CD19 and CD21 displayed a movement of approximately 28 mm away from the canal, compared with previous total movements of 41 and 30 mm respectively into the canal during the period 1984 to 1986. There are indications from the movement-depth profiles of these two inclinometers that there may be a concentration of movement developing at a depth of between 5.0 and 5.5 metres beneath the crest of the canal dyke.

Inclinometer CD29 displayed a movement of approximately 25 mm away from the canal compared with a total movement of some 30 mm also away from the canal during the period 1984 to 1986. There are also indications from the movement-depth profile that the movement is concentrated at a depth of approximately 4 meters below the crest of the canal dyke.

The results of the canal dyke crest elevation survey are presented on Figure 2. With the exception of the data for Stations 2+325 and 2+400 the elevations compare very favourably with the 1985 and 1986 profiles. The measured crest elevations at Stations 2+325 and 2+400 indicate settlements of approximately 0.3 metres at both locations. However, the elevations remain higher than the design dyke crest.

3.2 Canal Backslope

3.2.1 Thermal Regime

No thermistor readings were taken in the canal backslope during 1987.

3.2.2 Piezometers

No piezometer readings were taken in the canal backslope during 1987.

3.2.3 Ground Movement

Inclinometers designated BS17 and BS18 were monitored during 1987. The results are presented on Table 2. Inclinometer BS11 displayed a

movement of 22 mm downslope compared with a total downslope movement of 34 mm during the period 1984 to 1986. Inclinometer BS18 displayed a movement of 9 mm downslope, compared with a total downslope movement of 25 mm during the period 1984 to 1986. This data would indicate that movement in the backslope may be increasing in the vicinity of BS11, but decreasing around BS18.

3.3 Spoil Piles

3.3.1 Thermal Regime

The three thermistor strings designated SP2, SP3 and SP5 were monitored during 1987, and the results are summarized in Table 3. At thermistor locations SP2 and SP3 the depth of thaw has increased, and the temperatures were warmer than observed in 1986.

At SP5 the depth of thaw has decreased, and the temperatures were colder than 1986.

The combination of both warmer and colder thermal regimes in the spoil piles compared to 1986 may indicate that increased seepage from the canal is causing increased thawing at SP2 and SP3. At SP5, seepage effects may be minimal, and the colder temperatures may reflect differences between the winters' mean monthly temperatures and also snowcover.

3.3.2 Ground Movement

No survey stations or inclinometers were monitored in the spoil pile area during 1986.

4.0 CROSS VALLEY DAM

4.1 Thermal Regime

A summary of the thermal regime at the Cross Valley Dam is presented in Table 4. Thermistor CVDC1 located in the north abutment was thawed over its entire depth and temperatures were slightly cooler than observed in 1986. This perhaps reflects the apparent general trend of cooler ground temperatures in 1987 compared to 1986. Thermistors CVDT4 ad CVDC11 both located in the south abutment were generally warmer than 1986. Temperatures observed in CVDC11 remain some 2 to 3°C higher than CVDT4, indicating that canal seepage may be impacting the backslope above the south abutment in which CVDC11 is located.

Thermistor 79-20 in the north abutment was thawed between 2 and 12 metres and temperatures were slightly warmer than observed in 1986. This may indicate that some seepage is occurring through the north abutment.

4.2 Piezometer Readings

In general, water levels observed in piezometers installed in and around the Cross Valley Dam have decreased in 1987 compared to the levels observed in 1986. Decreases in elevation in water levels in piezometers installed through the crest of the dam were typically in the range 0.1 to 0.5 metres. Decreases in water levels of the order of 0.1 metres have also occurred in piezometers located in the original valley floor sediments downstream of the dam.

Two piezometers installed in the southern section of the dam have displayed increases in water level. The deep hydraulic piezometer at CDVC9 has increased in level by 2.39 metres and the pneumatic piezometer CVDP9 at the same location, but situated approximately 14 metres higher, increased in water level by 0.42 metres. The reasons for these increases in water level at these two locations may be related to adjustment of the base of the permafrost upslope of the abutment, and its effect on seepage from the diversion channel.

In the south abutment, the water level in CVDC11 dropped by 0.63 metres compared to 1986. This is of the same order as the general water level decreases beneath the dam, and is consistent with the pond behind the dam being operated at levels somewhat lower than those of 1986.

4.3 Ground Movement

No survey stations were monitored in the Cross Valley Dam during 1987.

4.4 Cross Valley Dam Seepage

Seepage through and beneath the Cross Valley Dam is captured in a ditch along the toe of the dam and measured using three v-notch weirs (W2 and W3 and W6). The total seepage flows through W3, while flows through W2 and W6 reflect primarily the contribution of the north and south abutment areas respectively. The recorded flows are presented in Table 5. Weir 1, situated south of W2, has not been read for the past 2 years.

The pond elevation during 1987 was similar to or somewhat lower than the 1986 elevation.

A plot of the total seepage flows for Weir 3 with time for the years 1983 through 1987 is presented in Figure 3. The available data for 1987 is monthly average flows, and these have been plotted as horizontal bars. The 1987 flows through Weir 3 are slightly lower than 1986, which correlates with the lower pond elevations in 1987.

Flows through Weir 2 during the period May to September 1987 were comparable with the 1986 flows. The October to December 1987 flows were higher than in 1986.

Flows through Weir 6 were generally lower in 1987 than in 1986, but the transition from pipe flow measurement (1986) to use of a V-notch Weir may have involved some calibration adjustment.

5.0 INTERMEDIATE DAM

5.1 Thermal Regime

Only one thermistor string located in the south abutment of the Intermediate Dam was monitored in September 1987. The results indicate that the ground was thawed over the full depth of the instrumentation, and the temperatures were typically 0.8 to 1.2°C warmer than in 1987.

5.2 Piezometers

All the piezometers monitored in the Intermediate Dam show a decrease in water level of between 0.05 and 0.35 metres from 1986 to 1987. One piezometer (IP3) located adjacent to the spillway displayed a decrease in level of 0.84 metres.

Two piezometers located in the south abutment displayed rises in water level of 0.11 and 0.18 metres between 1986 and 1987.

6.0 FIELD INSPECTION BY GOLDER ASSOCIATES

The Down Valley Project was inspected by Mr. H.G. Gilchrist of Golder Associates during the period September 29 to October 2, 1987. Discussions were held with Curragh Resources' Kevin Coombs, Bill Scheding, Ian Bailey and John Huntley, during the course of the inspection. Mr. Huntley accompanied Mr. Gilchrist during the entire inspection and on October 2nd a post-inspection summary tour was held in the company of Kevin Coombs, Ian Bailey and John Huntley.

The purpose of the site visit was to examine the facilities in detail for evidence of deficient performance, to provide further basis for a later review of the frequency of performance monitoring recommended in 1986 to observe maintenance undertaken subsequent to the 1986 inspection, and to review points of immediate concern with Curragh personnel, should such arise as a consequence of the inspection.

6.1 Facilities Examination and Required Remedial Works

The principal components of the project (Diversion Canal, Cross Valley Dam, and Intermediate Dam) were inspected on foot, as was the North Valley Wall Interceptor Ditch, its diversion point, and its outfall.

6.1.1 Diversion Canal

The dyke section, top of the backslope, and the shoreline downslope of the canal were examined in detail. The dyke examination was made to review the state of visible cracking associated with settlement and to review toe-of-dyke seepage occurrences. Likewise, the shoreline inspection was made to review seepage occurrences at that elevation, and to review the performance of the waste material slopes which, to date, have been responsive to such seepage.

Top of dyke settlement due to melting of permafrost produced localized dyke settlement between Sta. 1+900 and 2+700 that was corrected in mid-1985 as illustrated by Figure 2.

The dyke was apparently graded in 1986, and again in 1987, resulting in the loss of many of the settlement spikes that were used for the observation of ongoing dyke settlement in the vicinity of Sta. 2+000. Although this makes it difficult to directly relate the cracking pattern in this area with dyke performance, currently active cracks between Sta. 1+975 and 2+230 makes it clear that dyke settlement is continuing. By comparison with the crack mapping done in 1981, it is evident that the area of cracking is only marginally greater than it was at that time and thus it is inferred that the activity is related to yet incomplete permafrost thaw-consolidation, rather than a developing local instability. It was also noted that the activity is related to yet incomplete permafrost thaw-consolidation, rather than a developing local instability. It was also noted for this local reach that the channel bottom adjacent to the pilot channel was submerged, whereas at other locations the flow is contained within the pilot channel. This is taken as further evidence of thaw and associated settlement.

Elsewhere along the top of the dyke there is minor cracking which parallels the left edge of the dyke, which is not active, and which is inferred to be related to the zoned construction of the dyke and its differential behaviour in response to freezing. Typically, the cracking runs parallel to the left edge of the dyke, ranging between 0.5 and 2 m from the edge of the dyke. Cracking in the right portion of the dyke is not often apparent but, where it occurs it is more random, and it extends further in from the edge. This pattern is not surprising because, although the dyke material was sand and gravel, it was placed over a stripped surface that was sometimes contaminated with excavation material, particularly between Sta. 1+600 and 2+540, as was noted in Golder Associates' "As-Constructed" report for the project.

As was noted during the 1986 inspection, the ramp that was cut down the face of the dyke to gain access to the rock quarry remains to be repaired, and until that is done, there is hazard to the local integrity of the dyke.

Inspection of the thermal liner along the backslope revealed that Curragh had recently graded the surface with a motor grader to aid in gaining access for repair of the erosion gullies. While access was substantially improved, the activity has served to re-arrange the established top-of-slope drainage patterns which, in turn, have determined the location of the erosion gullies. Instructions were left with site personnel to correct the drainage re-arrangement and it was suggested that the motor grader be used to construct a cross-slope on the surface to prevent longitudinal flow and local flow concentrations. As has been noted in previous years, there remains a need to stabilize the erosion gullies with riprap materials, and to shape the materials in a manner which will encourage the drainage not to erode a new channel adjacent to the repaired gully.

Also of note from inspection of the backslope was a minor crack in the top of the thermal liner just a short distance downstream from the rock quarry. It was situated about one metre to the right of the junction between the liner and the mountainside cutslope. It is inferred to be related to permafrost adjustment, and it is noted that the prior grading of the top of the liner did not proceed past the rock quarry, hence the age of the crack is not precisely known.

Both Goodall and Cornish Creeks are still trending towards outflanking the rock wedges which were built to convey the flow over the edge of the slope into the Rose Creek Diversion Canal. This situation was again noted to site personnel, and their attention was drawn to instructions provided at the time of the 1986 inspection.

The inspection also revealed that the main channel immediately upstream from the automatic water level recorder is accumulating bed load material and the flow is gradually being diverted through the upstream end of the construction bypass channel as shown in the mosaic photograph of Figure 4. Instructions were left with site personnel to backfill the channel, such that the full flow will be forced to use the intended channel.

The condition of the rock weirs was compared with photographs taken in previous years and it was concluded that very little annual change is occurring. However, it will soon be necessary to have a carefully controlled maintenance program to place single large rocks so to improve the integrity of a number of the weir crests where rocks placed during construction have become dislocated.

Finally, the continuing degradation of the bed of the Rose Creek channel just downstream from the outfall was noted and instructions were left with site personnel for installation of an additional one or two rock weirs to provide adequate protection against undermining of the existing weirs during heavy creek flow. The changes in the channel between 1986 and 1987 can be seen by close comparison to the photographs presented in Figure 5. It is estimated that a bed elevation loss of about 0.3 m has occurred during the past year downstream of the placed rock.

The annual inspection of the south valley wall shoreline between the 1974 Tailings Dam and the Cross Valley Dam is made with emphasis on discovery of new seepage emergences. Such seepages yield indication of the integrity of the Diversion Canal although inferences must be carefully drawn because of the pond storage and bank storage available at many locations between the shoreline and the canal dyke.

During the past year there has been tailings accumulation along the south shoreline sufficient to almost cover the channel plug which was constructed in 1982. Upstream from that point there are shallow water depths and evidences of artesian pressure relief (see Figure 6) which are believed to be associated with release of water due to tailings consolidation. If it were an indication of Rose Creek Diversion Canal leakage it would be expected that there would be a tendency for the features to be of greater concentration near the shoreline than vice versa.

Waste material sloughing around Borrow Pit "I" is continuing and the seepage that is emerging from the north corner of the borrow pit is essentially unchanged from a year earlier (see Figure 7).

Between Borrow Pit "I" and the current limit of the tailings beach there are several evidences of small seepages along the toe of the slope. There are also small boils in the tailings along the edge of the deposit. The most notable shoreline seepage is immediately upstream from the construction haulroad ramp which meets the channel dyke at Sta. 1+680; the rate of flow is estimated to be between 7 and 17 litres/ minute. In total, there are about 10 to 12 such seepage locations (toe of slope flows and artesian boils in the tailings) between Borrow Pit "I" and the end of the tailings deposit.

Inspection of the shoreline further downstream reveals some acceleration in the retrogression of very localized waste pile surface mudflows and shallow instabilities. These instabilities are believed most active in the spring and early summer and they do not constitute any hazard to the Diversion Canal. Interestingly, the amount of ponded water which is present at some locations between the toe of the Diversion Canal dyke and the waste dumps has increased since the 1986 inspection even though the flow rate over the edge of the spoil bank seems little different than in previous years. It is possible that the permafrost melt is proceeding downslope from the channel dyke and that the pond basin elevations are getting lower, while the overflow points remain unaffected. In that these areas are downslope of the dyke reach where the previously-described cracking was concentrated, it is inferred that permafrost melt is the likely cause of the observed behaviour. One seepage emergence point carrying a flow of about 15 litres/minute was found in the shoreline reach between the principal area of dyke cracking and the Intermediate Dam.

The condition of the shoreline between the Intermediate Dam and the Cross Valley Dam continues to be excellent. The full pond level continues to preclude comparison of minor seepage emergences that were identified in 1984, or review of the seepage volumes emerging from the junction of the Intermediate Dam with the steep slope below the Diversion Canal. The only location where minor seepage was present was just beyond the abutment of the Intermediate Dam. Although no seepage was noticed at this location last year, it has been noted that there has been seepage in the area of the abutment since 1981, and that it is most evident when the Cross Valley Reservoir water level is at a low level.

The general conclusion reached from inspection of the shoreline is that the waste dump faces are showing an increased amount of face instability, and that there has been a minor adjustment in the distribution of seepage emergences along the toe of the slope. There is no evidence to suggest that these changes provide cause for concern but they do give strong justification for continuing the program of inspection.

6.1.2 Cross Valley Dam

Inspection of the dam comprised examination of the spillway area, detailed inspection of the crest area for evidence of cracking, inspection of the thaw-affected south abutment area, and inspection of the downstream toe area where foundation seepage flow is emerging.

Examination of the spillway and decant areas reveals that they are in good condition, that repair has been made to the spillway channel erosion scars that were present at the time of the 1986 inspection, and that Curragh is in the process or riprapping the spillway channel. It is understood that this is being done at the request of Government officials.

Inspection of the upstream area of the south abutment reveals the beginning of some sloughing of the unprotected loose edge of the glacial till blanket that was placed against the slope upstream of the dam, and which is integral with the core of the embankment.

The downstream toe area of the dam was inspected with particular reference to the seepage patterns, and although the south abutment area toe channel is being gradually cleaned of loose material, there has been no visual change in the pattern or quantity of seepage, or in the seepage locations. Moving toward the north abutment, the areas of artesian seepage that have been noted in previous inspections are still flowing, but they appear to be considerably less active than in 1986. This represents a continuation of the trend that was noted a year ago wherein the activity was reduced from that observed in 1985, and in spite of the currently full reservoir level.

During the past year flow measurement location W6 has been transformed from a pipe into a steel plate weir, and it would be advisable to replace the other plywood weir plates with steel. As noted in the 1986 annual inspection, it would also be helpful to install a weir about 50 metres south of the Weir 6 location to obtain more definitive information concerning the distribution of seepage emergence from the south abutment area. It would also be advisable to also read the flow at Weir 1 which is located a short distance south of Weir 2. Observations of the flow at this weir were last made in 1985.

In conclusion, the locations and quantities of seepage are not mobile from year to year and it is concluded that a stable condition is persisting. However, the pervious nature of the dam's foundation and the fact of meltout of the south abutment permafrost dictates that there should be continuing vigilence over the structure to remain abreast of any changes in performance which may occur.

6.1.3 Intermediate Dam

At the time of the inspection the tailings pond level upstream of the Intermediate Dam was at its full operating level, as indicated by the nominal flow over the emergency spillway which is set at El. 1066.5 metres. The Cross Valley Reservoir was slightly below its design level, with both the siphons and the decant operating. In view of these water levels the inspection has again been restricted to an inspection of the crest and abutment areas.

As has been noted since construction, there has been south abutment seepage issuing from the junction between the abutment and the embankment although it is most evident when the downstream pond is at reduced level. Conditions at the location where seepage would be expected are unchanged from 1986 and, as noted in the discussion of the shoreline between the two dams, minor seepage is issuing from the area immediately downstream from the abutment junction with the valley slope.

Of principal note from the inspection is the persistence of upstream edge-of-crest cracking as illustrated in the photographs in Figure 8. The crack is considered to be currently inactive, and to be associated with the zoning of the embankment section and the differing response of the materials to freezing. As such, the cracking is likely to occur during the winter and to be visable after the snow disappears in the spring. Evidence for this conclusion includes the fact of no similar cracking along the downstream edge of the Intermediate Dam berm where there is no zoning but where the granular material and the relative height above the water level is the same. It is also noted that the crack may be a manifestation of some differential settlement between the shell and the core materials, as was noted in the 1986 report. In that case it whould not be an annually recurring phenomenon. As previously recommended, the crack should be dressed out and the crest edge observed in future to determine whether it is annually persistent.

Damage which was done to the spillway channel in 1986 had not yet been repaired and some general maintenance of the riprap in the entry to both the decant and the spillway is also required. It will correct damage that has been done in the interest of effecting water level management in the tailings pond.

6.1.4 North Valley Wall Interceptor

Inspection of the interceptor in 1986 revealed that some maintenance and improvement is required but not all the work had been accomplished at the time of the 1987 inspection. Specifically, instructions were left with site personnel in 1986 to raise the dyke grade at the Guardhouse Creek diversion point. It was to be raised to the requisite 1.5 m height using locally available materials. Local aggradation of the channel and prior temporary construction have made the diversion point less positive than would be required to accommodate a flash runoff, particularly if the channel were to be ice-filled, such as may occur in the fall or spring of the year.

The outfall of the interceptor on the west edge of Borrow Area "F" situated high above the Intermediate Dam remains in need of some stabilization using mine waste. Details of the required work were discussed with Curragh Resources personnel at the time of the 1986 inspection.

Although no mine waste had been placed to stabilize the outfall, the channel diversion point at the south end of Borrow Area "F" had been repaired in keeping with the instructions provided in 1986.

The conclusion of the inspection is that the channel is functioning well. There remains the need to undertake the maintenance noted in 1986. At some time there will also be a requirement to stabilize some small instabilities in the cutslopes which are situated a short distance downstream from the upstream end of the ditch.

6.2 Performance Monitoring and Annual Review

In accordance with recommendations contained in the 1986 Performance Monitoring Report, the prior frequency of instrumentation observation was reduced and hence the 1987 review reflects a lesser flow of data. Analysis of this data has demonstrated the general validity of the recommendation and there is no cause to revert to more frequent observation. However, in keeping with the reduced frequency of instrument observation it remains important that Golder Associates continue to make an annual early fall site visit to inspect the facilities, and that Golder Associates continue to examine the monitoring data obtained by the client's personnel.

7.0 RECOMMENDATIONS FOR FURTHER MONITORING

The frequency of data acquisition from the installed instruments has been reduced as discussed above and in accordance with recommendations contained in the 1986 report. Performance of the facility, as illustrated by both the instrumentation data analysis and the site inspection, indicates that the monitoring schedule presented in the 1986 report need be changed only to obtain additional data on the reach of the Rose Creek Diversion Channel where adjustment of the dyke indicates that the permafrost melt is not yet complete. Accordingly, the 1988 performance monitoring program should be as previously, with additional monitoring as noted by the underlined instruction.

7.1 Diversion Canal

- Read all dyke top and spoil pile thermistors annually in late September because they will provide data related to the warming effects of canal seepage, particularly as will be affected by the intended intermittent operation of the canal.

- Read backslope thermistors in 1988 and every 2 years thereafter

- Read slope indicator stations CD 15, CD 19, CD 21, CD 29, BS 11 and BS 18 annually in late September. <u>Read also the slope indicator installation at SP3 and SP5.</u>

- Read all functioning dyke top and spoil piezometers annually in September.

- Read backslope piezometers in September 1988 and every 2 years thereafter.

- Read all survey monuments in 1988 and every second year thereafter, including the dyke top profile between stations 1+700 and 2+300. Determine the dyke top profile in late April and again in late September using the spikes previously installed between Stations 1 + 700 and 2 + 300.

7.2 Cross Valley Dam

- Read all instrumentation annually in September and the piezometers additionally in May of each year.

- Determine all backslope toe weir flows monthly, while also noting the Cross Valley Reservoir level on the record sheets.

- Discontinue reading of survey monuments until advised otherwise. Nevertheless, the installations must still be carefully protected.

7.3 Miscellaneous Requirements

It will be helpful to the ongoing appreciation of project component performance to continue monitoring Rose Creek stream flow at the automatic recording station. The program of water temperature recording initiated in 1987 should be continued. The location of interest are at the automatic flow recording station, the Intermediate Dam and Cross Valley Dam outflows, and at Weir 3. Observations should be taken on a bi-weekly basis.

TABLE 1

DIVERSION CANAL DYKE THERMAL REGIMES

LOCATION		THERMAL REGIME (Depth in metres)					
NO.	STN.	SEPTEMBER/82	SEPTEMBER/83	SEPTEMBER/84	OCTOBER/85	OCTOBER/86	SEPTEMBER/87
CD4	0+400	Frozen 4.7 - 4.9	Thawed	Thawed	Thawed	Thawed, warmer than 1984 & 1985	Thawed, colder than 1986
CD5	0+510	Thawed to 3.9	Frozen 4.8 - 5.2	-	Thawed	Thawed, warmer than 1984 & 1985	Thawed, colder than 1986
CD10	0+990	Frozen 4.8 - 6.0	Thawed	Frozen 4.8 - 5.4	Thawed	Thawed, warmer than 1984 & 1985 except at 7.8 m	Thawed, colder than 1986
CD15	1+530	Frozen 3.8 - 6.0	Thawed	Thawed	Thawed	Thawed, similar to 1985	Thawed, colder than 1986
CD17	1+705	Thawed to 3.8	Thawed	Frozen 7.8 - 8.2	Frozen 1.5 - 2.4	Thawed and warmer	Thawed, colder than 1986
CD19	1+900	Thawed to 3.5	Thawed to 4.5	Thawed to 3.8	Thawed to 4.2	Thawed to 4.4 m	Thawed to 4.3 m: warmer than 1986
CD20	2+000	Frozen 3.8 - 5.0	Thawed to 6.0	Thawed to 5.3	Frozen 5.3 to 6.9	Frozen 6.2 to 6.7 m	Partially frozen 6.0 to 9.0 m: colder than 1986
CD21	2+100	Thawed to 4.6	Thawed to 4.3	Thawed to 6.0	Thawed to 4.8	Thawed to 4.4 m	Thawed to approximately 4.7 m: similar to 1986
CD24	2+365	Frozen 3.7 - 6.0	Thawed	Thawed	Thawed	Thawed and slightly warmer	Thawed, warmer than 1986
CD25	2+460	Thawed	Thawed	Thawed	Thawed	Thawed and warmer	Thawed, similar to 1986
CD26	2+600	Frozen 4.2 - 9.2	Frozen 5.5 - 7.8	Frozen 4.5 - 7.7	Frozen 4.5 - 7.0	Thawed	Thawed, colder than 1986
CD27	2+765	Frozen 4.0 - 7.2	Thawed	Thawed	Thawed	Thawed and warmer	Thawed, colder than 1986
CD28	2+900	Thawed to 3.6	Frozen 3.0 - 6.2	Frozen 3.3 - 5.4	Frozen 4.0 - 5.2	Thawed to 7.7 m	Thawed to approximately 7.7 m: warmer than 1986
CD29	3+000	Thawed to 2.5	Thawed to 2.9	Thawed to 3.4	Thawed to 3.2	Frozen 4.2 to 6.2 m	Thawed, warmer than 1986
CD30	3+130	Thawed	Thawed	Thawed	Thawed	thawed	Thawed, warmer than 1986

TABLE 2

TABULATED GROUND MOVEMENTS

STATION		SETTLEMENT (mm)		HORIZONTAL MOVEMENT (mm)[3]		SLOPE INDICATOR SURFACE MOVEMENT (mm)[1]		
		82-84	84-86	82-84	84-86	82-84	84-86	86-87
CANAL DYKE								
CD 4	0+400	20	-2	18 SW	20 SW			
CD 10	0+990	31	-2	5 N	9 SW	3 up		
CD 15	1+530	21	-3	14 S	16 SW	12 dn	17 up	1 dn
ED 16	1+610	55	34					
CD 18	1+800	229	200					
CD 19	1+900	29	32	11 SW	55 SW	9 dn	41 up	28 up
CD 20	2+000	33	21					
CD 21	2+100	31	26	9 E	24 S	1 up	30 up	28 up
CD 22	2+200	315	117	95 SW	14 NE		some upstream	
CD 29	3+000	270	80	97 SW	51 SE	136 dn	25 dn	20 dn
BACKSLOPE								
	1+200	N/A[2]	48					
	1+900	166	153	26 E	36 E			
BS 11	2+100	0	60	58 N	31 N	52 up	34 dn	22 dn
	2+460	17	56					
BS 16	2+900 U	17	-9	40 N	41 NE			
BS 16	2+900 L	13	0	62 N	69 N			
BS 18	3+000	115	33	18 NE	2 SE	18 up	25 dn	9 dn
	3+130	64	30					
SOIL PILES								
SP 1	0+990	180	87	30 E	22 S			
SP 2	1+530	117	63	16 NW	17 SW			
SP 3	1+900	224	160	102 NE	66 NE			
	2+040	124	221	22 NE	32 N			
SP 5	2+950	101	52	33 SW	10 W			

[1] "up" means upslope; "dn" means downslope
[2] "n/a" means not available
[3] indicated movements are vector sums over the time period shown.

TABLE 3

CANAL BACKSLOPE AND SPOIL PILE THERMAL REGIMES

LOCATION		THERMAL REGIME (Depth in metres)					
NO.	STN.	SEPTEMBER/82	SEPTEMBER/83	SEPTEMBER/84	OCTOBER/85	OCTOBER/86	SEPTEMBER/87
BS2	0+400	Frozen 1.5 - 7.8	Frozen 2.0 - 7.8	Frozen 1.5 - 6.5	Frozen to 7.9 m	Frozen full depth	
BS5	0+960	Frozen 1.4 - 4.8	Frozen 2.3 - 2.8	Thawed	Thawed to 5.5	Thawed full depth	
BS9	1+530	Thawed	Thawed	Thawed	Thawed	Thawed and slightly warmer	Reading of backslope thermistors planned for 1988
BS10	1+900	Thawed to 1.3	Thawed to 2.2	Thawed to 2.0	Thawed to 2.0	Thawed to 2.8	
BS11	2+100	Thawed to 1.3	Thawed to 0.5	Frozen	Frozen	Thawed to 1.0	
BS12	2+260	-	Thawed	Thawed	Thawed	Thawed	
BS15	2+760	-	-	Thawed	Thawed	Thawed	
BS16	2+900	Thawed to 1.5	Thawed to 2.0	Thawed to 2.3	Thawed	Thawed to 3.2 m	
BS17	2+900	Thawed to 2.3	Thawed to 2.5	Thawed to 2.5	Frozen	Thawed to 3.3 m	
BS18	3+000	Thawed to 2.3	Thawed to 3.4	Thawed to 2.8	Thawed to 3.1	Thawed to 4.1 m	
SP2	1+530	Thawed to 3.2	Thawed to 3.8	Thawed to 3.0	N/D	Thawed to 3.3 m	Thawed to approximately 4 m, warmer than 1986
SP3	1+900	Thawed to 2.8	Thawed to 2.6	Thawed to 2.6	N/D	Thawed to 4.3 m	Thawed to approximately 4.6 m, warmer than 1986
SP5	2+950	Thawed to 2.9	Thawed to 3.1	Thawed to 4.7	Thawed to 3.4	Thawed to 4.4 m	Thawed to approximately 3.7 m, colder than 1986

BS denotes canal backslope
SP denotes canal spoil pile

Notes: 1 - No data for thermister a 3.3 m depth

TABLE 4

CROSS VALLEY DAM THERMAL REGIMES

LOCATION	THERMAL REGIME (Depth in metres)					
NO. STN.	SEPTEMBER/82	SEPTEMBER/83	SEPTEMBER/84	OCTOBER/85	OCTOBER/86	SEPTEMBER/87
CVDT4 0+630	Thawed 4.5 - 14.2	Thawed 2.5 - 8.5	-	Thawed to 8.4	Thawed to >11.4	Thawed to approximately 14 m, warmer than 1986
CVDC1 0+050	Frozen 4.8 - 5.8	Thawed	Thawed > 15	Thawed > 15	Thawed and warmer	Thawed, slightly cooler than 1986
CVDC11 0+645	Thawed to 4.6	Thawed to 5.4	Thawed to 4.4 and 9.2 - 12.8	Thawed	Thawed and very warm	Thawed, slightly warmer than 1986
79 - 20 (North Abut)			Frozen 4.5 - 6.5 m		No change from 1984	Thawed from 2 to 12 m: slightly warmer than 1986

TABLE 5
CROSS VALLEY DAM SEEPAGE FLOWS
Pond Elevation and Weir Flows At The Downstream Toe

DATE	POND ELEV. (m)					WEIR FLOW (I.G.P.M.)																
						WEIR 1					WEIR 2					WEIR 3					WEIR 6	
	1983	1984	1985	1986	1987	1983	1984	1985	1986	1987	1983	1984	1985	1986	1987	1983	1984	1985	1986	1987	1986	1987
May 15														185	178				1265	1216	90	66
June 6	1058.56	1060.15	1063.20													4650*						
June 10														245					1475		140	
June 13	1058.31					225	215	450							200	4600*	1305	1700		1379		190
June 20	1058.21					250										4150*						
June 27	1058.20					225										4200*						
July 4	1058.31	1059.35	1061.90			245	210	395			725					1500	1280	1800				
July 11	1058.78					275					800					1550						
July 12														280	246				1685	1590	200	193
July 18	1059.11					300					690					1700						
July 25	1059.30					310					905			245		1800			1685		205	
Aug. 1	1059.19	1059.40	1060.60			300	200	350		NO	950	NO				1690	1180	1520				
Aug. 8	1058.45					290					850					1560						
Aug. 11														245					1685	1685	225	145
Aug. 16	1057.88					290					800				273	1575						
Aug. 22	1057.56					240					725			215		1425			1575		240	
Aug. 29	1057.37			Main-		240					650			245		1350			1285		240	
Sept. 6	1057.20	1059.50	1062.05	tained		230	190	350		DATA	640	DATA				1290	1190	1330				
Sept. 8				at										245								
Sept. 12	1057.07			Elev-		200					600			280	279	1220			1685	1685	225	143
Sept. 19	1056.93			ation		200					550					1175			1795		230	
Sept. 26	1056.85			1063.2		190					550					1125						
Oct. 3	1057.42	1059.40	1062.05			200	175	350	AVAILABLE		600	AVAILABLE				1175	1075	1330				
Oct. 11	1058.21					240					690					1220						
Oct. 17	1058.80					250					740					1375						
Oct. 23														200	260				1475	1568	185	121
Oct. 25	1059.67					290					750					1400						
Oct. 31														185					1475		180	
Nov. 1	1060.04	1059.40	1062.05			275	180	350			780					1450	1085	1330				
Nov. 6														185					1475		180	
Nov. 7	1060.36					250					850					1480						
Nov. 13														185					1475	1430	190	97
Nov. 14	1060.45					300					860				218	1510						
Nov. 21														185					1475		180	
Nov. 22	1060.66					280					860					1510						
Nov. 28	1059.41	1061.20	1062.05			275	180	350			800			155		1510	1345	1330	1380		160	
Dec. 4														155					1285		160	
Dec. 5						230					675					1310						
Dec. 8	1058.53																					
Dec. 10														155						1419		
Dec. 12						220					650				227	1190			1285		140	92
Dec. 16														185					1285		150	
Dec. 23														185					1285		130	
Dec. 31														185					1285		115	

NOTE:
- Abnormally high flow rates through Weir 3 in June, 1983 are due to the 16 inch siphon discharging upstream of the weir. Hence the flow reocrded is both seepage and decant.

- 1984 and 1985 data represents selected same date points abstracted from pond elevation and weir flow hydrographs.

- 1986 data presents all available information; W6 volume is estimated when it exceeds 210 I.g.p.m.

- Weir 6 was a pipe flow measurement location until 1987 when the pipe was replaced with a V-notch weir.

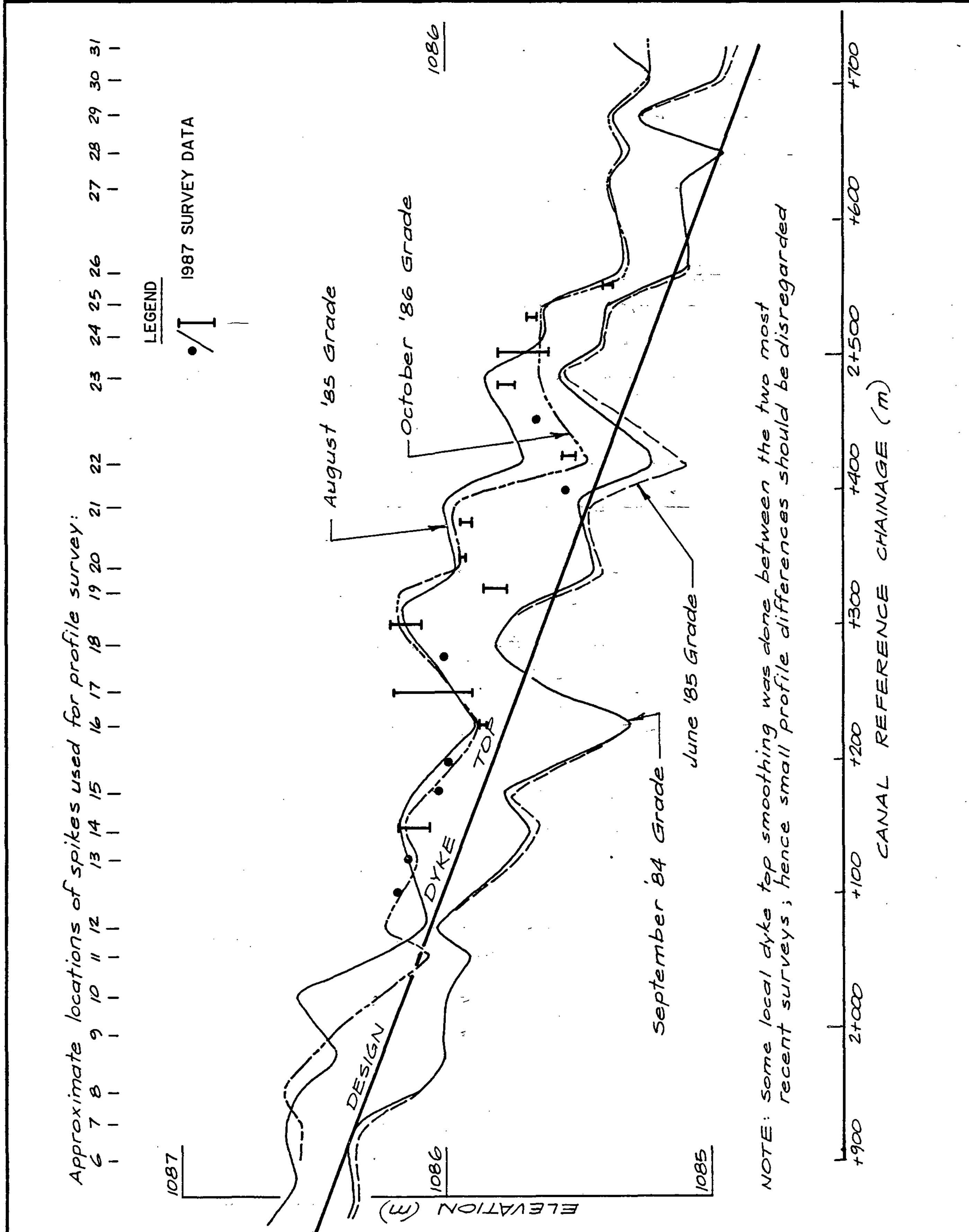
TABLE 6
TOTAL PRECIPITATION - FARO AIRPORT

	1983	1984	1985	1986	1987
April	2.2	2.5	13.9	12.9	10.0
May	20.6	36.8	17.2	35.1	40.1
June	55.6	49.1	28.2	12.8	50.8
July	49.1	16.7	62.6	76.3	92.4
August	65.8	65.0	80.8	78.7	63.5
September	21.2	5.5	46.3	44.4	30.2
October	16.3	11.0	20.0	22.7	26.8
Total	230.8	186.6	269.0	282.9	313.8

NOTE: All precipitation readings in mm.

DIVERSION CANAL DYKE
(LOCALIZED SETTLEMENT RECORD)

Figure 2



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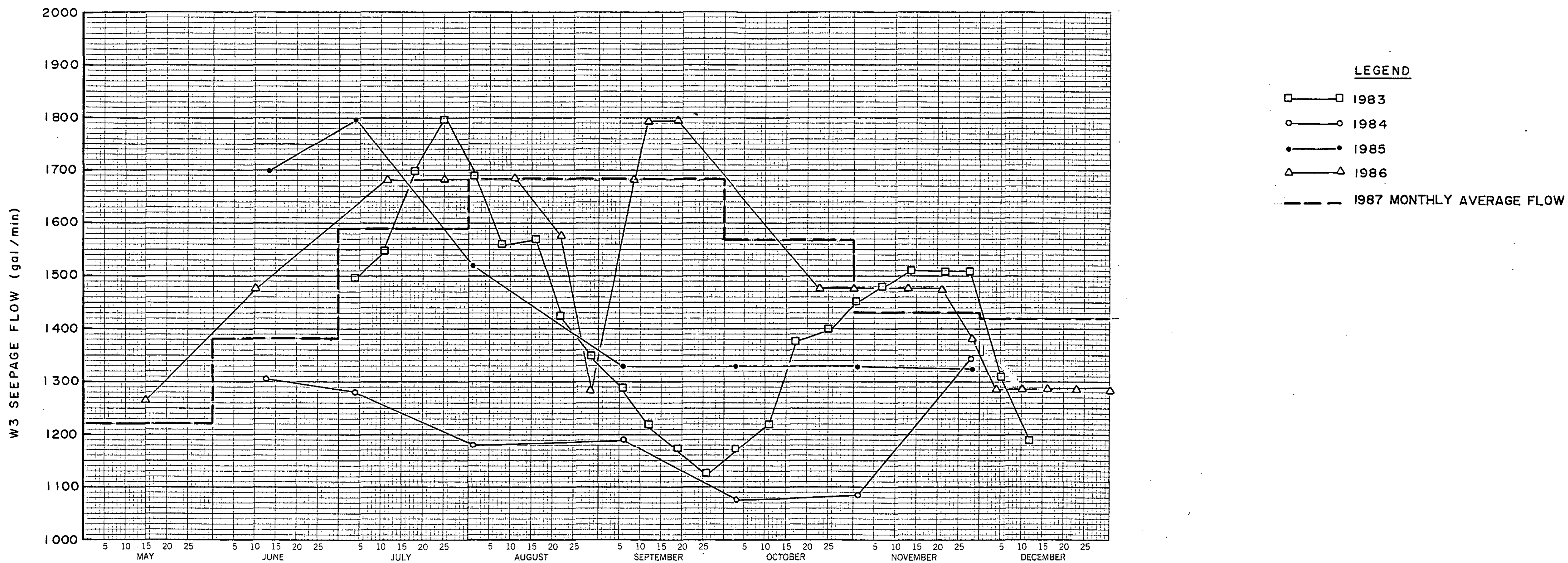
CROSS VALLEY DAM
RECORD OF FLOW AT WEIR 3

Figure 3



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1987 SITE INSPECTION PHOTOGRAPHS

Figure 4

Looking downstream toward the Diversion Dam, the Rose Creek Diversion Channel flow has begun to also use the right channel; it was excavated to effect flow bypass during construction of the project. The intended channel is to the left, and the flow can be restored to that channel by extending the right bank of the 1974 Diversion Channel through to the Diversion Dam. The old temporary channel would be backfilled. Photo date - October 1, 1987.

1987 SITE INSPECTION PHOTOGRAPHS	Figure 5

The Rose Creek Diversion Channel Outfall on October 1, 1987 (upper photo), and on October 3, 1986 (lower photo). Note that the natural channel downstream from the last rock weir has suffered a minor amount of grade degradation.

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1987 SITE INSPECTION PHOTOGRAPHS | Figure 6

Evidence of artesian pressure release points along the left (south) shoreline of the tailings pond where the water is shallow. The photo location is about 100 meters beyond the 1974 diversion channel outfall.

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1987 SITE INSPECTION PHOTOGRAPHS

Figure 7

These photographs illustrate the relative flows on September 29, 1987 (above) and October 03, 1986 (below) which is exiting Borrow Pit "I", situated just downslope from the diversion channel dyke, and just upstream of spoil pile instrumentation location SP2 (see Figure 1).

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1987 SITE INSPECTION PHOTOGRAPHS

Figure 8

These photographs illustrate the crack which is present along the upstream crest edge of the Intermediate Dam. The lower photo is of the local area in the centre of the upper photo. The cracking is inferred to be a reflection of the zoning in the embankment, and its differing frost reactivity.

Photo date - September 30, 1987.

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APPENDIX 5

ASSESSMENT OF FISH HABITAT IMPACTS ASSOCIATED WITH FLOW REDUCTIONS IN ROSE CREEK BELOW THE SOUTH FORK CONFLUENCE

- prepared by P.A. Harder and Associates

ASSESSMENT OF FISH HABITAT IMPACTS ASSOCIATED WITH FLOW REDUCTIONS IN ROSE CREEK BELOW THE SOUTH FORK CONFLUENCE.

The milling operation at the Faro mine site presently extracts process waters from the pumphouse pond located on the south fork of Rose Creek approximately 50 m upstream of the north fork confluence. In addition to south fork flows, the pumphouse pond also receives water that is diverted from the north fork 150 m downstream of the haul road crossing. Due to increased water requirements at the mill, additional water will be diverted from the north and south forks during 1988 and subsequent years. This will result in substantial flow reductions to lower Rose Creek during the winter months. Although precise data are not available it is conceivable that all north and south fork flows will be diverted to the mill during certain time periods between November and April.

These changes would affect over-wintering capabilities in a 5.2 km section of the Rose Creek channel upstream of the tailings pond effluent discharge to approximately 150 m below the north fork haul road crossing and in the 50 m section of the south fork downstream of the pumphouse pond. In addition to these impacts, reduced flows would also decrease the dilution capacity of lower Rose Creek below the tailings effluent, thereby potentially affecting downstream water quality.

The signifigance of potential impacts to over-wintering capabilities was assessed on the basis of observed habitat characteristics, a subjective evaluation of over-wintering requirements for Arctic grayling and observed fish distributions in the affected channel during early May of 1987.

Habitat Capability Assessment

The affected section of channel encompasses four major habitat types. Above the south fork confluence the north fork channel is characterized by a continuous steep gradient riffle with a cobble substrate. This 760 m section has been channelized. Below the south fork confluence the creek is also channelized as part of the diversion canal. This section is a low gradient run which flows adjacent to the tailings pond over a distance of 3,400 m. The substrate is comprised of predominantly small gravels and fines. A high degree of glaciation was evident in most of this section during May 1987. Near the second tailings dam, the diversion canal becomes a high gradient stepped channel designed to pass adult fish into the upper system. This section is characterized by a series of rip-rap weirs at approximate 10 m intervals with a 0.5 to 1.0 m drop at each weir over a distance of 1500 m. A small unnnamed tributary enters Rose Creek at the downstream extent of the diversion canal. The 150 m section of channel between this point and the confluence of the tailings pond effluent is part of the natural Rose Creek channel and is characterized by 60% pool habitat and a 40% run/riffle complex. Undercut banks and overhanging bank vegetation are abundant throughout this section.

Based on physical habitat characteristics, the lowermost section of Rose Creek would appear to provide the highest over-wintering capabilities within the affected channel between the effluent confluence and the north fork haul road. This is due to the presence of deep water pools and runs with a high degree of instream cover. Over-winter habitat capabilities in the steep section of the diversion canal are extremely low due to the high channel gradient and icing conditions. Similarily over-winter capabilities in the low gradient section of the diversion canal would be severly limited by channel glaciation processes. Capabilities in the lower portion of the north and south forks are limited by the absence of pool habitat.

Mid-winter fish sampling has not been conducted in Rose Creek. However, sampling conducted between May 8 and 12, 1987 are probably indicative of winter fish distributions since water temperatures were still below 2.0°C at this time. Sampling was conducted at three sites within the affected section of channel during this period. These data have been used to develop a quantitative assessment of habitat capabilities.

Electrofishing between the effluent discharge and the diversion canal indicated an absence of grayling and a low abundance of slimy sculpins (N=3) during May 1987. This is based a sample area of 462 m^2. These results could be indicative of fish avoidance due to water quality limitations in the vicinity of the tailings pond effluent discharge. Angling surveys below the effluent discharge and visual observations at a seepage area below the tailings pond also indicated an absence of over-wintering fish.

Impact Assessment

Sampling conducted in Rose Creek immediately below the north fork confluence resulted in a total catch of one grayling and one sculpin over an area of 165 m^2. These results represent grayling densities of 0.6 fish per 100 m^2. Although sampling at the north fork culvert pool resulted in a grayling density of 4.7 fish per 100 m^2, this area was not representitive of downstream habitats. Therefore, using the observed grayling density data from the lower sample site and applying it to the total area of stream habitat between the north fork diversion point and downstream to the steep section of the diversion canal, provides a crude estimate of potential fish losses associated with a complete diversion of the north and south fork waters. Based on a channel area of approximately 40,000 m^2 and a fish density of 0.6 grayling per 100 m^2, total losses would be approximately 240 fish for this section of creek. Given that the sample results are taken from the most suitable over-wintering habitats within the impact zone and the high degree of glaciation observed throughout most of the channel, it is likely that this calculation is an over estimate of actual fish losses. Fish sampling was not conducted in the steep section of the diversion canal, however it is our opinion that no over-wintering fish would be found in these habitats. Electrofishing conducted over an area of 88 m^2 in the 50 m long section of the south fork below the pumphouse pond resulted in no grayling. Over-winter capabilities in this section are extremely limited by shallow water.

In summary, the proposed flow reductions would impact existing over-winter habitat capabilities in the upper section of the Rose Creek diversion canal below the south fork confluence. Habitat capabilities within this section are extremely low compared to over-wintering capabilities in the south fork of Rose Creek between the pumphouse pond and freshwater reservoir. Based on observed grayling densities at the north and south fork confluence, it is estimated that total losses would probably be less than 240 fish assuming all waters from the north and south forks are diverted.

The proposed winter flow reduction would also decrease the dilution capacity of Rose Creek below the tailings pond effluent discharge. This could further degrade water quality in the lower creek during the winter period. An assessment of this potential impact would require analysis of effluent water quality, downstream dilution factors and existing fish use in lower Rose Creek during the winter period.

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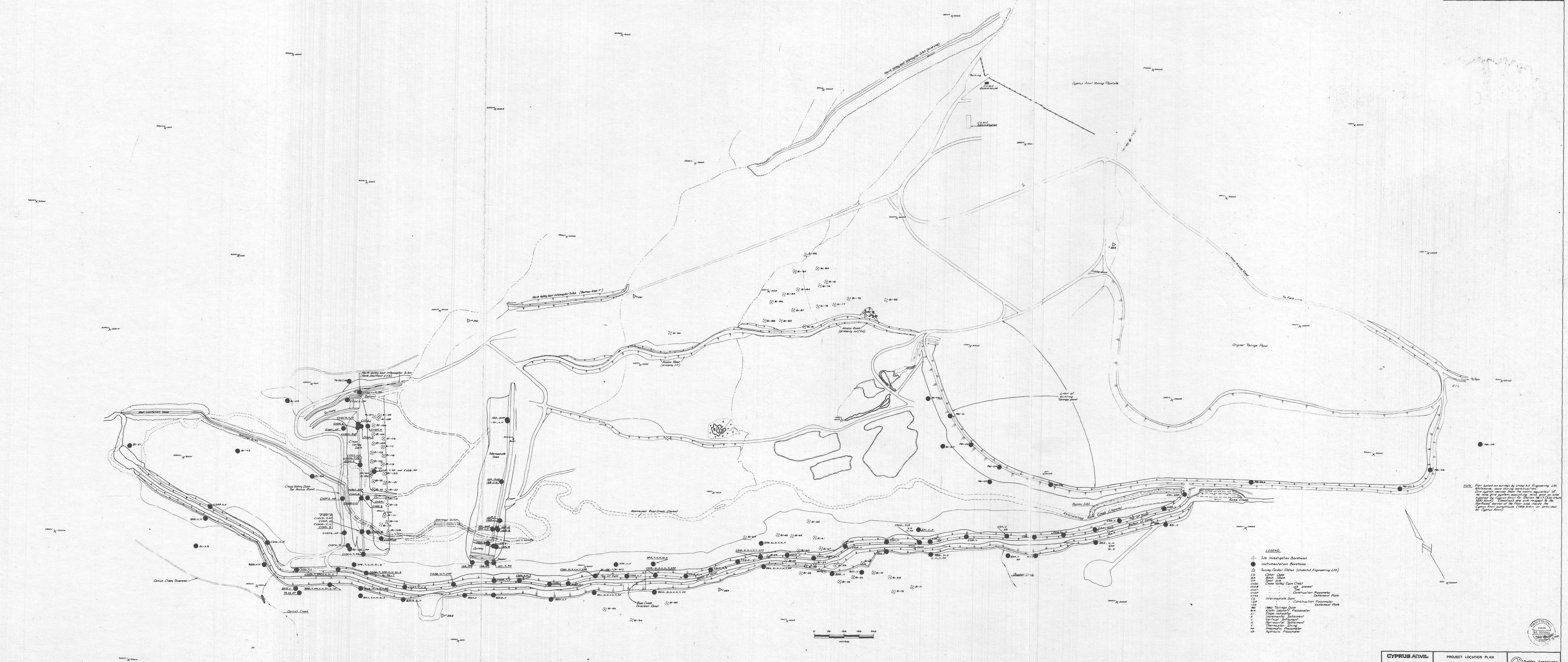
FIGURE 1



CYPRUS ANVIL	PROJECT LOCATION PLAN	Golder Associates (Western Canada) Ltd
Faro Yukon Territory Cyprus Anvil Mining Corporation	INSTRUMENTATION & BOREHOLE LOCATIONS	
	DOWN VALLEY TAILINGS PROJECT	Sheet of