Bruce J. Donald
Reclamation Manager

November 17, 2004

Prairie & Northern Region
Environment Canada
Room 200, 4999 98th Ave.
Edmonton, AB T6B 2X3

Attention: Peter Blackall, Regional Director of Environmental Protection

Dear Sir;

Re: Polaris Mine – 2004 3rd Quarter Metal Mining Effluent Regulations Report

Please find attached the Metal Mining Effluent Report for the Polaris Mine for the 3rd Quarter of 2004. Discharge from Garrow Lake is no longer controlled by siphoning as Garrow Dam was removed earlier this year. As a result the timing of flow and a wide fluctuation in the flow rates was experienced this year. Flow initiated at the beginning of July, later than expected due to an unseasonably cold winter and spring. Flow continued through July and August.

The associated water quality sampling and environmental effects monitoring were conducted as required but with some complications. To ensure we captured two sub-lethal toxicity tests this year, we initiated testing with our first water sampling event of the season. However, on our first attempt, there were problems with the laboratory specimens (the Echinoderms were stimulated to spawn and only one of 39 partially spawned so the test was not initiated) and the Champia parvula sexual reproduction tests were not conducted due to problems at the commercial laboratory. Sandra Blenkinsopp was kept informed of these issues as they arose. We subsequently conducted two additional sub-acute toxicity tests which were successfully processed. The available results from all three sub-acute sampling events are presented in this report.

The first water sample of the discharge season taken on July 7th 2004 at the final discharge point was out of compliance with respect to Total Suspended Solids (TSS). Laboratory results indicated a TSS concentration of 117 mg/L compared to the MMER Schedule 4 limit of 30 mg/L for a single grab sample. All other Schedule 4 parameters were compliant. Concurrent with the July 7th sample, a set of monthly acute lethality samples were

also taken. The results of the acute lethality were compliant with the MMER and showed no acute toxicity to either the Rainbow Trout or the Daphnia magna (i.e. LC50s in both cases were > 100% effluent). Subsequent weekly sampling results for TSS, metals concentrations and acute toxicity results have all been compliant. Sid Bruinsma and Craig Broome were both promptly notified upon our receiving the laboratory results.

Effluent from Garrow Lake ceased flowing by mid-August but surface run off from adjacent slopes maintained water flow at the designated final discharge point into August. By August 17th there was still water at the final discharge point in a pool but the flow was too low to be measured. However, we continued to collect water samples for the remainder of August, so there are water quality results presented in the attached report until August 31, 2004 but the loading calculations are zero due to the lack of flow for the last three weekly samples. The flow conditions during August as well as their implications for effluent sampling were discussed with Environmental Canada representatives in early August.

I will forward a paper copy of this report by mail. Please contact me if there are any questions related to enclosed information.

Yours truly,
Original signed by B Donald

Bruce Donald

Attachments: 3rd Quarterly Monitoring Report

cc:
Walter Kuit (Teck Cominco Limited)
Randy Baker (Azimuth Consulting Group)

POLARIS MINE – MMER MONITORING REPORT

3rd QUARTER 2004

APPENDIX A

i. Information specified by Section 8.1 of Reference Method EPS 1/Rm/13: 96 hr acute rainbow trout test

APPENDIX B

i. Information specified by Section 8.1 of Reference Method EPS 1/Rm/14: 72 hr acute *Daphnia magna* test

APPENDIX C

i. Information specified in Schedule 5 of the MMER (June 2002) for Reference Method EPAW 95-EPA West Coast: 7-day Topsmelt Survival and Growth Tests.

APPENDIX D

i. Information specified in Schedule 5 of the MMER (June 2002) for Reference Method EPS 1/Rm/27-EC: 92 hr Echinoderm (sand dollar) Fertilization Test

APPENDIX E

i. Information specified in Schedule 5 of the MMER (June 2002) for Reference Method EPA/600/4-91-003, Method 1009.0: Algae (*Champia parvula*) 7-day Sublethal Growth Tests

APPENDIX F (Mass Loadings)

i. Concentration & monthly mean concentrations of each deleterious substance of Schedule 4
ii. pH of the effluents samples as required by subsection 12(1)
iii. Description of sample collection method
iv. Total volume of effluent deposited during each month of the quarter as per section 19
v. Mass loading of the deleterious substances set out in Schedule 4 and as per section 20

APPENDIX G

i. Results of the effluent characterization as per paragraph 15(1)(a)

APPENDIX A

96-h Acute Rainbow Trout Toxicity Test

Reporting Requirements for Reference Method EPS 1/RM/13

Section 8.1.1 Effluent

i. Name & location of operation generating the effluent
   - Polaris Mine, Little Cornwallis Island, Nunavut
   - Final Discharge Point for Garrow Lake is geo referenced as 75° 22' 32" N, 97° 48' 37" W.

ii. Date & time of sampling
   - Samples for monthly acute toxicity testing were collected
   - Test 1: Wednesday July 7, 2004 – 2200h
   - Test 2: Tuesday July 27, 2004 – 2130h
   - Test 3: Tuesday August 24, 2004 – 1500h

iii. Type of sample
   - Final effluent water

iv. Brief description of sampling point
   - 20m downstream of the siphon discharge point at Garrow Lake dam

v. Sampling method
   - Water was collected from at least 15cm below the surface using a water pump with silicon tubing
   - Water was collected from the upstream direction
   - The pump was flushed with site water for at least one minute prior to sample collection
   - 2 x 20L sample bottles were filled

vi. Name of person submitting samples
   - Dennis Lu (Gartner Lee) – July 7, July 27, 2004
   - Patrick Allard (Azimuth) – August 24, 2004

Section 8.1.2 Test Facilities and Conditions

i. Test type & method
   - 96-hour Rainbow Trout LC_{50}

ii. Indications of deviations from requirements in Sections 2 to 7 of Method EPS 1/RM/13
   - No deviations from requirements
   - Salinity controls were run
   - Sample water salinity was 7ppt (Test 1); 3ppt (Test 2), and 6ppt (Test 3)

iii. Name and city of testing laboratory
   - EVS Environment Consultants, North Vancouver, BC

iv. Percent mortality of fish in stock tank(s)
   - Test 1: 0%
   - Test 2: 0.25%
   - Test 3: 0%

v. Species of test organism
   - Rainbow Trout (*Oncorhynchus mykiss*)

vi. Date and time for start of definitive test
   - Test 1: Monday July 12, 2004 – 1445h
   - Test 2: Sunday August 1, 2004 – 1030h
   - Test 3: Friday August 27, 2004 – 1100h

vii. Person(s) performing the test and verifying the results
   - Rachel DeWynter, Robert Harrison

viii. pH, temperature, dissolved oxygen, and conductivity of unadjusted, undiluted effluent
   - Test 1: pH – 8.1, T - 14.0°C, DO - 10.0mg/L, C – 11730 µS/cm
   - Test 2: pH - 7.6, T - 14.0°C, DO - 10.1mg/L, C – 4870 µS/cm
   - Test 3: pH – 7.7, T - 15.0°C, DO – 9.9mg/L, C – 7416 µS/cm

Reporting Requirements for Reference Method EPS 1/RM/13

ix. Confirmation that no adjustment of sample or solution pH occurred
- Test 1: No pH adjustment
- Test 2: No pH adjustment
- Test 3: No pH adjustment

x. Indication of aeration of test solutions before introduction of fish
- Test 1: 6.5 ± 1 mL/min/L for 30mins
- Test 2: 6.5 ± 1 mL/min/L for 30mins
- Test 3: 6.5 ± 1 mL/min/L for 30mins

xi. Concentrations and volumes tested
- Concentrations (% effluent volume / total volume) tested and total volumes used were:
- Control (0%) - 10 L (test 1&2), 12 L (test 3)
- 6.25% - 10 L (test 1&2), 12 L (test 3)
- 12.5% - 10 L (test 1&2), 12 L (test 3)
- 25% - 10 L (test 1&2), 12 L (test 3)
- 50% - 10 L (test 1&2), 12 L (test 3)
- 100% - 10 L (test 1&2), 12 L (test 3)
- Salinity Control - 10 L (test 1&2), 12 L (test 3)

xii. Measurements of dissolved oxygen, pH and temperature
- Test 1: DO: 9.3 - 10.1 mg/L, pH: 7.0 – 8.3, T: 14.0 – 16.0 °C
- Test 2: DO: 9.6 - 10.1 mg/L, pH: 6.8 - 8.3, T: 14.0 °C
- Test 3: DO: 9.1 – 10.1 mg/L, pH: 7.2 – 7.9, T: 15.0 – 16.0 °C

xiii. Number of fish added to each test vessel
- 10 fish/ vessel

xiv. Mean and range of fork length of control fish at end of test
- Test 1: 34mm (29-37)
- Test 2: 33mm (31-35)
- Test 3: 40mm (38 -44)

xv. Mean wet weight of individual control fish at end of the test
- Test 1: 0.39g (0.22-0.54)
- Test 2: 0.34g (0.29-0.42)
- Test 3: 0.45g (0.31-0.61)

xvi. Estimated loading density of fish in test solutions
- Test 1: 0.39g/L
- Test 2: 0.34g/L
- Test 3: 0.38g/L

Section 8.1.3 Results

i. Number of mortalities of fish in each test solution
- Results were the same for Test 1, Test 2, and Test 3, except where noted
- Control (0%) - 0
- 6.25% - 0
- 12.5% - 0
- 25% - 0
- 50% - 0
- 100% - 0
- Salinity Control - 0

Reporting Requirements for Reference Method EPS 1/RM/13

ii. Number of control fish showing atypical/stressed behaviour
- None in Test 1, Test 2, or Test 3

iii. Mean mortality rate in solutions of effluent and control water
- Results were the same for Test 1, Test 2, and Test 3, except where noted
- Control (0%) - 0%
- 6.25% - 0%
- 12.5% - 0%
- 25% - 0%
- 50% - 0%
- 100% - 0%
- Salinity Control - 0%

iv. Estimate of 96-h LC50 in multi-concentration tests
- Results were the same for Test 1, Test 2, and Test 3
- 96hr LC_{50} concentration > 100% effluent

v. Most recent 96-h LC50 for reference toxicity test(s)
- Reference toxicity tests for Toxicant: SDS
- Test 1: (Jun-21-04) 96-h LC_{50} = 23mg/L SDS, 95% CL = 20 - 25mg/L
- Test 2: (Jul-23-04) 96-h LC_{50} = 21mg/L SDS, 95% CL = 17 - 26mg/L
- Test 3: (Aug-27-04) 96-h LC_{50} = 38mg/L SDS, 95% CL = 33 - 44mg/L

APPENDIX B

72-h Acute *Daphnia magna* Toxicity Test

Reporting Requirements for Reference Method EPS 1/RM/14

Section 8.1.1 Effluent

i. Name & location of operation generating the effluent
   - Polaris Mine, Little Cornwallis Island, Nunavut
   - Final Discharge Point for Garrow Lake is geo referenced as 75° 22' 32" N, 97° 48' 37" W.

ii. Date & time of sampling
   - Samples for monthly acute toxicity testing were collected
   - Test 1: Wednesday July 7, 2004 – 2200h
   - Test 2: Tuesday July 27, 2004 – 2130h
   - Test 3: Tuesday August 24, 2004 – 1500h

iii. Type of sample
   - Final effluent water

iv. Brief description of sampling point
   - 20m downstream of the siphon discharge point at Garrow Lake dam

v. Sampling method
   - Water was collected from at least 15cm below the surface using a water pump with silicon tubing
   - Water was collected from the upstream direction
   - The pump was flushed with site water for at least one minute prior to sample collection
   - 2 x 20L sample bottles were filled

vi. Name of person submitting samples
   - Dennis Lu (Gartner Lee), Test 1 & 2
   - Patrick Allard (Azimuth), Test 3

Section 8.1.2 Test Facilities and Conditions

i. Test type & method
   - 48-hour *Daphnia magna* LC_{50}

ii. Indications of deviations from requirements in Sections 2 to 7 of Method EPS 1/RM/13
   - No deviations from requirements
   - Salinity controls were run
   - Sample water salinity was 7ppt (Test 1); 3ppt (Test 2), and 6ppt (Test 3)

iii. Name and city of testing laboratory
   - EVS Environment Consultants, North Vancouver, BC

iv. Species of test organism
   - *Daphnia magna*

v. Date and time for start of definitive test
   - Test 1: Sunday July 11, 2004 – 1400h
   - Test 2: Friday July 30, 2004 – 1400h
   - Test 3: Friday August 27, 2004 – 1100h

vi. Person(s) performing the test and verifying the results
   - Armando Tang, Rachel DeWynter

vii. pH, temperature, dissolved oxygen, and conductivity of unadjusted, undiluted effluent
   - Test 1: pH - 7.8 – 7.9, T - 20.0 – 22.0 °C, DO – 9.1 – 11.4mg/L, C - 11850µhos/cm
   - Test 2: pH - 7.8 – 8.0, T – 21.5 – 22.0 °C, DO - 8.8 – 12.1mg/L, C - 5020µhos/cm
   - Test 3: pH – 7.8 - 8.1, T – 22.0 – 23.0 °C, DO - 8.7 – 10.2mg/L, C - 9320µmhos/cm

viii. Confirmation that no adjustment of sample or solution pH occurred
   - Test 1: No pH adjustment
   - Test 2: No pH adjustment
   - Test 3: No pH adjustment

Reporting Requirements for Reference Method EPS 1/RM/14

ix. Indication of any adjustment of hardness of effluent sample
- Test 1: No hardness adjustment
- Test 2: No hardness adjustment
- Test 3: No hardness adjustment

x. Indication of any aeration of sample
- Test 1: Aeration for 9mins
- Test 2: Gentle Aeration for 10mins
- Test 3: 20mins

xi. Concentrations and volumes tested
- For all 3 Tests the concentrations (% effluent volume / total volume) tested and total volumes used were:
    - Control (0%) - 200 mL
    - 6.25% - 200 mL
    - 12.5% - 200 mL
    - 25% - 200 mL
    - 50% - 200 mL
    - 100% - 200 mL
    - Salinity Control - 200 mL

xii. Measurements of dissolved oxygen, pH and temperature
- Test 1: DO: 8.6 – 9.1 mg/L, pH: 7.7 – 8.2, T: 20.0 - 21.5 °C
- Test 2: DO: 8.6 - 9.1 mg/L, pH: 7.6 - 8.0, T: 20.0 - 21.5 °C
- Test 3: DO: 8.5 - 9.0 mg/L, pH: 7.6 - 8.1, T: 20.5 - 22.0 °C

xiii. Estimates of time to first brood, average number of neonates per brood, and percent mortality during the seven-day period prior to the test
- Test 1: 8 days to brood, 27.5 neonates/brood, 9.5% mortality in 7d prior to test
- Test 2: 7 days to brood, 24 neonates/brood, 6.0% mortality in 7d prior to test
- Test 3: 7 days to brood, 21 neonates/brood, 0% mortality in 7d prior to test

xiv. Number of neonates per test vessel and milliliters of solution per daphnid
- Methods for all tests and dilution series were the same:
- 10 neonates per vessel
- 200 mL of solution per daphnid

Section 8.1.3 Results

i. Number of dead and/or immobile daphnids in each test solution including controls
- Results were the same for Test 1, Test 2, and Test 3, except where noted
- Control (0%) - 0 dead / immobile
- 6.25% - 0 dead / immobile
- 12.5% - 0 dead / immobile
- 25% - 0 dead / immobile
- 50% - 0 dead / immobile
- 100% - 0 dead / immobile (test 1), 3 dead/immobile (test 2), 0 dead/immobile (test 3)
- Salinity Control - 0 dead / immobile

ii. For single-concentration test the number of daphnids dead in each of three replicate effluent solutions and in each of three replicate control solutions at end of test. Also report the mean value.
- Single concentration test was not conducted, dilution series tests were conducted

Reporting Requirements for Reference Method EPS 1/RM/14

iii. Estimate of 48-h LC50 and 95% confidence limits in multi-concentration tests, 48-h EC50 for immobilization and 95% confidence limits, indication of statistical method on which results are based.
- Test 1: 48-h LC_{50} = > 100% effluent
- Test 2: 48-h LC_{50} = > 100% effluent
- Test 3: 48-h LC_{50} = > 100% effluent

iv. Most recent 48-h LC50 for reference toxicant test(s), reference chemical(s), date test initiated, historic geometric mean LC50 and warning limits.
- Reference toxicity tests for Toxicant: Zinc
- Test 1: (July-6-04) 48-h LC_{50} = 483µg/L Zinc, 95% CL = 403-578µg/L
- Test 2: (July-27-04) 48-h LC_{50} = 683µg/L Zinc, 95% CL = 578-807µg/L
- Test 3: (Aug-24-04) 48-h LC_{50} = 536µg/L Zinc, 95% CL = 438-656µg/L

APPENDIX C

7-d Topsmelt Growth and Survival Toxicity Test

Effluent Sample

i. Name & location of operation generating the effluent
   - Polaris Mine, Little Cornwallis Island, Nunavut
   - Final Discharge Point for Garrow Lake is geo referenced as 75° 22' 32" N, 97° 48' 37" W.

ii. Date & time of sampling
   - Samples for sublethal toxicity testing were collected:
     Test 1 - Wednesday July 7, 2004 – 1100h
     Test 2 - Tuesday July 27, 2004 – 0930h
     Test 3 – Tuesday Aug 24, 2004 – 1500h

iii. Type of sample
   - Final effluent water

iv. Brief description of sampling point
   - 20m downstream of the siphon discharge point at Garrow Lake dam

v. Sampling method
   - Water was collected from at least 15cm below the surface using a water pump with silicon tubing
   - Water was collected from the upstream direction
   - The pump was flushed with site water for at least one minute prior to sample collection
   - 4 x 20L sample bottles were filled

vi. Name of person submitting samples
   - Dennis Lu (Gartner Lee) Tests 1 & 2
   - Patrick Allard (Azimuth) Test 3

Test Organisms Imported from External Supplier

i. Species of test organism
   - Topsmelt (*Atherinops affinis*)

ii. Name and city of testing laboratory
   - EVS Environment Consultants, North Vancouver, BC

iii. Source of test species
   - Aquatic Bio Systems (ABS), Fort Collins, Colorado

iv. Date test species acquired on
   - Test 1 – July 8, 2004
   - Test 2 – July 29, 2004
   - Test 3 – August 26, 2004

v. Indications of deviations from EC guidance on the importation of test organisms
   - No deviations from EC requirements

vi. Percent mortality of fish in 24-hour period preceding the test
   - Test 1 - <10% mortality
   - Test 2 - <10% mortality
   - Test 3 - <10% mortality

vii. Age at start of test
   - Test 1 - 11 days post-hatch
   - Test 2 – 10 days post-hatch
   - Test 3 – 10 days post-hatch

viii. Unusual appearance, behaviour, or treatment of larvae before their use in the test
   - None noted for any test.

ix. Confirmation that larvae are actively feeding and swimbladders are not inflated
   - All tests - Larvae actively feeding and swimbladders not inflated

x. Confirmation that temperature change was <3°C and dissolved oxygen was maintained at >6mg/L during transport

- Temperature change was <2°C and dissolved oxygen supersaturated mg/L during transport

xi. Test organism acclimation rate at the testing laboratory
- Holding water conditions upon arrival were DO=supersaturated, pH = 7.9, T = 20°C
- Organisms were acclimated slowly overnight
- Addition of EVS lab seawater at intervals of 30 – 60min to reach acceptable conditions
- Organisms were acclimated to DO = 7.4mg/L, salinity = 28ppt, T=20°C

Test Facilities and Conditions

i. Test type & method
- 7-day Topsmelt (*Atherinops affinis*) Survival and Growth Toxicity Test
- Static renewal
- Sample water was renewed daily
- Reference Method - EPA/600/R-95/136 (EPAW 95-EPA West Coast)

ii. Indications of deviations from requirements in Sections 11 of Method EPA/600/R-95/136 (EPAW 95-EPA West Coast)
- No deviations from requirements
- Salinity controls were run
- Sample water salinity for
    - Test 1 was 7ppt
    - Test 2 was 2.6 ppt
    - Test 3 was 5.2ppt

iii. Date and time for start of definitive test
- Test 1 Saturday July 10, 2004 – 1730h
- Test 2 Friday July 30, 2004 – 1500h
- Test 3 Tuesday August 27, 2004 – 1230h

iv. Test vessel description
- For all tests was a 600mL beaker

v. Person(s) performing the test and verifying the results
- Test 1: Testing by: Andy Diewald, Anja Fouche, Keven Goodearle, Ann-Marie Norris and Jenny Shao; Statistical analyses by Jenny Shao and QA/QC by Julianna Kalokai
- Test 2: Testing by: Andy Diewald, Ann-Marie Norris and Jenny Shao; Statistical analysis by Jenny Shao and Kathryn Sentance; QA/QC by Armando Tang
- Test 3: Testing by Andy Diewald, Anja Fouche and Jenny Shao; Statistics by Jenny Shao and Kathryn Sentance; QA/QC by Julianna Kalokai

vi. pH, temperature, dissolved oxygen, and conductivity of unadjusted, undiluted effluent
- Test 1: pH 8.1, T 19.5 °C, DO 9.3 mg/L, C 11660 µmhos/cm
- Test 2: pH 7.8, T 20.0 °C, DO 10.7 mg/L, C 4880 µmhos/cm
- Test 3: pH 7.6, T 20.0 °C, DO 10.1 mg/L, C 9230 µmhos/cm

vii. Confirmation that no adjustment of sample or solution pH occurred
- No pH adjustment

viii. Indication of aeration of test solutions before introduction of fish
- Pre-aeration at 6.5mL/min/L for 30mins due to supersaturation of sample with O_2 when sample was heated to 19°C

ix. Indication that EC guidance document for salinity adjustment was followed
- The following was done for all 3 tests:
    - No deviations from EC guidance document on preparation of hypersaline brine
    - HSB prepared from natural seawater concentrated to 90ppt (by freezing/refreezing to remove frozen layer and concentrate salts)

- No deviations from EC guidance document for salinity adjustment of sample
- HSB was added to samples to salinity adjust them to 30ppt

x. Type and source of control/dilution water
- For all 3 tests, control/dilution water was UV-sterilized, 0.45µm-filtered natural seawater from the Vancouver Aquarium

xi. Concentrations and volumes tested:
- Concentrations (% effluent volume / total volume) tested and total volumes used were:
- For Test 1:
    - Control (0%) - 200 mL
    - Salinity Control (0%) - 200 mL
    - 4.5% - 200mL
    - 9.1% - 200mL
    - 18.2% - 200mL
    - 36.3% - 200mL
    - 72.6% - 200mL
- For Test 2:
    - Control (0%) - 200 mL
    - Salinity Control (0%) - 200 mL
    - 4.3% - 200mL
    - 8.6% - 200mL
    - 17.3% - 200mL
    - 34.5% - 200mL
    - 69.0% - 200mL
- For Test 3:
    - Control (0%) - 200 mL
    - Salinity Control (0%) - 200 mL
    - 4.4% - 200mL
    - 9.0% - 200mL
    - 18.0% - 200mL
    - 36.0% - 200mL
    - 71.0% - 200mL

xii. Number of replicated per concentration
- For all 3 tests: 5 replicates per concentration

xiii. Number of organisms added to each test vessel
- For all 3 tests: 5 fish per vessel

xiv. Manner and rate of exchange of test solutions
- For all 3 test: Daily renewal

xv. Measurements of dissolved oxygen, pH and temperature
- Test 1: DO: 6.1 - 7.9 mg/L, pH: 7.8 - 8.3, T: 19.0 - 21.0 °C
- Test 2: DO: 6.4 - 7.7 mg/L, pH: 7.8 - 8.1, T: 20.0 – 20.5 °C
- Test 3: DO: 6.4 - 7.6 mg/L, pH: 7.8 - 8.3, T: 20.0 - 21.0 °C

Results

i. Number and % of mortalities of fish in each test solution
- Test 1: Totals from all 5 replicates are presented:
    - Control (0%) – 1/25 = 4%

- Salinity Control 1/25 = 4%
- 4.5% - 0/25 = 0%
- 9.1% - 0/25 = 0%
- 18.2% - 0/25 = 0%
- 36.3% - 1/25 = 4%
- 72.6% - 2/25 = 8%

- Test 2: Totals from all 5 replicates are presented:
  - Control (0%) – 0/25 = 0%
  - Salinity Control 0/25 = 0%
  - 4.3% - 1/25 = 4%
  - 8.6% - 1/25 = 4%
  - 17.3% - 0/25 = 0%
  - 34.5% - 0/25 = 0%
  - 69.0% - 1/25 = 4%
- Test 3: Totals from all 5 replicates are presented:
  - Control (0%) – 0/25 = 0%
  - Salinity Control 0/25 = 0%
  - 4.4% - 0/25 = 0%
  - 9.0% - 0/25 = 0%
  - 18.0% - 0/25 = 0%
  - 36.0% - 1/25 = 4%
  - 71.0% - 0/25 = 0%

ii. Average dry weight per original fish in test vessel

- Test 1: Means from all 5 replicates are presented:
  - Control (0%) – 0.93 mg
  - Salinity Control – 1.08 mg
  - 4.5% - 1.00 mg
  - 9.1% - 1.04 mg
  - 18.2% - 0.96 mg
  - 36.3% - 1.10 mg
  - 72.6% - 0.99 mg
- Test 2: Means from all 5 replicates are presented:
  - Control (0%) – 0.98 mg
  - Salinity Control – 0.99 mg
  - 4.3% - 0.91 mg
  - 8.6% - 0.87 mg
  - 17.3% - 0.78 mg
  - 34.5% - 0.90 mg
  - 69.0% - 0.77 mg
- Test 3: Means from all 5 replicates are presented:
  - Control (0%) – 0.93 mg
  - Salinity Control – 0.96 mg
  - 4.4% - 1.06 mg
  - 9.0% - 0.87 mg
  - 18.0% - 0.97 mg
  - 36.0% - 0.92 mg
  - 71.0% - 0.87 mg

iii. Estimate of 7-d LC_{50} (95% CL)

- Test 1: 7-d LC_{50} concentration > 72.6% effluent (highest concentration tested due to dilution for salinity adjustment)
- Test 2: 7-d LC_{50} concentration > 69.0% effluent (highest concentration tested due to dilution for salinity adjustment)
- Test 3: : 7-d LC_{50} concentration > 71.0% effluent (highest concentration tested due to dilution for salinity adjustment)
- Quantal statistic methods not applicable

iv. Estimate of 7-d IC_{25} (95% CL) for growth

- Test 1: 7-d IC_{25} concentration > 72.6% effluent (highest concentration tested due to dilution for salinity adjustment)
- Test 2: 7-d IC_{25} concentration > 69.0% effluent (highest concentration tested due to dilution for salinity adjustment)
- Test 3: 7-d IC_{25} concentration > 71.0% effluent (highest concentration tested due to dilution for salinity adjustment)

v. Current reference toxicity tests (95% CL) for 7-d LC_{50} for survival and 7-d IC_{50} for growth

- Test 1 :Reference toxicity tests for Toxicant: Copper
    - Test conducted on July 10, 2004, same day as effluent test
    - Reference toxicant test was conducted on the same batch of externally supplied topsmelt used in the effluent test and under the same experimental conditions as the effluent test
    - 7-d LC_{50} survival = 161mg/L Cu, 95% CL = 139-188mg/L
    - 7-d IC_{50} growth = 147mg/L Cu, 95% CL = 119-169mg/L
- Test 2 :Reference toxicity tests for Toxicant: Copper
    - Test conducted on July 30, 2004, same day as effluent test
    - Reference toxicant test was conducted on the same batch of externally supplied topsmelt used in the effluent test and under the same experimental conditions as the effluent test
    - 7-d LC_{50} survival = 130mg/L Cu, 95% CL = 115-147mg/L
    - 7-d IC_{50} growth = 124mg/L Cu, 95% CL = 87-144mg/L
- Test 3 :Reference toxicity tests for Toxicant: Copper
    - Test conducted on August 27, 2004, same day as effluent test
    - Reference toxicant test was conducted on the same batch of externally supplied topsmelt used in the effluent test and under the same experimental conditions as the effluent test
    - 7-d LC_{50} survival = 121mg/L Cu, 95% CL = 107-137mg/L
    - 7-d IC_{50} growth = 128mg/L Cu, 95% CL = 85-150mg/L

vi. Reference toxicity warning limits (+/- SD) for 7-d LC_{50} for survival and 7-d IC_{50} for growth

- Test 1: Reference toxicity tests for Toxicant: Copper
    - 7-d LC_{50} survival = 137 ± 56mg/L Cu
    - 7-d IC_{50} growth = 135 ± 51mg/L Cu
- Test 2: Reference toxicity tests for Toxicant: Copper
    - 7-d LC_{50} survival = 129 ± 48mg/L Cu,
    - 7-d IC_{50} growth = 130 ± 52mg/L Cu
- Test 3: Reference toxicity tests for Toxicant: Copper
    - 7-d LC_{50} survival = 132 ± 48mg/L Cu,
    - 7-d IC_{50} growth = 131 ± 51mg/L Cu

APPENDIX D

92-h Echinoderm Fertilization Test

Reporting Requirements for Reference Method EPS1/RM/27-EC 92 (Sperm Cell)

Effluent Sample

i. Name & location of operation generating the effluent
   - Polaris Mine, Little Cornwallis Island, Nunavut
   - Final Discharge Point for Garrow Lake is geo referenced as 75^{o} 22' 32" N, 97^{o} 48' 37" W.

ii. Date & time of sampling
   - Samples for sublethal toxicity testing were collected:
     Test 1 - Wednesday July 7, 2004 – 1100h
     Test 2 - Tuesday July 27, 2004 – 0930h
     Test 3 – Tuesday Aug 24, 2004 – 1500h

iii. Type of sample
   - Final effluent water

iv. Brief description of sampling point
   - 20m downstream of the siphon discharge point at Garrow Lake dam

v. Sampling method
   - Water was collected from at least 15cm below the surface using a water pump with silicon tubing
   - Water was collected from the upstream direction
   - The pump was flushed with site water for at least one minute prior to sample collection
   - 4 x 20L sample bottles were filled

vi. Name of person submitting samples
   - Dennis Lu (Gartner Lee) Tests 1 & 2
   - Patrick Allard (Azimuth) Test 3

Test Organisms

i. Species of test organism
   - Sandollar Echinoid (*Dendraster excentricus*)

ii. Name and city of testing laboratory
   - EVS Environment Consultants, North Vancouver, BC

iii. Source of test species
   - M-REP, Escondido, California
   - All adults providing gametes are from the same population and source
   - Gametes are spawned in-house at EVS

iv. Date test species acquired on
   - Test 1: Test was not initiated due to inability of the Sandollars to spawn.
   - Test 2: July 30, 2004
   - Test 3: August 27, 2004

v. Holding time and conditions for adults
   - Test 1: N.A.
   - Test 2: Adults received at the testing laboratory the day of the test.
   - Test 3: Adults received at the testing laboratory the day of the test.

vi. Indications of deviations from EC guidance on the importation of test organisms
   - Test 1: na
   - Test 2: No deviations from EC requirements
   - Test 3: No deviations from EC requirements

vii. Weekly percent mortality of adults being held over 7d preceding test
   - Test 1: na
   - Test 2: <2% per day over the 7 days preceding the test
   - Test 3: <2% per day over the 7 days preceding the test

viii. Age of test organisms
   - Test 1: n.a.
   - Test 2: < 4 hours after spawning

Reporting Requirements for Reference Method EPS1/RM/27-EC 92 (Sperm Cell)

- Test 3: < 4 hours after spawning

ix. Unusual appearance, behaviour, or treatment of adults or gametes before test start
- Test 1: Test was not initiated due to inability of the Sandollars to spawn
- Test 2 Organisms appear healthy
- Test 3: Organisms appear healthy

Test Facilities and Conditions

i. Test type & method
- Echinoderm (*Dendraster excentricus*) Fertilization Toxicity Test
- Static
- Reference Method – EPS/1/RM/27 with 1997 amendments

ii. Test duration
- Test 1: na
- Test 2: 10:10 min (10min sperm + 10min sperm & egg)
- Test 3: 10:10 min (10min sperm + 10min sperm & egg)

iii. Date and time for start of definitive test
- Test 1: na
- Test 2: Friday July 30, 2004 – 1620h
- Test 3: Friday August 27, 2004 – 1334h

iv. Test vessel description
- Test 1: na
- Test 2: 16 x 125mm test tubes
- Test 3: 16 x 125mm test tubes

v. Person(s) performing the test and verifying the results
- Test 1: na
- Test 2: Testing by Kathryn Sentance and Ann-Marie Norris. Statistical analyses by Jenny Shao and Kathryn Sentance. QA/QC reviewed by Julianna Kalokai.
- Test 3: Testing by Kathryn Sentance and Ann-Marie Norris. Statistical analyses by Jenny Shao and Kathryn Sentance. QA/QC reviewed by Julianna Kalokai.

vi. Indication of rate and duration of pre-aeration of test solutions before initiation of test
- Test 1: na
- Test 2: No pre-aeration noted.
- Test 3: No pre-aeration noted.

vii. Confirmation that no adjustment of sample or solution pH occurred
- Test 1: na
- Test 2: No pH adjustment
- Test 3: No pH adjustment

viii. Procedure for sample filtration
- Test 1: na
- Test 2: No sample filtration
- Test 2: No sample filtration

ix. Procedure for preparation of hypersaline brine (HSB) as per EC guidance document on salinity adjustment – July 1997
- Test 1: na
- Test 2: 30 ppt adjusted with hypersaline brine (HSB). Preparation of HSB and salinity adjustment as per EC guidance document on Salinity adjustment – July 1997
- Test 2: 30 ppt adjusted with hypersaline brine (HSB). Preparation of HSB and salinity adjustment as per EC guidance document on Salinity adjustment – July 1997

x. Procedure for salinity adjustment as per EC guidance document on salinity adjustment – July 1997

Reporting Requirements for Reference Method EPS1/RM/27-EC 92 (Sperm Cell)

- No deviations from EC guidance for salinity adjustment
- Test 1: na
- Test 2: salinity adjusted from 2.8 to 28 ppt
- Test 3: salinity adjusted from 5 to 28 ppt

xi. Type and source of control/dilution water
- Test 1: na
- Test 2: UV-sterilized, 0.45µm-filtered natural seawater from the Vancouver Aquarium
- Test 3: UV-sterilized, 0.45µm-filtered natural seawater from the Vancouver Aquarium

xii. Concentrations and volumes tested
- Test 1: na
- Test 2: Concentrations (% effluent volume / total volume) tested and total volumes used were:
    - Control (0%) - 10mL
    - Salinity Control (0%) - 10mL
    - 4.6% - 10mL
    - 9.1% - 10mL
    - 18.3% - 10mL
    - 36.6% - 10mL
    - 73.1% - 10mL
- Test 3: Concentrations (% effluent volume / total volume) tested and total volumes used were:
    - Control (0%) - 10mL
    - Salinity Control (0%) - 10mL
    - 4.7% - 10mL
    - 9.4% - 10mL
    - 18.8% - 10mL
    - 37.5% - 10mL
    - 75.1% - 10mL

xiii. Number of replicated per concentration
- Test 1: na
- Test 2: 4 replicates per treatment concentration
- Test 3: 4 replicates per treatment concentration

xiv. Number of organisms per container
- Test 1: na
- Test 2: 100 eggs per vessel
- Test 3: 100 eggs per vessel

xv. Measurements of pH and dissolved oxygen in sample water before use
- Test 1: na
- Test 2: pH 8.1, DO 8.5
- Test 3: pH 8.0, DO 8.5

xvi. Measurements of pH, temperature, dissolved oxygen, and salinity during test
- Test 1: na
- Test 2: pH – 8.0 – 8.1, T - 15.0-16.0°C, DO - 8.2-8.5mg/L, salinity - 28ppt
- Test 3: pH – 8.2 – 8.5, T - 15.0-16.0°C, DO - 8.2-8.5mg/L, salinity - 28ppt

Results

i. Number and % of fertilized eggs in each test concentration
- Test 1: na
- Test 2: (Number is equal to percent since totals were 100)
    - Control (0%): #F = 59, 62, 56, 65 #UF = 41, 38, 44, 35
    - Salinity Control: #F = 60, 57, 59, 62 #UF = 40, 43, 41, 38

Reporting Requirements for Reference Method EPS1/RM/27-EC 92 (Sperm Cell)

- 4.6%: #F = 60, 66, 56, 58 #UF = 40, 34, 44, 42
- 9.1%: #F = 46, 42, 45, 42 #UF = 54, 58, 55, 58
- 18.3%: #F = 39, 39, 37, 36 #UF = 61, 64, 63, 64
- 36.6%: #F = 31, 34, 25, 31 #UF = 69, 66, 75, 69
- 73.1%: #F = 19, 20, 21, 20 #UF = 81, 80, 79, 80

- Test 3: (Number is equal to percent since totals were 100)
  - Control (0%): #F = 77, 80, 74, 77 #UF = 23, 20, 26, 23
  - Salinity Control: #F = 76, 73, 79, 77 #UF = 24, 27, 21, 23
  - 4.7%: #F = 78, 74, 76, 72 #UF = 22, 26, 24, 28
  - 9.4%: #F = 61, 62, 62, 60 #UF = 39, 38, 38, 40
  - 18.8%: #F = 56, 58, 59, 55 #UF = 44, 42, 41, 45
  - 37.5%: #F = 49, 50, 50, 48 #UF = 51, 50, 50, 52
  - 75.1%: #F = 25, 27, 24, 27 #UF = 75, 73, 76, 73

ii. Estimate of IC_{25} (95% CL) for fertilization success

- Test 1: na
- Test 2: IC_{25} concentration = 8.7 (7.6 – 9.9)% v/v effluent
- Test 3: IC_{25} concentration = 17.5 (11.6 – 22.6)% v/v effluent

iii. Current reference toxicity tests (95% CL) for IC_{50} for fertilization

- Test 1: na
- Test 2: Reference toxicity tests for Toxicant: Sodium Dodecyl Sulfate
  - Test conducted on July 30, 2004, same day as effluent test
  - Reference test conducted under same conditions
  - IC_{50} for fertilization = 2.1mg/L SDS, 95% CL = (1.9 – 2.4)mg/L
- Test 3: Reference toxicity tests for Toxicant: Sodium Dodecyl Sulfate
  - Test conducted on August 27, 2004, same day as effluent test
  - Reference test conducted under same conditions
  - IC_{50} for fertilization = 2.3mg/L SDS, 95% CL = (2.1 – 2.4)mg/L

iv Reference toxicant warning limits (+/- 2SD) for IC_{50} for fertilization

- Test 1: na
- Test 2: 4.2 +/- 4.8 mg/L SDS
- Test 3: 3.9 +/- 4.6 mg/L SDS

APPENDIX E

7-d Sublethal *Champia* (Algae) Toxicity Test

Reporting Requirements for Reference Method EPA/600/4-91/003 Method 1009.0

Effluent Sample

i. Name & location of operation generating the effluent
   - Polaris Mine, Little Cornwallis Island, Nunavut
   - Final Discharge Point for Garrow Lake is geo referenced as 75° 22' 32" N, 97° 48' 37" W.

ii. Date & time of sampling
   - Samples for yearly sublethal toxicity testing were collected:
     Test 1 - Wednesday July 7, 2004 – 1100h
     Test 2 - Tuesday July 27, 2004 – 0930h
     Test 3 – Tuesday Aug 24, 2004 – 1500h

iii. Type of sample
   - Final effluent water

iv. Brief description of sampling point
   - 20m downstream of the siphon discharge point at Garrow Lake dam

v. Sampling method
   - Water was collected from at least 15cm below the surface using a water pump with silicon tubing
   - Water was collected from the upstream direction
   - The pump was flushed with site water for at least one minute prior to sample collection
   - 1 x 4L sample bottles were filled

vi. Name of person submitting samples
   - Dennis Lu (Gartner Lee) Tests 1 & 2
   - Patrick Allard (Azimuth) Test 3

vii. Temperature of water upon receipt at lab
   - Test 1: Test was not conducted as sample was delayed by weather and person qualified to conduct the work at the lab left for vacation. This was discussed with Sandra Blenkinsopp at the time to provide direction.
   - Test 2: 8°C
   - Test 3: 17°C

Test Organisms

i. Species of test organism
   - Algae (*Champia parvula*)

ii. Name and city of testing laboratory
   - Saskatchewan Research Council [SRC], Saskatoon, SK

iii. Source of test species
   - Test 1: na
   - Test 2 and Test 3
     - Sexually mature male and female branches
     - Obtained from USEPA, Hatfield Marine Science Center, Newport Oregon, 1995
     - Appear in good health
     - Females have trichogynes, males have sori with spermatia

Test Facilities and Conditions

i. Test type & method
   - *Champia parvula* sexual reproduction test
   - Static, non-renewal
   - 2-day exposure, followed by 5-7 day recovery period for cystocarp development
   - Reference Method - EPA/600/4-91/003, Method 1009.0

ii. Date and time for start of definitive test
   - Test 1: na

Reporting Requirements for Reference Method EPA/600/4-91/003 Method 1009.0

- Test 2: Friday July 30, 2004 – time not noted but lab notes state tests started within 72 hrs of collection
- Test 3: Friday August 27, 2004 – time not noted but lab notes state tests started within 72 hrs of collection

iii. Test vessel description
- Test 1: na
- Test 2: 270mL transparent polystyrene cups with polystyrene lids
- Test 2: 270mL transparent polystyrene cups with polystyrene lids

iv. Person(s) performing the test and verifying the results
- Test 1: na
- Tests 2 & 3 - Mary Moody

v. Indication of pre-aeration of test solutions
- Test 1: na
- Tests 2 & 3 - No pre-aeration

vi. Confirmation that no pH adjustment of sample or solution occurred
- Test 1: na
- Tests 2 & 3: - No pH adjustment

vii. Indication that EC guidance document for salinity adjustment was followed
- Test 1: na
- Test 2:
    - No deviations from EC guidance document on preparation of hypersaline brine
    - HSB prepared from natural seawater at 90ppt
    - No deviations from EC guidance document for salinity adjustment of sample
    - Salinity adjustment: 600mL effluent + 250mL HSB + 8.5mL test nutrient solution
    - Salinity of samples adjusted from 4ppt to 30ppt
- Test 3:
    - No deviations from EC guidance document on preparation of hypersaline brine
    - HSB prepared from natural seawater at 90ppt
    - No deviations from EC guidance document for salinity adjustment of sample
    - Salinity adjustment: 600mL effluent + 230mL HSB + 10 ml test nutrient solution
    - Salinity of samples adjusted from 5ppt to 30ppt

viii. Type and source of control/dilution water
- Test 1: na
- Tests 2 & 3
    - Natural seawater collected at the Pacific Environmental Center, Environment Canada, North Vancouver, BC
    - Filtered to 0.2μm and autoclaved prior to use
    - Salinity adjusted as per EC guidance document to 30ppt with HSB from the same source

ix. Concentrations and volumes of test solutions
- Concentrations (% effluent volume / total volume) tested and total volumes used were:
- Test 1: na
- Tests 2:
    - Control (Natural Seawater) (0%) - 100mL, 4.5cm depth
    - Salinity Control Brine (0%) - 100mL, 4.5cm depth
    - 4.38% - 100mL, 4.5cm depth
    - 8.75% - 100mL, 4.5cm depth
    - 17.5% - 100mL, 4.5cm depth

Reporting Requirements for Reference Method EPA/600/4-91/003 Method 1009.0

- 35.0% - 100mL, 4.5cm depth
- 70.0% - 100mL, 4.5cm depth

- Tests 3:
  - Control (Natural Seawater) (0%) - 100mL, 4.5cm depth
  - Salinity Control Brine (0%) - 100mL, 4.5cm depth
  - 4.5% - 100mL, 4.5cm depth
  - 9.0% - 100mL, 4.5cm depth
  - 18.0% - 100mL, 4.5cm depth
  - 36.0% - 100mL, 4.5cm depth
  - 72.0% - 100mL, 4.5cm depth

x. Number of replicated per concentration
- Test 1: na
- Tests 2 & 3: 3 replicates per concentration

xi. Number of organisms per test chamber
- Test 1: na
- Tests 2 & 3: 5 female branches + 2 male branches per chamber

xii. Measurements of pH, temperature, dissolved oxygen, and salinity of sample before use
- Test 1: na
- Test 2: pH - 7.78, T – 22.0 °C, DO – 7.9mg/L, salinity - 4ppt
- Test 3: pH - 7.58, T – 23.0 °C, DO – 8.0mg/L, salinity - 5ppt

xiii. Measurements of pH, temperature, dissolved oxygen, and salinity of sample during test
- Test 1: na
- Test 2: pH – 8.20, T – 23 °C, DO – 7.9, salinity: 30ppt
- Test 3: pH – 8.33, T – 22 °C, DO – 7.9, salinity: 29ppt

Results

i. Number and % mortality of female plants after recovery in each test solution
- Totals from all 3 replicates are presented:
- Test 1: na
- Test 2:
  - Control (0%): 0 (0%) mortality
  - Salinity Control (0%): 0 (0%) mortality
  - 4.38%: 0 (0%) mortality
  - 8.75%: 0 (0%) mortality
  - 17.5%: 0 (0%) mortality
  - 35.0%: 0 (0%) mortality
  - 70.0%: 0 (0%) mortality
- Test 3:
  - Control (0%): 0 (0%) mortality
  - Salinity Control (0%): 0 (0%) mortality
  - 4.5%: 0 (0%) mortality
  - 9.0%: 0 (0%) mortality
  - 18.0%: 0 (0%) mortality
  - 36.0%: 0 (0%) mortality
  - 72.0%: 0 (0%) mortality

Reporting Requirements for Reference Method EPA/600/4-91/003 Method 1009.0

ii. Mean number of cystocarps per plant in each test concentration

- Test 1: na
- Test 2:
    - Control (0%): 92.1
    - Salinity Control (0%): 92.5
    - 4.38%: 105.1
    - 8.75%: 105.1
    - 17.5%: 90.7
    - 35.0%: 61.9
    - 70.0%: 13.3
- Test 3:
    - Control (0%): 58.3
    - Salinity Control (0%): 58.6
    - 4.5%: 59.7
    - 9.0%: 59.4
    - 18.0%: 60.9
    - 36.0%: 51.3
    - 72.0%: 26.3

iii. Estimate of IC_{25} (95% CL) for cystocarp development

- Test 1: na
- Test 2: IC_{25} concentration = 26.6 (20.8 – 31.5)% effluent v/v
- Test 3: IC_{25} concentration = 45.3 (36.3 – 58.1)% effluent v/v
- Quantal statistic method was linear interpolation

iv. Current reference toxicity tests (95% CL) for IC_{50} for cystocarp development

- Reference toxicity tests for Toxicant: Sodium Dodecyl Sulfate
- Test 1: na
- Test 2: Test conducted on July 27, 2004, within 30 days of effluent test
    - Reference toxicant test was conducted under the same experimental conditions as the effluent test
    - IC_{50} cystocarp development = 1.48mg/L SDS, 95% CL = (1.38 - 1.62) mg/L
    - Reference toxicity warning limits 1.40 (+/- 2SD) for IC_{50} for cystocarp development
- Test 3: Test conducted on July 27, 2004, within 30 days of effluent test
    - Reference toxicant test was conducted under the same experimental conditions as the effluent test
    - IC_{50} cystocarp development = 1.48mg/L SDS, 95% CL = (1.38 - 1.62) mg/L
    - Reference toxicity warning limits 1.40 (+/- 2SD) for IC_{50} for cystocarp development

v. Reference toxicant warning limits (+/- 2SD) for IC_{50} for cystocarp development

- Reference toxicity tests for Toxicant: Sodium Dodecyl Sulfate
- Test 1: na
- Test 2: 1.40 (1.6-1.70) mg/L SDS
- Test 3: 1.40 (1.6-1.70) mg/L SDS

APPENDIX F

Effluent Metals Concentrations and Loadings

2004 3rd QUARTER MMER REPORT

LOCATION - FINAL DISCHARGE POINT FROM GARROW LAKE (GARROW LAKE DAM SIPHONS)

CONCENTRATIONS OF EFFLUENT FOR MMER SCHEDULE 4 SAMPLED WEEKLY

Sample Taken During The Week of	Date Sample Taken	DELETERIOUS SUBSTANCE (mg/L)[1] Arsenic	Copper	Cyanide	Lead	Nickel	Zinc	TSS	Radium 226[1]	pH[1]	Collection Method
05-Jul-04	7-Jul-04	0.001	0.003	0.005	0.003	0.004	0.198	117	0.020	8.1	Water pump
12-Jul-04	13-Jul-04	0.002	0.001	0.005	0.000	0.002	0.106	6	0.007	7.9	Water pump
19-Jul-04	20-Jul-04	0.002	0.000	0.005	0.001	0.001	0.044	3	0.005	7.9	Water pump
26-Jul-04	27-Jul-04	0.001	0.001	0.005	0.002	0.002	0.043	3	0.005	7.9	Water pump
02-Aug-04	3-Aug-04	0.000	0.001	0.005	0.003	0.003	0.035	3	0.006	8.0	Grab
09-Aug-04	10-Aug-04	0.001	0.001	0.006	0.001	0.007	0.048	3	0.005	8.0	Grab
16-Aug-04	17-Aug-08	0.000	0.001	0.005	0.002	0.006	0.042	5	0.010	8.0	Water pump
23-Aug-04	24-Aug-04	0.000	0.001	0.005	0.001	0.010	0.050	4	0.008	7.8	Water pump
30-Aug-04	31-Aug-04	0.000	0.001	0.005	0.003	0.013	0.078	15	0.008	7.9	Grab
06-Sep-04	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]
13-Sep-04	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]
20-Sep-04	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]
27-Sep-04	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]

Note[1] - All concentrations are in mg/L except Radium 226 which is Bq/L and pH which is in pH units

Note [2] - "nd" refers to no effluent discharge to sample

MONTHLY MEAN CONCENTRATIONS OF EFFLUENT FOR MMER SCHEDULE 4

MONTH OF	MONTHLY MEAN CONCENTRATION[1] OF DELETERIOUS SUBSTANCE[3] Arsenic	Copper	Cyanide	Lead	Nickel	Zinc	TSS	Radium 226
July/04	0.002	0.001	0.005	0.002	0.002	0.098	32	0.009
August/04	0.001	0.001	0.005	0.002	0.005	0.072	18	0.008
September/04	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]	nd[2]

Note[1] - All concentrations are in mg/L except Radium 226 which is Bq/L

Note [2] - "nd" refers to no effluent discharge to sample

Note[3] - Monthly Mean Concentrations - the MEAN value of the concentrations measured in all water samples collected during each month when a deleterious substance is deposited.

MASS LOADING OF DELETERIOUS SUBSTANCE FOR EACH DAY SAMPLED

Sample Taken During The Week of	Date Sample Taken	DAILY MASS LOADING OF DELETERIOUS SUBSTANCE (kg/day)[1]								Average Daily Flow Rate (m^3/day)
		Arsenic	Copper	Cyanide	Lead	Nickel	Zinc	TSS	Radium 226[1]	
05-Jul-04	7-Jul-04	0.018	0.054	0.091	0.054	0.072	3.588	2120	362,440	18,122
12-Jul-04	13-Jul-04	0.752	0.376	1.880	0.000	0.752	39.850	2256	2,631,608	375,944
19-Jul-04	20-Jul-04	0.205	0.000	0.512	0.102	0.102	4.509	307	512,395	102,479
26-Jul-04	27-Jul-04	0.028	0.028	0.141	0.056	0.056	1.213	85	141,090	28,218
02-Aug-04	3-Aug-04	0.000	0.026	0.132	0.079	0.079	0.926	79	158,700	26,450
09-Aug-04	10-Aug-04	0.026	0.026	0.155	0.026	0.181	1.243	78	129,470	25,894
16-Aug-04	17-Aug-08	0	0	0	0	0	0	0	0	0
23-Aug-04	24-Aug-04	0	0	0	0	0	0	0	0	0
30-Aug-04	31-Aug-04	0	0	0	0	0	0	0	0	0
06-Sep-04	nd[2]	0	0	0	0	0	0	0	0	0
13-Sep-04	nd[2]	0	0	0	0	0	0	0	0	0
20-Sep-04	nd[2]	0	0	0	0	0	0	0	0	0
27-Sep-04	nd[2]	0	0	0	0	0	0	0	0	0

Note[1] - Mass Loading is in kilograms per day of the deleterious substance deposited except Radium 226 which is in Bq per day

Note [2] - "nd" refers to no effluent discharge to sample

MASS LOADING PER CALENDAR MONTH FOR EACH DELETERIOUS SUBSTANCE

CALENDAR MONTH OF	MASS LOADING[1] FOR DELETERIOUS SUBSTANCE (kg/month)[2]								Average Weekly Flow Rate[3] (m^3/week)	Total Monthly Volume[4] (m^3/month)
	Arsenic	Copper	Cyanide	Lead	Nickel	Zinc	TSS	Radium 226[2]		
July/04	7.77	3.55	20.33	1.65	7.62	381.00	36,952.22	28,268,381	131,191	4,066,913
August/04	0.16	0.32	1.78	0.65	1.62	13.45	973.60	1,786,654	10,469	324,533
September/04	0	0	0	0	0	0	0	0	0	0

Note[1] - Total Mass Loading for Calendar month calculated by multiplying the Average Daily Mass Loading for the Month x # days in the month

Note[2] - Mass loading units are in kg per month except Radium 226, which is in Bq permonth

Note[3] - Average Weekly Flow Rate calculated by multiplying Average Daily Flow Rate x 7 days per week

Note[4] - Total Monthly Volume calculated by multiplying Average Daily Flow Rate for the month x days in month

APPENDIX G

Results of Effluent Characterization

RESULTS OF EFFLUENT CHARACTERIZATION

AS PER PARAGRAPH 15(1)(a)

Nine effluent samples were collected on a weekly basis during the 3rd Quarter of 2004 beginning on July 7, 2004 and ceasing on August 31, 2004. Four of the nine samples were "monthly" samples and analysed for a wider suite of elements, as per the guidance document. Monthly loadings of metals to Garrow Bay were calculated based on average weekly discharge volumes from Garrow Lake to Garrow Bay via the creek outflow.

Monthly characterization samples were attempted during early July however ice conditions at Garrow Bay made it unsafe to collect Garrow Bay water samples until July 27, 2004. During the July 27th sampling event it was still not safe to collect reference samples due to ice conditions. On August 17th and again on August 24th monthly characterization samples were obtained including Garrow Bay and the reference location.

No holding times were missed for any of the water chemistry of toxicity testing samples.

Water samples for acute and sublethal toxicity testing were collected using a pump system from about 20 m downstream of the dam on Garrow Lake, within the main flow of the creek. Acute Lethality Testing was conducted 3 times during two months (2 in July and 1 in August) during the quarter. There were no adverse effects observed for either the 96-hr Rainbow Trout toxicity tests, or the 48-hr *Daphnia magna* toxicity tests. LC_{50} values were >100% effluent for both species in all testing events.

Sublethal Toxicity Testing was attempted three times during the quarter with the first test being partially successfully completed (7-D Topsmelt successfully completed, the echinoderm fertilization toxicity test was not initiated due to the inability of the sand dollars to spawn, and the Champia parvula Sexual Reporduction test was not conducted due to laboratory problems which were out of our control), and the other two sets of sublethal toxicity tests were completed successfully. As this is considered a marine discharge, marine species were used for sublethal testing following brine adjustment of the brackish effluent (as per test protocols). Testing for fish (7-d Topsmelt growth and survival) and invertebrates (Sand dollar) was conducted at EVS Environment Consultants, Vancouver, while algae (48-h *Champia*) testing was undertaken by the Saskatchewan Research Council, Saskatoon.

There were no effects observed in the Topsmelt Survival and Growth Test at maximum concentration tested which were below 100% v/v effluent due to the salinity adjustments.

Sublethal effects were observed for the echinoid and algal tests and concentrations less than 100% effluent v/v. In the echinoid *(Dendraster excentricus)* fertilization tests (EVS Consultants) for:

- The July 27, 2004 tests, the LOAEL was 4.6% v/v effluent, the IC_{25} was 8.7% v/v, and the IC_{50} was 37.3% v/v.
- The August 24, 2004 tests, the LOAEL was 4.7 %v/v effluent, the IC_{25} was 17.5%v/v, and the IC_{50} was 50.7%v/v.

In the *Champia parvula* sexual reproduction test (Saskatchewan Research Council) for:

- The July 27, 2004 tests, the LOAEL was 35%v/v effluent, the IC_{25} (95% CL) was 26.6% v/v and the IC_{50} (95% CL) was 43.3% v/v.
- The August 24, 2004 tests, the LOAEL was 72%v/v effluent, the IC_{25} (95% CL) was 45.3% v/v and the IC_{50} (95% CL) was 66.8% v/v.

Zinc was the primary contaminant of potential concern (COPC) identified in mine effluent and is the only metal to consistently exceed BC Ambient Water Quality Guidelines (BC AWQG) in effluent. During the 9 week discharge period, effluent zinc concentration averaged 72 µg/L (range 35 – 198µg/L), which is well below the MMER effluent limit of 500µg/L. The BC AWQG is 10µg/L. On July 27, 2004 and August 24, 2004 when the sublethal samples were collected, the respective concentrations of Zn in the effluent was 43µg/L and 50 µg/L. Converting the echinoid test endpoints for the July 27, 2004 tests into Zn concentrations results in a Lowest Observed Adverse Effect Level (LOAEL) of 1.9µg/L Zinc, an IC_{25} of 3.7µg/L, and an IC_{50} of 16.0µg/L. Converting the echinoid test endpoints for the August 24, 2004 tests into Zn concentrations results in a Lowest Observed Adverse Effect Level (LOAEL) of 2.3µg/L Zinc, an IC_{25} of 8.8µg/L, and an IC_{50} of 25.4µg/L. Reference toxicity tests of zinc on *Dendraster* fertilization give mean EC_{50} concentrations of 8.5-60µg/L (Dinnel et al. 1983). The concentrations of zinc in the effluent that corresponds to the IC_{50} (i.e., 16.0 to 25.4 µg/L) are within the effects range reported in reference *Dendraster* fertilization tests. Thus the echinoid test is quite sensitive to zinc, with the LOAELs being less than the BC AWQG concentration.

Endpoints for the July 27, 2004 *Champia* test in terms of zinc concentrations were 15.1µg/L Zn (LOAEL), 11.4µg/L (IC_{25}), and 18.6µg/L (IC_{50}). Endpoints for the August 24, 2004 *Champia* test in terms of zinc concentrations were 36µg/L Zn (LOAEL), 22.6µg/L (IC_{25}), and 33.4µg/L (IC_{50}). The reference IC_{25} endpoint for zinc in the *Champia* test performed in-house at SRC was 27µg/L (95% confidence limits 16-42µg/L). This reference concentration is very similar to zinc concentrations in the mine effluent at the toxicity endpoints observed in the *Champia* test.

Given the similarity between zinc concentrations in the effluent samples and the effects concentrations of zinc in reference tests, it is likely that zinc is responsible for the sublethal effects observed in both the *Dendraster* and *Champia* tests.

Reference: Dinnel, P.A., Q.J. Stober, J.M. Link, M.W. Letourneau, W.E. Roberts, S.P. Felton, and R.E. Nakatan. 1983. Methodology and Validation of a Sperm Cell Toxicity Test for Testing Toxic Substances in Marine Waters. Final Report, FRI-UW-8306, Fisheries Research Inst., School of Fisheries, University of Washington, Seattle, WA :208. Source: EPA EcoTox database.