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FARO MINE ABANDONMENT PLAN

RESEARCH AND MONITORING

DETAILED SCHEDULE

AUGUST, 1988

CURRAGH RESOURCES, INC.

WHITEHORSE

**FARO MINE ABANDONMENT PLAN RESEARCH AND MONITORING:**  
**DETAILED SCHEDULE**

**OVERVIEW**

The research and monitoring program is designed to answer three questions:

**1. How will the abandoned minesite affect Rose Creek?**

Projects 1 through 10.

Examination of potential sources of structural failure and water contamination following abandonment. The latter culminates in a water quality model that will be used to predict loadings to Rose Creek from all potential sources of contamination, through all pathways, under different abandonment scenarios. This research includes assessments of the effectiveness of different abandonment measures.

**2. What are the resources of Rose Creek that could be affected?**

Projects 11 through 13.

Assessment of the flow characteristics, water quality and biota of Rose Creek, with emphasis on the fish habitat in the Rose Creek system.

**3. How could the abandoned minesite impact those resources?**

Projects 14 through 16.

Assessment of impact of potential contaminants on the downstream resources and assessment of the impact of the physical configuration of the abandoned mine on fish habitat. This integrates information from all projects and culminates in an environmental impact evaluation. Recommendations for abandonment plan design standards will be formulated in conjunction with the development of a fuller understanding of the downstream resources and of the options for abandonment.

## PROJECTS

### 1. Seep Surveys

Seeps from the Faro pit and area will be sampled to determine sources and extent of acid mine drainage and metal leaching. Receiving waters will be sampled at points throughout the site to assess impact on streams of seeps, groundwater flow and contact with waste rock. Extensive seep surveys will be carried out for a year, then a seep monitoring program will be developed. The monitoring program will focus on key seeps located during the seep surveys and provide a long term record of the water flow and quality.

#### Sample locations:

- a. Seeps from upper walls of pits
- b. Seeps from waste dumps
- c. Stream sites:
  - Faro Creek upstream of point of diversion
  - Faro diversion channel 2.2 km downstream of point of diversion
  - North Fork Rose Creek:
    - upstream of Faro Creek (from 1989)
    - downstream of Faro Creek
    - upstream of rock causeway
    - downstream of rock causeway
    - at mine road (X2)

#### Parameters:

flow (for seeps), temperature, pH, specific conductance, total metals (Zn, Cu, Fe), SO<sub>4</sub>, total alkalinity or acidity  
Dissolved metals measured when appropriate.

#### **Timing:**

September, 1987 to September, 1988: Six full seep surveys.

March, 1989: Mapping and analysis of seep surveys completed and seep monitoring program established. Results presented in 1988 annual report.

Spring, 1989 until final abandonment: seep monitoring program to continue. Results interpreted and the following year's program presented in each annual report.

## 2. Waste dump stability assessment

- i) Assessment of stability of waste dumps by a geotechnical engineer

**Timing:** 1988  
Results in 1988 annual report.

- ii) Annual inspection of waste dumps for signs of instability

**Timing:** 1989 until final abandonment.  
Results reported in each annual report.

## 3. Waste rock characterization

- i) Acid-base accounting of representative waste rock types.  
Waste rock types will be categorized and representative samples taken from drill core. Samples will be tested for potential to produce and consume acid. Results will be assessed and humidity cell tests done as required to further assess the potential to generate acid.

**Timing:** 1988  
Results in 1988 annual report.

- ii) Slake and freeze-thaw tests of representative waste rock types

The potential for rock deterioration due to slaking and freeze-thaw cycles will be tested using the drill core samples taken for section 3 i). Results will be used in predicting long term acid generation potential of these rock types, as well as assisting in the evaluation of long term dump stability.

**Timing:** 1988  
Results in 1988 annual report.

- iii) Surface survey of old dumps

A map will be produced, by a geologist, of rock types on the surface of the old dumps as well as an assessment of the possibility that the observations are applicable to the dumps as a whole.

**Timing:** 1988-1989  
Results reported in 1989 annual report.

iv) Trenching program on old waste dumps

Trenches will be dug and the rock types categorized as an extension of the surface mapping program. Composite samples may be taken and tested for acid-base accounting.

**Timings:** 1989  
Results reported in 1989 annual report.

v) Characterization of weathered sulphide waste rock

Extraction tests will be performed on samples of sulphide waste subjected to varying periods of exposure. Results will be used in predicting pit water quality and the impact of sulphide waste dump.

**Timings:** 1988-1989  
Results reported in 1989 annual report.

vi) Evaluation of data and further studies

Results from the above waste rock characterization studies, combined with dump seep survey results and an analysis of old mining records, will be evaluated with the objective of producing a qualitative description of the waste dumps. Further testing may be required to fulfil this objective. These tests may include further acid-base accounting tests and/or kinetic tests (such as columns or humidity cells), particularly on mixtures of rocks indicated to be likely waste dump compositions by earlier studies.

**Timings:** 1989-1990  
Results in 1990 annual report.

#### 4. Groundwater studies

Groundwater studies are aimed at assessing the potential for transport of metals leached from the pits and dumps via groundwater to Rose Creek.

i) Installation of well

Piezometer nets, consisting of three wells, will be installed for groundwater sampling and piezometric readings:

- South of Zone II
- Southwest of sulphide waste dump

**Timings:** 1988

- ii) Groundwater monitoring  
Piezometric readings and sampling of groundwater from wells.

**Timing:** 1988 to final abandonment.  
Results reported in each annual report and incorporated into groundwater flow and water quality models.

- iii) Test pits  
Test pits will be dug with a backhoe along waste dump toes to sample shallow groundwater flow.

**Timing:** 1989  
Results in 1989 annual report.

- iv) Assessment of groundwater data  
A preliminary assessment will be made, sampling adapted as required and a groundwater flow model developed.

**Timing:** 1989: Preliminary assessment of groundwater data.  
1990: Development of groundwater model. Results in annual report and incorporated into water quality model.  
1991 until final abandonment: refinement of groundwater model as more data become available.

##### 5. Assessment of the loss of flow from Faro Creek

- i) Prepare channel sections for metered flow measurements at:  
-Faro Creek at the point of diversion  
-Faro Creek diversion channel at:  
1. Downstream end of source of seepage to Zone I/III pit through the Faro Valley waste dump  
2. Downstream end of source of direct seepage to the Faro pits

**Timing:** 1988

- ii) Carry out monthly flow measurements during ice-free months.

**Timing:** Spring 1989 until Faro Creek is diverted into pit.

6. Assessment of compacted phyllite as a dump cover

In-situ permeability tests will be conducted on existing compacted phyllite surfaces on dumps in order to estimate the rate of infiltration of precipitation through the cover planned for the sulphide waste dump.

**Timing:** 1989  
Results in 1989 annual report and incorporated into water quality model.

7. Assessment of Water Quality in the Faro Pits

- i) Sampling of Zone I/III pit water  
As the pit fills, samples will be taken at depth intervals. Water will be analysed to determine if density stratification is occurring and to assess changes in water chemistry.

**Timing:** Completion of mining of the pit until the pit overflows. Results in annual reports and incorporated into water quality model.

- ii) Sampling of Zone II pit water  
A groundwater sampling well will be drilled through the waste rock in the low part of the pit. As the pit fills, water level will be measured and samples will be taken to assess changes in water chemistry.

**Timing:** 1988: Installation of well in backfilled Zone II pit.  
1988 until the pit overflows:  
Sampling from well. Results in annual reports and incorporated into water quality model.

- iii) Sampling of overflow from pits  
After each pit is full, samples will be taken of the overflow.

**Timing:** For each pit, from the time overflow occurs until final abandonment. Results in annual reports and incorporated into water quality model.

8. North Fork Rock Drain

i) Annual inspection

A geotechnical engineer will inspect the drain annually, report on its performance and make recommendations for maintenance, monitoring or modifications.

**Timings:** 1988 until final abandonment. Results presented in annual reports.

ii) Water quality monitoring

Water samples will be taken in conjunction with seep surveys upstream and downstream of the rock drain. Suspended solids will be included in the list of parameters.

**Timings:** 1988 until final abandonment. Results included in annual reports, as part of seep surveys.

iii) Photographic record

A photographic record will be kept of the extent of the impoundment behind the drain.

**Timings:** 1988 until final abandonment.

9. Freshwater Reservoir

Annual inspection of the dam

A geotechnical engineer will inspect the dam and provide recommendations for maintenance, monitoring and upgrading, including plans for upgrading to abandonment standard.

**Timings:** 1988 to final abandonment. Results in annual reports.

10. Development of a water quality model.

A model will be developed to predict water quality of the various components of the Faro pit and area, to predict impact on Rose Creek water quality and to assess abandonment options.

**Timings:** Preliminary model developed in 1988, results in 1988 annual report.  
Model updated annually, results in annual reports.

## 11. Hydrology

- i) Review of data and methodology  
Regional and local hydrology studies and data reviewed by a hydrologist with a view to providing updated peak flow estimates for the drainage basins of concern in the Rose Creek system.

**Timings:** 1988. Results in 1988 annual report.

- ii) Hydrometric station on North Fork Rose Creek.  
A continuous flow monitoring station will be installed in North Fork Rose Creek above the Faro Creek diversion channel to expand the local data base for flood level estimates (for design of structures) and for stream flow estimates (for impact assessment).

**Timings:** 1988

- iii) Operation of hydrometric stations  
The hydrometric station in the Rose Creek diversion canal and the station on North Fork Rose Creek will be operated during ice-free periods. This entails maintenance of flow recording stations, compilation of flow records, periodic updating of flood and streamflow estimates.

**Timings:** 1988 (diversion canal) and 1989 (North Fork) to final abandonment. Results presented in annual reports and incorporated into design of structures and impact assessment.

## 12. Assessment of Rose Creek water quality.

Rose Creek water quality and benthic invertebrate data will be compiled and reviewed; additional stream water quality samples will be taken as necessary to provide a more comprehensive data base.

**Timings:** 1988-1989. Results in 1989 annual report.

### 13. Fisheries studies

i) Assessment of fish resources of Rose Creek.

A comprehensive study of the existing fish populations and habitat capability of Rose Creek and lower Anvil Creek, from the headwaters of the North and South Forks of Rose to the Pelly River, will be undertaken.

**Timings:** 1988: spring study.  
 1988 or 1989: summer study, depending on flow conditions.  
 Results in 1988 annual report (and 1989 report if summer study is postponed).

ii) Freshwater Reservoir fish habitat assessment and depth survey

A lake survey will be carried out by a fisheries biologist to determine species, abundance and population structure of fish in the reservoir and to assess the reservoir as overwintering habitat.

**Timings:** 1988. Results in 1988 annual report (may be postponed to 1989).

iii) North Fork Rose Creek fish habitat assessment

An assessment will be made by a fisheries biologist of the habitat capability of the upper North Fork and the extent of the loss of habitat through the construction of the barrier to fish passage.

**Timings:** 1988. Results in 1988 annual report.

### 14. Assessment of toxicity of potential contaminants following mine abandonment.

A literature review of metals (especially zinc) toxicity to fish (especially Arctic grayling) will be undertaken. If this review indicates a need, lab or in situ testing of toxicity of zinc to grayling under site specific conditions will be conducted.

**Timings:** 1988-1989. Results in 1989 annual report.

15. Assessment of impact of Faro Mine following abandonment.

Integration of water quality predictions and toxicity data with baseline information on resources to provide impact assessment. This assessment will be refined as data are acquired.

**Timing:** Preliminary assessment presented in 1988 annual report. Assessment updated annually.

16. Setting of abandonment plan design standards

Design standards, both for flood and earthquake protection and for protection of downstream water quality, will be recommended by Curragh Resources Inc., following discussions with the Northern Affairs Program and Environmental Protection. These recommended standards will be submitted to the Water Board for approval.

**Timing:** 1989: Provide recommendations for design standards for protection against failure due to floods or earthquakes.  
1990: Provide recommendations for standards to protect downstream water quality.