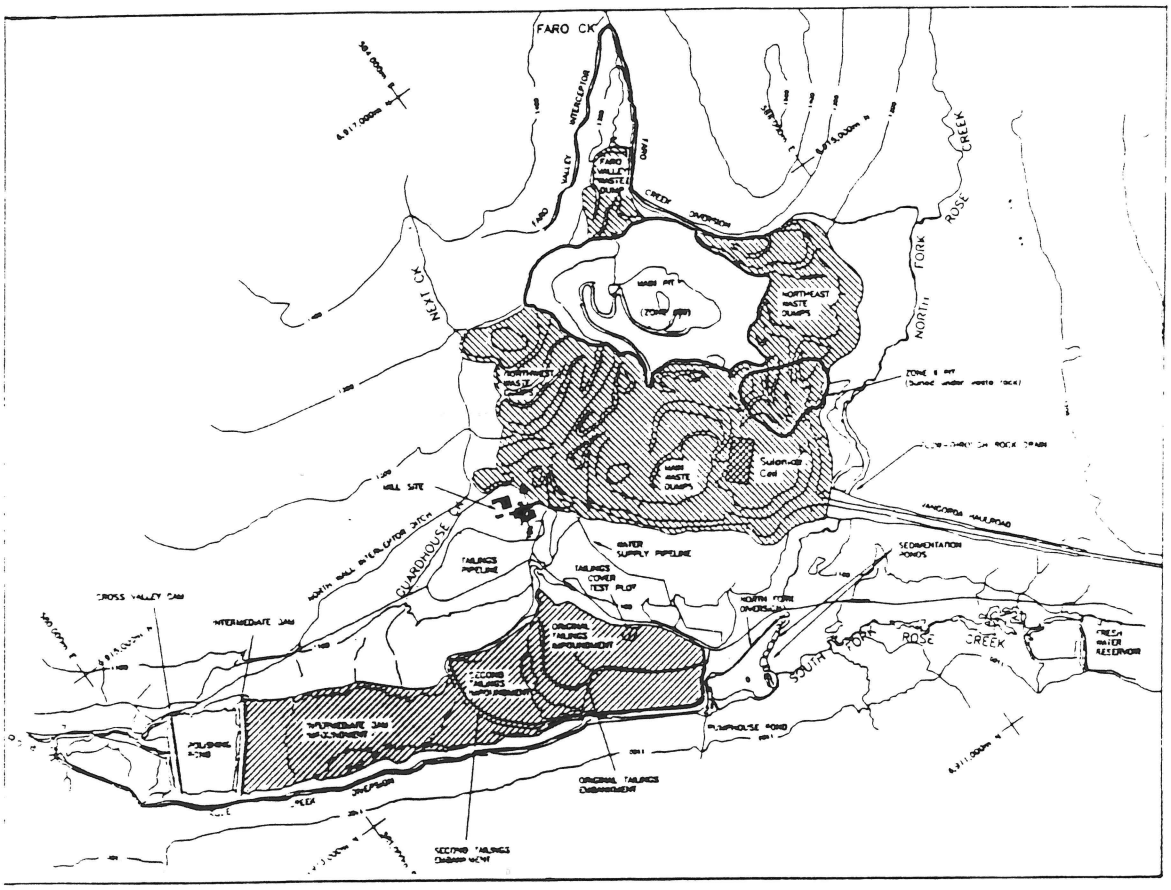
GOVERNMENT OF CANADA

NORTHERN AFFAIRS PROGRAM
WHITEHORSE, YK

CURRAGH INC.

DOWN VALLEY TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN - ALTERNATIVE 4



EVALUATION REPORT

Report # NAP301

April 1993

GOVERNMENT OF CANADA

NORTHERN AFFAIRS PROGRAM
WHITEHORSE, YK

CURRAGH INC.

DOWN VALLEY TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN - ALTERNATIVE 4

EVALUATION REPORT

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Note: Plan on cover taken from SRK report # 60635
Figure 1.2

CURRAGH INC.

DOWN VALLEY TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN - ALTERNATIVE 4

SECTION 1.0

INTRODUCTION

CURRAGH INC.

DOWN VALLEY TAILINGS IMPOUNDMENT

ALTERNATIVE 4

1.0 INTRODUCTION

Robert J. Rodger, P. Eng. was retained by the Government Consulting Group on behalf of the Department of Indian and Northern Affairs (DIAND) Northern Affairs Program - Whitehorse to review the cost estimates for Alternative 4 of the Down Valley Tailings Impoundment Decommissioning plan submitted by Curragh Inc. As part of this review, Dr. Iain Bruce, Ph.D., P.Eng. contributed specialized input on tailings pond design parameters.

The terms of reference for this review, as presented on February 25, 1993 are as follows:

DOWN VALLEY TAILINGS IMPOUNDMENT - ALTERNATIVE 4

1. "Review the costs of decommissioning and abandonment of the Down Valley tailings impoundment and the Faro pit submitted by Curragh concerning Alternative 4, which is contained in the document SRK 60635 (Volumes I to IV).

2. Provide an estimate of additional costs of decommissioning the tailings pond and the Faro pit which are not covered in the Curragh's submission.

3. Provide a proposed program and estimate of costs related to administration, monitoring and maintenance of the site after closure of the mine, and,

4. Provide a spreadsheet outlining the accrued liabilities of the company in respect to abandonment of the tailings facility, using constant 1993 dollars."

The cost review was prepared in response to a Yukon Territory Water Board (YTWB) decision to attach Alternative 4 to the water licence, as a back-up alternative to the Curragh Inc. decommissioning plan. The acceptability of Alternative 4 as a back-up alternative has not, as yet, been established by DIAND, Environment Canada nor Fisheries and Oceans Canada.

CURRAGH INC.

DOWN VALLEY TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN -

ALTERNATIVE 4

SECTION 2.0

REVIEW OF CURRAGH DECOMMISSIONING PLAN COSTS

2.0 REVIEW OF CURRAGH DECOMMISSIONING COST

Five alternatives were studied by Curragh Inc. for the decommissioning of the Down Valley Tailings Impoundment. Their selected alternative - **ALTERNATIVE 5**, was presented to the Yukon Territory Water Board (YTWB) in January 1992. This alternative was reviewed by PBK Engineering Ltd in November 1991 (Project # 91116).

The YTWB attached Alternative 4 to the water licence, as a back-up alternative to the Curragh Inc. decommissioning plan.

2.1 DESCRIPTION OF ALTERNATIVE 4

Alternative 4 was described by Curragh Inc in the submission to the YTWB, as follows:

The Original and Second Impoundments be covered with a composite soil cover, consisting of three layers - a fresh tailings slimes layer (minimum 0.5 m) overlain by uncompacted till (min. 0.5 m) and then by non acid generating waste rock (min. 0.5 m). Prior to placement of the covers, the tailings would be terraced and divided into paddies with low dykes. A synthetic membrane liner would be used to cover embankment and dyke faces.

The Intermediate Impoundment would be covered with water. The Intermediate Dam would be raised to an elevation 3.0 m above the 2.0 m water cover, or to an elevation of 1055.7 m, based on the elevation of the tailings during April 1991. The dam was reportedly raised to an elevation of 1052.7 m during 1991. The final elevation of the dam would depend on the elevation of the tailings in the Intermediate Impoundment on decommissioning. The dam would be modified to have a 2.5 Horizontal to 1.0 Vertical slope on the downstream side. The dam crest would be 10 m wide.

A concrete side channel spillway would be constructed on the northern abutment of the Intermediate Dam to handle water discharging from the Intermediate Impoundment.

The Rose Creek diversion channel south of the Intermediate Impoundment would be abandoned. The water flow in Rose Creek would be directed through the Intermediate Impoundment by breaching the dam at the southwest corner of the Second Impoundment area. The Rose Creek diversion to the east of the dam would be broadened and covered with riprap to withstand a half PMF event.

In addition to assuming that the work is undertaken by contractors, it is assumed that the major components, such as the tailings covers, are let under single contracts. The unit prices should be lower for relatively larger contracts.

Given the relatively limited information base for estimating costs, relatively more effort was devoted to the major cost items.

The estimated quantities prepared by Steffen Robertson Kirsten (SRK) were re-estimated from the plans in their reports. In some cases such as the Lower Faro Creek diversion, the quantities estimated by SRK were checked and used because it is assumed they had access to more complete plans.

Unit costs estimates were reviewed on the basis of in-house data, and compared to rates charged by contractors in Northern B. C. and Yukon as well as the rates contained in the DIAND report entitled "Mine Reclamation in the Northwest Territories and Yukon".

A 20 % contingency and engineering estimate was applied by Curragh Inc. to the cost estimate. This is too low. The amount of contingency, applied to the total estimated cost, depends on the level of engineering which has been undertaken on a project. In this case, the design is considered to be conceptual, reflecting a low level of engineering design. In addition, there are sufficient uncertainties regarding dam stability, effectiveness of the proposed covers and other factors that the minimum contingency which should be applied is 20 %.

Engineering, procurement and construction management (EPCM) for this type of project would commonly cost 8 to 12 % of the project cost after contingency. These are the percentages used in this review.

The costs are presented in Table 2.1.

2.1.2 Schedule

For this report, it is assumed that the decision to undertake Alternative 4 is made during 1994 and work is initiated during that year. The till cover and dykes would be placed over the Original and Second Impoundments during 1994-95. To prevent uncontrolled water flows over the covers, the Lower Faro Creek diversion would also have to be constructed at the same time.

should be constructed before the pit is full of water to ensure control of flood and other events.

The tailings and water pipelines from the mill to the Faro open pit and to the Down Valley tailings impoundment will have to be removed.

2.2.1 Cost Review

The basis for this cost review is the same as outlined in Section 2.1.1 of this report.

The quantities for the inlet and outlet spillways are based on the estimates contained in the PBK report.

The costs are presented in Table 2.2.

CURRAGH INC

DOWN VALLEY TAILINGS IMPOUNDMENT
ALTERNATIVE 4

Table 2.1 COST ESTIMATE
(Constant 1993 dollars)

DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST ($ 000)	TOTALS
CROSS VALLEY DAM & POND					
Drain Pond	l.s.			15	
Clean Pond	cu. m.	209,000	$3.00	627	
Breach Dam	cu. m.	70,000	3.00	210	
Channel Excavation	cu. m.	81,000	3.00	243	
RipRap	cu. m.	10,900	12.60	137	
					1,232
INTERMEDIATE DAM					
Foundation Treatment	sq. m.	31,400	2.00	63	
Dam Exterior Shell	cu. m.	563,000	4.50	2,534	
Dam Exterior Filter	cu. m.	20,000	12.00	240	
Dam Core	cu. m.	49,000	11.00	539	
Dam Interior Filter	cu. m.	20,000	12.60	252	
					3,627
INTERMEDIATE SPILLWAY					
Excavation	cu. m.	23,400	3.00	70	
Concrete Works	cu. m.	1,200	450.00	540	
Other	l.s.			200	
					810
TAILINGS COVERS					
Tailings Removal	cu. m.	60,000	2.00	120	
Dykes	m.	5,020	448.00	2,249	
Dyke Spillways		22	360.00	8	
Tailings Placement	cu. m.	406,000	4.00	1,624	
Till Placement	cu. m.	406,000	5.00	2,030	
Mine Rock Placement	cu. m.	406,000	4.00	1,624	
					7,655
ORIGINAL EMBANKMENT					
Regrading	cu. m.	18,600	2.00	37	
Membrane	sq. m.	41,800	10.00	418	
Till	cu. m.	38,800	5.00	194	
Mine Rock	cu. m.	18,600	4.00	74	
Spillways		6	900.00	5	
					729
SECOND EMBANKMENT					
Regrading	cu. m.	17,200	2.00	34	
Membrane	sq. m.	90,300	10.00	903	
Till	cu. m.	45,100	5.00	226	
Mine Rock	cu. m.	137,600	4.00	550	
Spillways		6	1260.00	8	
					1,721

CURRAGH INC

DOWN VALLEY TAILINGS IMPOUNDMENT
ALTERNATIVE 4

Table 2.2 FARO PIT DECOMMISSIONING
COST ESTIMATE
(Constant 1993 dollars)

DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST ($ 000)	
FARO INLET SPILLWAY					
Excavation	cu. m.	11,000	$3.00	$33	
					$33
FARO OUTLET SPILLWAY					
Waste Rock Removal	cu. m.	280,000	3.40	952	
Rock Excavation	cu. m.	18,000	8.50	153	
					1,105
PIPELINE REMOVAL	m.	1,700	20.00	34	
					34
OTHER					
Faro Creek Diversion	l.s.			20	
					20
Subtotal					1,192
Contingency (20 %)					238
Subtotal					1,430
EPCM (10 %)					143
TOTAL					$1,573

CURRAGH INC.

DOWN VALLEY TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN -

ALTERNATIVE 4

SECTION 3.0

ADDITIONAL DECOMMISSIONING COSTS

3.0 ADDITIONAL DECOMMISSIONING COST

The work which could be considered additional to the work outlined by Curragh Inc. includes the Faro pit tailings preparation. This work must be undertaken in order to deposit tailings into the pit. As indicated below, some of the work has been completed.

3.1 FARO PIT TAILINGS PREPARATION

The work undertaken to prepare the open pit for tailings deposition included installation of the tailings pipeline from the mill to the pit and construction of a temporary inlet to allow water to flow from Faro Creek into the pit. It is assumed that this work has been completed, and no cost estimate has been included in the closure liability.

In addition, a plug dam is to be constructed at the south end of the Faro open pit to allow the water in the pit to rise to the 1173.5 m (3850') elevation. Construction of the plug dam is necessary to prevent water flow from the pit into Zone II. The Curragh Inc. schedule provided for construction during 1993. There was also provision for installation of a siphon to reclaim water from the Faro pit for use in the mill. It is assumed that this dam has not been constructed and that the siphon has not been installed as yet.

Other work includes restoration of the Faro Creek channel below the outlet spillway described in Section 2.2 of this report. The channel would require regrading and installation of drop weirs in the steep section to attenuate the impact of the flows.

There has been no provision for revegetation in the closure plans. Given the low growth rates prevalent in the Faro area, it is felt that provision should be made for planting of native species to speed re-establishment of ground cover.

3.1.1 Cost Review

The basis for this cost review is the same as outlined in Section 2.1.1 of this report.

The costs are presented in Table 3.1.

CURRAGH INC.

DOWN VALLEY TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN -

ALTERNATIVE 4

SECTION 4.0

ADMINISTRATION, MONITORING AND MAINTENANCE

4.0 POST DECOMMISSIONING ADMINISTRATION, MONITORING AND MAINTENANCE

The monitoring and maintenance costs presented in the Curragh Inc. reports are based on Alternative 5. The monitoring required for Alternative 4 should not be significantly different.

4.1 MONITORING COST

Based on the monitoring outlined in the SRK report (Section 13) prepared for Curragh Inc. reports, but assuming this is carried out by third parties, an estimate was prepared of the annual cost. The estimate is based on the PBK report.

It is assumed that the monitoring is carried out by technical personnel specialized in the particular field. There are essentially three components to the monitoring.

4.1.1 Water Quality

Sample Collection	$ 7,500
Sample Analysis	1,600
Travel and Lodging	1,500
Report Preparation	2,500
	$13,100

4.1.2 Biological Monitoring

Site Work	7,800
Sample Enumeration	2,500
Helicopter	9,000
Report Preparation	2,500
	$21,800

CURRAGH INC.

DOWN VALLEY TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN -

ALTERNATIVE 4

SECTION 5.0

SUMMARY OF CLOSURE LIABILITY

5.0 SUMMARY OF CLOSURE LIABILITY

The closure costs, based on the estimates in constant 1993 dollars outlined in Sections 2.0 and 3.0, are summarized in Table 5.1 below. An assessment was undertaken of the mitigation measures remaining each year. This assessment is presented on a yearly basis in Table 5.2. The funding required for post decommissioning monitoring and maintenance is not included in this table.

The liability for a particular year represents the liability remaining at the end of that year in the event of a premature closure of the mining operation during the year.

The timing and the amount of the liability depends on a decision to opt for Alternative 4 over Alternative 5. In this report, it is assumed that this decision is made during 1994 and work is initiated during that year. Therefore, the till cover and dykes are placed over the Original and Second Impoundments during 1994-95. To prevent uncontrolled water flows over the covers, the Lower Faro Creek diversion would also have to be constructed at the same time.

It is also assumed that the work has been, and will be, constructed as designed, and that there are no required remedial measures.

CURRAGH INC

DOWN VALLEY TAILINGS IMPOUNDMENT
ALTERNATIVE 4

Table 5.2 SUMMARY OF CLOSURE LIABILITY
(Thousand 1993 dollars)

DESCRIPTION	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DOWN VALLEY																		
TAILINGS COVERS	$7,655	$7,655	$7,655	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORIGINAL EMBANKMENT	729	729	729	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SECOND EMBANKMENT	1,721	1,721	1,721	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROSS VALLEY DAM & POND	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	0	0
INTERMEDIATE DAM	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	3,627	0
INTERMEDIATE SPILLWAY	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	0
ROSE CREEK DIVERSION	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	1,518	0
LOWER FARO CREEK DIVERSION	824	824	824	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER WORK	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	0
FARO PIT DECOMMISSIONING																		
FARO INLET SPILLWAY	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	0
FARO OUTLET SPILLWAY	1,105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PIPELINE REMOVAL	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	0
OTHER	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	0
ADDITIONAL WORK																		
PLUG DAM	465	465	465	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FARO CREEK REHAB	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REVEGETATION	246	246	246	102	102	102	102	102	102	102	102	102	102	102	102	102	102	0
MONITORING																		
SUBTOTAL	20,632	19,427	19,427	7,889	7,889	7,889	7,889	7,889	7,889	7,889	7,889	7,889	7,889	7,889	7,889	7,889	6,239	0
CONTINGENCY (20 %)	4,126	3,885	3,885	1,578	1,578	1,578	1,578	1,578	1,578	1,578	1,578	1,578	1,578	1,578	1,578	1,578	1,248	0
SUBTOTAL	24,758	23,312	23,312	9,467	9,467	9,467	9,467	9,467	9,467	9,467	9,467	9,467	9,467	9,467	9,467	9,467	7,487	0
EPCM (10 %)	2,476	2,331	2,331	947	947	947	947	947	947	947	947	947	947	947	947	947	749	0
TOTAL LIABILITY	$27,234	$25,644	$25,644	$10,413	$10,413	$10,413	$10,413	$10,413	$10,413	$10,413	$10,413	$10,413	$10,413	$10,413	$10,413	$10,413	$8,235	$0

CURRAGH INC.

DOWN VALLEY TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN -

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SECTION 6.0

RECOMMENDATION

6.0 RECOMMENDATION

In order to effectively assess the likelihood and impact of catastrophic failure of structures, such as the Intermediate Dam, a risk assessment should be conducted by Curragh Inc. as part of the Integrated Comprehensive Closure Plan (ICCP). An analysis of all possible events and the probabilities would serve to indicate the funding required to deal with these events.

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DOWN VALLEY TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN -

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APPENDIX I

REFERENCES

APPENDIX I

REFERENCES

1.0 Curragh Resources Inc.
Down Valley Tailings Impoundment Decommissioning Plan.
Steffen, Robertson, Kirsten (B.C.) Inc. Report # 60635
Volumes I to IV
April 1991

2.0 Curragh Resources Inc.
Faro Decommissioning - Overview of the Environmental Plans
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December 1991

3.0 Yukon Territory Water Board IN89-001-PH91
Curragh Resources Inc.
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4.0 Northern Affairs Program
Down Valley Tailings Impoundment Decommissioning Plan.
Evaluation Report
PBK Engineering Ltd. Project # 91116
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5.0 Environmental Protection Environment Canada
Critical Evaluation of Curragh, Down Valley Tailings Acid Mine Drainage Modelling, 1986 - 1991
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Draft Final Report
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6.0 Northern Affairs Program
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Report on 1992 Inspection.
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