Attachment A
Closure Options from Previous Studies

Attachment A-1 – Closure Options Assessed During Operations

This attachment summarizes closure options assessed in the following reports:

1. Faro Mine Tailings Abandonment Plan, Klohn Leonoff Consulting Engineers (1981)
2. Abandonment Submission: Summary Report, Curragh Resources Inc. (1988)
3. Down Valley Tailings Abandonment Plan, SRK (1991)

Rose Creek Tailings									
Stability	**Specific Component (source)**	**Specific Issue**	**Description of Methods**	**Description**	**Considerations**	**Limitations/Concurrent Activities**	**Evaluation of Success at the time**	**Additional Information Needed/Available**	**Document Reference**
	Rose Creek Tailings	Physical stability, metal leaching and ARD	Alternative 1 Retain tailings in unsaturated state and cover.	Route all water around tailings facility and treat tailings surface.	This might minimize infiltration of water and "maximize inherent strength of the tailings and tailings dams."	Continued oxidation of tailings. Difficulties in design and construction of Rose Creek diversion structure.	Concerns remain with water quality.	Curragh, 1988	Klohn Leonoff, 1981
				Surface runoff from Rose Creek and tributary drainages would be diverted around tailings using Rose Creek and North Valley Wall Interceptor structures.	Scheme was previously proposed by Golder 1977.	Construction of either upgraded channel or tunnel for Rose Creek diversion. Recommended channelling Faro Creek flow and Zone II pit outflow into North Fork Rose Creek. Construction of low permeability, low sulphide cover.	Advantages - channel water away from tailings and minimize infilration and metal leaching, economically attractive as uses existing structures, maintains fish passage. However there are concerns with log-term stability of diversion structures, design of channels to carry PMF, measures to prevent channel from blocking and design to prevent failure of channel and flow across unsaturated tailings.	Curragh, 1988	Klohn Leonoff, 1981
				Construct cover.				Curragh, 1988	Klohn Leonoff, 1981
			Alternative 2 Submerge tailings.	Construct dam downstream of tailings to flood area.	Some levelling of tailings might be required. Reservoir could also act as a settlign basin, and provide attenuation of peak flood events.	Construct spillway.	Concerns are quality of rock in abutments, permafrost, blockage of spillway.	Curragh, 1988	Klohn Leonoff, 1981
				Raise one of the dam crests to flood impoundment.		Faro Creek will flow through the Main Pit and spill into the flooded tailings reservoir.		Curragh, 1988	Klohn Leonoff, 1981
				Construct spillway to carry Rose Creek flow downstream of the dam and into the original Rose Creek Valley.	Location of the dam - proposed either moving the Cross Valley Dam downstream (selected) or using the Intermediate Dam.	Runoff from upstream of flooded impoundment must be routed through impoundment. Also must route overflow from Main Pit through flooded impoundment. Anticipated some tailings would have to be moved from higher elevation in impoundment to below flooded level.	Has advantages of control of oxidation, wind erosion, sedimentation basin however the concerns are the physical stability and expense of the spillway and increased infiltration through the tailings.	Curragh, 1988	Klohn Leonoff, 1981
			Alternative 3 Remove tailings from Rose Creek Valley.	Remove all or a portion of tailings to Main Pit.	Consider that all tailings would need to be removed otherwise containment facility would still be needed.	Cleanup of exposed ground required after tailings removed, remove Cross Valley and Intermediate Dams.	Very high cost.	Curragh, 1988	Klohn Leonoff, 1981

Other Facilities, Independent of Closure of Rose Creek Tailings								
Specific Component (source)	**Specific Issue**	**Measure**	**Description of Methods**	**Considerations**	**Limitations/Concurrent Activities**	**Evaluation of Success at the Time**	**Additional Information Needed/Available**	**Document Reference**
Freshwater Supply Dam		Remove dam and restore stream bed.		Removal of dam restores fish passage up Rose Creek.		Selected	Suggested that at closure this dam might be used for power generation.	Klohn Leonoff, 1981
Pumphouse and Related Facilities		Pumphouse will be removed, pond drained and dam removed.		This dam is not necessary with the implementation of Alternative 2, as recommended by the consultant.	Concern about release of sediments when dam is removed.	Selected		Klohn Leonoff, 1981
North Fork Rose Creek Diversion		Diversion structure removed and original channel improved to return creek to pre-mine condition.				Selected		Klohn Leonoff, 1981
Faro Creek Diversion		Diversion structure will be removed and Faro Creek allowed to flow into pit.			Did not consider closure requirements for open pit in this plan.	Selected		Klohn Leonoff, 1981
Waste Rock Dumps	Physical Stability	No concerns based on observation and design.		Abandonment concern could be slides into North Fork Rose Creek but not anticipated with current design and foundation conditions.		Selected		Klohn Leonoff, 1981
Waste Rock - Sulphides	Geochemical	Isolate to minimize oxidation and leaching.	No measures recommended.			Selected		Klohn Leonoff, 1981
Open Pits		Backfill Zone II pit, allow Main pit to flood.	For Alternative 3, tailings would also be placed in Main Pit.	Exposed sulphides above flooded level not considered a concern.	Outflow from pit will flow through waste dump therefore a overflow channel is required, and a small berm at point of outflow from waste dumps.	Selected		Klohn Leonoff, 1981

All Facilities

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations/Concurrent Activities	Evaluation of Success at the Time	Additional Information Needed/Available	Document Reference
Open Pits		Flooding of both the Main pit and the Zone II pit.	After completion of mining, Faro Creek would be diverted into Main Pit to fill. Two dykes to be constructed at low points to raise flooded elevation (west and south sides of pit).	Groundwater will be monitored by sampling wells south of Zone II and surface water monitoring.	Overflow would be pumped and treated until suitable for discharge to North Fork Rose Creek.	Selected measure		Curragh, 1988
			Construction of overflow spillway and exit channel.			Selected measure		Curragh, 1988
			Zone II pit will be allowed to fill.	Overflow exits through a constructed rock drain to a sump.	Water will be pumped from sump to treatment facility until suitable for discharge.	Selected measure	Sources of contaminants and variations in loading with seasons and over time.	Curragh, 1988
		Backfill of Zone II pit will be completed.	Plan was to be backfilling with non-acid generating rock.	Plan was that long-term treatment from this pit would not be necessary.	Construction of interceptor ditches for surface water and shallow groundwater away from pit to limit inflow through pit walls.	Selected measure		Curragh, 1988
Tailings	ARD, physical stability					Selected measure		Curragh, 1988
Waste Dumps - Under construction at the time.	ARD	Separate sulphide dump, then backfill all reactive rock into Main Pit.	Plan was to haul all non acid generating rock to Zone II, east and intermediate dumps.		Construction of separate cellular sulphide dump with base of calc silicates and a compacted phyllite cover.	Selected measure		Curragh, 1988
Waste Dumps - Existing Dumps	ARD	Assessment of problem.	Take water samples to assess concerns. Map and sample rocks on dumps.	Assume dumps will not generate acid but are concerned about elevated zinc levels.		Selected measure	Didn't know composition of dumps, no ARD testing.	Curragh, 1988.
Waste Dumps	Slope stability	No action required.	Based on observation, 2:1 dump slopes are considered stable.		Planned to do an assessment of dump slope stability with ongoing monitoring until closure.	Selected measure		Curragh, 1988
North Fork Rock Drain	Stability under high flows	Rock drain causeway will be breached and emergency spillway constructed.	Spillway will be constructed and downstream slope prepared to minimize erosion.	Commented on water sampling but no concerns with respect to water quality at that time.	Concern about fisheries habitat loss as a result of construction.	Selected measure		Curragh, 1988
Pumphouse Dam	Physical stability	Dam will be breached and concrete broken up, removed or buried.				Selected measure		Curragh, 1988
Freshwater resrevoir.		Reservoir dam will be upgraded, spillway lowered by 2 m and dam left in place.		To maintain overwintering habitat and as a flood reservoir for protection downstream.		Selected measure		Curragh, 1988
Faro Creek Diversion		Construct temporary channel to divert Faro Creek into pit to flood faster.	Diversion will be maintained until water quality in pit suitable for discharge, at which time a permanent channel to put Faro Creek into pit will be constructed.	If permanent water treatment required, channel will be upgraded to maintain diversion.	Construction of permanent diversion channel complicated by presence of Faro Valley dumps. Must construct around dumps to minimize flow through acid generating waste rock in these dumps. Possibly must remove part of dumps.	Selected measure	Extent of acid generation from dumps. Potential for clean pit option.	Curragh, 1988
North Valley Wall Interceptor Ditch		Upgrade and leave in place.	Increase capacity by 50%, armour and stabilize slopes.			Selected measure		Curragh, 1988
North Fork Rose Creek		Return to original channel.	At confluence with Rose Creek, upstream of the pumphouse.			Selected measure		Curragh, 1988

Down Valley Tailings Facility								
Specific Component (source)	**Specific Issue**	**Measure**	**Description of Methods**	**Considerations**	**Limitations/Concurrent Activities**	**Evaluation of Long-term Success at the Time**	**Additional Information Needed/Available**	**Document Reference**
Rose Creek Tailings	Control acid generation and metal leaching.	Alternative 1 No Covers (Base Case)	Tailings surfaces left bare, no contouring or covers.			Not acceptable to objectives of decommissioning plan. High metal loadings and therefore high predicted receiving water zinc concentrations. Poor evaluation with respect to long-term stability because of risks associated with Rose Creek either in a chann		Curragh, 1988
			Intermediate Dam left at final elevation (estimated at 1049.3 masl). Spillway upgraded. Channel constructed across surface of impoundment to carry Rose Creek.	Spillway upgraded to carry half PMF with 1 m of freeboard or full PMF with no freeboard. Channel sized for full PMF with no freeboard.			This was estimate of final dam height, based on predictions at the time (1990).	Curragh, 1988
			Polishing pond behind Cross Valley dam drained and fines/contaminated soils removed to the Intermediate Dam. Cross Valley dam breached and channel constructed to redirect spillway discharge into original Rose Creek channel.					Curragh, 1988
			Upper reach of Rose Creek diversion widened and riprapped to carry half PMF. Lower Rose Creek diversion (along Intermediate Dam Impoundment) would be abandoned and armoured channel sized for PMF constructed across Intermediate Impoundmetn to carry Rose C					Curragh, 1988
			Construct diversion channel around north side of Second and Intermediate Dam to carry flows from pit and waste dumps.	Channel would discharge into Intermediate Dam spillway.				Curragh, 1988
			North Wall Interceptor ditch would be abandoned and Next Creek returned to original channel (Guardhouse Creek) and then discharge into new diversion channel.					Curragh, 1988
			North Fork Rose Creek would be returned to original channel.	This would join the South Fork immediately upstream of the Pumphouse Reservoir.	The North Fork diversion would be abandoned and the four sediment control dams in the original channel removed. Dam forming Pumphouse Reservoir would be removed.			Curragh, 1988
		Alternative 2 Soil Cover	Three types of covers are considered within this option; composite soil cover (2a), simple soil cover (2b), or synthetic membrane cover (2c). The cover would be placed on all three impoundments.	All measures from Alternative 1 would be implemented, plus placement of covers on all three tailings impoundments.		Acceptable predicted receiving water chemistry however these predictions depend on cover performance and metal mobility. Poor evaluation with respect to long-term stability because of risks associated with Rose Creek either in a channel through the Inter		Curragh, 1988
			Intermediate Dam left at current elevation. Spillway upgraded. Channel constructed across surface of impoundment to carry Rose Creek.	Spillway upgraded to carry half PMF with 1 m of freeboard or full PMF with no freeboard. Channel sized for full PMF with no freeboard.				Curragh, 1988
			Polishing pond behind Cross Valley dam drained and fines/contaminated soils removed to the Intermediate Dam. Cross Valley dam breached and channel constructed to redirect spillway discharge into original Rose Creek channel.					Curragh, 1988
			Upper reach of Rose Creek diversion widened and riprapped to carry half PMF. Lower Rose Creek diversion (along Intermediate Dam Impoundment) would be abandoned and channel constructed across Intermediate Impoundmetn to carry Rose Creek flow.	Channel would be sized for PMF and armoured.				Curragh, 1988
			Construct diversion channel around north side of Second and Intermediate Dam to carry (storm) flows from pit and waste dumps.	Channel would discharge into Intermediate Dam spillway or a point downstream.	Must be control on water quality of pit and dump drainage, and mill site runoff.		Chemistry of pit and dump drainage and effect on receiving water.	Curragh, 1988

Down Valley Tailings Facility

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations/Concurrent Activities	Evaluation of Long-term Success at the Time	Additional Information Needed/Available	Document Reference
			North Wall Interceptor ditch would be abandoned and Next Creek returned to original channel (Guardhouse Creek) and then discharge into new diversion channel.					Curragh, 1988
			North Fork Rose Creek would be returned to original channel.	This would join the South Fork immediately upstream of the Pumphouse Reservoir.	The North Fork diversion would be abandoned and the four sediment control dams in the original channel removed. Dam forming Pumphouse Reservoir would be removed.			Curragh, 1988
		Alternative 3 Water Cover	Establish minimum 2 m water cover over all tailings by moving tailings and raising Intermediate Dam.	Two variations were considered; minimal tailings rehandle and 29.3 m raise of Intermediate Dam (Alternative 3a), or significant tailings rehandle to lower maximum tailings surface elevation and a 24.3 m raise of Intermediate Dam (Alternative 3b).	For alternative 3a conventional shovel and truck equipment would be used. For alternative b3, hydraulic monitoring would be used and therefore there is a significant water management and water treatment requirement during mining and until a "clean" water	Considered best technology to prevent further oxidation, however still produces a significant metal load to seepage, at least in the short term. Considered reasonable with respect to long-term stability (best after alternative 5).	Amount of tailings rehandle, and required elevation of Intermediate Dam depends on final tailings surface elevation.	SRK 1991
			Rose Creek Diversion abandoned and flow of Rose Creek routed through the flooded impoundment area.					SRK 1991
			Spillway required for Intermediate Dam.	Sized to carry PMF.				SRK 1991
			North Wall Interceptor ditch would be abandoned and Next Creek returned to original channel (Guardhouse Creek), discharging into flooded impoundment.					SRK 1991
			Pit overflow and drainage would flow into flooded impoundment area.	No armoured channel required in this alternative.	Control of water chemistry of pit and dump drainage flowing into flooded impoundment.			SRK 1991
			North Fork diversion would be abandoned and North Fork Rose Creek would flow into directly into flooded impoundment.	No need to breach sediment dams in original channel or breach dam forming Pumphouse Reservoir.	North Fork Diversion would be abandoned.		North Fork Diversion would be abandoned. Disagree, these probably need to be removed for physical stability at closure.	SRK 1991
		Alternative 4 Water/Composite Soil Cover	This alternative combines a water cover over the tailings in the Intermediate dam, combined with a composite soil cover over the tailings in the Original and Second Impoundments and a synthetic membrane liner on embankment faces.			Similar predictions to Alternatives 2 and 3. However considered a moderate risk with respect to long-term stability due to control structures required.	Required elevation of Intermediate Dam depends on final tailings surface elevation.	SRK 1991
			Intermediate Dam raise required.	To establish a 2 m water cover over the Intermediate Dam, it was estimated that a 10 m raise would be required.				SRK 1991
			Spillway required for Intermediate Dam.	Sized to carry PMF or half PMF with 1 m freeboard.				SRK 1991
			Polishing pond behind Cross Valley dam drained and fines/contaminated soils removed to the Intermediate Dam. Cross Valley dam breached and channel constructed to redirect spillway discharge into original Rose Creek channel.					SRK 1991
			Section of Rose Creek diversion beside Intermediate Impoundment would be abandoned, diversion dam breached and Rose Creek allowed to flow through flooded Intermediate Dam. Rose Creek diversion south of Second Tailings Impoundment would upgraded.	Diversion would be expanded and armoured to carry half PMF.				SRK 1991
			North Wall Interceptor ditch would be abandoned and Next Creek returned to original channel (Guardhouse Creek), discharging into flooded impoundment.					SRK 1991

Down Valley Tailings Facility

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations/Concurrent Activities	Evaluation of Long-term Success at the Time	Additional Information Needed/Available	Document Reference
			Construct diversion channel around north side of Second and Intermediate Dam to carry flows from pit and waste dumps.	Channel would discharge into Intermediate Dam Impoundment or spillway.	A control structure may be included to periodically route water to Original and Second Impoundments to maintain saturated layer in composite cover. Also, requires control of chemistry of drainage flowing into flooded impoundment.		Chemistry of pit and dump drainage and effect on receiving water.	SRK 1991
			North Fork Rose Creek would be returned to original channel.	This would join the South Fork immediately upstream of the Pumphouse Reservoir.	The North Fork diversion would be abandoned and the four sediment control dams in the original channel removed. Dam forming Pumphouse Reservoir would be removed.			SRK 1991
			Cover constructed.	selection of material for saturated (slimes) layer of cover.				SRK 1991
			Recontouring of tailings to form a series of level terraces, followed by construction of low dykes to form "paddies" on the tailings surface that would maintain saturation in covers.	Effect of tailings handling on surface water chemistry.	Water management and water treatment until "clean" water established (not addressed in plan?).			SRK 1991
		Alternative 5 Water Cover with Reprocessing	Tailings would be recovered from Down Valley Facility and pumped to mill for reprocessing. Water cover would be established at 1046.3 m elevation.	Water cover would be established using the existing Intermediate Dam (not raised).	Concentrator would need to be modified. Tailings would be pumped to pit.	Selected: Results in lowest predicted contaminant load, however success is contingent on removal of a significant volume of tailings. Considered to have the lowest long-term stability risk, again contingent on extent of tailings removal.	Metallurgical feasibility?	SRK 1991
			Spillway would be constructed on north abutment.	Sized to pass 1 in 500 year event with 1 m freeboard..	Considered that no additional stabilization of Dam is required.		Amount of tailings that would be left in Intermediate Impoundment. Consequences of failure of Intermediate Dam.	SRK 1991
			Tailings recovered how? How much tailings?	Spillway elevation is below original ground surface elevation in some areas of impoundment. Therefore after tailings are removed, some contaminated soils will also have to be removed and placed underwater.				SRK 1991
			Rose Creek Diversion abandoned and flow of Rose Creek routed through the flooded impoundment area.					SRK 1991
			North Wall Interceptor ditch would be abandoned and Next Creek returned to original channel (Guardhouse Creek), discharging into flooded impoundment.					SRK 1991
			Pit overflow and drainage from waste dumps would flow into flooded impoundment area via original Faro Creek channel.				Chemistry of pit and dump drainage and effect on receiving water.	SRK 1991
			North Fork Rose Creek would be returned to original channel.	This would join the South Fork immediately upstream of the Pumphouse Reservoir.	The North Fork diversion would be abandoned and the four sediment control dams in the original channel removed. Dam forming Pumphouse Reservoir would be removed.			SRK 1991

Attachment A-2 – Closure Options from 1996 ICAP

This appendix summarizes closure options assessed in the following report:

1. Integrated Comprehensive Abandonment Plan, Robertson Geoconsultants (1996)

Faro Mine Facility

Mine Workings

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations/Concurrent Activities	Evaluation of Success at the time	Additional Information Needed/Available	Document Reference
Main Zone Pit	Pit water chemistry, specifically decant from pit, to achieve compliance objectives for closure.	Option 1: Isolated pit option.	Maintain the pit as a secure long-term contaminated water storage facility, keeping it isolated from Faro Creek	Pit water discharge would be controlled therefore water quality standards would probably be a requirement to meet receiving water in Rose Creek	Faro pit is primary contaminated water storage facility. Therefore, consider storage requirements for high precipitation and inflow periods. Uses an existing facility, rather than construction of a new facility for contaminated water storage.	This option was selected over the Option 2 because of the difficulties anticipated in achieving water quality objectives in pit either in short or long term. Anticipated that water treatment would be required prior to discharge.	Remaining uncertainties as of ICAP; rates of consolidation of tailings and waste rock in pit, migration of water through pit rock and tailings, drainage chemistry from in-pit rock and Faro valley dumps and particularly migration of contaminated water from pit.	ICAP, 1996
			Construction of a dam (called both the Plug dam and the Faro dam) to raise flooded elevation to 3850 ft and an emergency spillway.	Dam to increase storage capacity from 44 Mm^3 to 55 Mm^3. A concern is potential for contaminated water seepage, especially from Zone 2 pit	Upgrade and maximize diversions.	Plug dam had been proposed in 1991 as part of the in-pit tailings disposal evaluation. Technically feasible, concern is cost and construction.		ICAP, 1996
			Upgrade of Faro Creek Diversion and other diversions to minimize clean water flow into pit.	To minimize clean water flow into pit to ensure sufficient volume.	Faro Creek diversion would require significant upgrading and probably relocation to pass appropriate design even for long term and to ensure physical stability given the progressive degradation of the (north) pit wall.	Technically feasible, concern is cost.	Seepage from pit, flows from Zone II pit. Potential flows for treatment from Vangorda, tailings facility depending on those closure alternatives.	ICAP, 1996
			Provisions for pumping/discharge to water treatment facility.	If water treatment is required prior to discharge, this option can allow the pit to effectively be used for interception and storage of drainage from the Faro Valley Dump, Faro Creek diversion and Faro waste dumps draining to pit. Additionally, contaminated water from other areas e.g. Zone II pit can be pumped to pit for secure storage.	New water treatment plant and associated pumping/piping/ponds must be constructed.			ICAP, 1996
			Construction of new water treatment plant.	Construction of water treatment plant for pit overflow, dump drainage and seepage. Consideration for plant sizing is whether to treat seasonally or year round.	Construction of contaminated water storage reservoir in Lower Faro Creek Valley and sludge settling ponds.	Required method.	Geotechnical investigations for design of facilities.	ICAP, 1996
		Option 2: pit integrated into Faro Creek flow system. "Clean Pit" option.	Faro Creek would be allowed to flow through the Main zone pit, and become part of the Faro Creek system.	Limits would probably be somewhere between 0.03 and 0.5 mg/L Zn (CCREM, IN89001 licenced discharge).	Ability to apply closure measures to all of the sources of water and therefore contaminant loading into the pit, to meet something close to receiving water standards within the pit. Requires removal of Faro Valley dumps.	This was the original plan before the pit became a tailings impoundment. However it was rejected during the ICAP because of the uncertainty of achieving instream water standards. Specific technical uncertainties - rate of tailings consolidation, migration of water through pit rock, acidic drainage inputs to pit from dumps, groundwater.		ICAP, 1996
			Relocation of acid generating dumps draining into Main pit - both external and internal dumps that would be above water level.	Move Faro Valley waste rock dump to the Northwest Dump, collect/pump/treat seepage in the Lower Faro Creek valley until cleaned up.	Still uncertainty about release of load from in-pit waste rock - rate and extent of release, effect of disturbing rock.		Might not need to relocate dumps already in pit, covered now by tailings or water? Also question of how to physically move the rock - access.	ICAP, 1996
			Relocate Faro Creek Diversion to west bank of Faro Valley and into Main pit.		Can only be done after pit water is of acceptable quality to be part of the Faro Creek system.			ICAP, 1996
			Construct inlet structure for Faro Creek to pit.	Stability of pit wall on north side where flow would enter pit.		Remaining concerns with handling of PMF, dissipation of energy of flow into pit over north wall.		

Mine Workings								
Specific Component (source)	**Specific Issue**	**Measure**	**Description of Methods**	**Considerations**	**Limitations/Concurrent Activities**	**Evaluation of Success at the time**	**Additional Information Needed/Available**	**Document Reference**
			Construct Faro Dam and spillway.	To achieve high flooded water level and minimize oxidation of sulphides in pit walls.	Dam similar to Option 1 but spillway must be much larger as not maintaining water level by pumping.			ICAP, 1996
			Maintain current Faro diversion and water treatment until instream water quality objectives are met.	Requires installation of pumping to take pit water to water treatment plant, until acceptable pit water quality is achieved.	Could take a LONG time to achieve "acceptable" pit water quality given the stored load in waste rock in pit plus all sources of drainage to pit. Comment in ICAP that it would be "extremely difficult to demonstrate that the water quality in Faro Pit will achieve discharge water quality within several decades."	Very difficult to ensure pit water will be clean - ever.	Field data for geochemical since 1996 survey to evaluate loading to pit, geochemical controls.	ICAP, 1996
			Construct contaminated water storage reservoir at mill site.	This is a very large volume of water to store, same as in option 1, because of the anticipated lag time till acceptable water quality is achieved in pit.	New water treatment plant and associated pumping/piping/sludge ponds must be constructed.		Geotechnical investigations for design of facilities.	ICAP, 1996
			Construction of new water treatment plant.	Construction of water treatment plant for pit overflow, dump drainage and seepage. Consideration for plant sizing is whether to treat seasonally or year round.	Construction of contaminated water storage reservoir in Lower Faro Creek Valley and sludge settling ponds. Reservoir in this case is larger than required for Option 1.	Required method.	Geotechnical investigations for design.	ICAP, 1996
Zone II Pit and In-pit Rock Dumps	Contaminant loading from waste rock in-pit, pit walls, Main Zone pit seepage and subsequent seepage from the Zone II pit.	Continue pumping to maintain water level at 3642.	Utilize existing system, possibly requires additional pumping capacity.	Additional monitoring for water level was recommended. Concerns remain about long-term sources of metals and acidity in the in-pit dumps, seepage from Main Pit.	Requires on-going maintenance of existing pumps plus provision for increased capacity if pit flooding results in increased flow from the Main Pit to the Zone II pit.	Good, however for clean pit option might require water treatment.	Change in pumping capacity as a result of possible increase in seepage from Main Pit after flooding.	ICAP, 1996
Faro Underground Workings	only use of these workings for water treatment sludge disposal	none proposed		Possibly use for water treatment sludge storage.				ICAP, 1996

Tailings

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations/Concurrent Activities	Evaluation of Success at the time	Additional Information Needed/Available	Document Reference
Rose Creek Tailings Facility	Acid generation, metal leaching, physical stability and potential for erosion of dams and tailings by Rose Creek.	Option 1: Partial relocation of tailings to Faro pit, establishment of water cover.	Remove sufficient tailings from all three impoundments to allow a 2 m water cover over the remaining tailings without raising the Intermediate Dam.	Reprocessing of tailings required to mitigate contained contaminant load in tailings slurry to pit. Water management and some form of water treatment would be required in tailings pond during and after physical removal of the tailings to mitigate resultant water chemistry as water cover is being established.	Requires construction of a permanent spillway in the Intermediate Dam, abandonment of the Rose Creek Diversion and the North Valley Wall Interceptor Ditch followed by redirection of flows through the tailings facility (possibly requiring a stilling pond), removal and cleanup of the polishing pond behind the Cross Valley Dam, breaching of the Cross Valley dam, construction of toe buttress for Intermediate Dam. Also (possibly) requires construction of Plug dam and Spillway in pit to increase final flooded elevation.	Selected option.		ICAP, 1996
		Removal of tailings progressively from Original and Second Impoundment then Intermediate Dam by dredging or hydraulic monitoring. Process tailings and deposit final tailings in Faro pit.		Need to check exposed ground for contamination and reclaim as appropriate.	Portion of Second Tailings Dam (constructed of tailings) would also be removed. Assumes acceptable process metallurgy.		Assumption was made that seepage water quality through contaminated material would be controlled by attenuation capacity of underlying soils.	ICAP, 1996
		Construction of a permanent spillway in the Intermediate Dam.	Sized for the PMF for entire upstream catchment of the dam.	Recommended construction in south abutment.				ICAP, 1996
		Maintain existing diversions around Rose Creek tailings complex during mining of the tailings.		Water management and water treatment during tailings recovery.				ICAP, 1996
		Once mining completed and discharge water quality achieved, abandonment of the Rose Creek Diversion followed by redirection of flows through the tailings facility.	Might require a stilling pond for high flows into facility.				Time until acceptable water quality for water cover, seepage to aquifer.	ICAP, 1996
		Abandonment of the North Valley Wall Interceptor Ditch followed by redirection of flows to Guardhouse Creek channel and into impoundment.						ICAP, 1996
		Removal and cleanup of the polishing pond behind the Cross Valley Dam, breaching of the Cross Valley dam.		Place sludges underwater in Intermediate Pond.	This pond would be maintained during mining and initial flooding, and used as part of water treatment system until discharge water quality achieved.			ICAP, 1996
		Construction of toe buttress for Intermediate Dam.					Existing geotechnical information was considered inadequate to assess stability.	ICAP, 1996
		Option 2: Complete relocation of tailings to Faro Pit.	All tailings would be dredged or hydromonitored from the Rose Creek facility to the open pit, and the Rose Creek Channel re-established.	Storage volume available in pit.	As above. Also must excavate embankments and dispose of construction materials, probably in pit.	Fatally flawed at the time as insufficient storage volume available for storage of all tailings plus the future developments.	However, need to check struck level curves to see if there is room without Grum u/g and Grizzly.	ICAP, 1996
		Option 3: Covers on existing tailings.	Composite soil cover on Original and Second Impoundments, Water Cover on Intermediate Impoundments.	Closure objectives: long-term stability of Original and Second tailings embankments for MCE, erosion protection of Rose Creek diversion for PMF, CCREM water quality standards in Rose Creek.	Intermediate Dam raised and stabilized for MCE, plus construction of a permanent spillway designed for PMF. Cross Valley Dam breached, polishing pond cleaned and removed, and channel excavated to direct spillway discharge into Rose Creek channel. Upper Rose Creek diversion upgraded for PMF.	This alternative was also considered in the 1991 closure plan for the tailings facility. Not selected as the closure objectives could not be achieved at a sustainable cost. Key concerns are not achieving control of acid generation and contaminant migration, and with stability of dams.	Time until acceptable water quality for water cover, seepage to aquifer.	ICAP, 1996
			Intermediate Dam raised and stabilized, plus construction of a permanent spillway.	Structures stable for MCE, spillway sized for PMF.				ICAP, 1996
			Cross Valley Dam breached, polishing pond cleaned and removed, and channel excavated to direct spillway discharge into Rose Creek channel.					ICAP, 1996
			Upper Rose Creek diversion upgraded for PMF.					ICAP, 1996

Tailings								
Specific Component (source)	**Specific Issue**	**Measure**	**Description of Methods**	**Considerations**	**Limitations/Concurrent Activities**	**Evaluation of Success at the time**	**Additional Information Needed/Available**	**Document Reference**
		Option 4: re-contour tailings and establish 2 m water cover.	Redistribute tailings from the Original and Second Impoundments to lower elevation and flood all tailings.		Requires raising of Intermediate Dam, construction of spillway, re-routing of Rose Creek, water management and water treatment during and after handling of tailings.	This option was originally proposed in the 1981 Abandonment plan. Concerns at the time remain; stability of high dam required in Rose Creek and high spillway to handle MCE and PMF, control of water quality, and cost.	Time until acceptable water quality for water cover, change in seepage to aquifer.	ICAP, 1996

Waste Dumps								
Specific Component (source)	**Specific Issue**	**Measure**	**Description of Methods**	**Considerations**	**Limitations or Required Concurrent Activities**	**Evaluation of Success at the time**	**Additional Information Needed/Available**	**Document Reference**
Faro Creek Valley Dump	Two issues: contaminant loading to Main Pit and that Faro Creek diversion leaks through the dump plus has the potential to erode the dump in event of ditch failure.	Option 1: leave dump as is.	Dump remains in place and disturbance is minimized.	All contaminated drainage will report to the Main pit.	Eliminates Faro Pit Option 1 of "clean pit" i.e. pit incorporated into Faro Creek.	selected option		ICAP, 1996
		Option 2: relocate	Remove all Faro Valley waste rock including reactive rock from diversion ditch construction and place on the upper surface of the Northwest Faro Dumps. Also requires treatment and reclamation of original ground.	Could be significant contamination of underlying ground, also alluvium.	Still requires collection and treatment of this load, that would now report to X23. Ongoing collection and treatment as contaminants are flushed from underlying alluvium. Possible upgrading of diversion required while works in progress.	Required for Option 2 (clean pit) for Faro Pit, to minimize contaminated seepage to the pit.	Amount of rock to be moved, extent of contamination of underlying alluvium.	ICAP, 1996
Faro Main, Intermediate, NE, and NW waste Dumps	Contaminant migration to surface and groundwater.	Three approaches were considered. 1.Collection	Interception and collection of contaminated surface and groundwater flows.	Drainage controlled by topography - requires both surface ditches and groundwater interception.	Extensive, complex.	Considered to be only feasible option.	Long-term predictions of water chemistry and, more significantly, water flow from the dumps. Also, uncertainty as to flowpath of water that (should be) draining from dump as less reports to surface water courses that expected.	ICAP, 1996
		2. Minimize infiltration		Covers and surface treatments evaluated.	Infiltration can be minimized, but will not eliminate requirement for collection and treatment.	Not sufficient.		ICAP, 1996
		3. Remove source.	Oxidized sulphides.	Large existing loads of oxidation products, combined with ongoing reactions.	No existing technically feasible methods to removed existing loads or prevent further oxidation.	No.		ICAP, 1996
		Option 1. Recontour surface, install collection.	Areas of free dumped piles will be recontoured to avoid ponding and minimize infiltration and erosion. Surface water directed by ditching to storage ponds for pumping to contaminated reservoir. Deep dewatering wells required for groundwater flow below ditches.	Slurry walls may be required for cutoff of deep groundwater flows.	Significant construction required of surface and groundwater interception systems. Also intermediate storage ponds for contaminated groundwater flows.	Selected method, however there is insufficient understanding of the groundwater flow regime and extent of contaminant plume development.	Considerable uncertainty about groundwater flow regime, extent of plumes and insufficient info for installation of a groundwater capture system at this time.	ICAP, 1996
		Option 2. Recontour dumps and cover.	Recontour all slopes to 3:1 or flatter, install low permeability cover.	Low permeability materials not locally available. Geomembrane would required replacement every 125 years.	Not economically achievable.	Rejected as not certain could attain sufficiently low permeability cover. Some water treatment would still be required.		ICAP, 1996
Near Pit Dumps (Ranch Dumps)	High source of loading as all rock is sulphide.	Relocate dumps to pit if the Option 2: Faro Clean pit, is selected.						ICAP, 1996
		Option 1: Leave dumps in place.	Leave dumps in place, combined with collect and treat run-off and seepage.	Option appropriate with the contaminated pit option for the Faro pit.				ICAP, 1996
		Option 2: Relocate.	Relocate to below water in the Faro Main pit.	Will increase contaminant load to Main pit during and after placement.	Must be done if Faro Pit Option 2 is selected. Rock must be placed below water, probably with some alkali addition.			ICAP, 1996
Low Grade Stockpiles	Contaminant migration to surface and groundwater.	Option 1: Process through mill.	During operations screen and process coarse fraction.	Might have been economically processed but only in conjunction with processing of new ores.	Fine fraction of ore cannot be processed and would have to be deposited in pit, below water level.	Selected option.		ICAP, 1996
		Option 2: Leave in place.	Leave in place, combined with collection and treatment of runoff.			Selected option if not feasible to process ore in mill.		ICAP, 1996
		Option 3: Relocate.	Relocate to below water in the Faro Main pit.	This would apply to portions of the stockpile draining to the Main pit, if the Clean Pit option is selected.				ICAP, 1996

Water Management

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations or Required Concurrent Activities	Evaluation of Success at the time	Additional Information Needed/Available	Document Reference
Water Treatment Plant		Construct and operate water treatment plant.	HDS water treatment plant is recommended option.	LDS or HDS plant, year round versus seasonal operation, treating just Faro water or also Vangorda/Grum (option not selected).	Construction of surface and groundwater collection, contaminated water storage reservoir, sludge ponds, pumping/piping for plant.	Required.	Water chemistry, water flows for design. Geotechnical investigations for design.	ICAP, 1996
Faro Creek Diversion	Stability during extreme flood events, erosion of valley alluvium or tailings, seepage from diversion increasing leaching from tailings, stability of Faro north pit wall.	Faro Pit Option 1: Isolated pit.	For this option, the diversion is redesigned to accommodate a 1 in 500 year flood event with reserve storage in pit for all events in excess of the 500 year.	Diversion is also relocated to avoid the north wall failure. Objective of diversion is to minimize clean water inflow, and maximize storage for contaminated water.	Selected option.			ICAP, 1996
		Faro Pit Option 2:	Relocate diversion to a new channel on west side of valley and into pit.	Concern is how to dissipate the flow energy in the event of the PMF, avoiding the north wall of the pit.		Concern is erosion of the pit wall and of the tailings, and consequent increase in TSS and metals in pit water.		ICAP, 1996
Rose Creek Diversion	Capacity of spillway to pass PMF, ability to locate spillway in rock.	Removal of Cross Valley dam and polishing pond, re-routing of lower portion of diversion through tailings pond or Intermediate Pond, construction of spillway, possible raise and buttress of Intermediate Dam depending on selected tailings option.						ICAP, 1996
North Fork of Rose Creek Diversions		North Fork of Rose Creek diverted back into original channel.	North Fork of Rose Creek upstream of the Pumphouse will be diverted back into original channel, small dams downstream will be removed. Dam forming Pumphouse pond will be breached.					ICAP, 1996
North Fork Rock Drain	Plugging of the rock drain in the long term, back up water in the Zone II pit.	Option 1: breach rock drain.	The rock drain will be breached to a level just above the then current pond elevation. A discharge channel will be construction. Road surface will be scarified to encourage vegetation.	Significant rock excavation required.		Selected option.		ICAP, 1996
		Option 2: maintain rock drain.	Rock drain would be left in place with no modifications.	Plugging of rock drain over time.		Not selected as long term performance of the rock drain is uncertain. Concern is water backing up into Zone II pit.		ICAP, 1996
North Valley Wall Interceptor Ditch	no material issues	Flow will be redirected into Intermediate Impoundment.	Upper flows redirected to Guardhouse Creek and then into the Intermediate Impoundment. Lower portion of ditch will be breached to allow this flow also into the Intermediate Impoundment.					ICAP, 1996
Intermediate Dam	Stability of Intermediate Dam under MCE.	Option 1:Stabilize Dam.	For selected tailings option (partial removal and flooding), Intermediate Dam will be buttressed and a spillway constructed.	Required to address concerns with stability under MCE and PMF conditions.	Requires partial removal of tailings to achieve flooded water cover. Possible alternative routing of Rose Creek water to maintain water cover.		Dynamic stability of proposed design under MCE.	ICAP, 1996
		Option 2: Raise Dam		Raise dam to provide additional storage capacity for tailings from Original and Second Impoundments, and for water cover.	Flood routing, spillway construction.	Concerns with physical stability.	Dynamic stability of proposed design under MCE.	ICAP, 1996
		Option 3: Remove Dam.			Only feasible if tailings are completely relocated to pit.	Concerns with physical stability.		ICAP, 1996
Cross Valley Dam	Cross Valley Dam must be stable until in-situ water treatment no longer needed.	No action until water cover established and water quality acceptable.						ICAP, 1996
	Closure	Dam and pond will be removed.	Pond will be drained, basin hydraulically monitored to remove sludges which will be placed in the Faro pit underwater. Dam will be breached.					ICAP, 1996

Water Management

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations or Required Concurrent Activities	Evaluation of Success at the time	Additional Information Needed/Available	Document Reference
Pumphouse Pond		Drain pond and breach.						ICAP, 1996
Freshwater Reservoir	Has become fish habitat and some portion of dam would need to be maintained to retain this overwintering habitat.	Option 1: Complete breaching of dam.	Dam would be breached in two stages to allow settling and removal of suspended solids and revegetation of the reservoir basin.	Fish habitat, release of sediments to downstream water course when dam is breached.				ICAP, 1996
		Option 2: Partial breach of maximum height of 4 m.	Dam would be lowered to maximum height of 4 m to achieve stability and overwintering habitat.	Would also require construction of a spillway and modification of the low level outlet if this facility to be maintained.	However, owner (Anvil Range) was requiring transfer of responsibility for facility to a custodian for closure.	Possible if custodian could be found.		ICAP, 1996
		Option 3: Upgrade dam to pass PMF and MCE.				Rejected based on cost.		ICAP, 1996

Mine and Mill Facilities

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations or Required Concurrent Activities	Evaluation of Success at the time	Additional Information Needed/Available	Document Reference
Buildings	Public safety, environmental impact.	Dismantle for salvage or scrap. Concrete removed, or broken up and buried.		Can use facilities such as mill basement or crusher basement for waste disposal (building materials or scrap components).		Standard approach		ICAP, 1996
Mine Shop and Equipment		Salvage or scrap on site.				Standard approach		ICAP, 1996
Waste Disposal Areas						Standard approach		ICAP, 1996
Special areas	process or stockpile	Cleanup, stabilize and revegetate.	Concentrate loadout, ore stockpiles, coal plant, explosives plant extraction pit, PCB storage facility			Standard approach		ICAP, 1996
Chemical Inventory Disposal		Return to supplier, process through mill to tailings, or treat.				Standard approach		ICAP, 1996
Other Infrastructure		Block roads, scarify for revegetation, maintain those required for ongoing operation.				Standard approach		ICAP, 1996

Vangorda Grum Mines: Mine Workings

Mine Workings

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations/Concurrent Activities	Evaluation of Success at the time	Additional Information Needed/Available	Document Reference
Vangorda Pit	Acid generation and metal leaching from in-pit dumps/stockpiles and pit walls.	Option 1 Pit as Contaminated Water Storage Reservoir	Vangorda pit would be used as a reservoir for contaminated drainage	Contaminated water storage facility for both the Vangorda and Grum mining areas. Using existing facility as a contaminated water reservoir upstream of treatment plant, rather construction of new facility.	Maintain Vangorda Creek Diversion and all other diversions to minimize clean water flow into pit. Maintain and operate treatment plant. On-going care and maintenance for diversions. Also requires water management facilities to route all contaminated water to pit, and then to treatment plant. Control access to pit.	Selected as anticipated that will not be possible to achieve discharge water quality in Vangorda pit. Pit provides reservoir upstream of treatment plant. Insufficient information to predict long-term water quality.	Seepage flowpaths out of pit. Variations in chemistry of feed to treatment plant due to leaching from pit walls resulting from fluctuating water levels in pit (to provide sufficient storage). Spillway not mentioned but assume would be needed.	ICAP, 1996
		Option 2 Partially backfill pit and use as contaminated water reservoir.	Pit serves as contaminated water reservoir, pit partially backfilled and a channel constructed on the fill to route Vangorda Creek through the pit. Pumping installed in pit.	Pit water level to be maintained below 1120 m.	Till covers required on upper pit walls, above flooded elevation. Maintain and operate water treatment plant. Must control access to pit.	Option rejected due to potential instability of Vangorda creek channel, inability to reduce contaminant load to pit sufficient to eliminate need to treatment plant, insufficient storage capacity in pit because of backfilling.	Effectiveness of till covers on pit walls, extent of stored oxidation products, channel design and sizing for Vangorda Creek. Assume spillway needed from pit.	ICAP, 1996
		Option 3 Backfill pit.	Entire pit is backfilled to original contours, pump water using in-pit well, Vangorda Creek routed over fill.	Loss in water storage capacity as a result of backfilling.	Maintain and operate water treatment plant. Must control access to pit.	Option rejected for same reasons as Option 2 plus high cost for somewhat uncertain benefits.	Effectiveness, ability to store sufficient water. Assume spillway needed from pit.	ICAP, 1996
		Option 4 Clean Pit.	Cleaning and covering of reactive rock, lime addition during flooding and routing Vangorda Creek through pit.	Requires on-going water treatment and maintenance of Vangorda diversion until discharge water quality achieved.	Construction of inlet and outlet channels for Vangorda Creek. Construction of new reservoir for contaminated water storage (Little Creek Dam not sufficient). Relocation of in-pit dumps and stockpiles. Must control access to pit. Maintain and operate treatment plant until water quality in pit acceptable.	Rejected - uncertainties of achieving discharge water quality, construction costs and requirements for new contaminated water storage pond.	Time and extent of water treatment required to achieve discharge water quality from pit. Does not consider water management for other components of site - may still need water treatment plant anyway.	ICAP, 1996
Grum Pit	Possible concern with respect to metal leaching, physical stability of pit walls unless pit flooded.	Option 1 Flood pit and use as contaminated water reservoir.	Treat only water that is discharged.	Extent and effect of seepage from pit.	Once pit is flooded, pumping from Vangorda pit would stop. Maintenance of northeast diversion around Grum pit.	Lowest cost option, selected option.		ICAP, 1996
		Option 2 Flood pit and treat to achieve clean water.	Start treatment once sulphides are flooded, pumping water to Vangorda treatment plant.		Treated water containing excess lime then pumped back to Grum pit for disposal. If this does not result in clean pit water, water would be pumped to treatment plant and then discharged to environment.	High cost for questionable success.		ICAP, 1996
		Option 3 Slow flooding of pit	Northeast Diversion ditch is maintained to route clean water around the pit.	Sulphides are exposed in pit walls up to 1210 m elevation, pit can be flooded to 1230 m. Estimated time to fill is 105 years.	Once pit is filled, water will need to be treated prior to discharge to Vangorda Creek. With slower filling, more contaminant load is expected and therefore more extensive (and possibly longer) water treatment is required.		Seepage to aquifer at the East end of the Grum pit - insufficient information to quantify seepage flowpath and quantity. Was any Grum underground developed?	ICAP, 1996
		Option 4 Rapid flooding of pit.	Northeast Diversion ditch is maintained. Contaminated water is pumped from the Vangorda pit.	Estimated time to fill is 25 years.	Requires that there is a water storage reservoir in Vangorda pit, and pumping capacity to Grum pit.		Seepage to aquifer at the East end of the Grum pit - insufficient information to quantify seepage flowpath and quantity. To what extent was Grum underground developed.	ICAP, 1996

Waste Dumps

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations/Concurrent Activities	Evaluation of Success at the time	Additional Information Needed/Available	Document Reference
Vangorda Waste Dumps	No long term dump stability issues but concerns with cover stability and geochemical.	Reslope, cover entire dump, collect and treat.	Cover would be 1 m thick compacted till cover. Water collected in existing ditch system and pumped to pit, prior to treatment.	To be successful, requires relocation of other waste rock piles to main dump e.g. in-pit piles (for clean pit option), oxide fines.	Requires contaminated water storage reservoir (assumes pit in this case), pumping and water treatment plant. Also, long-term care and maintenance of water management systems and treatment plant.	Measures based on those proposed in 1989 Water Licence Application. Requires long-term seepage collection and water treatment.	Is all contaminated drainage from the dumps being collected in ditch system? Long-term integrity and effectiveness of till cover and replacement/maintenance requirements.	ICAP, 1996
Vangorda in-pit rock dumps (two).	Acid generation and metal leaching.	Remain in pit or remove to waste dump.		Depends on pit option chosen - would probably need to be moved for clean pit option.				ICAP, 1996
Vangorda in-pit low grade stockpile.	Acid generation and metal leaching.	To be removed for processing.		Depends on pit option chosen - would need to be moved for clean pit option.				ICAP, 1996
Oxide fines on Vangorda waste dump.		Move to sulphide cell and cover.		Very high stored soluble load of metals and acidity.				ICAP, 1996
								ICAP, 1996
Grum Dumps		Combination of covers on reactive areas plus surface and groundwater collection and treatment.		To what extent is acid generation and metal leaching observed, expected in future.	Long-term care and maintenance for covers, ditches and water management (pumping for treatment).	Measures based on 1989 Water Licence Application and subsequent Anvil Range dump design modification (1996).	Evaluation of field data to determine if there is a water quality issue.	ICAP, 1996
Grum till dump	erosion, TSS	Reslope and vegetate.			Proposed revegetation trials.		No vegetation plan developed at the time.	ICAP, 1996
Grum Southwest Dump	acid generation and metal leaching	Stockpile to be removed and processed before closure.		Stockpile may not have been processed due to early closure. However drainage reports to sump from the sulphide cell.			Was it removed? Actions depend on whether is it anticipated that the Grum dump drainage needs collection and treatment.	ICAP, 1996
Main Dump		Reslope sulphide cell and place 1 m till covers over sulphide areas.		The originally proposed intermediate till layers are not being installed (1996 design modification).				ICAP, 1996
		Establish vegetation on covers.		To control erosion. But may effect integrity of cover.			Effectiveness and integrity of cover.	ICAP, 1996
		Construction of sumps to intercept seepage.						ICAP, 1996
		Construction of monitoring wells to evaluate groundwater quality and determine if additional deeper groundwater interception is required.					Groundwater regime not well understood - not sufficient to evaluate potential flowpaths nor to design interception system.	ICAP, 1996

Water Management

Specific Component (source)	Specific Issue	Measure	Description of Methods	Considerations	Limitations/Concurrent Activities	Evaluation of Success at the time	Additional Information Needed/Available	Document Reference
Vangorda Creek Diversion	Physical stability of diversion, water management with respect to pit.	Option 1: Upgrade and maintain diversion system.	Construct new channel to replace culvert and associated earthwork, breach haul road and construct new plunge pool at confluence with Vangorda Creek.		Long-term care and maintenance.	Selected option.		ICAP, 1996
		Option 2: Construct channel to flow over pit.		Must be done in conjunction with selected pit option i.e. requires some backfilling of pit.	Physical stability, sufficient storage for contaminated water either in-pit or in new ponds.			ICAP, 1996
		Option 3: Allow to flow into pit.		Water management decisions for open pit.	Requires either clean pit option, or sufficient in-pit storage prior to treatment.			ICAP, 1996
Little Creek Dam		Upgrade, construct spillway and maintain dam.	Dam will be used for storage of waste dump drainage prior to treatment.	Does not allow for storage of an other contaminated water prior to treatment.	If other flows have to be treated, e.g. Grum or Vangorda pit waters, reservoir capacity probably not sufficient.	Good.	Seepage losses.	ICAP, 1996
Water Treatment Plant		Option 1: Continue treatment plant operation as planned for closure.	Existing lime sludge neutralization plant as per IEE and Water Licence Application.	Depends on whether treatment is required of Grum pit water; possibly plant should be refurbished or moved.	Final sludge disposal location. Grizzly and Grum underground workings were proposed, also Little Creek dam if plant is moved. However, initial sludge settling ponds must be constructed.	Selected option. However, as a result of ICAP there are a number of additional sources of water that may require treatment over a longer time period than anticipated in design.	For all options, limitation is ability to predict long-term water chemistry and water flows for treatment.	ICAP, 1996
		Option 2: Relocate treatment plant to Little Creek Pond, near Vangorda pit.	Vangorda pit would be the contaminated water storage reservoir upstream of plant.	LDS or HDS plant. HDS would considerably reduce sludge volumes and lime consumption.	Construction of new sludge settling ponds required prior to final disposal of sludge in underground or Grum pit at depth.			ICAP, 1996
		Option 3: Upgrade existing treatment plant to HDS.	Currently plant operates as a straight lime neutralization circuit, low density sludge.					ICAP, 1996
		Option 4. Pump all water to Faro for treatment.	Sludge disposal in Faro underground workings.	Consider seasonal or year round water treatment, affects sizing of plant and contaminated water storage reservoir.	Construction of pipeline between Vangorda/Grum to Faro.	Separate water treatment plant would be built at Faro, but only to treat Faro drainage.		ICAP, 1996
		Option 5: Evaluate alternative treatment technologies.	Considered ion exchange, wetlands, limestone trenches, alkali addition to tailings, in-pit treatment.	To replace requirement for active water treatment.	Passive treatment alone was not considered to be sufficient, and an active water treatment plant would still be required.	Passive methods not sufficient for water quality compliance.	Consider advances since then in passive treatment.	ICAP, 1996
Pelly Pond		Embankment breached and vegetation established.						ICAP, 1996
Sheep Pad Pond		Ditch between treatment plant and pond will remain as permanent discharge channel from treatment plant. Ponds will remain for sediment control structures.		If water quality acceptable for discharge, flow will be ditched to Vangorda Creek system.				ICAP, 1996
Groucho Ponds		Pond drained, berms removed and area revegetated.	Located between Grum pit and the treatment plant.					ICAP, 1996

Infrastructure								
Specific Component (source)	**Specific Issue**	**Measure**	**Description of Methods**	**Considerations**	**Limitations/Concurrent Activities**	**Evaluation of Success at the time**	**Additional Information Needed/Available**	**Document Reference**
Roads	Access, reclamation.	Maintain those required for closure. Berm off, remove culverts and abutments, revegetation for others.				Standard measures.		ICAP, 1996
Borrow Areas	Erosion, stability.	Minor resloping, revegetation.						ICAP, 1996
Pipelines, power lines.		Maintain those required for closure. Salvage or bury others.						ICAP, 1996
Buildings		Buildings not required for on-going care and maintenance will be dismantled, salvaged, or burned/buried.						ICAP, 1996
Mine Equipment		Salvaged or scrapped.						ICAP, 1996
Fuel and Oil Storage		Remaining supplies consumed or burned. Tanks salvaged or scrapped.						ICAP, 1996

Attachment A-3 – Closure Options from 2003-2006 Reports

This appendix summarizes closure options considered in the following report:

1. "Tailings Relocation Studies, Anvil Range Mining Complex."SRK 1CD003.40. SRK 2004
2. "Hydrotechnical Study for Closure Planning, Faro Mine Site Area."Northwest Hydraulic Consultants Ltd. and BGC Engineering Inc., 2004
3. "Rose Creek Diversion Canal, Conceptual Closure Options."BGC Engineering Inc., 2004.
4. "Water Treatment Requirements for the Anvil Range Site."SRK 1CD003.54. SRK 2005
5. "North Fork Rock Drain - Technical Studies."John Brodie, August 2004 Memo.
6. "Assessment of Vangorda Pit Backfilling" SRK 1CD003.48. SRK 2004a.
7. "Detailed Comparison of Alternatives for the Relocation of the Faro Creek Diversion. "Golder Associates Ltd., 2004.
8. "Waste Rock Pile and Tailings Covers for the Anvil Range Mining Complex. "SRK 1CD003.26. SRK, 2004b (Draft Only).
9. "Water Treatment Requirements for the Anvil Range Site. "SRK 1CD003.54. SRK 2005a
10. "Revised Oxide Fines Management Plan, Anvil Range Mine Site. "SRK 1CD003.44.200. SRK 2005b
11. "Continued Seepage Investigation, Zone 2 Pit Outwash Area. "SRK 1CD003.73. SRK 2006 (Draft Only).
12. "2005 Seepage Investigation at the Emergency Tailings Area. "SRK 1CD003.73. SRK 2006b (Draft Only).
13. "Progressive Reclamation of the Emergency Tailings Area."SRK 1CD003.081. SRK 2006c
14. "Assessment of Vangorda Pit Backfilling. "SRK 1CD003.48. SRK 2006a.
15. "Evaluation of the Vangorda Creek Diversion to Dixon Creek. "SRK 1CD003.080. SRK, 2006b.
16. "Anvil Range Pit Lakes, Evaluation of In-Situ Treatment. "SRK 1CD003.46. SRK, 2006c.
17. "Waste Rock Pile and Tailings Covers for the Anvil Range Mining Complex. "SRK 1CD003.26. SRK, 2004a (Draft Only).
18. "Alternatives Assessment for Vangorda Creek Diversion. "SRK 2002.
19. "Water Treatment Requirements for the Anvil Range Site. "SRK 1CD003.54. SRK 2005a.

Tailings Area – Alternatives Considered

Tailings Area
Alternatives Considered

Component	Option	Description of Option	Under Current Consideration?	Example Alternative	Rational for Current Exclusion	Options Reports
Tailings Area Overall	**Relocate to Faro Pit**	Relocate all tailings to Faro Pit	y	TA2		
	Cover (non-water)	Cover all tailings to stabilize them in place - various cover materials considered (see below).	y	TA1		
	Leave as is	Leave tailings in place without cover, and rely on collection/treatment of contaminated water.	n		"Leave as is" concept considered unacceptable due to risks of human health and ecological effects associated with increased contaminant release through both terrestrial and aquatic pathways.	
	Relocate/Cover Combination	Relocate some tailings to Faro Pit, and cover remainder - various partial relocation and cover options considered (see below).	y	TA3		
	Other in situ containment	Stabilize tailings with soil tackifier, construct fence around tailings. Reliance on permafrost aggradation to stabilize tailings in the valley. Use of permeable reactive barriers to limit flow of contaminants	y	TA4	Establishment of permafrost at this location is unreliable. Permeable reactive barriers considered as possible future method for water treatment - to be addressed at design stage.	
	Chemical stabilization	In-situ chemical treatment to stabilize tailings in place - either leaching or neutralizing.	n		Not considered technically feasible at this time.	
	Reprocessing	Reprocessing of tailings to recover residual metals.	n		Reprocessing is a possible component of tailings relocation - consideration for reprocessing would be considered if this method were selected.	
	Water cover	Establishment of a water cover over tailings to reduce ongoing oxidation of tailings - various partial relocation options considered (see below)	n		Tailings contain significant existing oxidation products due to weathering over periods up to 40 years. Water quality modeling predicts that establishment of water covers over these tailings will lead to increased release rates for oxidation products, and unacceptable water quality impacts in downstream receiving waters.	
	Relocate as dry tailings	Relocation of dry tailings to the valley walls, to allow re-establishment of Rose Creek in its original channel.	n		Relocation of tailings to the valley walls would require construction of new dams along the length of the valley - not considered practical at this time.	
Tailings Relocation Methods	**Hydraulic Monitoring**	Use hydraulic monitors to mobilize tailings, pump to pit as slurry.	y	TA2		SRK 2004
	Dredge	Utilize floating dredge to mobilize tailings, pump to pit as a slurry.	n		Large quantities of water required for dredge activities - leading to significant water management issues and increased hydraulic gradients leading to higher contaminant release rates.	SRK 2004
	Drag Line	Utilize a drag line to excavate tailings for transfer to the Faro Pit.	n		Initial investigations showed that draglines would not be as effective as monitoring or dredging.	
	Mechanical	Utilize trucks and shovels to mechanically relocate tailings.	y	TA2	Truck and shovel methods will be utilized to relocate tailings for valley clean-up. This method was considered for all tailings, but unit costs are expected to be substantially higher than for hydraulic monitoring. Mechanical relocation is not practical for wet tailings (much of the Intermediate Impoundment).	SRK 2004
	Conveyor	Transfer tailings to the Faro Pit using a conveyor.	n		Conveyor methods are not effective in combination with hydraulic monitoring and are also not effective for wet tailings. Quantities for clean-up using trucks and shovels are likely not large enough to warrant construction of conveyor facilities. This could be reconsidered during design.	
Relocation Options	**Move all tailings**	Relocate all tailings to Faro Pit	y	TA2		
	Move Intermediate Tailings	Relocate Intermediate Tailings to Faro Pit, leave Original and Secondary Tailings in place with a cover.	y	TA3		
	Move Original/Secondary Tailings	Relocate Original/Secondary Tailings to Faro Pit, leave Intermediate Tailings in place with a cover.	n		The relocation of the Original and Secondary Tailings was discussed in relation to water cover on the Intermediate Tailings because the relocation of the older tailings allows establishment of a water cover on the remaining tailings with a smaller dam. Because a water cover is not currently under consideration, this partial relocation option is also not under consideration. Partial relocation of the Intermediate Tailings offers significant advantages for upgrading of the Rose Creek Diversion - these advantages are not present for relocation of the Original/Secondary Tailings. A further argument against this option was that, after we pay for the lime addition and relocation of the Original and Secondary tailings, it would be a relatively small cost to relocate the smaller volume of less reactive Intermediate Tailings.	
	Redistribute tailings within existing impoundment.	Relocate tailings within the overall impoundment to allow establishment of a full water cover.	n		This option has all of the issues associated with water covers. In addition, it would distribute the most oxidized higher tailings over the entire surface of the impoundment.	
Tailings Cover Options (non-water)	**Store and Release Soil Cover**	Establishment of a soil cover that relies on store and release mechanisms to limit infiltration into the tailings.	y	TA1, TA3		
	Infiltration Barrier Soil Cover	Establishment of a soil cover that relies on low permeability to limit infiltration into the tailings	n		Low-permeability soil covers are difficult to maintain in the climate of Faro. Cost for construction is expected to be high due to the need for frost protection layers. Long-term viability is questionable and repair costs would be high for earthquake events leading to liquefaction of underlying tailings.	
	Simple Waste Rock Covers	Place a layer of unreactive waste rock over the tailings, primarily to prevent dust release. There wouold be no expectation of revegetation.	n		Modeling studies indicate that a waste rock cover layer would significantly increase infiltration, leading to more rapid flushing of contaminants into aquifer, and higher NPV water treatment costs.	
	Iron Oxide Cover		n		Not demonstrated elswehere.	
	Geosynthetic Cover	Establishment of a cover system that relies on geosynthetic materials to limit infiltration into the tailings.	n		Cost of geosynthetic covers prohibitive for the entire tailings area. Performance under earthquake conditions is not well understood. Geosynthetics have a finite life, leading to requirements for periodic replacement.	
Rose Creek Diversion	**Retain and Upgrade to PMF on current alignment - excavation into valley wall.**	Upgrade the RCDC for its entire length by excavating into the valley wall and raising the existing dyke.	y	TA1	Note: Work currently in progress to further evaluate options for RCDC.	NHC 2004
	Retain and Upgrade to PMF on current alignment - with construction on tailings surface	Upgrade the RCDC for its entire length by excavating into the valley wall and raising the existing dyke including, where necessary, raising the dyke by constructing on tailings	n		Construction of critical water retaining structure on tailings leads to uncertainty about long-term performance.	NHC 2004
	Retain and Upgrade (PMF) Upper Portion - remainder reroute to valley	Upgrade the upper portion of the RCDC by excavating into the valley wall. After relocation of Intermediate Tailings, return the remaining portion of Rose Creek to its original alignment.	y	TA3		NHC 2004
	Retain existing channel, build PMF channel over tailings	Retain the existing RCDC to carry day-to-day flows, construct an overflow structure that would allow flood flows to pass through a new channel constructed on top of covered tailings, leading to an improved Intermediate Dam Spillway on the north side of the valley.	n		Construction of a PMF channel across tailings is not under current consideration due to risks of mobilizing tailings into the downstream environment during flood events. Construction of a stable long-term channel over tailings would be very challenging due to long-term settlement and liquefaction in earthquakes.	NHC 2004

Component	Option	Description of Option	Under Current Consideration?	Example Alternative	Rational for Current Exclusion	Options Reports
Rose Creek Diversion (con't)	**PMF flows addressed through NFRD/upgraded channel combination**	Retain/upgrade the existing North Fork Rock Drain (NFRD) for flood attenuation, and upgrade the RCDC to carry floods that are expected to arise after considering this attentuation.	n		This option was extensively investigated. The North Fork Rock Drain would need relatively minor stabilization, but the current drain would otherwise perform well as a flood attenuator. PMF flows through the RCDC would be significanty reduced. The option was dropped because of concerns about long-term degradation of the rock and or upstream erosion leading to plugging of the drain, and because the ponding of water above the drain complicates the management of contaminated groundwater.	BGC 2004 (Draft Only) and John Brodie 2006
	PMF flows addressed through NFRD and new SFRD/upgraded channel combination	Retain/upgrade the existing NFRD for flood attenuation, build a new rock drain on the South Fork Rose Creek and upgrade the RCDC to carry floods that are expected to arise after considering this attentuation.	n		See above re: NFRD. While preliminary hydraulic calculations suggest this option would greatly reduce the peak flow through the RCDC in a PMF, construction of new structures, with their own risks of failure, upstream of high consequence tailings facility was not considered good practice.	BGC 2004 (Draft Only)
	Attenuate flood in Intemediate Impoundment	Enlarge the Intermediate Impoundment by relocating tailings to elevation 1042 m. Retain existing RCDC to carry day-to-day flows, floods would pass into the enlarged impoundment and be attenuated before leaving in an improved spillway on the north abutment.	n		This type of partial relocation option was linked to water covers which are not under current consideration. Flood routing calculations show that the Intermediate pond has very limited attenuation capacity, and a much higher dam would be required.	NHC 2004
	Pass flood through X-Valley	Upgrade the RCDC to PMF upstream of the Intermediate Dam, retain existing RCDC d/s of Intermediate Dam, pass floods through the X-Valley pond to utilize an improved spillway on the north abutment of the X-Valley Dam.	n		This option remains a possible variant for alternatives that include leaving tailings in place. However, the construction of a PMF spillway with two sharp turns is considered problematic.	
	Tunnel to Pelly River	At a location upstream of the tailings, reroute flood flows of Rose Creek directly to the Pelly River. Retain the existing diversion to carry day-to-day flows	n		Cost prohibitive.	
PMF Spillway	**Concrete Spillway d/s of Intermediate Dam**	Construct a concrete spillway to pass PMF flows - likely in combination with retention of the existing spillway to carry day-to-day flows	y	TA1	Included as costed component in current example alternative.	NHC 2004
	Rock-lined spillway d/s of Intermediate Dam	Construct a rock-lined spillway to pass PMF flows - likely in combination with retention of the existing spillway to carry day-to-day flows	n		Option still under consideration for example alternative TA1 - with inclusion of a buried concrete section so erosion could not propagate upstream past the dam in the event of rip rap failure.	NHC 2004
	Upgraded Intermediate Dam spillway on north abutment	Upgrade the Intermediate Dam Spillway to pass PMF flows.	n		Flows would have to be routed over the tailings - such options are not currently under consideration.	NHC 2004
	Upgraded X-Valley Dam spillway on north abutment	Upgrade the X-Valley Dam Spillway to pass PMF flows.	n		This option was considered in combination with RCDC options that are not currently under consideration.	
	Side Discharge Erodable Spillway d/s of X-Valley Dam	Retain the existing RCDC spillway to carry day-to-day flows, flood flows would pass through a side discharge erodable spillway structure on the hillside downstream of the existing RCDC	n		Not under current consideration due to concerns about long-term integrity and maintenance requriements.	BGC 2004 (Draft Only)
	Rock-lined spillway d/s of Secondary Dam	Construct a rock-lined spillway to pass PMF flows and to carry day-to-day flows - to allow re-establishment of Rose Creek in the valley.	n		This option is linked to the partial relocation option - a rock-lined spillway is still being considered.	
	Concrete Spillway d/s of Secondary Dam	Construct a concrete spillway to pass PMF flows and to carry day-to-day flows - to allow re-establishment of Rose Creek in the valley.	y	TA3	Included as costed component in current example alternative.	
Intermediate Dam	**Raise Dam**	Raise Intermediate Dam to allow establishment of water cover.	n		Option is linked to water cover, which is currently not under consideration.	
	Retain As Is	Leave the Intermediate Dam in place in its current condition	n		Option not consistent with management for a high-consequence dam.	
	Breach	Breach the Intermediate Dam after removing tailings	y	TA2, TA3		
	Retain and Upgrade	Upgrade the Intermediate Dam to withstand MCE.	y	TA1, TA4		
Second Dam	**Retain as is**	Leave the Secondary Dam in place in its current condition	n		Option not consistent with management for a high-consequence dam.	
	Breach	Breach the Secondary Dam after removing tailings	y	TA2, TA3		
	Retain and Upgrade	Upgrade the Secondary Dam to withstand MCE.	y	TA1, TA3, TA4		
X-Valley Dam	**Retain and Upgrade**	Upgrade the X-Valley Dam to withstand MCE	n		X-Valley Dam currently considered unnecessary for closure. Dam foundations would require upgrading to withstand MCE.	
	Retain as is	Retain the X-Valley Dam in its current condition.	n		X-Valley Dam currently considered unnecessary for closure. Option not consistent with management for a high-consequence dam.	
	Retain as emergency storage facility	Lower the invert of the X-Valley Spillway and dewater the pond so that it can serve as an emergency storage basin in the event of failure of groundwater pumping systems.	n		May be considered in final design if tailings remain in place.	
	Breach	Breach the X-Valley Dam after removing sediments.	y	TA1, TA2, TA3, TA4		
Water Treatment	**Status Quo – in plant**	Treat water from tailings in existing treatment plant	n		Existing treatment plant does not utilize lime efficiently, and may not be effective for long-term treatment of expected loads.	
	Wetland Treatment	Treatment of contaminated water from tailings in constructed wetlands.	n		Contaminant loads and flows expected to be too high for wetland treatment. Area required would be prohibitive.	
	Passive Barriers for groundwater	Establishment of permeable reactive barriers for removal of contaminants in groundwater	n		Considered as an optimization option for groundwater collection/treatment requirements.	
	New Water Treatment Plant	Construction of a high density sludge treatment plant for treatment of contaminated water from the tailings area.	y	TA1, TA2, TA3, TA4		SRK 2005
	Nutrient Addition	Addition of nutrients to groundwater and/or surface water to encourage microbial stabilization of contaminants.	n		Technical and practical feasibility not sufficiently documented in conditions similar to Faro - could be considered for optimization during implementation.	
	Other Chemical Treatment Methods	Utilization of alternative chemical treatment methods.	n		Comparisons of other treatment methods have shown lime treatment to be the most cost effective option. Other options could be re-considered at a later date.	SRK 2005

"Tailings Relocation Studies, Anvil Range Mining Complex." SRK 1CD003.40. SRK 2004.
"Hydrotechnical Study for Closure Planning, Faro Mine Site Area." Northwest Hydraulic Consultants Ltd. and BGC Engineering Inc., 2004.
"Rose Creek Diversion Canal, Conceptual Closure Options." BGC Engineering Inc., 2004.
"Water Treatment Requirements for the Anvil Range Site." SRK 1CD003.54. SRK 2005
"North Fork Rock Drain - Technical Studies." John Brodie, August 2004 Memo.

Faro Mine Area – Alternatives Considered

Faro Mine Area
Alternatives Considered

Component	Option	Description of Option	Under Current Consideration?	Example Alternative	Rational for Current Exclusion	Options Reports
Faro Creek Diversion	**Upgrade to East**	Construct new, larger Faro Creek Diversion on east side of pit, connecting to the North Fork Rose Creek.	y	FM2, FM3, FM4	Note: Implementation of this option is delayed for FM3	Golder 2004
	Upgrade to West	Construct new, larger Faro Creek Diversion on west side of pit, connecting to North Wall Interceptor (also upgraded) and Rose Creek d/s of the tailings impoundment.	n		Higher cost than the upgrade to the east. Requires substantial upgrading of the North Wall Interceptor.	Golder 2004
	Tunnel to East	Construct tunnel to divert Faro Creek on the east side of the pit, connecting to North Fork Rose Creek.	n		High construction costs.	Golder 2004
	Reroute to Faro Pit	Reroute Faro Creek into the Faro Pit via a channel around and/or over the Faro Valley Dump. Energy dissipation may be required to minimize mixing of pit water.	y	FM1		
	Retain as is	Retain and maintain the existing Faro Creek Diversion.	y	FM3	Existing diversion will not be stable in long-term. Capacity for large floods is not adequate, and pit wall regression will ultimately lead to failure.	
Faro Pit	**Contaminated Water Storage Reservoir**	Use the Faro Pit as a reservoir for storage of contaminated water from the Faro Mine Area - to provide surge capacity for efficient operation of water treatment facilities. Discharge treated water to Rose Creek.	y	FM2, FM3, FM4		
	Biological Treatment Reservoir	Use the Faro Pit as a biological treatment reservoir, adding nutrients each summer to encourage algae growth for zinc removal. Discharge treated water via pumping/syphon to Rose Creek.	y	FM1		
	Dilution Reservoir	Use the Faro Pit as a dilution reservoir - adding water from Faro Creek to dilute contaminants before discharge to Rose Creek.	y	FM1		
	In-Pit Chemical Treatment Reservoir	Use the Faro Pit as a chemical treatment reservoir - adding reagents to reduce contaminant levels before discharging treated water to Rose Creek (either directly or via a treatment plant).	n		Inefficient use of treatment reagents, especially since the Faro Pit is stratified.	
Faro Pit	**Construct Plug Dam**	Construct a plug dam at the invert of the Faro Pit to raise the water level to allow discharge near the ramp to the current pump barge.	y	FM1, FM4	Construction of a plug dam will raise the water level and reduce production of oxidation products from pit walls. All options presented in the Example Alternatives could be carried out either with or without a plug dam.	
	No Plug Dam	Leave the pit invert at its current elevation and location adjacent to the Zone 2 Pit.	y	FM2, FM3		
	Tailings Storage	Use the Faro Pit for storage of relocated tailings (along with the tailings already stored in the pit).	?		With all tailings in the pit, there is still adequate capacity for any Faro Pit option. Tailings storage does not affect other options for the Faro Pit.	
	Combination Purposes	Use the Faro Pit for several of the above options - optimizing water management in the Faro Mine area.	?		Most likely option for the Faro Pit.	
Faro Pit Discharge	**Flow-Through to Upgraded North Wall Interceptor**	Construct a plug dam and discharge channel to allow a "natural" discharge along the alignment of the current road towards the mill, with discharge to an upgraded North Wall Interceptor.	n		Water quality predictions indicate that water quality will be seasonally unacceptable for uncontrolled discharge.	
	Pump/Syphon to Upgraded North Wall Interceptor	Construct a plug dam and discharge channel along the alignment of the current road towards the mill, with discharge to an upgraded North Wall Interceptor, but rely on seasonal discharge using pumps or syphons.	y	FM1		
	Pump, with Spillway on Plug Dam	Construct a plug dam with an emergency spillway, but rely on pumps to discharge water from the Faro Pit - either directly or via a treatment plant.	y	FM4	Having pit invert at plug dam adds additional physical risks - i.e. failure of pumps/spillway could lead to potential compromise of Plug Dam. Any accidental discharges at this location would lead to increased contaminant loads from Zone 2.	
	Flow-Through to North Fork Rose Creek	Construct a lined discharge channel across the Zone 2 pit to allow "natural" discharge at the current pit invert.	n		Channel failures and leakage in this area would lead to increased contaminant loads from Zone 2. Pit water levels would lead to increased seepage flows to Zone 2.	
	Pump to Treatment Plant	Rely on pumps to remove water from the Faro Pit - with treatment in a treatment plant before discharge. No Plug Dam.	y	FM2, FM3		
Waste Rock Covers	**Rudimentary Soil Covers**	Till cover with nominal thickness of 0.5 m, primarily intended to provide growth media for re-vegetation. Minor reduction of infiltration is expected due to store and release characteristics.	y	FM1, FM2, FM3	Preliminary trade-off calculations were completed to compare the costs of cover construction vs. incremental water treatment requirements. On this basis, rudimentary soil covers were identified as the most practical option for most waste dumps.	
	Store and release covers	Till covers of varying thickness (1m to 2.5m) designed to reduce infiltration by store and release mechanisms.	y	FM1, FM2, FM4	Preliminary trade-off calculations were completed to compare the costs of cover construction vs. incremental water treatment requirements. On this basis, effective store and release covers were identified as the most practical option for dumps with high sulphide contents. Effective store and release covers were identified as a practical option for reducing source loads in FM4.	
	Infiltration Barrier Soil Covers.	Soil covers incorporating a compacted, low infiltration layer and a frost protection layer, designed to reduce infiltration by acting as an infiltration barrier.	n		Long-term integrity of compacted, low-permeability materials is uncertain in areas of deep frost penetration unless significant frost protection layers (several metres) are applied. This is cost prohibitive.	
	Infiltration Barrier Synthetic Covers	Plastic covers with overlying soil to provide protection from ultraviolet radiation, and a medium for revegetation.	y	FM1, FM2, FM4	Preliminary trade-off calculations were completed to compare the costs of cover construction vs. incremental water treatment requirements. On this basis, plastic covers were identified as a cost effective cover for very high load sources.	
	Reactive Covers	Covers utilizing chemically reactive components intended to either: (1) consume oxygen, or (2) form low permeability layers and/or barriers to oxygen diffusion.	n		Good materials for reactive covers have not been identified in the vicinity of the Faro Mine. As a result, this option was not considered further. Also, while limiting oxygen will slow ongoing oxidation, it does not address the existing soluble oxidation products present in the Faro waste.	SRK 2004b (Draft Only)
Oxide Fines and Low-Grade Ore	**Mix with Lime and Relocate to Faro Pit**	Excavate all oxide fines/low grade ore and relocate to the Faro Pit after mixing with lime. Materials would be tremmied to the bottom of the pit to avoid severe water quality effects in the pit.	y		This option is currently identified as an alternative closure method for the oxide fines and low grade ore in FM1 and FM2, with similar costs to consolidating and covering.	SRK 2005b
	Relocate to Faro Pit without Lime Amendment	Excavate all oxide fines/low grade ore and relocate to the Faro Pit without lime amentment. Water treatment of pit water would be required to address water quality issues.	n		Oxide fines and low grade ore contain high levels of soluble oxidation products. Calculations indicate that water treatment costs would exceed costs for lime amendment.	SRK 2005b
	Cover in Place with Robust Covers	Cover oxide fines and low grade ore "in place" using synthetic cover system, revegetate.	n		There are several small piles of oxide fines and low grade ore scattered across the Faro Mine site. All of these are potentially significant sources of contaminant load. The cost of constructing and maintaining several small covers is higher than the cost of relocation to larger piles.	SRK 2005b
	Cover in Place with Rudimentary Covers	Cover oxide fines and low grade ore "in place" using soil covers, revegetate.	y	FM3		
Oxide Fines and Low-Grade Ore	**Consolidate to Larger Piles and Cover**	Relocate smaller stockpiles of oxide fines and low grade ore to a few larger stockpiles. Cover using synthetic covers, revegetate.	y	FM1, FM2, FM4		SRK 2005b
	Relocate to Vangorda Pit	Relocate the Faro oxide fines and low grade ore to the Vangorda Pit along with relocated Vangorda waste rock.	n		Cost prohibitive if carried out on its own. Relocation of this material as a backhaul during cover construction at Faro has been discussed.	SRK 2004

Component	Option	Description of Option	Under Current Consideration?	Example Alternative	Rational for Current Exclusion	Options Reports
Sulphide Cells (Main)	**Cover in Place with Store and Release Covers**	Cover the Faro Main Sulphide Cells in place, with store and release covers, revegetate.	y	FM1, FM2, FM4	Trade-off studies used to evaluate cover type. See above re: cover options.	
	Cover in Place with Rudimentary Covers	Cover the Faro Main Sulphide Cells in place, with rudimentary covers, revegetate.	y	FM3	Rudimentary covers utilized for minimize construction alternative.	
	Relocate to Faro Pit	Excavate the Faro Main Sulphide Cells and relocate them to the Faro Pit (either with or without lime amendment).	n		Excavation and relocation of the Faro Main Sulphide Cells is both impractical (sulphide cell delineation is poorly defined) and cost prohibitive.	
Sulphide Cell (Northeast)	**Cover in Place with Store and Release Covers**	Cover the Faro Northeast Sulphide Cell in place, with store and release cover, revegetate.	y	FM1, FM2	Trade-off studies used to evaluate cover type. See above re: cover options.	
	Cover in Place with Rudimentary Covers	Cover the Faro Northeast Sulphide Cell in place, with rudimentary cover, revegetate.	y	FM3	Rudimentary covers utilized for minimize construction alternative.	
	Relocate to Faro Pit	Excavate the Faro Northeast Sulphide Cell and relocate material to the Faro Pit (either with or without lime amendment).	n		Option not evaluated closely - assumed to be cost prohibitive on basis of evaluations done for other waste rock.	
	Relocate to Faro Main Sulphide Cells	Excavate the Faro Northeast Sulphide Cell and relocate material to the Faro Main Sulphide Cells where it could be covered.	y	FM4		
Faro Valley Dumps	**Cover in Place with Store and Release Covers**	Cover the Faro Valley Dumps in place, with store and release covers, revegetate.	y	FM1, FM2	Trade-off studies used to evaluate cover type. See above re: cover options.	
	Cover in Place with Rudimentary Covers	Cover the Faro Valley Dumps in place, with rudimentary covers, revegetate.	y	FM3	Rudimentary covers utilized for minimize construction alternative.	
	Relocate to Faro Pit with Lime Amendment	Excavate the Faro Valley Dumps, mix material with lime and relocate material to the Faro Pit.	n		Uncertainty about water quality effects in the pit combined with higher cost (lime amendment not required) led to rejection of this relocation option, in favour of relocation to the Main Sulphide Cells - which has similar benefits.	
	Relocate to Faro Pit without Lime Amendment	Excavate the Faro Valley Dumps and place the material directly in the Faro Pit - potentially by end dumping from the pit wall.	n		Uncertainty about water quality effects led to rejection of this option.	
	Relocate to Faro Main Sulphide Cells	Excavate the Faro Valley Dumps and relocate material to the Faro Main Sulphide Cells where it could be covered.	y	FM4		
Other Waste Rock Dumps	**Retain as is**	Leave non-reactive waste rock uncovered.	n		Not considered acceptable for aethetic and land use reasons.	
	Cover in Place with Rudimentary Covers	Cover non-reactive waste rock with rudimentary soil covers, revegetate.	y	FM1, FM2, FM3	Trade-off studies used to evaluate cover type. See above re: cover options. Note: FM3 does not include covers on all non-reactive waste rock.	
	Cover in Place with Store and Release Covers	Cover non-reactive waste rock with store and release covers, revegetate.	y	FM4		
Zone 2	**Pump to Faro Pit**	Continue to manage Zone 2 water by pumping to Faro Pit	y	FM1, FM2, FM3, FM4		
	Pump to Treatment Plant	Manage Zone 2 water by pumping directly to a treatment plant.	n		Selection of location for Zone 2 water will be undertaken as optimization for treatment conditions.	
	Pump to Faro Underground	Pump Zone 2 water into the Faro Underground via existing borehole. Directly connected to lower part of Faro Pit - but may be able to utilize sulphide reduction in the underground workings.	n		Requires additional pumping capacity (increased head).	
	Treat Water In-situ	Utilize biological or chemical means to treat water within the Zone 2 Pit	n		Hydrogeological regime around the Zone 2 Pit is not well understood. Increased water levels could lead to increased contaminant loading from other surrounding waste materials.	
	Reduce Inflows by Regrading and Covering	Regrade the waste rock in the Zone 2 catchment to encourage runoff, cover with low-infiltration covers.	n		Zone 2 catchment is not well understood. Cost would be high, and pumping of water would likely still be required in the long-term.	
Zone 2 Outwash	**Relocate to Intermediate Dump**	Excavate the Zone 2 Outwash materials and relocate them to the Intermediate Dump where they will be covered.	y	FM1, FM2, FM4		SRK 2006a
	Leave in Place	Leave the Zone 2 Outwash materials in their current location	y	FM3		
Emergency Tailings Area	**Cover Tailings in Place**	Cover ETA Tailings in their current location, with low-infiltration cover.	n		Water management across and through the tailings would be problematic because the ETA tailings are in the bottom of the original Faro Creek channel. The ETA tailings are a significant source of iron that will affect operation of d/s groundwater collection systems in the long-term.	SRK 2006b
	Relocate to Faro Pit with Lime Amendment	Excavate the ETA Tailings and relocate them to the Faro Pit after mixing with lime.	y	FM1, FM2, FM4	Note: Location of ETA tailings relocation may vary depending on the selection of a closure option for the Tailings.	SRK 2006c
	Relocate to Faro Pit without Lime Amendment	Excavate the ETA Tailings and relocate them to the Faro Pit with no lime amendment.	n		Water quality uncertainties led to current rejection of this option.	
	Relocate to Tailings Impoundment	Excavate the ETA Tailings and relocate them to the Tailings Impoundment (either with or without lime amendment).	y	FM1, FM2, FM4	Note: Location of ETA tailings relocation may vary depending on the selection of a closure option for the Tailings.	
	Leave as is	Leave the ETA Tailings in their current location, with no covers.	y	FM3		
Water Treatment	**Status Quo – in plant at mill**	Treat water from Faro Mine Area in existing treatment plant in Faro Mill.	n		Existing treatment plant does not utilize lime efficiently, and may not be effective for long-term treatment of expected loads.	
	New Water Treatment Plant	Construction of a high density sludge treatment plant for treatment of contaminated water from the Faro Mine area.	y	FM2, FM3, FM4		
	Biological Treatment in Faro Pit	Add nutrients to Faro Pit to promote algae growth - relying on algae to stabilize contaminants in the pit.	y	FM1		
	Other Chemical Treatment Methods	Utilization of alternative chemical treatment methods.	n		Comparisons of other treatment methods have shown lime treatment to be the most cost effective option. Other options could be re-considered at a later date.	SRK 2005a
	Combination of Treatment Methods	Utilize a combination of biological and chemical treatment methods	n		Considered the most likely option for treatment in the Faro Mine area - will be optimized as part of closure plan implementation.	
Ground Water Collection and Treatment	**Passive Barriers for groundwater**	Establishment of permeable reactive barriers for removal of contaminants in groundwater	n		Considered as a potential future optimization option for groundwater collection/treatment requirements.	
	Seepage Collection Trenches	Establishment of trenches to intercept seepage flows.	y	FM1, FM2, FM3, FM4		
	High Permeability Trenches	Establishment of trenches/walls containing high permeability materials to intercept groundwater.	y	FM1, FM2, FM3, FM4		
	Pumping Wells	Collection of groundwater using pumping wells	y	FM1, FM2, FM3, FM4		SRK 2005
	Wetlands	Treatment of contaminated water from groundwater in constructed wetlands.	n		Contaminant loads and flows expected to be too high for wetland treatment. Area required would be prohibitive.	
	Cut-off Walls	Restriction of groundwater flow paths using cut-off walls, to support groundwater collection upgradient, and reduction of clean water inflow.	y	FM1, FM2, FM3, FM4		

"Assessment of Vangorda Pit Backfilling" SRK 1CD003.48. SRK 2004a.
"Detailed Comparison of Alternatives for the Relocation of the Faro Creek Diversion." Golder Associates Ltd., 2004.
"Waste Rock Pile and Tailings Covers for the Anvil Range Mining Complex." SRK 1CD003.26. SRK, 2004b (Draft Only).
"Water Treatment Requirements for the Anvil Range Site." SRK 1CD003.54. SRK 2005a
"Revised Oxide Fines Management Plan, Anvil Range Mine Site." SRK 1CD003.44.200. SRK 2005b
"Continued Seepage Investigation, Zone 2 Pit Outwash Area." SRK 1CD003.73. SRK 2006 (Draft Only).
"2005 Seepage Investigation at the Emergency Tailings Area." SRK 1CD003.73. SRK 2006b (Draft Only).
"Progressive Reclamation of the Emergency Tailings Area." SRK 1CD003.081. SRK 2006c

Vangorda/Grum Mine Area – Alternatives Considered

Vangorda/Grum Mine Area
Alternatives Considered

Component	Option	Description of Option	Under Current Consideration?	Example Alternative	Rational for Current Exclusion	Options Reports
Vangorda Creek Diversion	**Upgrade Near Current Alignment**	Construct new, larger Vangorda Creek Diversion near the current alignment with revised drop structures.	y	VG2, VG3	Note: Implementation of this option is delayed for VG3	SRK 2002
	Upgrade via Dixon Creek	Construct new, larger Vangorda Creek Diversion on east side of pit, connecting to Dixon Creek, Shrimp Creek and Vangorda Creek.	n		Option would require significant channel construction for the entire length of Dixon Creek and possibly Shrimp Creek. Cost higher than other options.	SRK 2006b
	Over Backfilled Pit	Realign Vangorda Creek along its original alignment, in a lined channel across a backfilled Vangorda Pit.	y	VG1, VG4		SRK 2006a
	Over Partially Backfilled Pit	Construct a causeway across the Vangorda Pit and realign Vangorda Creek in a lined channel across the causeway.	n		Cost higher than other options when considering the additional costs of causeway construction.	SRK 2002
	Retain as is	Retain and maintain the existing Vangorda Creek Diversion.	y	VG3	Existing diversion will not be stable in long-term. Capacity for large floods is not adequate, and existing diversion structure requires significant ongoing maintenance.	SRK 2002
Vangorda Pit	**Contaminated Water Storage Reservoir**	Use the Vangorda Pit as a reservoir for storage of contaminated water from the Vangorda/Grum Mine Area - to provide surge capacity for efficient operation of water treatment facilities. Discharge treated water to Vangorda Creek.	y	VG2, VG3		
	Biological Treatment Reservoir	Use the Vangorda Pit as a biological treatment reservoir, adding nutrients each summer to encourage algae growth for zinc removal. Discharge treated water to Vangorda Creek, either with or without additional treatment.	n		Test work has indicated that Vangorda Pit is not conducive to biological treatment - contaminant levels too high, contaminant loads too high, surface area too small, direct sunlight inadequate.	SRK 2006c
	Dilution Reservoir	Use the Vangorda Pit as a dilution reservoir - adding water from Vangorda Creek to dilute contaminants before discharge to Vangorda Creek.			Contaminant loading to Vangorda Pit is too high. Water quality will not be acceptable for discharge.	
	In-Pit Chemical Treatment Reservoir	Use the Vangorda Pit as a chemical treatment reservoir - adding reagents to reduce contaminant levels before discharging treated water to Vangorda Creek (either directly or via a treatment plant).	n		Inefficient use of treatment reagents.	
	Backfill with Rock	Drain the Vangorda Pit and backfill with the Vangorda Waste Rock after amending with lime.	y	VG1, VG4		
Grum Pit	**Biological Treatment Reservoir**	Use the Grum Pit as a biological treatment reservoir, adding nutrients each summer to encourage algae growth for zinc removal. Add additional loads from other Vangorda/Grum components. Discharge treated water to Grum Creek.	y	VG1, VG2, VG3, VG4		SRK 2006c
	In-Pit Chemical Treatment Reservoir	Use the Grum Pit as a chemical treatment reservoir - adding reagents to reduce contaminant levels before discharging treated water to Grum Creek (either directly or via a treatment plant).	n		Grum Pit appears conducive to treatment by biological means, which is less costly than treatment with chemical reagents. In pit chemical treatment results in inefficient use of treatment reagents.	
	Store Waste Rock	Utilize the Grum Pit for subaqueous storage of waste rock.	n		Vangorda Pit is already being considered as a location for storage of strongly acid generating waste rock at Vangorda/Grum site. Vangorda Pit is best choice for this purpose because it will not serve effectively for biological treatment and is located closer to most of the problematic waste materials.	
Waste Rock Covers	**Rudimentary Soil Covers**	Till cover with nominal thickness of 0.5 m, primarily intended to provide growth media for re-vegetation. Minor reduction of infiltration is expected due to store and release characteristics.	y	VG1, VG2, VG3	Preliminary trade-off calculations were completed to compare the costs of cover construction vs. incremental water treatment requirements. On this basis, rudimentary soil covers were identified as the most cost effective option for most waste dumps.	
	Store and release covers	Till covers of varying thickness (1m to 2.5m) designed to reduce infiltration by store and release mechanisms.	y	VG1, VG2, VG4	Preliminary trade-off calculations were completed to compare the costs of cover construction vs. incremental water treatment requirements. On this basis, effective store and release covers were identified as the most practical option for dumps with high sulphide contents. Effective store and release covers were identified as a practical option for reducing source loads in FM4.	
	Infiltration Barrier Soil Covers.	Soil covers incorporating a compacted, low infiltration layer and a frost protection layer, designed to reduce infiltration by acting as an infiltration barrier.	n		Long-term integrity of compacted, low-permeability materials is uncertain in areas of deep frost penetration unless significant frost protection layers (several metres) are applied. This is cost prohibitive.	
	Infiltration Barrier Synthetic Covers	Plastic covers with overlying soil to provide protection from ultraviolet radiation, and a medium for revegetation.	n		Preliminary trade-off calculations were completed to compare the costs of cover construction vs. incremental water treatment requirements. On this basis, plastic covers were identified as a cost effective cover for very high load sources. None have been proposed for sources at Vangorda/Grum because very high load sources are all located within the catchment of the Vangorda Pit and can be easily collected and treated.	
	Reactive Covers	Covers utilizing chemically reactive components intended to either: (1) consume oxygen, or (2) form low permeability layers and/or barriers to oxygen diffusion.	n		Good materials for reactive covers have not been identified in the vicinity of the Faro Mine. As a result, this option was not considered further. Also, while limiting oxygen will slow ongoing oxidation, it does not address the existing soluble oxidation products present in the Faro waste.	SRK 2004a (Draft Only)
Baritic Fines and Low-Grade Ore	**Mix with Lime and Relocate to Vangorda Pit**	Excavate all Baritic fines/low grade ore and relocate to the Vangorda Pit after mixing with lime.	y	VG1, VG4		
	Cover in Place with Store and Release Covers	Cover baritic fines and low grade ore "in place" using store and release soil cover, revegetate.	y	VG2		
	Cover in Place with Rudimentary Covers	Cover oxide fines and low grade ore "in place" using soil covers, revegetate.	y	VG3		

Component	Option	Description of Option	Under Current Consideration?	Example Alternative	Rational for Current Exclusion	Options Reports
Grum Sulphide Cell	**Cover in Place with Store and Release Covers**	Cover the Grum Sulphide Cell in place, with store and release covers, revegetate.	y	VG1, VG2, VG4	Trade-off studies used to evaluate cover type. See above re: cover options.	
	Cover in Place with Rudimentary Covers	Cover the Grum Sulphide Cell in place, with rudimentary covers, revegetate.	y	VG3	Rudimentary covers utilized for minimize construction alternative.	
	Relocate to Grum Pit	Excavate the Grum Sulphide Cell and relocate to the Grum Pit (either with or without lime amendment).	n		The Grum Sulphide Cell was established for long-term management of sulphide waste from the Grum Pit. Excavation and relocation of this material is both inpractical and cost prohibitive.	
Vangorda Waste Rock	**Cover in Place with Store and Release Covers**	Cover the Vangorda Waste Rock in place, with store and release cover, revegetate.	y	VG2	Trade-off studies used to evaluate cover type. See above re: cover options.	
	Cover in Place with Rudimentary Covers	Cover the Vangorda Waste Rock in place, with rudimentary cover, revegetate.	y	VG3	Rudimentary covers utilized for minimize construction alternative.	
	Relocate to Vangorda Pit with Lime Amendment	Excavate the Vangorda Waste Rock, mix it with lime and and relocate material to the Vangorda Pit.	y	VG1, VG4		
	Relocate to Vangorda Pit without Lime Amendment	Excavate the Vangorda Waste Rock and relocate material to the Vangorda Pit, without lime amendment.	n		Vangorda Waste Rock already contains significant oxidation products. Groundwater level will rise in the pit, and soluble oxidation products would be released to environment.	
Ore Transfer Pad	**Cover in Place with Store and Release Covers**	Cover the Ore Transfer Pad in place, with store and release covers, revegetate.	y	VG1, VG2, VG4	Trade-off studies used to evaluate cover type. See above re: cover options.	
	Cover in Place with Rudimentary Covers	Cover the Ore Transfer Pad in place, with rudimentary covers, revegetate.	y	VG3	Rudimentary covers utilized for minimize construction alternative.	
	Relocate Entire Ore Transfer Pad	Relocate all of the material from the Ore Transfer Pad to the Vangorda Pit or the Grum Sulphide Cell	n		Much of the material at the Ore Transfer Pad is not acid generating. As a result, complete relocation has not been proposed.	
	Relocate ARD Portion to Vangorda Pit with Lime Amendment	Excavate the ARD portion of the Ore Transfer Pad, mix with lime and relocate material to the Vangorda Pit in conjunction with backfilling of Vangorda Waste Rock into the Pit. Cover remainder with soil cover.	y	VG1, VG4		
	Relocate ARD Portion to Grum Sulphide Cell	Excavate the ARD portion of the Ore Transfer Pad and relocate material to the Grum Sulphide Cell where it will be covered. Cover remainder with soil cover.	y	VG2, VG3		
Grum Waste Rock (Except Sulphide Cell)	**Cover in Place with Store and Release Covers**	Cover the Grum Waste Rock in place, with store and release cover, revegetate.	y	VG4	Trade-off studies used to evaluate cover type. See above re: cover options.	
	Cover in Place with Rudimentary Covers	Cover the Grum Waste Rock in place, with rudimentary cover, revegetate.	y	VG1, VG2, VG3	Trade-off studies used to evaluate cover type. See above re: cover options.	
	Leave as is	No cover	n		Would not meet minimum requirements for land reclamation and would not provide any source control.	Jan 2005 workshop
	Relocate to Grum Pit	Excavate all Grum Waste Rock and relocate to Grum Pit.	n		Not cost effective and adds little source control value.	
Water Treatment	**Status Quo – in Existing Vangorda Treatment Plant**	Treat water from Vangorda/Grum Mine Area in existing Vangorda treatment plant.	n		Existing treatment plant does not utilize lime efficiently, and may not be effective for long-term treatment of expected loads.	
	New Water Treatment Plant	Construction of a high density sludge treatment plant for treatment of contaminated water from the Vangorda/Grum Mine area.	y	VG2, VG3		
	Biological Treatment in Grum Pit	Add nutrients to Grum Pit to promote algae growth - relying on algae to stabilize contaminants in the pit.	y	VG1, VG2, VG3, VG4		
	Other Chemical Treatment Methods	Utilization of alternative chemical treatment methods.	n		Comparisons of other treatment methods have shown lime treatment to be the most cost effective option. Other options could be re-considered at a later date.	SRK 2005a
	Combination of Treatment Methods	Utilize a combination of biological and chemical treatment methods	y	VG2, VG3		
	Passive Barriers for groundwater	Establishment of permeable reactive barriers for removal of contaminants in groundwater	n		Considered as an optimization option for groundwater collection/treatment requirements.	
Ground Water Collection and Treatment	**Seepage Collection Trenches**	Establishment of trenches to intercept seepage flows.	y	VG1, VG2, VG3, VG4		
	High Permeability Trenches	Establishment of trenches/walls containing high permeability materials to intercept groundwater.	y		May be implemented if necessary as part of future adaptive management in some areas.	
	Pumping Wells	Collection of groundwater using pumping wells	y	VG1, VG2, VG3, VG4		
	Wetlands	Treatment of contaminated water from groundwater in constructed wetlands.	n		Contaminant loads and flows expected to be too high for wetland treatment. Area required would be prohibitive.	
	Cut-off Walls	Restriction of groundwater flow paths using cut-off walls, to support groundwater collection upgradient, and reduction of clean water inflow.	n		May be implemented if necessary as part of future adaptive management in some areas.	

"Assessment of Vangorda Pit Backfilling" SRK 1CD003.48. SRK 2006a.
"Evaluation of the Vangorda Creek Diversion to Dixon Creek." SRK 1CD003.080. SRK, 2006b.
"Anvil Range Pit Lakes, Evaluation of In-Situ Treatment." SRK 1CD003.46. SRK, 2006c.
"Waste Rock Pile and Tailings Covers for the Anvil Range Mining Complex." SRK 1CD003.26. SRK, 2004a (Draft Only).
"Alternatives Assessment for Vangorda Creek Diversion." SRK 2002.
"Water Treatment Requirements for the Anvil Range Site." SRK 1CD003.54. SRK 2005a