Anvil Range Mining Corporation Interim Receivership Closure Alternatives Workshop

Workshop Notes and Findings

Vancouver, April 2002

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1. Introduction

This report is a summary of the proceedings and findings of the Anvil Range Mining Corporation Interim Receivership Closure Alternatives Workshop (hereafter referred to as "Workshop"), held from April 14 – 17, 2002 at the Deloitte Consulting offices in Vancouver, British Columbia. Attendees at the Workshop were as follows:

- Joanna Ankersmit - DIAND
- Jim Cassie - BGC
- Valérie Chort – D&T
- Claudia David - DIAND
- Eric Denholm – Gartner Lee Limited
- Shannon Glenn – D&T
- Leslie Gomm - DIAND
- Dana Haggar – Anvil Range Mine Receivership
- Peter Healey - SRK
- Daryl Hockley - SRK
- Tony Keen – A.J. Keen Mining Consultants Inc.
- Randy Knapp – SENES Consultants Ltd.
- Bart Koppe – Cantox Environmental
- Kristine MacPhee – D&T
- Bud McAlpine - DIAND
- Doug Sedgwick – D&T
- Dave Sherstone - DIAND
- Wes Treleaven – D&T

2. Objectives

The objectives of this Workshop were:

- To identify remediation methods and build closure alternatives, where:
  - **Methods** are the steps (studies, activities, etc.) that can be taken to address specific problems or requirements.
  - **Alternatives** are complete combinations of steps (*methods*) that are able to take the project from start to finish.

- To identify and define remediation projects that can be proposed as part of the Water License renewal, i.e., to be completed 2003 – 2008.

- To identify critical information needs for the Water License renewal and the Integrated Comprehensive Abandonment Plan (ICAP) that will need to be finalized by 2008.

- To design and prioritize investigations to acquire such information.

Table 1 – Agenda

Sunday, April 14

- Individual Documentation Review - Appendix 1. Reference Documents from Data Room
- Welcome and Introductions – Valerie Chort / Daryl Hockley
- Overview of Anvil Range Mining Interim Receivership – Wes Treleaven

Monday, April 15

- Objectives – Daryl Hockley
- Understanding the Problem
  - Virtual Tour of Site – Eric Denholm (Appendix 2)
  - Permitting Schedule – Shannon Glenn (Appendix 3)
  - Risk Assessment Tool – Valérie Chort (Appendix 4)
  - Tailing Impoundment – Eric Denholm (Appendix 5)
  - Mass Loading Balance – Eric Denholm (Appendix 6)
  - Geochemical Overview – Steve Day of SRK (Appendix 7)
  - Stakeholders – Shannon Glenn (Appendix 8)
- Evaluation Criteria – Daryl Hockley (Appendix 9)
- Conceiving Solutions
  - Group Brainstorming

Tuesday, April 16

- Example Alternatives - Generation
  - Worked Example – Daryl Hockley
  - Example Alternatives Theme Selection
  - Group Brainstorming – Story Board Creation
  - Story Board presentation and discussion
- Example Alternatives – Evaluation
  - Group Brainstorming
  - Presentation and Discussion
- Revised Example Alternatives – Development
  - Definition of Alternatives
  - Group Brainstorming – Story Board Creation
  - Story Board Presentation and Discussion
- Evaluation of Revised Alternatives
  - Green Light - Red Light

Wednesday, April 17

- The Path Forward – Critical Uncertainties and Tasks
  - "Tossed Salad" – Group Brainstorming
  - Defining and Designing Tasks – Group Brainstorming
  - Task Presentation and Discussion
  - Task Prioritization and Scheduling– Designing the Path Forward

Thursday, April 18 – Post Workshop Wrap-up

- Detailed Work Plan Creation

- Finalization of Proposed Schedule, Short and Long Term Planning

Table 2 – Group Assignments

Monday, April 15

Group 1
- Joanna Ankersmit
- Jim Cassie
- Valérie Chort
- Tony Keen
- Bart Koppe
- Dave Sherstone

Group 2
- Claudia David
- Shannon Glenn
- Dana Haggar
- Randy Knapp
- Bud McAlpine
- Wes Treleaven

Group 3
- Eric Denholm
- Leslie Gomm
- Peter Healey
- Kristine MacPhee
- Doug Sedgwick

Tuesday, April 16

Same as Monday

Wednesday, April 17

Group A – Geotechnical
- Jim Cassie
- Peter Healey*
- Tony Keen
- Bud McAlpine
- Doug Sedgwick

Group B – Water Management
- Eric Denholm
- Dana Haggar
- Bart Koppe
- Randy Knapp
- Wes Treleaven

Group C – Policy / Permitting
- Joanna Ankersmit
- Valérie Chort
- Claudia David
- Shannon Glenn
- Leslie Gomm
- Dave Sherstone

*absent for the morning session

3. Understanding the Problem

3a. Virtual Site Tour – Eric Denholm

See Appendix 2. Eric Denholm used photographs and maps to provide a "tour" of the site and ensure that everyone had a basic orientation to the site. A few key points from the presentation and subsequent discussion include:

- Drainage on the site is divided between two drainage basins: Rose Creek and Vangorda Creek. The water flows as follows:
  - Rose Creek → Anvil Creek → Pelly River
  - Vangorda Creek → Pelly River
- Salmon-bearing waters associated with the site: Pelly River, Blind Creek; Anvil Creek (lower parts – may or may not be used by salmon), Vangorda Creek (juvenile rearing for Chinook salmon)
- Rose Creek – fresh water fish habitat
- Site is part of a Thin Horn Sheep herd (ewes and kids) migration route. Winter habitat - Sheep Mountain by the Pelly River. Summer habitat – Mount Mye. Migration route crosses the Vangorda property.
- Fresh water reservoir – 5,000,000 cubic meters
- Faro pit water depth at least 100 m
- Site landfill zone – fire started in January 1997, burned brightly for 1 week and has been smouldering every since. Have tried several different techniques for putting it out.
- Faro Zone II pit – mined and then backfilled with waste rock. A dewatering well, which is pumped a few times a summer, was installed. Water is put back into the Faro main pit.
- Run-off from the rock dumps that run along side the Rose Creek north fork
- It is estimated that a fair bit of the loading for the water in the Faro pit results from the fact the Faro Creek that is not captured in the diversion
- Load-out area – residual concentrate in the load-out shed
- Emergency tailings area – has the old Faro Creek channel running through it. The creek comes out from under the rock dumps. Current zinc ppm = 1100 ppm.
- Dynamite building - on mining lease but operated by contractors
- Tailing spill 1975 – evidence is still visible in the down valley area
- Grum pit still has some ore. There are 4 phases of Grum. Only one phase was completed.
  - East pit wall is crumbling
  - Rock dump built in shelves up the hill
- Vangorda pit
  - Poorest water quality of all three pits
  - Wall rocks are all mineralized
  - Water diverted in an open culvert. Perched on a pit wall that is not stable in the long term.
  - Little Creek dam is for run-off from the Vangorda rock dump

3b. Permitting Schedule – Shannon Glenn

See Appendix 3. Shannon Glenn presented the timeline for the permitting schedule with respect to the preparation and approval of a new Water License and a final ICAP. A few key points from the presentation and subsequent discussion include:

- Different regulatory processes to which the project will be subjected are:
  - CEAA – Canadian Environmental Assessment Act (Federal)
  - YEAA – Yukon Environmental Assessment Act– a mirror of CEAA
  - DAP – is similar to YEAA but has First Nations included as a decision maker
- The project will stay under the regulatory framework under which it was defined, despite the evolution of CEAA into YEAA and then into DAP
- Devolution – unknown how it will play out with respect to decision making, funding, and responsibilities
  - YTG becomes an Responsible Authority (RA) at devolution with unknown impacts on regulatory/approval processes (CEAA)
- Timeline notes:
  - Current Water Licenses expires December 31, 2003
  - The previous discussion had been around seeking a new 5 year License that would allow time to prepare a comprehensive ICAP that could be supported by the majority if not all of the stakeholders. Further this timeline is respectful of all the regulatory changes taking place in the Yukon, namely Devolution and the impacts on the environmental assessment process.
  - CEAA does not need to be complete before submitting a License application to the water board
  - Through the summer of 2002, RA's will formally comment on the EAR guidelines which will be formally given to us in the Fall of 2002
  - The Yukon Water Board has no set timeline to work within
  - Over all timeline will be laid out through the Workshop
- The Minister of each Federal Government RA has to review their document and sign-off
- The regulatory process is out of the proponent's control once the EAR is submitted
- The interim receiver must decide how it will deal with the Grum viability question (perception or otherwise)
  - The PRIVIT Study found that the Grum should stay in–situ for 5 years to see if the price of zinc goes back up to make the pit viable

3c. Risk-Based Management Approach – Valérie Chort

See Appendix 4. Valerie Chort presented the Deloitte & Touche Risk-Based Management Approach that was developed for the Anvil Range site in 2001. This approach has guided the care and maintenance work that has taken place at the site and will be updated annually to ensure it is relevant and addresses issues in order of highest priority. A few key points from the presentation and subsequent discussion include:

- The Fresh Water Supply dam (FWSD) was ranked with the highest risk at the site (2001)
- The matrix will be updated to reflect new information that has been generated (i.e. rock dump geochemistry) and to reflect closure elements, as they become known.

3d. Tailings Impoundment – Eric Denholm

See Appendix 5. Eric Denholm gave an overview of the history and current condition of the tailings impoundment including a presentation of results from *2001 Tailings Impoundment Study (Draft Report)*. A few key points from the presentation and subsequent discussion include:

- 2001 study built on the geochemistry work done by SRK in 1991
- Tailings ISOPAC – thickness is up to 25 m
- The fieldwork plan for the 2001 study was agreed to by Environment Canada and DIAND prior to work being completed. This ensured acceptance of the results by the regulators.
- Study work plan included:
  - Review of available information and identification of gaps that need to be filled to create up-to-date profile
  - The selection of 4 revisity lines – for subsurface information
  - Test pits for collection of tailing samples
  - Auger holes both into the tailings and into the aquifer
- Surface revisity – looking for preferential flow paths that were not being currently detected by the current monitoring locations – no flow paths were found
- Tailings – range from "goopy" to dry sandy stratified profiles
- Monitoring wells – put in several places to mirror previous study points as well as several new wells
  - New hole into toe of Intermediate dam
  - Two monitoring holes in the Cross Valley dam – into bedrock
- Sulphate concentrations in groundwater:
  - Hot spots indicated by big circles on study maps – 20,000 ppm in the base of the tailings
  - Concentrations do not decrease with depth
  - Tailing types aid in movement and oxidation of sulphates – e.g. sandy tailings→ increased concentrations, also the history of the saturation of the tailings impact hotspots
  - Transporting downstream and hotspots showing up at the toe of Intermediate dam
- Zinc hotspots – similar location to sulphates
  - By depth – a little increase
  - Not being transported downstream, i.e., not showing up at the toe of the Intermediate dam
- pH – varies with location of water
- Groundwater flow: 10 years to get down through tailings into the aquifer (vertical transfer) and then another 10 years to travel downstream in the aquifer to the Intermediate dam (horizontal transfer)
- A "contaminant transfer model" based on all borehole logs was developed found:
  - Contaminates released stay at the depth of their release. They push down a little deeper under the Polishing Pond due to the pressure of the water but come back up after the Cross Valley dam.
- Ponds have a concentration of SO_4 630 mg/L which is slightly higher than the levels detected below ground, thus there is some recharge into the aquifer occurring at the two tailings ponds (Polishing and Intermediate)
- Study confirmed we are not seeing a downstream transportation of contaminants
- Approximately 80% of the contaminants in the tailings are located in about 20% are of the overall land area of the tailings impoundment. It should be noted the two hot spot areas are both areas have gone through periods of un-saturation and have sandy-tilly soils.
- The Intermediate Pond water level – controls the saturation level of the tailings. This is a key point for reclamation of the tailings

3e. Mass Loading Balance – Eric Denholm

See Appendix 6. Eric Denholm gave a presentation of results from 2001 Mass Loading Balance study. A few key points from the presentation and subsequent discussion include:

- The purpose of this study was to determine what proportion of the contaminants are coming from what sources. This information is a requirement for developing closure alternatives.
- (Flow) x (Concentration) = Loading (sulphate and zinc)
- At Location V8 (lower Vangorda Creek in the Town of Faro), there was a poor record of data collection and the information contained in the report is based on interpolation. The interpolation data was verified by matching it to data from the Ross River Station.
- The Vangorda Creek water balance inclusion discussion points:
  - Grum interceptor ditch – includes waters from Groucho and Sheep Pad Pond
  - Ore transfer area drains into the West Fork. It was not originally included in the water balance pictorial review. Gartner Lee Limited will review this.
- A few conclusions from the study:
  - North Fork Rose Creek
    - Validation of result: 111% of observed sulphate loading at location X2
    - 0% of zinc was predicted
    - Largest source sulphate loading during the period of the study (1996-2001) was natural run-off from upstream reference location (X7 – upstream of Faro Creek diversion) at 43% of total
      - The second greatest source was Faro Creek diversion (23%) (this is from the diversion itself and not from the background H_20 entering the diversion) and then the Intermediate rock dump at 22%
    - Zinc loading over entire period of study (1996-2001) was natural run-off upstream of location R7 (52% of total) followed by the Faro Creek diversion (31%)
    - Again, it is the diversion itself that is increasing zinc loading and not the background levels in the water following into the diversion.
    - Predictive vs. actual loadings are following the same trending over time, although quantities may be different.
  - Rose Creek models are only predicting 60 and 69% of loadings. Therefore, there are some missing sources or underestimating of the ones included within the model
  - Sulphate loading largest source – surface release from Cross Valley Pond (64%)
  - Vangorda Creek (location v8):
    - Model is predicting 111% of sulphate loading and 113% of zinc loading
    - Time period of study 1998-2001
    - Largest source of sulphate loading was west fork of Vangorda Creek (58%). This area is closest to sampling location V5.
    - Largest zinc loading was west fork of Vangorda Creek (25%) and the Grum rock dump via Grum Creek (23%), followed by the Vangorda Creek diversion channel (19%)
  - Finally, the Grum Creek should be paid close attention over the next few years with respect to changes in mass loading

3f. Geochemical Overview – Steve Day

See Appendix 7. Steve Day, of SRK Consulting joined the Workshop to give a geochemical overview of the entire site. A few key points from the presentation and subsequent discussion include:

- Faro Pit
  - Waste rock is the controlling factor for geochemistry of the water in the Faro pit
  - Information from the 1996 ICAP studies:
    - Dominant rock is non-calcareous schist, at approximately 42%. This rock type is crumbly and do not contain acid buffers, as a result it is potentially acid generating. Currently, the rocks are not generating acid.
    - AG = Acid Generating – sulphides rock (on mass about 13%), averages about 16% sulphur
    - Intrusives – Potential Acid Generating (PAG) – average 0.62% sulphur
- Waste Rock Dumps
  - Sulphides are not well mixed in but there are “pockets” of sulphides all over the place
  - Currently, we are not seeing acid in any of the seepage, but the load is going somewhere, i.e. it is being stored in the rock piles some where and if we start moving it around it might POTENTIALLY start to seep out
- How well is the rock mixed? (refer to slide “waste rock general”)
  - Sulphide Cells - Stored in pockets – (done to keep the sulphides out of the water and away from O_2) delayed acid rock drainage and increased zinc load
  - We have sulphide cells at Faro, in particular the dumps in the emergency tailings area
  - A key fact is that it is known what rock type went into the dumps but it is not known where they were put in
    - The best scenario is if they are well mixed
  - Delayed Acid Generating rocks are the main rock dump, Zone 2 pit, Intermediate dump, and Faro Valley dump
    - Once these rocks go acid – then the zinc and other metals that are in-situ may go through the roof because the lowered pH will liberate contaminants in the rock (e.g. zinc, copper)
    - Increase by a factor of 10 to 15 is a very reasonable estimate
- Grum
  - Worst case scenario but unlikely, is that all 4% of the sulphate rock was all put in one place
  - Much lower chance of ARD here
- Vangorda Pit
  - Pit lake is currently non-acidic, with increasing zinc at depth
  - Seeps may drive this lake’s chemistry in future, e.g. if the lake becomes acid, then its ability to capture contaminants through in-lake participation will be reduced.
  - If the pit flooded, it is expected that the discharge might be greater than allowed downstream. Effluent levels would be okay. Thus flow-through option is not viable here.
- Vangorda Rock Dumps
  - Flows from seepage are lower than expected.

3g. Stakeholders – Shannon Glenn

See Appendix 8. Shannon Glenn, presented an overview of the stakeholders for this project as well as for various sub-projects (i.e. Water Licence Renewal and CEAA process).

4. Evaluation Factors

See Appendix 9. Daryl Hockley discussed evaluation factors that have been used for assessing closure alternatives in previous projects. These factors were classified into one of three groups: cost, risk and acceptance. This grouping pattern allows for comparability among the factors within a specific group. For example, all the cost factors can be converted to a dollar figure and thus compared against each other. The evaluation factors proposed for use in this Workshop were circulated and participants were given the opportunity to make additions or deletions. The following list reflects the input received:

I. COST
- Net present value
- Uncertainty in cost estimate (e.g. regulatory or technical uncertainty)
- Implementation cost (e.g. short term “closure” activities)
- Long term costs (e.g. “post-closure” water collection and treatment)
- Cash flow smoothabiliy
- Local expenditures (e.g. jobs, services, etc.)

II. RISK
- Human health risk due to contamination
- Ecological risk due to contamination
- Conventional risks
- Extreme events risk
- Institutional failure risk (i.e. what happens if there is no government)
- Performance Risk

III. ACCEPTANCE
- Local public concerns (e.g. Town, First Nations, TAC)
- Regulator and licensing (e.g. DFO, DOE, DIAND, YTG)
- Political and funder

5. Conceiving Solutions

A "divergent thinking" group brainstorming technique was used to generate a list of possible methods[1] that could be applicable to various physical and management elements of the site.

The participants were divided into three groups as per Table 2 (Monday). Each group was given an *element* and the individuals within the group were each assigned a different *key word* (see List 1). The participants were then asked to write down all methods they could think of relating to that key word. At the end of one minute, the pages were then passed to the next member in the group who expanded along a thought tree already started or added new methods to the page. Throughout the process, thought triggers were given to the groups to spur on creativity and combat mental blocks.

At the end of this process, the participants consolidated their findings into one list of methods, each briefly described, for each of the elements (see List 2).

List 1. The *elements* and associated *key* words used for the methods brainstorming exercise were:

- ***Pits***
  - Faro pit
  - Faro Zone II
  - Grum
  - Vangorda
- ***Waste Rock Dumps***
  - Faro (Valley, Northeast, Zone II, main, Northwest, Small dumps)
  - Grum (Grum dump, overburden dump, Ore transfer pad)
  - Vangorda
  - Haul Road
- ***Clean Water Management System***
  - FWSD and reservoir
  - Rose Creek diversion
  - Rose Creek downstream
  - Vangorda Creek diversion and pit diversion ditches
  - North Fork rock drain and diversion
  - Faro Creek diversion and interceptor ditch
- ***Licensing and Regulation***
  - Risk assessment
  - Stakeholder communications
  - Receiving water quality requirements
- ***Tailings System (Down Valley and Emergency Tailings)***
  - Original Impoundment and dam
  - Second Impoundment and dam
  - Intermediate Impoundment and dam
  - Polishing Pond and Cross Valley dam
  - Emergency tailings area
  - Faro main pit tailings
- ***Management***
  - Policy
  - Long term site management
  - Funding
- ***Dirty Water Management System***
  - Faro
  - Grum
  - Vangorda
  - Down valley
  - Sludge disposal
- ***Infrastructure***
  - Concentrate load-out pad
  - Mill
  - Access road
  - Mine roads
- ***Other***

[1] *Methods* are steps (studies, activities, etc.) that can be taken to address specific problems or requirements.

List 2. The methods brainstormed for each element were:

Pits

- Do nothing
- Status quo
- Pump and treat
- Flow diversions through with a fast fill of the pits
- Flow diversions through channels in backfilled pits
- Backfill with waste rock, hotspot rocks, tailings or other, with or without cover
- In-situ water treatment
- Control of surface run-off and seeps
- Cover pit walls with till
- Wall stabilization – relocate diversionary ditches
- Faro Zone II pit
  - Break wall into main pit
  - Construct air access shaft to accelerate oxidation and drainage
- Grum pit – cut slot to empty pit
- Faro pit – build a plug dam

Waste Rock Dumps

- Do nothing
- Recontour and cover
- Cover (artificial impermeable barriers, natural seed and till)
- Relocate (all or hot spots only) to pits or tailings impoundments
- Collect and treat seepage
  - With existing or water treatment plant
  - By mixing it with the tailings
  - Via wetlands
  - In-situ using lime
- Collect and redivert run-off
- Recontour for drainage
- Freeze (e.g. using thermosyphons)
- Grum dump and ore transfer pad
  - Process for ore values
  - Remove and use as rip rap
- North Faro Valley dump
  - "Push" in to Faro pit
  - Relocate to other dumps

Dirty Water Management System

- Leave as is
- Treat in-situ, lime, in existing mill or build new WTP
- Reduce pit loading through better diversions
- Isolate contaminant sources
- Dilute with clean water (e.g. flow-through)
- WTPs- upgrade; combine into one down valley site; caustic, soda ash, hydrated lime
- Vangorda – transfer to Grum pit; inject into groundwater aquifer
- Down valley – aquifer recharge to dilute plume; use Polishing Pond as emergency treatment; seepage collection wells below the Cross Valley dam
- Grum – create slot to discharge
- Little Creek water management – evaporation; maintain dam; release downstream; passive treatment
- Sludge disposal – use as waste rock cover; market as a product; reprocess for lime and zinc; move to appropriate pit; move to tailings ponds; dewatering; stabilization; landfill, smelter pit

Tailings System (Down Valley and Emergency Tailings)

- Do nothing
- Monitor only
- Relocate (all, partial, or hot spots only) to Faro pit with or without reprocessing
- Protect from Rose Creek overflow
- Cover
  - Water (partial/full)
  - Soil → composite → vegetation
  - Synthetic
  - Rock
- Remove hot spots and redistribute
- Upgrade dams
- Remove dams (e.g. secondary impoundment, Intermediate)
- Polishing Pond
  - Remove or redistribute solids within
  - Breach Cross Valley dam
  - Leave as is for future use
  - Upgrade monitoring
  - Fill with reprocessed tailings
  - Prevent the ingestion by fauna
  - Line bottom of Pond
- Faro pit tailings
  - Remove
  - Reprocess

Management

- DIAND policy
  - Create and define
  - Minimize costs
  - Protect environment
  - Do what is needed to walk away
  - Do not set a bad precedent
  - Relinquish to YTG
- Short term
  - Leave Grum open
  - Care and maintenance only
  - Use of court orders
  - Bankrupt ARMC
  - Train back-up manager
  - Risk-based approach
  - Government managed
- Long term
  - Complete abandonment
  - Faro Environmental School
  - Fees from rock collectors
  - Establish end of life use
  - Establish responsibilities (DIAND, local, YTG, 1st Nations, private)
- Partnerships
  - Mining industry – funding for studies
  - Employees – profit sharing
- Long term funding
  - Court orders
  - Reclamation trust
  - Operations / capital
  - Industry associations
  - DIAND/YTG
  - Tourism
  - Distribution (Contractors / Residents)
  - "Super Fund"
  - Create DIAND Reclamation Fund

Licensing and Regulation

- Declare a Section 39
- Court order
- Water Licence
  - Compliance to current
  - Change via amendments, renewals, court orders
  - Consultation with stakeholders
- Background information
  - Compilation; gap analysis; scoping
  - New characterization
  - Mapping; air photos; satellite recon
- Receiving water guidelines
  - Standards – drinking water, CCME, MMLER, Water Licence
  - Risk-Based or stakeholder based
  - Site specific EA
  - 500yr/1000yr criteria vs. PMF
- Stakeholder communications
  - What to do and to what extent?
  - Vehicles – newspaper, website, newsletter, summary reports, video, bilingual, public meetings, site tours, committees, focus groups
  - Goal – build trust and transparency of process
  - Form joint-venture with Ross River
- Risk assessment
  - Decisions – adopt approach or not? Act on or not?
  - Decide on planning horizon
  - Categories
  - Expand to social and regulatory
  - Qualitative – quantitative balance

Infrastructure

- Mill building and equipment
  - Keep, convert, sell, tear down
- Treatment plants
  - Upgrade, maintain, remove, combine, relocate
  - Build new – volume, location, cost, technology, energy source
- Main access road
  - Use as an air strip
  - Maintain by upgrading culverts
  - Secure / block gates, seasonal access
- Concentrate load-out
  - Characterize; sell; into pit; smelter
  - Tear down – scrap and bury
- Other – Grum office, primary crusher, fuel storage, mine roads
  - Sell or rehabilitate as needed

Other

- Structures, e.g. roads, pipelines, transfer pads, garbage dump, fuel tanks, buildings, Anvil owned houses
- Infrastructure:
  - Energy; telephone; material supplies (rip rap, till); pipelines
- Site security:
  - EQT – emergency response
  - Records, succession
- Fauna control – migration routes; habitat (creation/destruction)
- Revegetation – type, where, species
- Contaminated soils across site
- Vangorda diversion drop box requirements
- Tax implications
- Land Claims impacts

Clean Water Management System

- Vangorda Creek / diversion
  - Rebuild in place
  - Maintain as is
  - Realign up hill
  - Flow through Vangorda pit – in a backfilled pit, open channel, suspend pit using gravity flow
  - Remove drop box
- Rose Creek diversion
  - Do nothing
  - Eliminate "bend" at second impoundment
  - Cut a channel through the tailings (upstream)
  - Upgrade channel with uniform capacity/sizing
  - Upgrade banks to prevent overflow into tailings
  - Cut a "pilot" channel (notch in base of Creek for ice jam control)
  - Upstream flow control
- Rose Creek downstream
  - Do nothing and monitor
  - Clean up 1970's tailing spill
  - Cover and revegetated
  - Use as dilution treatment
  - Situate a new treatment plant
  - Tunnel
- North Fork Rose Creek – rock dam / diversion
  - Do nothing
  - Diversion / return to natural channel
  - Breach Haul Road (bridge, culvert)

Clean Water Management System con't

- Fresh Water Supply dam and Reservoir
  - Do nothing and monitor
  - Low level pipe remove or remediate
  - Full breach
  - Lower dam level
  - Partial breach / slot
  - Create a second spillway
  - Syphon to maintain low level
  - Maintain (e.g. seal cracks)
  - Use as a collection pond for Grum and Vangorda pit water
  - Complete rehabilitation of dam to PMF/MCE
- Faro Creek diversion
  - Maintain current with pit wall reinforced
  - Realign through pit (water or backfilled)
  - Relocated uphill or through a tunnel to North Fork Rose Creek
  - Floating waterline across pit lake
  - Remove ARD rock from containment dyke
  - Upgrade channel (lining, riprap, culvert size)
  - Relocate through

6. Example Alternatives

On Tuesday, the groups were tasked with generating example closure alternatives that could be evaluated to help direct future work at the site. The example alternatives are not intended to be comprehensive or exhaustive models that can be followed through to closure. Rather, they are tools that can be used to highlight critical paths, uncertainties, knowledge gaps and combination of methods that will inform the decisions on how to move forward with the eventual abandonment of the Anvil Range site.

To generate example alternatives, the participants were asked to incorporate methods (as generated from Monday's "Conceiving Solutions" activity, see Section 5) that were consistent with the overall theme or objective of the example alternative they had been asked to develop. This process of method selection is in large part a trial and error endeavour. Finally, the example alternatives were evaluated based on the Workshop's evaluation factors (see Section 4).

6.1 Methods Consolidation

Monday's session generated a broad list of unconstrained methods (see List 3). In order to develop example closure alternatives this list of methods needed to be organized and consolidated. This was done by paring out equivalents, variants and methods that are linked (i.e. one thing cannot happen without the other).

6.2 A Worked Example

Daryl Hockley took the participants through the process of developing an example alternative using the 1996 ICAP as a sample. Each example alternative was structured along a storyboard which outlined the main aspects an example alternative must consider: title, purpose, assumptions/constraints; Faro elements; Vangorda/Grum elements; tailings elements; Licensing/Regulatory; Management; Cost; Other; Schedule; and Issues/Uncertainties.

Sample Example Alternative Story Board

TITLE	1996 ICAP
PURPOSE	Develop a scheme that had the minimum NPV (Net Present Value) cost
ASSUMPTIONS / CONSTRAINTS	Water Licence requirements
FARO ELEMENTS	• *Dirty water treatment*: o Store dirty water in pit o Build Faro plug in-pit dam to maximize storage o Initiate water treatment in 2025 • *Waste rock dumps and pit* o Recontour waste rock dump to enhance surface run-off o Put in place water collection ditches o Continue to pump water from Faro II pit • *Clean water* o Breach north fork rock drain • Upgrade to 1/500 event and maintain indefinitely
VANGORDA / GRUM ELEMENTS	• *Dirty water* o Vangorda & Grum pits for dirty water o Pits would be full in 2035 thus start water treatment in 2035 o Little Creek dam, Sheep Pond, Pelly Pond maintained • *Waste rock / pit* o 1 m till cover on the Vangorda waste dump o Regrade Grum waste rock and place 1m cover on high sulphide cell • *Clean water management* o Upgrade and maintain Vangorda diversion indefinitely
TAILINGS AREA ELEMENTS	• Reprocess tailings for 25 years to bring down to a uniform elevation across down valley. Reprocess tailings set to pit. • Establish a water cover over levelled tailings • Upgrade Intermediate dam spillway to PMF • Intermediate dam spillway • Rose Creek diversion breeched
LICENSING / REGULATORY	• Meet Water License requirements
MANAGEMENT	• (How is the site going to be managed in perpetuity?)
OTHER	• (Other issues to be considered)
COST	• $17.8m NPV Capital • 2002-2025 annual cost $2.0M • 2025-2035 annual cost $4.0M • 2035 onwards annual cost $9.1M • Total NPV = $32.9M
SCHEDULE	• (A timeline with significant milestones)
ISSUES AND UNCERTAINTIES	• Can the tailings be reprocessed until 2025? • Can water be stored in Grum until 2035?

6.3 Example Alternatives Theme Selection

Daryl Hockey had the participants individually list a number of themes that could be used as a basis for developing example alternatives. The following is the list of the themes that were generated by the participants:

- Minimal cost with acceptable environmental risk
- Pristine site
- Design to all published criteria
  - i.e. meet fresh water aquatic life criteria (i.e. CCME)
- Industry Best Management Practices – (BATEA - Best available technologically economically achievable, i.e. actions that if everyone in the industry had to do it about 10-30% might go out of business)
  - The right thing to do relative to the best in the mining industry
- Maximum stakeholder acceptance
- Maximize the local socio-economic benefits
- Leaving site – as good as it was during operations
- Consistent ongoing cash requirement
- Maximum environmental protection
- Minimum long term cost

The participants then informally voted on which themes would be the most useful in terms of developing the most diverse example alternatives. It was decided that the following themes would be pursued in Tuesday morning's exercise:

1. Minimum Cost with Acceptable Environmental Risk
2. Maximum Environmental Protection
3. Minimum Long Term Cost

6.4 Example Alternative – Minimum Cost with Acceptable Environmental Risk

Group 1 (see Table 2 - Tuesday) was asked to brainstorm an example alternative storyboard for the theme "minimum cost with acceptable environmental risk".

TITLE	Minimum Cost with Acceptable Environmental Risk
PURPOSE	• *Not discussed by group*
ASSUMPTIONS / CONSTRAINTS	• As proven by ecological / human health risk assessment • Will always be some perpetual care, i.e. it will not be a zero cost situation over time • No point in doing a risk assessment to question 0.5 Zinc • Use gravity for drainage as much as possible

FARO ELEMENTS	• Continue to store dirty water in pit
	    • Upgrade WTP at existing mill location
	    • Pump Zone II pit water to WTP
	• Minimal contour and shaping
	    • Collect toe seepage and treat if necessary
	• Direct Faro Creek into new tunnel or ditch located up hill (preferred)
	    • Maintain current rock drain
	• Leave existing tailings in Faro pit

VANGORDA / GRUM ELEMENTS	• Single point collection and treatment via a portable mill and sludge:
	    • Settling Pond
	    • "Controlled" flow into WTP (weir)
	• Location: near access road to allow winter access and power generation
	    • Self generating power
	    • Grum
	    • Allow water to rise to "reasonable" level
	    • Blast to cover pit walls
	    • Deepen slot to allow gravity feed to WTP
	• Grum Creek to WTP
	• Little Creek Pond to WTP
	• Minimal contour and shaping
	• Relocate Vangorda Creek to next valley over (Shrimp Creek)

TAILINGS AREA ELEMENTS	• Remove hotspots to pit • Cover 1st and 2nd impoundments with soil • Raise the Intermediate dam to level of 2nd impoundment dam toe • Construct new spill way Intermediate dam abutment (to PMF) • Breach diversion dam to allow Rose Creek diversion channel to flow through Intermediate impoundment • Breach Cross Valley dam • Construct waste rock settling pond within impoundment • Remove FWSD • *Discussion*: • Create a settling pond in the Intermediate dam created with waste rock that would be used for water treatment from Faro

<table>
<tr><td>LICENSING / REGULATORY</td><td>Not discussed by group</td></tr>
<tr><td>MANAGEMENT</td><td>Not discussed by group</td></tr>
<tr><td>OTHER</td><td>Not discussed by group</td></tr>
<tr><td>COST</td><td>
<table>
<tr><td>Capital</td><td>CDN $ (Million)</td></tr>
<tr><td>Excavate hot spots</td><td>1.0</td></tr>
<tr><td>Raise Intermediate dam and spillway</td><td>3.0</td></tr>
<tr><td>Cover tailings (1st & 2nd impoundment)</td><td>4.0</td></tr>
<tr><td>Remove FWSD</td><td>1.0</td></tr>
<tr><td>Portable WTP</td><td>5.5</td></tr>
<tr><td>Relocation of Vangorda and Faro Creeks</td><td>4.0</td></tr>
<tr><td>Contour and shaping of dumps (all rock work, drilling blasting, ditching)</td><td>5.0</td></tr>
<tr><td align="right">Total</td><td>23.5</td></tr>
<tr><td>Operating</td><td>CDN $ (Million)</td></tr>
<tr><td>Faro WTP</td><td>2.0</td></tr>
<tr><td>Vangorda WTP</td><td>1.0</td></tr>
<tr><td>Staffing</td><td>1.2</td></tr>
<tr><td>Misc.</td><td>1.0</td></tr>
<tr><td>On going equipment upgrades</td><td>0.8</td></tr>
<tr><td align="right">Total</td><td>6.0</td></tr>
</table>
</td></tr>
<tr><td>SCHEDULE</td><td>Not discussed by group</td></tr>
<tr><td>ISSUES AND UNCERTAINTIES</td><td>Risk assessment may conflict with regulatory requirements (fisheries – metal mining effluents regulations)
YTG Environmental Protection Act – are fixed requirements there is no flexibility (soils and $H_2$0) – don't know if it is applicable to us?
Volume of water may be too much for Shrimp Creek?</td></tr>
</table>

During the presentation of this example alternative, the group raised the following discussion points and questions:

- Faro elements should include the collection of seeps to be treated in the water treatment plant and then disposed of into the pit
- Is it known if Faro can ever be a non-treated body of water?
- The unit cost for tailings cover was debated. It was decided during Wednesday's activities that a consistent database of unit costs would be required.
- Overall NPV of this scenario would be $150M

6.5 Example Alternative – Maximum Environmental Protection

Group 2 (see Table 2 - Tuesday) was asked to brainstorm an example alternative storyboard for the theme "maximum environmental protection".

TITLE	Maximum Environmental Protection
PURPOSE	Implement methods that maximize environment protection, taking in account of diminishing environmental returns (spend money as long as it had a good environment protection return).
ASSUMPTIONS / CONSTRAINTS	• Not constrained by $ • Constrained by technical knowledge (engineering) and common sense • Time constraints: short season to work in but no target date to finish
FARO ELEMENTS	1. Faro Valley dump put into pit (4M tonnes) 2. Relocate diversion flume 3. Cap sulphide cell 4. Revegetated the top of dumps but not the sides 5. Breach haul road and take out culverts 6. Treatment plant – new 7. Build plug dam, redirect dirty water
VANGORDA / GRUM ELEMENTS	1. Dirty material to overflow level of pit 2. Cap and revegetated Vangorda waste rock 3. Treatment plant at outlet of Little Creek dam 4. Remove material selectively form Grum dump 5. Fill in pit with sulphide dump and select Grum sulphides

TAILINGS AREA ELEMENTS	• Relocate Down Valley tailings into Faro pit
	  o Note on some discussion internally in the group before reaching this consensus:
	    ▪ Originally only removing 2/3, but Randy thought that the costs and environmental risk of putting all the structures in place to secure the remaining 1/3 would be too great and thus removing all tailings was the best option

LICENSING / REGULATORY	• Timing Issues
MANAGEMENT	• Contract and local labour
OTHER	• Buildings • Roads • Local long term management • Misc. ponds and cores *not discussed by group*

<table>
<tr><td>COST</td><td>
<table>
<tr><td></td><td>CDN $ (Million)</td></tr>
<tr><td>Tailings ($3/tonne, all trucking and no slurring)</td><td>165.0</td></tr>
<tr><td>Valley</td><td>10.0</td></tr>
<tr><td>Faro pit backfill (10M tones @ $2.5/tonne)</td><td>25.0</td></tr>
<tr><td>Dumps (covering rock dumps is mainly for looks)</td><td>7.0</td></tr>
<tr><td>Faro water treatment plant</td><td>10.0</td></tr>
<tr><td>Faro diversion ($2000/m)</td><td>2.0</td></tr>
<tr><td>Vangorda</td><td>2.0</td></tr>
<tr><td>Vangorda pit</td><td>12.5</td></tr>
<tr><td>Vangorda cap</td><td>10.0</td></tr>
<tr><td>Vangorda water treatment plant</td><td>6.0</td></tr>
<tr><td>Vangorda diversion</td><td>1.0</td></tr>
<tr><td>Grum – cap and vegetate</td><td>2.0</td></tr>
<tr><td>PV long term care</td><td>48.0</td></tr>
<tr><td>Subtotal</td><td>300.5</td></tr>
<tr><td>Total including Misc. 20% increase</td><td>350</td></tr>
</table>
</td></tr>
<tr><td>SCHEDULE</td><td>• Not discussed by group</td></tr>
<tr><td>ISSUES AND UNCERTAINTIES</td><td>1. Upgrade / remove FWSD (ensure not net fish habitat loss across site)
2. Supply over burden (from Faro)
3. Freezing potential of dumps
4. Finding Grum sulphide cell
5. CBA of residual tailings and structures
6. ARD of Faro dumps</td></tr>
</table>

During the presentation of this example alternative the group raised the following discussion points and questions:

- The Faro sulphide dumps should be relocated into the Faro pit (6,000,000 tonne)
- The Goal is to have Grum as water that does not need to be treated
- Costs:
  - Faro Creek diversion adit through wall will be approx - $2000/m
  - Grum is not being capped
  - Ongoing care and maintenance would be approx $48M
  - $300M plus 20% for misc. (work not specified here) thus total $360M
  - Differences in groups on unit costs and distances moved need to be resolved
- Maximum Environmental Protection means: putting everything thing within a managed perimeter and not back to where it came from
- Residual tailings area clean up, minor covering - $10M to clean up the valley. They are accepting residual contamination.
- Question Group #2 asked themselves: What did they have to do to ensure that 100 years from now the aquifer would not be negatively impacted?
- Only moving the stuff that currently acidic or outside the water shed
- Group #2 thought that there was no place where you could put all the waste rock

6.6 Example Alternative – Minimum Long Term Cost

Group 3 (see Table 2) was asked to brainstorm an example alternative storyboard for the theme “minimum long term cost”.

TITLE	Minimize long term costs
PURPOSE	Minimize long term costs
ASSUMPTIONS / CONSTRAINTS	1. Minimal perpetual long term water treatment 2. Minimal operation and maintenance costs over the long term 3. Long term means 15 years plus 4. Accept high upfront capital cost 5. Develop and get approved site-specific receiving water quality standards
FARO ELEMENTS	1. Discharge all pit water currently there, treat and release • This can happen before or during the backfilling 2. Fill pit waste rock (this is to minimize the need for ongoing water treatment). • Fill it all up and mound it a bit, no waste rocks outside drainage area • Compacted till cover (1.5 m cover – has ecological and socio-economic implications) • Increase compaction by how the rock is put into the and thus reduce infiltration 3. Zone II pit – eliminate need for on going pumping by removing adjoining wall with main pit (possible technique: blasting) 4. Install dewatering wells for seasonal pumping • Treat using modular WTP near tailings 5. Realign Faro Creek to north fork of Rose Creek
VANGORDA / GRUM ELEMENTS	1. Discharge pit water – treat and release • This can happen before or during backfilling 2. Backfill with all Vangorda waste rock and Grum sulphide cell • (Daryl – add lime into backfill to help treat in place) 3. Mound – contour for drainage and cover (1.5 m till) • (Group question – how big is the mound going to be and how much more material is there versus available space in pit) 4. Install dewatering wells and modular water treatment at Little Creek dam • (Group question – what does modular mean) • (Group question - why did you assume you could not operate without a treatment plant – because we thought there was water inflow) • (Comment - through compaction and impermeable cover you may reduce inflow to such a level such that pump and treat would not be necessary – you also get more rock in the pit this way) 5. Surface reclamation at removed waste dump 6. Grum waste rock – stabilized and re-contoured to promote drainage 7. Ore transfer pad – reclaim empty site (moved mineralized rock only to Vangorda pit)

	8. Vangorda Ck to channel across filled pit in a 2-3 m clay lined channel with riprap. 9. Remove Grum Interceptor ditch and divert flow into Grum pit 10. Grum pit fill with clean water and have over-flow flow through a constructed channel to Vangorda Creek 11. Sheep Pad Pond taken out and revegetate 12. Remove current treatment plant

TAILINGS AREA ELEMENTS	1. Grade and contour to the level at the Intermediate dam
	2. Cover with composite soil cover, with O_2 diffusion barrier
	3. Breach Intermediated dam to level of covered tailings
	4. Remove Cross Valley dam and Polishing Pond – thus no standing water impounded
	o Remnants of the Cross Valley dam will become the toe buttress for the Intermediate dam
	5. Consolidate emergency tailings into covered tailings
	6. No planned collection or treatment of water
	  o Contingency – use Faro pit system
	  o Group discussion
	    o What about groundwater flowing through and having some tailings that are saturated? Response --- the cover will really reduce any new O_2 or H_2O getting in thus will limit groundwater
	    o Creation of our own standards – do we have any movement with respect to the mining effluent standards?
	    o Randy – the aquifer is too much water to treat
	7. Upgrade Rose Creek to 1000 year

LICENSING / REGULATORY	• Risk-Based assessment and development of "site specific receiving water criteria" • 1000 year flood criteria
MANAGEMENT	• Subcontracting closure aspects • Stakeholder involvement • Utilize local labour

OTHER	1. FWSD – full breach with some channel work
	2. Haul Road
	  • Decommission
	  • Breach rock drain and all stream crossings
	  • Scarify road surface

COST

	CDN $ (Million)
Faro – Movement of waste rock (100M m^3 @ $5/$m^3$)	500
Faro – Cover the pit (1.06 km^2, 1.5 m thick @ $10/$m^3$)	15
Consolidate and reshape tailings (2 km^2, 1 m thick @ $20 m^3)	40
Rose Creek diversion upgrade (4 km)	10
Breach FWSD	4
Cross Valley dam to lower level	2
Breach rock drain on North Fork Rose Creek	1
Spillway at Intermediate dam	1.5
Faro Creek realignment (4 km)	4
Haul Road decommissioning	1.5
Cap and reclaim other areas (6 km^2)	10
All Vangorda/Grum work	57.5
Long term water treatment	Unknown
Total	646.5

SCHEDULE	• 0-15 years major works • 15 years onwards - longer term seasonal treatment and minor operations and maintenance
ISSUES AND UNCERTAINTIES	• Unit costs • Material quantities – i.e. how much Faro waste rock is there? • Water treatment costs for the long term? • Ability to get site specific receiving H_2O standards

During the presentation of this example alternative the ensemble group raised following discussion points and questions:

- Residual Faro Creek becomes an overflow water source over the tailings!
- WT - How would you decant the Faro pit with what you have right now
- No costs in place here for dewatering pits (might add $50M to $100M)
- Unit costs for waste rock is uncertain

6.7 Evaluation of Example Alternatives

Using the evaluation factors discussed in Section 4 of this report, the participants evaluated each example alternative in an open discussion forum. Figures 1 through 3 summarize the results.

FIGURE 1 – Mind Map Evaluation of Example Alternative "Minimum Cost with Acceptable Risk"

FIGURE 2 – Mind Map Evaluation of Example Alternative "Maximum Environmental Protection"

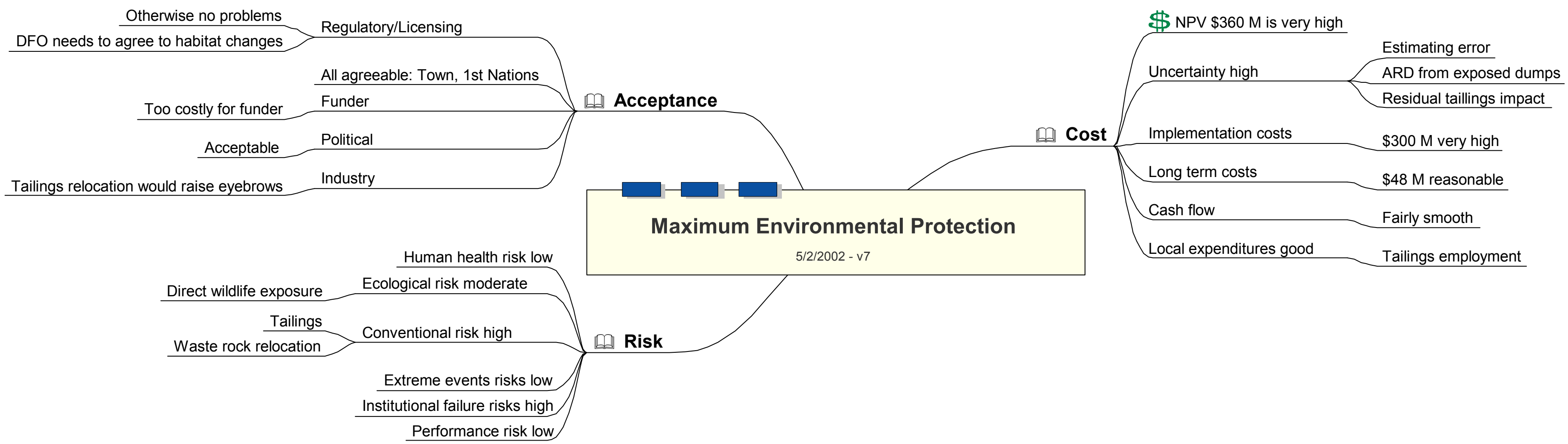
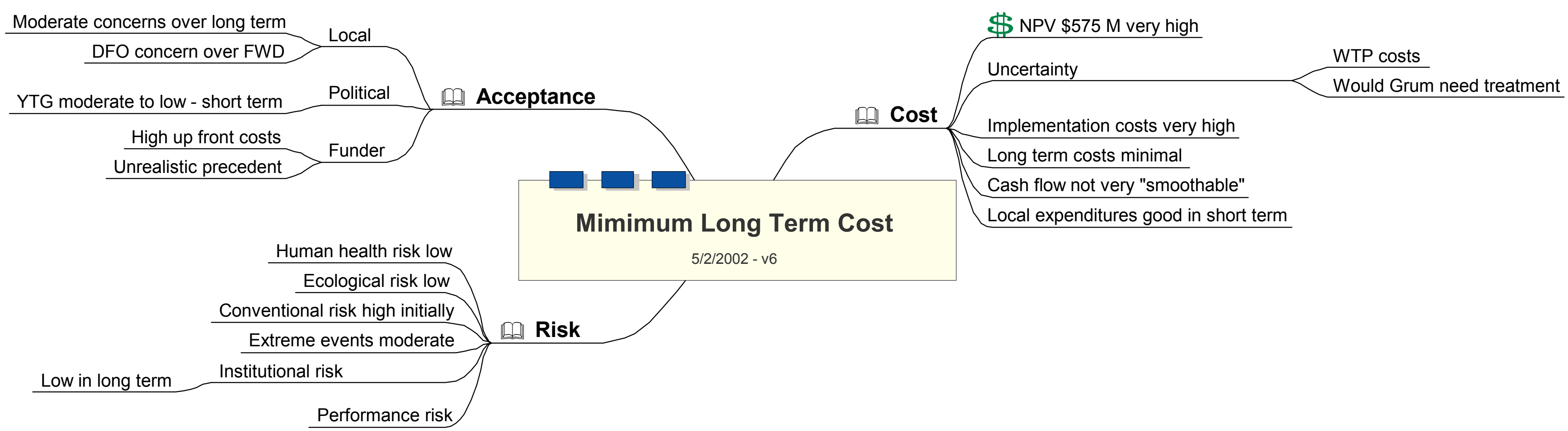


FIGURE 3 – Mind Map Evaluation of Example Alternative "Minimum Long Term Cost"



7. Revised Example Alternatives

The next step in the process was to revise and refine the example closure alternatives developed Tuesday morning. The premise for this revision was to select variants of the morning's themes that incorporated the most realistic possibilities to go forward with. Further, constraints were added to each theme to ensure relevant issues are carried through. As a large group, the participants selected three themes that were going to be developed into three "revised" example alternatives, as well the constraints that had to be considered by each group.

The revised theme and constraints used by the groups were as follows:

1. Minimal cost with acceptable environmental risk
    a. Short term and long term considerations
    b. Take the "Lower Cost" discussions from Tuesday morning and include the issues raised
    c. Should also reflect "industry best management practices"

2. Minimize requirements for long term perpetual care
    a. ARD issue
    b. Complete and low risk "walk-away" from Vangorda (i.e. what level could you flood to vs. cost of pumping all water out now)
    c. Relocate the tailings
    d. Wildlife exposures (direct / indirect)
    e. Need to "dream big"
    f. Have to discuss this option so we can say why we are not walking away
    g. First nations need not to be afraid of using the land

3. Optimize Incremental Benefit / Cost (Middle of Road Option)
    a. Meet all regulatory requirements without risk
    b. Optimize local stakeholder involvement
    c. Cap tailings
    d. Cover all PAG rock dumps
    e. Relocate or cover AG rock dumps

Based on these new criteria the groups created new storyboards, paying particular attention to the estimation of costs.

The revised example alternatives and discussion points that were raised from the presentation of the storyboards are outlined in sections 7.1 to 7.3 inclusive.

7.1 Revised Example Alternative – Minimal Cost with Acceptable Environmental Risk

Group 1 (see Table 2 – Tuesday) was asked to brainstorm a revised example alternative for the theme "Minimal Cost with Acceptable Environmental Risk".

	FARO	COSTS ($M)	VANGORDA / GRUM	COSTS ($M)	TAILINGS	COSTS ($M)	OTHER	COSTS ($M)
Minimum Cost	On going water treatment (and pumping)	69	Backfill with sulphide waste rock and cover	34	Cover with composite soils	25	As before, re: mill area	tbd
	Minimize seeps (intercept)	0.3	Including concurrent in-situ treatment		Upgrade Rose Creek diversion (Risk-Based design criteria)	5	Remove rock drain & other crossings on Haul Road	tbd
	Relocate Faro Creek diversion up hill (long term)	4	Relocate Vangorda Creek through a lined channel across the backfilled pit	2	Lower Intermediate dam & buttress with Valley dam material (cost included above)		Additional 20%	17
	Build new water treatment plant	6	Balance of waste rock at Vangorda - recontour and cover	1	Breach Cross Valley dam	2		
	Waste rock collect & treat seeps	0.3	Allow Grum pit to flood and release untreated to the environment if feasible		Breach Fresh Water dam	2		
	Minimize run-off through Faro Creek Valley dump	0.4	Recontour Grum waste rock	0.5	Transfer emergency tailings to tailings area (included above)		*Total Capital*	*100*
			Operate WTP = 3 years @ $2M/yr and after that 0.5M/yr	16			*Total Operating*	*85*
	TOTAL	**80.0**	**TOTAL**	**53.5**	**TOTAL**	**34**	**EXAMPLE ALTERNATIVE TOTAL**	**185**

- Only a small WTP at Vangorda/Grum would be required
- It is assumed that all sulphides 6,000,000 m^3 will be put in to Vangorda pit and the remainder volume made up with philites
- Goal is to keep Grum water clean

7.2 Revised Example Alternative – Minimized Requirements for Long Term Perpetual Care

Group 2 (see Table 2 - Tuesday) was asked to brainstorm a revised example alternative storyboard for the theme "Minimized Requirements for Long Term Perpetual Care".

	FARO	COSTS ($M)	VANGORDA / GRUM	COSTS ($M)	TAILINGS	COSTS ($M)	OTHER	COSTS ($M)
MINIMIZE LONG TERM CARE	Relocate AG waste and excavate cut (35M tonnes)	88	Relocate 16M tonnes of Vangorda PAG waste to Vangorda and Grum pits	44	Relocate 55x106t $3/t	165		
	Create plug dam	2	Cap pits with low permeability till	3	Remediate Faro Valley breach dams (allow)	12		
	Cap PAG dumps	15.75	Add lime	5	Add lime to tailings (allow)	5		
	Recontour and vegetate non-PAG	10	Cap / vegetate the Grum dump	10.5				
	Seepage collection	2	Reclaim site / restore drainage	3				
	Lime addition into materials when pit is being filled	5						
	Misc. clean up	5						
	New treatment plant	2						
	Operating costs (4 months per year pump form Zone II plus $1M/year strait ops times 25 for NPV)	25						
	TOTAL	**154.75**	**TOTAL**	**65.5**	**TOTAL**	**182**		

- Moving all tailings into Faro pit (including the emergency tailings) necessitates the building of a plug dam
- To goal at Vangorda is to be able to walk away. This means that: 1. all sulphate wastes get moved into Vangorda and Grum pits, they are capped and tapped down; 2. all acid seeps into the pits are eliminated; 3. fresh water lakes will be allowed to form on top; and finally 4. there is no requirement for a water treatment plant.
- Key difference from this morning's exercise is that only the sulphates are put into the pit.
- DISCUSSION: 1. Grum pit is more questionable in this situation; 2. Concern around assuming the non-PAG rock dumps as not generating any contaminants; and 3. Faro pit must be drained low enough to build plug dam.

7.3 Revised Example Alternative – Optimized Incremental Benefit / Cost

Group 3 (see Table 2 - Tuesday) was asked to brainstorm a revised example alternative storyboard for the theme "Optimize Incremental Benefit / Cost (Middle of Road Option)".

	FARO	COSTS ($M)	VANGORDA / GRUM	COSTS ($M)	TAILINGS	COSTS ($M)	OTHER	COSTS ($M)
MIDDLE OF THE ROAD	Move Faro Valley dump into Faro pit (4.1M tonnes)	10	Cover main dump	4.2	Cap tailings (1.5 m thick)	20.4	Capital costs (infrastructure removal)	1.0
	Contour & cover main/Intermediate dump	17.3	Contour main dump	0.6	Remove hotspots	2.0		
	Toe collection system for the main/Intermediate dump	0.2	Move (not "push") sulphide dump into Vangorda pit	1.1	Upgrade Rose Creek channel (to Intermediate dam)	8.5	Remove contaminated soil	
	Move low-grade ore stock pile into Faro pit	21	New WTP	5.5	Notch dams (Cross Valley and Intermediate) & new water channel	2.4		
	Pump Faro pit dirty water to WTP at mill location (replace plant)	5.5	New collection pipe to WTP	1.5	Rehabilitate FWSD to PMF	3.5		
	Move Faro Creek into new tunnel or ditch	5	Covering and slot cut at Grum pit	5.0	Well water collection and treatment	1.2		
	No change to North Fork Rose Creek rock drain	0	Vangorda Creek diversion to Shrimp Creek (pipe & dam)	1.0	Upgrade Intermediate dam	2.0		
	Zone II pit water to be treated at WTP	0	Ore transfer pad material to Vangorda pit	1.2	Operating ($0.3M/year)	7.5	*Total Capital*	*121.0*
	Operating water treatment and pumping ($2.75M/year)	68.8	Operating water treatment system ($1.0M/year)	25.0			*Total Operating*	*101.3*
	TOTAL	**127.8**	**TOTAL**	**45.1**	**TOTAL**	**122.0**	**EXAMPLE ALTERNATIVE Total**	222.3

- WTP to be left in existing location
- The diversionary channel across tailings would have lining, bedding and rip rap
- Inflation through the tailings cover and bit through channel → thus pumps and wells at bottom of tailings to be installed
- The group discussed the practicality of putting a full permeable liner over the tailings and felt it was impractical

7.4 Green Light - Red Light

The three revised example alternatives provided a myriad of methods. As a means to "see where we were at" the group was asked to rank the methods as a green, yellow or red light with respect to feasibility, where:

- **Green Light** → activities that should be completed during the course of the current and next Water License and where approvals either exist or are easy to obtain
- **Yellow Light** → activities that would be nice to do over the next five years but most likely will be difficult to complete or get approved
- **Red Light** → activities that must wait till final abandonment and the ICAP

This exercise will give direction to our work on Wednesday, which involves identifying critical uncertainties and required tasks for those methods identified as Green and Yellow lights.

Green Light

- Breach Fresh Water dam
- Minimize run-off through Faro Creek Valley dump
- Minimize seeps (intercept)
- Misc. clean up
- Move Faro Creek into new tunnel or ditch
- No change to North Fork Rose Creek rock drain
- On going water treatment (and pumping)
- Operate WTP = 3 years @ $2M/yr and after that $0.5M/yr
- Operating water treatment and pumping ($2.75M/yr)
- Operating water treatment system ($1.0M/yr)
- Recontour Grum waste rock
- Rehabilitate FWSD to PMF
- Relocate Faro Creek diversion up hill (long term)
- Seepage collection
- Transfer emergency tailings to tailings area (included above)
- Waste rock collect & treat seeps
- Zone II pit water to be treated at WTP

Yellow Light

- Add lime
- Backfill with sulphide waste rock and cover
- Balance of waste rock at Vangorda - recontour and cover
- Cap / vegetate the Grum dump
- Cap pits with low permeability till
- Contour & cover main/intermediate dump
- Contour main dump
- Cover main dump
- Including concurrent in-situ treatment
- Move sulphide dump into Vangorda pit
- Ore transfer pad material to Vangorda pit
- Relocate 16M tonnes of Vangorda PAG waste to Vangorda and Grum pits
- Relocate Vangorda Creek through a lined channel across the back-filled pit
- Toe collection system for the main/intermediate dump

Red Light

- Add lime to tailings (allow)
- Allow Grum pit to flood and release untreated to the environment if feasible
- Breach Cross Valley dam
- Build new water treatment plant
- Cap PAG dumps
- Cap tailings (1.5 m thick)
- Cover with composite soils
- Covering and slot cut at Grum pit
- Create plug dam
- Lime addition into materials when pit is being filled
- Lower Intermediate dam & buttress with Cross Valley dam material
- Move Faro Valley dump into Faro pit (4.1M tonnes)
- Move low-grade ore stock pile into Faro pit
- New collection pipe to WTP
- New treatment plant
- Notch dams (Cross Valley, Intermediate) & new water channel
- Pump Faro pit dirty water to WTP at mill location (replace plant)
- Reclaim site / restore drainage
- Recontour and vegetate non-PAG
- Relocate 55x106t
- Relocate AG waste and excavate cut (35M tonnes)
- Remediate Faro Valley breach dams (allow)
- Remove hotspots
- Upgrade Intermediate dam
- Upgrade Rose Creek channel (to Intermediate dam)
- Upgrade Rose Creek diversion (Risk-Based design criteria)
- Vangorda Creek diversion to Shrimp Creek (pipe & dam)
- Well water collection and treatment

8. The Path Forward

The final set of objectives for this Workshop involved defining the path forward based on the information generated through the Monday and Tuesday sessions. To accomplish this, participants were asked to identify, define and prioritize tasks that could/needed to take place during the current Water License and those that should occur through the next Water License, to ensure that all work would be leading toward the preparation of an ICAP. Further the participants identified the critical information needs that would guide which methods would ultimately be selected to become the comprehensive closure alternative.

8.1 "Tossed Salad" – Brainstorming Critical Uncertainties and Tasks

The work up until Wednesday morning had generated methods and examples of alternatives for closure. The next step was to try to determine what, if anything was holding us back from acting on a proposed method. To accomplish this, the group was asked to brainstorm their thoughts around critical uncertainties for a series of topics. In addition they were also asked to list the investigations/studies/activities or "tasks" that would be required to address the uncertainty or question they originally wrote down.

For example, if the topic was "Fate of the Faro Creek" a critical uncertainty might be "How long can the north west wall of the Faro pit withstand erosion back to the diversion?" and finally a task that could address this uncertainty would be "Stability Analysis of the pit Walls".

Uncertainties and tasks were generated for the following topics:

1. Critical obstacles from Tuesday afternoon session (revised example alternatives)

2. What is the critical question that needs to be answered to choose between the Minimum Cost, Middle of the Road, or Minimal Long Term Care example closure alternatives to come up with "the" closure alternative?

3. What were the critical assumptions or uncertainties presented in the information given on the Monday session (background information)?

4. Assuming you are going to do one of these alternatives (Minimum Cost, Middle of the Road, or Minimal Long Term Care), what **major** studies would be required, e.g. building a plug dam requires a major geotechnical report? A study is not considered major if it can be done during the course of the actual work being performed. Major can be in terms of cost or importance to going forward.

5. Assuming you are going to do one of these alternatives (Min Cost, Middle of the Road, or Min Long Term Care), what are the regulatory and licensing agencies going to ask you?

6. Assume Vangorda/Grum sites are on an accelerated time frame: what are the major questions/uncertainties associated with Vangorda / Grum that need to be answered before we can move forward?

At the conclusion of the exercise, all of the unique uncertainties/questions and tasks/studies/actions were classified as to the field of expertise that would be needed to address the issue. The classifications used were: geotechnical, water management and other. Once all the issues were classified, they were vetted in order to group similar or co-dependent issues into a single task grouping. In this process, the 44 unique issues were coalesced into 21 separate tasks.

Each task was then assigned to a subgroup made of the participants organized by their specialties: a. geotechnical; b. water management; and c. policy and permitting (see Table – Wednesday) for further delineation.

Task	Group
01. Characterization of ARD of W/R	B
01. Characterize ARD potential pit walls.	B
02. Define preferred requirements for Vangorda pits	B
02. Characterize impact of waste rock on pit chemistry.	B
02. Evaluate all pit lakes contaminant loads	B
02. Evaluate flow through feasibility for Grum and Faro	B
03 Complete seismic hazard assessment	A
03. Assess risk of lower than PMF	A
03. Confirm structure foundations conditions	A
03. Define risk based design criteria	A
04. Define waste dump water balance	A
04. Evaluate waste rock temperature	A
04. Improve site wide water/load balance	A
05a. Evaluate cover performance of tailings	A
05b. Evaluate tailings decommissioning techniques	A
06. Evaluate borrow sources (i.e. where do we get the till?)	A
07a. Define / understand stakeholder objectives	C
07b. Consult First Nations/strategy	C
07b. Identify final land use	C
08. Define project management structure (how are we going to get there)	C
08. Define YTG/Canada role (post devolution)	C
08. Define funding availability	C
08. Determine cash flow considerations	C
08. Resolve bonding requirements	C

Task	Group
09. Compile cost assumption database	A and B
10. Study socio-economic impact	C
11. Negotiate DFO FWSD concerns	C
11. Renegotiate existing regulator conditions	C
12. Define post closure risks	A and B
12. Determine downstream effects	A and B
13. Assess tailings groundwater contaminant loads	A
13. Continue tailings area hydrogeology	A
14. Investigate Faro, Vangorda, Grum flume options	A
15. Study fish habitat	B
16. Define other contaminant sources (e.g. soil)	
17. Evaluate interim WT benefits of source control	B
18. Develop interim WT Plan	B
18. Optimize water management / collection and treatment	B
19. Develop the ICAP	C
20a. Evaluate cover performance of waste rock	A
20b. Evaluate W/R decommissioning techniques	A
21. Complete human and eco risk assessment	B
22. Communicate economic potential.	C
20b. Evaluate W/R decommissioning techniques	A
21. Complete human and eco risk assessment	B
22. Communicate economic potential	C

8.2 Defining and Designing Tasks

Defining the tasks generated from the "Tossed Salad" exercise was the next step in our process. Each task was assigned to a subgroup, whose participants were matched by specialty (a. geotechnical; b. water management; and c. policy and permitting - see Table 2: Wednesday). The groups were asked to come up with a plan (definition and design) for each of their tasks that included a title; purpose; three-line description; list of major components; rough cost estimate; and time requirements. The results of this exercise are presented in Table 3.

Table 3 – Tasks and Cost Estimates for Critical Question Studies/Actions

#	Tasks	Purpose	Objective	Timing	Components	Initial Cost estimate ($K)
1	ARD Characterization	Waste rock ARD	1. Define current conditions; 2. Define future acid generation potential; 3. Estimate water quality under various scenarios		Gap analysis	25
					Field work	250
					Lab testing	75
					Data analysis	25
					Reporting	25
				8 mth min	**Total**	**400**
DISCUSSION POINTS - No considerations for Vangorda						
2	ARD Assessment		1. To predict future loadings and pit lake quality with and without remediation; 2. Need to assess treatment and remediation requirements	6 mth (after Study #1)	Desk study	150
					Total	**150**
3	Risk Based Criteria For Engineering Considerations	Establish Risk-Based criteria for engineered structure in consideration of potential environmental impact	1. Can we be in MCE/PMF 2. Define design events and problems; 3. FMEA - fault and event tree analysis; 4. Co-ord with eco risk		Review seismic hazards / probabilities for seismic events	
					Same for hydrological events	
					Evaluate current structure conditions	
					FMEA to predict consequences	
					Risk mitigation / acceptance	
				1 mth	1. Review data / critical assessment / gap analysis	20
				1 year (full cycle)	2. Field work for structures / instrumentation	200
				1 mth	3. Assessment and interpretation	30
					Total	**250**
4	Waste Dump Water Balance		Determine infiltration and seepage outflow rates		Onsite collection of climate and water flow data	20
					Use input from #1	10
					Preliminary assessment	10

#	Tasks	Purpose	Objective	Timing	Components	Initial Cost estimate ($K)
				6 mth	**TOTAL**	**40**
DISCUSSION POINTS – 1. Timeline could be extended if more data collection is required 2. We can never know for sure what is going on in the dump but we can find out what goes in and comes out						
5	Tailing Decommission Methods	Range of options and evaluation (relocate, covers, flood)		1 mth	Determine options and hybrids	
				1 mth	Design criteria to meet env. requirement (coordination with ARD work, structures)	
				1 mth	Assess data and gaps	
				3 mth	Fieldwork and testing	
				2 mth	Feasibility "design" of each option and env. impacts	
				3 yr + (unknown)	Prototype verification	
				2 mth	Selection of Final alternative	
					Man power to do the study and data review / assessment	200
					Drilling	100
					Test cells	500
					Total	**800**
DISCUSSION POINTS – 1. Where are environmental impacts of each option compared? 2. With cover testing, we need to have buy-in from stakeholders in terms of scope of testing						
6	Borrowed Sources		Determine amount	1-2 mth	1. Define likely material needs (co-ord with ARD work)	
				1 mth	2. Data compilation of available sources	
				1 mth	3. Terrain mapping for other sources	
				3 mth	4. Ground work for new source verification (testing included)	
				2 mth	Prepare and inventory and compare to what we think our requirements are	
					Task 1-4	180
					If onsite source testing is required	150
					Total	**330**
7	Plan / Implementation Stakeholder Involvement	Get "buy-in for AVR project			1. Identify stakeholders	
					2. Consultation strategy (2 way)	

#	Tasks	Purpose	Objective	Timing	Components	Initial Cost estimate ($K)
					3. Two-way consultation with public and special formalized actions with First Nations	
					4. Communications (education, open houses, pamphlets, feed back)	
					5. Incorporate results	
				Next 2 years		250
				3 to 6 years out (2005-2008)		750
					TOTAL	**1000**
8	Project Management and Administration	To provide overall management to final abandonment			Cost involved to bring key project managers (DIAND; YTG; D&T) around the table to agree to roles and responsibilities	**100**
					Total	**100**
DISCUSSION POINTS - What it will cost to run the project for the next 5 years?						
9	Complete Cost Assumption Database			1 mth	1. List items and needs (co-ord with other eng)	
				3 mth	2. Define quantities and locations	
				3 mth	3. Cost evaluation techniques (a. equipment selection using first principals; b. cost database verification)	
				2 mth	4. Evaluate results to feed to others involved	
					TOTAL	**100**
10	Study Socio-economic Impact	Impacts of pre and post closure activity			1. Terms of reference (direct and indirect)	10
					2. Contract work (Year 1 $200k and $50k for years 2 to 5)	400
					Integrate into licence renewals and ICAP and consultations ($10k over 5 years)	50
				5 years	**Total**	**460**

#	Tasks	Purpose	Objective	Timing	Components	Initial Cost estimate ($K)
12	Define Post Closure Risks and Downstream Environmental Impacts			1 mth	1. Define final design structures and define the significant risks to them	
				1.5 mth	2. FMEA - event tree	
				2 mth	3. Determine monitoring schedule with links to environmental requirements	
					Total	**75**
DISCUSSION POINTS – Long term monitoring have to be added to these costs.						
13	Tailings Area of Hydrogeology with Groundwater Contaminant Loading			1 mth	1. Evaluation current program - inform critical review	
				1 mth	2. Determine data gaps	
				3 mth (could be a lag based on requ'd	3. Additional monitoring and fieldwork	
				2 mth	4. Revise groundwater model	
				2 mth	5. Final determination of results (contaminant loading	
					Task 1-4	180
					If onsite source testing is required	150
					Total	**330**
14	Evaluation of Faro and Vangorda/Grum Diversion Options			1 mth	1. Review current conditions and lifespan	
				2 mth	2. Determine long term design criteria	
				1 mth	3. Formulation of options (with timing)	
				6 mth	4. Fieldwork - structure mapping and boreholes	
				2 mth	5. Final options report (timing and cost estimates	
					Task 1-3 and 5	200
					Task 4 fieldwork	300
					Total	**500**
DISCUSSION POINTS – Would the costs be less if studying for a tunnel?						
15	Study Fish Habitat		To establish current and future habitats / fisheries characteristics (no net loss)	3 mth	Field work	75
					Office assessment	25
					DFO negotiations	

#	Tasks	Purpose	Objective	Timing	Components	Initial Cost estimate ($K)
					TOTAL	**100**
DISCUSSION POINTS – 1. Should the fish habitat study be expanded to cover all wildlife? 2. What is the value of fish habitat?						
17 & 18	Optimize Water Management Treatment		1. Develop interim water treatment plan; 2. The long term plan		1. Assess ARD characterization studies	10
					2. Incorporate result of env. and human health risk assessment	10
					3. Incorporate water balance info	10
					4. Define treatment requirements	50
				6-8 mth	**TOTAL**	**80**
19	Develop ICAP	Prepare ICAP Doc for 2006 (?) submission			Compile all supporting documents	
					Prepare 1st draft	
					Review with D&T / DIAND	
					Final report	
					Submit and revise with Yukon Water Board	
				4 mth	**TOTAL**	**200**
20	Waste Rock Decommission Techniques			1 mth	1. Determination options (moving, regrading, covers, and seepage collection)	
				1 mth	2. Design criteria for env. required - link to ARD	
				1 mth	3. Assess data gaps	
				3 mth	4. Fieldwork for data gaps	
				1 mth	5. Physical stability considerations	
				1-3 years?	6. Fieldwork verification of options	
				2 mth	7. Final alternative selection	
					For Consultant's time	200
					Drilling	100
					1 Year Study	100
					TOTAL	**400**

#	Tasks	Purpose	Objective	Timing	Components	Initial Cost estimate ($K)
21	Ecological and Human Health Risk Assessment	Identify ecological and human health risks associated with various closure alternatives	1. Water quality remediation objectives 2. Same for soil		Problem formulation (stakeholder consultation, data gap analysis and gather what is missing)	70
					Quantity risks	70
					Presentation of risk	10
				6 -12 mth	**TOTAL**	**150**

DISCUSSION POINTS –

1. Task 1 – The cost is most likely underestimated and will be the biggest church of time
2. Fisheries may drive this process
3. Need to get the hunters, fishers and all stakeholder input in the front to have them help inform what the indicators are

8.3 Task Prioritization

To develop a work plan that will guide the project team's efforts in the short and long term, two different group brainstorming techniques were used to determine which, out of all the tasks that had been generated, were the ones to be done this summer (before the end of 2003 and through final abandonment beyond 2005). The Workshop techniques used to prioritize were 1. "How much would you pay?" and 2. Fridge Magnet.

8.3.1 How Much Would I Pay?

As a means of determining which of the tasks were most important to the overall project, each group was given $4,600,000 in play money to spend on the list of 20 tasks defined in Section 9.2. The total cost of all the tasks if they were to be completed as laid out in Table 3 is $5,970,000. Thus the participants in this exercise would not be able to select and pay full price for all of the tasks. How much each group was willing to pay for each task gives guidance to the relative priority it has over the others presented. The amounts the groups "spent" are captured in Table 4. A few results that bear separate mention are:

- All three groups place relatively the same importance on the three distinctive categories of tasks (geotechnical, water and policy/licensing) as indicated by the fact that each spent roughly the same amount of money in each section.

- As a full group it was determined that the following task couplets should be rolled into single items as there were many overlapping or concurrent elements between them:
  1. Stakeholder communications and Socio-economic impacts (however capping the joined task budget at $1,000,000 and not the combined $1,460,0000);
  2. Waste dump water balance and Optimized water management & treatment; and
  3. Tailings decommissioning techniques and Waste rock decommissioning techniques

- Across the board, all three groups felt that the Tailings & area hydrology; Borrowed sources; Socio-economic impact and Risk-Based criteria tasks were overpriced when they were originally defined. The Environmental assessment task was the most significantly underfunded, with the groups paying less that 50% of the value originally estimated. The rationale most commonly put forth for this choice was that an environmental risk assessment should be an element of each project that is completed from this point forward and that the comprehensive site assessment should be able to draw heavily on the work already completed, thus reducing the cost.

- All groups agreed to pay the originally estimated cost for the Acid Rock Drainage (ARD) characterization and the Study of fish habitat.

- Further, all groups increased the funds estimated to complete the Ecological risk assessment.

- Group C felt that the budget for the Tailings decommissioning techniques task was too steep and did not reflect the work that has been done on this topic to date. On the contrary, they dramatically increased the budget for the Waste rock decommissioning techniques task as they felt this was a new area of study that had not been previously looked.

Their rationale of decreasing budgets based on the belief that a fair bit of the work has already been done was also applied to the Evaluation of diversions; study of tailings area hydrology and Borrowed sources and the development of Risk-Based criteria.

- Group A agreed with Group C with respect to the perception that a fair bit of work has already been done for the study of tailings area hydrology and thus does not require the full budget estimated. With respect to the Define post closure risk, Group A felt this task could be covered off with the Environmental Assessment and thus did not allocate any funds.

Table 4 – How Much Would I Pay?

Gr.	Task	*Original Cost Estimate ($K)*	Group A ($K)	Group B ($K)	Group C ($K)
A	Project management structure (determining and agreeing to roles and responsibilities	*100*	100	100	100
A	Stakeholder communications	*1000*	1000	700	1000
A	Study socio-economics	*460*	100	300	100
A	Obtain internal (DIAND approval)				
A	Prepare ICAP 2006 document	*200*	200	200	200
	Section subtotal	*1760*	*1400*	*1300*	*1400*
C	ARD characterization	*400*	400	400	400
C	ARD assessment	*150*	100	100	200
C	Study fish habitat	*100*	100	100	100
C	Environmental assessment	*500*	100	200	250
C	Ecological and human health risk assessment	*150*	200	200	150
C	Waste dump water balance	*40*	100	0	40
C	Optimize water management and treatment	*80*	100	100	60
	Section subtotal	*1420*	*1100*	*1100*	*1200*
B	Risk-Based criteria	*250*	200	100	100
B	Tailings decommission techniques	*800*	800	800	500
B	Tailings and area hydrogeology	*330*	200	200	200
B	Borrow sources	*330*	100	200	100
B	Evaluation Faro, Vangorda, Grum diversions	*500*	400	300	300
B	Compile cost assumptions	*100*	0	100	50
B	Waste rock decommission techniques	*400*	400	500	700
B	Define post closure risk	*80*	0	0	50
	Section subtotal	*2790*	*2100*	*2200*	*2000*
	TOTAL COSTS ESTIMATES	***5970***	**4600**	**4600**	**4600**

8.3.2 Fridge Magnets

Finally, in order to put the tasks into a reasonable order of connectivity and priority, each task was written on an index card that was then placed on a board with magnets. Lines were drawn between the cards indicating the linkages between the tasks. As the discussion on each task progressed, cards were moved around the board and their associated lines redrawn until a reasonable order developed. The objective of this exercise was to identify a preliminary critical path. Although not documented here, the preliminary critical path created at this point was developed into the work plan described in section 10.

The following are some of the discussion points that were generated during this process:

- Independent Tasks – tasks that do not rely on other work or licensing/regulatory issues being completed first:
  - Collect and treat seeps
  - Clean up miscellaneous material
  - Remediate fuel storage sites
  - Remove unneeded ancillary buildings (small and unneeded e.g. core shacks, contractor building)

- Faro Minimize Seeps – This task is dependent on what is done with the dumps, as this will impact the loading rate into the pit. Ideally, no work should be done on the seeps until the Optimize water treatment study is complete.

- Defining options for the fresh water supply dam (FWSD) has to be done before any Rehabilitation to the FWSD. Also before any rehabilitation work can begin the Department of Fisheries buy-in will be required. Defining of risk-based criteria must also occur concurrently or before these tasks.

- Many of the tasks depend on having an approved comprehensive closure plan:
  - Ore pad into Vangorda/Grum pit
  - Realign Vangorda Creek
  - Relocate Grum sulphides
  - Recontour of Grum waste dump
  - Cover Faro dumps
  - Contour and vegetate PAG dumps
  - Cap Faro PAG
  - Reslope and cover Vangorda/Grum dump
  - Backfill Vangorda/Grum pit
  - Relocate and cover Vangorda/Grum dump

8.3.3 Path Forward Timeline and Hurdles

During the Fridge Magnet exercise, many comments and observations were made with respect to the timeline the project is facing in terms of its Water License applications (2003 and potentially 2008) and associated regulatory processes. The following are some highlights from that dialogue:

- It is estimated that it will take 2 – 3 years to build the final ICAP. Thus it will not be possible to have the ICAP ready prior to the submission of the 2003 Water License application.

  - With this in mind the 2003 Water License will most likely be based in continuing with care and maintenance, stating that we are in the process of developing an ICAP (examples of our work plan to get it done) and the timeline for its completion.

- Although the changes and actions being considered for inclusion in the 2003 Water License application are being chosen (although not explicitly) to trigger CEAA screenings vs. comprehensive studies, it is possible the public will demand comprehensive studies be completed.
  - With this in mind it was suggested that neither the licence nor the tasks in it be written to try to avoid a comp study.

- Any changes the 2003 Water License proposed from the current Water Licenses need to be validated through studies or other definitive means.

- The management of the public perception of what may be deemed “another care and maintenance” licence will be critical. The rational behind why more studies vs. actions are required should be clearly communicated.

- It was suggested D&T review the ramifications of filing under Section 39 (abandonment) to determine if and at what point this may be a valid recourse.

- The CEAA Project Description required with the anticipated Water License application will include where are we going next and the rationale.

- Currently the Yukon Water Board has the DFO initiated amendment to the Anvil Range water Licence pending. Unclear how this will be impacted or will impact the new application?

- Key question is - What studies can we accelerate and do this summer? How will they link to the other required studies?

9. Anvil Range – Work Plan For Today Through 2008

At the conclusion of the Workshop the participants had generated task flow diagram that highlighted the milestones and critical paths for the work to be done over the next year, in order to receive a new Water License by January 1, 2004 as well as over the next six years to develop an ICAP for the projected 2008 Water License (see Section 8.3.2). On the Thursday following the Workshop, Jim Cassie, Eric Denholm, Shannon Glenn and Daryl Hockley refined the work done by the group to generate a comprehensive work plan that could be followed for the next six years. The work plan, presented in Section 9.1, is a series of 89 tasks interconnected through 16 sections culminating in 2008 with a new ICAP and Water License. In addition to refining the work plan, the team created descriptions for each task. These are presented in Section 9.2.

It should be noted that the work plan is a project logic diagram that shows connectivity rather than an absolute schedule. Scheduling cannot be accurately done until all resources (e.g. contracts, funding) have been established. For the purposes of developing this plan, all tasks were started at the earliest date possible to clearly highlight critical path items. In this sense, the choices of when to start some tasks were arbitrary. As such, the work plan indicates December 31, 2007 as the date when the 2008 Water License should be approved. In reality, if a new Water License were sought for 2008, it would not be to the end of that year, December 31, 2008, when the property would have to be in receipt of the new licence. This time lag was generated to create a "float" year. The float year is a built in safety factor to account for tasks not starting or finishing on the precise dates indicated.

Work Plan Sections

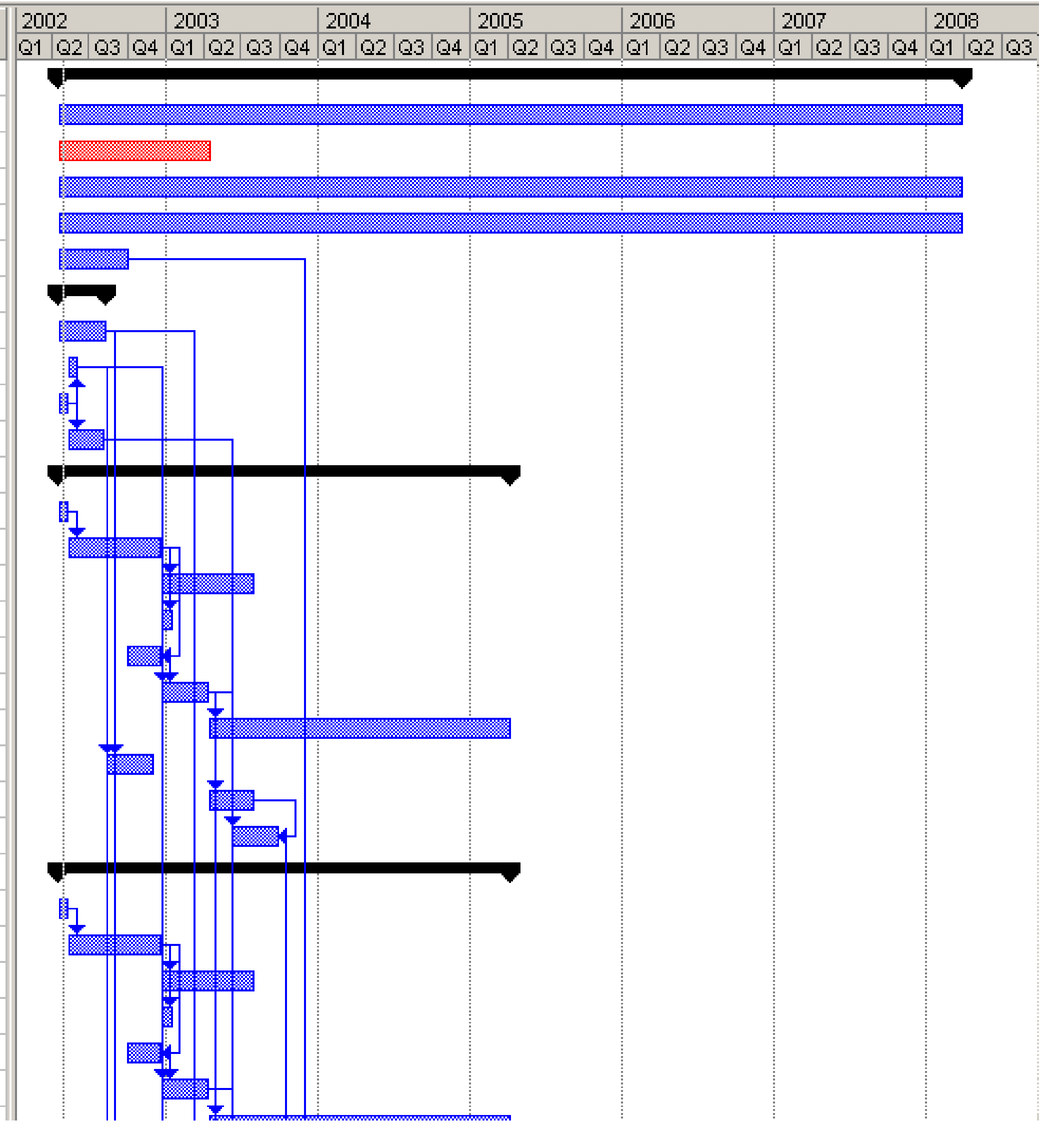
1 General
2 Basic Engineering Data
3 Faro Mine Area
4 Vangorda/Grum Area
5 Rose Creek Area
6 Human & Ecological Risk Assessments
7 ICAP Preparation
8 EA Process for ICAP
9 2008 Water Licensing
10 DFO Authorizations
11 Receive ICAP Licences & Approvals
12 FWSD Remediation
13 CEAA for 2003 Water Licence Application
14 2003 Water Licence Application
15 Site Activities Not Requiring Approval
16 Site Activities Potentially Requiring Approval

Based on this work plan a number of activities are recommended to begin during 2002. These are:

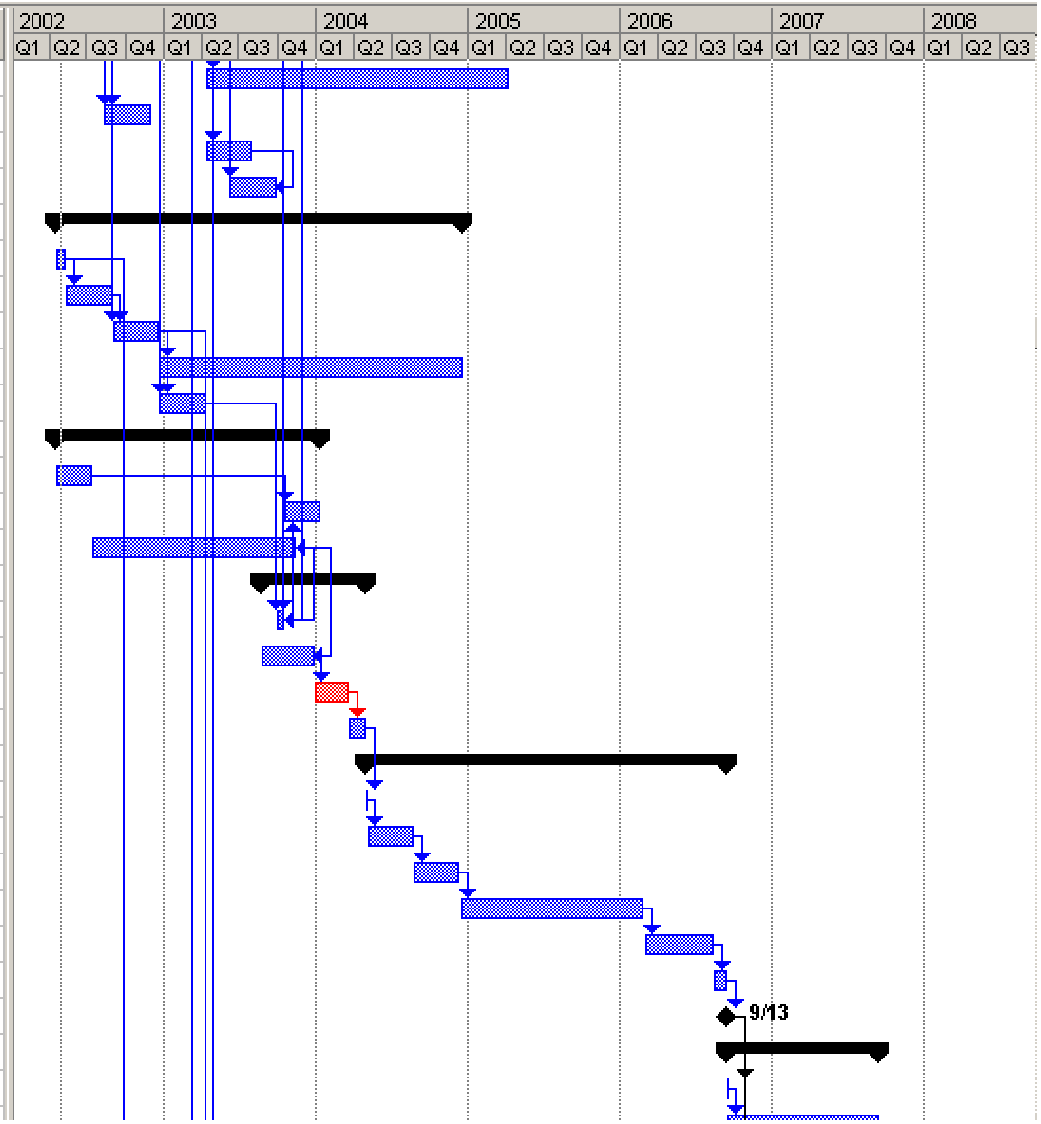
1	General
1.1	Continue Care and Maintenance
1.2	Define Project Management Structure
1.3	Manage Development of 2003 WL Application and ICAP
1.4	Continue Stakeholder Communication
1.5	Complete Socio-economic Studies
2	Basic Engineering Data
2.1	Define Risk-based Engineering Criteria
2.2	Define Cost Assumptions
2.3	Complete Phase 1 Borrow Source Survey
2.4	Complete Phase 2 Borrow Source Investigations
3	Faro Mine Area
3.1	Faro Mine Area Scoping Study
3.2	Characterize Faro Waste Rock ARD Status & Potential
3.3	Continue ARD Monitoring or Lab Studies
3.4	Improve Faro Dump Water Balance
3.5	Complete Water Quality Predictions
3.6	Develop Faro Waste Rock Decommissioning Methods
3.8	Develop Faro Diversion Ditch Methods
4	Vangorda/Grum Area
4.1	Vangorda/Grum Scoping Study
4.2	Characterize Vg/G Waste Rock ARD Status & Potential
4.3	Continue Vg/G ARD Monitoring or Lab Tests
4.4	Improve Vg/G Dump Water Balance
4.5	Complete Water Quality Predictions
4.6	Develop Vg/G Waste Rock Decommissioning Methods
4.8	Develop Vangorda Diversion Ditch Methods
5	Rose Creek Area
5.1	Rose Creek Scoping Study
5.2	Complete Tailings Areas Studies
5.3	Develop Tailings Decommissioning Methods
5.4	Complete Tailings Cover Tests
5.5	Select Tailings Closure Methods
6	Human & Ecological Risk Assessments
6.1	Complete Level 1 HHERA
6.3	Complete Environmental Assessment
12	FWSD Remediation
12.1	Obtain DFO Approval for FWSD Lowering
12.2	Lower FWSD
12.3	Assess Fish Habitat
12.4	Define Options for FWSD Phase 2
13	CEAA for 2003 Water Licence Application
13.1	Complete Draft Project Description
13.2	Review Draft Project Description
13.3	Submit Project Description
13.4	Coordinate Federal RA's
13.5	Complete RERC and Public Reviews
13.6	Receive EAR Guidelines
13.7	Prepare EAR
13.8	DIAND Completes Comprehensive Study
14	2003 Water Licence Application
14.2	Complete Studies to Challenge Current WL Conditions
14.3	Check Hydraulic Conductivity of Rose Diversion
14.4	Check Sizing of Vangorda Dam and Culvert
14.5	Select Landfill Site and Prepare Design
14.6	Prepare Draft Water Licence Application
15	Site Activities (Probably) Not Requiring Approval
15.2	Remove Unnecessary Minor Buildings
15.3	Clean Up Miscellaneous Material
15.4	Upgrade Seepage Collection
15.5	Remove Pumphouse Dam
15.6	Remediate Fuel Storage Sites
15.7	Move Emergency Tailings
15.8	Improve Faro Creek Diversion Intake
15.9	Upgrade Faro Creek Diversion
15.10	Upgrade Vangorda Creek Diversion
15.11	Remove Salvage and Scrap

9.1 Workshop Derived Work Plan 2002 through 2008

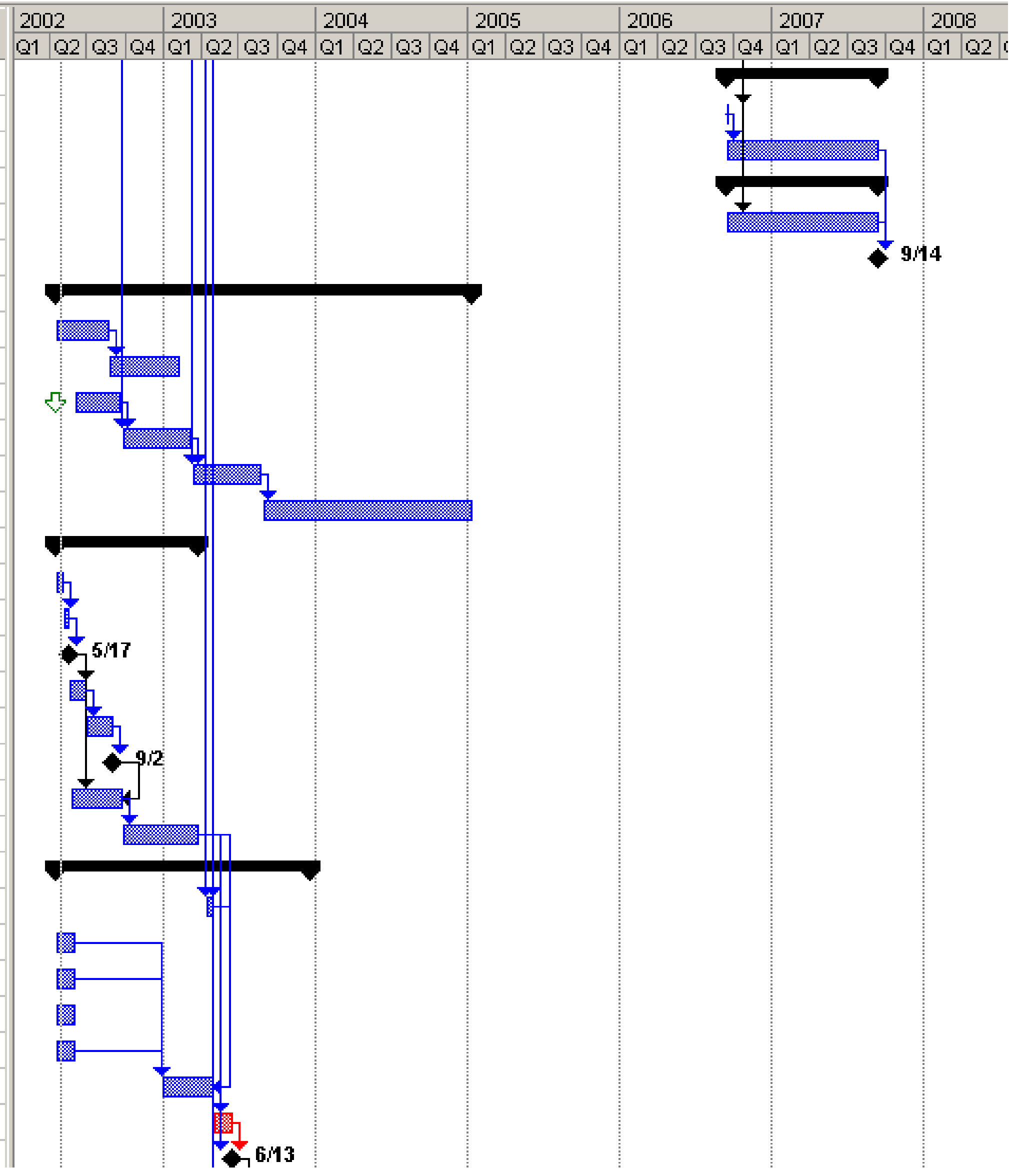
	ımbe	Task Name	Finish
1	**1**	**General**	**Thu 3/27/08**
2	1.1	Continue Care and Maintenance	Thu 3/27/08
3	1.2	Define Project Management Structure	Thu 4/17/03
4	1.3	Manage Development of 2003 WL Applicatior	Thu 3/27/08
5	1.4	Continue Stakeholder Communication	Thu 3/27/08
6	1.5	Complete Socio-economic Studies	Thu 10/3/02
7	**2**	**Basic Engineering Data**	**Thu 8/8/02**
8	2.1	Define Risk-based Engineering Criteria	Thu 8/8/02
9	2.2	Define Cost Assumptions	Thu 5/30/02
10	2.3	Complete Phase 1 Borrow Source Survey	Thu 5/9/02
11	2.4	Complete Phase 2 Borrow Source Investigati	Thu 8/1/02
12	**3**	**Faro Mine Area**	**Thu 4/7/05**
13	3.1	Faro Mine Area Scoping Study	Thu 5/9/02
14	3.2	Characterize Faro Waste Rock ARD Status &	Thu 12/19/02
15	3.3	Continue ARD Monitoring or Lab Studies	Thu 7/31/03
16	3.4	Improve Faro Dump Water Balance	Thu 1/16/03
17	3.5	Complete Water Quality Predictions	Thu 12/19/02
18	3.6	Develop Faro Waste Rock Decommissioning I	Thu 4/10/03
19	3.7	Complete Faro WR Cover Tests	Thu 4/7/05
20	3.8	Develop Faro Diversion Ditch Methods	Thu 11/28/02
21	3.9	Develop Faro Water Collection and Treatment	Thu 7/31/03
22	3.1	Select Faro Closure Methods	Thu 9/25/03
23	**4**	**Vangorda/Grum Area**	**Thu 4/7/05**
24	4.1	Vangorda/Grum Scoping Study	Thu 5/9/02
25	4.2	Characterize Vg/G Waste Rock ARD Status &	Thu 12/19/02
26	4.3	Continue Vg/G ARD Monitoring or Lab Tests	Thu 7/31/03
27	4.4	Improve Vg/G Dump Water Balance	Thu 1/16/03
28	4.5	Complete Water Quality Predictions	Thu 12/19/02
29	4.6	Develop Vg/G Waste Rock Decommissioning	Thu 4/10/03
30	4.7	Complete Vg/G Cover Tests	Thu 4/7/05



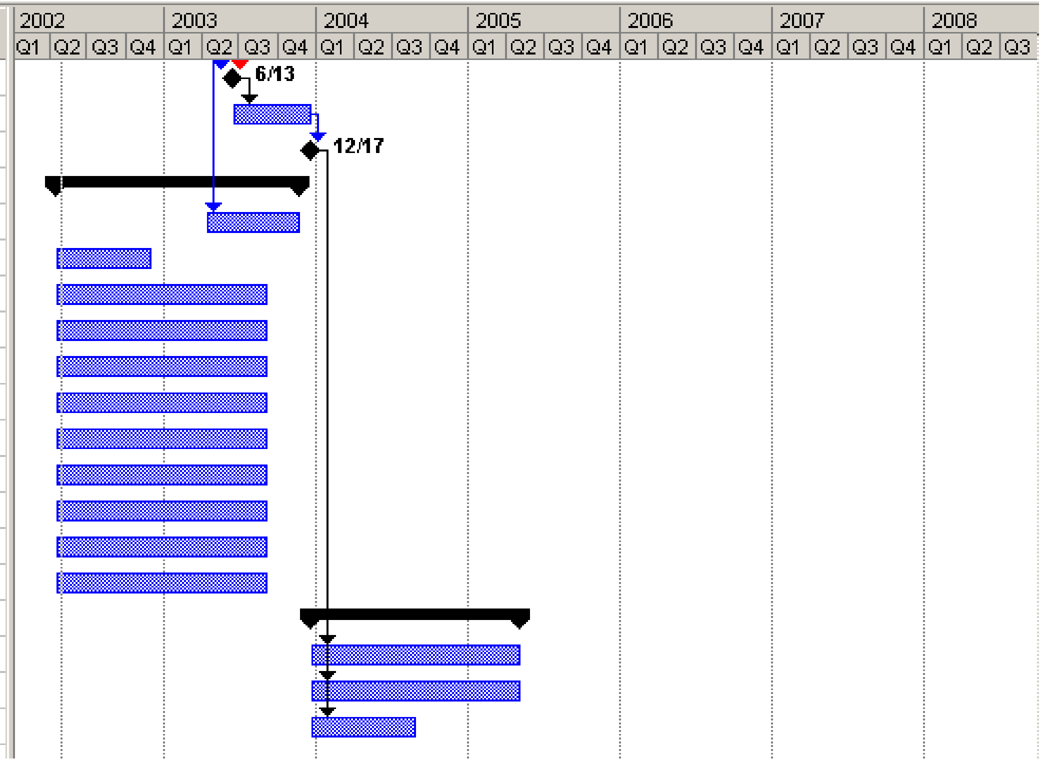
	ımbe	Task Name	Finish
30	4.7	Complete Vg/G Cover Tests	Thu 4/7/05
31	4.8	Develop Vangorda Diversion Ditch Methods	Thu 11/28/02
32	4.9	Develop Vg/G Water Collection and Treatmen	Thu 7/31/03
33	4.1	Select Vg/G Closure Methods	Thu 9/25/03
34	**5**	**Rose Creek Area**	**Thu 12/16/04**
35	5.1	Rose Creek Scoping Study	Thu 5/9/02
36	5.2	Complete Tailings Areas Studies	Thu 8/29/02
37	5.3	Develop Tailings Decommissioning Methods	Thu 12/19/02
38	5.4	Complete Tailings Cover Tests	Thu 12/16/04
39	5.5	Select Tailings Closure Methods	Thu 4/10/03
40	**6**	**Human & Ecological Risk Assessments**	**Thu 1/8/04**
41	6.1	Complete Level 1 HHERA	Thu 7/11/02
42	6.2	Complete Level 2 HHERA	Thu 1/8/04
43	6.3	Complete Environmental Assessment	Thu 11/13/03
44	**7**	**ICAP Preparation**	**Thu 4/29/04**
45	7.1	Prepare Initial Plan	Thu 10/16/03
46	7.2	Prepare Draft ICAP Document	Thu 12/25/03
47	7.3	Obtain DIAND Approvals	Thu 3/18/04
48	7.4	Prepare Final ICAP Document	Thu 4/29/04
49	**8**	**EA Process for ICAP**	**Wed 9/13/06**
50	8.1	Trigger Initial Review	Fri 4/30/04
51	8.2	Receive EAR Terms of Reference	Fri 8/20/04
52	8.3	Complete EA Studies & Report	Fri 12/10/04
53	8.4	Complete Comprehensive Study	Fri 2/24/06
54	8.5	Obtain Ministerial Approvals (RA's and MOE)	Fri 8/11/06
55	8.6	CEAA Public Consultation Period	Tue 9/12/06
56	8.7	Obtain Final Determination	Wed 9/13/06
57	**9**	**2008 Water Licensing**	**Thu 9/13/07**
58	9.1	Submit Water License Application	Thu 9/14/06
59	9.2	Water License Approvals	Thu 9/13/07



	mbe	Task Name	Finish
57	9	2008 Water Licensing	Thu 9/13/07
58	9.1	Submit Water License Application	Thu 9/14/06
59	9.2	Water License Approvals	Thu 9/13/07
60	10	DFO Authorizations	Wed 9/12/07
61	10.1	Negotiate DFO Approvals	Wed 9/12/07
62	11	Receive ICAP Licenses & Approvals	Fri 9/14/07
63	12	FWSD Remediation	Fri 1/7/05
64	12.1	Obtain DFO Approval for FWSD Lowering	Thu 8/22/02
65	12.2	Lower FWSD	Thu 2/6/03
66	12.3	Assess Fish Habitat	Fri 9/20/02
67	12.4	Define Options for FWSD Phase 2	Fri 3/7/03
68	12.5	Obtain DFO Approval for FWSD Phase 2	Fri 8/22/03
69	12.6	Carry out FWSD Phase 2	Fri 1/7/05
70	13	CEAA for 2003 Water License Application	Wed 3/26/03
71	13.1	Complete Draft Project Description	Thu 5/2/02
72	13.2	Review Draft Project Description	Thu 5/16/02
73	13.3	Submit Project Description	Fri 5/17/02
74	13.4	Coordinate Federal RA's	Fri 6/28/02
75	13.5	Complete RERC and Public Reviews	Fri 8/30/02
76	13.6	Receive EAR Guidelines	Mon 9/2/02
77	13.7	Prepare EAR	Mon 9/23/02
78	13.8	DIAND Completes Comprehensive Study	Wed 3/26/03
79	14	2003 Water License Application	Wed 12/17/03
80	14.1	Prepare Preliminary ICAP & Decision Tree	Thu 5/1/03
81	14.2	Complete Studies to Challenge Current WL Cc	Thu 5/30/02
82	14.3	Check Hydraulic Conductivity of Rose Diversi	Thu 5/30/02
83	14.4	Check Sizing of Vangorda Dam and Culvert	Thu 5/30/02
84	14.5	Select Landfill Site and Prepare Design	Thu 5/30/02
85	14.6	Prepare Draft Water License Application	Thu 5/1/03
86	14.7	Obtain DIAND Approval for WL Application	Thu 6/12/03
87	14.8	Submit Water License Application	Fri 6/13/03



	mbe	Task Name	Finish
87	14.8	Submit Water License Application	Fri 6/13/03
88	14.9	Water License Review Process	Tue 12/16/03
89	14.1	Receive Water License	Wed 12/17/03
90	**15**	**Site Activities (Probably) Not Requiring App**	**Thu 11/20/03**
91	15.1	Recontour Grum Waste Dump	Thu 11/20/03
92	15.2	Remove Unnecessary Minor Buildings	Thu 11/28/02
93	15.3	Clean Up Miscellaneous Material	Thu 9/4/03
94	15.4	Upgrade Seepage Collection	Thu 9/4/03
95	15.5	Remove Pumphouse Dam	Thu 9/4/03
96	15.6	Remediate Fuel Storage Sites	Thu 9/4/03
97	15.7	Move Emergency Tailings	Thu 9/4/03
98	15.8	Improve Faro Creek Diversion Intake	Thu 9/4/03
99	15.9	Upgrade Faro Creek Diversion	Thu 9/4/03
100	15.1	Upgrade Vangorda Creek Diversion	Thu 9/4/03
101	5.11	Remove Salvage and Scrap	Thu 9/4/03
102	**16**	**Site Activities (Potentially) Requiring Appro**	**Wed 5/4/05**
103	16.3	Landfill Demolition Waste	Wed 5/4/05
104	16.2	Remove Unnecessary Major Buildings	Wed 5/4/05
105	16.3	Consolidate/Cover High ARD Sources	Wed 8/25/04



9.2 Work Plan Task Descriptions

9.2.1 General

1.1 Continue Care and Maintenance

Continue activities to manage site in compliance with existing Water Licence requirements. Continue water collection and treatment. Continue monitoring of water quality per licence requirements. Make routine upgrades to site as needed for care and maintenance.

1.2 Define Project Management Structure

Agree on management team organizational structure, lines of communication and levels of authority for Deloitte & Touche, DIAND, YTG and other project stakeholders.

1.3 Manage Water Licence and ICAP Development Project

Manage the development of the 2003 Water Licence Application and supporting documents. Manage development of the ICAP. Include identification of priorities, development of project schedules and task description, development of budgets and supporting cost estimates, procurement of contractor/consultant support, and contractor/consultant management.

1.4 Continue Stakeholder Communication

Identify key stakeholders and prepare communication plan. Consider revision to TAC or replacement with alternative communication process as part of Water Licence renewal. Prepare attendee lists, minutes and notes at all communication events. Prepare annual report providing a summary of key finding and append attendee lists and meeting notes. Review communications plan annually and revise where necessary.

1.5 Complete Socio-economic Studies

Prepare terms of reference for socio-economic studies. Include review of current socio-economic conditions and assessment of effects of proposed closure measures. Procure contractor to carry out socio-economic studies and prepare report for attachment to ICAP.

9.2.2 Basic Engineering Data

2.1 Define Risk-based Engineering Criteria

Collate previous seismic studies and obtain definitive opinion on event-recurrence relationship. Collate hydrology and develop event probabilities for required watersheds. Collate design, as-built, and inspection information from major structures. Complete representative risk assessments of tailings failures, dump failures, and diversion structure failures to provide a basis for future option selection and initial engineering.

2.2 Define Cost Assumptions

Compile summary list of expected cost items and provide consistent assumption list on consumables (e.g. fuel cost, power costs, etc.). Define expected quantities for each cost item and the location involved with each cost item. Provide unit rate estimates based on two methods; firstly from appropriate equipment size selection and first principals (assessing purchase vs. lease arrangements) and secondly from mining cost databases for verification. Evaluate results and indicate implications for closure planning options. Provide a summary report.

2.3 Complete Phase 1 Borrow Source Survey

Compile material requirements (type and amount) for various granular, construction and erosion protection needs. Compile baseline summary of borrow/quarry site presently existing on-site with a summary of expected material quantities available. Undertake terrain mapping to identify other potential sources of material existing on the current mine leases. Undertake reconnaissance site visit to inspect and confirm existing borrow/quarry sites and inspect and sample (likely shallow drilling and/or test pitting) new identified sites. Provide an assessment report outlining expected material types, quantities and location with recommendations for follow-up work.

2.4 Complete Phase 2 Borrow Source Investigations

Based on the Phase 1 report, and on possible revised quantity requirements, provide further detailed assessment of potential borrow sources. Undertake detailed sampling and assessment of proposed borrow sites, along with required quality control testing to validate material conditions versus expected material specifications. Provide summary report.

9.2.3 Faro Mine Area

3.1 Faro Mine Area Scoping Study

Review 1996 ARD characterization and hydrology. Assemble available information on pit wall stability, original topography, current topographic maps, original pit storage capacity, tailings deposition history, current bathymetry, water levels, and water quality information. Estimate costs for dump relocation, dump covering, and clean water management measures. Estimate effects on long term drainage and pit water quality and water treatment needs. Estimates costs/benefits of improvements to water collection and treatment system. Prepare a definitive list of methods for further consideration, with justification for their selection. Define critical information needs.

3.2 Characterize Faro Waste Rock ARD Status & Potential

Compile all previous studies of Faro acid rock drainage (ARD) and complete gap analysis. Subject to priorities arising from Task 3.1, carry out the following investigations to define current conditions and future ARD potential. Complete drillholes to sample waste rock and install temperature and gas monitoring devices. Sample rock from drillholes and test to confirm ARD potential mapped in the 1996 ICAP. Complete additional test pits to investigate changes since 1996 ICAP, characterize unmapped areas or dumps, and obtain samples for laboratory testing. Review all available seepage water quality data and carry out additional seep surveys. Carry out laboratory tests to determine acid-base accounts, stored soluble contaminant loads, and contaminant leaching rates. Include grain size analyses, permeability, compaction and other testing for geotechnical classification of selected samples. Prepare report summarizing geochemical tests. Prepare data report summarizing geotechnical testing.

3.3 Continue ARD Monitoring or Lab Studies

Continue monitoring of temperature and gas in Faro waste dumps for at least one full year. If necessary, continue laboratory testing of samples from above task. Prepare annual data report.

3.4 Improve Faro Dump Water Balance

Carry out snow surveys on Faro waste rock dumps. Combine with results of the geotechnical testing from Task 3.2 to prepare improved estimates of the rate at which water infiltrates the waste rock dumps. Use results of drillhole monitoring to assess possible effect of frozen conditions on rates of water seepage .out of the dumps. Prepare technical memorandum providing revisions to dump water balances from 1996 ICAP.

3.5 Complete Water Quality Predictions

Combine results of Tasks 3.1 and 3.2 to predict contaminant concentrations in seepage from Faro waste rock dumps and in Faro pit lake for several closure scenarios. Include consideration of possible changes due to future acid generation. Prepare report summarizing key results from Tasks 3.1 to 3.5.

3.6 Develop Faro Waste Rock Decommissioning Methods

Develop conceptual designs and cost estimates for Faro waste rock decommissioning methods, including do nothing, regrading, covering, relocation, and other methods identified in Task 3.1. Identify requirements for further testing (e.g. cover tests). Prepare options analysis report.

3.7 Complete Faro W/R Cover Tests

If required by Task 3.6, design, construct and monitor cover test areas on Faro waste rock dumps. Design trial cover profiles and monitoring system. Specify and procure necessary monitoring instruments. Prepare construction drawings and specifications. Construct test areas. Install and test monitoring systems. Prepare as-built report. Continue monitoring for at least three years. Prepare data report and interpretation after first year. Prepare annual data reports thereafter.

3.8 Develop Faro Creek Diversion Methods

Review current Faro Creek diversion system and predict life span. Develop conceptual designs and cost estimates for changes. Design and carry out field studies to support final selection of preferred method. Include consideration of upgrades of the current system, re-alignment to the northeast, and re-routing through the pit, through a backfilled pit, and through a constructed channel or tunnel in the pit area, as well as any other methods identified as promising in Task 3.1. Prepare options analysis report.

3.9 Develop Faro Water Collection and Treatment Methods

Develop conceptual designs and cost estimates for changes to the Faro water collection and treatment system. Consider relocation of plant to allow water collection by gravity drainage. Consider effects of changes to inflows and contaminant loads resulting from waste rock management methods and/or acid rock drainage. Prepare options analysis report.

3.10 Select Faro Closure Methods

Select preferred closure methods for the Faro Mine area. Consider long term contaminant loads and risk-based design criteria. Prepare layouts, typical sections and profiles. Prepare feasibility level cost estimates for major earthworks and water collection system. Prepare scoping level estimates for water treatment plant capital and operating costs. Include range of uncertainty in cost estimates. Prepare summary report.

9.2.4 Vangorda/Grum Area

4.1 Vangorda/Grum Scoping Study

Review 1996 ARD characterization and hydrology, 2000 report on Vangorda pit water quality. Assemble available information on Vangorda pit wall stability, original topography, current topographic maps, original pit storage capacity, current bathymetry, water levels, and water quality information. Estimate costs for dump relocation, dump covering, clean water management methods and other methods identified in the April 2002 Workshop. Estimate effects on long term drainage and pit water quality and water treatment needs. Estimates costs/benefits of improvements to water collection and treatment system. Prepare a definitive list of methods for further consideration, with justification for their selection. Define critical information needs.

4.2 Characterize Vangorda/Grum Waste Rock ARD Status & Potential

Compile previous ARD studies and complete gap analysis. Subject to priorities arising from Task 4.1, carry out the following investigations to define current conditions and future acid generation potential. Complete drillholes to sample waste rock and install temperature and gas monitoring devices. Sample rock from drillholes and test to confirm ARD potential mapped in the 1996 ICAP and 1999 SRK pit lake study. Complete additional test pits to investigate changes, characterize unmapped areas (including the ore transfer area), and obtain samples for laboratory testing. Review all available seepage water quality data and carry out additional seep surveys. Carry out laboratory tests to determine acid-base accounts, stored soluble contaminant loads, and contaminant leaching rates. Include grain size analyses, permeability, compaction and other testing for geotechnical classification of selected samples. Include agricultural testing of Grum overburden. Prepare report summarizing geochemical tests. Prepare data report summarizing geotechnical testing.

4.3 Continue ARD Monitoring or Lab Studies

Continue monitoring of temperature and gas in Vangorda and Grum waste dumps for at least one full year. If necessary, continue laboratory testing of samples from above task. Prepare annual data report.

4.4 Improve Vangorda and Grum Dump Water Balances

Carry out snow surveys on Vangorda and Grum waste rock dumps. Combine with results of the geotechnical testing from Task 3.2 to prepare improved estimates of the rate at which water infiltrates the waste rock dumps. Use results of drillhole monitoring to assess possible effect of frozen conditions on rates of water seepage .out of the dumps. Prepare technical memorandum providing revisions to dump water balances from 1996 ICAP.

4.5 Complete Water Quality Predictions

Combine results of Tasks 4.1 and 4.2 to predict contaminant concentrations in pit lakes and in seepage from waste rock dumps. Include consideration of possible changes due to future acid generation. Prepare report summarizing key results from Tasks 4.1 to 4.5.

4.6 Develop Vangorda/Grum Waste Rock Decommissioning Methods

Develop conceptual designs and cost estimates for waste rock decommissioning methods. Include do nothing, regrading, covering, and relocation of both Vangorda waste rock and Grum high sulphide waste rock. Include do nothing, re-sloping, and covering of Grum waste rock, and any other methods identified as promising in Task 4.1. Identify requirements for further testing (e.g. cover tests). Prepare options analysis report.

4.7 Complete Vangorda W/R Cover Tests

If required by Task 4.6, design, construct and monitor cover test areas on Faro waste rock dumps. Begin with detailed inspection and testing of 1994 cover trials. Design trial cover profiles and monitoring system. Specify and procure necessary monitoring instruments. Prepare construction drawings and specifications. Construct test areas. Install and test monitoring systems. Prepare as-built report. Continue monitoring for at least three years. Prepare data report and interpretation after first year. Prepare annual data reports thereafter.

4.8 Develop Vangorda Creek Diversion Ditch Methods

Develop conceptual designs and cost estimates for changes to the Vangorda Creek diversion system. Design and carry out field studies to support final selection of preferred method. Include consideration of upgrades of the current system, re-alignment to Blind Creek, and re-routing through the pit, through a backfilled pit, and through a constructed channel or tunnel in the pit area, as well as all other methods identified in Task 4.1. Prepare options analysis report.

4.9 Develop Vangorda/Grum Water Collection and Treatment Methods

Develop conceptual designs and cost estimates for changes to the Faro water collection and treatment system. Consider relocation of plant to allow water collection by gravity drainage. Consider effects of changes to inflows and contaminant loads resulting from waste rock management methods and/or acid rock drainage. Prepare options analysis report.

4.10 Select Vangorda/Grum Closure Methods

Select preferred closure methods for the Vangorda and Grum areas. Consider long term contaminant loads and risk-based design criteria. Prepare layouts, typical sections and profiles. Prepare feasibility level cost estimates for major earthworks and water collection system. Prepare scoping level estimates for water treatment plant capital and operating costs. Include range of uncertainty in cost estimates. Prepare summary report.

9.2.5 Rose Creek Area

5.1 Rose Creek Scoping Study

Prepare summary of borrow availability in area. Prepare sensitivity analyses of groundwater model. Estimate costs and effectiveness for covers, flooding, relocation, and other methods identified in the April 2002 Workshop. Estimate cost and effectiveness of modifications to FWSD and Rose Creek diversion channel. Prepare a definitive list of methods for further consideration, with justification for their selection. Define critical information needs.

5.2 Complete Tailings Area Studies

Review available information regarding the hydrogeology and geochemistry of the tailings facility in the context of providing a characterization adequate for the development and assessment of decommissioning methods. This will represent a follow up and finalization of the characterization study conducted in 2001. Design and carry out desktop and field activities appropriate to providing an adequate characterization. Provide a project report that describes the work completed and the final hydrogeological and geochemical interpretations.

5.3 Develop Tailings Decommissioning Method

Develop decommissioning methods for the Rose Creek tailings Facility (including the North Fork of Rose Creek diversion channel, Rose Creek diversion canal and the Cross Valley dam) to a conceptual/pre-feasibility level. The decommissioning methods are to include wet covers, dry covers, relocation to the Faro main pit and other methods identified in the April 2002 Workshop. The following information will be provided: hydrogeological and geochemical characterization of the Rose Creek valley aquifer, risk-based engineering criteria, unit cost assumptions and borrow area source survey. Collect and analyze field samples, as required. Assess water treatment requirements and provide a summary prediction of anticipated water volumes and quantity. Provide a conceptual/pre-feasibility design for each method that includes description, design drawings, material quantities, material specifications, preferred borrow source areas, costs, schedule, construction considerations, environmental implications and water treatment requirements. Provide a comparison and ranking of the methods based on those factors.

5.4 Complete Tailings Cover Test Cells

Design and construct a tailings cover test cell program that will support and optimize the use of the cover as an acceptable long term decommissioning method. A pre-feasibility cover design will be provided that includes description, design drawings, material specifications, material quantities and construction considerations. The following information will be provided: risk-based engineering criteria, unit cost assumptions and borrow area source survey. Provide a written operating and monitoring plan to the mine operator such that routine operation and monitoring for a period of up to 24 months can be conducted by mine personnel. Provide technical support to the mine personnel including regular receipt and evaluation of data results. Provide a project report that includes the design and construction details of the program and an interpretation of results at the earlier of 8 months or at the end of the program. If the program proceeds beyond 8 months, then provide an update report that describes any operating and monitoring issues or concerns and that includes an updated interpretation of results every four months.

5.5 Select Tailings Closure Methods

Provide a basic/feasibility design for the decommissioning of the Rose Creek tailings Facility (including the North Fork Rose Creek diversion, the Rose Creek diversion canal and the Cross Valley dam) based on a conceptual design that will be provided. The decommissioning method will consist of wet cover, dry cover, relocation of tailings to the Faro main pit or a hybrid. The provided conceptual design will include: description, design drawings, material quantities, material specifications, preferred borrow source areas, costs, schedule, construction considerations, environmental implications and water treatment requirements. The following information will also be provided: risk-based engineering criteria, unit cost assumptions and borrow area source survey. Conduct field surveys and materials testing, as appropriate. Identify gaps or new information relevant to the provided water treatment requirements but do not conduct additional studies.

9.2.6 Human & Ecological Risk Assessments

6.1 Complete Level 1 Human Health and Ecological Risk Assessment

Complete Level 1 assessments of human health and ecological risks associated with current discharges from the site, and with hypothetical increased contaminant levels. Prepare Level 1 risk assessment report identifying any possible concerns. If significant concerns are found, identify any site-specific information required for Level 2 assessment.

6.2 Complete Level 2 Human Health and Ecological Risk Assessment

Complete revised Level 1 assessments of human health and ecological risks associated with discharges from the site after the implementation of methods proposed in Task 7.1. If Level 1 assessment indicates any significant concerns, carry out Level 2 risk assessment. Complete risk assessment report to be included as attachments to environmental assessment report.

6.3 Complete Environmental Assessment

Compile and review available baseline environmental data for the area. Complete gap analysis. Design and carry out field studies to fill in data gaps. Also design and carry out field investigations to acquire site specific information as needed for risk assessment. Prepare environmental assessment report presenting summary baseline information, results of risk assessments, and discussing expected impacts and mitigation measures associated with the closure plan proposed in Task 7.1.

9.2.7 ICAP Preparation

7.1 Prepare Initial Plan

Convene a meeting of project team to agree upon an initial comprehensive abandonment plan. Include methods for closure of all site components. Estimate of post-closure water quality for use in the Tier 2 human health and ecological risk assessment (Task 6.2). Include any other information needed for the environmental assessment of post-closure conditions (Task 6.3).

7.2 Prepare Draft ICAP Document

Compile the results of Task 7.1, together with any modifications required as a result of Tasks 6.2 and 6.3. Prepare a comprehensive plan for closure of all facilities at the site. Collate cost estimates for individual methods and prepare an overall cost estimate. Collate schedules for individual methods and prepare an overall implementation schedule. Prepare an outline for the ICAP report. Review technical reports from Tasks 2.4, 3.5, 3.10, 4.5, 4.10, 5.5, 6.2, and 6.3, and prepare summary sections for the ICAP report. Prepare a complete draft of the ICAP report. Include the reviewed technical reports as Supporting Documents.

7.3 Obtain DIAND Approvals

This task allows for DIAND's internal review of the Draft ICAP. Presentations to DIAND and responses to queries will be required.

7.4 Prepare Final ICAP Document

After receiving review comments from DIAND, prepare final ICAP report for submission to the Water Board.

9.2.8 EA Process for ICAP

8.1 Trigger Initial (EA) Review

Submission of the ICAP document will trigger an Environmental Assessment by DIAND. No specific activities are required by the proponent beyond submission of the document.

8.2 Receive EAR Terms of Reference

DIAND will provide Terms of Reference (or “Guidelines”) for the Environmental Assessment Report. No specific activities are required by the proponent.

8.3 Complete EA Studies and Report

Prepare an Environmental Assessment Report (EAR) that meets the requirements of the Terms of Reference provided by DIAND based on the Integrated Comprehensive Abandonment Plan (ICAP) that was previously submitted. Conduct any required environmental or socio-economic studies that are not already in place. Provide a report appropriate for submission to DIAND.

8.4 Complete Comprehensive Study Report

During preparation of the Comprehensive Study Report (CSR) by DIAND, provide technical support, as requested, in response to Information Requests (IR’s) or attendance at technical information sessions. Provide additional technical interpretations and conduct additional studies on a priority basis as determined in consultation with the proponent. Provide topic related technical memoranda, technical reports and presentation information, as requested.

8.5 Obtain Ministerial Approvals

This task is internal to the DIAND review process. There are no specific activities required by the proponent.

8.6 CEAA Public Consultation Period

This task is internal to the DIAND review process. There are no specific activities required by the proponent.

8.7 Obtain Final Determination

This is a milestone included for scheduling purposes only. There are no specific activities required by the proponent.

9.2.9 2008 Water Licensing

9.1 Submit Water Licence Application

Prepare and submit the appropriate Water Licence Application forms to the Yukon Territory Water Board. Complete this submission immediately upon successful completion of the DIAND Environmental Assessment process.

9.2 Water Licence Approvals

Review and prepare responses to Interventions received by the Yukon Territory Water Board within the allowed timeframes. Prepare for and attend Public Hearings and other information sessions.

9.2.10 DFO Authorizations

10.1 Negotiate DFO Approvals

Conduct negotiations with the Department of Fisheries and Oceans (DFO) to obtain the necessary authorizations to conduct the work specified in the Integrated Comprehensive Abandonment Plan (ICAP) with the exception of Phase 2 remediation of the Fresh Water Supply dam. Prepare and submit any required application forms, supporting documentation and responses to information requests in a timely manner.

9.2.11 Receive ICAP Licences & Approvals

This is a milestone included for scheduling purposes only, and does not require any specific activities by the proponent.

9.2.12 FWSD Remediation

12.1 Obtain DFO Approval for FWSD Lowering

Conduct negotiations with the Department of Fisheries and Oceans (DFO) to obtain the necessary authorizations to conduct the work specified in the Phase 1 work plan for Remediation of the Fresh Water Supply dam (FWSD) in a timely manner.

12.2 Lower FWSD

Carry out the Phase 1 Work Plan for Remediation of the Fresh Water Supply dam (FWSD) according to the detailed engineering designs and in accordance with applicable licences, authorizations and regulations. Solicit, receive and assess contractor quotations for performance of the physical work and provide a recommendation to the proponent. Prepare and execute contract documents for the physical work. Provide project management for the physical work including cost control, technical inspection and engineering quality control. Provide all environmental protection measures that may be required to ensure that the requirements of applicable environmental licences and regulations are achieved. Provide appropriate on-site spill response equipment and training and respond to any spills in accordance with applicable regulations and site protocols. Provide written weekly project progress reports for the duration of the project that include updated costs, schedule, physical progress, quality control and any other relevant information. Provide a final as-built report that includes final survey detail, quality control data and other relevant information.

12.3 Assess Fish Habitat

Investigate fish habitat in Freshwater Supply Reservoir, Rose Creek North Fork, and Rose Creek downstream of tailings area. Prepare report and habitat map. Present findings to DFO.

12.4 Define Options for FWSD Phase 2

Develop decommissioning methods for the Fresh Water Supply dam (FWSD) to a feasibility level. The options will include both complete and partial breaching of the dam. Conduct additional field and laboratory testing programs, including fisheries habitat assessments, as required. Provide a feasibility level design for each method that includes description, design drawings, material quantities, material specifications, preferred borrow source areas, costs, schedule, construction considerations, environmental implications and water treatment requirements. Provide a comparison and ranking of the methods based on those factors.

12.5 Obtain DFO Approval for FWSD Phase 2

Subsequent to the selection of a preferred final remediation method for remediation of the Fresh Water Supply dam (FWSD), conduct negotiations with the Department of Fisheries and Oceans (DFO) to obtain the necessary authorizations to conduct the required work in a timely manner.

12.6 Carry out FWSD Phase 2

Carry out the Phase 2 (Final) Work Plan for Remediation of the Fresh Water Supply dam (FWSD). Develop detailed engineering designs and specifications based on the provided basic/feasibility design. Conduct additional field and laboratory studies, as appropriate. Provide a detailed design report for approval by the proponent. Solicit, receive and assess contractor quotations for performance of the physical work and provide a recommendation to the proponent. Prepare and execute contract documents for the physical work. Provide project management for the physical work including cost control, technical inspection and engineering quality control. Provide all environmental protection measures that may be required to ensure that the requirements of applicable environmental licences and regulations are achieved. Provide appropriate on-site spill response equipment and training and respond to any spills in accordance with applicable regulations and site protocols. Provide written weekly project progress reports to the proponent for the duration of the project that include updated costs, schedule, physical progress, quality control and any other relevant information. Provide a final as-built report that includes final survey detail, quality control data and other relevant information.

9.2.13 CEAA for 2003 Water Licence Application

13.1 Complete Draft Project Description

Compile a Draft Project Description document for final internal review by the proponent. The document should include all planned components of the Final Project Description including Sections 1, 2 and 3 and the 2002 Baseline Environmental Information Appendix. Distribute the Draft document for internal review.

13.2 Review Draft Project Description

Internal (Proponent) review of Draft Project Description and editing of the document to incorporate comments.

13.3 Submit Project Description

This is a milestone representing submission of the Project Description to DIAND by the Proponent.

13.4 Coordinate Federal RA's

This task is internal to the DIAND review process and does not require any activities by the proponent.

13.5 Complete RERC and Public Reviews

This task is internal to DIAND and does not require any activities by the proponent.

13.6 Receive DIAND Guidelines for the Environmental Assessment Report

This is a milestone representing receipt of Guidelines/Terms of Reference for the Environmental Assessment Report. No activities are required by the proponent.

13.7 Complete Environmental Assessment Report

Prepare an Environmental Assessment Report (EAR) that meets the requirements of the Guidelines/Terms of Reference provided by DIAND based on the Project Description that was previously submitted. Conduct any required environmental or socio-economic studies that are not already in place. Provide a report appropriate for submission to DIAND.

13.8 DIAND Comprehensive Study Report

During preparation of the Comprehensive Study Report (CSR) by DIAND, provide technical support, as requested, in response to Information Requests (IR's) or attendance at technical information sessions. Provide additional technical interpretations and conduct additional studies on a priority basis as determined in consultation with the proponent. Provide topic related technical memoranda, technical reports and presentation information, as requested.

9.2.14 2003 Water Licence Application

14.1 Prepare Preliminary ICAP and Decision Tree

Prepare a description of the progress and information compiled to date regarding the Integrated Comprehensive Abandonment Plan (ICAP) and a preliminary overview of the remediation methods and alternatives under consideration. Describe the decision matrix that is being implemented for continuing and finalizing the ICAP.

14.2 Assess Opportunities for Beneficial Amendments to Current Water Licence Conditions

Identify conditions in the current Water Licences, QZ95-003 (Faro) and IN89-002 (Vangorda Plateau), that are in conflict with current conditions or that could be proposed to be amended for the benefit of the project. Develop suggested amendments to those terms and identify relevant studies that would support the proposed changes. Present this information to the proponent as a Technical Memorandum supported by a teleconference or in-person meeting. Conduct and report on any of the proposed studies that are approved by the proponent.

14.3 Check Hydraulic Conductivity of Rose Creek Diversion Canal

Search available information to determine the hydraulic conductivity of the Rose Creek diversion canal. The available information will include: design and as-built reports, original hydrologic and flood assessments, recent (2001) hydrologic and flood assessments. Recommend any additional studies or surveys that may be beneficial.

14.4 Check Hydraulic Capacity of Vangorda Creek Headworks Dam and Vangorda Creek Diversion Flume

Search available information to determine the hydraulic conductivity of the Vangorda Creek Headworks dam and Vangorda Creek diversion flume. The available information will include: design and as-built reports, original hydrologic and flood assessments, recent (2001) hydrologic and flood assessments. Recommend any additional studies or surveys that may be beneficial.

14.5 Select Landfill Site and Prepare Design

Develop estimates of maximum possible landfill requirements based on assumed on-site disposal of all non-hazardous debris from demolition of mine buildings. Identify alternative locations and provide a comparison based on volume, potential for expansion, closure considerations, cost considerations, ease of operation and environmental considerations. Proved a conceptual/pre-feasibility design for each alternative including individual location plans and sections as appropriate.

14.6 Prepare Draft Water Licence Application

Prepare a Draft Water Licence Application for internal review by the proponent. The Draft should include all of the information that is to be to included into the Final Application including: completed application forms, proposed changes to terms and conditions, Preliminary ICAP and Decision Tree, Landfill Site Selection and Design Reports and studies in support of proposed changes to terms and conditions of the Licence.

14.7 Review Draft Water Licence Application

Internal (Proponent) review of Draft Water Licence Application and editing of the document to incorporate comments.

14.8 Submit Water Licence Application

This is a milestone representing submission of the Water Licence Application to the Yukon Territory Water Board by the Proponent.

14.9 Water Licence Review Process

Review and prepare responses to Interventions received by the Yukon Territory Water Board within the allowed timeframes. Provide technical support to the proponent in preparation for and attendance at Public Hearings and other information sessions.

14.10 Receive Water Licence

This is a milestone representing receipt of the Water Licence. No activities are required by the proponent.

9.2.15 Site Activities Not Requiring Approval

15.1 Re-Contour Grum Waste Dump

Design re-sloping of Grum Waste dump to attain stable slopes, move fines to surface, and allow for covering. Prepare drawings showing re-sloping sequence and typical sections. Survey areas to be resloped. Procure heavy equipment contractor to carry out re-sloping. Carry out re-sloping. Complete final slope surveys and prepare as-built reports. Consider the possibility of covering Grum dump, but only if the cover design arising from Task 4.10 is in accordance with current Water Licence conditions (otherwise will need ICAP approval prior to covering).

15.2 Remove Unnecessary Minor Buildings

Remove buildings that are not anticipated to be required for any long term land use. First identify and remove any hazardous materials and send off-site for disposal. Then remove salvage and scrap to storage. Then demolish building and dispose of non-hazardous waste in the current landfill or in a landfill to be approved as part of Task 17.1.

15.3 Clean Up Miscellaneous Material

Clean up miscellaneous materials around the site. Store salvage and scrap. Dispose of non-hazardous waste in the current landfill or in a landfill to be approved as part of Task 17.1.

15.4 Upgrade Seepage Collection

Design and construct improvements to seepage and drainage collection systems to reduce uncontrolled releases of contaminated water. Route contaminated water to either treatment or in-pit storage.

15.5 Remove Pumphouse Dam

Drain the Pond and remove the Rose Creek pumphouse dam. If necessary, construct improvements to the Rose Creek diversion ditch intake system. (*This task may require Water Board approval?*)

15.6 Remediate Fuel Storage Sites

Delineate hydrocarbon contaminated soil, as defined by YTG regulations, at former fuel storage sites. Design, obtain permission for, and construct a bio-remediation cell. Remove hydrocarbon-contaminated soil to the bio-remediation cell. Monitor and make necessary amendments to the bio-remediation cell.

15.7 Move Emergency Tailings

Delineate areas of tailings in the emergency tailings areas. Excavate tailings and remove to a cell constructed in the tailings impoundment.

15.8 Improve Faro Creek Diversion Intake

Design and make improvements to the Faro Creek diversion intake system. Consider improvements to intake structure at upstream end of diversion, improvements to ditch running along Faro Creek Valley, and construction of a lined pond upstream of the Faro Creek Valley waste rock dump.

15.9 Upgrade Faro Creek Diversion

Complete routine maintenance of the existing Faro Creek diversion system. Prepare designs for upgrading or relocation of the Faro Creek diversion system. If necessary, complete emergency upgrading or relocation prior to approval of the ICAP.

15.10 Upgrade Vangorda Creek Diversion

Complete routine maintenance of the existing Vangorda Creek diversion system. Prepare designs for upgrading or relocation of the Faro Creek diversion system. If necessary, complete emergency upgrading or relocation prior to approval of the ICAP.

15.11 Remove Salvage and Scrap

Identify salvage (items that can be re-sold and used for their original purpose) and scrap (items that can be re-sold only for their raw material value) from around the site. Select a location for a single salvage yard and a single scrap yard. Move all salvage and scrap to the appropriate yard.

9.2.16 Site Activities Potentially Requiring Approval

16.1 Landfill Demolition Waste

Select a location for a new landfill for non-hazardous waste. Obtain required approvals. Place non-hazardous waste from building demolition and site cleanup in landfill.

16.2 Remove Unnecessary Major Buildings

Identify major buildings that are not anticipated to be required for any long term land use. Identify and remove any hazardous materials and send off-site for disposal. Remove salvage and scrap to storage. Prepare detailed demolition plan and schedule. Prepare detailed health and safety plan. Train workers in demolition health and safety. Then demolish building and dispose of non-hazardous waste in the current landfill or in a landfill to be approved as part of Task 17.1.

16.3 Consolidate/Cover High ARD Sources

Subject to the findings of Tasks 3.6 and 4.6, consolidate areas of waste rock that are identified as significant current and future sources of ARD. Cover or otherwise maintain the problem material to minimize the generation of additional contaminants.

10. Appendices

1. Reference Documents – Data Room Listing
2. Visual Tour of Site – Eric Denholm
3. Permitting Schedule – Shannon Glenn
4. Risk Assessment Tool – Valerie Chort
5. Tailing Impoundment – Eric Denholm
6. Mass Loading Balance – Eric Denholm
7. Geochemical Overview – Steve Day of SRK
8. Stakeholders – Shannon Glenn
9. Evaluation Factors – Darryl Hockley

Appendix 1 - Reference Documents – Data Room Listing

- Available on Workshop CD

Appendix 2 - Visual Tour of Site

- Available on Workshop CD

Deloitte & Touche

Appendix 3 - Permitting Schedule

- Available on Workshop CD

Appendix 4 – Risk-Based Management Approach

- Available on Workshop CD

Appendix 5 - Tailing Impoundment

- Available on Workshop CD

Deloitte & Touche

Appendix 6 - Mass Loading Balance

- Available on Workshop CD

Appendix 7 - Geochemical Overview

- Available on Workshop CD

Appendix 8 - Stakeholders

- Available on Workshop CD

Appendix 9 - Evaluation Factors

- Available on Workshop CD