



# Faro Mine Complex Faro-Vangorda Haul Road Reclamation Cost Estimate

**2007/08 Task 20b - FINAL**



*Prepared for:*

***Deloitte and Touche Inc.***

*On behalf of*

***Faro Mine Closure Planning Office***

*Prepared by:*



*Project Reference Number  
SRK 1CD003.100*

***July 2008***

**Anvil Range Mining Complex  
Faro-Vangorda Haul Road  
Reclamation Cost Estimate**

**2007/08 Task 20b - FINAL**

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## Executive Summary

This study has been undertaken to obtain a more accurate estimate of the cost of reclaiming the 10 km long Faro-Vangorda Haul Road than existed previously. This haul road connects the Faro and Vangorda/Grum sides of the Faro Mine Complex and it is conceivable that the final closure plan will require the removal of the culverts, rock drains and associated fill at the various drainages along the haul road in order to return them to their pre-mining condition.

Following a review of aerial photos and a detailed site reconnaissance, ten drainages were identified along the Faro-Vangorda Haul Road. Excavation criteria were established with a view to estimating the volume of material associated with breaching the haul road at each of these drainages.

For purpose of this study, three drainages were selected for detailed analysis of the reclamation costs. The sites were selected with a view to evaluating the range of deconstruction requirements and reclamation quantities. Each of the three sites were evaluated on the basis of material quantities derived from excavation concepts and site specific assumptions related to equipment, access roads and dump sites. The unit costs were selected primarily from the cost data base used in the development of site wide closure options.

Based on the analytical results from these three sites, an interpolative approach was then used to assess the excavation costs associated with the other seven drainages.

The total estimated cost of reclamation at the Faro-Vangorda Haul Road is \$11.1 million. Of this total, the three sites that underwent detailed analysis accounted for 89% of the excavation volumes and 84% (\$9.4 million) of the total estimated cost of reclamation. The sites for which costs were interpolated amounted to only 11% of the excavation volumes and 16% (\$1.8 million) of the total estimated cost of reclamation. Therefore, even if there were significant errors in the interpolated reclamation costs, the impact on the total estimated cost of reclaiming the haul road would likely be quite small (well under \$1 million). Furthermore, these potential differences will almost certainly be immaterial relative to the project-wide cost of reclaiming the FMC. For this reason, and given the current status of the closure plan selection and approval process, the reclamation cost estimate provided in Table 5.1 is considered adequate.

More rigorous cost estimates will be required as the selection and approval process moves forward.

\* \* \*

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# 1 Introduction

The process of selecting and approving a closure plan for the Faro Mine Complex (FMC) in the south central Yukon is presently underway. Concurrent with this process, studies are continuing with a view to reducing technical uncertainties and, in some cases, refining the associated cost estimates. The cost of culvert removal from the 10 km long haul road that connects the mine at Faro on the west side of the FMC with the Vangorda and Grum mines on the east side is one such case.

The haul road, referred to as the Faro-Vangorda Haul Road, is comprised of an elevated waste rock fill that is typically about 30 m wide and, on centreline, ranges in height from less than 10 m to about 56 m. Along its route, the haul road crosses a series of drainages, some of which are perennial and others of which are seasonal. Within the road fill, culverts are present at some of these drainages and rock drains or simply segregated waste rock fill are present at others.

It is conceivable that the final closure plan will require the removal of the culverts, rock drains and associated fill at the various drainages along the haul road in order to return them to their pre-mining condition. Given the height and width of the haul road fill, the quantity of material that will require removal at each drainage location is significant and, at some locations, quite large. It has been decided, therefore, that it would be prudent to develop a more accurate estimate of the material removal volumes and associated costs.

This report provides the basis of cost estimates for the removal of the culverts, rock drains and associated fill at the various drainages along the haul road.

## 2 Drainage Summary and Approach

Following a review of aerial photos and a detailed site reconnaissance, ten drainages were identified along the Faro-Vangorda Haul Road. For reference purposes within this study, the drainages have been labelled as follows:

- RC, for the rock drain in the north fork of Rose Creek; and
- HR-1 to HR-9, for the nine additional drainages along the haul road.

Figure 1 shows the locations of these ten drainages in plan view. Their locations relative to the Rose Creek rock drain, assuming the rock drain corresponds to kilometre 0, are also provided on the plan. Appendix A contains photos from nine of the ten drainages (there are no photos for HR-9). A table showing the embankment height, excavation or breach volume (calculated using GEMCOM software on the basis of certain excavation criteria) and information on the stream at each drainage location, is provided in the top right corner of Figure 1. For the RC drainage, two excavation options were assessed: one with a 10 m wide base and the other with a 25 m wide base. It is assumed that the 25 m wide base is most appropriate relative to pre-mining conditions but a 10 m wide base could be acceptable, subject to input on issues such as fisheries and peak flows in the north fork of Rose Creek.

A modified version of the table in Figure 1 is provided below.

**Table 2.1: Summary of Estimated Excavation Volumes by Drainage**

Drainage	Embankment Height (m)	Embankment Volume (m <sup>3</sup> )	% of Total Excavated Volume
RC25	56	721,576	72.1%
HR-8	30	159,653	15.9%
HR-1	8	7,871	0.8%
HR-2	6.7	6,449	0.6%
HR-9	7.5	8,755	0.9%
HR-3	10.8	12,582	1.3%
HR-4	14.9	28,688	2.9%
HR-5	19.5	42,917	4.3%
HR-6	5.8	4,189	0.4%
HR-7	7.9	8,543	0.9%
Total <sup>1</sup>		1,001,223	100%
Mean	16.7		

Table 2.1 demonstrates that most of the fill excavation that would be required is associated with the RC and HR-8 drainages. In fact, based on a 25 m basal excavation width at the RC drainage, approximately 880,000 m<sup>3</sup>, or 88% of the total volume of potentially excavated material in the ten drainages (1,001,000 m<sup>3</sup>) are linked to the RC and HR-8 drainages. This information is illustrated graphically in the lower left corner of Figure 1.

For purpose of this study, three drainages were selected for detailed analysis:

- the Rose Creek Rock Drain (RC) based on a 25 m basal excavation with;
- HR-8 based on a 5 m basal excavation width; and
- HR-3 based on a 5 m basal excavation width.

The sites were selected with a view to evaluating the range of deconstruction requirements and reclamation quantities. Each of the three sites were evaluated on the basis of material quantities derived from excavation concepts and site specific assumptions related to equipment, access roads and dump sites. The unit costs were selected from the cost data base used in the development of site wide closure options (SRK, 2008).

Based on the analytical results from these three sites, an interpolative approach was then used to assess the excavation costs associated with the other seven drainages.

## 3 Detailed Methodology and Assumptions

### 3.1 Cost Estimate Calculation Methodology

A construction fleet was selected based on judgement relative to the site conditions and, for the Rose Creek and HR-8 drainages, a fall/winter season of six months. It has been assumed that, at least for these two drainages, the work would be done in winter to mitigate concerns over sediment and potential impacts on local fisheries habitat.

For each of the selected drainages, the construction tasks have been listed as major activities that are required for each stage of construction. The corresponding quantities for each task were calculated using GEMCOM software. Excavation unit rates were calculated from load, haul, dump and place (LHDP) principles, with site specific assumptions for hauling distance and grade. Other unit rates were calculated from published data and assumed task productivities.

Productivities were assigned based on SRK in-house experience with recent construction projects in similarly remote areas. Hourly equipment rates were based on the rates provided in the report that discusses the site wide closure options (SRK, 2008).

### 3.2 Equipment

It was assumed that all construction equipment would be mobilized and demobilized from Whitehorse for the deconstruction works in each drainage. Only the equipment needed for any given season would be mobilized. However, at peak construction, the following fleet is anticipated:

- Three CAT 740 Rock Trucks;
- CAT 330 and 350 Excavators;
- CAT D9 Dozer; and
- One pickup truck.

A hydro-seeding truck would also be needed, but it is likely it would not be on site until the deconstruction works at each drainage are completed.

The equipment sizes listed above have been selected to ensure adequate productivities. However, due to the fact that the working areas are relatively constrained, experience-based judgement was also used to select equipment that would be well suited to the site specific conditions.

The CAT 740 Rock Trucks have been selected for their manoeuvrability. Larger trucks could be used for deconstruction, but our experience indicates that it is better to select slightly smaller trucks that have higher manoeuvrability and general availability for work. The 350 excavator and the D9 dozer have been selected based on their capacities and their general availability within the Yukon. The smaller 330 excavator has been selected for detailed work such as sediment pond construction

and culvert removal. The pickup truck has been selected for the labourer and spotter to use around the site for the installation of sediment control structures and for managing truck traffic. The hydro-seeding truck would be mobilized for re-vegetation when the earthworks at each drainage are completed.

Small equipment rental, installation and consumables costs have been built into the larger unit costs. All heavy equipment is assumed to be available for the construction at the specified cost listed in the site wide closure options report (SRK, 2008). Some small equipment costs have been selected on the basis of the 2008 B.C. Blue Book.

### **3.3 Manpower**

It is assumed that the work will be undertaken using multiple shifts, so that work will proceed 24 hours per day, 7 days per week for the duration of construction. The cost estimate accounts for the required size of the work crew needed for the construction, including technicians and engineers. Monitoring and environmental personal are not included in this cost estimate, nor is there an allowance for food and lodging for project-related personnel.

### **3.4 Earthworks and Excavation Criteria**

It is assumed that the deconstruction works on the haul road will start at the west end, at the Faro side of the FMC, and move 'one drainage at a time' to the east. However, the sequence could also be east to west or the work could start near the middle and then proceed sequentially to the east and west ends. Whatever sequence is selected, it will be essential to maintain access based on the existing roads.

The overall slope of the waste rock fill on either side of the breach is assumed to be 2 horizontal to 1 vertical (2H:1V). This slope has been selected on the basis of a 1.5H:1V angle of repose for the waste rock.

The minimum base width of each drainage channel has been taken as 5 m, except for the RC drainage. The north fork of Rose Creek is a major perennial creek and it is expected that a 25 m base width may be necessary at RC. However, as noted previously, and subject to input from other technical disciplines, it may be reasonable to reduce the base width to as low as about 10 m. Post-closure, light vehicle access across these drainages is considered feasible only in winter months or low flow periods.

The deconstruction method of the embankments will be a combination of excavation and dozer breach. Excavation will be done in 5 m deep bench cuts. Temporary haul roads will be constructed on 10 m vertical increments to simultaneously service two benches and thereby minimize temporary road construction. Safety berms should be considered pending the development of the detailed construction method by the Contractor. The hauling distance and slope length will vary slightly for each bench cut. The overall distance and grade do not affect cycle time significantly or lead to changes in the number of haul trucks.

The material near the bottom of the embankments which are less than 10 m in height will probably be removed by dozer methods because of limitations related to truck manoeuvrability. The dozer will also complete the final slope grade on either side of the drainage and will decommission all temporary haul roads related to the deconstruction process.

Drainages that require haul and dump operations will have a dump site identified at the nearest possible location. It is assumed that all the material removed from the excavation, including the culvert, can be buried inside the respective dump site. Each dump site, breached area and area of disturbance will be reclaimed by hydro-seeding, which should eliminate the potential need for topsoil haulage.

It is assumed the dump locations identified in this study are suitable and that permits for closure purposes will be obtainable.

#### **3.4.1 Breaching Details for Rose Creek**

The dump area for deconstruction of the RC drainage is approximately 450 m away and has sufficient capacity to hold all material from the breach. After the breach is completed, all the temporary haul roads and disturbed areas will be re-graded for closure and hydro-seeded. The breach is estimated to require 205 days of hauling to remove all the designated material. Figure 2 shows the proposed breach layout.

#### **3.4.2 Breaching Details for HR-8**

The dump areas for deconstruction of the HR-8 drainage are approximately 650m away. Three different areas have been identified to accommodate all the material removed from the drainage. The breach is estimated to require 47 days of hauling to remove the designated material. Figure 3 shows the proposed breach layout.

#### **3.4.3 Breaching Details for HR-3**

There is no proposed dump area for the deconstruction of the HR-3 drainage because the proposed removal will be done solely by dozer breach. The breach is estimated to require 19 days of dozer time. Figure 4 shows the estimated area of disturbance associated with the breach.

### **3.5 Sediment Control**

Sediment controls, such as silt fences and sedimentation ponds, will be installed downstream of the construction areas. The cost of silt fences has been estimated on the basis of a quote from the Layfield Group. The cost of sedimentation ponds has been estimated as a unit cost of \$50,000 each. The final design of the sedimentation ponds will require engineering that accounts for grain size distribution of the waste rock, precipitation and catchment areas.

An option for the RC drainage that was not specifically explored as part of this study is the potential use of the three sediment ponds at the site of the former fresh water pump house. These ponds

would likely have to be upgraded, but it is possible they could provide a cost effective option to sediment control below the RC drainage.

Another sediment control option that could be implemented is to pump and pipe water around the deconstruction areas. This approach would be best suited to the low flow periods the site typically experiences in August and September. However, in the event this approach is given serious consideration, it would be appropriate to acquire flow data suitable for use in the design of the respective pump and piping system.

### **3.6 Quantities**

Construction quantities have been modeled and calculated using GEMCOM software. A bulking factor of 1.25 has been applied to the banked volume calculated by GEMCOM. The bulked volumes are used in the cost estimate for LHDP. The assumed disturbed areas have been calculated using the 3D surface from the software. The footprints of the dump sites have been modeled with banked cubic volume, as it is assumed that the truck traffic will compact the material.

## 4 Costs Calculated for Selected Drainages

### 4.1 Summary

The estimated costs for reclamation of drainages RC, HR-8 and HR-3 are summarized in Table 4.1 below. The detailed breakdowns of these estimated costs are presented in Table 4.2 and are based on the following assumptions:

- Construction is assumed to occur during 6 month intervals that span the fall/winter period. No specified start year is provided.
- The estimated costs are based on 2008 data. Net present value corrections have not been applied.
- No taxes have been included in these costs.
- The indirect costs include the survey and engineering costs, as well as a 20% contingency on all other costs.

**Table 4.1: Summary of Estimated Reclamation Costs for RC, HR-8 and HR-3 Drainages**

<b>Task</b>	<b>Sub-Total</b>	<b>Total</b>
<b><i>Rose Creek Drainage</i></b>		<b>\$ 7,175,000</b>
- Mob/Demob	\$ 133,000	
- Pre-Construction	\$ 306,000	
- Road Breach	\$ 5,004,000	
- Post-Construction	\$ 64,000	
- In-Directs	\$ 1,668,000	
<b><i>HR-8 Drainage</i></b>		<b>\$1,981,000</b>
- Mob/Demob	\$ 133,000	
- Pre-Construction	\$ 145,000	
- Road Breach	\$ 1,220,000	
- Post-Construction	\$ 26,000	
- In-Directs	\$ 457,000	
<b><i>HR-3 Drainage</i></b>		<b>\$ 218,000</b>
- Mob/Demob	\$ 44,000	
- Pre-Construction	\$ 104,000	
- Road Breach	\$ 15,000	
- Post-Construction	\$ 4,000	
- In-Directs	\$ 51,000	

**Table 4.2: Detailed Breakdown of Reclamation Costs for RC, HR-8 and HR-3**

Task	Item	unit	quantity	unit rate	total	Task Sub-Total
<b>RC</b>						<b>\$ 7,175,000</b>
<b>MOB/DEMOB</b>						<b>\$ 133,000</b>
	Mobilization	unit	1	\$ 66,398.30	\$ 66,398	
	Demobilization	unit	1	\$ 66,398.30	\$ 66,398	
<b>PRE-CONSTRUCTION</b>						<b>\$ 306,000</b>
	LHDP Elev 1135m Construction Haul Road to Dump site	m <sup>3</sup>	16,860	\$ 5.73	\$ 96,628	
	LHDP Elev 1125m Construction Haul Road to Dump site	m <sup>3</sup>	16,790	\$ 5.73	\$ 96,227	
	Regrade Elev 1115m Construction Haul Road from old road	m <sup>3</sup>	270	\$ 5.73	\$ 1,547	
	Regrade Elev 1105m Construction Haul Road from old road	m <sup>3</sup>	783	\$ 5.73	\$ 4,488	
	Regrade Elev 1095m Construction Haul Road from old road	m <sup>3</sup>	833	\$ 5.73	\$ 4,774	
	Install Silt Fences	m	200	\$ 7.61	\$ 1,523	
	Install Sedimentation Pond	unit	2	\$ 50,000.00	\$ 100,000	
<b>ROAD BREACH</b>						<b>\$ 5,004,000</b>
	Excavate Haul Road fill down to Elev. 1135m	m <sup>3</sup>	157,561	\$ 5.73	\$ 903,012	
	Excavate Haul Road Fill down to Elev. 1125m	m <sup>3</sup>	179,614	\$ 5.73	\$ 1,029,399	
	Excavate Haul Road Fill down to Elev. 1115m	m <sup>3</sup>	193,339	\$ 5.73	\$ 1,108,060	
	Excavate Haul Road Fill down to Elev. 1105m	m <sup>3</sup>	179,969	\$ 5.73	\$ 1,031,434	
	Excavate Haul Road Fill Down to Elev. 1095m	m <sup>3</sup>	139,106	\$ 5.73	\$ 797,243	
	Dozer Breach Leftover material	m <sup>3</sup>	52,401	\$ 0.19	\$ 10,063	
	Remove Rock Drain	m <sup>3</sup>	15,000	\$ 8.30	\$ 124,550	
<b>POST-CONSTRUCTION</b>						<b>\$ 64,000</b>
	Dress Haul Road Side Slopes	m <sup>2</sup>	30,164	\$ 0.19	\$ 5,792	
	Redress construction Haul Roads	m <sup>2</sup>	16,825	\$ 0.19	\$ 3,231	
	Revegetation on the overall disturbed areas	m <sup>2</sup>	101,244	\$ 0.54	\$ 54,672	
<b>IN-DIRECTS</b>						<b>\$ 1,668,000</b>
	Engineering	%	10%		\$ 537,400	
	Survey	hr	224	\$ 130.00	\$ 29,120	
	Contingency	%	20%		\$ 1,101,400	
<b>HR-8</b>						<b>\$ 1,981,000</b>
<b>MOB/DEMOB</b>						<b>\$ 133,000</b>
	Mobilization	unit	1	\$ 66,398.30	\$ 66,398	
	Demobilization	unit	1	\$ 66,398.30	\$ 66,398	
<b>PRE-CONSTRUCTION</b>						<b>\$ 145,000</b>
	Clear temporary haul foot print	m <sup>2</sup>	1,177	\$ 4.17	\$ 4,912.01	
	Establish Haul Roads to Dump sites	m <sup>3</sup>	6,610	\$ 5.73	\$ 37,883.12	
	Install Silt Fences	m	200	\$ 7.61	\$ 1,522.88	
	Install Sedimentation Pond	unit	2	\$ 50,000.00	\$ 100,000.00	
<b>ROAD BREACH</b>						<b>\$ 1,220,000</b>
	Excavate Haul Road Fill down to Elev. 1175m	m <sup>3</sup>	175,368	\$ 5.73	\$ 1,005,063	
	Excavate Road Fill down to bottom of Creek	m <sup>3</sup>	24,199	\$ 5.73	\$ 138,687	
	Dozer Breach Leftover material	m <sup>3</sup>	0	\$ 0.19	\$ -	
	Remove Rock Drain	m <sup>3</sup>	10,000	\$ 7.61	\$ 76,144	
<b>POST-CONSTRUCTION</b>						<b>\$ 26,000</b>
	Dress Side Slopes	m <sup>2</sup>	14,866	\$ 0.19	\$ 2,855	
	Redress construction Haul Roads	m <sup>3</sup>	6,089	\$ 0.19	\$ 1,169	
	Revegetation	m <sup>2</sup>	40,183	\$ 0.54	\$ 21,699	
<b>IN-DIRECTS</b>						<b>\$ 457,000</b>
	Engineering	%	10%		\$ 139,100	
	Survey	hr	94	\$ 130.00	\$ 12,220	
	Contingency	%	20%		\$ 304,800	
<b>HR-3</b>						<b>\$ 218,000</b>
<b>MOB/DEMOB</b>						<b>\$ 44,000</b>
	Mobilization	unit	1	\$ 21,758.60	\$ 21,759	
	Demobilization	unit	1	\$ 21,758.60	\$ 21,759	
<b>PRE-CONSTRUCTION</b>						<b>\$ 104,000</b>
	Install Silt Fences	m	450	\$ 7.61	\$ 3,426.48	
	Install Sedimentation Pond	unit	2	\$ 50,000.00	\$ 100,000.00	
<b>ROAD BREACH</b>						<b>\$ 15,000</b>
	Dozer Breach material to top of culvert	m <sup>3</sup>	15,728	\$ 0.19	\$ 3,020.20	
	Remove Culvert	hr	12	\$ 167.95	\$ 2,015.40	
	Cleared up channel slope at bottom of crossing	m <sup>3</sup>	3,000	\$ 3.11	\$ 9,341.25	
<b>POST-CONSTRUCTION</b>						<b>\$ 4,000</b>
	Dress Side Slopes	m <sup>2</sup>	2,572	\$ 0.19	\$ 493.91	
	Revegetation	m <sup>2</sup>	6,000	\$ 0.54	\$ 3,240.00	
<b>INDIRECT</b>						<b>\$ 51,000</b>
	Engineering	%	10%		\$ 12,300	
	Survey	hr	38	\$ 130.00	\$ 4,940	
	Contingency	%	20%		\$ 33,400	

## 4.2 Key Items of Cost Uncertainty

There are several items which are subject to uncertainty beyond what would be considered normal for a cost estimate at the level commensurate with this study. In particular, these items correspond to potential changes and unknowns which might affect the presented cost estimates.

One of the items is related to the review and monitoring of the deconstruction activities. In conjunction with the breaching of the Faro Fresh Water Storage Dam several years ago, numerous reviews were undertaken by various parties over the course of planning and permit approval. These reviews added significantly to the overall cost of the project. The current cost estimates do not allow for the permitting procedure and related costs.

Another item of significant uncertainty is the sediment control measures that may be required. This study assumes that most of the work will occur in the fall/winter season, when flows in the creeks and drainages are low or, in some cases, absent. In addition, each of the dump areas has an adequate buffer zone for sediment to settle naturally before reaching the nearest creek. However, since the gradation distribution and related classification testing on the waste rock material has not been done, it is premature to predict with confidence the specific requirements for sediment control. If additional or more sophisticated sediment ponds are required, the costs for sediment control could increase significantly.

One of the closure options for the Rose Creek tailings impoundment is for the tailings to remain in place and for a complex (i.e. multi-layer) cover to be placed over the tailings. In the event this option is selected, the details of the cover will be determined as part of the final engineering design. However, a large quantity of material would be required for this cover and it is likely that the cover volume will be of the same order of magnitude as the volume of material that will be removed from the combined RC and HR-8 drainages. The RC drainage is of particular interest since the rock drain at this drainage is comprised of waste rock that is relatively inert geochemically. In the event that substantial portions of the material removed from one or both of these drainages are used as cover material, there would be an incremental cost of hauling this material. On the other hand, there could be a reduction in the cost of providing “new” cover material for the tailings impoundment. In any case, this variant to the hauling costs has not been calculated as part of this study.

## 5 Interpolation of Costs at Other Drainages

For expediency, the reclamation cost estimates developed at three drainages in accordance with the methods described in Section 3 have been used to interpolate the reclamation costs at the remaining seven sites (HR-1, HR-2, HR-4 through HR-7 and HR-9). The following points form the basis of this interpolation.

- The graph on Figure 1 indicates that suggests that correlation between the height of the waste rock embankment and the embankment volume is approximately linear below an embankment height of 20 m. This is shown more clearly on Figure 5. The trend line curves to account for areas where the embankment height is greater than 20 m (RC and HR-8), as shown on Figure 1.
- Figure 6 shows the correlation between unit cost of reclamation (which is primarily the cost of deconstruction, and has been calculated by dividing the reclamation cost by the embankment volume at drainages RC, HR-8 and HR-3) and the embankment height. The relationship follows a “power series” trend line and, as one would expect, the unit cost for reclamation is less at locations where the embankment is higher, primarily due to the efficiencies of handling larger volumes of material. The data point at a height of 5.8 m in Figure 6 corresponds to HR-6, the cost of which was selected to provide an optimum fit to the “power series” trend line defined by RC, HR-8 and HR-3. Therefore, this data point is actually an extrapolation and the unit cost, shown as \$21.50 on Figure 6, could conceivably be lower by \$2 or \$3. However, as discussed below, the impact of breaching the embankment where the embankment height is less than 20 m is relatively modest due to the correspondingly small embankment volumes.

The curve in Figure 6 has been used to provide an estimate of the unit costs of reclamation as a function of embankment height. The unit reclamation costs for HR-1, HR-2, HR-7 and HR-9 have been interpolated between the selected unit cost for HR-6 and the calculated unit cost for HR-3. Similarly, the unit reclamation costs for HR-4 and HR-5 have been interpolated between the unit costs for HR-3 and HR-8. The selected values have then been multiplied by the embankment volume at the respective drainage (Table 2.1) to obtain an estimate of the total reclamation cost at each drainage. The results are summarized in Table 5.1.

**Table 5.1: Summary of Total Estimated Reclamation Costs for the Haul Road**

<b>Drainage</b>	<b>Calculated Cost</b>	<b>Calculated Cost per Unit Volume</b>	<b>Interpolated Unit Cost</b>	<b>Embankment Volume (m<sup>3</sup>)</b>	<b>Interpolated Cost</b>	<b>Total Estimated Cost</b>
RC25	\$ 7,175,000	\$ 9.94				\$ 7,175,000
HR-8	\$ 1,981,000	\$ 12.41				\$ 1,981,000
HR-1			\$ 19.20	7,871	\$ 151,123	\$ 151,123
HR-2			\$ 20.20	6,449	\$ 130,270	\$ 130,270
HR-9			\$ 19.70	8,755	\$ 172,474	\$ 172,474
HR-3	\$ 218,000	\$ 17.33				\$ 218,000
HR-4			\$ 15.60	28,688	\$ 447,533	\$ 447,533
HR-5			\$ 14.20	42,917	\$ 609,421	\$ 609,421
HR-6			\$ 21.50	4,189	\$ 90,064	\$ 90,064
HR-7			\$ 19.30	8,543	\$ 164,880	\$ 164,880
	<u>\$ 9,374,000</u>				<u>\$ 1,765,764</u>	<u>\$ 11,139,764</u>

## 6 Summary of Total Estimated Costs

The summary of reclamation costs, including the costs from both quantity-based calculations (Section 3) and the interpolated costs (Section 5) is provided in Table 5.1. Based on these values, the total estimated cost of reclamation at the Faro-Vangorda Haul Road is \$11.1 million.

As noted above, there is a higher level of uncertainty with respect to the reclamation of drainages based on interpolated costs (HR-1, HR-2, HR-4 to HR-7 and HR-9) than there is for the reclamation of drainages based on actual estimates of reclamation quantities (RC, HR-8 and HR-3). However, it is important to view this uncertainty in the context of its potential significance. Drainages RC, HR-8 and HR-3 represent about 89% of the embankment volume that will have to be removed and about 84% (\$9.4 million) of the total estimated cost of reclamation (\$11.1 million). Therefore, even if there were significant errors in the interpolated reclamation costs at drainages HR-1, HR-2, HR-4 to HR-7 and HR-9 (\$1.8 million), the impact on the total estimated cost of reclaiming the haul road would likely be quite small (well under \$1 million). Furthermore, these potential differences probably will almost certainly be immaterial relative to the project-wide cost of reclaiming the FMC. For this reason, and given the current status of the closure plan selection and approval process, the reclamation cost estimate provided in Table 5.1 is considered adequate. More rigorous cost estimates will be required as the selection and approval process moves forward.

This report, “**Anvil Range Mining Complex, Faro-Vangorda Haul Road Closure Cost Estimate: 2007/08 Task 20b - FINAL**,” was prepared by SRK Consulting (Canada) Inc.

**Prepared by**

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Alvin Tong, E.I.T.  
Geotechnical Engineer

**Reviewed by**

ORIGINAL SIGNED  
AND STAMPED

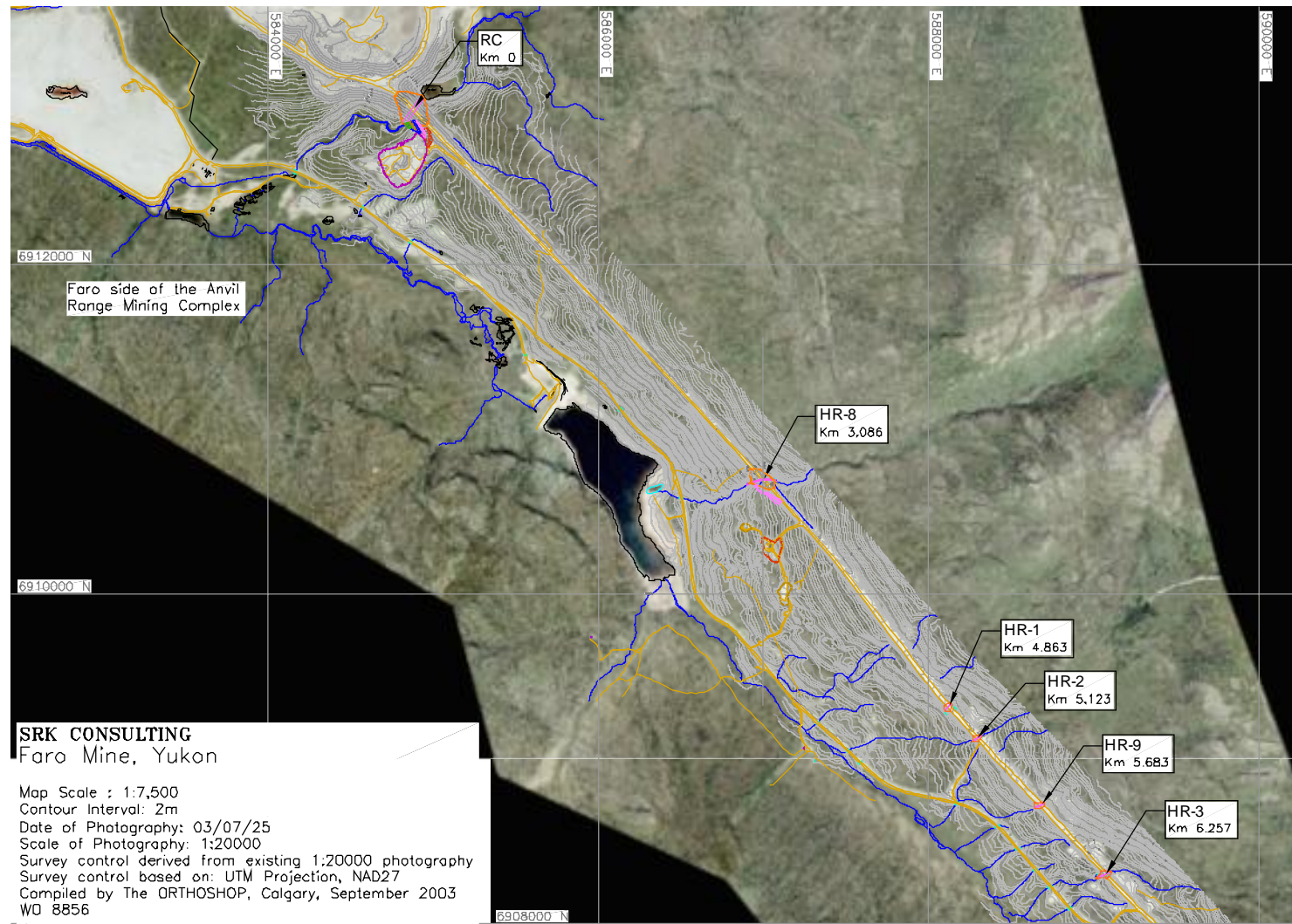
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Cameron Scott, P.Eng.  
Principal Engineer

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B.C. Road Builders & Heavy Construction Association, 2008. The Blue Book Equipment Rental Rate Guide.

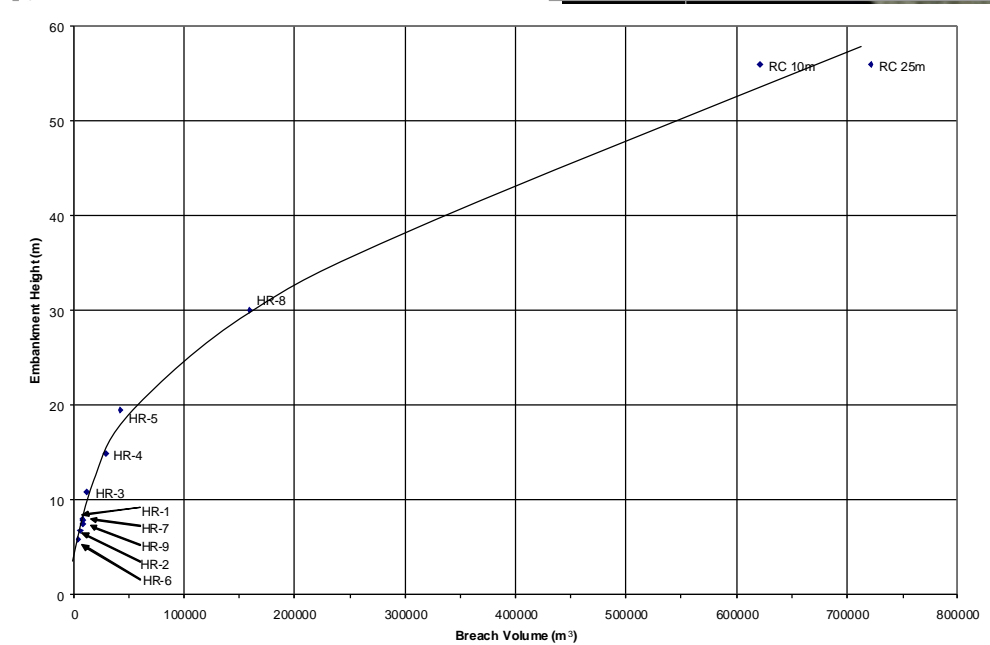
SRK Consulting, 2008. Options for Closure of the Faro Mine Complex. Report prepared for Indian and Northern Affairs Canada and Yukon Government. February 2008.

**Figures**

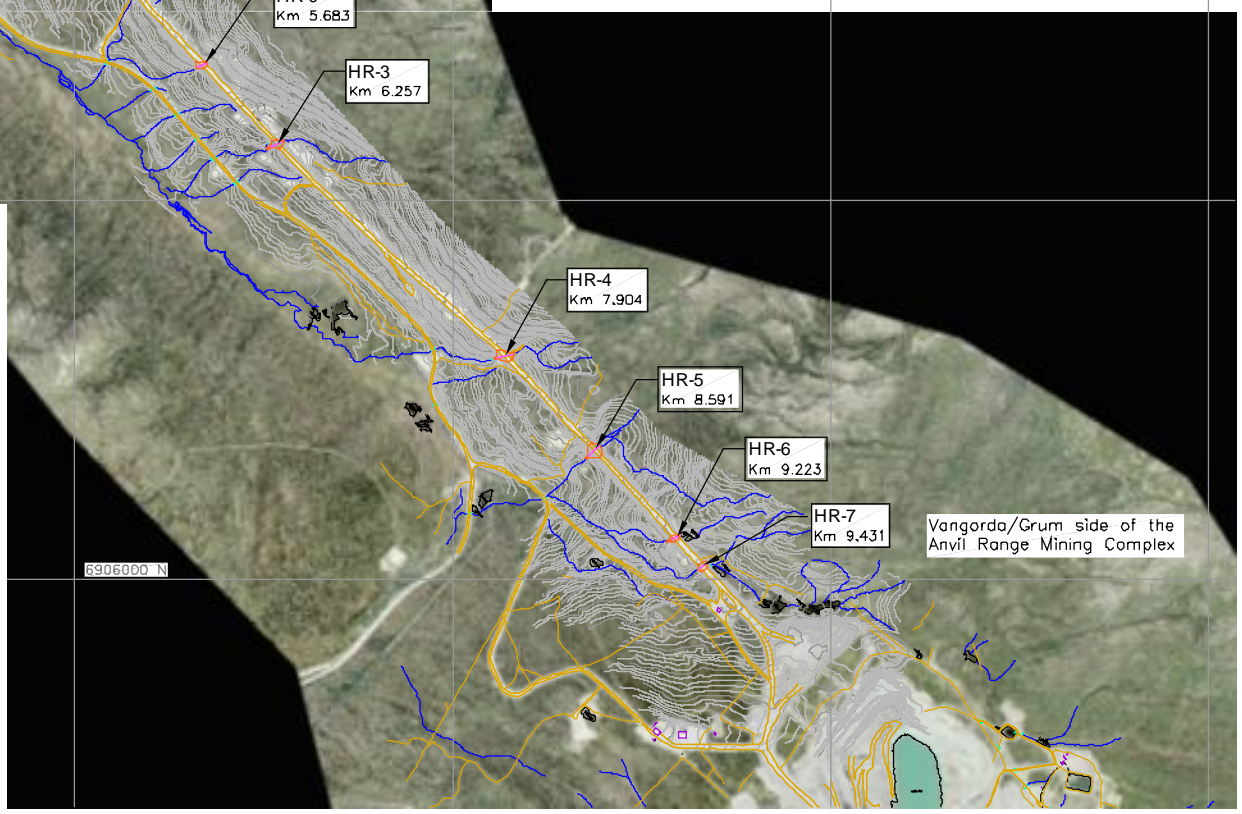


**SRK CONSULTING**  
Faro Mine, Yukon

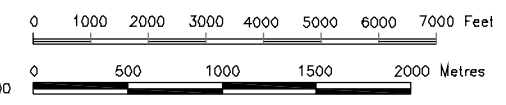
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Scale of Photography: 1:20000  
Survey control derived from existing 1:20000 photography  
Survey control based on: UTM Projection, NAD27  
Compiled by The ORTHOSHOP, Calgary, September 2003  
WD 8856



Identifier	Embankment Height (m)	Breach Volume (m <sup>3</sup> )	Culvert (yes or no)	Creek (perennial or ephemeral)	Other Remarks
RC 10m	56.0	620,803	N	P	Rose Creek Rock Drain assume 10m width at base of excavation
RC 25m	56.0	721,576	N	P	Rose Creek Rock Drain assume 25m width at base of excavation
HR-8	30.0	159,653	N	P	Water partially pooled on u/s side of road, large flow from d/s side
HR-1	8.0	7,871	Y	E	No evidence of culvert on d/s side (buried?); culvert bent and flattened on u/s side
HR-2	6.7	6,449	Y	P	2 culverts; flow through 1 culvert only. Doesn't appear as though all of the water is flowing through the culvert on the u/s side.
HR-9	7.5	8,755	N	?	Not observed in field.
HR-3	10.8	12,582	Y	P	2 culverts; flow through 1 culvert only.
HR-4	14.9	28,688	Y	P	2 culverts; flow through only 1 culvert only.
HR-5	19.5	42,917	Y	P	Long till cover over culvert on d/s side; rock-lined trench built up to culvert on u/s side
HR-6	5.8	4,189	?	E	No evidence of culvert. Ponded area on u/s side of road; trickling flow seeping from toe of haul road on d/s side.
HR-7	7.9	8,543	Y	P	Culvert partially buried on u/s side of road.



- Notes:
1. u/s = upstream; d/s = downstream.
  2. Inspection data obtained from site visit on Sep. 16, 2007.
  3. Embankment height is based on the haul road elevation and an interpolation between u/s and d/s toe elevations.
  4. Breach volumes are based on excavation to original grade. 5m wide breach width and 2H:1V side slopes.



DRAWING NO.	DRAWING TITLE	DRAWING NO.	DRAWING TITLE	NO.	DESCRIPTION	CHK'D	APP'D	DATE

PROFESSIONAL ENGINEER'S STAMP

**SRK Consulting**  
Engineers and Scientists

DESIGN: CS/MC    DRAWN: VY    REVIEWED: CS  
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**Deloitte & Touche**

FARO - VANGORDA

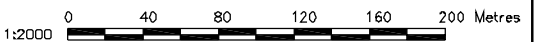
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Haul Road Reclamation Costs

DRAWING TITLE:  
Plan View of Haul Road and Potential Breach Locations

DRAWING NO.    SHEET    REVISION NO.  
Figure 1    -    A





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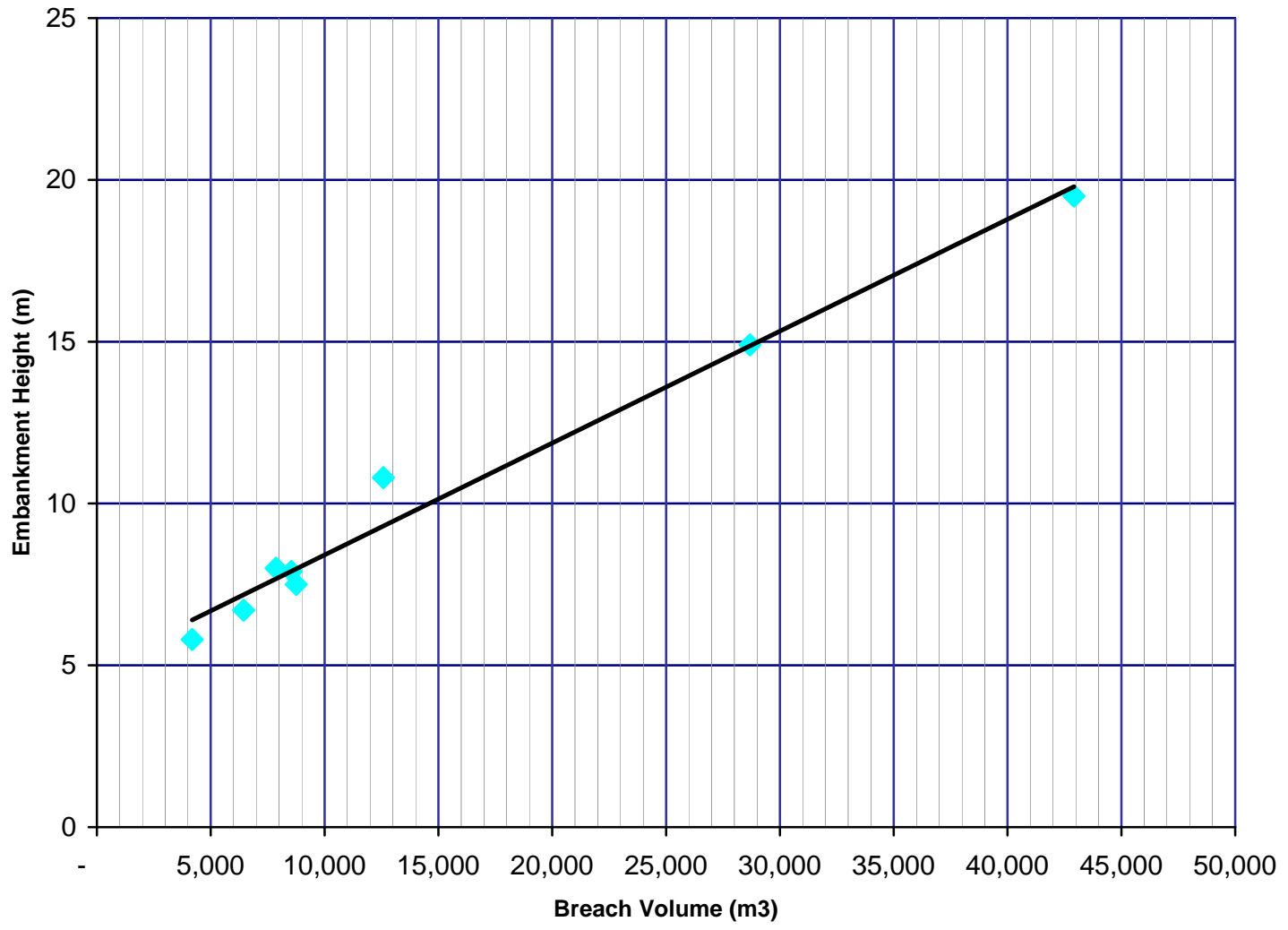
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FARO - VANGORDA

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Haul Road Reclamation Costs		
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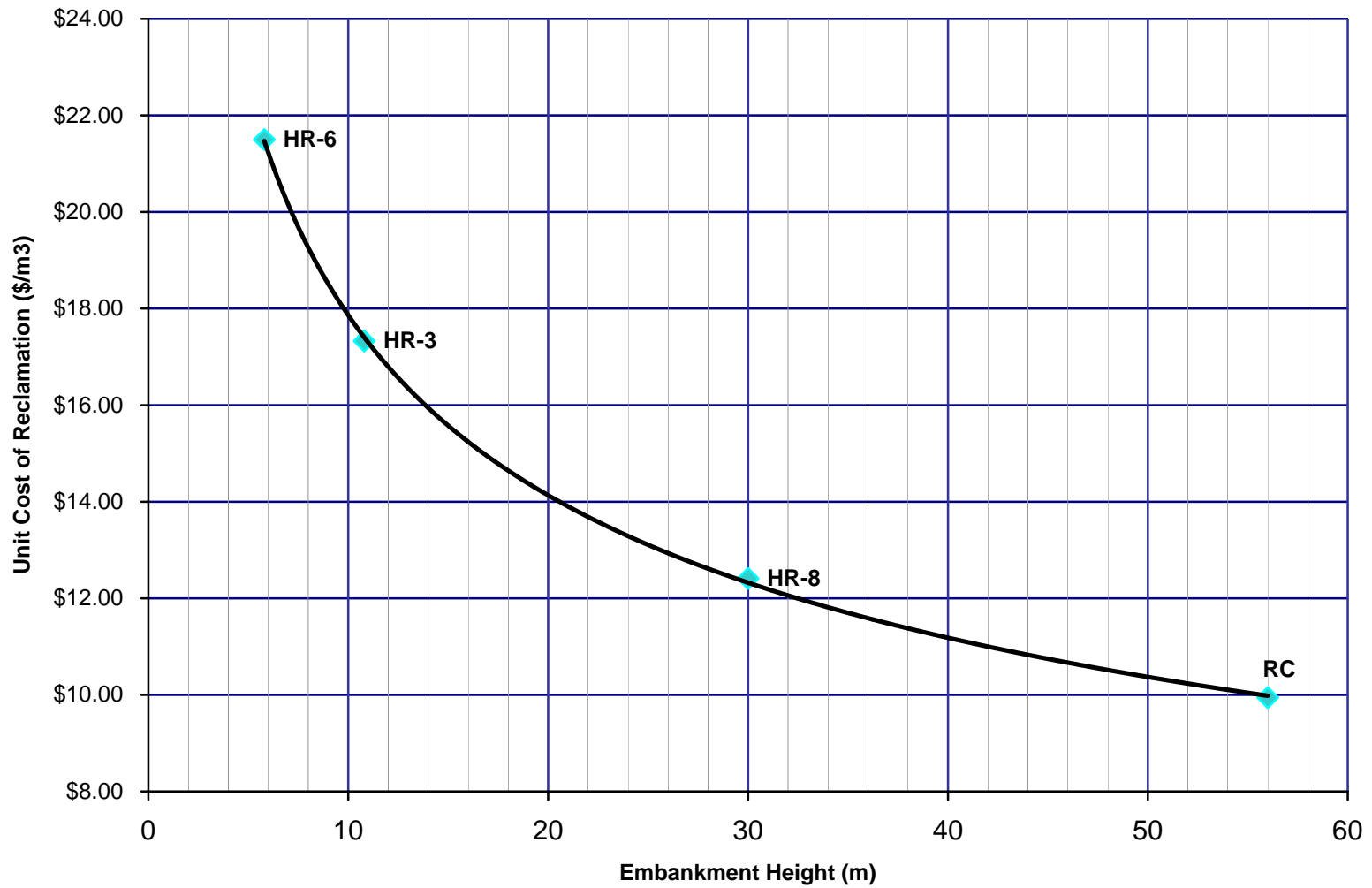


FARO - VANGORDA

Haul Road Reclamation Costs

**Relationship between Embankment Height and Breach Volume**

Date: May 2008	Approved: CCS	Figure: <b>5</b>
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Haul Road Reclamation Costs

**Relationship between Unit Cost of Reclamation and Embankment Height**

Job No: 1CD003.100  
File: Figures 5-6\_ht vs volume v2\_ck.xls

FARO - VANGORDA

Date:  
May 2008

Approved:  
CCS

Figure: **6**

**Appendix A**  
**Site Photographs**



Photo 1: RC drainage, showing water ponded upstream of the Rock Drain (May 24, 2004).



Photo 2: RC drainage area showing downstream face of the Haul Road (May 24, 2004).



Photo 3: RC drainage showing water discharging from the Rock Drain (May 24, 2004).



Photo 4: RC drainage showing area downstream of Rock Drain (May 24, 2004).



Photo 5: Water ponded upstream of the Rock Drain (June 22, 2006).



Photo 6: RC drainage showing water discharging from the Rock Drain (June 22, 2006).



Photo 7: Area on the downstream side of the Haul Road, immediately east of the RC Drainage (June 22, 2006).



Photo 8: Area on the downstream side of the Haul Road, immediately east of the RC Drainage (June 22, 2006).



Photo 9: Corrugated pipe at the inlet of HR-1 (Sept. 16, 2007).



Photo 10: Diffuse drainage at downstream toe area of HR-1 (July 7, 2008).

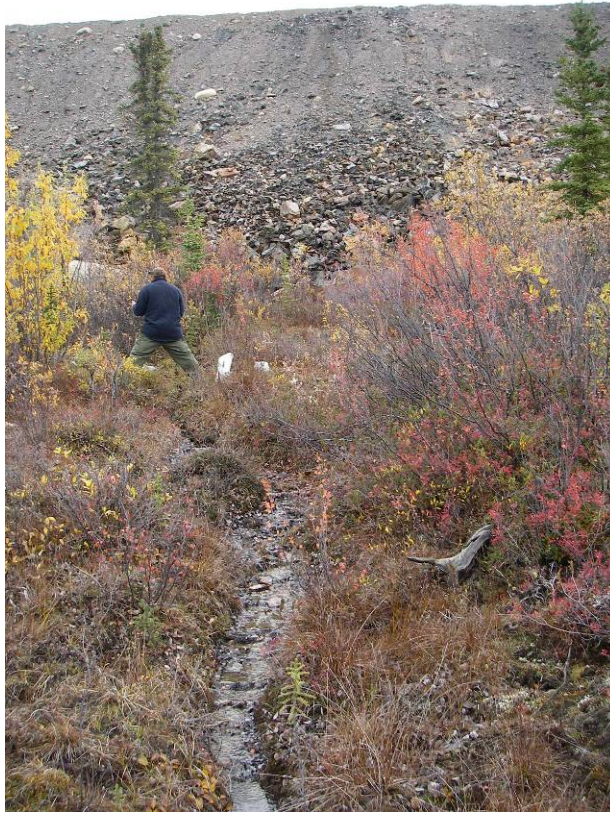


Photo 11: View towards Haul Road on downstream side of HR-1 (Sept. 16, 2007).



Photo 12: View away from Haul Road on downstream side of HR-1 (Sept. 16, 2007).



Photo 13: Looking towards two corrugated pipes at inlet of HR-2 (Sept. 16, 2007).



Photo 14: Corrugated pipes at inlet of HR-2 (Sept. 16, 2007).



Photo 15: Discharge at outlet of HR-2 (Sept. 16, 2007).



Photo 16: View away from Haul Road on downstream side of HR-2 (Sept. 16, 2007).



Photo 17: Area upstream of inlet to HR-3 (Sept. 16, 2007).



Photo 18: Corrugated pipes at inlet of HR-3 (Sept. 16, 2007).



Photo 19: Discharge at outlet of HR-3 (Sept. 16, 2007).



Photo 20: View away from Haul Road on downstream side of HR-3 (Sept. 16, 2007).



Photo 21: Area upstream of inlet to HR-4 (Sept. 16, 2007).



Photo 22: Corrugated pipes at inlet to HR-4 (Sept. 16, 2007).



Photo 23: Discharge at outlet of HR-4 (Sept. 16, 2007).



Photo 24: View away from Haul Road on downstream side of HR-4 (Sept. 16, 2007).



Photo 25: Area upstream of inlet to HR-5 (Sept. 16, 2007).

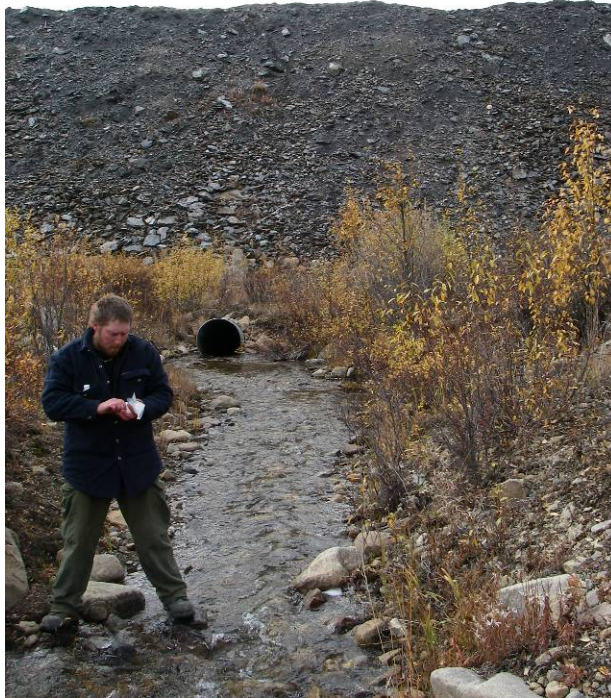


Photo 26: Corrugated pipe at inlet to HR-5 (Sept. 16, 2007).



Photo 27: Discharge at outlet of HR-5 (Sept. 16, 2007).



Photo 28: View away from Haul Road at downstream side of HR-5 (Sept. 16, 2007).



Photo 29: Poned water upstream of HR-06 (Sept. 16, 2007).



Photo 30: View towards Haul Road at inlet of HR-06 (Sept. 16, 2007).



Photo 31: Diffuse drainage at downstream toe area of HR-6 (July 7, 2008).



Photo 32: View away from Haul Road at downstream side of HR-6 (Sept. 16, 2007).



Photo 33: Area upstream of inlet to HR-7 (Sept. 16, 2007).



Photo 34: View of partially buried corrugated pipe at inlet to HR-7 (Sept. 16, 2007).



Photo 35: Discharge from corrugated pipe at outlet of HR-7 (Sept. 16, 2007).

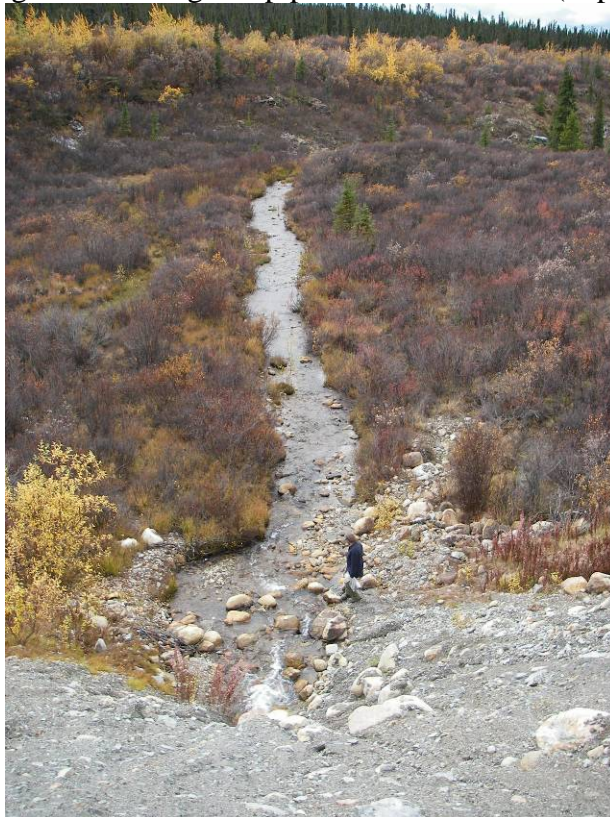


Photo 36: View away from Haul Road on downstream side of HR-7 (Sept. 16, 2007).



Photo 37: Area upstream of inlet to HR-8 (Sept. 16, 2007).



Photo 38: Pondered water at inlet to HR-8 (Sept. 16, 2007).

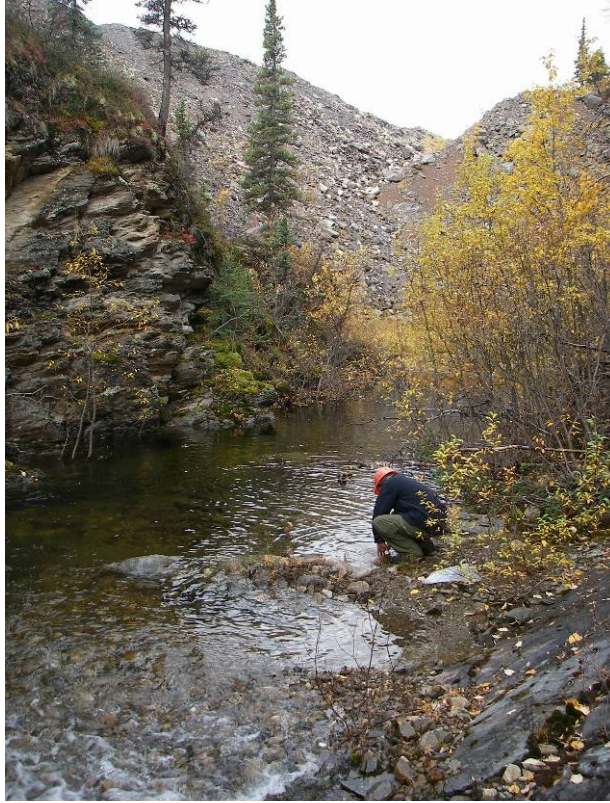


Photo 39: Discharge at outlet of HR-8 (Sept. 16, 2007).



Photo 40: View away from Haul Road at downstream side of HR-8 (Sept. 16, 2007).