Wolverine Project

ALL WEATHER ACCESS ROAD PLAN

VERSION 2006-01

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And
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1 Introduction

This report was prepared by Yukon Zinc Corporation (YZC) and Yukon Engineering Services Inc. (YES) with contributions from EBA Engineering Consultants Ltd. (EBA), AMEC Earth & Environmental (AMEC), and Klohn Crippen Berger (Klohn).

YZC retained YES to complete the route selection, preliminary design, geotechnical assessment, detailed design, tendering, construction management and quality assurance of the proposed all weather Access Road. YES retained the services of EBA to provide professional geotechnical evaluations of the route and sources, undertake a roadway geotechnical testing program, complete laboratory testing of samples taken along the route and from granular sources, and to provide construction recommendations resulting from their investigations and laboratory results. AMEC has developed the environmental (ARD/ML) testing protocol, and Klohn provided borrow source testing results.

Preliminary assessments of the access road alignment were conducted in 2005. Activities in 2005 also included biophysical and archaeological assessments as described in the *Wolverine Project Environmental Assessment Report* (YZC, 2005[1]). Detailed alignment layout and engineering will be completed, and additional fieldwork is required to finalize locations and detailed construction procedures. These details will be completed in June 2006, prior to project approval.

The following sections provide details pertaining to road design, stream crossing details, borrow sources, environmental and geotechnical testing protocols, traffic and access control measures, reclamation plans and cost estimates for the road and borrow sites, best management practices and mitigation measures for construction related activities, and construction monitoring plans.

2 All Weather Access Road

The project requires construction of a ~24 km long, all weather access road from the Robert Campbell Highway to the mine site. From the highway, the access road corridor follows the Light Creek and Chip Creek drainages before transitioning into the Go Creek drainage and the mine. The road design drawings are provided in Figure 1 and have been sealed by Paul J. Knysh, Yukon P.Eng. Cross-sections drawings at 25m intervals along the alignment are provided in Figure 2.

The access road will terminate near the proposed tailings facility. Continuation of the road to the industrial area has been classified as an existing site road and is not described within this report. The road will be a private, single lane road with passing bays, will have restricted access and will be operated under radio control. The road will be used year round with minimal load restrictions.

[1] Yukon Zinc Corporation, 2005. Wolverine Project Environmental Assessment Report. October 2005.

The proposed all weather access road alignment is or may be located on the Registered Quartz Mining Claims summarized in Table 2.1.

Table 2.1. Access Road Associated Quartz Mining Claims

Claim Name	Approximate km Location	Claim Name	Approximate km Location	Claim Name	Approximate km Location
Goalie 89	0	Goalie 260		Cup 15	
Goalie 102		Goalie 257	12	Puck 43	22
Goalie 100	1	Goalie 259		Cup 14	
Goalie 98		Money 12		Cup 13	
Goalie 96		Money 14		Puck 36	
Goalie 97	2	Money 13	13	Cup 11	
Goalie 94		Money 11		Cup 12	
Goalie 95		Money 2	14	Puck 34	
Goalie 93		Money 1		Puck 32	23
Goalie 292	3	Money 30		Puck 30	
Goalie 290		Money 29	15	Puck 28	24
Goalie 291		Goalie 306			
Goalie 289		Goalie 241			
Goalie 65	4	Goalie 239			
Goalie 63		Goalie 305			
Goalie 62		Goalie 240			
Goalie 60	5	Goalie 230	16		
Goalie 52		Goalie 232			
Goalie 50		Goalie 231			
Goalie 51	6	Goalie 233			
Goalie 48		Goalie 220			
Goalie 49		Goalie 219	17		
Goalie 47	7	Goalie 217			
Goalie 45		Goalie 215			
Goalie 43		Goalie 222	18		
Goalie 41	8	Goalie 213			
Goalie 40		Goalie 206			
Goalie 38		Goalie 205			
Goalie 39		Puck 71	19		
Goalie 36	9	Puck 69			
Goalie 37		Puck 70			
Goalie 35		Puck 67			
Goalie 34		Puck 68	20		
Goalie 32	10	Cup 19			
Goalie 33		Puck 59			
Goalie 30		Puck 61			
Goalie 31	11	Puck 62			
Goalie 29		Puck 47	21		
Goalie 258		Puck 45			

2.1 Road Design and Specifications

The design meets or exceeds Transportation Association of Canada (TAC) RLU 60 Single Lane Resource Road, (with inter-visible two lane sections) employing the standards summarized in Table 2.2.

Table 2.2. Transportation Association of Canada Single Lane Resource Road Standards

Desirable Minimum Curve Radii	170m
Minimum Curve Radii	150m
Minimum Switch-back Radii[2]	65m
Desirable Maximum Gradient[3]	8%
Minimum "k" Factor Crest	15
Minimum "k" Factor Sag	10
Single Lane Width	6m crowned @ 3%
Two Lane Width	8.5m crowned @ 3%
Super-elevation	Emax 8%
Minimum Culvert Diameter	600mm or Q^{100} whichever is greater
Culvert Installations	as per *YG 06010-1, -2, -3, -4, -5, -6, -7 (Appendix A)*
Clearing	Machine and Hand Clearing as per: *YG Sections 03010, 03011 (Appendix A)* to 15m either side minimum, or 3m beyond cuts (tree root protection), 6m beyond fills (access to reclaim stripping), whichever is greater.
Surfacing Aggregate	300mm as per *YG Section 04060 (Appendix A)*
Sideslopes (fill)	2H:1V ratio (except as geotechnically modified) 1.5H:1V ratio, where safety berms are employed
Backslopes (earth cut)	1.5H:1V ratio (except as geotechnically modified)
Backslopes (rock cut)	0H:1V ratio (except as geotechnically modified)
Ditch Depth	1m
Ditch Type	"V" Ditch, with widenings for side-borrow.
Safety Berms	0.75m Ht. where Fills > 10m, or where downhill side hazard requires. Roadbed widened 1.5m to accommodate.
Compactive Density	95% Standard Proctor (Embankment) 98% Standard Proctor Density (Surfacing Aggregate and culvert bedding/backfill)

[2] Utilized in 2 situations: Bunker Ck. at km 10.4, to avoid a beaver dam, and at km 13.1, to avoid two stream crossings and for economic considerations.

[3] TAC recommends maximum gradients of 12% in mountainous terrain, and 10% in semi-mountainous terrain. 8% was selected for safety, erosion control and reduced operating costs. 10% grades were required at km 10.4 for bridge approaches at Bunker Ck., which requires traffic to slow regardless.

As noted previously, the road design is not approved for construction purposes, (tender-level drawings only) pending geotechnical investigations. This is not atypical; all assessments to date have been completed using low impact measures, suiting the level of investigation required using systematic development planning. This approach allows for superior and timely planning of subsequent investigations and designs. For example, designs have been based on topography derived from satellite imagery: eliminating the need for premature clearing; and air photo interpretation of soils conditions: eliminating the need for premature clearing and test-pitting.

Route selection is based on prior hydrology studies, stream data collection, terrain analyses and air photo interpretation of soils conditions, and by hand sample truthing of the mapped interpretations. Air photo and satellite imagery interpretation have been completed and/or assessed by:

- *Surface Geology, Soils and Associated Interpretations. Wolverine Biophysical Surveys* (Mougeot Geoanalysis 1996)
- Axys Environmental Consulting Ltd. (satellite imagery interpretation of *Surficial Materials Distribution*)
- Jack Dennett, P.Geol., EBA Engineering Consultants Ltd. (air photo interpretation)
- Paul J. Knysh, P.Eng., Yukon Engineering Services Inc. (air photo interpretation)

The route is “final”, within acceptable uses of the term, pending proper geotechnical investigations. The alignment is suitable for physical confirmation of soils types and conditions. The alignment is fixed within a defined corridor of 200m in width, except at controlling stream crossings listed in Table 2.3, where the alignment is considered final at its present location to within the accuracy of the imagery-based topography (+/-10m). Stream crossing details are also provided in both Figure 1 (Plan/Profile Sheets) and Figure 2 (Design Cross Sections).

Table 2.3. Controlling Stream Crossings Along the Road Alignment

Creek Crossing	Figure 1 Dwg #	km Location	Latitude	Longitude	Structure Type
Light	"km 3"	3.03	61° 28’ 46.8”	129° 53’ 33.5”	1600mm Dia. CSP*
Pitch	"km 1.5"	2.89	61° 28’ 50.1”	129° 53’ 32.1”	2400mm Dia. CSP*
Bunker	"km 9"	10.39	61° 25’ 21.6”	129° 56’ 01.6”	20m Bridge**
Chip	"km 15"	15.11	61° 24’ 00.3”	129° 59’ 25.2”	1400mm Dia. CSP***
Hawkowl	"km 22.5"	23.19	61° 24’ 00.4”	130° 03’ 49.8”	1000mm Dia. CSP*
*	CSP = Corrugated Steel Pipe Helical Culvert. All diameters shown are "minimum anticipated", and are subject to further field confirmation.				
**	Figure 1 shows a SPCSP **or** 20m Bridge. A bridge is planned.				
***	Fluming is indicated in Figure 1. This will be confirmed following detailed topographic surveys.				

All culverts in fish-bearing streams will also incorporate the requirement to permit fish passage.

All other surface drainages encountered during assessment activities were observed to be undefined or ephemeral channels. These surface drainage and overland runoff will be controlled with ditches along the upslope side of the road that will connect to culverts installed at regular intervals. Culverts will be sized to local hydrological conditions and will consider factors such as icing potential.

Confirmation of soils types and conditions will be by way of a the road geotechnical investigation *(See Section 5).*

The road construction contract is currently being tendered to qualified contractors. All bidders have been instructed according to:

- Yukon Government Highways and Public Works design specifications. Appropriate specifications will be provided following the completion of the roadway geotechnical investigation. To date, bidders have been provided with all YG specifications. Additional particular specifications will become known and applicable once the roadway geotechnical investigation and report have been completed.

- As the Tender Drawings (Figures 1 and 2) are based on topography derived from satellite imagery, the *intent* of the design will be honoured in the Issued for Construction (IFC) Drawings. Heights of fills, depths of cuts, the location of the alignment (except for possible revisions necessitated by soils conditions), the design standards, drainage management and erosion protection protocols will be employed as provided in the Approved for Tender Drawings.

2.2 Access Tie-In and Staging Areas

Yukon Engineering Services has completed a preliminary assessment of the proposed intersection of the all weather access road with the Campbell Highway. This has been done by way of confirming required sight distances based on the Rural Arterial 80 km/hr posting (TAC RAU 80) and designation of the Campbell Highway at present, and the intended RAU 90 designation of the Campbell Highway upgrades over the coming years.

The intended intersection with the Campbell Highway occurs at approximately km 198.8, with the proposed staging area close by, as shown in Figure 4. A road construction camp will be required near the Campbell Highway. A staging area will also be required, which will be used throughout the construction of the mine and road, and the operation of the mine. It is proposed to combine these two developments for the construction stage.

Detailed topographic surveys will be completed of the proposed Campbell Highway intersection during the upcoming geotechnical investigation program. Detailed site drawings and proposed intersection details will then be presented to Yukon Highways and Public Works to ascertain their specific requirements or concerns. A Public Highways Access permit application will then be submitted to YG HPW for approval.

Construction needs for the staging area will include:

- Access road construction camp, engineering office
- Temporary storage of materials and plant awaiting availability of access to the mine site.
- Storage of culverts and other associated road construction materials.
- Parking and maintenance of construction equipment.
- Fuel, parts and lubricants storage and control.

Operational needs for the staging area include:

- Chaining of trucks during the winter months.
- Fuel for maintenance equipment.
- Holding area for vehicles awaiting authorization to proceed onto the access road.
- Parking of private vehicles off site.

3 Borrow Sources

Planned borrow sources for common roadway embankment materials will be through the widening of roadway cuts, rather than the development of separate borrow pits. This reduces the footprint of impact as well as reclamation requirements. This will be confirmed through the roadway geotechnical investigation program.

Potential borrow pits for common embankment material, granular surfacing and culvert bedding/backfill materials, as well as for concrete aggregate will be investigated according to the following field operation plan, as shown in Figure 3.

Primary granular source locations were selected based on air photo interpretation, satellite imagery interpretation and ground truthing of material types as described in Section 2.1. The development of at least three granular deposits is necessary for economic, quantitative and quality management purposes.

Figure 3 provides location sketches of each proposed borrow area / investigation targets. The absolute location, limits and certainty of these targets will be confirmed through the investigation program. Three primary granular targets have been selected for granular investigation within the YZC Mineral Claims:

- Primary Target #1 - Approximately km 0.5 right. This is also the proposed staging area and construction camp location.
- Primary Target #2 - Approximately km 11 right.
- Primary Target #3 - Approximately km 23 left.

Six alternative or secondary granular targets were also selected for investigation within the YZC Mineral Claims:

- Secondary Target #1 - Approximately km 1 right
- Secondary Target #2 - Approximately km 2.6 right
- Secondary Target #3 - Approximately km 2.6 left

- Secondary Target #4 - Approximately km 5 left
- Secondary Target #5 - Approximately km 8.5 left
- Secondary Target #6 - Approximately km 13.5 right of the roadway

This secondary testing will be completed if adjacent primary targets prove inadequate in terms of required quantity or inadequate in terms of granular gradation or quality.

The quantities of granular material are required for the Wolverine Project as well as the quantities of raw granular material (borrow) anticipated to be required to manufacture the respective aggregate products are summarized in Table 3.1. A summary of the testing frequency protocol is provided in Table 3.2.

Table 3.1. Quantities of Granular Material Required for Construction and Maintenance Activities

Description	Manufactured Product	Raw Material
Granular Surfacing for Construction	50,000 m^3	60,000 m^3
Granular Surfacing for Maintenance	20,000 m^3	25,000 m^3
Culvert Bedding and Backfill	8,000 m^3	10,000 m^3
Common Borrow for Construction	50,000 m^3	50,000 m^3
Concrete Aggregate (Mill Site and "other")	2,000 m^3	5,000 m^3
Totals	**130,000 m^3**	**150,000 m^3**

Table 3.2. Testing Frequency Protocol for Granular Borrow Investigation

Test Frequency for Granular Borrow Investigation Program	Unit	Quantity	Acceptable Material (m3) per Test Completed
Road Alignment Length	km	24	
Required Acceptable Material	m^3	150,000	
Anticipated Average Depth	m	3	
Anticipated Net Development Area	Ha.	5	
Required Granular Sources	#	3	
Anticipated Required Tests per Source	#	8	
Required Tests (3 Primary Sources)	#	24	6250
Required Tests (w/ 1 Alternate Tested)	#	32	4688
Required Tests (w/ 2 Alternates Tested)	#	40	3750
Required Tests (w/ 3 Alternates Tested)	#	48	3125
Required Tests (w/ 4 Alternates Tested)	#	56	2679
Required Tests (w/ 5 Alternates Tested)	#	64	2344
Required Tests (w/ 6 Alternates Tested)	#	72	2083

Once confirmed, granular borrow sources will be developed according to acceptable construction practices, and to standards currently employed by the Yukon Government in its execution of highway construction contracts. Specifically:

- Test pit information will be used to determine the optimum depth of planned excavation.
- Depths will be used to determine the planimetric extents of the planned source, with appropriate consideration to setbacks from streams and escarpments, as well aesthetic screening requirements.
- Observed depths of organic overburden and root mat (from test pit information) will be used to determine the required perimeter storage area of organic soils and overburden. Typically, overburden storage makes up from 10% to 30% of the overall borrow and stockpile area, depending on the depths of the overburden and of the granular materials being excavated.
- These limits will be used to determine the planimetric extents of the required clearing.
- The haul road to/from the source will be selected according to best practices and in consultation with YZC Environmental personnel, and with EMR.
- A *Borrow Source Development Plan* drawing will be completed by YES, and provided to YZC Environmental personnel for approval. Once approved, the plan will be provided to the Contractor. This plan will include instructions for the development stage: storage of overburden soils and organic stripping materials, stockpiling of granular screened or crushed product for construction and maintenance, designated area for setting up of plant, limits of clearing, any required drainage remedies, and buffer areas; and for the reclamation stage: sloping of borrow walls (2H:1V maximum steepness recommended), re-contouring of pit area and haul road, creation of enhancements as may be directed by YZC, contouring of organic overburden over the surface area, and seeding.
- Limits of clearing for the borrow source and the haul road, will be flagged in the field by YES.
- Clearing, disposal and salvage will be completed by the Contractor, according to standards provided in *YG Sections 03010, 03011* (Appendix A).
- Once cleared, the extents of the planned borrow excavation will be laid out in the field by YES, leaving the required overburden storage and buffer zones.
- Grubbing and stripping operations will be by way bulldozing materials to the perimeter of the cleared area, leaving adequate space to re-access the materials for reclamation.
- Excavation will be limited to the development area as shown on the *Borrow Source Development Plan,* and as laid out in the field by YES.
- Where granular deposits are underlain by colluvium, till or other materials suitable for common embankment, these materials will be used for roadway sub-grade construction purposes.
- Oversize boulders rejected by crushing or screening operations will be employed as rip rap where feasible, or stockpiled for future use as rock pile barricades at the entrances to the borrow source haul roads.
- Following construction and maintenance requirements are met, the borrow source site will be reclaimed as identified in the *Borrow Source Development Plan*.

The granular investigation program will provide site-specific development plan details for each source. Based on available surficial and geological mapping of the area, the potential for acid rock drainage or metal leaching from aggregate used for the road, is low to nil (Section 3.1). Nonetheless, protocols as recommended in *Protocol for Environmental (ARD/ML) Testing of Construction Materials, Wolverine Project* (May 15, 2006, AMEC: Sibbick, Kavalench, et al) will be employed at each source investigated and each source developed as outlined in Section 4.

3.1 ARD/ML Potential

Borrow material samples were collected from test pits located in the tailings impoundment and from the project borrow area located northwest of the tailings facility. Details are provided in the Environmental Assessment Report (YZC, 2005) and a summary of the results of shake flask tests and acid base accounting tests (ABA) are summarized in Table 3.3 and Table 3.4.

Table 3.3. Summary of Metal Leachate Analyses for Borrow Materials

Sample Name	Units	Project Borrow (Near Airstrip)	Project Borrow (Sample #1)	Project Borrow (Sample #3)	Impoundment Borrow Site (TP05-78, 1.5 m)
Conventional Parameters					
Hardness (Total) CaCO3	mg/L	3.2	1.1	0.6	1.3
Metals Analysis					
Aluminum Al	mg/L	0.059	0.25	0.13	0.066
Antimony Sb	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Arsenic As	mg/L	0.0005	0.0002	< 0.0002	0.0005
Cadmium Cd	ug/L	< 0.04	< 0.04	< 0.04	< 0.04
Copper Cu	mg/L	0.0073	0.0053	0.0027	0.0049
Iron Fe	mg/L	0.04	0.13	0.01	0.08
Manganese Mn	mg/L	0.0067	0.01	0.013	0.0039
Mercury Hg	ug/L	< 0.02	< 0.02	0.03	< 0.02
Molybdenum Mo	mg/L	0.0003	< 0.0001	< 0.0001	< 0.0001
Nickel Ni	mg/L	0.0005	0.0003	0.0002	0.0004
Selenium Se	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Silver Ag	mg/L	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Thallium Tl	mg/L	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Tin Sn	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Zinc Zn	mg/L	0.002	0.004	0.003	0.002

The testing confirms that metal leaching from the borrow materials are not a concern and that the soils are not potentially acid generating.

Table 3.4. ABA Results for Borrow Materials

Sample ID	Unit	Project Borrow Impoundment Site 1 (Near Airstrip)	Project Borrow (Sample #1 East)	Project Borrow (Sample #2 central)	Project Borrow (Sample #3 West)	Tailings Dam Borrow Material						
						Near MW05-6	TP05-72 @2.5 m	TP05-75 @1.5 m	TP05-78 @1.5 m	TP05-81 @1.5 m	TP05-87 @3.3 m	TP05-89 @1.5 m
Paste pH	-	7.66	5.74	6.00	6.53	6.54	8.45	8.80	7.89	7.62	8.06	8.11
Rinse pH	-	6.42	4.87	5.01	4.99	5.63	5.88	7.54	6.12	5.7	6.34	6.2
Total Sulphur	%S	*0.005*	0.04	0.07	0.09	0.05	0.06	0.08	0.09	0.02	0.03	*0.005*
Sulphate Sulphur	%S	0.01	0.01	0.02	0.01	0.01	0.005	0.005	0.005	0.005	0.005	0.005
Sulphide Sulphur	%S	0.005	0.005	0.05	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Insoluble Sulphur	%S	0.01	0.03	0.05	0.08	0.04	0.06	0.08	0.09	0.02	0.03	0.005
AP	kg CaCO3/t	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Modified Sobek NP	kg CaCO3/t	3	-4.4	-3.1	-2.4	-1.2	3.1	5.1	2.6	0.2	3.3	2.9
Total Carbon	% C	0.51	1.74	1.52	1.13	0.31	0.14	0.21	0.43	0.25	0.18	0.16
Total Inorganic Carbon	% C	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Carb NP	kg CaCO3/t	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*
Net Sobek NP	kg CaCO3/t	3	-4.4	-3.1	-2.4	-1.2	3.1	5.1	2.6	0.2	3.3	2.9
Sobek NPR	-	20.00	-29.33	-20.67	-16.00	-8.00	20.67	34.00	17.33	1.33	22.00	19.33
Carb NPR	-	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67

Note: Values in *italics* were reported by the laboratory as less than their detection limit and are shown here at one-half the detection limit.

4 Environmental Testing Protocol

Construction materials used as borrow material along the road route may consist of unconsolidated sediments (soils, till, gravel, etc.) and bedrock. The following sections provide a protocol for sampling and analysis techniques of potential road construction materials along the access road.

Potential borrow sources will be identified as part of the road planning stage and possibly during the road construction phase of the project. In all cases, once a potential source of borrow material is identified, visual inspection, sampling, analysis and assessment will be carried out.

4.1 Visual Inspection

An inspection of the borrow source site by a qualified geoscientist or engineer. The inspection will be used to assess the borrow area for potential ARD/ML conditions. The visual inspection should include a geologic assessment of the following parameters:

- rock type(s);
- sulphide content;
- carbonate content; and
- presence or absence of other ARD/ML indicators (iron-staining, etc.).

The inspection should be focussed on the potential for the borrow source to produce ARD/ML if disturbed. This assessment should include a visual characterization of the mineralogy of the borrow material. Detailed descriptions of the type and amount of sulphide mineralization should include the size and shape of grains, any visible weathering, and a visual estimate of the proportion of sulphides to host rock. Careful attention should also be paid to things such as quartz and carbonate veins in the host rock, as well as the presence of iron staining and secondary precipitates that may have formed on the host rock during in situ weathering.

4.2 Sampling

Following the completion of the visual inspection, the borrow source will be sampled to provide sufficient material for environmental testing. Sampling should be conducted to collect a representative sample from each geologically distinct unit within the borrow source area. Samples should weigh a minimum of two kilograms and should be collected to be as representative as possible of the borrow source volume. Depending upon their volume, large homogenous borrow sources may require multiple samples. After sampling, each sample must be bagged and carefully labelled with a unique identifier.

4.3 Sample Analysis

Samples will be submitted to a certified environmental laboratory for testing. This will include the following analyses:

- Paste pH
- Total sulphur
- Sulphate sulphur
- Sulphide sulphur (by difference)
- Neutralization potential
- Metals by aqua regia-ICP

Analytical methods will follow current industry standards and/or those described in the Draft BC ARD Guidelines (Price, 1997[4]).

4.4 Assessment

The resulting field inspection and testing data will be assessed by a qualified geoscientist or engineer. The data will be assessed according to the guidelines and criteria described in the Draft BC ARD Guidelines (Price, 1997). This will include an assessment of the neutralization potential, acid generation potential and metal leaching potential of the borrow sources. Additional testing or assessment may be required as a result of the initial assessment. Test results will be reported to EMR as part of weekly update reports.

5 Geotechnical Testing Protocol

Air photo interpretation, satellite imagery interpretation and hand ground truthing by the others (as noted in Section 2.1) have been used to select the road alignment in its present form. Also as noted previously, this current alignment and the Approved for Tender Design is suitable for field confirmation of soils suitability, with allowance for possible revisions to the alignment where soils prove to be unsuitable.

The following roadway geotechnical program will be undertaken:

1. Test locations have been selected along the road alignment. These are areas typified as:
   a. Potential permafrost areas.
   b. Requiring confirmation as to soils types and moisture content.
   c. Requiring bedrock delineation.
   d. Potential waste cuts.
   e. Typically in proposed cuts (Approved for Tender Drawings).

[4] Price, W.A. 1997. Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia, British Columbia Ministry of Employment and Investment.

2. YES will flag one proposed edge of clearing (as shown in Figure 1, the Approved for Tender Drawings) from the Campbell Highway to the airstrip near Wolverine Camp. The selected edge will preferably be the high side limit. YES will also demark areas of obvious permafrost, solufluction and ice rich soils for hand clearing. See 4. below.

3. LGP (Low Ground Pressure) bulldozers will be used to doze a 4m wide swath and construct a tote trail through the project length, keeping within the proposed clearing limits as flagged in 1., above.

4. Where permafrost conditions appear, smaller trees or shrubs will be laid down by the dozer on top of the organic mat. In areas of larger trees, a 4m wide slash will be hand cleared to provide access for the bulldozer, ATV's and the excavator to follow. Salvage requirements will apply.

5. As the bulldozer progresses in non-permafrost segments, shallow test pits (<2m depth) will be excavated along the roadway. The test pits will be left open initially. The test pits will be numbered and located with GPS by YES.

6. Using the tote trail already constructed within the proposed clearing limits, a tracked excavator will now proceed along the tote trail, to complete the deeper test pits (<7m depth). EBA qualified technical personnel will accompany the excavator. EBA will log the shallow test pits already excavated by the dozer, and will take samples as the excavator progresses along the tote trail. The testing frequency protocol for geotechnical investigation is provided in Table 5.1.

7. The tracked excavator will complete the deeper test pits required, and EBA will log and sample the pits as required. These test pits will also be survey located using GPS.

8. Once the test pitting, logging and sampling operations have been completed, the dozer will return to backfill the test pits, and all personnel will demobilize from the site.

9. Samples will be processed in the Whitehorse EBA office. Laboratory testing will be completed and the geotechnical report and recommendations will be provided to YES. This report will be sealed by a Professional Engineer registered in the Yukon, and will include:
    a. Soils gradation / sieve analyses of samples catalogued by Test Pit# and depth.
    b. Updated delineation and confirmation map of various soil types.
    c. Proctor and optimum moisture determination of material types for later Test Strip tasks.
    d. Construction recommendations.
    e. Executive Summary and Recommendations. Recommendations will include:
        i. Recommendations for embankment in permafrost conditions. This will specify minimum height of fill (ie: 1.2 to 1.5m nominal) to optimize preservation of permafrost, and will include protecting and not disturbing the organic mat in areas of permafrost.

ii. Recommendations for installation of culverts in permafrost areas.
iii. Recommendations for "Issued for Construction" (IFC) fill and cut slopes in different material types.
iv. Recommendations for IFC Granular Surfacing thickness, on an area-by-area basis.

Table 5.1. Testing Frequency Protocol for Geotechnical Investigation

Test Frequency for Roadway Geotechnical Investigation Program	Unit	Quantity	Material (m3) per Test Completed
Road Alignment Length	km	24	
Required Material	m^3	450,000	
Anticipated Average Depth of Test	m	3	
Anticipated Net Development Area	Ha.	70	
Anticipated Required Tests per Ha.	#	1	
Anticipated Required Tests per km	#	3	
Anticipated Required Tests	#	72	6250

6 Access and Traffic Control

The all weather access road will be operated and maintained as a low volume, single lane, radio-controlled access to the mine site from the RCH. Two lane sections of the single lane access road have been selected for inter-visibility, and to accommodate the daily traffic activities of the road (Figure 1). The road will be posted with highly visible Kilometer Post markers at each km location along the way, as well as at features along the Access Road, such as stream crossings and borrow accesses.

Prior to operation of the access road, and prior to completion of the road construction, YZC will develop a *Manual of Rules for the Operation of the Wolverine All Weather Access Road*. This manual will provide final procedures for access road control, traffic control plans, and rules for use. In general terms, the Manual will formalize the following:

- All travelers will be advised that respecting the posted speed limit of 60 km/hr is mandatory for single vehicle traveling safety and so that all authorized vehicle drivers can anticipate the progress of other vehicles on the road, between Kilometer announcements.

- As all authorized vehicles and maintenance equipment will be radio-equipped, the following policy will be respected by all operators of authorized vehicles and maintenance equipment:

  - After authorizing a vehicle to proceed, and upon the vehicle passing the gate, the Gate Operator will announce "*Authorized Vehicle*" (or "Authorized Visitor" to suggest lesser familiarity on the part of the driver) "*Kilometer 0.5 Empty*"[5], "*Unit 17,Service Truck*". This provides an aural outline or reminder of the announcement protocols for all drivers.

  - "Loaded" traffic already on the road will announce their updated locations in a similar manner

[5] "Loaded" refers to the direction of haul for loaded concentrate haulers (ie: from the mine site to shipping port)

("*Kilometer 17 Loaded, Concentrate Hauler*", or "*Kilometer 6, Grader on the Road*")

- Empty vehicles must yield to loaded vehicles. Empty vehicles will pull over in designated two lane areas when a loaded vehicle is within 2 km, and will announce: "*Kilometer 7.6 Pullout, Empty Waiting, Unit 17, Service Truck*"

Access control will be by way of a staffed gate house at or near km 0.5 of the proposed access road, as shown on Figure 4. Traffic control plans will be executed and enforced through the gate house and the Wolverine Mine site.

The gate house will be staffed by a trained operator, with current Advanced First Aid, during all hours and on all days that the road is to be used. The facility will be equipped with the following:

- Heated facility with electrical generation, telephone, facsimile and VHF radio communications
- Instructions for Authorized Use of Access Road
- Current manifest of Authorized Users. Authorized Users will be limited to company vehicles and authorized company personnel, contract suppliers, transporters (supplies, concentrate haul), company agents of specialists, and YG personnel
- Access road VHF radios and visitor unit numbers for authorized visitors and emergency vehicles.

The gate house operator's duties will include:

- Confirming authorization for access
- Declining unauthorized access to the site
- Ensuring that all vehicles are equipped with operable access road VHF radios (radios will be checked at the gate by the operator) and visitor unit numbers. VUN's will be highly visible magnetic unique decals attached high on the driver's door of all visiting vehicles.
- Maintaining a manifest of authorized visitor access road VHF radios and visitor unit numbers.
- Retrieving all radios from authorized visitors.
- Providing written instructions for access road rules, and access road radio use. Providing a verbal review of the instructions to first time visitors.
- Logging all access road radio communications, and locations of all vehicles along the road.
- Monitoring access road radio communications, to eliminate "chatter" and non-safety communications.
- Dispatching emergency or retrieval equipment and personnel.
- Advising all traffic, including road maintenance traffic of unnoticed or unacknowledged traffic activity on the road.
- Advising all traffic of road conditions or hazards, including wildlife.
- Providing a daily access road report of all activities and traffic.

6.1 Access Control and Reclamation Plans at Closure

Reclamation of the all weather access road will involve the removal of all culverts and drainage structures and decommissioning of the roadbed itself.

6.1.1 Culvert and Drainage Structure Removal

All culverts and drainage structures will be removed and disposed of off-site at an approved location. The following activities are proposed:

- Trenches resulting from the removal of culverts will be swaled or contoured to match the surrounding terrain.
- Where warranted due to fine grain soils, erosion protection will be installed within the remaining swales, to a point where the reclaimed watercourse meets with its original path in undisturbed soil.
- Ditch blocks will be removed where this is desirable. There may be instances where cross drainage should be maintained through such as the ditch blocks employed as part of the construction project (Figure 1).
- Where ditches are to be left intact (some steeper sections) existing ditch erosion protection may be left in place, again due to fine-grained soils.
- Fisheries/riparian habitat enhancement at decommissioned crossing locations.

6.1.2 Roadbed Decommissioning

The roadbed itself will be contoured and rounded throughout its length, and the following activities are proposed:

- In smaller cuts and fills, ditches will be filled in, and the soils shaped to match the surrounding topography.
- In large cuts and fills, the embankment or excavation footprint will be reshaped to a lesser extent, but all slopes will be flattened or rounded to better suit the surrounding terrain.
- Organic stripping materials placed at the toe of fills during the original construction phase, will be re-contoured along the downhill side to act as a sediment filter, and to re-establish longer term re-vegetation.
- Surfaces of gradients less than 25% will be scarified (using scarifiers on bulldozers, excavators and graders) to better accept seeding.

Permanent closure of the road access is also required. Ideally, this permanent blocking of vehicular (including all terrain vehicles) access should occur as close as possible to the Robert Campbell Highway intersection location, to reduce any access and related impacts, outside of the highway corridor in the long term. It has been recommended (YG Environment, M. George May 8/06 email to P. Ladyman) that "*a portion of the road be cut into a steep hill side for a length between 100 to 300 meters*".

As such, a section of the side-hill "through cut" will be filled in with road embankment materials from adjacent fills, and re-contoured to the original ground terrain. A suitable location has been selected for further investigation from km 0.60 to km 0.80 on the proposed alignment as shown in Figure 5, which includes cross sections of the sidehill terrain before and after construction, and the following reclamation (back to original terrain).

Temporary road closures for periods of inactivity when access to the site is not required will be by way of a secure, locked iron gate at the gate house. Bollard style gate posts will be constructed of 8" diameter iron pipe, filled with concrete. Impassable obstacles will be configured into the trees on either side of the gate posts. These may take the form of used dozer blades or boulder piles placed into the trees to a point where vehicular access (including all terrain vehicles) will be impossible to navigate.

The entire disturbed surface of the roadway footprint and specific sites including the construction camp and staging area, the access control gate and all borrow sources will be seeded for re-vegetation according to the following guidelines:

- Slopes with <25%[6] gradient – machine or hand seeding of indigenous grasses, shrubs, trees as determined by the forthcoming YZC *Reclamation and Closure Plan*.
- Slopes with >25% gradient – hydro-seeding as determined by the forthcoming YZC *Reclamation and Closure Plan*.

Table 6.1 provides a Class "C" cost estimate of $750,000, for completing the all weather access road reclamation plan, as described above. This estimate is based on the best information at hand, is subject to forthcoming geotechnical information, IFC designs, and conditions of the *Reclamation and Closure Plan*. Estimates are expressed in 2006 CDN$, and reflect actual performance expectations of applicable equipment, resources and expertise to achieve the objectives of the plan.

Table 6.1. Wolverine All Weather Access Road Reclamation Cost Estimate

Task	Unit	Estimated Quantity	Estimated Unit Cost	SubTotal Estimated Cost	Total Estimated Cost
Drainage and Crossing Structures					
Structures Removal	Each	60	$ 1,200	$ 72,000	
Structures Disposal	Load	15	$ 4,400	$ 66,000	
Swale Trenches	Hour	60	$ 150	$ 9,000	
Swale Erosion Protection	Each	10	$ 1,000	$ 10,000	
Removal of Ditch Blocks	Hour	5	$ 200	$ 1,000	
Habitat Enhancement	Each	3	$ 15,000	$ 45,000	
SubTotal >				**$ 203,000**	**$ 203,000**
Roadway Footprint					
Recontour Roadbed	Ha.	20	$ 1,200	$ 24,000	
Permanent Closure km 0.6 to 0.8	m3	4000	$ 8	$ 32,000	
Recontour Organic Stripping	Ha.	30	$ 1,000	$ 30,000	
Scarification of Disturbed Areas	Ha.	40	$ 1,000	$ 40,000	
Seeding	Ha.	35	$ 2,000	$ 70,000	
Hydro-seeding	Ha.	45	$ 1,000	$ 45,000	
SubTotal >				**$ 241,000**	**$ 241,000**
Reclaim Borrow Sources					
Recontour Pits and Haul Roads	Ha.	15	$ 1,200	$ 18,000	
Recontour Organic Stripping	Ha.	15	$ 1,000	$ 15,000	
Scarification of Disturbed Areas	Ha.	15	$ 1,000	$ 15,000	
Seeding	Ha.	10	$ 2,000	$ 20,000	
Hydro-seeding	Ha.	5	$ 1,000	$ 5,000	
SubTotal >				**$ 73,000**	**$ 73,000**
Staging Area and Access Gate					
Buildings, Plant, Septic	Est.	1	$ 20,000	$ 20,000	
Recontour	Ha.	5	$ 1,200	$ 6,000	
Recontour Organic Stripping	Ha.	5	$ 1,000	$ 5,000	
Scarification of Disturbed Areas	Ha.	4	$ 1,000	$ 4,000	
Seeding	Ha.	5	$ 2,000	$ 10,000	
Hydro-seeding	Ha.	0	$ 1,000	$ -	
SubTotal >				**$ 45,000**	**$ 45,000**
Total Estimated Reclamation Cost, All Weather Access Road (2006 CDN$)					**$ 562,000**

[6] 25% gradient is equal to: a 4H:1V slope, which is equal to: 14º from horizontal.

7 Best Management Practices

To ensure road construction has minimal impact on the environment, all activities will follow best management practices as outlined below. In areas where culverts will be installed, best management practices will include but not be limited to the following:

- Culvert installations at fish-bearing streams will be conducted during the instream work window.
- Heavy machinery will operate from the stream bank and in a manner that minimizes disturbance to the banks and bed of the creek crossing.
- Machinery will be clean and well maintained (i.e., free of fluid leaks).
- All machinery will carry emergency spill kits in case of a fluid leak or spill.
- Fuel, machinery and other materials will be stored away and equipment refueled away from watercourses to minimize the potential for the release of a deleterious substance downstream.
- Riparian vegetation removal will be minimized.
- All exposed areas will be revegetated and/or measures to control erosion will be installed.

In addition to the implementation of these best management practices, procedures outlined in the Wildlife Protection Plan and Archaeology Contingency Plan provided in the Wolverine Project Environmental Assessment Report (YZC, 2005) will apply.

Impact avoidance is the preferred means of protecting the environment; adverse environmental effects can be minimized by incorporating BMPs into construction activities. While it is recognized that there are general environmental techniques and procedures to minimize environmental damage, site-specific conditions will usually require a solution unique to that location. The generic BMPs listed below are not intended to be definitive, nor should they be interpreted as the only acceptable options.

All onsite activities that interact with the environment will be reviewed by the onsite Environmental Coordinator. The main steps for review and approval of an activity are as follows:

- Obtain information pertaining to the job activity
- Determine environmental risk, consider risk and determine mitigation measures
- If required, contact government regulatory agencies and prepare regulatory applications

Examples of BMP procedures that will be incorporated in project planning activities are summarized in the sub-sections that follow.

7.1 Instream Construction Windows

Instream works at watercourse crossings with known or inferred fish presence will be undertaken during the approved fisheries work window. For the three species in the project area, the approved work window (or periods of least risk) is as follows:

- Northern pike: July 01 – April 30

- Arctic grayling: July 15 – March 31
- Bull trout: June 15 – August 15

A combination of these periods is required if more than one species occurs within a watercourse where activities are being conducted.

7.2 Sediment and Erosion Control Mitigative Measures

The key to controlling erosion and sedimentation caused by work-related activities is to manage off and onsite runoff. In general, to minimize erosion and sedimentation, work-related activities will be conducted to:

- minimize disturbance to vegetation and limit area of clearing
- install sediment control measures (silt fences, sediment traps, etc.) before starting work
- inspect sediment control measures regularly and make necessary repairs immediately
- minimize length of time that unstable erodible soils are exposed
- direct sediment-laden or turbid runoff into vegetated areas
- stabilize erodible soils as soon as practical by seeding or installing erosion control blankets
- cover temporary fills or stockpiles with impermeable covers (e.g. plastic) during heavy rainfall

Effective ways to control erosion and trap sediment are summarized in Table. 7.1. All sediment traps and barriers (i.e., silt fences, straw bales, etc.) must be cleaned regularly while they are in place if they are to remain effective.

Table 7.1. Description of Sediment and Erosion Techniques

Technique	Description	Application
Vegetation: preservation and replanting	Maintain vegetation, minimize grubbing and maintain root mat, reseed/ replant	On slopes, stream banks, floodplains to permit infiltration and minimize surface disturbance
Silt fences	Geotextile vertical barrier that causes sediment deposition	On slopes with erodible soils – surface applications only (not to be used instream (i.e., flowing water))
Straw bales	Barrier that causes sediment deposition	On slopes with erodible soils and in low surface or low flows only
Sediment traps or basins	Excavate minor depressions to allow sediment to settle	In areas where high volumes of sediment-laden water occurs; may be used with silt fencing or bales
Flumes/ spillways	A chute or pipe of non-erodible material to convey runoff down a slope	In areas with concentrated high velocity surface runoff
Check dams	Small dams to reduce the velocity of storm water flows in swales/ditches	In small open channels
Erosion control blankets	Natural fibre matting used to minimize surface erosion	In areas with surface runoff or channels
Plastic covers	tarp to cover erosive soils	In non-vegetated areas where a temporary measure is required to control runoff until the site is stabilized

7.2.1 Runoff Control

Drainage design and runoff mitigation has been provided to Q^{100} (1 in 100 year) peak flood event. The project minimum culvert diameter of 600mm was selected for maintenance consideration and is therefore over-designed for most cross-drain culverts. Culvert diameters and flow velocities at stream crossing locations will be based on requirements for fish species present (*i.e.*, burbot).

Runoff control and erosion protection measure in the proposed design include, but are not necessarily limited to the following:

- Isolating techniques will be required for the construction and installation of crossing structures at stream locations. These techniques will be approved by YZC Environmental Monitor (in the field), and will include: temporary diverting, pumping and fluming, during the actual culvert installations (See Section 7.3).

- Utilizing low risk, high service drainage design parameters adopted from YG Highways and Public Works. Typical culvert installations will be to standards provided in *Ref YG 06010-1* in Appendix A.

- Where road gradients exceed 6% for distances of greater than 100 m, ditches will be lined with erosion protection rip rap, in the form of blast rock or cobbles. Typical particle size will be <300mm in diameter and well graded. The erosion protection will cover the ditch bottom and extend 0.5m up the side slope, and 0.5m up the backslope, and will be

approximately 300mm thick throughout.

- Additional erosion protection in ditches includes the employment of ditch blocks to manage cross drainage into intermediate culverts on long gradients, and to ensure that run-off does not exceed the capacity of cross drain culverts during a Q100 event. (*Ref YG 06010-2 Appendix A*)

- Culvert gradients do not exceed 10%.

- Where gradient controls necessitate culvert outlets occurring above the toe of embankment on the low (outlet) side, “half-pipe” fluming and/or rip rap protection will be applied at the outlet, on the outlet side slope down to the toe, and for a distance of 2 times the culvert diameter beyond the outlet toe, as per *Ref YG 06010-3* in Appendix A.

- Potential up-hill and down-hill sloughing (of back-slopes and side-slopes) resulting from runoff occurrences will be dealt with following the geotechnical investigation. Designs will be applied on a case by case basis and will be provided in the IFC Design Drawings.

Should runoff create erosion occurrences beyond those anticipated in the design, stockpiled cobbles, rip rap or other erosion resistant materials will be applied at the problem site. Chronic runoff erosion issues will also arise that may create flows of silt and fine-grained sands in ditches and against side-slopes. In these instances, we anticipate the installation of silt fencing or other acceptable devices.

Where uphill/upstream watercourses change or exceed anticipate flows, solutions will be applied depending on the specific circumstances, such as:

- Interceptor ditching can be cconstructed to manage the problem.

- Existing culverts can be replaced with larger diameter structures.

- Off-take downstream ditching can be completed to reduce possible backed up runoff.

7.2.2 Dust Control

Dust will be controlled in areas where it poses a risk to the environment or worker health and safety. Detailed plans will be provided in the *Manual of Rules for the Operation of the Wolverine All Weather Access Road*.

7.3 Site Isolation Mitigative Measures

Isolation techniques are required for instream work where sensitive habitat is potentially affected, or in areas where site activities have the potential to have impacts downslope. The isolation of a site reduces erosion and the release of contaminants offsite. Methods of isolating a work site so that works may proceed in isolation of flowing water or surface runoff include

instream diversions, surface diversion berms or dikes, and swales, by-pass pipes, and coffer dams. A brief description of these mitigation techniques is provided in Table 7.2.

Table 7.2. Description of Site Isolation Techniques.

Technique	Description	Application
Instream diversion	Divert streams using dams, alternate channel, berms, pumps, etc.	To isolate an area to work in the dry; may be used with other techniques to minimize erosion and sedimentation
Diversion berms/dikes	Low berm used to divert surface water	Near slopes or around a work site; good for containing an area or preventing runoff into an area
Swales	Ditch to intercept storm runoff and divert to acceptable area	Along uphill side of exposed slopes to minimize runoff flowing across slope; may be used with other techniques to minimize erosion and sedimentation
By-pass pipes	Flexible hoses, pipes, or flumes used to carry/ pump water through or around a site	To isolate an area to work in the dry; limits sediment release, maintains streamflow
Coffer dams	sandbags, sheet piling, geotextiles used as a dam, pumps used to remove water	To isolate or contain a work area on larger streams

8 Construction Monitoring Plans

The purpose of monitoring is to ensure that site activities impact the environment as little as possible. Monitoring activities and priorities vary between sites and construction works and may include inspections to ensure that:

- All equipment used for instream work is clean and is in good mechanical order with no fluid leaks
- All fuels and lubricants are stored well away from the watercourse
- refueling and changing of oils/lubricants is completed away from bodies of water
- Spill containment and clean-up equipment are onsite at all times
- All cast in place concrete is isolated from flowing waters for a minimum curing period of 72 hours to allow the pH to reach neutral levels.
- All water displaced from concrete forms during concrete pouring is discharged into a sump
- All stockpiles of material are kept above high watermarks.

Environmental monitoring will ensure a high standard of environmental protection and compliance with all regulatory requirements. Details of monitoring programs will be specific to

each work activity and specific plans will be developed in conjunction with the various contractors. A fulltime Construction Management and Inspection Team will monitor all construction activities throughout the construction schedule, including clearing operations. This team will be comprised of the following qualified personnel:

Site Personnel:

YES

- Construction Manager / Project Engineer
- Civil Inspector / Survey Crew Chief
- Survey Technician

YZC

- Environmental Monitor for all drainage work, borrow developments, clearing and related activities presenting higher level potential impacts.
- Geoscientist to undertake all ARD/ML protocol requirements:
  1. Visual Inspection
  2. Sampling

  Processing and transfer of samples to specialist labs for:
  3. Analysis
  4. Assessment

EBA

- Sr. Geotechnical Technologist (for Test Strip Recommendations)

Off Site Personnel:

YES

- Sr. Review, Quality Assurance and Site Visits by Sr. Project Engineer, Paul Knysh, P.Eng., and by Principal in Charge / Designer, Rob Harvey.
- Design, Engineering, Survey, Management support as required.

YZC

- Sr. Review and coordination of Environmental Monitoring and ARD/ML protocols.

EBA

- Sr. Review, Quality Assurance by Sr. Geotechnical Engineer, Richard Trimble, M.Sc. (Eng.), P.Eng.
- Laboratory support as required.

A qualified Construction Manager / Project Engineer will be on site to coordinate:

- The activities of the contractor.
- Quality control activities of the inspection personnel.
- Layout and measurement of the work.
- Re-design to accommodate changes in conditions (ie: soils conditions not found during the geotechnical investigation, grade-line corrections following topographic surveys)
- Activities and attention by required specialists including YES, YZC and EBA personnel.
- Daily reports of all construction activities, including equipment employed, areas works, personnel involved, and possible mishaps, outcomes and remedies.
- Daily photographic Journal of all activities.
- Monitoring of any safety infractions, near misses, outcomes and remedies.
- Weekly summary report of the above.
- Ensuring contractor compliance with all regulatory, permitting and contractual

conditions.

All work limits and grades will be surveyed in the field. This will provide for control of the lines and grades as approved in the IFC drawings, will contain operations to the areas approved, control slopes and grades to minimize impacts, and control the development of borrow sources to the extent identified in the *Approved Borrow Source Development Plan*(s).

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As noted previously, EBA Engineering Consultants Ltd. will perform "test strips" to identify required compactive effort on the part of the contractor, utilizing various compacting equipment. The test strip results will be used by YES inspection personnel to ensure that the required densities are achieved, through proper packing of various materials, and through the application of acceptable lift thicknesses.

Placement of erosion protection devices such as riprap, will also be monitored. Rip rap for example will be examined for compliance with requirements, and to ensure that excessive fines are not introduced to the drainage courses.

All culvert installations will be survey-located, and inspected to ensure proper installation procedures are followed.

Tables 8.1 and 8.2 provide the testing frequency protocols for roadway quality control monitoring and slope and gradient control, respectively.

Table 8.1. Testing Frequency Protocol for Roadway Quality Control Monitoring

Test Frequency for Roadway Quality Control Monitoring	Unit	Quantity	Material (m3) per Test Completed
Road Alignment Length	km	24	
Required Material	m^3	450,000	
Anticipated Average Lift Thickness	m	0.5	
Anticipated Average Height of Fill	m	1.5	
Average # of Lifts (Embankment)	#	3	
Required Tests per km, per Lift	#	10	
Required Average Tests per km	#	30	
Required Tests Entire Roadway	#	720	625

Table 8.2. Testing Frequency Protocol for Roadway Slope and Gradient Control

Test Frequency for Roadway Slope and Gradient Control	Unit	Quantity	Material (m3) per Test Completed
Road Alignment Length	km	24	
Required Material	m^3	450,000	
Average Test Station Interval	m	25	
Average Tests per Test Station	#	20	
Required Average Tests per km	#	800	
Required Tests Entire Roadway	#	19200	23

9 Summary

This plan is based on the best available information available at the time, and is provided without the benefit of a field geotechnical and granular investigations. Upon completion of these investigation programs, and confirmation or modification of conditions and resultant designs, a revised plan will be prepared to suit the additional information.