



**Anvil Range**  
MINING CORPORATION

**Grizzly Deposit  
Underground Exploration**

**APPLICATION for WATER LICENCE**

**October 1996**

Yukon Waters Act

Schedule IV Application

If Amendment or Renewal: Licence # Not Applicable

1. NAME: ANVIL RANGE MINING CORPORATION

2. PERMANENT MAILING ADDRESS:

117 Industrial Road,  
Whitehorse, Yukon  
Y1A 2T8

TELEPHONE: (403)633-5588

FAX: (403)668-6518

SEASONAL MAILING ADDRESS (if different from permanent)

From \_\_\_\_\_ to \_\_\_\_\_  
(Date) (Date)

TELEPHONE:

FAX:

4. LOCATION OF UNDERTAKING:

WATER SOURCE: Blind Creek/Side Creek Tributary of Pelly River

WASTE DEPOSIT: Side Creek, Tributary of (Describe location, attach map, indicate location of waste deposit)  
Blind Creek (Supporting Information Section 5)

5. QUANTITY OF WATER TO BE USED: 1,635 m<sup>3</sup>/day  
(300 US gpm)

6. PROPOSED EXPIRY DATE OF LICENCE: December 31, 2000

7. TYPE OF UNDERTAKING

- Industrial \_\_\_\_\_
- Placer Mining \_\_\_\_\_
- Quartz Mining X
- Municipal \_\_\_\_\_
- Power \_\_\_\_\_
- Agriculture \_\_\_\_\_
- Conservation \_\_\_\_\_
- Recreational \_\_\_\_\_
- Other (attach description) \_\_\_\_\_

8. WATER USE:

- To obtain water X
- To divert water X
- To store/alter flow of water \_\_\_\_\_
- To modify the bed or bank of a watercourse \_\_\_\_\_
- To cross a watercourse \_\_\_\_\_
- Other (attach description) \_\_\_\_\_

9. OTHER PERSONS OR PROPERTIES AFFECTED BY THIS UNDERTAKING:

10. NAME, ADDRESS, TELEPHONE AND FAX NUMBER OF AGENT OR ALTERNATE CONTACT (if applicable):

Signature F. Fugger Date October 21, 1996

FOR OFFICE USE ONLY

Application Fee Amount \_\_\_\_\_ Receipt No: \_\_\_\_\_

Water Use Deposit Amount \_\_\_\_\_ Receipt No: \_\_\_\_\_

Department of Indian and Northern Development

M I N I N G I N D U S T R Y

INFORMATION SHEET  
for  
WATER-USE APPLICATION

Part 1  
GENERAL

1. Name of Applicant: ANVIL RANGE MINING CORPORATION (403)633-5588  
[company, corporation, owner] [telephone number]

117 Industrial Road, Whitehorse, Yukon Y1A 2T8  
[postal address]

2. Officers of Company: [a] Kurt A. Forgaard (403)633-5588  
[President] [telephone number]

\_\_\_\_\_  
[b] F.F. 'Fritz' Prugger (403)633-5588  
[Mine Manager] [telephone number]

\_\_\_\_\_  
[c] Not Applicable \_\_\_\_\_  
[Mill Manager] [Telephone Number]

\_\_\_\_\_  
[Postal Address]

3. Indicate the status of the mine and/or mill on the date of application:

	Mine	Mill
Design	<u>X</u>	<u>Not Applicable</u>
Under Construction	<u>_____</u>	<u>_____</u>
Operation	<u>_____</u>	<u>_____</u>
Suspended	<u>_____</u>	<u>_____</u>
Abandoned	<u>_____</u>	<u>_____</u>

If a change in the status of the mine or the mill is expected, indicate the date of such change.

Exploration activities to commence upon receipt of water license.

4. Indicate the present [or proposed] mine-mill operating schedule:

[a] Mine:	hours per day	24	[b] Mill:	hours per day	Not Applicable
	days per week	7		days per week	-
	weeks per year	52		weeks per year	-
	shift periods	8		shift periods	-
	# of employees	35		# of employees	-

5. Attach a layout plan showing the relative locations of the mine, mill and tailings area. Gas, electricity and water utility route locations are to be included and also road and rail access to the mine or plant.

Supporting information - Section 4

6. Indicate the type of mining operation to be used on the property:

conventional underground:  X

conventional open pit: \_\_\_\_\_

other underground operations: \_\_\_\_\_  
[e.g. bacterial leaching]

combined open pit and conventional underground: \_\_\_\_\_

strip mining: \_\_\_\_\_

other mining activity [please explain]: \_\_\_\_\_

7. Physiography:

The applicant should provide an analysis and interpretation of the geologic and hydrologic environment in the immediate vicinity of the mine or plant. The investigation should extend from ground surface downward to the base of the glacial drift.

Supporting information - Sections 2 and 3

[i] topographic maps: copies of the most recent and largest scale topographic maps available covering the area where the mine, mill and waste disposal basin are [or are to be] located.

Supporting information - Section 4

[ii] soil maps: copies of the most recent and largest scale soil maps available covering the area where the mine, mill and waste disposal basin are [or are to be] located.

Supporting information - Section 3

[iii] geologic maps: copies of the most recent geologic maps and reports available that cover the area where the mine, mill and waste disposal basin are [or are to be] located.

Supporting information - Section 2

[iv] any information on groundwater patterns in the area.

Supporting information - Section 3

Part II  
GEOLOGY - MINERALOGY

8. Briefly describe the physical nature of the orebody. Include known dimensions and approximate shape:

Supporting Information - Section 2

9. Briefly describe the country rock in the general vicinity of the orebody.

Supporting Information - Section 2

10. List, in order of importance, the ore minerals of the deposit:

<u>Mineral</u>	<u>%</u>	<u>Mineral</u>	<u>%</u>
1. Sphalerite	1-8%	4.	
2. Galena	1-8%	5.	
3. Chalcopyrite	0.1%	6.	

11. List, in order of importance, the individual gangue minerals that occur within the orebody:

<u>Mineral</u>	<u>%</u>	<u>Mineral</u>	<u>%</u>
1. Pyrite	10-60%	4. Carbonates/Micas	2% - 30%
2. Quartz	10-60%	5.	
3. Barite	0-40%	6.	

12. Are pyrite [marcasite] and/or pyrrhotite present in the orebody?

Pyrite and Pyrrhotite \_\_\_\_\_  
 Yes  No

13. If "yes" above, please indicate the amount of each present in the orebody:

Pyrite: Trace to Massive Pyrrhotite: Trace to Pyrite-pyrrhotite mixture: 5% of ore body  
30%

14. Is arsenopyrite present in the orebody?  Yes  No xx

15. If "yes" above, please indicate the amount of arsenopyrite present:  
Trace

16. Indicate the average grain size of the ore minerals. Please include pyrite and/or pyrrhotite if present in the orebody.

Mineral	Mesh No.	Other Size Description
	1.	Not determined in detail - comparable to Vangorda and Grum
	2.	
	3.	

Part III  
THE MINE

17. Indicate the number of shafts or other openings that are presently on the property. Please signify whether or not the openings referred to are presently in use:

<u>Shaft [name or number]</u>	<u>Present Depth</u>	<u>Proposed Depth</u>
<u>None</u>	_____	_____
_____	_____	_____
_____	_____	_____

<u>Adit [name or number]</u>	<u>Present Depth</u>	<u>Proposed Depth</u>
<u>None</u>	_____	_____
_____	_____	_____
_____	_____	_____

<u>Open Pit</u>	<u>#1</u>	<u>#2</u>	<u>#3</u>
<u>Present Surface Length</u>	<u>None</u>	_____	_____
<u>Maximum Future Surface Length</u>	_____	_____	_____
<u>Present Surface Width</u>	_____	_____	_____
<u>Maximum Future Surface Width</u>	_____	_____	_____
<u>Present Depth</u>	_____	_____	_____
<u>Maximum Future Depth</u>	_____	_____	_____

18. If open pit operations are presently being carried out or are proposed, will conventional underground operations follow?

Yes:   N/A   No:       

19. If "yes" above, please indicate the approximate time lapse before underground operations are initiated:

Not Applicable

At once:\_\_\_ Months:\_\_\_ Years:\_\_\_

20. Indicate the expected life of the mine [pit, etc.]:  
18 [months, years]

21. Indicate the present average rate of production [including dilution] from all ore sources on the property:  
0 tons ore/day Exploration Only

22. Indicate the expected maximum rate of production from all ore sources on the property:  
0 tons ore/day Exploration Only

23. Will material leaving the mine be subjected to preconcentration steps before the initial stages of comminution in the mill?  
Yes:\_\_\_\_\_ No: X \_\_\_\_\_

24. If "yes" above, indicate the type and quantity of material that will be rejected and the method of disposal of this material.

Not Applicable  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

25. Indicate all uses of water in the mine and source and volume of water for each use.

<u>Source</u>	<u>Use</u>	<u>Volume [IMP. gal/day]</u>
1. <u>Groundwater</u>	<u>Drilling</u>	<u>360,000 Imp. gal/day</u>
2. _____	_____	_____
3. <u>Supporting Information - Section 5</u>	_____	_____
4. _____	_____	_____
5. _____	_____	_____

26. Indicate the volume of groundwater [natural water] presently gaining access to the mine workings:

No workings  
exist Imp. gal/day.

27. Indicate the total volume of water to be discharged from the mine during normal operations:

360,000 Imp. gal/day

28. Will a mill be operating on the property in conjunction with mining?

Yes: \_\_\_\_\_ No: X

29. If "yes" above, will all mine [underground, open pit, etc.] water be directed to the mill for re-use?

Yes: Not Applicable No: \_\_\_\_\_

30. If "no" above, indicate the proposed point of discharge for the mine water and the volume of the discharge:

Point of Discharge: Supporting Information - Section 5

Volume of Discharge: Supporting Information - Section 5

31. What are chemical characteristics of the above mine water?

pH \_\_\_\_\_ ppm

SO<sub>4</sub> \_\_\_\_\_ ppm

Fe \_\_\_\_\_ ppm

Mn \_\_\_\_\_ ppm

Supporting Information - Section 5

Part IV  
THE MILL

32. Attach a copy of the mill flow sheet. The flow sheet should indicate the points of addition of the various reagents [chemicals] that are [or will be] used.

33. Is milling in progress on the property at the present time?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

34. If "yes" above, indicate the present rate of milling:

\_\_\_\_\_ tons/day

35. What is the present [or proposed] maximum capacity of the mill?

\_\_\_\_\_ tons/day

36. Indicate the type and quantity [in lbs./ton ore milled] of all reagents used in the mill:

[a] \_\_\_\_\_

[b] \_\_\_\_\_

[c] \_\_\_\_\_

[d] \_\_\_\_\_

[e] \_\_\_\_\_

[f] \_\_\_\_\_

[g] \_\_\_\_\_

[h] \_\_\_\_\_

[i] \_\_\_\_\_

NOT APPLICABLE

NOT APPLICABLE

37. Is the [proposed] milling circuit based on autogenous grinding?

Yes: \_ No: \_ Partially: \_\_\_\_\_

38. If the [proposed] mill is not based on autogenous grinding, indicate the present [or expected] total rod and/or ball metal losses:

\_\_\_\_\_ lbs./ton ore

39. Indicate the present [or expected] mill heads:

_____ oz. Au/ton	_____ % Cu	_____ % U <sub>3</sub> O <sub>8</sub>
_____ oz. Au/ton	_____ % Ni	_____ %
_____	_____ % Zn	_____
_____	_____ % Pb	_____

40. Indicate the present [or expected] overall efficiency of the mill:

	_____ % recovery
Cu circuit	_____ % recovery
Zn circuit	_____ % recovery
Pb circuit	_____ % recovery
__ circuit	_____ % recovery
__ circuit	_____ % recovery

NOT APPLICABLE

NOT APPLICABLE

41. Indicate the present [or expected] grind in the mill:

\_\_\_\_\_ % - 200 mesh \_\_\_\_\_

42. Indicate the amount[s] of concentrate[s] produced in the mill:

1. \_\_\_\_\_ lbs./day of \_\_\_\_\_
2. \_\_\_\_\_ lbs./day of \_\_\_\_\_
3. \_\_\_\_\_ lbs./day of \_\_\_\_\_
4. \_\_\_\_\_ lbs./day of \_\_\_\_\_
5. \_\_\_\_\_ lbs./day of \_\_\_\_\_
6. \_\_\_\_\_ lbs./day of \_\_\_\_\_
7. \_\_\_\_\_ lbs./day of \_\_\_\_\_

43. Indicate all uses of water in the mill; include the quantity and source of the water for each use:

Source	Use	Volume [Imp. gals/day]
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____

NOT APPLICABLE

NOT APPLICABLE

44. Indicate the total volume of water discharged from the mill:  
 \_\_\_\_\_ Imp. gals/day

45. Of the above volume, indicate what quantity is returned to the mine for re-use:  
 All: \_\_\_\_\_ None: \_\_\_\_\_ Some: \_\_\_\_\_ Imp. gals/day \_\_\_\_\_

46. Indicate the average quantity of tails [dry weight] discharged from the mill.  
 \_\_\_\_\_ tons/day

47. What is the liquid-solid ratio of the tails leaving the mill?  
 \_\_\_\_\_: \_\_\_\_\_ Imp. gals/ton \_\_\_\_\_  
 liquid solid

48. Are all "liquid" wastes leaving the mill being directed to the tailings area?  
 Yes: \_\_\_\_\_ No: \_\_\_\_\_

49. If "no" above, please specify:  
 \_\_\_\_\_  
 \_\_\_\_\_

50. Is the mill handling at present [will the mill handle in the future] customs lots of ore from other properties?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

51. If "yes" above, please specify:

NOT APPLICABLE

NOT APPLICABLE

52. Are tailings being recovered in the mill [or elsewhere] for use as backfill [etc.] in the mine [etc.]?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

53. If "yes" above, please indicate [tons/day] the quantity of solid tails being recovered from the mill stream; also indicate the size fractions [% mesh] being removed:

\_\_\_\_\_  
\_\_\_\_\_

Part V  
THE TAILINGS AREA

54. Attach a detailed scale plan drawing of the present [or proposed] tailings area. The drawing should include the following:

- [a] precise details of all retaining structures [length, width, height, materials and construction, etc.]
- [b] details of all decant [etc.] mechanisms
- [c] details with regard to the direction and route followed by the flow of wastes and/or wastewaters from the area
- [d] indications on the distance to the nearest major watercourse

**NOTE:** Individual detailed large scale drawings of any facility [dam, decant system, ditch, etc.] to be constructed must be attached. Specific details with regard to the methods of construction, materials to be used, etc. are required.

55. The total area of the existing tailings basin is: \_\_\_\_\_ acres.

56. The total area of the proposed tailings area is: \_\_\_\_\_ acres.

57. The total capacity of the existing tailings area is:  
\_\_\_\_\_ dry tons[tails].

58. The total capacity of the proposed tailings area is:  
\_\_\_\_\_ dry tons[tails].

59. Will the present tailings area contain the entire production from the mine/mill complex for the life of the complex?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

60. Will the proposed tailings area contain the entire production from the mine/mill complex for the life of the complex?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

61. If "no" above, please indicate what plans have been made for future tailings disposal on the property.

---

62. Do the tailings area and all related treatment facilities lie on company held claims?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

63. If "no" above, indicate claim boundaries [and owners] on tailings area plan map [see question #54]. Also, attach a copy of all pertinent agreements signed with the owners of the claims not held by the Company.

64. Does the present tailings area occupy a former lake basin?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

65. If "yes" above, give the approximate size of the basin occupied by the former lake:

\_\_\_\_\_ acres.

NOT APPLICABLE

66. Will the proposed tailings area engulf or otherwise disturb any existing watercourse?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

NOT APPLICABLE

67. If "yes" above, attach all pertinent details [name of watercourse, present average flow, direction of flow, proposed diversions, etc.]

68. Does any existing natural watercourse gain access to the existing tailings area?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

69. If "yes" above, indicate the volume of water gaining access to the tailings area from the natural source[s] in question:

<u>Name of Source</u>	<u>Volume [Imp. gals/day]</u>
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____

70. Will any existing watercourse gain access to the proposed tailings area?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

71. If "yes" above, indicate the volume of water which will gain access to the tailings area from the natural source[s] in question:

<u>Name of Source</u>	<u>Volume [Imp. gals/day]</u>
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____

NOT APPLICABLE

NOT APPLICABLE

72. Will some [or all] of the tailings area decant [or water ponded on the tailings area] be directed back to the mill for re-use?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

73. If "yes" above, indicate the volume of water that will be directed back to the mill:

\_\_\_\_\_ Imp. gals/day

74. What is the present volume of the decant overflow?

75. What is the expected average volume of the decant overflow when the property is running full capacity?

\_\_\_\_\_ Imp. gals/day

76. Name the first major watercourse that the decant overflow encounters as it leaves the area of company operation:

77. Indicate the average depth of the tails in the existing tailings area:

\_\_\_\_\_ feet.

78. Indicate the expected average depth of tails in the tailings area after all operations on the property cease: \_\_\_\_\_ feet.

79. Describe the present chemical characteristics of the tailings area decant:

80. Describe the expected chemical characteristics of the decant from the proposed tailings area:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
NOT APPLICABLE NOT APPLICABLE

81. Describe the methods of chemical treatment [reasons for, chemical addition volumes, equipment used, etc.] that are presently being used and/or will be used to control the quality of the tailings area decant [attach engineering drawings where applicable].

82. Indicate on the tailings area plan drawing [see question #64] all sources of seepage presently encountered in the vicinity of the tailings area, the volume of each seepage flow [Imp. gals/day], and the direction of each flow.

83. Are the seepage flows from the property presently being [chemically] treated?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

84. If "no" above, please explain:

85. Will all tailings areas on the property be revegetated or otherwise stabilized when conventional mining-milling operations on the property cease?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

86. If "no" above, please explain:



**Anvil Range**  
MINING CORPORATION

**Grizzly Deposit  
Underground Exploration**

**SUPPORTING INFORMATION  
for  
APPLICATION for WATER LICENCE**

**October 1996**

## SUMMARY

### General

Mining in the Anvil Range near Faro has been an important source of employment and economic growth for the Yukon since 1969. The development of ore deposits has progressed from the original Faro Open Pit to the Vangorda and Grum Open Pits on the Vangorda Plateau. The next step in this orderly progression is to first prove ore reserves and mineability of the Grizzly Deposit (previously known as the DY Deposit) by completing an underground exploration program and then bringing the mine into production provided that the exploration and feasibility studies are favourable.

The Grizzly deposit is the only known deposit in the Anvil Range which can realistically be brought into production prior to the depletion of ore reserves in the Grum Open Pit and, thereby, ensure the continuation of ore supply to the concentrator plant. A smooth continuation of ore supply is of critical importance since the costs associated with care and maintenance of the Faro concentrator could prohibit the continued operation of the complex if there was a "window" between ore supply from Grum and the next deposit to come on line. Furthermore, this would cause hardship for many people and the town of Faro. An interruption of concentrate supply to Anvil Range Mining Corporation's customers would also have serious consequences on the company's market position.

The confidence level surrounding the Grizzly deposit is not great enough to allow a production decision to be made at this time. An underground exploration program must first be performed to accurately delineate the mineable ore reserves and the geo-engineering characteristics of the ground.

The Grizzly deposit lies within the Blind Creek drainage basin approximately 3 km south east of the Vangorda Open Pit (further from the Faro concentrator). An Environmental Management Plan has been developed which will both minimize and monitor the impacts of the exploration program on Blind Creek. Blind Creek is recognized as a regionally important chinook salmon spawning creek and as an important traditional hunting and fishing area for the Ross River Kaska Dena.

Anvil Range Mining Corporation has instituted a baseline environmental characterization program for Blind Creek. The broad based information accumulated from company environmental surveys, DIAND flow monitoring and DFO/Ross River Dena fisheries surveys provides a solid background from which impacts resulting from the exploration program can be measured.

Anvil Range Mining Corporation anticipates that this Application will undergo a Level I Review under the Canadian Environmental Assessment Act prior to issuance of a Type B Water Licence under the Yukon Waters Act. The purpose of this document is to provide information necessary for environmental screening and regulatory review of the proposed underground exploration project. The underground exploration project will commence immediately upon receipt of the Water Licence.

**SUMMARY (continued)**

**Exploration Plan**

The exploration project will be performed as efficiently and economically as possible such that the required information is gathered and the Environmental Management Plan is followed. The broad objective of the project is to gather the information necessary to allow a well informed and logical production decision to be made. The project has a budget of \$20 million and is scheduled to take 18 months to completion.

Underground methods must be used to gather the required information because the deposit is located from 580 to 900 metres below surface. The most efficient manner to achieve exploration access to the deposit is via a decline. The practical benefits of a decline over a vertical shaft have been evaluated and include: faster and less expensive access to the deposit via better understood ground conditions, pre-development of a useful component of the mine should the project proceed to the mining stage, and no concern of eliminating ore from the mineable reserve due to a shaft safety pillar.

The portal site previously established by Curragh Resources in 1990/91 has been confirmed to be the most practical location for the portal. This location provides a significantly shorter access to the deposit than the alternatives examined. Both single heading and double heading declines are being considered. The alternatives are being evaluated on the basis of size of opening, ventilation requirements, safety and cost.

The selection of the type of decline is an operational issue which does not impact on the Environmental Management Plan and should not impact on the review of this Application for Water Licence. Written notification of the decline option selected will be made to the Water Board prior to the commencement of work.

**Environmental Management Plan**

The Environmental Management Plan addresses the environmental issues which may arise as a result of the proposed underground exploration project.

The decline will initially be dewatered to the portal site where water will be passed through a settlement pond prior to discharge into Side Creek which is a tributary of Blind Creek. No metal contamination and, therefore, no chemical treatment is anticipated during this initial stage of activity as the excavation will be through acid consuming rock. Suspended solids will be retained in the settlement pond.

**SUMMARY (continued)**

The decline will be dewatered via a vertical hole to surface once the linear advance has progressed to approximately 255 metres. This water handling system will take advantage of local topography to allow for an adequately sized settlement pond and to utilize Side Creek as the initial receiving water for effluent discharge. A larger settlement pond will be required during this stage of activity to manage increased volumes of water as the decline encounters an increased number of water bearing fault zones. Water will be chemically treated as required to remove zinc or suspended solids prior to release from the settlement pond. Zinc contamination requiring chemical treatment is expected to occur once the decline encounters mineralized rock.

The rock removed from the upper portion of the decline will be acid consuming and will be used to enlarge the existing rock pad at the portal site. Any acid generating rock removed from the lower portion of the decline and lateral development will be removed from the portal site. The trucks used will be capable of utilizing the existing road to the Vangorda Plateau in order to eliminate the need for a major upgrade of the existing road. The acid generation characteristics of the rock types associated with the Grizzly Deposit have been inferred from previous testwork and will be confirmed with site specific tests.

A water quality monitoring schedule and a list of maximum allowable discharge limits have been proposed which are based, in part, on the existing Vangorda Plateau Water Licence. A discharge limit for ammonia is proposed which is derived from guidelines for the protection of aquatic life published by the Canadian Council of Ministers of Environment - Freshwater Aquatic Life Guidelines.

Measures to be implemented in the cases of a temporary suspension of activities or for closure of the site are proposed. These measures include a definition of what constitutes temporary or permanent cessation of activities, modifications to the water quality monitoring schedule, modifications to the reporting schedule and the physical work to be performed.

**Ross River Kaska Dena**

The traditional use of the land in and around the Blind Creek watershed by the Ross River Kaska Dena has been documented in the 1992 report titled "Just Like People Get Lost". The Blind Creek area has traditionally been intensely utilized for fishing, trapping and as a travel route to the Vangorda Plateau.

The use of the land has changed significantly since the development of the Faro mining complex due, in part, to mine related activities. The use of the area is less intense and centres around observations of environmental conditions. At present, the land is not intensely utilized for fishing or trapping.

The potential impacts on land use arising from the underground exploration program will take the form of wildlife avoidance behaviour in the immediate portal area. The protection measures implemented through the Environmental Management Plan will be adequate to ensure that the resources of Blind Creek are protected and that their continued use is assured. \_

**TABLE OF CONTENTS**

SUMMARY

1.	INTRODUCTION	1
	1.1 General	1
	1.2 Project Location and Setting	1
	1.3 Historical Perspective	3
2.	GEOLOGY	5
	2.1 District Geology	5
	2.2 Deposit Geology	7
3.	ENVIRONMENTAL SETTING AND LAND USE	10
	3.1 Land Use Overview	10
	3.2 Biophysical Environment	11
	3.2.1 Regional Climate	11
	3.2.2 Surface Water Hydrology	14
	3.2.3 Groundwater Hydrology	16
	3.2.4 Water Quality	16
	3.2.5 Fisheries Resources	19
	3.2.6 Wildlife Resources	20
4.	PROPOSED UNDERGROUND EXPLORATION PLAN	23
	4.1 Introduction	23
	4.1.1 General	23
	4.1.2 Underground Access	23
	4.1.3 Underground Exploration	25
	4.2 Details of Work	25
	4.2.1 Portal and Surface Facilities	25
	4.2.2 Decline	28
	4.2.3 Underground Exploration	30
	4.2.4 Evaluation of Results and Feasibility Study	34
	4.3 Project Schedule	34

**TABLE OF CONTENTS (continued)**

5.	ENVIRONMENTAL MANAGEMENT PLAN	36
	5.1 Management of Excavated Rock	36
	5.1.1 Upper Decline (Acid Consuming Rock)	36
	5.1.2 Lower Decline and Lateral Development (Acid Generating Rock)	37
	5.1.3 Ore	39
	5.2 Management of Surface Facilities	40
	5.2.1 Water Supply	40
	5.2.2 Sewage System	40
	5.2.3 Used Oil Handling	40
	5.2.4 Gasoline, Fuel and Glycol Handling	41
	5.2.5 Chemical Handling and Storage	41
	5.2.6 Garbage and Scrap Material Handling	41
	5.2.7 Fire Fighting Equipment	41
	5.2.8 Safety/First Aid Coverage	41
	5.2.9 Access Roads	42
	5.3 Water Management System	42
	5.3.1 Normal Operations	42
	5.3.2 Spill Reporting	47
	5.3.3 Contingency Plan	47
	5.4 Water Quality Monitoring	47
	5.4.1 Proposed Discharge Limits	47
	5.4.2 Water Sampling Locations and Parameter Frequency Matrix	47
	5.4.3 Ammonia	50
	5.4.4 Discussion of Proposed Discharge Limit for Total Ammonia	50
	5.4.5 Heavy Metals	51
	5.4.6 Total Suspended Solids	52
	5.5 Reporting Procedures	52
	5.6 Suspension of Activities	52
	5.7 Closure Plan	53
	5.8 Environmental Impact Assessment	54
	5.8.1 Assessment of Impact on Wildlife	54
	5.8.2 Assessment of Impact on Fisheries	55
	5.8.3 Assessment of Impact on Public Land Use	57
	5.8.4 Cumulative Impacts	57
6.	ASSESSMENT OF IMPACT ON TRADITIONAL KASKA LAND USE	58
	6.1 Just Like People Get Lost (Kaska Use of Blind Creek)	58
	6.2 Impacts from the Underground Exploration Project	59
7.	REFERENCES	60

**LIST OF FIGURES**

Figure 1.1	Location of the Grizzly Ore Body .....	2
Figure 2.1	Ore Body Locations Relative to the Mt. Mye and Vangorda Formations .....	6
Figure 2.2	Grizzly Deposit Section 650E .....	8
Figure 2.3	Deposit Vicinity Plan .....	9
Figure 3.1	YTG Big Game Zones Relative to the Grizzly Deposit .....	12
Figure 3.2	Fisheries Resources and Water Quality Sampling Sites .....	18
Figure 3.3	Sheep Distribution in Relation to the Grizzly Deposit .....	21
Figure 4.1	Grizzly Deposit Surface Drillhole Plan .....	24
Figure 4.2	Grizzly Deposit Underground Exploration Program (Plan) .....	26
Figure 4.3	Grizzly Project Decline for Underground Exploration .....	27
Figure 4.4	Conceptual Layout of Surface Facility .....	29
Figure 4.5	Single Ramp Typical Section Using Small Diesel Truck .....	31
Figure 4.6	Single Ramp Typical Section Using Large Diesel Truck .....	32
Figure 4.7	Twin Ramp Conveyor Haulage .....	33
Figure 4.8	Project Schedule .....	35
Figure 5.1	Conceptual Section Through Ultimate Rock Pad .....	38
Figure 5.2	Layout of Treatment Facilities and Water Sampling Locations .....	43
Figure 5.3	Conceptual Layout of Dewatering and Treatment Facilities .....	45
Figure 5.4	Conceptual Layout of Treatment Building .....	46

**LIST OF TABLES**

Table 3.1	Regional Mean Monthly Temperatures	13
Table 3.2	Regional Mean Monthly Precipitation at Grum Camp, Faro and Anvil	14
Table 3.3	Mean Monthly Discharge at Selected Gauging Stations	15
Table 3.4	Blind Creek Water Quality Database (1975++)	17
Table 3.5	Peak and Typical Concentrations of Selected Metals in Blind Creek	19
Table 5.1	Acid Base Accounting Results for Calcareous Phyllite	36
Table 5.2	Acid Base Accounting Results for Acid Generating Rock Types	37
Table 5.3	Proposed Maximum Allowable Discharge Limits	48
Table 5.4	Sampling Locations and Parameter Frequency Matrix	49
Table 5.5	Canadian Freshwater Aquatic Life Guideline for Total Ammonia	51
Table 5.6	Evaluation of Water Quality in Blind Creek During the Exploration Project Relative to CCREM Guidelines	56

## 1. INTRODUCTION

### 1.1 General

Anvil Range Mining Corporation (ARMC) is a Canadian-controlled company that owns and operates the lead-zinc mining and concentrating operations located in the Anvil District near Faro, Yukon Territory (Figure 1.1). Five ore deposits have been identified in the Anvil District: Faro, Vangorda, Grum, Grizzly (formerly DY) and Swim. Pre-mining in-situ geological inventory for all five deposits totaled 120 million tonnes. To-date, only three of the deposits are being or have been mined: the Faro, Vangorda and Grum deposits. Open pit mining of the Faro deposit was completed in August of 1992, and underground mining was completed in October 1992. The Faro pit is currently being used for tailing disposal. Open pit mining of the Vangorda deposit is nearly complete and open pit mining of the Grum deposit is underway.

The purpose of this document is to provide supporting information for the Application for Water Licence which will allow the proposed underground exploration program to proceed. The supporting information presented here includes the geology of the ore body and host formation, the plan for exploring the ore body, the related infrastructure development, and an overview of the environmental management plan.

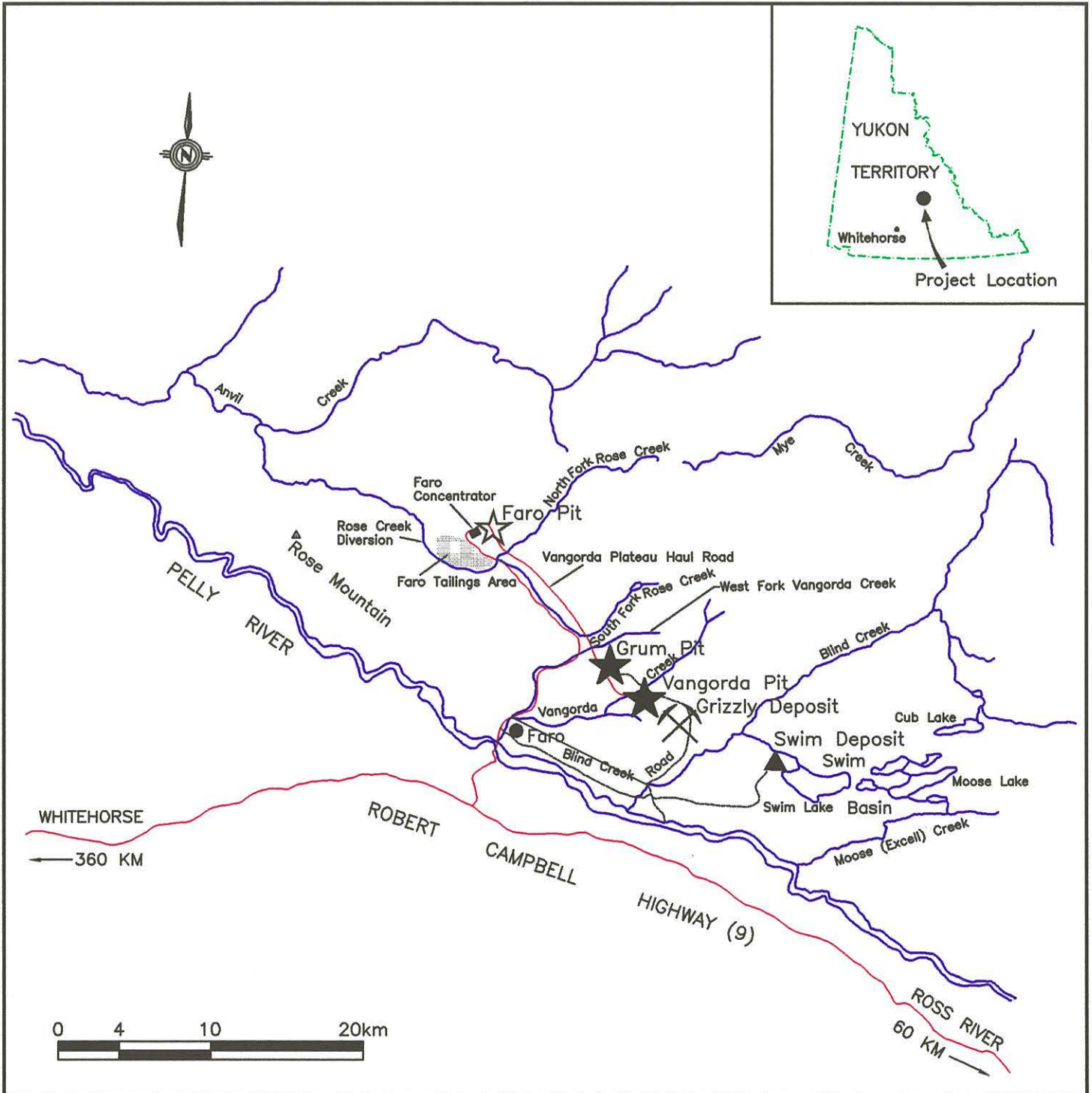
ARMC is committed to completing this project in an environmentally sound and economically efficient manner such that there will be no significant impacts on the receiving environment in either the short or long term and such that the final production decision is based on adequate information. The total budget for the project is \$20 million and the total time frame to completion and production decision is 2 years.

### 1.2 Project Location and Setting

The Grizzly property is located in the Anvil Range lead-zinc-silver district 12 km east of Faro (approximately 200 km northeast of Whitehorse), Yukon Territory, with coordinates 62° 13' N and 133° 08' W (Figure 1.1). Specifically, it is situated 6 km southeast of the Grum Deposit on the Vangorda Plateau on the south slopes of Mt. Mye. Ground surface in the general area of the deposit is at an elevation of 1,140 m (3,740 ft). The driving distance from the town of Faro to the proposed portal site is 16 km.

Surface exploratory drilling to delineate the deposit was carried out periodically at Grizzly from 1976 through 1991. Drill indicated mineral inventory for this property is estimated to be 21 million tonnes grading 5.8% lead and 6.8% zinc at a cut-off grade of 9% combined lead plus zinc. In addition, the ore contains 83.0 g/t of silver and 0.94 g/t of gold. The deposit remains open to extension in several directions.

The proposed site for the surface facilities required to conduct the underground exploration program is located on a southeast facing slope which is comprised of a thin veneer of overburden overlying bedrock. The soil texture ranges from sandy loam at the surface to slightly heavier textures (loam - silt loam) in the subsurface.



# GRIZZLY PROJECT

UNDERGROUND EXPLORATION PROGRAM



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Fig. 1.1 Location of the Grizzly Ore Body

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The predominant vegetation in the area is shrub to forest-shrub consisting of willow (*Salix* spp.), scrub birch (*Betula glandulosa*), aspen poplar (*Populus tremuloides*), white spruce (*Picea glauca*), and lodgepole pine (*Pinus contorta* var. *latifolia*). Willow, shrub birch and small popular dominate on open slopes. The area was subject to a forest fire in recent history and relatively dense, immature stands of lodgepole pine are common to many sites. White spruce tends to predominate at lower elevations giving way to jack pine at higher altitudes. The tree line is at approximately 1,476 m (4,800 ft).

Access to the property is from the northwest via a secondary road which is an extension of the main mine access road servicing the Faro, Grum and Vangorda open pits. Access can also be gained to the site from the southwest from the town of Faro via the Blind Creek Road (Figure 1.1).

### **1.3 Historical Perspective**

The initial mineral discovery in the Anvil Range was the Vangorda deposit which was first drilled in 1953 through 1955 by Prospector Airways. Systematic geological mapping of the Anvil District was not carried out until 1961 by Roddick and Green of the Geological Survey of Canada (Curragh Inc. 1993). The locating of the Vangorda deposit was followed by the subsequent discoveries of the Faro (1964), Swim (1964), Grum (1973) and Grizzly (1976) deposits. Exploration in the area has been continued by ARMC with a 1996 budget of approximately \$5 million.

The Faro deposit was the first of these ore bodies to be developed and brought into production. Mining of the Faro deposit commenced in 1969 under the auspices of the Anvil Mining Corporation, later Cyprus Anvil Mining Corporation (CAMC). Under CAMC's management, production of ore reached rates of up to 10,000 tonnes per day. In the mid 1970s, CAMC embarked on a program of expansion which included both an aggressive exploration program, resulting in the Grizzly discovery, and the acquisition of mineral deposits and claims on the Vangorda Plateau and Swim basin held by Kerr Addison Mines Ltd. (successor to Prospector Airways), including the Grum, Vangorda, and Swim deposits. The objective of the acquisition was to bring other Vangorda Plateau deposits into production to supplement the Faro mill feed.

Depressed base metal prices coupled with low productivity and high operating costs at Faro, and the added burden of the debt load brought about by expansion, led to a major slowing of production at Faro and closure of the concentrator by CAMC in 1982. Some open pit waste stripping operations were carried out between June 1983 and October 1983 but mining had ceased completely by the end of 1984.

In November 1985, Curragh Resources (later Curragh Resources Inc. and Curragh Inc.) acquired the holdings of Cyprus Anvil Mining Corporation and reactivated the Faro operation in January 1986. Concentrator operations resumed in June 1986 and the first concentrates were shipped in July 1986. In 1989, development of the Vangorda Plateau was begun with stripping of the Vangorda and Grum deposits. Ore mined from the Vangorda pit was used to supplement and, in turn, replace mill feed from the Faro pit. The property was held on a care and maintenance basis from 1993 to 1994 following the demise of Curragh Inc.

GRIZZLY UNDERGROUND EXPLORATION PROJECT - APPLICATION FOR WATER LICENCE

In 1994, Anvil Range Mining Corporation acquired the Faro holdings of Curragh Inc. and mine operations resumed in the Vangorda and Grum Pits. The mined out Faro pit was used for tailings deposition.

The concentrator at Faro is currently processing approximately 13,000 tonnes of ore per day. The concentrator produces two products; a lead concentrate which includes payable quantities of gold and silver, and a zinc concentrate. The concentrates are hauled in custom-designed, sealed containers via road to Skagway, Alaska where they are bulk loaded on ships for markets in Europe and Asia. Proven open pit mineable ore reserves indicate a mine life of approximately five years. Successful development of the Grizzly deposit would ensure the continuity of mining operations feeding the concentrator plant. This would maintain the current economic benefits to Faro and the Yukon from operations at the Faro mining complex as well as providing resources to finance the overall district closure plan.

## **2. GEOLOGY**

### **2.1 District Geology**

The Anvil Range lead-zinc-silver district, in central Yukon Territory, lies in the Selwyn Basin metallogenic province and the Yukon Plateau physiographic province. The district geology was reported on by Jennings and Jilson (1986).

The ore deposits of the Anvil district formed in the shale-rich, outboard portion of the early Paleozoic-late Proterozoic North American miogeocline, and are located within the southwest portion of the Selwyn Basin sub-province of the Northern Canadian Cordillera.

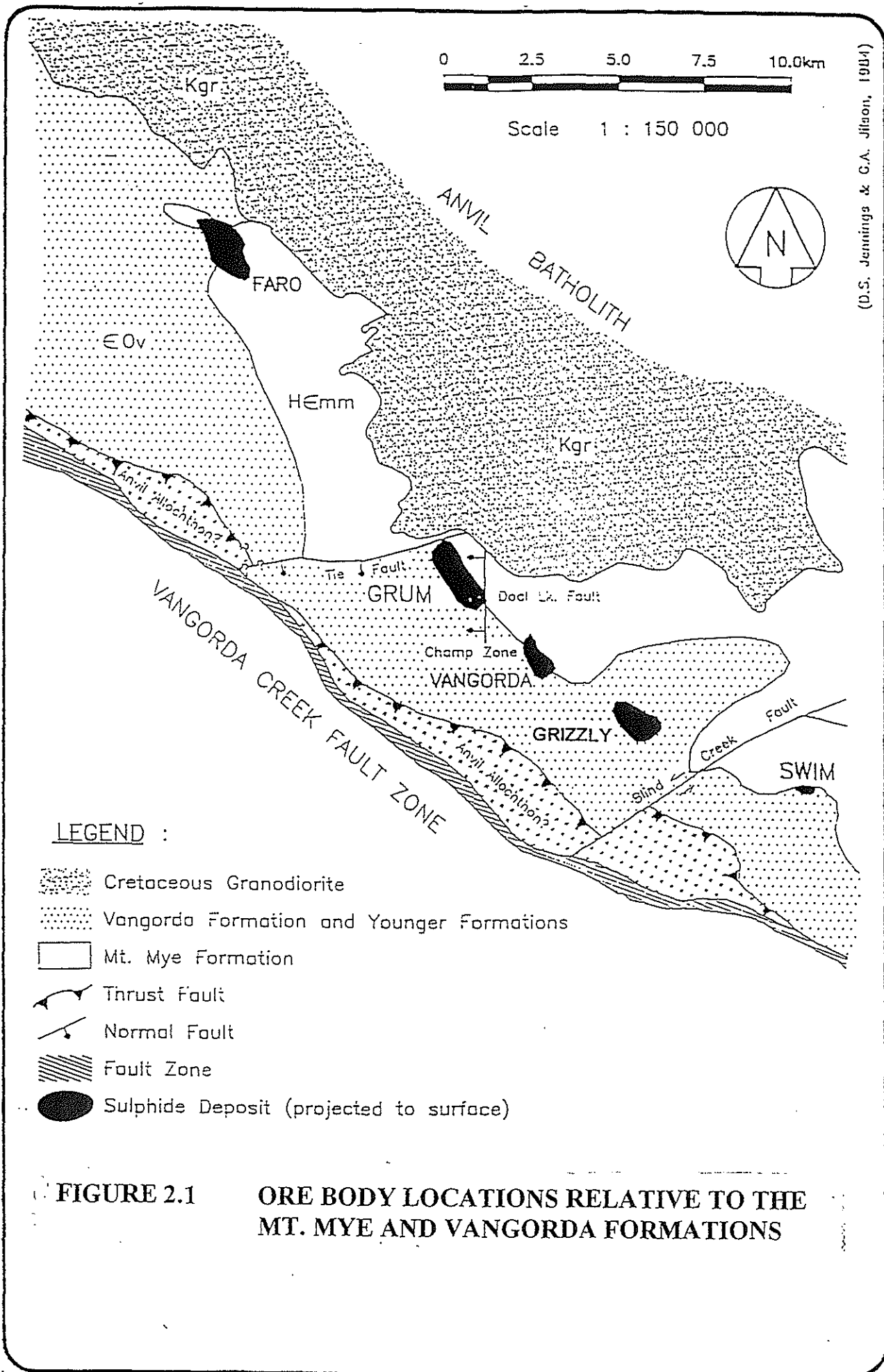
Geologically, the district is structurally complex, polydeformational terrain exposed in the Anvil Arch, a northwest trending structural uplift whose core is underlain by Cretaceous granitic suite. Around the flanks of the Arch is a sequence of late Precambrian to upper Paleozoic metasedimentary and metavolcanic rocks which host the ore deposits.

The syn-sedimentary, exhalative massive sulphide orebodies in the Anvil camp show a distinct stratigraphic control. Specifically they are localized within an approximately 150 m thick transition zone between the late Precambrian to lower Cambrian Mt. Mye and the Cambrian to Ordovician Vangorda Formations (Figure 2.1).

The Mt. Mye formation is essentially a monotonous sequence of metamorphosed shales. It is diagnostically non-calcareous. The formation ranges in thickness up to 2 km and becomes more heterogeneous towards the top with the appearance of some calcareous and meta-igneous members. The Mt. Mye formation is only weakly pyritic and static ABA testing in Vangorda Plateau (Curragh Resources Inc. 1989) indicates the rocks comprising the formation show limited potential for acid generation.

The Vangorda Formation, characterized by calcareous phyllites (metamorphosed calcareous shales) and metamorphosed mafic igneous rocks, is separated from the underlying Mt. Mye by a complex transition zone. This transition zone is typified by regionally extensive units of graphite phyllite along with a mixture of non-calcareous and calcareous phyllites and some basaltic meta-volcanic and meta-intrusive units. Rocks of the formation are notable for their calcite content and consequent acid consuming nature. However, the basal unit of the formation and other carbon rich members may be slightly acid generating locally.

All of the known massive sulphide deposits to date in the Anvil camp are associated with the dark coloured carbon rich phyllites within the transition zone between the Mt. Mye and Vangorda Formations. There are five known deposits found along a prominent curvilinear trend in the district with a total pre-mining geological reserve of 120.1 million tonnes averaging 3.7% Pb and 5.6% Zn. They are from northwest to southeast, the Faro, Grum, Vangorda, Grizzly, Swim. To date, the Faro, Grum, and Vangorda deposits which represent 95 million tonnes of the above geological reserves, have been developed by open pit.



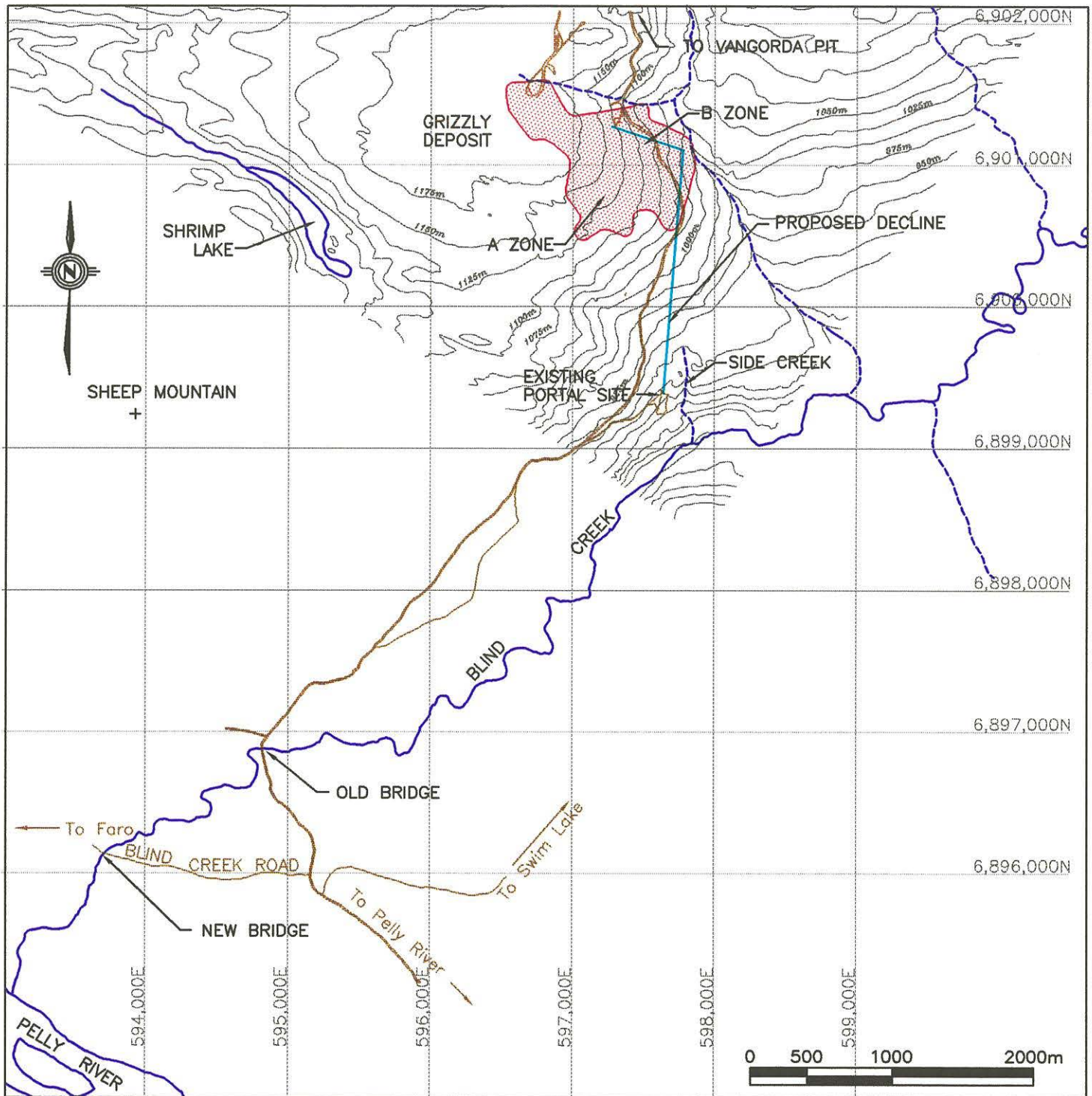
The deposits are thought to have formed from hot metalliferous brines discharged from submarine fumaroles localized along a syn-sedimentary fault or hinge line which developed in response to Cambrian extensional tectonism. The sulphide ores in the Anvil camp occur as massive, sheet-like to lenticular, predominantly pyritic bodies showing distinct lateral and vertical zonation. This zonation of sulphide ore types, the Anvil Cycle, is common to all Anvil sulphide deposits. A typified sequence would consist of a ribbon banded graphitic quartzite facies, overlain by a more massive pyritic sulphide facies in turn overlain by baritic facies. Laterally, the same zonation is commonly seen with the uppermost baritic facies occupying the more central area of the deposit. Each deposit has associated with it a white-mica dominant alteration (or bleaching) envelope in the surrounding phyllites which suggests a hot ore fluid/wallrock interaction at the time of sulphide deposition. All ore types and subeconomic sulphide rocks will potentially be acid generating. Some or all bleached or altered phyllite is likely to be acid generating.

## **2.2 Deposit Geology**

In the Grizzly deposit, there are three, possibly five mineralized horizons defined (Figures 2.2 and 2.3). The internal structure of the deposit is too poorly understood to allow for a reasonable evaluation of stratigraphy and thus the deposit ore type distribution. However, there does appear to be a predominance of more baritic ore type in the southwest (A Zone) compared to a predominance of pyritic massive and of disseminated, variably graphitic, ores in the northeast (B Zone). The central part of the deposit consists of massive, semi-massive and disseminated sulphides which are currently considered to be sub ore grade (less than 9% combined lead plus zinc). As the internal geometry of the deposit is presently understood, the deposit lies on upper Z symmetry (looking northwest) long limb of megascopic F1 antiform with local superimposition of moderate scale F2 folds. The major low angle extensional faults occur beneath the deposit cutting it off at the north west and south east limbs. There also appear to be numerous steep faults that cut the deposit but their orientation is not well known.

An understanding of faults and folds will be critical to the development and evaluation of mining options for the Grizzly deposit and delineation of these structures is a major objective of the underground exploration program. The underground exploration program will also provide for a more accurate delineation of the structure and dimension of the orebody.





# GRIZZLY PROJECT

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Fig. 2.3 Deposit Vicinity Plan

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### **3. ENVIRONMENTAL SETTING AND LAND USE**

#### **3.1 Land Use Overview**

Mining presently constitutes the single largest land use in the region. Less prominent land uses include trapping; commercial, subsistence and sport fishing; native food and sports hunting; and both native and non-native commercial woodcutting (firewood). There is very limited forestry and no agricultural activity in the region.

##### *Trapping*

Trapping is carried out by the Native peoples of the Kaska Dena Nation (Ross River Band), who hold the group trapping rights to the area. The species of prime interest to the trappers are mink, marten, otter, lynx, fox (for furs) and the snowshoe hare (for food). Other less sought after species include wolf, beaver, muskrat, bear and wolverine. Few details on the number of animals taken during the winter harvest are available.

It has been previously reported (Curragh Resources Inc. 1993) that the area in the vicinity of the proposed exploration activity is regularly trapped for marten and fox and that catches of marten (the most sought after species) have decreased noticeably since the inception of the original Faro mine in 1969. It is acknowledged that the increased human activity associated with this exploration program will add to the cumulative impact of regional mining activities. However, the Environmental Management Plan described in Section 5 is designed to minimize the potential impacts from this activity.

##### *Commercial, Subsistence and Sport Fishing*

No Commercial fishing licences were issued at Faro or Ross River during the period from 1981 to 1991 (Curragh Resources Inc. 1993). However, there are several subsistence fisheries centered at both Pelly Crossing and Ross River which exploit Chinook salmon populations in the Pelly River and Blind Creek systems. The subsistence fishery provides food for humans and dogs, and is important culturally in that it maintains a traditional lifestyle. This fishery predominantly harvests Chinook salmon (*Oncorhynchus tshawytscha*), but other species such as whitefish (*Prosopium* spp.), northern pike (*Esox lucius*), inconnu (*Stenodus leucichthys*), and Arctic grayling (*Thymallus arcticus*) are also taken. No estimates of the numbers of these species taken are available.

Sports angling takes place in Vangorda and Blind Creeks, the Pelly River and in Blind and Swim Lakes. The predominant species angled for include Arctic grayling and Chinook salmon. The primary objective of the environmental management plan is to ensure that the proposed exploration program will not have an adverse impact on the fisheries resources in Blind Creek and subsistence and sport fishery usage.

### *Subsistence and Sport Hunting*

There is little available information to quantify the level of subsistence hunting being conducted by native and/or resident hunters in the vicinity of the proposed exploration portal. However, it is known that hunting activity by local and non-resident hunters in the Faro region is restricted. The area encompassing Faro falls under Big Game Sub Zone #4-51 (Figure 3.1) has been closed to the hunting of all big game (Curragh Resources Inc. 1993) to protect the local Fannin Sheep population from exploitation through hunting and poaching. Faro residents wishing to hunt must go farther afield to the Swim Lakes Big Game Sub Zone (#4-47) or Mt. Mye Big Game Sub Zone (#4-46).

## **3.2 Biophysical Environment**

The Grizzly property lies within the Blind Creek drainage basin. Blind Creek flows in a southwesterly direction into the Pelly River. The Pelly River drains west into the Yukon River which flows northwest into Alaska to Ft. Yukon where it alters course and flows west, through Alaska, and discharges into the Bering Sea.

### **3.2.1 Regional Climate**

The average number of days with some precipitation is generally in the order of 100 to 120. Snow can occur at any time of the year, but will generally cover the ground in most years from October to May. Evaporation in the Yukon generally exceeds the total precipitation and ranges between 350 and 450 mm per annum.

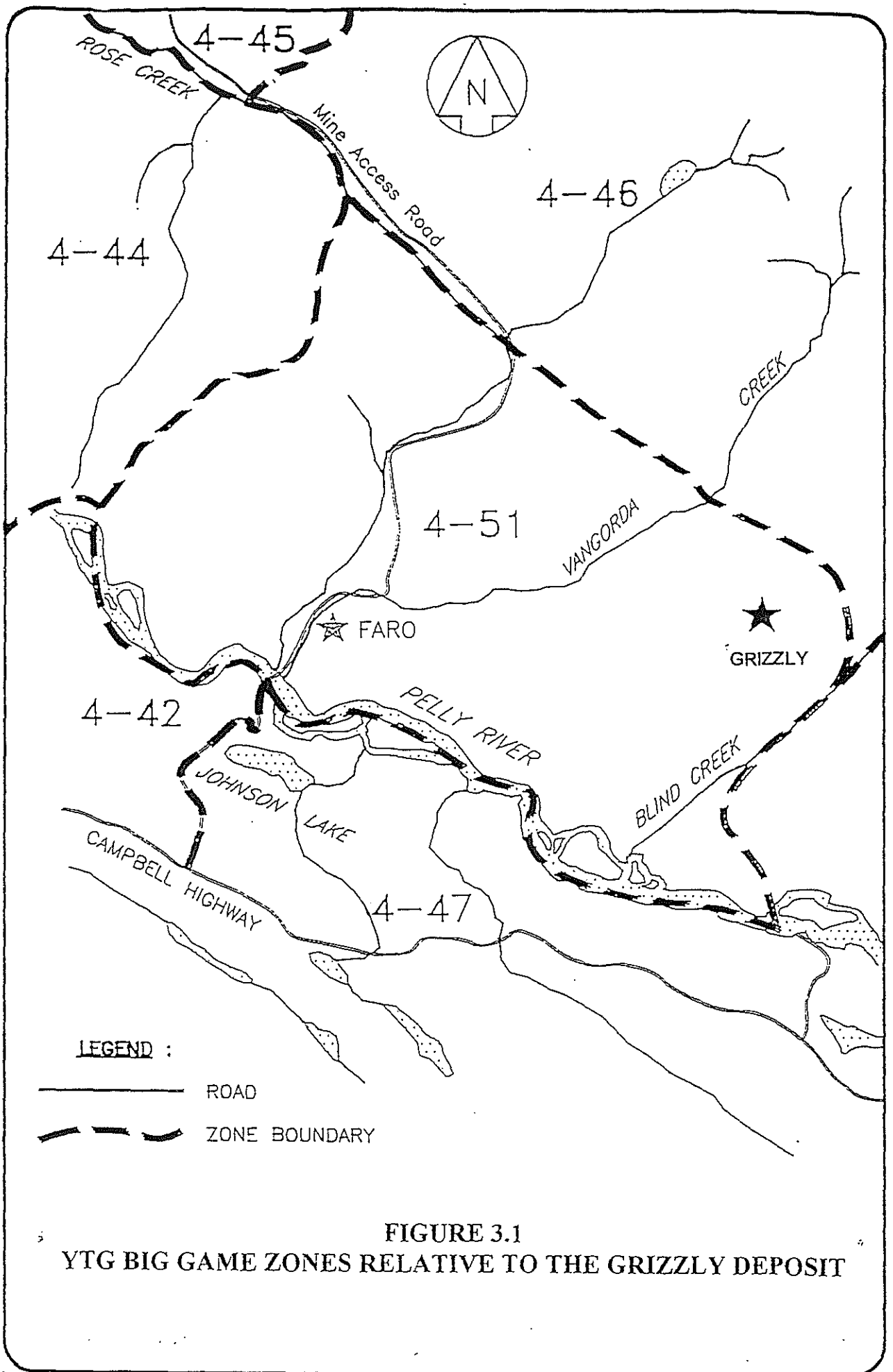
The Atmospheric Environment Service (AES) established three meteorological stations near the proposed mine: at the Faro airport in 1977, at the Anvil mine site in 1967, and at Grum Camp in 1983. Daily measurements of temperature and precipitation were recorded. The station at the Faro airport continues to be operated.

#### *Temperature*

Based on the period of record for the Faro station, it is estimated that mean monthly temperatures in the area would range from a high of 14.9°C in July to a low of -24.5°C in January. The extreme cold temperatures in the region make outside construction in the winter very difficult. The working season for surface construction will generally be from May to September.

The mean monthly temperature normals for Grum, Faro and Anvil are shown in Table 3.1.

The relatively high temperature in January and December at Grum Camp compared to the temperature recorded in Faro and at the Anvil station for the same month, is attributed to the uncommonly warm temperatures recorded for 1985 and 1986. Given the elevation of the proposed portal site (835 m), temperatures at the Grizzly project site will likely approach those recorded at the Faro stations.



*Precipitation*

The mean annual precipitation recorded at the Grum Camp station, based on 6 years of data collection, is 539 mm (21.2 inches). The maximum total monthly precipitation occurs in July as rainfall. The least amount of precipitation falls in November and generally consists of snowfall. There is no measurement available concerning the 24-hour maximum precipitation recorded at Grum. However at Faro, according to Canadian climate normals published by Environment Canada, the greatest 24-hour rainfall recorded was 46.7 mm. The greatest 24 hour rainfall at Anvil is 36.8 mm. The mean monthly precipitation distribution based on data recorded at Grum Camp, Anvil and Faro is presently in Table 3.2.

Precipitation at the Grizzly site is expected to be between that at the Faro and Grum stations since the Grizzly site is closer to Mt. Mye and higher in elevation than the Faro station.

**TABLE 3.1**

**Regional Mean Monthly Temperatures in Degrees Celsius**

<b>Month</b>	<b>Faro</b>	<b>Anvil</b>	<b>Grum Camp</b>
January	-24.5	-19.8	-10.8
February	-15.9	-13.9	-13.1
March	-10.1	-11.2	-9.3
April	-0.8	-3.2	-4.3
May	7.1	4.0	2.9
June	12.5	9.9	8.1
July	14.9	11.5	11.7
August	12.4	9.5	8.1
September	7.1	4.6	3.0
October	-0.4	-3.1	-2.9
November	-13.8	-11.6	-13.1
December	-21.7	-17.2	-13.4
Mean Monthly	-2.8	-3.4	-2.8
Elevation (m)	694	1158	1150
Years of Record	11	12	5

Source: Curragh Inc. 1993

TABLE 3.2

**Regional Mean Monthly Precipitation Distribution  
at Grum Camp, Faro and Anvil**

Months	Grum Camp			Anvil	Faro
	Total Precip (mm)	Total Rainfall (mm)	Total Snowfall (cm)	Total Precip (mm)	Total Precip (mm)
January	25.4	0.0	25.4	26.0	21.0
February	25.9	0.0	25.9	22.4	16.4
March	31.2	0.0	31.2	30.4	24.6
April	32.8	0.8	32.0	15.5	7.6
May	51.9	7.9	44.0	16.3	17.4
June	56.6	49.7	6.9	41.6	50.4
July	98.5	98.5	0.0	49.7	28.7
August	80.4	67.6	12.8	41.5	25.2
September	42.3	25.1	17.2	32.9	31.1
October	47.8	7.6	40.2	36.9	21.7
November	22.3	0.0	22.3	29.9	27.0
December	23.7	0.0	23.7	24.6	18.6
Mean Annual Years of Record	538.8 6	257.1 6	281.6 6	367.7 12	287.7 11

Source: Curragh Inc. 1993

### 3.2.2 Surface Water Hydrology

The Grizzly area is located on the western slopes of the Blind Creek watershed, which drains to the Pelly River (Figures 1.1 and 2.3). These southeast facing slopes of the plateau runoff directly to Blind Creek. Surface run off from the exploration portal site drains into Blind Creek. Water pumped from the exploration decline will be passed overland into Side Creek which is a tributary of Blind Creek.

Historic and current stream flow records for Blind Creek are shown in Table 3.3. A continuous stream recorder was installed by DIAND in 1992 and has recorded flows during the spring and summer seasons. Other relevant streams are also listed on Table 3.3 for reference. The missing flow data for Bind Creek (winter months) was extrapolated from an excellent correlation with the Tay River (pers. comm. P. Bryan). This method of "patching" flow data from correlation with regional continuously monitored streams provides a reasonable estimate of data especially given a strong correlation such as exists between Blind Creek and the Tay River (pers. comm. P. Bryan).

**TABLE 3.3 MEAN MONTHLY DISCHARGE in m<sup>3</sup>/sec at SELECTED GAUGING STATIONS**

Location	Year	Drainage sq km	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blind Creek	1975 (1)	618	NR	NR	NR	NR	NR	12.90	6.15	4.50	5.41	NR	NR	NR
Blind Creek	1992 (2)		1.07	0.90	0.80	1.09	8.49	21.8	9.87	4.47	3.87	2.51	1.79	1.12
Blind Creek	1993 (2)		0.73	0.61	0.58	1.28	16.5	13.9	8.93	7.51	6.88	3.73	1.68	1.69
Blind Creek	1994 (2)		0.96	0.69	0.65	1.79	9.81	10.7	3.92	1.48	2.83	2.64	1.24	0.85
Blind Creek	1995 (2)		0.60	0.49	0.42	1.28	8.15	5.20	4.71	4.91	5.87	3.07	1.11	1.00
Blind Creek	Mean '92-'95		0.84	0.67	0.61	1.36	10.7	12.9	6.86	4.59	4.86	2.99	1.46	1.17
Pelly River (09BC004)	(1)	22,100	27.00	23.60	22.70	24.60	321.00	837.00	548.00	277.00	260.00	165.00	49.90	36.40
Ross River (09BA001)	(1)	7,250	9.42	7.52	6.42	7.51	132.00	295.00	184.00	94.00	68.10	52.00	11.60	8.50
Vangorda Creek at Faro	(1)	90.8	NR	NR	NR	NR	NR	2.01	1.26	1.06	1.05	NR	NR	NR
Rose Creek	1968 (1)	208.0	0.27	0.21	0.20	0.24	4.01	6.14	4.58	4.24	5.43	1.39	0.92	0.64

R=No Record

(1) = Source:Curragh Resources Inc. 1983

(2) = Source: P. Bryan1996 and DIAND Water Resources 1996

**Shaded Numbers** were "patched" from correlation with the Tay River.

### **3.2.3 Groundwater Hydrology**

A hydrogeological assessment of the deposit area was performed by EBA Engineering Consultants Ltd. In 1990. The field work performed consisted of falling head and constant head permeability testing in diamond drill holes. The constant head tests used double and triple packer equipment.

The general conclusion of the testing was that the observed rock permeabilities were in the range of  $5 \times 10^{-8}$  to  $2 \times 10^{-9}$  m/s with lower permeabilities in fault zones (EBA Engineering Consultants, 1990).

The observed data was used to estimate the order of magnitude of potential inflows into a single heading decline for both instantaneous conditions when a fault zone was encountered and for a long term steady state condition. The estimate for the instantaneous condition was approximately 4 litres per second (50 l/gpm) for severely fractured zones which do not contain gouge or other joint healing. The estimate for the long term steady state condition was up to 28 litres per second (370 l/gpm).

This information has been used to size the capacity of the water treatment facilities described in the Environmental Management Plan in Section 5.

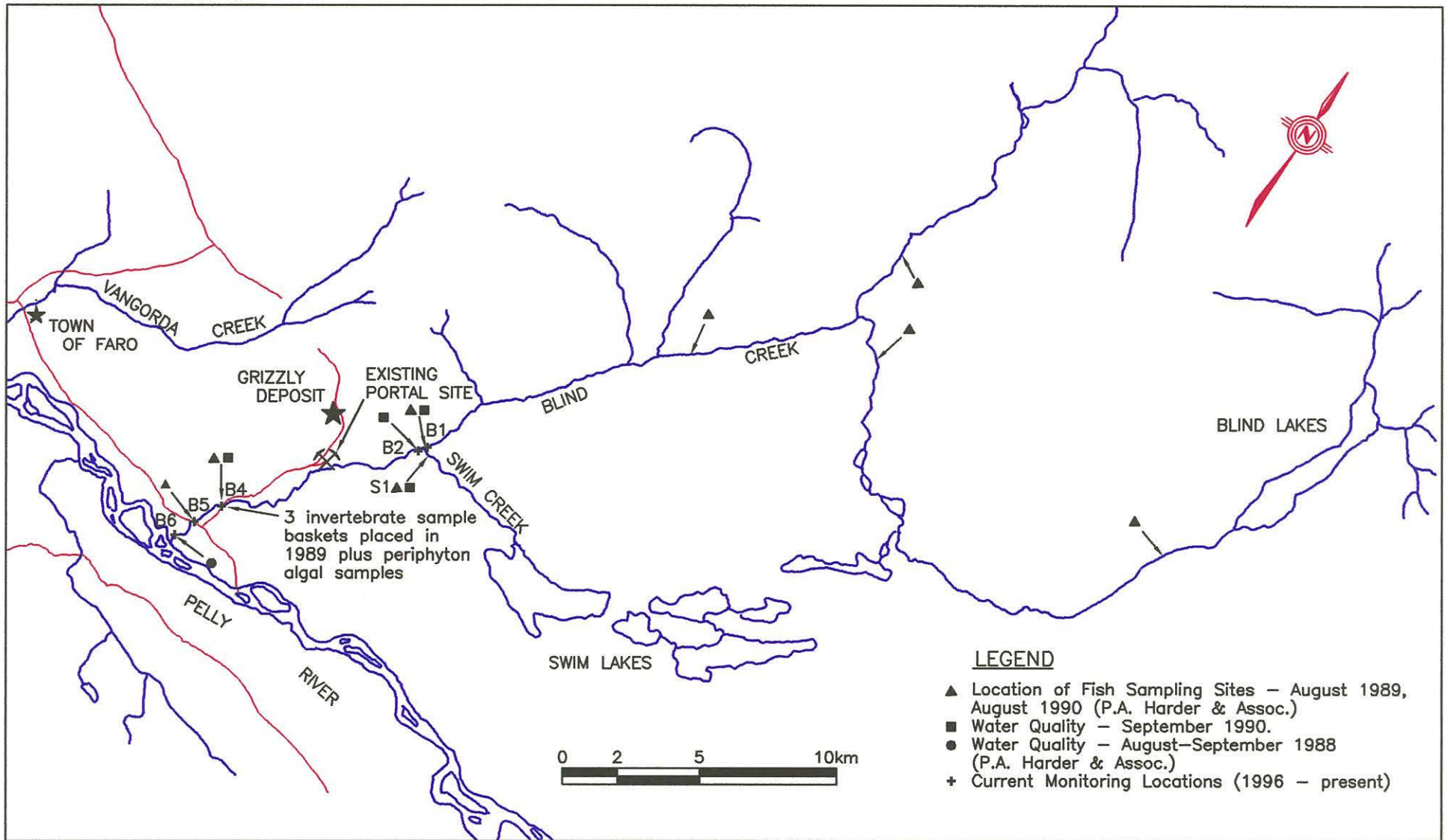
### **3.2.4 Water Quality**

Baseline water quality surveys of Blind Creek were initiated in 1975 by Kerr Addison Mines Ltd. Baseline monitoring was continued by Cyprus Anvil Mining Corporation in 1980 and re-initiated by Curragh Resources in 1990. ARMC again re-initiated baseline environmental studies in 1996. Four sites in Blind Creek were sampled and analyzed on more than one occasion (Table 3.4; Figure 3.2). Generally this water course can be described as slightly alkaline in pH, relatively soft in hardness and low in suspended solids. Total and dissolved metals are typically present at low levels although occasional spikes have been recorded. Typical and peak concentrations of selected metals are summarized on Table 3.5.

The hardness of Blind Creek water varies seasonally as shown on Table 3.4. This is in agreement with longer term observations in Vangorda Creek. The basal groundwater flow from the Vangorda Formation rocks provides higher levels of hardness during the low flow winter months when freshwater dilution is at a minimum. This is beneficial in terms of water quality and metal toxicity since metal toxicity generally decreases with increasing hardness.

A water quality monitoring schedule for Blind Creek is in place and will continue until it is either no longer deemed necessary or until it is replaced with the exploration program monitoring schedule outlined in the Environmental Management Plan described in Section 5. The current schedule calls for monthly sampling at the downstream reference location (B4) at the "new" (southern) bridge and less frequent sampling approximately 4 times per year at the upstream reference location (B1). The upstream reference location is accessed by air.





# GRIZZLY PROJECT

## UNDERGROUND EXPLORATION PROGRAM

Fig. 3.2 Fisheries Resources and Water Quality Sampling Sites

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**Table 3.5 Peak and Typical Concentrations of Selected Metals in Blind Creek**

	Zn(tot)	Zn(diss)	Pb(tot)	Pb(diss)	Fe(tot)	Fe(diss)
peak	0.20	0.031	0.032	0.01	2.51	0.326
typical	<0.03	<0.01	<0.02	<0.01	<0.20	<0.10

Source: Table 3.4

### 3.2.5 Fisheries Resources

Previous fisheries studies in the Blind Creek drainage include work done for Curragh Resources Inc. in 1989 and 1990 (Harder pers. comm.). More recently, Anvil Range Mining Corporation conducted a chinook salmon spawner survey in August 1996 (Harder 1996a). Other work in the drainage includes a counting weir that was installed in the lower river during the chinook salmon spawning period in 1995 and 1996. The weir was installed and operated by the Ross River Dena Council in cooperation with the Department of Fisheries and Oceans.

Fish species found in Blind Creek include chinook salmon, Arctic grayling, round whitefish, burbot and slimy sculpins. These fish species are found in the system throughout the year. Three survey results (1989, 1990 and 1996) indicate that Blind Creek supports a stable returning population of adult chinook salmon. There has been a close similarity between spawner timing and distributions during the three years of observation with the total number of spawners estimated at 600 to 800 fish (Harder 1996a). A total count of about 800 adult chinook was reported for the 1995 weir operation (Nora Ladue pers. comm.). Data from the 1996 weir count is not yet available.

Extensive juvenile fish sampling during August 1989 found that the most abundant species (% of total biomass in gm/m<sup>2</sup>) were slimy sculpin (36.4%), Arctic grayling (29.3%) and chinook salmon (25.4%). Burbot and round whitefish were less prevalent representing 8.4% and 0.4% of the total biomass respectively. Fish sample sites used during the 1989 study are presented in Figure 3.2.

Juvenile and adult chinook salmon are found throughout the lower 35 km of the system downstream of the Blind lakes chain. Arctic grayling are most abundant in the headwater reach (near the lakes) and in the lower reach upstream of the Pelly River confluence. Slimy sculpin are found in high abundance throughout the system.. Burbot and whitefish are only found in the lower reach within 2 km of the Pelly River confluence.

The fish resources of Blind Creek have been utilized for subsistence and recreational fishing for many years. Chinook salmon and Arctic grayling are the two most important fish species to these fisheries.

Benthic invertebrate communities in Blind Creek have been investigated most recently by Anvil Range Mining Corporation in 1996 (Laberge Environmental Services: in progress).

### 3.2.6 Wildlife Resources

Wildlife having management, economic or recreational importance in the Grizzly Project area include ungulates such as moose (*Alces alces*), caribou (*Rangifer tarandus caribou*), and mountain sheep (*Ovis dalli stonei*); carnivores such as grizzly (*Ursus arctos*) and black bear (*Ursus americanus*), wolves (*Canis lupus*), foxes (*Vulpes vulpes*), wolverine (*Gulo gulo*) and lynx (*Lynx lynx*); furbearers such as marten (*Martes americanus*), mink (*Mustela vison*), otter (*Lontra canadensis*) and beaver (*Castor canadensis*); game birds such as ptarmigan (*Lagopus lagopus*), and blue grouse (*Dendragapus canadensis*); ruffed grouse (*Bonasa umbellus*) and spruce grouse (*Canachites canadensis*); and small mammals like the snowshoe hare (*Lepus americanus*).

#### *Ungulates*

Distribution and density of ungulates in the region is seasonal. A formal survey of wildlife in the Faro area, including the proposed exploration portal was conducted in September 1990. During this survey, moose were only found at elevations between 1,756 m (4,500 ft) and 1,950 m (5,000 ft) which is at or slightly above the treeline. However, dense growths of willow, aspen and poplar located in the sub-alpine transition zone, which includes the location of the proposed portal, and in the flood plain of the Pelly River suggests that these areas provide summer and winter forage habitat for moose. During the September 1990 survey, a single-transect survey through willow-brush habitat between the deposit location and Blind Creek resulted in a count of 8 pellet groups over 100 m. This suggests significant use of the area by moose.

Caribou were only observed in alpine meadows on Mt. Mye, above 1,950 m (5,000 ft). This is typical of their distribution during summer months (Lortie, Grant pers. comm.). These animals are known to overwinter in the Tay River valley to the north of Mt. Mye, far removed from the location of the exploration activities. There have been no reported sightings of caribou on the south-facing slopes of Mt. Mye (Curragh Resources Inc. 1993).

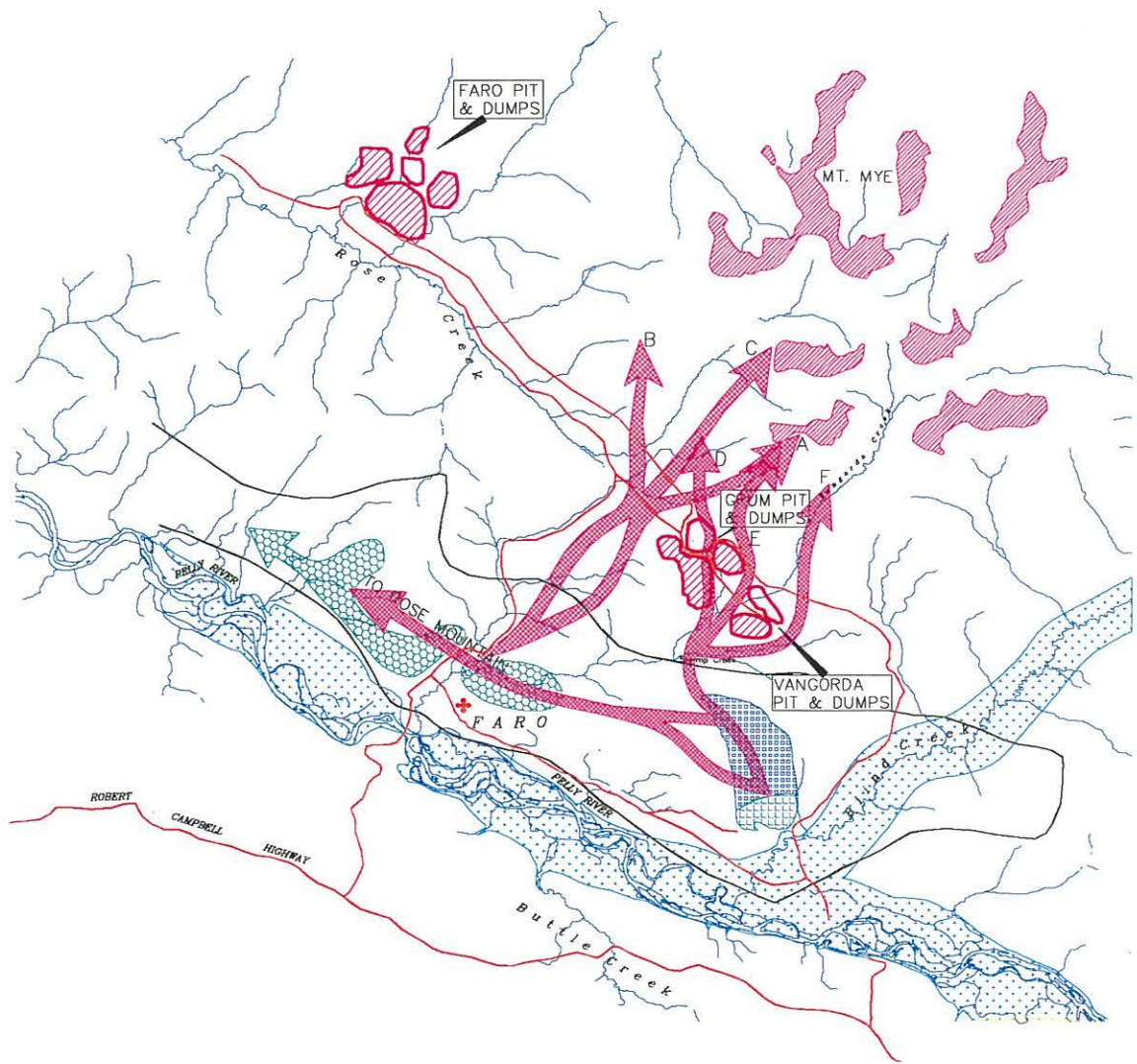
The high alpine on Mt. Mye provides summer range for a population of Fannin sheep (Figure 3.3; Curragh Resources Inc. 1993; Lortie, Grant pers. comm.). During an aerial survey in September 1990, one flock of 11 young rams were seen utilizing summer habitat on Mt. Mye while the largest portion of the known herd, a flock containing approximately 8 rams and 32 ewes was observed at much lower elevations migrating towards their known wintering grounds on Sheep Mountain near the town of Faro (Figure 3.3). Sheep Mountain is a sparsely treed ridge between 980 m and 1,750 m elevation with a predominantly south-facing aspect where the animals find grasses and other forage under a comparatively thin blanket of snow.

The area of the proposed exploration activity has not been identified as close to the Sheep migration route. Anecdotal evidence from mine operations personnel has confirmed that the Sheep migration route through the Vangorda Plateau is used by the Sheep for their annual migration(s). Informal confirmation that the Sheep migration was taking place via the Vangorda Plateau route has also been given by wildlife biologist Grant Lortie following a site visit during August 1996. Although personnel access to the exploration site will be via the Blind Creek road from the town of Faro, the "new" road which was constructed to bypass the Sheep over wintering area will minimize the impact of increased traffic along this public road.

Note: True North 1° 33' W of Grid North  
Magnetic North 30° East  
Magnetic Declination decreasing annually 4.1'

**LEGEND**

- Ram Winter Range
- Sheep and Caribou – Summer Range (Alpine Habitat)
- Lambing Area
- Moose Winter Range – from local knowledge  
See Weinstain 1992
- Sheep Winter Range
- Probable Sheep Migration Routes – Routes A, B, C, D, E & F after McCleod (1981).  
Routes B and C remain unconfirmed in available literature, however, remain as most likely route for Rams into Mt. Mye from known winter ranges above Faro (supported by local observation).
- Outline of Area burned in 1969 Fire
- Rivers
- Pit
- Dump
- Roads



0 1000 2000 3000 4000 5000 6000 meters  
SCALE 1:125 000



**FIGURE 3.3**  
SHEEP DISTRIBUTION RELATIVE TO THE GRIZZLY DEPOSIT

October 1996      Figure 3.3

*Carnivores*

Grizzly bear and black bear frequent the Faro area. Both species are omnivorous scavengers and are attracted to any easy source of food such as at a camp or dump.

No observations of wolves or lynx were made during a September 1990 wildlife survey (Curragh Resources Inc. 1993). However, scats of either fox or lynx (or both) were found in and around the local area.

Marten and mink are reported to have been trapped in the area (Curragh Resources Inc. 1993). Mink inhabit stream banks, lakeshores, swamps and forest edges. There have been no recently reported trappings or sightings of beaver in this area although they have been sighted/trapped in the past (Curragh Resources Inc. 1993).

*Game Birds and Small Mammals*

The dense brush near the proposed exploration site provides good habitat for game birds like grouse and ptarmigan and small mammals like the snowshoe hare. A single 150 m transect walk through this habitat resulted in the sighting of 3 ruffed grouse, 1 spruce grouse, 3 blue grouse, 2 willow ptarmigan, and 7 snowshoe hares (Curragh Resources Inc. 1993).

## **4. PROPOSED UNDERGROUND EXPLORATION PLAN**

### **4.1 Introduction**

#### **4.1.1 General**

A total of 86 surface diamond drill holes were drilled between 1976 to 1991 of which 56 holes intersected the main AB zone of the Grizzly ore deposit. The remainder of the holes were drilled for geotechnical purposes or for investigation of other zones. All holes were drilled to a depth of approximately 1,000 metres below surface. The diamond drill holes are illustrated in relation to the deposit on Figure 4.1.

The surface drill hole intersections have provided sufficient information to verify the existence of significant mineral resources. The wide spacing of the surface drill holes, however, does not allow for a rigorous interpretation of the mineralized horizons. It is necessary, therefore, to perform an underground exploration program in order to prove the existence of an economically mineable orebody.

The economic analysis of the Grizzly deposit will benefit from the pre-existence of important infrastructure including the town of Faro, the concentrator plant at the Faro mine site, an operating organization, road access and communications systems. The intent of the evaluation studies performed on the Grizzly deposit will be to begin ore production prior to depletion of open pit reserves in the Grum Pit.

#### **4.1.2 Underground Access**

The Grizzly deposit is located from 580 to 900 metres below surface. Access to the orebody could be established via either a vertical shaft or a decline. Due to the expenses involved in underground development, the underground access developed for the exploration program would be incorporated into future mining plans if the economic feasibility is positive.

Five potential shaft locations have been considered to date. Curragh Resources Inc. tested one location north of the deposit and completed a pilot hole at this location in 1990. Severe ground conditions and a major fault zone eliminated this location from further consideration.

It is difficult to identify suitable locations for a shaft due, in part, to the need to incorporate exploration development into future mining plans. A shaft requires a surrounding safety pillar which, since the deposit is open to extension in all directions, effectively removes a significant quantity of potential ore grade material from the mineable reserve. This fact together with the higher cost of a shaft are the reasons for rejecting the shaft option for this exploration program.

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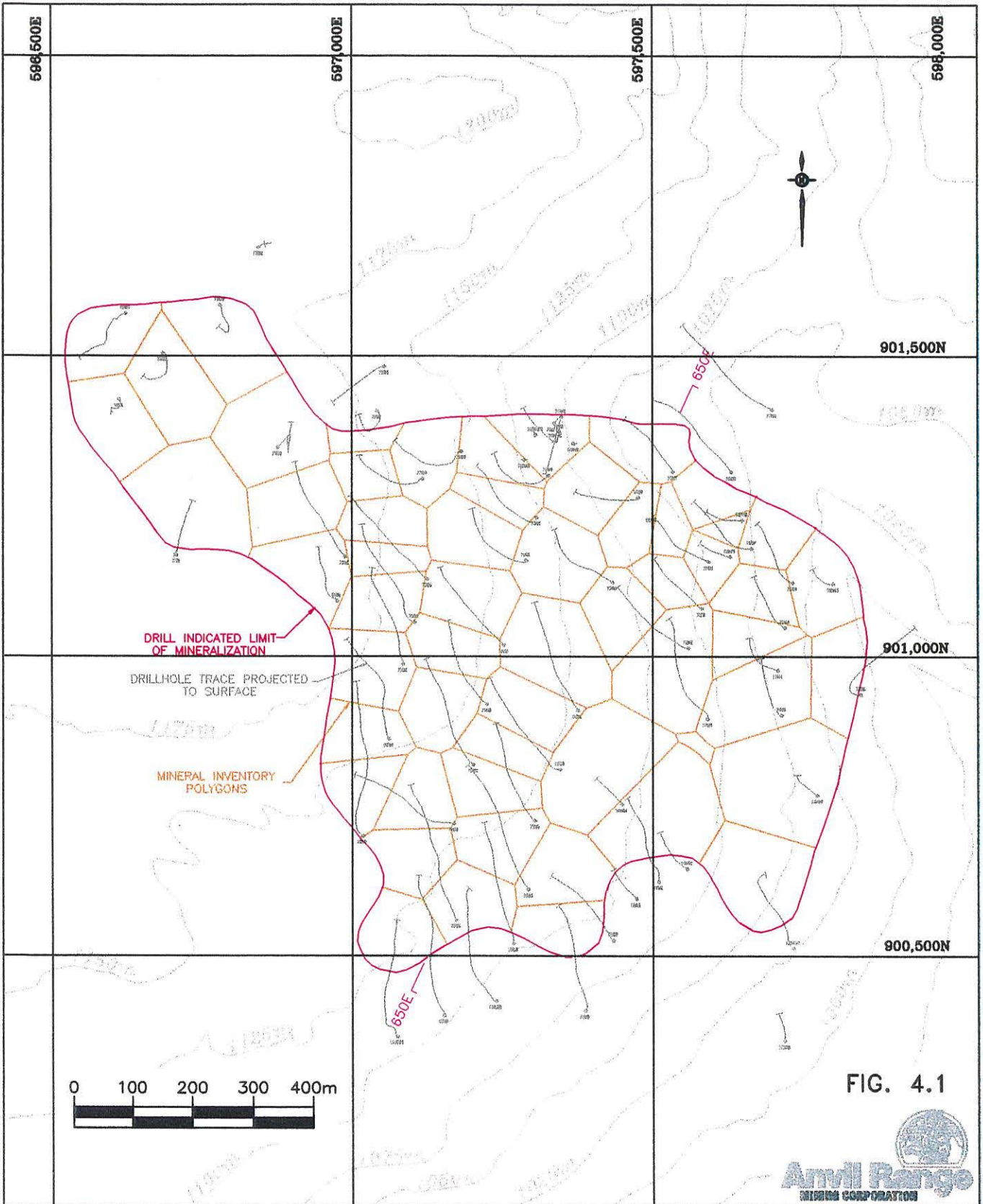


FIG. 4.1



The portal (entrance) of a decline is generally best located at a relatively low elevation within reasonable distance from the deposit. For the Grizzly underground exploration project, the most suitable location was selected at the established portal site in the Blind Creek valley. The preparation of this site (cleaning the face and building the rock pad) was completed by Curragh Resources in 1990. Anvil Range Mining Corporation reopened the road to the portal site and leveled some areas of the rock pad to allow the appropriate investigations to be performed. The location of the portal site is identified on Figures 2.3 and 3.2.

The decline could potentially be used for ventilation and/or equipment access during the production stage if the economic feasibility is positive. The decline would not be used for production haulage of ore during the future potential production stage.

#### **4.1.3 Underground Exploration**

Access to the Grizzly deposit will be gained by a decline (ramp) from the established portal site in the Blind Creek valley at elevation 835 masl (metres above sea level). The decline will be driven at -18% and will be approximately 1,700 metres in length. The decline is illustrated in plan view on Figure 4.2 and in long section on Figure 4.3.

One concept for hangingwall, footwall and in ore exploration is illustrated on Figures 4.2 and 4.3. The actual layout of exploration drifts may differ from the concept illustrated. Figure 2.3 shows the concept of diamond drilling a fan of holes from the hangingwall and footwall drifts.

The underground exploration program includes the following areas:

- Portal and surface facilities
- Decline
- Underground exploration
- Evaluation of results and feasibility study

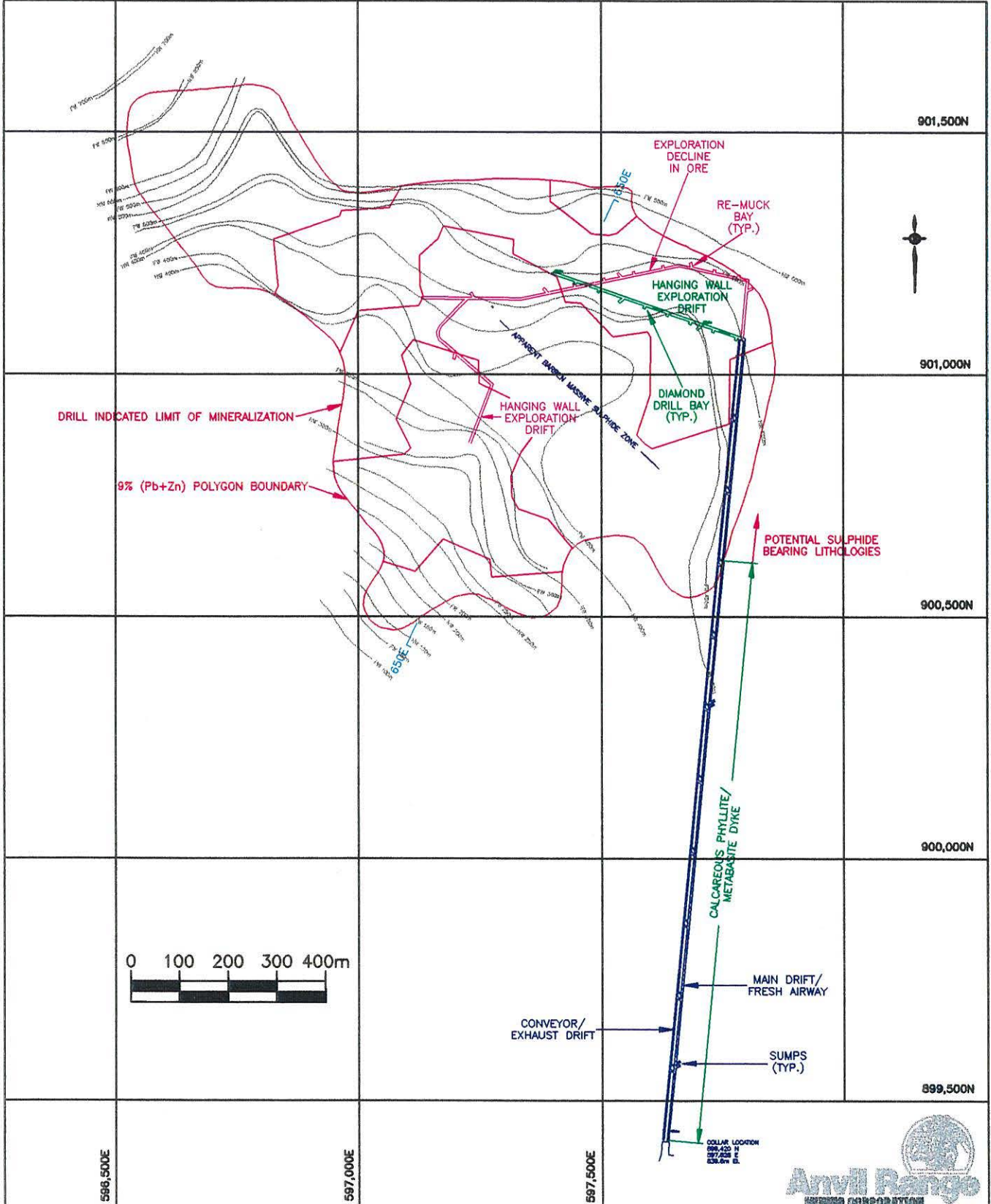
### **4.2 Details of Work**

#### **4.2.1 Portal and Surface Facilities**

The surface activities for preparation of the existing rock pad and face development were performed by Curragh Resources Inc. in January 1991 and February 1991. Dozer work included the construction of a vehicle access road, excavation and leveling to facilitate the collaring of a decline and installation of surface infrastructure.

The existing rock pad will allow initial installation of the facilities required immediately. The pad will then be enlarged using acid consuming and neutral rocks excavated in the upper portion of the decline such that the remaining facilities may be installed.

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The surface facilities for the underground exploration project will include mine ventilation fans, mine air heating, mine office, diesel air compressors, diesel generators, fuel tanks, propane tanks and a maintenance shop/warehouse. Core sheds will be constructed with the commencement of underground exploration drilling. Personnel will be housed at the Cando camp in the town of Faro with the dry/shower facility located either at the portal site, at the existing Vangorda Plateau dry or in the town of Faro. One concept for the layout of surface facilities at the portal site is illustrated on Figure 4.4. The actual layout of the facilities may differ from the concept illustrated.

The Blind Creek road from the town of Faro will be used for transportation of personnel. Heavy materials will most likely be delivered to site via the upper Blind Creek road from the Grum/Vangorda mine site in order to eliminate the need for an upgrade of creek crossing structures on the lower Blind Creek road.

#### **4.2.2 Decline**

The ramp or decline will provide access to the underground deposit to allow further exploration work to be carried out.

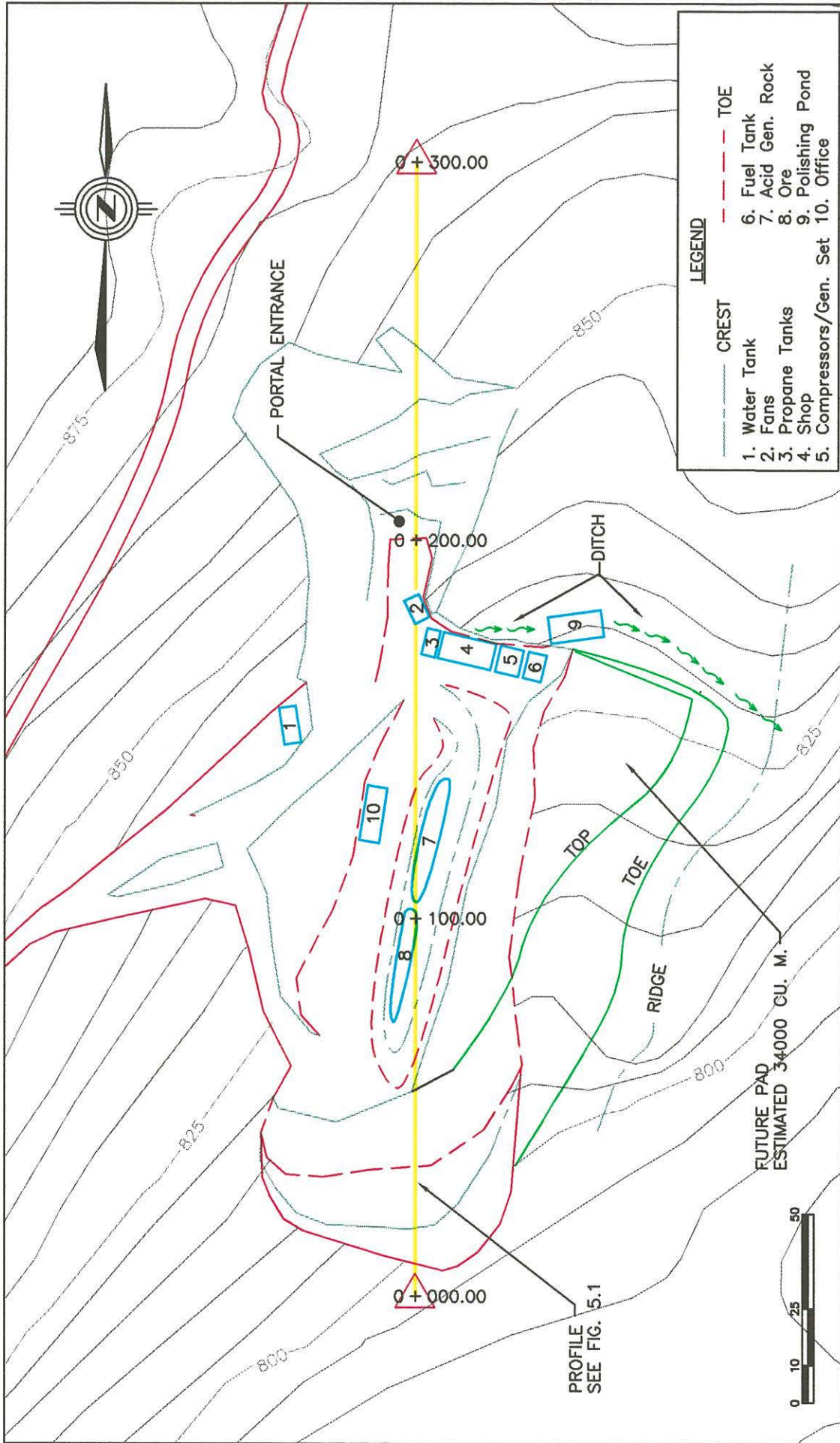
Preparatory investigations for driving the decline were carried out by Curragh Resources during 1990 and 1991. Ten geotechnical test holes were drilled along the proposed alignment of the decline in order to collect information regarding ground conditions and engineering geology. This information remains valid and has been incorporated into the current proposal.

Mechanized advance with a full faced tunnel boring machine (TBM) or road header type continuous miner was considered as an alternative to the conventional drill and blast mining cycle. However, the frequent occurrence of quartz veins and diorite dykes combined with uncertainty regarding hydrogeological conditions render the application of mechanized advance very risky.

Conventional drilling and blasting will be used to drive the decline. The initial water supply for drilling will be from a water tank filled from an off site source as described in the Environmental Management Plan in Section 5. Once water is encountered in the decline, this water will be collected in underground sumps and used for drilling as much as practical.

In general, the difficult ground conditions indicated from the geotechnical surface drilling dictate that the underground openings be kept as small as possible. This is an important consideration in selecting the configuration of the decline.

Because of the great distance to the deposit, large (possibly 6 feet diameter) ventilation ducting would be required to provide fresh air for the mobile diesel equipment and personnel required to drive a single heading decline. The diesel powered equipment and large ventilation ducting would require a large opening which is in conflict with the expected ground conditions. A costly and time consuming effort would be necessary to support the size of opening required for a single heading decline.



- LEGEND**
- CREST
  - TOE
  - 1. Water Tank
  - 2. Fans
  - 3. Propane Tanks
  - 4. Shop
  - 5. Compressors/Gen. Set
  - 6. Fuel Tank
  - 7. Acid Gen. Rock
  - 8. Ore
  - 9. Polishing Pond
  - 10. Office

# GRIZZLY PROJECT

## UNDERGROUND EXPLORATION PROGRAM

Fig. 4.4 Conceptual Layout of Surface Facility.

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DATE	96/10



A twin ramp would take advantage of two parallel headings of relatively small size as compared to a single heading decline. In addition to smaller sized openings which would require significantly less effort for installation of ground support, the double heading decline offers several other important advantages over the single heading decline.

In a twin ramp, one heading would be used as a conveyor gallery and for return air. The conveyor would significantly reduce the numbers of pieces of mobile diesel equipment required underground and, thereby, the volume of fresh air required. The second heading of a twin ramp would be used for fresh air supply and to provide access for people and equipment. Each of the two headings of the twin ramp would be considerably smaller than a single ramp. Thus, ground control would be less difficult.

Figures 4.5 through 4.7 illustrate the difference in opening sizes for the single heading and double heading declines. The sizes illustrated are conceptual and are intended to allow a comparison of the two options rather than provide a detailed design of either option.

A final decision regarding whether the single or double heading decline will be selected is pending. The decision will be forwarded to the Yukon Territory Water Board prior to the start of work.

The selection of the type of decline to be driven does not affect the Environmental Management Plan in Section 5 except in terms of the volumes of rock to be excavated from the decline. There will be approximately 8% more material removed from the double heading decline than from the single heading decline. The type of decline to be driven is an operational issue which should not impact on the environmental aspects of the project.

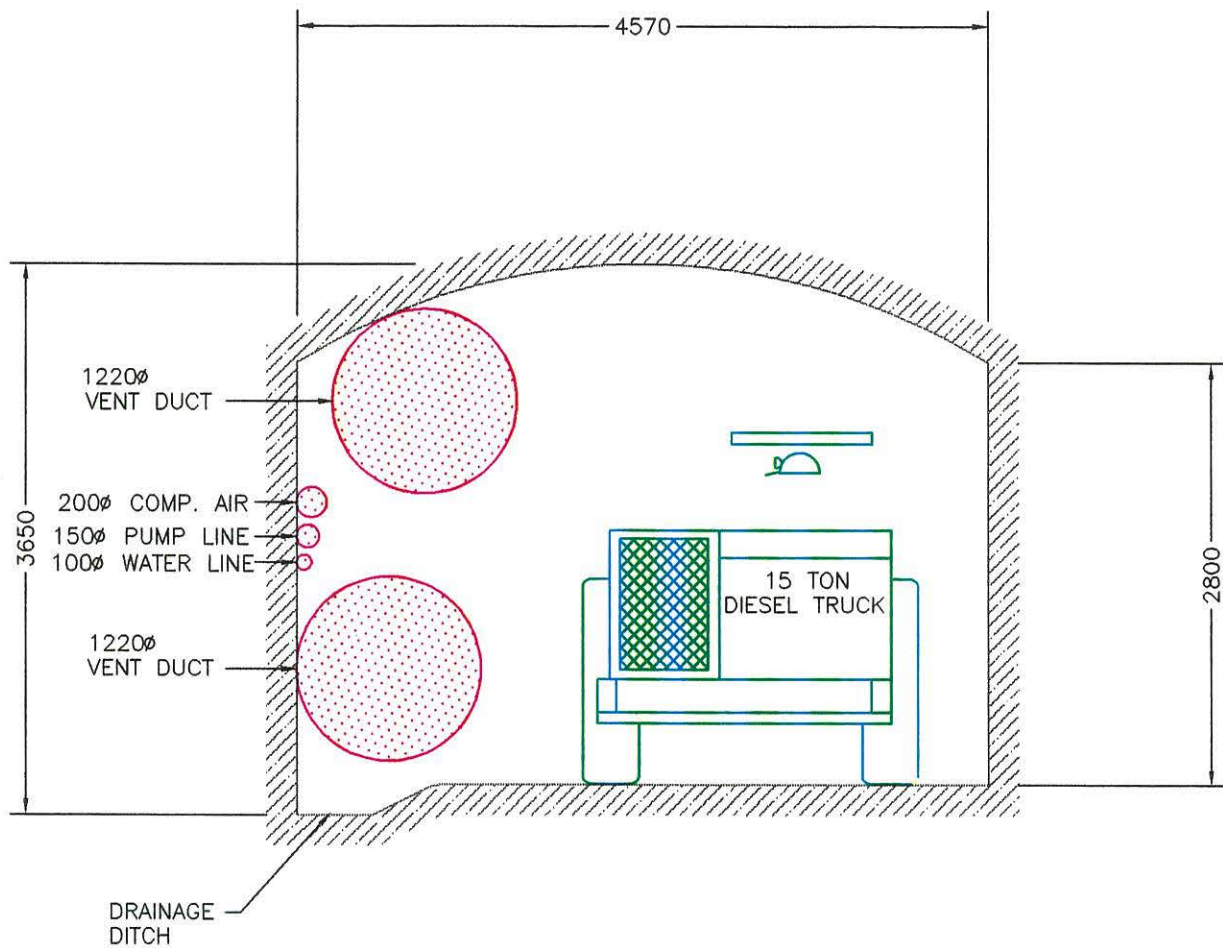
### **4.2.3 Underground Exploration**

Underground exploration will enhance the knowledge of the deposit and improve the confidence factor of ore reserves. The program can be carried out through diamond drilling from the hangingwall or footwall or by drifting within the ore horizon. A combination of these methods is contemplated as a means of confirming the continuity of ore horizons as well as gathering data on the structure of ore blocks. While drilling from the hangingwall and footwall provides a better overall picture of an ore block, it is only by drifting within the ore horizon that geotechnical data and ore samples for metallurgical testing can be obtained.

Existing drill data is being reworked and turned into a 3-dimensional computer model.

New information from the proposed underground exploration program will be evaluated immediately and used to define the next step. Thus, the underground exploration program will be designed with this flexibility in mind.

Thickness, continuity, grade and dip of the orebody as well as characteristics of the hangingwall and footwall are required to determine mining methods and operating costs.



MAIN RAMP DRIFT SECTION

TYPICAL DURING EXCAVATION PHASE

**GRIZZLY PROJECT**

UNDERGROUND EXPLORATION PROGRAM

Fig. 4.5 Single Ramp – Typical Section Using Small Diesel Truck



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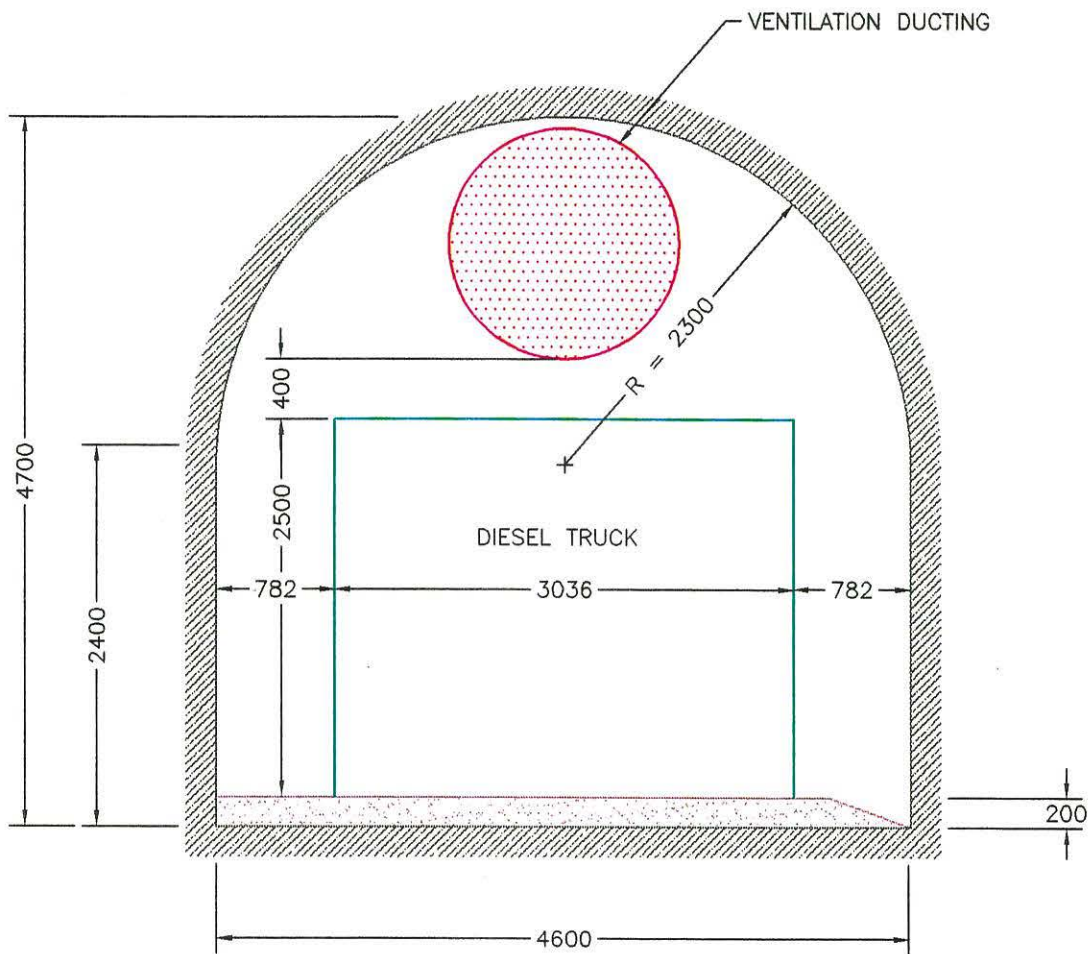
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AREA 19.34 sq. m.

# GRIZZLY PROJECT

UNDERGROUND EXPLORATION PROGRAM

Fig. 4.6 Single Ramp – Typical Section Using Large Diesel Truck



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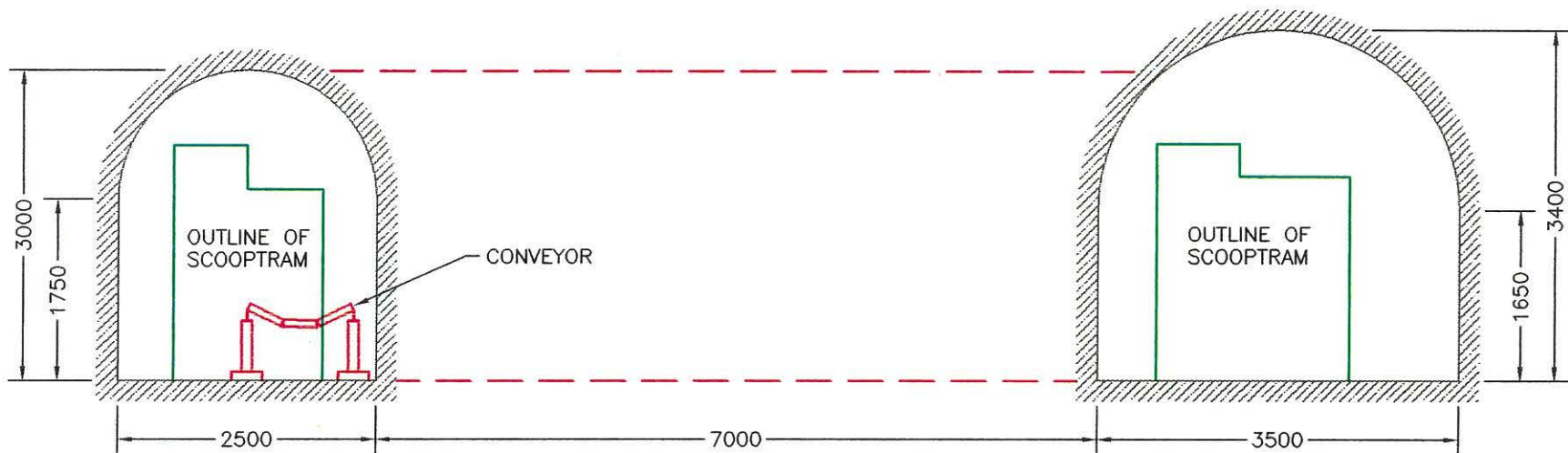
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**GRIZZLY PROJECT**  
 UNDERGROUND EXPLORATION PROGRAM

Fig. 4.7 Twin Ramp  
 Conveyor Haulage



In general, some of the physical parameters controlling the mining method are:

- orebody strike and dip
- orebody thickness
- ore uniformity (grade, thickness, strength)
- strength of ore, hangingwall and footwall
- depth of orebody and in-situ stresses

The purpose of the underground exploration program is to:

- enhance the existing knowledge of the deposit
- obtain geotechnical data for mine safety and mine design
- obtain hydrological data to evaluate pumping requirements
- obtain a representative sample for metallurgical testing

#### **4.2.4 Evaluation of Results and Feasibility Study**

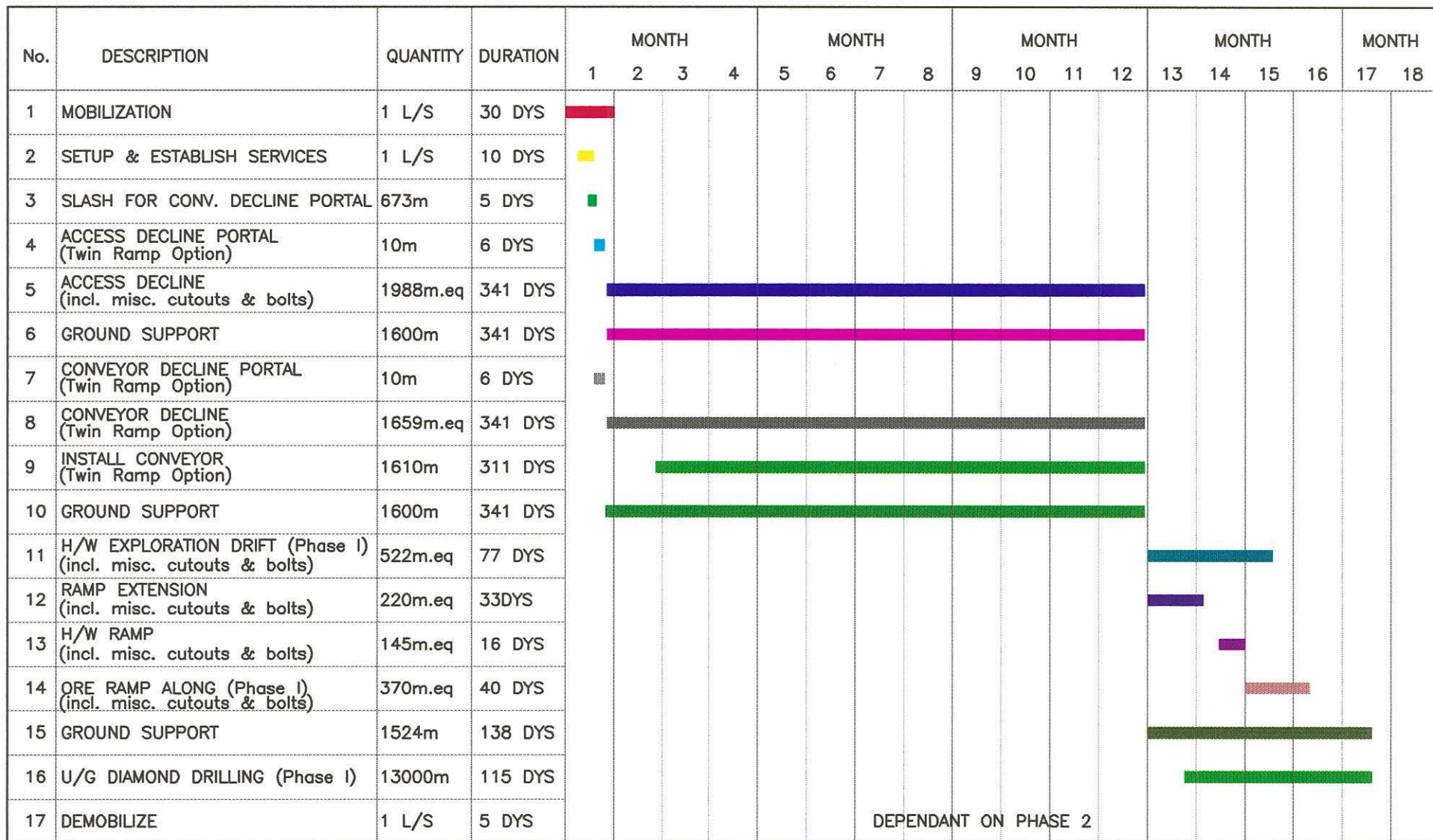
Initial information on the geology, hydrology and ground conditions will be obtained during the excavation of the ramp. Information obtained from the underground exploration program will form the basis for the feasibility study which will show whether or not the project is economically viable. Uncertain and low zinc prices combined with the expected difficult mining conditions and high costs for ore and concentrate transportation make the execution of the Grizzly project a great challenge for Anvil Range Mining Corporation and the people of the Yukon.

#### **4.3 Project Schedule**

The schedule for underground exploration is shown on Figure 4.8. Underground access with a decline is scheduled to take 12 months with phase 1 lateral development and exploration drilling to take another 5 months.

The amount of horizontal drifting and exploration drilling will be decided on a day to day basis as the work progresses. As new information is obtained, it will be fed immediately into a three dimensional computer model to allow for planning of the next step of the program. Using this flexible approach will make it possible to obtain the necessary information to reach the required objective of the program in the most efficient manner.

Phase 2 lateral development and exploration drilling may extend the project if it should be necessary to obtain additional information to satisfy the overall objectives of the underground exploration program.



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**GRIZZLY PROJECT**  
UNDERGROUND EXPLORATION PROGRAM

Fig. 4.8 Project Schedule



**5. ENVIRONMENTAL MANAGEMENT PLAN**

**5.1 Management Of Excavated Rock**

**5.1.1 Upper Decline (Acid Consuming Rock)**

The rock mined during the initial 7 months of advance will be from the upper portion of the decline (0-1,225 metres) and will consist of acid consuming calcareous phyllites with minor amounts of calcareous meta igneous mafic dykes of the Vangorda Formation. The rock types have been logged in the drill holes illustrated on Figure 4.1. These rocks have a low sulphide content and contain a significant amount of calcite (10-30% in calcareous phyllites).

Testing of comparable rocks from the Vangorda Plateau shows that the calcareous phyllites of the Vangorda Formation are strongly acid consuming. Test results presented in the Vangorda Plateau Development Application for Water Licence for calcareous phyllite are reproduced in Table 5.1 and show net neutralization potentials of +167 and +104 kg CaCO<sub>3</sub>/tonne for the Vangorda and Grum pits, respectively. Site specific acid base accounting analyses and shake flask extraction tests will be performed to confirm the nature of acid consuming rocks associated with the Grizzly deposit.

**TABLE 5.1  
ACID BASE ACCOUNTING RESULTS FOR CALCAREOUS PHYLLITE**

Source	Paste pH	Total Sulphur %	Max. Pot. Acidity	Neutralization Potential	Net Neut. Potential
Vangorda Pit	8.4	0.06	1.80	169.10	167.30
Grum Pit	8.23	0.32	10.03	113.61	103.58

Units: kg CaCO<sub>3</sub>/tonne

Source: Curragh Resources Inc. 1989

As described in Section 4.2.2, the volume of material to be removed from the decline will depend on the selection of either a single heading or twin ramp. However, for the purposes of this Application for Water Licence, the twin ramp has been assumed since this option results in a greater volume of material (about +8%) to be handled at the portal site. For the twin ramp, there will be an estimated 37,000 m<sup>3</sup> (approximately 92,500 tonnes) of acid consuming rock excavated from the upper portion of the decline (including an allowance for overbreak and a swell factor of 33%).

This material will be used to enlarge the existing work area and for resurfacing of the existing Blind Creek Road to the Vangorda Plateau. The ultimate boundaries of the work area are illustrated on Figure 4.4 and will not encroach into the drainage of Side Creek located immediately north of the portal site. The layout illustrated on Figure 4.4 is conceptual and the actual layout of facilities and the final boundaries of the rock pad may vary within the design constraints of the ridge to the north of the rock pad.

The rock removed from the decline and placed on the rock pad will increase the present pad height by approximately 7 metres. The maximum height above natural ground of the rock pad will be increased from approximately 12 metres (current) to about 17 metres (ultimate). Rock will be placed to ensure an overall lower slope angle of 2H:1V in order to increase the geotechnical stability of the pad. A typical section through the ultimate rock pad is shown on Figure 5.1.

No significant subsidence or failure of the existing rock pad has been observed during recent inspections by mine engineering personnel beyond minor cracking along the crest. These observations were made after the pad had been in place for approximately 6 years which provides confirmation that the ground conditions are suitable for the rock pad envisioned for the exploration program.

**5.1.2 Lower Decline and Lateral Development (Acid Generating Rock)**

The lower portion of the decline (1,225 metres plus) and parts of any hangingwall or footwall drifts will be driven in various rock types which will include some calcareous phyllite (described in Section 5.1.1) and some acid generating rock types. The rock types have been logged in the drill holes illustrated on Figure 4.1. The rock types which are acid generating will be removed from the portal site and placed in the Vangorda Rock Dump or Vangorda Open Pit.

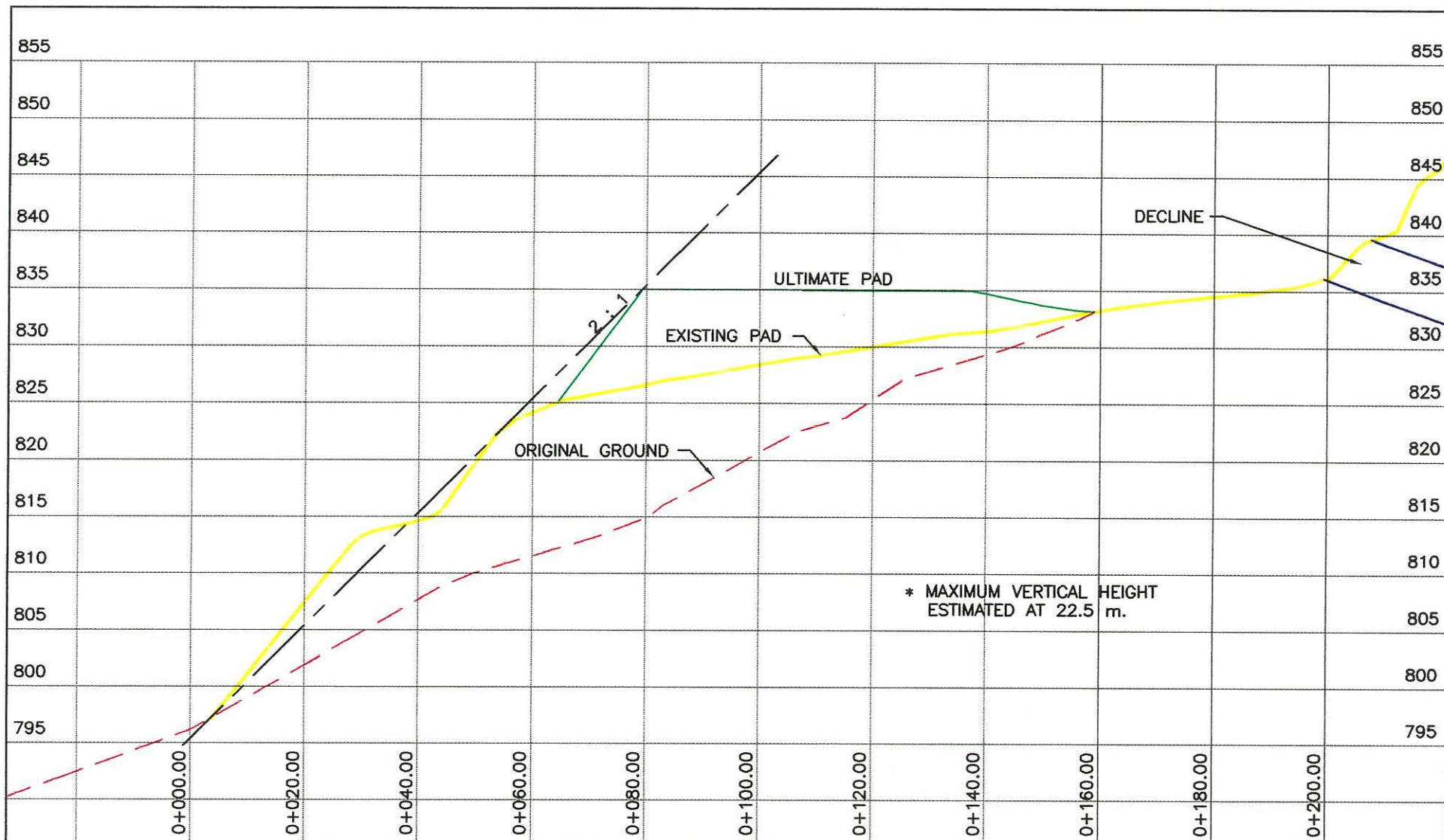
Testing of comparable rocks from the Vangorda Plateau shows that the acid generating rock types vary from neutral to strongly acid generating with net neutralization potentials ranging from +17/-12 for non-calcareous phyllite to -1,367/-991 for pyritic massive sulphide (kg CaCO<sub>3</sub>/tonne). Test results presented in the Vangorda Plateau Development Application for Water Licence for these rock types are reproduced in Table 5.2. Site specific acid base accounting analyses and shake flask extraction tests will be performed to confirm the nature of acid generating rocks associated with the Grizzly deposit.

**TABLE 5.2  
ACID BASE ACCOUNTING RESULTS FOR ACID GENERATING ROCK TYPES**

Rock Type	Source	Paste pH	Tot S %	Max Pot. Acidity	Neut. Potential	Net Neut. Potential
Graphitic Q'ite	Vangorda Pit	5.80	8.44	263.50	3.88	-259.62
Graphitic Q'ite	Grum Pit	6.55	8.68	271.43	29.82	-241.62
Py Mass Sulph	Vangorda Pit	7.60	38.5	1200.00	208.55	-991.45
Py Mass Sulph	Grum Pit	5.88	44.9	1400.00	33.00	-1367.00
Altered Phyllite	Vangorda Pit	7.25	2.92	91.32	8.44	-82.88
Altered Phyllite	Grum Pit	7.98	1.87	58.53	23.52	-35.01
Carb Phyllite	Vangorda Pit	7.87	1.87	58.43	35.03	-23.41
Carb Phyllite	Grum Pit	7.62	1.45	45.35	25.83	-19.52
Non Calc Phyllite	Vangorda Pit	7.16	0.66	20.69	8.16	-12.53
Non Calc Phyllite	Grum Pit	7.93	0.38	11.90	28.78	16.88

Units: kg CaCO<sub>3</sub>/tonne

Source: Curragh Resources Inc. 1989



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# GRIZZLY PROJECT

## UNDERGROUND EXPLORATION PROGRAM

Fig. 5.1 Conceptual section through ultimate rock pad.



Some portion of the lower decline passes through rocks logged as calcareous phyllite but with less confidence due to uncertainties in the structural interpretations. In addition to the upcoming program of acid base accounting and extraction tests, rock from this location will be characterized on site to determine the environmental characteristics. Rock from this location will be handled as potentially acid generating material until proven otherwise. Any rocks confirmed to be acid consuming will be placed at the portal site as part of the rock pad.

The field characterization of rock type will be made by the on-site geologist whose responsibilities will also include face mapping and geological control. The calcareous phyllites are readily identifiable on a visual basis and the geologist will determine the suitability for placement at the portal site. The geological characterization will be performed at least every other round (approximately 3 metres advance) and generally every round.

Any material confirmed to be acid generating will be stockpiled separately from other rock as illustrated conceptually on Figure 4.4. This material will be removed from site at least monthly and taken to the Vangorda Plateau area where it will be placed in the Vangorda rock dump, the Grum rock dump or the Vangorda pit.

The trucks used to remove rock material from the portal site will be selected such that they can negotiate the existing Blind Creek road to the Vangorda Plateau. This will negate the need to make significant improvements to the upper Blind Creek road from the portal site to the Vangorda mine site.

As described in Section 4.2.2, the volume of material to be removed from the decline will depend on the selection of either a single heading or twin ramp. However, for the purposes of this Application for Water Licence, the twin ramp has been assumed since this option results in a greater volume of material (about +8%) to be removed from the decline and handled at the portal site.

For the twin ramp, there will be an estimated 60,000 m<sup>3</sup> (approximately 150,000 tonnes) of material removed beyond the 1,225 metre point of the decline (including 33% swell factor). As stated, it may not be necessary to remove all of this material from the portal site. The conceptual outline of the rock pad illustrated on Figure 4.4 allows for the placement of an additional volume of approximately 25,000 m<sup>3</sup> of acid consuming rock without enlarging the ground area occupied by the rock pad.

The inclusion of this volume of acid generating rock into the Vangorda Plateau Developments does not affect these developments due to the relatively small quantity relative to the volumes already placed or planned.

### **5.1.3 Ore**

Ore grade material will be removed during the exploration program as a result of in-ore test mining and in-ore exploration drifts. This material will be acid generating and will be segregated at the portal site prior to removal in the manner described in Section 5.1.2. This material will eventually be taken to the Faro mine site and passed through the concentrator plant. This will ensure that maximum use is taken from this natural resource.

The quantity of ore material removed from the Grizzly Deposit may total up to 100,000 tonnes which will include material used for metallurgical testing.

## **5.2 Management Of Surface Facilities**

### **5.2.1 Water Supply**

Initially, the water required for equipment operation will be supplied from off-site. Once groundwater is encountered underground (fault zones), this water will be used to supplement and/or replace the off-site water supply.

The initial water source could be from Side Creek located immediately north of the portal site. Water would be pumped, in this case, to a holding tank located at the portal site. Alternately, the off site source of water could be Blind Creek at the old (northern) bridge but will not be Blind Creek at any location where there is not an existing road access to the creek side. Pump intakes would be screened to Department of Fisheries and Oceans specifications. In this case, water would be trucked to a holding tank located at the portal site. The salmon spawning run during early August will be protected by a restriction on the taking of water from Blind Creek during this period.

The quantity of water used for drilling during this initial stage of the program is up to 50 US gpm.

The demand for potable water will depend on the selected location for the dry/shower facility. The options for locating the facility are at the portal site, at the existing Vangorda Plateau dry or in the town of Faro. If the dry facility is located at the portal site, then the water supply will be the same as described above.

Notification will be provided to the Water Board of the dry/shower facility option selected prior to the start of work.

### **5.2.2 Sewage System**

There are two options under consideration regarding sewage management. One option is for a septic system serving toilets associated with an on-site dry/shower facility. The septic system installed for this option would adhere to standards outlined in applicable legislation. The other option is to utilize chemical toilets which do not require a septic system.

Notification will be provided to the Water Board of the sewage management system option selected prior to the start of work.

### **5.2.3 Used Oil Handling**

Used oil will be generated during maintenance and repairs to underground heavy equipment. These procedures will take place in the maintenance shop located conceptually on Figure 4.4. The maintenance shop will be equipped with an impermeable floor and a clean out sump. This is necessary to prevent the migration of any spilled oil into the underlying rock pile.

Used oil will be stored on-site in drums and transported to the Faro mine site where it will be handled in the same manner as other used oil generated on the Faro site which is to mix with diesel fuel for burning in the heating plant.

#### **5.2.4 Gasoline, Fuel And Glycol Handling**

Diesel fuel and gasoline will be required to operate the underground heavy equipment, the diesel electric generators and various other equipment. Glycol (antifreeze) will be required during the winter season. Installation of the storage tanks will include secondary containment capable of containing 110% of the tank capacity.

The expected size of diesel fuel tank to be installed at the portal site is 10,000 US gallons.

#### **5.2.5 Chemical Handling and Storage**

The reagents used for water treatment may include sodium hydroxide, ferric sulphate and flocculants. The water treatment reagents will all be stored in the treatment building which will be kept locked when not attended.

These reagents are compatible for storage. Spill containment will be incorporated into design of the building as a raised concrete sill around the foundation which would contain 110% of the stored volume.

#### **5.2.6 Garbage And Scrap Material Handling**

Garbage containing putrescible (foodstuff) material will be temporarily stored in an enclosed shed or building and taken off site at least once per week (every seven days). The garbage will be taken either to the Faro town dump or to the Faro mine site where it will be handled in the same manner as other garbage. There will be no garbage containers for putrescible garbage located outside of an enclosed shed or building.

Non-putrescible scrap materials may be temporarily stored in bins or other open containers and taken as required to the Faro mine site where they will be handled in the same manner as other scrap materials.

#### **5.2.7 Fire Fighting Equipment**

It will be the responsibility of the mining contractor to provide the required fire fighting equipment pursuant to applicable legislation. The appropriate fire fighting equipment will be available and maintained at the site.

#### **5.2.8 Safety/First Aid Coverage**

It will be the responsibility of the mining contractor to provide the required safety and first aid coverage pursuant to applicable legislation. The appropriate safety and first aid equipment will be available and maintained at the site.

### **5.2.9 Access Roads**

The access road to the upper settlement pond will be a sidehill cut road approximately 400 metres in length which will provide vehicle access to the treatment building and settlement pond location. The roadway will be approximately 4 metres wide excluding allowance for side slopes. There are no known requirements for culverts along this right of way. However, culverts will be installed if deemed necessary at the time of road construction. Trees and brush removed from the road right of way will be either buried locally or piled and burned locally. This road may be surfaced with acid consuming rock removed from the portal or with quarried rock/gravel from the Vangorda minesite.

There are no requirements for alterations to the existing stream crossings of the Blind Creek Road. In order to facilitate safe vehicle travel, the Blind Creek road may be widened by up to 2 metres in locations which are narrow or which require widening for safety reasons (ie. placement of guardrails or upgrading blind corners). Local resurfacing of the Blind Creek road may also be performed in locations which are persistently soft, wet or slippery. The resurfacing would utilize either acid consuming rock removed from the decline or quarried gravel/rock delivered from off site.

Road maintenance will include grading and winter snow removal.

It is expected that large vehicles such as fuel tankers will travel to the portal site via the Vangorda Plateau and the upper Blind Creek Road. In this case, the only traffic on the lower Blind Creek road from the town of Faro would be light vehicles transporting personnel to and from the portal site.

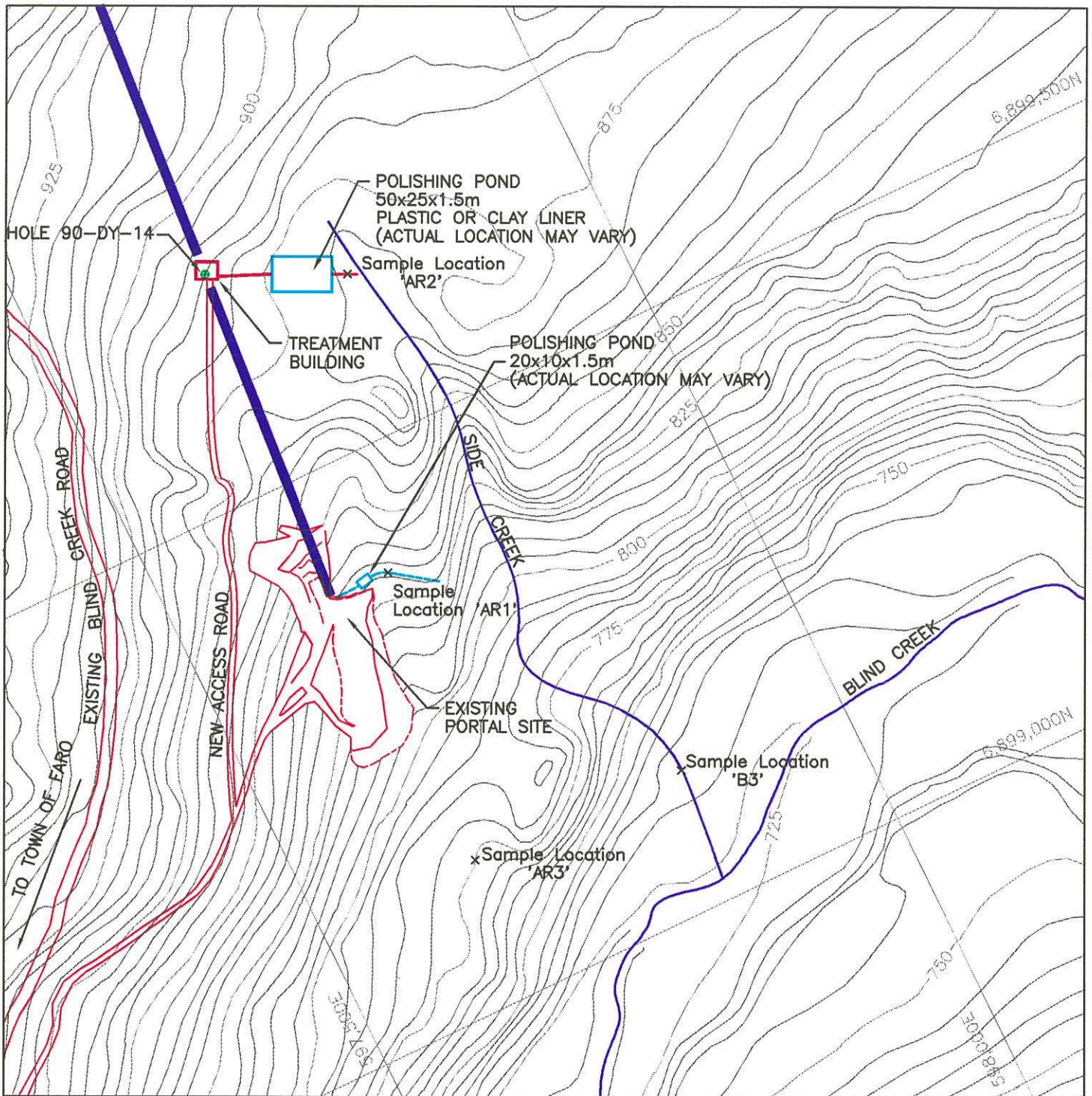
## **5.3 Water Management System**

### **5.3.1 Normal Operations**

Water required for drilling and various other underground operations will be recycled as much as possible through underground sumps. Underground sumps will be used to clarify water prior to re-use in operations or removal to surface.

The proposed water management system for water pumped from the decline achieves two basic goals. The first is that the system takes advantage of the local topography to allow room for an adequately sized settlement pond. The second goal achieved is that the system eliminates the need to handle water at the relatively small portal site close to Blind Creek.

The initial advance in the decline will be through acid consuming rocks as described in Section 5.1. During this stage, water pumped from the decline may contain suspended solids in excess of the maximum allowable discharge limit. All water which is pumped from the decline during this stage will be passed through a settlement pond at the portal site prior to discharge. The pond has been conceptually designed as 1.5 metres deep by 10 metres wide by 20 metres long with a liner of either an impermeable geomembrane or compacted local till. This design provides 24 hour retention time for the maximum estimated flow of 50 US gpm. The outflow from the settlement pond will be directed into Side Creek which flows into Blind Creek. The conceptual settlement pond is illustrated on Figure 5.2.



# GRIZZLY PROJECT

## UNDERGROUND EXPLORATION PROGRAM



**Anvil Range**  
MINING CORPORATION

Fig. 5.2 Layout of Treatment Facilities and Water Sampling Locations

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DRAWING:	TF-SITE.DWG	CHECKED	APPROVED 96/10

Once the advance of the decline has passed 1,255 metres, water collected in underground sumps which is not re-used underground will be pumped to surface via a vertical drill hole located at approximately 255 metres. This will eliminate the need for the portal site settlement pond. The drill hole will be a large diameter hole (estimated 5") near an existing hole which was drilled for geotechnical information (90-DY-14). The pumping system will be designed to lift 300 USgpm of water the vertical distance to surface of 85 metres. The location of the dewatering hole is shown in plan view on Figure 5.2 and in section on Figure 5.3.

The surface topography at this location is a local level area which will allow construction of a larger settlement pond capable of treating the increased volumes of water anticipated as the decline advances through water bearing fault zones. The volume of water used for design purposes is 300 USgpm.

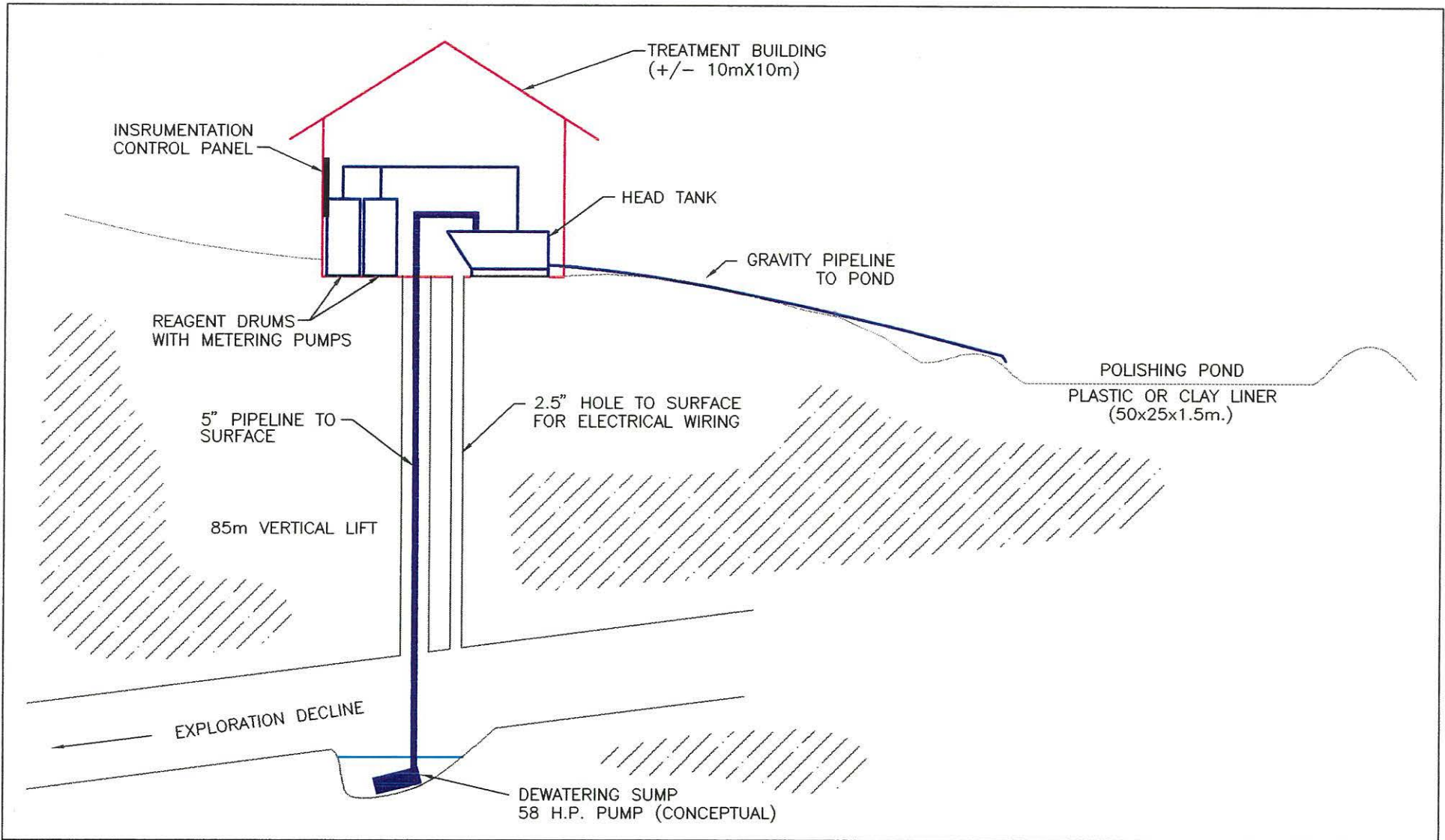
The upper settlement pond has been conceptually designed as providing 24 hour retention for the maximum estimated flows of 300 USgpm. Final design of the settlement pond will be performed in conjunction with a qualified professional engineering firm. The conceptual design of the pond is 1.5 metres deep by 25 metres wide by 50 metres long. The pond will be excavated into the local soils and lined with either an impermeable geomembrane or compacted local till. The inlet and outlet areas and spillways will be armoured with locally available rock.

The decline will encounter acid generating rock at some point past the 1,225 metre mark. During the following stages of exploration activity, water pumped from the decline may be contaminated with metals in excess of the maximum allowable discharge limits. A treatment facility will be constructed at the collar of the dewatering hole which will create the ability to add sodium hydroxide (caustic soda) and flocculant(s) to the water pumped up from the decline as required. The treatment process may include a control loop integrating metering pumps, flow meters and in line pH metres. This is a conventional mine water treatment method and does not involve any new or unproven technologies. Bench scale treatment testing is underway using water pumped from the Grum underground workings to verify the proposed treatment process and to establish reagent addition rates. Power will be supplied from the diesel generators located at the portal site. One possible layout of the treatment building is illustrated conceptually in Figure 5.4.

The water will discharge in a gravity flow pipeline from the treatment building to the constructed settlement pond. The outflow from the polishing pond will pass through a natural drainage path and flow into Side Creek which, in turn, drains into Blind Creek. The surface flow system is illustrated on Figure 5.2.

An assessment of the fisheries utilization of Side Creek was performed in September 1996 by P.A. Harder and Associates Ltd. of Vancouver who have performed all previous fisheries studies in Blind Creek. The findings of the assessment determined that the creek is not suitable for use as fish habitat due to steep gradients and inappropriate substrate (Harder 1996b).

Regular inspections of the outflow area will be performed to detect signs of erosion of surface soils. If channeling of outflow is observed to be resulting in significant erosion, then a channel will be constructed to cleanly pass polishing pond outflow into the side creek.

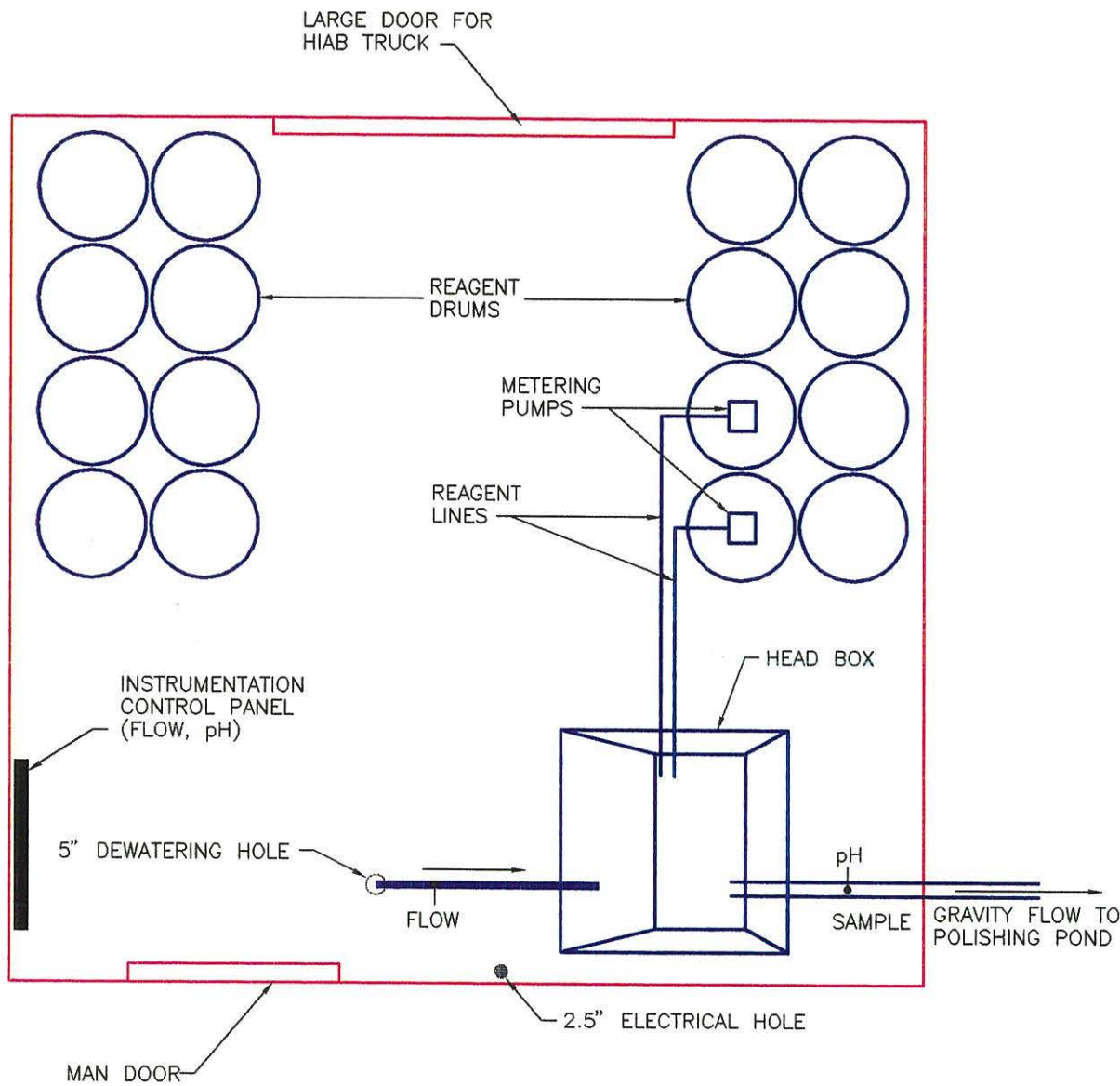


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**GRIZZLY PROJECT**  
 UNDERGROUND EXPLORATION PROGRAM

Fig. 5.3 Conceptual Layout of  
 of Dewatering and Treatment Facilities





# GRIZZLY PROJECT

UNDERGROUND EXPLORATION PROGRAM

Fig. 5.4 Conceptual Layout of Treatment Bldg.



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Sludge levels will be monitored and the settlement pond will be cleaned out as required to maintain efficient operation of the pond. Sludge will be removed to the Vangorda Plateau or to the Faro Open Pit.

### **5.3.2 Spill Reporting**

Spills or unauthorized discharges will be reported immediately to the Water Resources Division of the Department of Indian and Northern Development or to the 24-hour Yukon Spill Report Number.

A spill response plan for the Grizzly underground exploration program will be developed and submitted to the Yukon Territory Water Board prior to the commencement of the program. The response plan will specify actions and lines of responsibility to be followed in the event of a spill or unauthorized discharge.

### **5.3.3 Contingency Plan**

In the event that the discharge criteria are not met at the outflow of the polishing ponds, then an investigation will be performed into the sources of the contamination and a remedial program will be implemented.

A 96 hour LC<sub>50</sub> bioassay on rainbow trout will be performed on the non-compliant discharge and discharge will be stopped if the water is shown to be toxic. Discharge will not re-commence until a bioassay has been passed.

## **5.4 Water Quality Monitoring**

### **5.4.1 Proposed Discharge Limits**

The proposed concentrations which shall not be exceeded in any waste discharge are listed in Table 5.3 along with the corresponding limits from the Vangorda Plateau Water Licence (IN89-002).

The proposed limits for metals are the same as those in the Vangorda Licence. The proposed limit for total ammonia is greater than that in the Vangorda Licence. A discussion of the proposed ammonia limit is given in Section 5.4.4. The proposed limit for total suspended solids is 25 mg/L per the Metal Mining Liquid Effluent Regulations of the Fisheries Act. Cyanide is excluded from the proposed limits. There are no known sources of cyanide in this area and none will be introduced during this project. The units proposed for turbidity are changed from Jackson Units to the more commonly used NTU. The proposed limit for total arsenic is changed to total from dissolved to provide consistency with other parameters and for ease of analysis.

### **5.4.2 Water Sampling Locations and Parameter Frequency Matrix**

Water sampling will be performed according to the schedule listed in Table 5.4. The parameter matrix is based on the parameter matrix for the Vangorda Plateau Water Licence (IN89-002). The sample locations are illustrated in Figures 3.2 and 5.2.

**TABLE 5.3 PROPOSED MAXIMUM ALLOWABLE DISCHARGE LIMITS**  
(maximum concentration for any grab sample)

PARAMETER	PROPOSED	WATER LICENCE IN89-002	COMMENT
Suspended Solids (TSS)	25 mg/L	15 mg/L	same
pH	greater than 6.5	greater than 6.5	same
Colour	less than 20 Pt-Co	less than 20 Pt-Co Units	same
Turbidity	less than 15 NTU	less than 15 Jackson Units	change units
Oil and Grease	none visible	none visible	same
Total Ammonia as N	15.0 mg/L	3.50 mg/L	increase
Total Antimony	0.10 mg/L	0.10 mg/L	same
Total Arsenic	0.05 mg/L (total)	0.05 mg/L (dissolved)	change to total
Total Barium	1.00 mg/L	1.00 mg/L	same
Total Cadmium	0.02 mg/L	0.02 mg/L	same
Total Copper	0.20 mg/L	0.20 mg/L	same
Total Cyanide	-	0.05 mg/L	exclude
Total Lead	0.20 mg/L	0.20 mg/L	same
Total Mercury	0.005 mg/L	0.005 mg/L	same
Total Molybdenum	0.50 mg/L	0.50 mg/L	same
Total Nickel	0.50 mg/L	0.50 mg/L	same
Total Selenium	0.05 mg/L	0.05 mg/L	same
Total Silver	0.10 mg/L	0.10 mg/L	same
Total Zinc	0.50 mg/L	0.50 mg/L	same

The upstream reference location will be Blind Creek immediately below the confluence with Swim Creek referred to as B2. This location will be sampled four times per year since access is by helicopter. Sampling will be performed in conjunction with remote sampling in Anvil Creek per the Faro Water Licence (IN89-001).

Discharge from the two polishing ponds will be sampled weekly during periods of discharge for in-house analyses of total zinc, pH, temperature and conductivity in order to quickly identify trends. These locations will be sampled monthly for the complete set of analyses as shown on Table 5.4. Discharge from the smaller pond at the portal site will be referred to as AR1 and the discharge from the larger pond above the portal site will be referred to as AR2.

Surface discharge from the portal site and local area run off will be sampled in a natural flow path below the portal site referred to as AR3. Flow at this location has been observed only during heavy rainfall events. This location will be sampled monthly as flow rates allow.

Side Creek which receives discharge from the polishing ponds will be sampled near the confluence with Blind Creek as a further check on water quality entering Blind Creek. This location will be referred to as B3 and will be sampled monthly.

**TABLE 5.4 SAMPLING LOCATIONS AND PARAMETER FREQUENCY MATRIX**

Parameter	B2 Blind Ck Upstream	AR1 Portal Pond Discharge*	AR2 Upper Pond Discharge*	AR3 Portal Site Run Off*	B3 Side Creek*	B5 Blind Creek Downstream
PH	4A	M/W	M/W	M	M	M
Temp. (deg C)	4A	M/W	M/W	M	M	M
Cond. (umhos/cm)	4A	M	M	M	M	M
Suspended Solids (mg/L)	4A	M	M	M	M	M
Flow (m3/sec)	4A	M	M	-	M	M (staff gauge)
Total Alkalinity (mg/L)	4A	M	M	M	M	M
Total Ammonia (mg/L)	4A	M	M	M	M	M
Total Hardness (mg/L)	4A	M	M	M	M	M
Total Copper (mg/L)	4A	M	M	M	M	M
Total Iron (mg/L)	4A	M	M	M	M	M
Total Lead (mg/L)	4A	M	M	M	M	M
Total Zinc (mg/L)	4A	M/W	M/W	M	M	M
Dissolved Zinc (mg/L)	4A	M	M	M	M	M
Total Arsenic (mg/L)	4A	M	M	M	M	M
Sulphate (mg/L)	4A	M	M	M	M	M
LC50 Bioassay	-	Q	Q	-	-	-

4A=four times/year; Q=quarterly (every three months); M=monthly;  
W=weekly in-house analysis; "\*"=when flowing; "-"=not required

The downstream reference sample will be Blind Creek at the new (southern) bridge referred to as location B5. This station corresponds to the locations of the DIAND flow monitoring station and the DFO/Ross River Dena fish weir. This location will be sampled monthly.

### **5.4.3 Ammonia**

Residual traces of blasting agents can result in elevated levels of ammonia in drainage from mining activities. It is expected that ANFO (ammonium nitrate fuel oil) will be used as the primary underground blasting agent with minor amounts of gel or slurry agents used in very wet areas.

It has been reported that good housekeeping practices underground can reduce otherwise high ammonia levels in mine water. For example, ammonia concentrations were reduced by 30% at the Hemlo Gold Mines Golden Giant Mine in Northern Ontario following implementation of a rigorous housekeeping and education policy (Forsyth et al, 1995). Inspections of the workplaces underground will be made and environmental awareness training will be held with underground miners in order to ensure that good housekeeping practices are adhered to during the exploration program.

The enforcement of good housekeeping practices and the advantageous location of the polishing pond are expected to achieve the proposed discharge criterion for total ammonia.

### **5.4.4 Discussion of Proposed Discharge Limit for Total Ammonia**

Underground exploration methods inherently involve the use of ammonia based products which can lead to elevated concentrations of total ammonia in discharge water. The maximum allowable discharge limit for total ammonia per the Vangorda Plateau Water Licence (3.5 mg/L) is not realistically achievable for the underground exploration project. A maximum allowable discharge limit of 15 mg/L has been proposed along with the following discussion which shows that the concentration of total ammonia in Blind Creek will not exceed the Canadian Freshwater Aquatic Life Guidelines. The justification shows that the Guideline will be met even under worst case conditions with a safety factor of 2.6.

The Water Licence for Royal Oak Mines in the North West Territories includes a maximum allowable discharge limit for total ammonia of 19.5 mg/L. This provides a good reference for the proposed limit for this exploration project of 15 mg/L.

The Canadian Freshwater Aquatic Life Guidelines for total ammonia are reproduced in Table 5.5. The guidelines vary according to pH and temperature to reflect the change in the contained proportion of unionized ammonia which is the component toxic to aquatic life.

The observed maximum water temperature in Blind Creek is about 15 degrees Celsius and the observed maximum pH in Blind Creek is about 8 (Table 3.4). This combination of high pH and high temperature provide the lowest recommended total ammonia limit as per the Freshwater Aquatic Life Guidelines. As per Table 5.3, this lower limit is 1.33 mg/L total ammonia in Blind Creek. The guideline increases to 1.53 mg/L total ammonia for pH of 8 and temperature of 0 degrees Celsius which is more representative of winter conditions.

The worst case discharge scenario would involve a discharge concentration of 15 mg/L (proposed) at a time when Blind Creek was at 15 degrees Celsius and pH 8.0. The observed typical upper limit of total ammonia in Blind Creek is less than 0.05 mg/L (Table 3.4). Although four of the ten ammonia concentrations in Blind Creek are greater than 0.05 mg/L, three of these are from dates early in the sampling history (August 1988) and the fourth is also from early in the sampling history (September 1988). None of the ammonia concentrations recorded since 1988 have been greater than 0.05 mg/L.

**TABLE 5.5**  
**CANADIAN FRESHWATER AQUATIC LIFE GUIDELINE FOR TOTAL AMMONIA**  
**(mg/L)**

pH	0 °C	5 °C	10 °C	15 °C	20 °C	25 °C	30 °C
6.50	2.5	2.4	2.2	2.2	1.49	1.04	0.73
6.75	2.5	2.4	2.2	2.2	1.49	1.04	0.73
7.00	2.5	2.4	2.2	2.2	1.49	1.04	0.74
7.25	2.5	2.4	2.2	2.2	1.50	1.04	0.74
7.50	2.5	2.4	2.2	2.2	1.50	1.05	0.74
7.75	2.3	2.2	2.1	2.0	1.40	0.99	0.71
8.00	1.53	1.44	1.37	1.33	0.93	0.66	0.47
8.25	0.87	0.82	0.78	0.76	0.54	0.39	0.28
8.50	0.49	0.47	0.45	0.44	0.32	0.23	0.17
8.75	0.28	0.27	0.26	0.27	0.19	0.16	0.11
9.00	0.16	0.16	0.16	0.16	0.13	0.10	0.08

Source: Canadian Water Quality Guidelines

The worst case minimum flow condition in Blind Creek would occur in the winter but has not been measured directly. However, the "patched" flow estimates presented in Section 3.2.2 provide a good estimate of low flow conditions. Flows in months with no direct measurements were estimated using an excellent correlation with measured flows in the Tay River. The minimum flow in Blind Creek was projected in this manner to occur in March and to be 0.61 m<sup>3</sup>/sec or 610 litres per second.

The mass balance equation below provides an indication of the expected maximum concentration of total ammonia in Blind Creek given the worst case scenario outlined above. The scenario used is inherently conservative in that the conditions of maximum toxicity (high pH and temperature) would not occur during the period of lowest flow during the winter.

$$\begin{aligned} (\text{disch conc})(\text{disch flow}) + (\text{upstr conc})(\text{upstr flow}) &= (\text{downstr conc})(\text{downstr flow}) \\ (15)(19) + (0.05)(610) &= (\text{downstr conc})(629) \\ \text{therefore, downstr conc} &= 0.50 \text{ mg/L} \end{aligned}$$

This calculation shows that the Canadian Freshwater Aquatic Life Guideline for total ammonia would be met with a factor of safety of 2.6 even given an inherently conservative worst case scenario.

An additional factor of safety which is built into the above analysis is the assumption that there is no stripping of ammonia during residence time in Side Creek prior to entry into Blind Creek.

#### 5.4.5 Heavy Metals

Heavy metals (especially zinc) can be released from blasted muck piles containing mineralized material and from wall rocks exposed in underground workings. The release of metals from the Grizzly site will be minimized by the regular removal from site of mineralized rock.

In the event that metal levels measured in underground water exceed the maximum allowable discharge limits, then sodium hydroxide would be added at the treatment building located at the collar of the dewatering hole (Figures 5.2 through 5.4). Flocculants would also be added if required to enhance settlement. The treated water would be passed to the polishing pond where the treatment sediments would be deposited.

The treatment process may include a control loop integrating metering pumps, flow meters and in line pH metres. This is a standard mine water treatment method and does not involve any new or unproven technologies. Bench scale treatment testing is underway using water pumped from the Grum underground workings to verify the proposed treatment process and to establish reagent addition rates.

#### **5.4.6 Total Suspended Solids**

The suspended sediment load released from the site will be minimized by clarification in underground sumps and by a minimum 24 hour retention in the polishing ponds. If the total suspended solids concentration exceeds the maximum allowable discharge limit, then a combination of ferric sulphate and Percol E10 flocculants would be added at the treatment building located at the collar of the dewatering hole (Figures 5.2 through 5.4).

This method of enhanced settlement has been successfully used at the Vangorda Plateau Sheep Pad Pond.

#### **5.5 Reporting Procedures**

The monthly data report which is currently submitted in accordance with the Faro and Vangorda Plateau Water Licences (IN89-001 and IN89-002, respectively) will be expanded to include data collected for the Grizzly project.

Notification will be made immediately to the Water Resources Division of the Department of Indian and Northern Development of exceedances of the maximum allowable discharge limits based on either in-house or external laboratory analyses.

#### **5.6 Suspension of Activities**

The measures described here for "Suspension of Activities" will be implemented when the underground exploration project is completed and a final production decision is pending.

The measures to be implemented in the case of a temporary suspension of activities are intended to ensure that the Environmental Management Plan is maintained and that the potential for impacts on Blind Creek are not increased over the period of exploration activity.

If the decline is being dewatered during the period of suspension of activities, then the water quality sampling program described in the Environmental Management Plan will continue uninterrupted.

If the decline is not being dewatered, then the water quality sampling program will be modified to exclude sampling at locations AR1, AR2, AR3 and B3. Monthly sampling at location B5 (Blind Creek Downstream) and four times per year sampling at B2 (Blind Creek Upstream) will continue.

Regardless of whether or not the decline is being dewatered, the portal site will be inspected for signs of vandalism or deterioration once per month and a written log of the inspections will be maintained.

Public safety will be ensured by installation of a locked gate at the portal opening.

Any remaining acid generating rock will be removed from the portal site according to the schedule described in the Environmental Management Plan.

Any partially or completely filled containers of garbage, scrap material or used oil will be removed from the portal site according the schedule described in the Environmental Management Plan.

The water quality data and a summary of the site inspection logs will be submitted to the Water Board along with the monthly data reports required by the Faro and Vangorda Plateau Water Licences (IN89-001 and IN89-02).

## **5.7 Closure Plan**

The measures described here for the "Closure Plan" will be implemented when the exploration project is completed and a negative production decision has been made.

The polishing pond will be drained such that the sediments are allowed to dry or freeze. The sediments will then be removed to the Vangorda Plateau mine site where they will be placed in the Vangorda pit. The sediments will be removed as soon as practical following the instatement of closure status. This may allow for the seasonal drying of the sediments. Following removal of the sediments, the geotextile liner will be removed and the side slopes of the pond will be sloped to create a flow through area draining into the side creek.

The surface facilities at the portal site will be dismantled and removed. Any facilities not removed by the underground contractor including the treatment building will be removed by Anvil Range Mining Corporation. Any garbage, scrap or other waste materials will be handled and disposed of appropriately.

The soil bank on the upslope side of the access road from the Blind Creek road to the portal site will be pushed down onto the road such that vehicle access is blocked and the soil cover provides a surface for revegetation.

The portal site, the access road and the treatment building/polishing pond area will be grass seeded during the first spring or summer following removal of surface facilities. The grass seed mixture and fertilizer applications will be selected such that a self sustaining growth is achieved. The rock pad at the portal site is expected to support vegetation without a soil cover based on observations of good survival of invading grasses and plants during the period from 1991 to 1996.

The underground areas will flood to the elevation of the portal 835 (metres above sea level). This water level will cause all areas of mineralized rock walls to be flooded. The elevations illustrated on Figures 2.2 and 4.3 show the locations of mineralized areas relative to the closure water level. Groundwater recharge into the underground areas will discharge from the portal and flow into Side Creek which flows into Blind Creek. This is similar to the layout of the initial settlement pond illustrated on Figure 4.4.

Monthly water quality sampling will continue at location AR1 (portal discharge) and at location B5 (Blind Creek Downstream) for a period of one year following the instatement of closure status.

A monthly closure status report will be included with the monthly data submissions required by the Faro and Vangorda Plateau Water Licences for one year following the instatement of closure status.

An annual closure status report describing the status of the closure measures and water quality will be included in the annual report required under the Vangorda Plateau Water Licence (IN89-002) for the first two full calendar years following the instatement of closure status.

## **5.8 Environmental Impact Assessment**

### **5.8.1 Assessment of Impact on Wildlife**

The potential impacts of the project on wildlife and habitat usage in the area are expected to be minimal due to the small area of surface activity which is estimated at approximately 4 hectares including the portal site and the treatment site/upper polishing pond. There are no rare or endangered species reported in the area. The portal site is located near an existing access road and the area is already frequented by the public.

Most importantly, the area of activity is not within the known migration route of the Faro herd of Fannin sheep, where specific mitigation measures have been implemented as a result of development on the Vangorda Plateau.

Activities at the portal site may have a minor impact on local grouse and snowshoe hare which would be observed as avoidance behaviour. However, the portal site is not considered to provide unique habitat for these animals and avoidance behaviour would not be detrimental to the animals.

Grizzly bear and moose might be expected to occasionally inhabit the area and may exhibit avoidance behaviour as a result of exploration activities. Again, this would not be detrimental to the animals since the portal site is not considered to provide a unique habitat.

It is unlikely that the increased volume of light vehicle traffic traveling on the Blind Creek Road below Sheep Mountain will have a negative impact on the Fannin Sheep. The Blind Creek Road is a public access road which was relocated by the Yukon Territory Government in 1990 such that the road passes to the south of the known lambing grounds rather than through the area. The road has been cleared of snow as far as the new (southern) bridge over Blind Creek in previous years which indicates that vehicle traffic on this route during the winter is not a new occurrence.

Proposed closure measures will create the physical conditions conducive to natural restoration of the land. Specifically, the closure measures include contouring and revegetating the area of disturbance including the rock pad such that natural progression of vegetation is encouraged. The long term physical stability of the portal site is enhanced through the design specification for the rock pad which limits the overall slope angle to less than 2:1. Local access to the portal will be blocked.

### **5.8.2 Assessment of Impact on Fisheries**

The most important fisheries resource in Blind Creek is the chinook salmon spawning run. This spawning run was concluded by P.A. Harder and Associates to be of regional significance to the escapement into the Yukon River (Harder, 1990). Other species found in Blind Creek were Arctic grayling, slimy sculpin, burbot and round whitefish. Environmental protection measures are proposed to protect the salmon population which would also provide adequate protection for the resident fish populations.

The proposed Environmental Management Plan provides a high level of confidence that the fisheries resources in Blind Creek will be protected. An environmental effects monitoring program is also included which will ensure protection of this important fisheries resource. The Environmental Management Plan also includes maximum allowable discharge limits which are based either on the Vangorda Plateau Water Licence or a parameter specific justification.

The Environmental Management Plan outlines specific features which increase the environmental protection of the fisheries resources in Blind Creek. The construction of a treatment and discharge facility at the upper pond site reduces the risk to Blind Creek from accidental or non-compliant discharges by providing an adequately sized polishing pond to treat effluent prior to discharge to local receiving waters.

The proposed maximum effluent discharge concentrations for discharge from the polishing ponds which are based in part on the limits in the Vangorda Plateau Water Licence (IN89-002) will ensure that water quality in Blind Creek is not impaired as a result of excessive loadings of these parameters. Most importantly, the proposed limits ensure that pH, total suspended solids and heavy metals remain within an acceptable range. The proposed limits also ensure that discharged water will not be toxic to fish by requiring that 96 hour LC50 bioassays be performed.

The expected water quality in Blind Creek was estimated for winter and summer scenarios to allow a comparison to the Freshwater Aquatic Life Guidelines. The winter scenario represents low flow conditions (March data) while the summer scenario represents conditions during the salmon spawning run (August data). Water hardness determines the Freshwater Aquatic Life Guideline for some metals. The water quality data for Blind Creek presented in Table 3.4 verify previous experience at Vangorda Creek where hardness is in the lowest range (0-60 mg/L) during the summer months and increases to a higher range (60-120 mg/L) during the winter months due to a basal flow of groundwater discharge from rocks of the Vangorda Formation. The Freshwater Aquatic Life Guideline for total ammonia varies with temperature and pH and this is accounted for in this evaluation.

The evaluation of water quality in Blind Creek relative to the Freshwater Aquatic Life Guidelines is shown in Table 5.6. For the parameters to be monitored, water quality in Blind Creek will meet the Freshwater Aquatic Life Guidelines for all parameters to be monitored with the exceptions of total copper, total lead and total silver. Background water quality in Blind Creek shows that levels of total copper and total lead are commonly above the guideline even prior to mine development (Table 3.4). The exceedances of the guidelines for total copper and total lead, then, are not due to the proposed exploration project. The Freshwater Aquatic Life Guideline for total silver can not be achieved without an unreasonably low discharge limit of 0.003 mg/L. The proposed maximum allowable discharge limit for total silver is taken from the existing Vangorda Plateau Water Licence (IN-89-002) which is a reasonable approach.

This water quality evaluation has used the upper limits for contaminants in discharge effluent and in Blind Creek and, as a result, is a conservative approach.

Proposed closure measures provide for a continuation of the environmental effects monitoring for a specified period following closure of the site. The proposed reporting schedule will also ensure that environmental information continues to be distributed.

**TABLE 5.6  
EVALUATION OF WATER QUALITY IN BLIND CREEK DURING THE  
EXPLORATION PROGRAM RELATIVE TO CCREM GUIDELINES**

Parameter	Max Allow Disch Conc	Typ High Conc in Blind Ck	Summer (August)			Winter (March)		
			Blind Ck	CCREM	?	Blind Ck	CCREM	?
Suspended Solids	25	10	10.1	+10.0	Y	10.4	+10.0	Y
Ammonia	15	0.05	0.11	1.33	Y	0.5	1.53	Y
Arsenic	0.05	0.001	0.001	0.05	Y	0.002	0.05	Y
Cadmium	0.02	0	0.0001	0.0002	Y	0.0006	0.0008	Y
Copper	0.2	0.009	0.01	0.002	N	0.015	0.002	N
Lead	0.2	0.02	0.021	0.001	N	0.025	0.002	N
Mercury	0.005	0	0.00002	0.0001	Y	0.0001	0.0001	Y
Nickel	0.5	0.01	0.012	0.025	Y	0.025	0.065	Y
Selenium	0.05	0	0.0002	0.001	Y	0.001	0.001	Y
Silver	0.1	0	0.0004	0.0001	N	0.003	0.0001	N
Zinc	0.5	0.02	0.02	0.03	Y	0.03	0.03	Y

all units are mg/L

Source: Table 3.3, Table 3.4, Table 5.3, Canadian Water Quality Guidelines

"CCREM" = Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life

"Max Allow Disch Conc" = proposed discharge limits for the Grizzly Underground Exploration Project

"?" = Have the CCREM Guidelines been achieved (Yes or No)

Summer flow in Blind Creek = 4.59 m<sup>3</sup>/sec at hardness of 0-60 mg/L

Winter flow in Blind Creek = 0.61 m<sup>3</sup>/sec at hardness of 60-120 mg/L

Maximum Discharge Flow = 0.019 m<sup>3</sup>/sec (300 USgpm)

### **5.8.3 Assessment of Impact on Public Land Use**

The portal site is not known to be utilized as a unique recreational or subsistence location by the general public or by the Ross River Kaska Dena with the exception that the portal site is within the group trapping area of the Ross River Dena. As described in Section 3.2.5, the portal site does not provide unique habitat for small or large mammals and, therefore, trapping activities should not be limited by exploration activities at the portal site.

There is a Ross River Dena fishing camp at the new (southern) bridge of the Blind Creek Road. The camp is typically occupied during the summer season only at a time when recreational fishing in lower Blind Creek and the Swim Lakes is popular. It is not expected that light vehicle traffic on the Blind Creek Road related to the exploration project will create an increased disturbance at the fishing camp beyond that experienced in previous years.

The proposed closure measures include the provision for public safety through blocking access to the decline for either temporary or permanent closure of the site.

### **5.8.4 Cumulative Impacts**

The Anvil Range/Mt. Mye area has an extensive history of land use consisting of mine activity, recreational and traditional use. Mine activities have occurred in the Rose Creek drainage (Faro mine site) and the Vangorda Creek drainage (Vangorda and Grum mine sites). The Grizzly deposit and the surface activities associated with the proposed exploration project lie within the Blind Creek drainage with access existing from the town of Faro and from the Vangorda Plateau.

The current uses of the land within the Blind Creek drainage area include recreational and traditional subsistence uses. The only industrial use within the Blind Creek drainage is the existing portal site which was developed by the previous mine operator. There are no land uses which are similar to those activities associated with the proposed exploration project.

The environmental effects which have been identified for the proposed exploration project include potential impacts on aquatic resources (fish and fish habitat, water quality), terrestrial resources (wildlife and wildlife habitat) and other users (public use access and traditional usage). Mitigative measures have been proposed to control or eliminate these potential impacts. An Environmental Management Plan which includes a monitoring and reporting program is also proposed to track the success of the mitigative measures.

Potential environmental effects from other related activities were considered with predicted effects from the Grizzly exploration project. The scope of the Grizzly environmental effects were considered in relation to potential environmental effects from other activities within the Blind Creek drainage. As there are no known projects within the project area, the environmental effects could not be considered in combination with the Grizzly project. The activities of recreational and traditional usage do have the potential to affect wildlife and fisheries resources through over exploitation and this could occur regardless of the proposed Grizzly project as access into the area already exists.

These potential cumulative effects on wildlife and fisheries resources were not considered significant and are considered to be reversible after exploration activities are completed.

## 6. ASSESSMENT OF IMPACT ON TRADITIONAL KASKA LAND USE

### 6.1 Just Like People Get Lost (Kaska Use of Blind Creek)

The report "Just Like People Get Lost" (JLPGL) (Weinstein, 1992) provides a retrospective assessment of the traditional use of the land by the Ross River Kaska Dena and the changes in the use of the land which are attributable, in part, to the development of the Faro mine. The report is a good reference regarding First Nations land use in the areas affected by the proposed exploration activities.

The JLPGL report is based on land use maps constructed by people of the Ross River Kaska. The land use maps covered a large period of time and were used to perform a comparison of the utilization of traditional areas before, during and after development of the Faro mine complex (Faro and Vangorda Plateau).

The author (Martin Weinstein) states that the comparisons are not detailed since a complete record of information was not available. In addition, the author states that it is very difficult to separate social and economic changes which resulted directly from the mine development from those which resulted from other non-related events. In general terms, however, there is good information presented which is relevant to this proposal.

There are two core areas which have been traditionally utilized for trapping, hunting, fishing and gathering. The areas are informally under the stewardship of different family groups with each family group using Ross River as a central meeting place. Ross River serves as a loose dividing point between the eastern and western areas. The family groups share lands across the eastern/western divide and the boundaries described are used in a general rather than a definitive way.

The western core area is centered around Mt. Mye with intensive use of Swim Lakes, Blind Creek and Anvil Creek. The use of Blind Creek is of most relevance to this proposal.

The JLPGL report shows that both the frequency and intensity of utilization of the Blind Creek area has changed dramatically since the time prior to development of the Faro mine complex.

Blind Creek was extensively used as for fishing, trapping, hunting and as a travel route to the Vangorda Plateau prior to mine development.

Blind Creek continues to be used after mine development. However, the harvesting efforts and the intensity of use is extremely low. People return to Blind Creek because of family attachments and to observe environmental conditions rather than for harvesting.

There are several reasons presented in the JLPGL report for the change in use of Blind Creek. The combination of road access into the area and the local population of non-native residents has created an atmosphere unappealing to traditional use of the area. In addition, intensive fishing by local non-native residents has reduced fish stocks in the Swim Lakes. Furthermore, native hunting and trapping methods rely on an intimate understanding of wildlife behaviour which is upset when wildlife exhibits avoidance behaviour. There is also a perception that water quality and, thereby, fish and meat are tainted as a result of mine activities. This is particularly perceived for Rose and Anvil Creeks.

Blind Creek and area continued to be trapped at least as recently as the JLPGL report which was published in 1992. This was a direct result of the tenacity of several individuals who continued to utilize the area for traditional purposes in the face of development and competition.

During 1995 and 1996, a fish counting weir was operated by the Ross River Dena Council near the mouth of Blind Creek to monitor the number of salmon spawners using the Creek.

## **6.2 Impacts From The Underground Exploration Project**

The fact that the Ross River Dena are not currently utilizing the Blind Creek area as intensely as in previous years does not mean that Blind Creek is no longer important for cultural and economic reasons. The potential impacts of the underground exploration project must be minimized in order to protect this important resource.

The increase in direct impacts on land use resulting from the proposed exploration program will be small. The direct impacts will be limited to slightly increased traffic on the existing Blind Creek road and wildlife avoidance behaviour in the immediate area of the portal site (about 4 hectares). The Environmental Management Plan (EMP) described in Section 5 will maximize the protection afforded to Blind Creek. Even in light of the EMP, there will remain a small risk of spills or unauthorized discharges occurring during the exploration program which could enter Blind Creek. This risk will be controlled and minimized through implementation of the EMP and the associated monitoring and reporting programs.

The increase in indirect impacts on land use resulting from the proposed exploration program are less easily defined. The area of mine related activity will be expanded into the Blind Creek basin. This is a further encroachment into Kaska traditional lands and may increase the perception of impacts on water quality, fish and meat beyond those currently held. The sharing of up to date information regarding the environmental status in Blind Creek will assist in minimizing the effects of this issue. The terms of the existing cooperation agreement between Anvil Range Mining Corporation and the Ross River Dena Council ensure that the sharing of information between parties will take place.

## 7. REFERENCES

- Bryan, P. Hydrology Consultant. North Vancouver, B.C. Personal Communication.
- Canadian Water Quality Guidelines, Information Package for Water Quality Guidelines and Objectives Workshops.
- Cornett, D. Access Mining Consultants Ltd. Personal Communication.
- Curragh Resources Inc. 1989. Vangorda Plateau Development Water Licence Application.
- Curragh Resources Inc. 1991. Overview of Fish Resources in the Blind Creek Drainage.
- Curragh Inc. 1993. Advanced Exploration and Development of the DY Underground Mine.
- Department of Indian and Northern Development, Environment. 1996. Letter from Simpson to Denholm re. Summary of Comments from RERC Members: Advanced Exploration and Development of the DY Underground Mine
- Department of Indian and Northern Development, Water Resources. 1996. Memo from Jasek to Denholm re. flow measurements in Blind Creek.
- EBA Engineering Consultants Ltd. 1990. Preliminary Report DY Deposit Hydrogeology Testing.
- Forsyth et al. 1995. Explosives and Water Quality. Paper Presented at Sudbury '95 Conference on Mining and the Environment. Volume 2 page 795.
- Harder, P.A. and Associates 1996a. Chinook Salmon Spawner Aerial Survey, Blind Creek - August 1996.
- Harder, P.A. and Associates 1996b. Preliminary Assessment of Fish Habitat Capabilities in the Unnamed Tributary to Blind Creek.
- Jennings, D.S. and G.A. Jilson 1984. Geology and sulphide deposits of Anvil Range, Yukon; CIMM Special. Volume 37 p319-361.
- Jilson, G.A. Access Mining Consultants Ltd. Personal Communication.
- Ladue, N. Ross River Dena Council. Personal Communication
- Lortie, G. Personal Communication
- Weinstein, M. 1992. Just Like People Get Lost. A Report to the Ross River Dena Council.

