ECONOMIC EVALUATION OF BULGHAH MINE PROJECT GOLD DEPOSIT IN SAUDI ARABIA

Hamad Al Sifri

CYCLE D'ETUDES SUPERIEURES EN
EVALUATION ECONOMIQUE DE PROJETS MINIERS

CESPROMIN

Session 2008-2009

ECONOMIC EVALUATION OF BULGHAH MINE PROJECT GOLD DEPOSIT IN SAUDI ARABIA

AL SIFRI Hamad

SAUDI ARABIA

Juin 2009
CHALS090623

CES 2008 RAP/09-02

CESMAT
60, boulevard Saint-Michel
75272 PARIS Cedex 06

MINES PARISTECH
60, boulevard Saint-Michel
75272 PARIS Cedex 06

CENTRE DE GEOSCIENCES
35, rue Saint-Honoré
77305 FONTAINEBLEAU Cedex

Tél. : 33 (0)1.64.69.49.04. - Fax : 33 (0)1.64.69.47.11. - resp_cespromin@geosciences.ensmp.fr

ACKNOWLEDGMENT

Firstly, my thanks and gratitude to my God (Allah) for helping me to finish this study.

I would like to express my thanks to all those who gave me the supporting to complete this project and I would like to say a big of thank you to all off them.

I would like to sincerely thank to **Dr. Isabelle Thenevin** head supervisor of CESPROMIN. We are particularly grateful for her contribution to this project report through many fruitful discussions on present study and in giving the exact line of direction towards completion or the project report in spite of her very busy schedule.

I wish to record my appreciation and special thank to CESMAT and also thankful to **Prof**. **Damien Goetz** Director, Center des Geosciences. I am also thankful for CESPROMIN secretary **Ms Sandrine Motte**, who provided necessary help, guidance, advise and friendly approach to us since the beginning of the course.

Also special thanks for **Dr. Michel Duchene** who we are found from him all supporting, advising and interesting.

I would like also to express sincere thanks to CESPROMIN in promotion of grateful ideas and personal experiences, which we've passed together.

I am deeply indebted for Eng. Yahia Alshangiti, my Director and Eng. Saeed Alzahrani, my manager, brothers and teachers whom have been my main supporters and whom have a huge effect on my professional career.

Special thanks in this regard should be made for my colleagues in Bulghah mine and Eng. Mubark Alshaikhi from Alhjar mine.

Big thanks for all my colleagues in CESPROMIN, for their help, support and friendship.

In the final, I would like to gift this graduation for valuable people for me:

My Mother, merciful and kind. Who born, taught and loved me.

My family, my wife and my sons Adnan, Fahad, Naif and Zaed for their support and love.

My brothers and my sisters, for their attention and encouragement.

ABSTRACT

This project is an outcome of the postgraduate diploma course on Project evaluation, CESPROMIN, for the year 2008-09, one of the CESMAT cycles in the frame of Ecole des Mines de Paris. During this project I have tried to apply the concept I have learnt during the CESPROMIN course in regards to project costing & Project evaluation.

The objective of this project was to understand the methods of Economic Evaluation of a Mining Project, which includes the selection of Mining method & Reserve estimation & Financial Assessment.

To present my understanding on Mine Economics & impact of different parameters of Project Finance, as a part of Final report for the CESPROMIN Course, I have tried to do the Economic Evaluation of Bulghah North Gold Mine, which is still in conceptual stage. From the limited data available, I with the help of Dr. Isabelle Thenevin tried to run Whittle software to optimize the Pit but due to improper block model I could not succeed in optimizing the Pit design. The reason for that is the project is still geological evaluation stage, under the consultant engaged for the purpose.

As a result I have tried to do Project evaluation in three options

- **Option – I**

  With Cut-off of 0.3 g/t of Au & limited investment of 0.8 Million US Dollars. In this case the stripping ratio of 1.4 has been assumed.

- **Option – II**

  With Cut-off of 0.3 g/t of Au & with an additional investment of 2.51 Million US Dollars. With the existing processing plant the crushing capacity is the main bottleneck, which restricts recovery to only 52%. So in this case after a discussion with representative of METSO Company one or two additional crushers has been provided for a cost of 1.77 Million US Dollars. In this case also the stripping ratio of 1.4 has been assumed with a recovery of the final product to the tune of 65%.

- **Option – III**

  This is a study to represent the Scenario of Option II if the stripping ratio becomes 1.7.

EXECUTIVE SUMMARY

This project carried out to evaluate Bulghah North Gold Mine which should be starting operation before the end of 2009.

Bulghah North Gold Mine is owned by Saudi Arabian Mining Company “Ma’aden”. Ma’aden began to take it’s present shape in 1997, by transfer of mineral titles from Petromin (the General Petroleum and minerals Organization). Ma’aden recently run five Gold mines and more development work to utilize industrial minerals such as Phosphate, Bauxite and Magnetite.

The initial evaluation for Bulghah North Resource by Exploration department and Mine geologist is based on the concept of a heap leach operation with ore feed coming from an open pit mine exploitation.

The mine operation in Bulghah is coming to exhaustion & will be replaced by upcoming Bulghah north mine, which is still under the geological evaluation stage. The resources existing in Bulghah Mine will be utilized in the Bulghah North mine as well, so only limited investment the company has been considered for the project.

Processing plant facilities in Bulghah mine will be ready for receiving the ore from Bulghah north which is far around 5 km North .

The Mineralization Area consists from two Zones (West and East). In this study, I have focused on West Zone to make the Economic Evaluation of the project. The block model received from the Project Department, on was run to optimize the pit but due to limited data availability the Reserve of 22.62 Million tones of ore, with a cut-off of 0.3 g/t of Au has been considered in the study. The 22.62 Million ore consist of 2.66 Mt of weathered ore & 19.96 Mt of fresh ore.

The average grade of the weathered ore is 0.70 g/t of Au & 0.78 g/t of Au for Fresh rock has been ascertained by running the block model in Surpac software at **Ecole Des Mine de Paris**.

As stated in the Abstract in pre-page the project evaluation has been done in three options the summarized data of the three options are given as under.

SUMMARISED DATA

GEO-MINING PARAMETERS

	Option-I	Option-II	Option-III
Reserve			
Weathered Ore Cut off 0.3 g/t of Au	**2.66 Mt**		
Fresh Ore Cut off 0.3 g/t of Au	**19.96 Mt**		
Total Reserve with Cut off 0.3 g/t of Au	**22.62 Mt**		
Average Grade			
Weathered Ore "g/t of Au"	**0.70**		
Fresh Ore "g/t of Au"	**0.78**		
Waste	**31.67 Mt**	**31.67 Mt**	**38.45 Mt**
Stripping Ratio	**1.4**	**1.4**	**1.7**
Dilution	**5%**		
Mining Losses	**5%**		

TECHNICAL PARAMETERS

	Option-I	Option-II	Option-III
MINING PARAMETERS			
Annual Target of Waste	**4.2 Mt**	**4.2 Mt**	**5.1 Mt**
Annual Target for Ore	**3.00 Mt**		
Life of the Project	**7 Year**		
Working Days Per Year	**365**		
Dilution	**5.00%**		
Mining Losses	**5.00%**		
Reserve After Dilution & Mining Losses			
Weathered Ore Cut off 0.3 g/t of Au	**2.65 Mt**		
Fresh Ore Cut off 0.3 g/t of Au	**19.91 Mt**		
Total Reserve with Cut off 0.3 g/t of Au	**22.56 Mt**		
Grade After Dilution & Mining Losses			
Weathered Ore "g/t of Au"	**0.67**		
Fresh Ore Cut "g/t of Au"	**0.74**		

	Option-I	Option-II	Option-III
PLANT PARAMETERS			
Recovery for Weathered Ore	**80%**	**80%**	**80%**
Recovery for Fresh Ore	**52%**	**65%**	**65%**
Recoverable Metal			
Weathered Metal "Million Grams"	**1.42**	**1.42**	**1.42**
Fresh Metal "Million Grams"	**7.69**	**9.61**	**9.61**
Total Recoverable Metal "Million Grams"	**9.11**	**11.03**	**11.03**

FINANCIAL PARAMETERS

	Option-I	Option-II	Option-III
Equity	**40 %**		
Loan	**60 %**		
Interest Rate	**5%**		
Discount Rate	**12 %**		
Corporate Tax	**22 %**		
Period of Loan Repayment	**5 years**		
Period of Depreciation of Initial Capital	**5 years**		
Loan Repayment start Year	**Year - 1**		
Depreciation of Initial Capital start year	**Year - 1**		

ECONOMIC PARAMETERS

	Option-I	Option-II	Option-III
Initial Investment "Million US $"	**0.80**	**2.51**	**2.51**
Investment Phasing	**Entire investment in Year - 0**		
Selling Price	**850 $/Oz Au** **26.56 $/grams Au**		
Annual Revenue "Million US $"	**32.85**	**39.19**	**39.19**
Annual Expenses "Million US $"	**31.26**	**31.26**	**33.82**
Annual Cash Flow "Million US $"	**1.59**	**7.92**	**5.36**
Margin Ratio	**4.84 %**	**20.22 %**	**13.69 %**
Capitalistic Intensity	**0.02**	**0.06**	**0.06**

FINANCIAL CONCLUSIONS

	Option-I	Option-II	Option-III
Break Even Price “US $”	26.03	21.59	23.35
Cash Break Even Price “US $”	25.93	21.36	23.11
Pay Back Period			
Without Discount “years”	0.22	0.14	0.20
With Discount “years”	0.31	0.19	0.29
IRR “ % ”	362.94	591.47	392.40
Net Present Value “Million US $”	3.24	26.96	17.41

Sensitivity on Net Present Value
Option - I

Figures in Million US $

	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
Ore Reserve	-33.60	-24.49	-16.56	-8.94	-2.17	3.24	8.40	13.13	17.64	21.15	24.57
Ore Production	1.83	4.96	4.29	4.33	3.53	3.24	3.29	3.36	3.35	3.42	3.68
Selling Price	-72.85	-57.41	-41.97	-26.53	-11.08	3.24	15.42	27.47	39.51	51.56	63.60
Operating Cost	61.62	49.97	38.32	26.68	15.03	3.24	-10.58	-25.51	-40.44	-55.38	-70.31
Grade	-72.85	-57.41	-41.97	-26.53	-11.08	3.24	15.42	27.47	39.51	51.56	63.60
Loan	3.19	3.20	3.21	3.22	3.23	3.24	3.24	3.25	3.26	3.27	3.28
Corporate tax	3.80	3.68	3.57	3.46	3.35	3.24	3.12	3.01	2.90	2.79	2.67
Capital Investment	3.53	3.47	3.41	3.35	3.29	3.24	3.18	3.12	3.06	3.00	2.94
Recovery of Fresh Ore	-59.30	-46.57	-33.84	-21.11	-8.37	3.24	13.31	23.24	33.17	43.10	53.03

Sensitivity on Internal Rate of Return
Option - I

	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
Ore Reserve	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	362.94%	678.41%	949.62%	1186.89%	1397.48%	1586.73%
Ore Production	167.55%	207.70%	246.79%	285.63%	324.26%	362.94%	401.45%	440.05%	478.68%	517.00%	555.27%
Selling Price	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	362.94%	1163.73%	1964.45%	2765.20%	3565.95%	4366.71%
Operating Cost	4172.85%	3410.87%	2648.88%	1886.91%	1124.96%	362.94%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Grade	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	362.94%	1163.73%	1964.45%	2765.20%	3565.95%	4366.71%
Loan	216.80%	235.16%	257.27%	284.42%	318.59%	362.94%	422.88%	508.44%	640.59%	871.77%	1380.26%
Corporate tax	411.38%	401.69%	392.01%	382.32%	372.63%	362.94%	353.25%	343.55%	333.86%	324.15%	314.45%
Capital Investment	750.71%	621.48%	529.17%	459.93%	406.06%	362.94%	327.65%	298.21%	273.28%	251.88%	233.31%
Recovery of Fresh Ore	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	362.94%	980.51%	1598.00%	2215.52%	2833.04%	3450.57%

Sensitivity on Net Present Value
Option - II

Figures in Million US $

	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
Ore Reserve	-15.00	-3.37	5.58	13.44	20.36	26.96	33.35	39.32	45.20	49.99	54.26
Ore Production	18.65	24.27	25.12	25.90	26.21	26.96	27.93	28.75	29.49	30.13	30.95
Selling Price	-58.48	-39.85	-21.23	-2.60	12.44	26.96	41.49	56.02	70.54	85.07	99.60
Operating Cost	85.21	73.56	61.91	50.26	38.61	26.96	15.31	3.67	-10.16	-25.09	-40.02
Grade	-58.48	-39.85	-21.23	-2.60	12.44	26.96	41.49	56.02	70.54	85.07	99.60
Loan	26.82	26.85	26.88	26.91	26.93	26.96	26.99	27.02	27.05	27.08	27.10
Corporate tax	30.80	30.04	29.27	28.50	27.73	26.96	26.19	25.43	24.66	23.89	23.12
Capital Investment	27.25	27.20	27.14	27.08	27.02	26.96	26.90	26.85	26.79	26.73	26.67
Recovery of Fresh Ore	-44.93	-29.01	-13.10	1.99	14.55	26.96	39.38	51.79	64.20	76.62	89.03

Sensitivity on Internal Rate of Return
Option - II

	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
Ore Reserve	#DIV/0!	#DIV/0!	176.00%	348.15%	482.71%	591.47%	681.46%	757.39%	822.48%	879.07%	928.85%
Ore Production	283.60%	345.16%	406.73%	468.30%	529.88%	591.47%	653.06%	714.65%	776.24%	837.83%	899.41%
Selling Price	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	286.96%	591.47%	896.08%	1200.71%	1505.37%	1810.03%	2114.69%
Operating Cost	1806.64%	1563.59%	1320.54%	1077.50%	834.47%	591.47%	348.52%	104.80%	#DIV/0!	#DIV/0!	#DIV/0!
Grade	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	286.96%	591.47%	896.08%	1200.71%	1505.37%	1810.03%	2114.69%
Loan	348.19%	378.61%	415.32%	460.49%	517.44%	591.47%	691.62%	834.67%	1055.75%	1442.62%	2293.70%
Corporate tax	672.03%	655.92%	639.81%	623.70%	607.58%	591.47%	575.36%	559.24%	543.13%	527.01%	510.90%
Capital Investment	708.35%	681.55%	656.65%	633.44%	611.76%	591.47%	572.43%	554.53%	537.68%	521.78%	506.75%
Recovery of Fresh Ore	#DIV/0!	#DIV/0!	#DIV/0!	94.80%	345.33%	591.47%	837.64%	1083.83%	1330.04%	1576.25%	1822.47%

Sensitivity on Net Present Value
Option - III

Figures in Million US $

	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
Ore Reserve	-29.81	-17.60	-6.47	3.17	10.45	17.41	24.33	31.05	37.56	42.90	47.65
Ore Production	13.68	18.32	18.18	17.96	17.28	17.41	18.04	18.59	19.08	19.50	20.15
Selling Price	-70.73	-52.10	-33.48	-14.85	2.88	17.41	31.94	46.46	60.99	75.52	90.05
Operating Cost	80.43	67.82	55.22	42.62	30.01	17.41	4.81	-9.92	-26.08	-42.24	-58.40
Grade	-70.73	-52.10	-33.48	-14.85	2.88	17.41	31.94	46.46	60.99	75.52	90.05
Loan	17.27	17.30	17.32	17.35	17.38	17.41	17.44	17.47	17.49	17.52	17.55
Corporate tax	19.90	19.40	18.91	18.41	17.91	17.41	16.91	16.41	15.91	15.41	14.91
Capital Investment	17.70	17.64	17.58	17.53	17.47	17.41	17.35	17.29	17.23	17.18	17.12
Recovery of Fresh Ore	-57.18	-41.26	-25.35	-9.43	5.00	17.41	29.82	42.24	54.65	67.06	79.48

Sensitivity on Internal Rate of Return
Option - III

	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
Ore Reserve	#DIV/0!	#DIV/0!	#DIV/0!	98.15%	261.54%	392.40%	500.47%	591.47%	669.32%	736.84%	796.10%
Ore Production	184.03%	225.82%	267.47%	309.11%	350.75%	392.40%	434.05%	475.70%	517.36%	558.99%	600.63%
Selling Price	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	86.66%	392.40%	696.96%	1001.58%	1306.23%	1610.88%	1915.54%
Operating Cost	1707.06%	1444.10%	1181.15%	918.20%	655.27%	392.40%	129.21%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Grade	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	86.66%	392.40%	696.96%	1001.58%	1306.23%	1610.88%	1915.54%
Loan	234.35%	254.14%	277.99%	307.34%	344.33%	392.40%	457.42%	550.29%	693.79%	944.89%	1497.26%
Corporate tax	444.89%	434.39%	423.90%	413.40%	402.90%	392.40%	381.91%	371.41%	360.91%	350.41%	339.91%
Capital Investment	471.48%	453.35%	436.50%	420.80%	406.13%	392.40%	379.52%	367.42%	356.01%	345.26%	335.09%
Recovery of Fresh Ore	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	145.59%	392.40%	638.53%	884.71%	1130.90%	1377.11%	1623.32%

TABLE OF CONTENTS

1 GENERAL

1.1 SAUDI ARABIA……1

1.1.1 Introduction…….1

1.1.2 Geology of Saudi Arabia……1

1.1.3 The Arabian shield…….2

1.1.4 The Cover Rocks……4-5

1.1.5 Cenozoic and harrat Volcanism……5

1.1.6 Red Sea Coastal Plain……6

1.2 Gold Deposits……...6

1.3 MA'ADEN the Company…….....7-8

2 PROPERTY DESCRIPTION AND LOCATION FOR Bulghah North

2.1 LOCATION ……...…8

2.2 Terrain…….....8

2.3 Climate …….9

2.4 Title and Rights……..10

2.5 Geologic setting……..…11

2.5.1 Regional Geology……...…....11

2.6 Project Scale Geology...…….....12

2.6.1 Geology……..……12

2.6.1.1 Intrusive……..…...12

2.6.1.2 Meta-volcanics…….…….…13

2.6.1.3 Meta-sediments…….……....13

2.6.2.4 Basic dikes…….…14

2.6.2 Structures of Mineralization……..…15

2.6.3 Bulghah North Mineralization……..……..15-16

3 Exploration

3.1 Introduction……...17-18

3.2 Sampling and Analysis……19

3.3 Standards…….....…19

4 Resource Estimation

4.1 Methodology…….....21-22

5 Mine Design

5.1 Pit Optimization …….....24

5.1.1 Geotechnical Data ……..….25

5.1.2 Economic Constraints …….....25

5.2 Mining ……..

5.2.1 Introduction …….....26

5.2.2 Calendar Programme…….. 26-27

5.2.3 Drilling ……..……..27-28

5.2.4 Blasting …….29

5.2.5 Equipments Selection and Hauling…….....29-30

5.2.6 Auxiliary Equipment ……...30-31

5.2.7 Working Time …….31

5.3 PROCESSING……

5.3.1 Introduction…….....31

5.3.2 Crushing Pant …….....31-32

5.3.3 Agglomeration …….…33

5.3.4 Heap Stacking …….....…33-34

5.3.5 Leach Pads and Ponds ……...…..35-36

5.3.6 Process Solution System …….....36

5.3.7 Carbon Adsorption system …….……....36

5.3.8 Carbon Processing, Electrowinning and Smelting……..37

5.3.9 Water Supply …….
5.3.9.1 Raw Water (Low and High saline Water)….36
5.3.9.2 Potable Water ……..36
5.3.9.3 Control System ……..……....36
5.3.10 Power Supply ……...37
5.5.11 Communication ……38
6 FINANCE EVALUATION…….…….
6.1 Finance Evaluation Parameters……...39-40
6.2 Finance of Study……...41
6.3 Economic Studies and Diagram……....41-50
6.4 Gold Price……....51
7 Appendix……52
8 CONCLUSIONS AND RECOMMENDATIONS…….....53
9 REFERENCE…….....54

LIST OF FIGURES

Figure 1-1 : Arabian Shield Of Saudi Arabia……2
Figure 1-2 : Gold Occurrences in Arabia Shield…… 7
Figure 2.1 : General Terrain Over the Bulghah North Project Area….9
Figure 2-2 : Location Map Of Bulghah North Project Area…… 10
Figure 2-3 : Regional Geology Of the North Arabian Shield…… 11
Figure 2-4 : Bulghah North Tonalite……12
Figure 2-5 : Bulghah North Porphyritic Andesite…… 13
Figure 2-6 : Bulghah North Metasediments…… 14
Figure 2-7 : Bulghah North Tonalite with cross cutting dyke…… 14
Figure 2-8 : Structural Lineaments within Bulghah North Project Area (Landsat Image)…… …… 15
Figure 2-9 : Oxidized (Blue) / Transitional (Green) Material at Bulghah North…… 16
Figure 2-10 : Bulghah North 40º Dipping Mineralization (vertical Holes only)…… 17
Figure 2-11 : Bulghah North Mineralization Showing Down Dip Drilling And 40º Dip within Vertical Holes… ……17
Figure 3-1 : Drill hole Collar Location…… ……18
Figure 3-2 : Traces Looking North…… …… 18
Figure 3-3 : G301-1 _ RC Sample Stream…… …… 19
Figure 3-4 : G901-1 _ RC Sample Stream…… ……20
Figure 3-5 : G301-1 _ Diamond Sample Stream…… 20
Figure 3-6 : G901-1 _ Diamond Sample Stream…… 20
Figure 4-1 : Comparing Chart Between Tonnage and Average Grade …… ……22
Figure 4-2 : Solid of Mineralization ore …… 23
Figure 4-3 : Block Model with Topography…… 23
Figure 4-4 : Map and Cross Section……. …… 23
Figure 5-1 : Truck ANFO Explosive Charging …… …… 28
Figure 5-2 : Crushing Network …… …… …… 31
Figure 5-3 : The suggestion configurations from Metso…….. 32
Figure 5-4 : Heap Leach Design Daigram…….. …… … 33
Figure 5-5 : Heap Leach stacking Area ……. …… …… 34
Figure 5-6 : Heap Leach Conveyors Arrangement ……. …… 34
Figure 6-1 : Cumulative Cash Flow (Option – I) ……..… 41
Figure 6-2 : Cumulative Discounted Cash Flow (Option – I) ...… 43
Figure 6-3 : Net Present Value (Option – I) …… …… 43
Figure 6-4 : Cumulative Cash Flow (Option – II) ……..… 44

Figure 6-5 : Cumulative Discounted Cash Flow (Option – II) ..… 45
Figure 6-6 : Net Present Value (Option – II) …… … …… 45
Figure 6-7 : Cumulative Cash Flow (Option – III) …… 46
Figure 6-8 : Cumulative Discounted Cash Flow (Option – III) … 47
Figure 6-9 : Net Present Value (Option – III) …… … …… 47
Figure 6-10 : Sensitivity on NPV (Option – I) …… … …….. 48
Figure 6-11 : Sensitivity on NPV (Option – II) …… … …….. 48
Figure 6-12 : Sensitivity on NPV (Option – III) …… … …….. 49
Figure 6-13 : Sensitivity on IRR (Option – I) …… … …….. 49
Figure 6-14 : Sensitivity on IRR (Option – II) …… … …….. 50
Figure 6-15 : Sensitivity on IRR (Option – III) …… … …….. 50
Figure 6.16 : Gold Price for 30 days back……..51
Figure 6.17 : Gold Price for six months back……....51
Figure 6.18 : Gold Price for five years back……..51

LIST OF TABLE

Table 3-1: Diamond and RC Drilling holes Completed by Project Area…….. 18
Table 3-2 : Summary Statistics of the Geostats Standard……19
Table 4-1 : Block Model Parameters…… 21
Table 4-2 : Inverse Distance Parameters…… 21
Table 4-3 : Samples Definition…… 21
Table 4-4 : Resource Estimation by Geological Department… 22
Table 5-1 : Bulghah North Parameters ……. ……. 24
Table 5-2 : Bulghah North Pit Design Parameters ……. 25
Table 5-3 : Mining and Processing Cost …….. 25
Table 5-4 : Calendar Programme for Option-I……. 26
Table 5-5 : Calendar Programme for Option-II ……... 26
Table 5-6 : Calendar Programme for Option-III ……... 28
Table 5-7 : Specifications and Parameters of Drill Machines.. 29
Table 5-8 : Drill hole parameters for Drill Machine……... 29
Table 5-9. Dump Truck Specifications …….. ...… 29
Table 5-10 : Equipments Specifications. ……..….. … 29
Table 6-1 : Technical Parameters…… . …….. … 38
Table 6-2 : Financial Parameters…… . …….. … 39
Table 6-3 : Economic Parameters…… . …….. … 39
Table 6-4 : Financial Results (Option – I) …….. … 41
Table 6-5 : Financial Results (Option – II) ……. … 43
Table 6-6 : Financial Results (Option – III) …….. … 45

1 GENERAL

I saw from the best add this section to present some information about Saudi Arabia, Geology of Saudi Arabia, Gold occurrences and Ma'aden Company as the entrance for the Final Report which I well submit to ECOLE DES MINES DE PARIS.

1.1 SAUDI ARABIA

1.1.1 Introduction

The **Kingdom of Saudi Arabia**, **KSA.** is an Arab country and the largest country of the Arabian Peninsula. It has an estimated population of 27.6 million, and its size is approximately 2,150,000 square kilometers (830,000 hectare).The Kingdom is sometimes called "The Land of the Two Holy Mosques" in reference to Makkah and Medina, the two holiest places in Islam. The central institution of the Saudi Arabian government is the Saudi Monarchy . The Basic Law of Government adopted in 1992 declared that Saudi Arabia is a monarchy ruled by the sons and grandsons of the first king, Abdul-Aziz Al Saud. It also claims that the Qur'an is the constitution of the country, which is governed on the basis of the Sharia (Islamic Law). According to Economist's Democracy, the Saudi government is the ninth most authoritarian regime in the world. Riyadh is the capital city and official language is Arabic. Saudi Arabia is the world's leading petroleum exporter. Petroleum exports fuel the Saudi economy. Oil accounts for more than 90 percent of exports and nearly 75 percent of government revenues, facilitating the creation of a welfare state, which the government has found difficult to fund during periods of low Oil prices. Saudi Arabia is often called, along with Russia, an energy superpower. Human rights groups such as Amnesty International and Human Right's Watch have repeatedly expressed concern about the state of human rights in Saudi Arabia, although these concerns have been dismissed by the Saudi government.

1.1.2 Geology of Saudi Arabia

Saudi Arabia is geologically divided into four distinct and extensive terrains:

1. The Proterozoic Arabian Shield, comprising metamorphosed volcanosedimentary successions intruded by granite and gabbro.
2. The Phanerozoic Arabian platform of clastic, calcareous, and evaporitic successions dipping gently eastward away from the Shield.
3. The Tertiary 'harrats' (extensive basalt plateaus) mainly overlying the Shield.
4. The narrow Red Sea coastal plain of Tertiary and Quaternary sedimentary rocks and coral reefs.

1.1.3 The Arabian Shield

The Precambrian Arabian Shield is separated by the Red Sea rift from its counterpart, the Nubian Shield of Egypt and Sudan. The Arabian-Nubian Shield is itself part of the much larger East African orogen that extends throughout Eastern Africa and constituted the core of the end-Precambrian Gondwana super-continent.

The exposed Arabian Shield is a trapezoidal-shaped area of about 575,000 km2 in Saudi Arabia (plus smaller areas in Yemen and Jordan) that forms a western segment of the Arabian Peninsula.

It is bounded to the west by the Red Sea rift valley and its coastal plain (Tihama), and to the north and east by Phanerozoic sedimentary rocks. Including extensions in the northwest and southeast, the Shield is about 1,800 km long and has a maximum width of 700 km. Approximately 81,000 km2 of the Shield within the Kingdom are overlain by Cenozoic basaltic lava fields (harrats). The Shield is the basement of the Arabian Peninsula. It is composed of a variety of Precambrian rocks in contrasting belts of variously metamorphosed and deformed rocks and represents more than 1,200 million years of geological time.

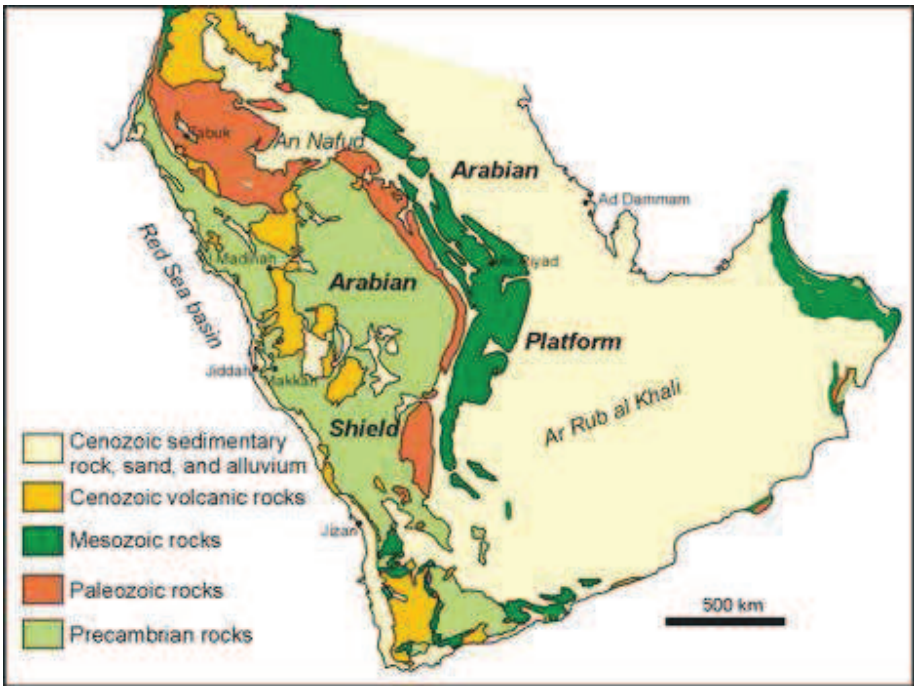


Figure 1.1: Arabian Shield of Saudi Arabia

The geologic evolution of the Arabian Shield includes:

- The deposition of sedimentary and volcanic rocks and intrusion of plutonic rocks in a series of magmatic arcs.
- The folding, faulting, and recrystallization of the rocks in a series of orogenic events.
- The collapse and extension of the orogenic belt in association with the deposition of younger sedimentary and volcanic basins and intrusion of late granites.

The main rock types of the Shield are volcanic and sedimentary; plutonic, mostly of the granitic type; metamorphic, including gneiss and schist derived from sedimentary and silicic volcanic rocks; and amphibolitic complexes formed from mafic igneous rocks.

The sedimentary and volcanic rocks underwent varied deformation, metamorphism, and alteration during evolution of the Shield, and were intruded by voluminous amounts of a variety of plutonic rocks. Plutonic rocks account for 55 percent of the area of the Shield. A total of 63 percent of them are granitic, 6 percent are mafic to ultramafic (including ophiolites), and 31 percent are of intermediate composition.

The emergence of plate tectonics as a unifying geological theory has brought into prominence the dynamic concept of 'terranes.' This concept implies that the juxtaposition of apparently unrelated rock assemblages may result from the assembly of geological entities that had originally been widely separated. Six or more terranes are postulated in the Shield, separated by four suture zones. The terranes in the west are made up of oceanic arcs and the eastern terranes are of continental affinity. At first, the terranes evolved separately and independently from one another but, after collision and amalgamation, they had a common history. The collision zones (or suture lines) are marked by highly deformed ophiolite complexes marked by distinctive mafic and ultramafic rocks. The two suture zones in the west (Bi'r Umq and Yanbu) represent the fusing of island arcs whereas those in the east are the result of oceanic-continent collision (Nabitah), or a probable major continental collision event (Al Amar). The amalgamation of the Shield terranes took place from about 715 to 630 million years ago. After amalgamation, the deformation and intrusion of igneous rocks related to collision continued. Thick deposits of sedimentary and volcanic rocks were formed, granitic rocks were intruded during 640 to 570 million years ago, and the major Najd wrench-fault system that operated from about 640 to 550 million years ago displaced the parts of the orogen to the northwest. These episodes marked the accretion of the Arabian portion of Gondwana during the Pan-African tectonic event.

Although radiometric data from the eastern terranes support the existence of a continental crust older than 1200 million years, the evolution of the Shield is poorly

understood prior to 850 million years ago. Between 850 and 700 million years, volcanosedimentary units commonly associated with plutonic rocks were deposited in the western terranes (Midyan, Hijaz, Asir).

Between 700 and 600 million years ago, the terranes became accreted to form an orogenic belt. Within the suture zones that represent the joins between the terranes, the rocks were metamorphosed, highly deformed, and commonly contain mafic and ultramafic rocks (ophiolites); this process is well represented by the suture between the Afif terrane and the Hijaz and Asir terranes.

The development of seas within the orogenic belt associated with collapse and extension of the orogen, led to the deposition of extensive shallow-water to terrestrial sedimentary deposits. The major magmatic activity during this period was marked by emplacement of granitic plutons and the extrusion of mainly rhyolitic volcanic rocks. Toward the end of this magmatic episode, basaltic and intermediate lavas were interbedded with sediments in continental basins that had resulted from movement along the northwest- to north-northwest-trending transcurrent faults of the Najd fault system.

The later history of the Arabian Shield was one of burial beneath the sedimentary cover of the Arabian platform, followed by uplift and erosion that exposed the present-day configuration of the Shield.

1.1.4 The Cover Rocks

The vast area of sedimentary rocks in the east and north of Arabia constitutes the Arabian platform. These rocks are less than 540 million years old and belong to the Phanerozoic Era. They overlie the older rocks of the Arabian Shield and hence are often termed the Cover Rocks.

Since Precambrian time, the Arabian Shield has been a relatively stable block. On its eroded surface was deposited the thick sequence of continental and shallow-marine sediments that now dip at low angles into the Arabian Gulf, and Rub'al-Khali sedimentary basins. However, the Shield did not escape the effects of plate tectonic movements, principally related to the break-up of the ancient continental mass of Gondwana. As a result, rift valleys were formed by faulting, and uplift and subsidence created domes, basins, arches, and troughs of considerable magnitude. Thus, the crest of the Ha'il arch is about 4 km above the base of the Nafud basin, and ancient rocks in the easternmost part of the Arabian plate are depressed beneath more than 10 km of sedimentary rocks. This results from the separation of Africa and Arabia, long after Gondwana broke up. Until about 60 million years ago, what is now the Arabian Peninsula formed part of the southeastern margin of the ancient Tethys ocean that occupied the area of the present-day Alpine-Himalayan mountain belt and

separated the ancient supercontinents of Gondwana (to the south) and Laurasia (to the north). Periodic marine invasions from the north and northwest resulted in a cyclic deposition of rocks. This paleogeography was modified due to the tectonic warping that was the precursor to Red Sea rifting. In the north of the Peninsula, the northerly trending Ha'il Arch marked the eastern limit of the incipient Red Sea. Easterly tilting of the Peninsula and downwarping associated with tectonic activities along the Zagros fold belt and the Oman Mountains, established the Arabian Gulf downwarp and allowed marine incursions from the Indian Ocean. Local differential subsidence created several secondary basins, the largest of which is that of Rub' al Khali. In mid-Tertiary times, crustal failure led to the development of the Red Sea rift system and renewed doming along the eastern margin of the rift, during which the western margin of the Arabian plate was elevated by as much as 3 km to form the Red Sea escarpment. Associated with the doming were the vast outpourings of basalt that form the harrats of western Arabia.

1.1.5 Cenozoic and Harrat Volcanism

A large part (180,000 km2) of the western Arabian plate is covered by extensive Tertiary and Quaternary lava fields extending in a broad, intermittent, north-trending belt from Yemen in the south to Syria in the north. Their distribution is related to the intense brittle tectonics (fracturing/faulting) associated with the opening of the Red Sea, which began at the end of the Oligocene or beginning of the Miocene (about 25 Ma), when the Arabian and African continental blocks were forced apart. Tensional stress caused substantial subsidence along the axis of the Red and its margins, and the extension fissures became conduits for basaltic magma; dikes of gabbro and dolerite running subparallel to the axis of the Red Sea at the western margin of the Arabian Shield originated as fissures filled with basic magma that crystallized at depth, but are now visible in outcrop due to subsequent erosion.

Most of the magma reached the surface and formed extensive flows that make up the basaltic plateaus (harrats) covering some 100,00 km2 of the Arabian Shield, Red Sea coastal plain, and escarpment. Eruptions have occurred from the Miocene (25 Ma) to the present (several eruptions are recorded in historical time). The harrats of Saudi Arabia, located between 50 and 500 km east of the Red Sea coast (except for the Al Birk volcanic field on the Red Sea coastal plain), show common volcanologic, petrographic, and structural features. They typically comprise an emissive axial zone, with complex alignments of volcanic-emission centers, and a number of emission points lateral to such zones.

The abundance of unweathered mafic and felsic flows, cones, and domes reflects extensive volcanic activity in the very recent geologic past, confirmed by radiometric age determination and historical records. The last eruption was from Harrat Rahat in A.D. 1256, when the lava flow stopped short of the gates of Al Madinah.

1.1.6 Red Sea Coastal Plain

The Red Sea coastal plain marks the eastern edge of a large graben, bounded by escarpments, that has been further widened through sea-floor spreading. The plain is relatively narow and comprises thick sequences of Oligocene-Recent sedimentary rocks.

Immediately underlying the first marine beds, directly related to the opening of the Red sea in middle Miocene times, a series of (now poorly preserved) continental clastic sediments were deposited on older marine Eocene deposits of Tethyan affinity. These continental clastic rocks are imperfectly known because they are only found in patches along the Red Sea coast itself and have been affected by graben faulting. It can be disputed whether the origin of the few remnants of Oligocene deposits in the Red Sea area was associated with pre-rifting tectonic activity in the area later to become the Red Sea, or whether such deposits were formerly widespread and are only preserved in the later rift zone. The volcanic activity that probably continued throughout much of the Oligocene, however, indicates the occurrence of tectonic events at that time.

1.2 Gold Deposits

Gold occurrences in Saudi Arabia are Precambrian rocks of the Arabian Shield located in the western part of the Arabian Peninsula. Phanerozoic rocks flank the shield on the north, east, and south, and cover Precambrian rocks at depths of up to 10 km in the remaining parts of the Peninsula apart from small structural highs that expose Precambrian basement in Oman.

Within the Shield, gold occurrences are abundant and widespread, commonly taking the form of ancient mines developed on gold-bearing quartz veins and gossans and, more rarely, placers. The distribution and concentrations of the ancient mines provide an invaluable ‘ first-order’ geochemical survey and a guide to areas of further potential.

The host rocks and geologic settings of the gold occurrences include mafic to felsic volcanic and volcaniclastic rocks, diorite, granodiorite, granite plutons, dikes, veins and shear zones.Tectonically, these rocks and structures belong to a series of amalgamated oceanic terranes or are varieties of syn-orogenic to post-orogenic intrusions, postamalgamation sedimentary and volcanic basins, cut by shear zones of many different trends and origins.

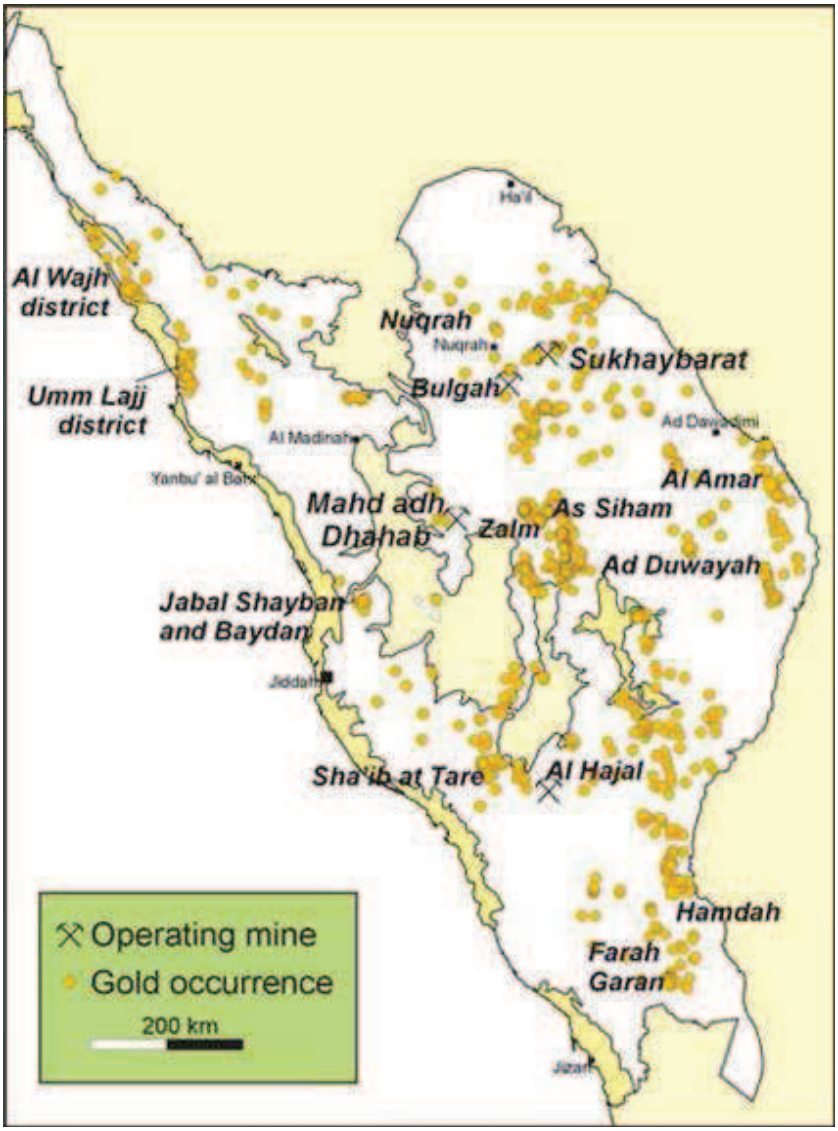


Figure 1.2 : Gold Occurrences in Arabian Shield

1.3 MA'ADEN COMPANY

Ma'aden is the Saudi Arabia Mining Company. The company was established in 1997, with the transfer of mineral titles from Petromin, the General Petroleum and Minerals Organization and working capital provided by the kingdom of Saudi Arabia. Although a relatively new company, Ma'aden is growing by both expanding its operations unilaterally and developing new ventures throughout the Kingdom of Saudi Arabia.
Ma'aden was shareholder owned company. The Government had sold half of these shares to Saudi Arabian investors.

With the prime objective of becoming a profitable and diversified international mining company, while being a leader in protecting human resources, healthy safety and environment. One of Ma'aden's principal aims is to promote new mining developments

and enable the mining industry to become a major source of revenue generation for the Kingdom during the coming decade. In this respect, Ma'aden is playing a key role in diversifying the industry base of Saudi Arabia into non-oil activities, such as mineral extraction and processing.

As part of its vision to utilize Saudi Arabian's diverse mineral resources. Ma'aden already has five operating gold mines and is undertaking detailed investigations at several other gold and base-metal prospects. Other initiatives address industrial minerals and include a large phosphate rock resource in northern Saudi Arabia, the bauxite deposits at Az Zabirah and a magnesite prospect at Zarghat.

2 PROPERTY DESCRIPTION AND LOCATION FOR Bulghah North

2.1 Location

Bulghah North is situated in the western region of the country known as the Hejaz in the Al Madinah Province, Saudi Arabia, approximately 520 km west-northwest of Riyadh, the capital city of Saudi Arabia. Located at latitude 24°59'N and longitude 41°36'E, at an elevation of 950 m amsl, the site is some 210 km northeast of the provincial capital Medina. The site is accessed along a combination of national (258 km – northwest from Medina to Hanakiyah along highway 60) and local (97 km – south towards the village of Bilghah) roads, a total travelled distance of 355 km from Medina. The village of Bilghah is located 5 km to the south of the Exploitation License and is situated in the GMT+3 time zone.

2.2 Terrain

The site is located on the central plain of the Crystalline Najd (the Arabian Shield), east of the Tuwayq escarpment. The topography on and around Bulghah is relatively flat, but shows a very slight downward slope from west to east. The elevation of the mine site is generally about 950 m amsl, but there are several rocky outcrops with peak elevations ranging from 960m amsl to up to 983 m amsl. The natural topography is typical for the central and southern plains region of Saudi Arabia where vegetation is sparse and is classified as xeromorphic dwarf-shrublands. Accordingly, land capability ranges from wilderness to rough grazing and nomadic herding.

Figure 2-1: General terrain over the Bulghah North project area

2.3 CLIMATE

The climate is dry with an average yearly precipitation of about 70 mm. The rainfall is normally coming with heavy storms during the cold season from November to April. The temperature during this period varies over the day between 0º to 30ºC. During the hot season the daily variation can be between 25º to 50ºC. The terrain is of stony desert type with thin layers of sand in lower land. The vegetation is scarce and appears mainly in the Wadis (dry streams) as grass, bushes and small trees.

2.4 Title and Rights

The Mawan EL situated in the NAS Region is collectively with the An Najadi EL, Nuqrah EL and Habla EL managed as a single entity by Ma'aden Gold. The total area under management is 1,847.1 km2 and comprises 8 prospects. The Mawan (261 km2) EL surrounds the Bulghah Exploitation Licence (39 km2) and the principal prospect is Bulghah North located 4.0 km from the open-pit at Bulghah.

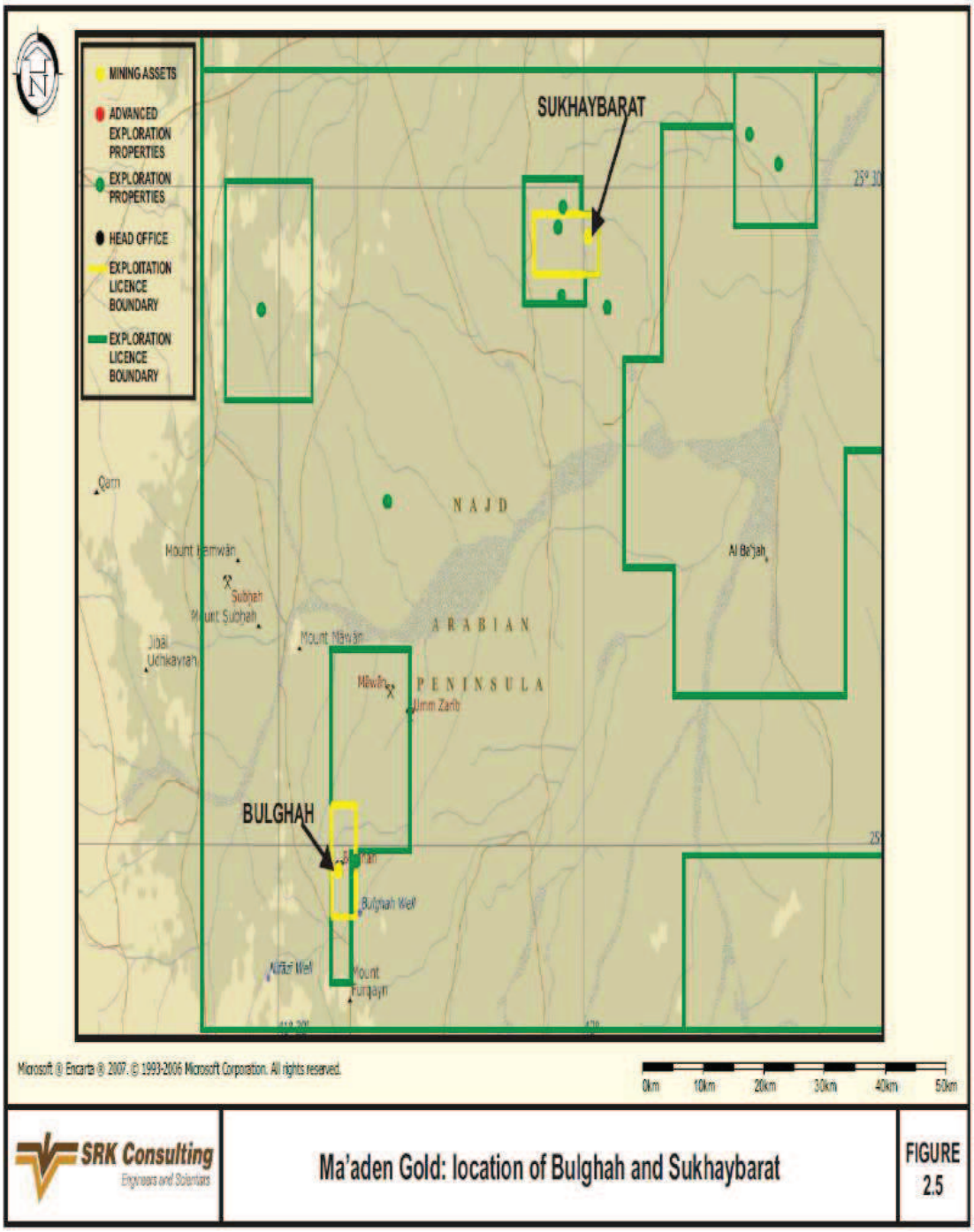


Figure 2-2: Location Map of the Bulghah North Project Area

2.5 Geologic setting

2.5.1 Regional Geology

Bulghah North and the adjoining areas is part of the Middle Proterozoic basement which is composed of meta-sedimentary and meta-volcanic rock belonging to Hulayfah Group. An intermediate intrusive of Shammer group trending north – south is inter layer between the supracrustal sequences. Younger dikes cut the whole rock sequence.

The gold mineralization is confined mainly to the intermediate intrusive. Quaternary deposit covers all low land areas and Wadi systems.

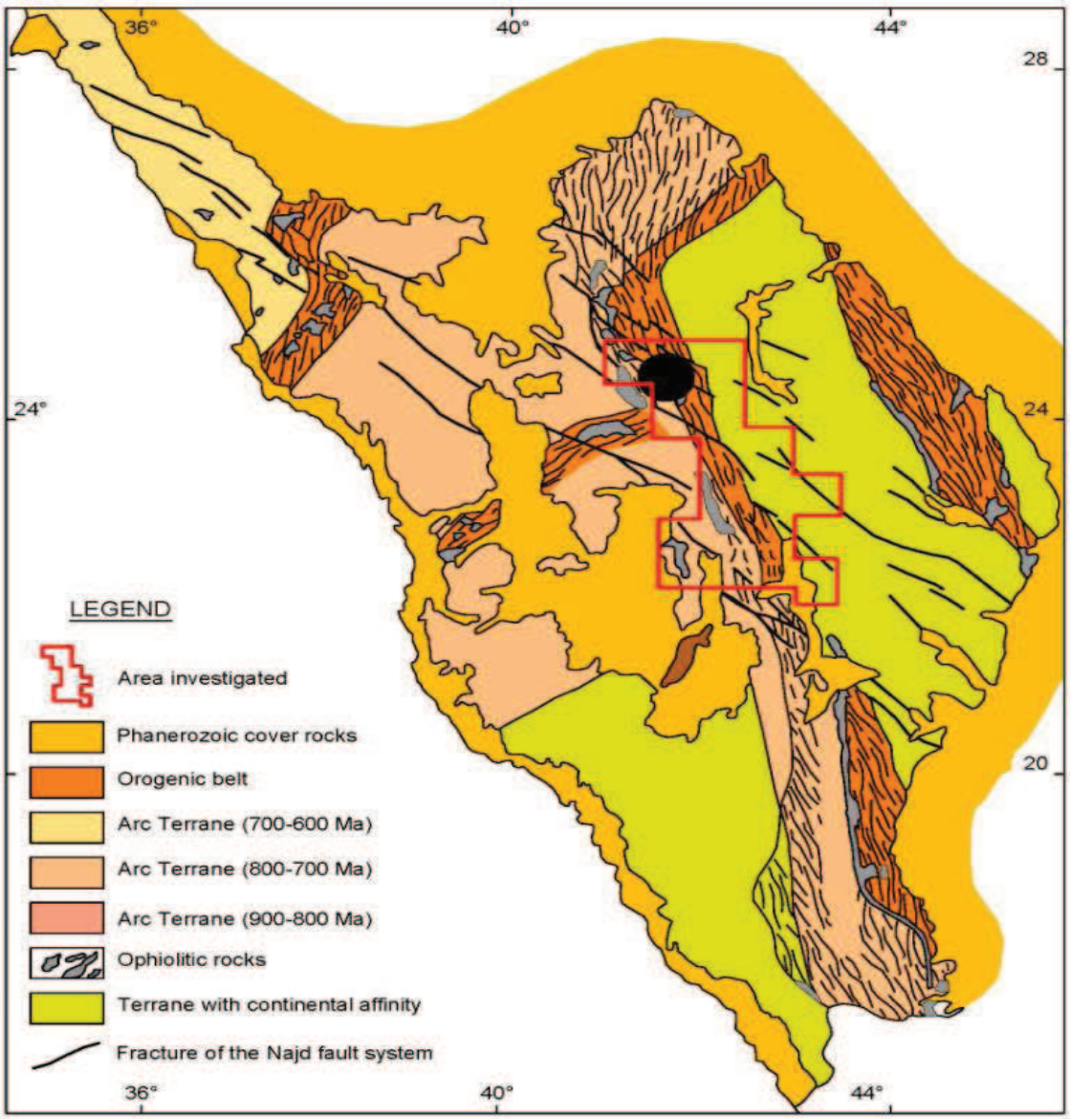


Figure 2-3: Regional geology of the North Arabian Shield

2.6 Project Scale Geology

2.6.1 Geology

Rocks in the Bulghah North area are comprised of Intrusive, Metavolcanics, Metasediments and Dikes.

2.6.1.1 Intrusive

The intrusive rocks which occupy much of the prospect area, consists mainly of diorite, quartz diorite and tonalite. They are in places cut by basic and felsic dikes.

Quartz diorite/ tonalite which occupy most of the intrusive are generally medium grained, light gray and consists of plagioclase and biotite set in a siliceous matrix. With increase of silica content the rock grades into tonalite. Reddish to pinkish orthoclase is present in a minor extent. Greenish coloration in some sections is due to chlorite alteration. Sulphides mainly pyrite and arsenopyrite are strictly confined along fractures and sometimes accompanied with quartz veining or silicification. In general they are slightly affected by chlorite-carbonate alteration. Diorite occurs along the margin of the intrusives and is also found as discordant bodies in the meta-sediments and meta-volcanic. Mega-scopically the rock is medium grained to slightly coarse-grained, dark grey to grayish black and consists mostly of plagioclase, hornblende and biotite. Color variations depend on the amount of ferromagnesians present in the rock. Some of the diorite grades from hornblende-biotite diorite to gabbro.

Figure 2-4: Bulghah North Tonalite

2.6.1.2 Meta-volcanics

The metavolcanic rock unit belongs to Afna Formation and found extensively along the eastern margin of the intrusives. The unit consists of basaltic-andesite to dacitic-andesite lava flows. They are generally massive, fine-grained, chloritized and with a vesicular texture.

Figure 2-5: Bulghah North Porphyritic Andesite

2.6.1.3 Meta-sediments

The meta-sedimentary unit belongs to Nuqrah Formation and found along the western margin of the intrusives. It is made up of a thick sequence of grayish to black, calcareous politic schist and blue marbles. The unit trends north-south and is slightly dipping to the east.

Figure 2-6: Bulghah North Metasediments

2.6.1.4 Basic dikes

Basic dikes consist mainly of andesite and diabase occurring as narrow dikes along the major fracture systems. The dikes are generally fine and medium grained, grayish black with porphyritic or ophitic textures. They are moderately to strongly jointed and affected by minor chlorite-carbonate alteration. Calcite and quartz fill the fractures.

Figure 2-7: Bulghah North Tonalite with cross cutting dyke

2.6.2 Structures of mineralization

The major structural feature in the area is the north-south trending lineament along the western contact which controls the emplacement of the intrusive. The general trend of the intrusion is north- south and with dip of 45º- 60º to the east. The intrusive is moderately fractured and in places moderately sheared or affected by cataclastic deformation. Figure 2-8 shows the major lineaments picked out from the Bulghah North Lands at image. The colors shown on the map can be related to the different lithologies in the project area. Whilst it is realized that the Lands at image does not truly identify the actually lithologies mapped, discreet areas can be identified and related back to the logged geology. For example, the material in the east and west regions of the drilled area (red box), being a yellow / green color can be linked to the host metavolcanics and the dark reddish color on the Lands at image relates to the tonalite intrusion. In fact, four discreet areas of tonalite can be inferred.

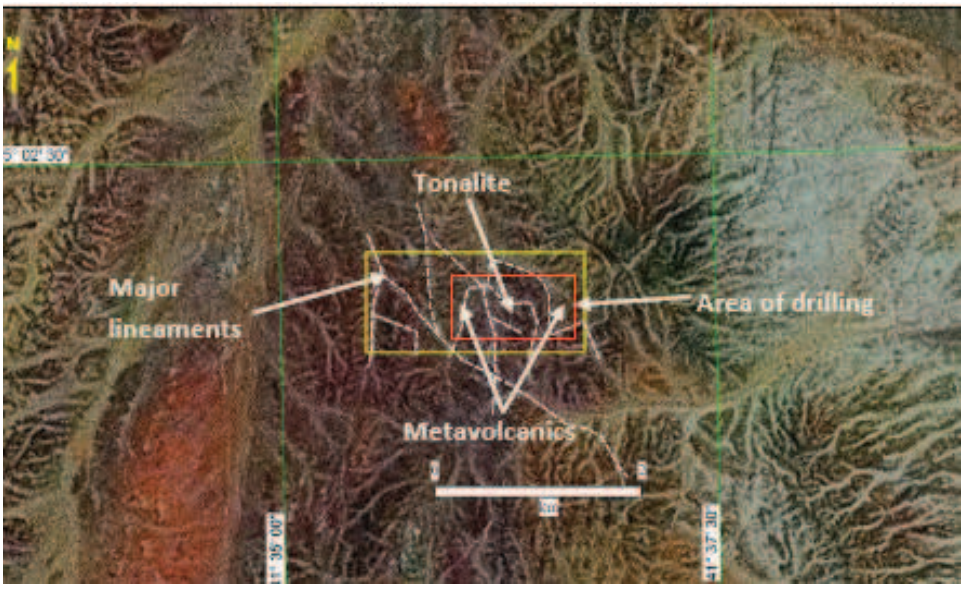


Figure 2-8: Structural lineaments within Bulghah North project area (Landsat image)

2.6.3 Bulghah North Mineralization

While the mineralization at Bulghah North occurs predominately within the intrusive body along quartz filled vein lets, stringers, fracture zones, shears, and joints, the ore body as whole does not have sharp geological contacts but rather comprises stock work style mineralization and as such its hanging wall and footwall contacts have been defined based on alteration and grade rather than by litho logical contacts. Sulphide minerals associated with the gold mineralization include arsenopyrite, pyrite (± minor pyrhotite), chalcopyrite, sphalerite and other trace sulphides. Mineralization is

subdivided into oxide, transitional and sulphide (fresh) ore. Supergene mineralization extends from surface to a maximum depth of approximately 100 m below surface. The majority of the supergene profile for Bulghah North has been logged as transitional with only a small portion of oxidized material being present within the central portion of the project area (Figure 2-9). Mineralization is also associated with iron oxides, primarily limonite and minor hematite.Microprobe and microscopic studies on Bulghah ore indicate that gold is associated with borders and fractures within arsenopyrite grains. Gold mineralization is associated to alesser extent with quartz and calcite and rarely with pyrite. In the supergene zone, gold is associated with hematite after sulphides. Porphyritic andesite dykes of varying size (commonly less than 1.0 m in width) intrude the mine area. These dykes are unmineralised and are not believed to affect the tenor of mineralization.

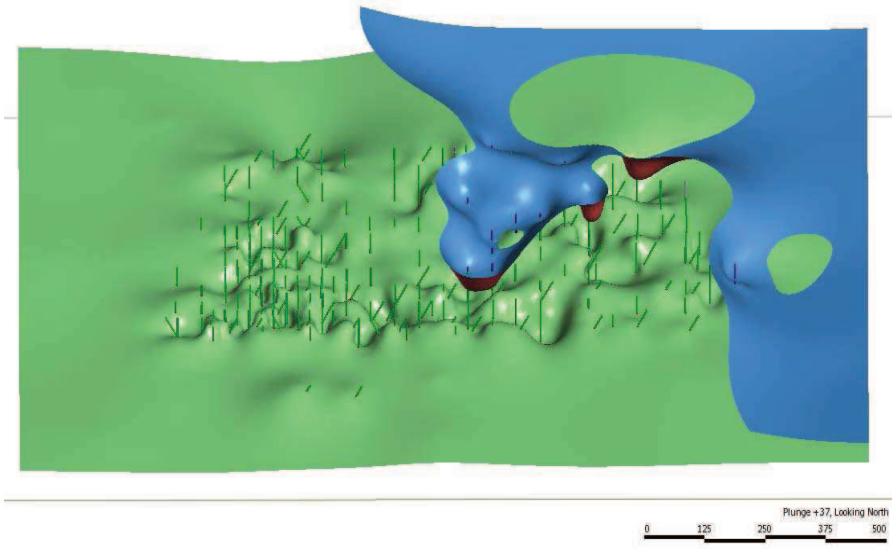


Figure 2-9: Oxidised (blue) / transitional (green) material at Bulghah North

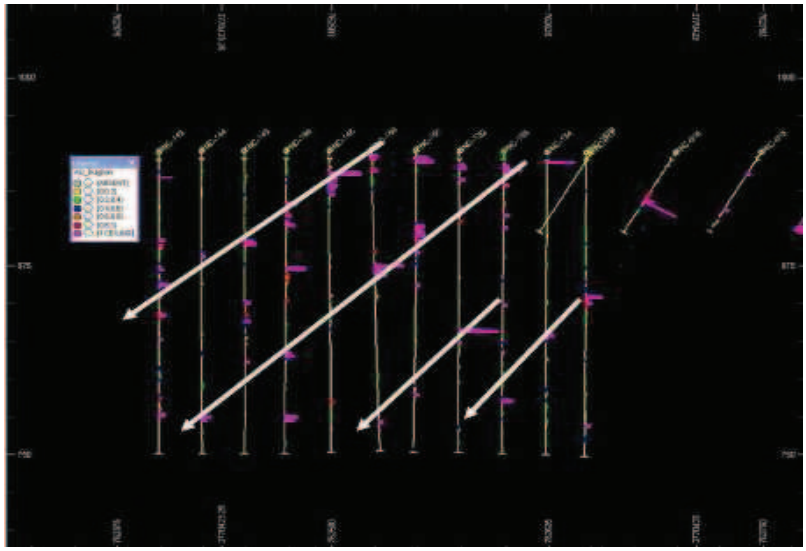


Figure 2-10: Bulghah North 40° dippin g mineralisation (vertical holes only)

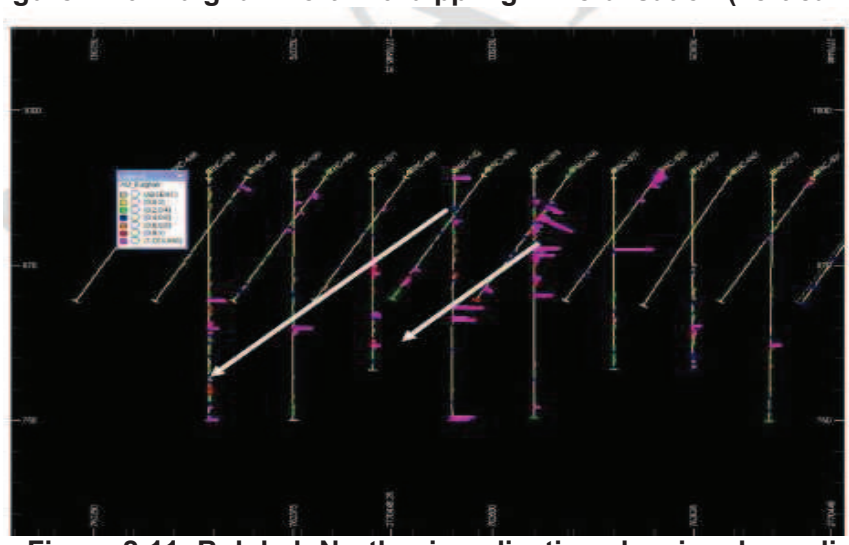


Figure 2-11: Bulghah North mineralisation showing down dip drilling and 40° dip within vertical holes

3 EXPLORATION

3.1 Introdution

Exploration activities on the Bulghah North project area commenced in 2005 with geochemical soil/rock investigations. This phase of exploration identified a significant gold anomaly (1.6 km by 1.0 km in size) with corresponding high arsenic values approximately 3 km north of the Bulghah open-pit. RC exploration drilling commenced early in 2006 along 400 m spaced east-west oriented lines at 200 m centers. Follow up RC and diamond exploration resulted in a total of 608 drill holes on an incomplete 25mE by 25mN grid with a dominant drill spacing of 25mE by 50mN. Figure 3-1shows the location of the

drillhole collars for Bulghah North. The topography surface shows a relatively flat project area with the exception of small north-south trending ridges to the east and west of the project area. In total, 259 diamond drill holes and 349 RC drill holes have been drilled at Bulghah North for the completion of 88,253 drilled meters (Table 3-1).

Table 3-1: Diamond drilling completed by project area

Project	Dominant Drill Spacing	Number of drillholes	Total Metres
Diamond	25mE by 50mN	259	48,265
RC	50mE by 50mN	349	40,258
	Total	**608**	**88,523**

Figure 3-2 and Figure 3-3 show the downhole drill hole traces for Bulghah North. Holes have been drilled dipping at 60° to the west and ve rtically. Drilling was not observed during the site visit, with all exploration activities having been completed in 2008.

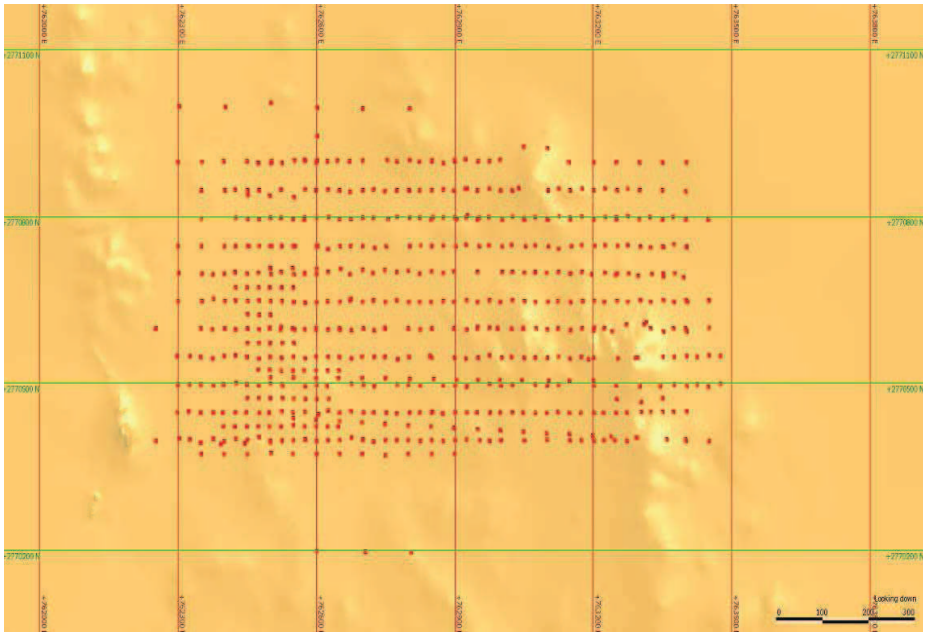


Figure 3-1: Drillhole collar location

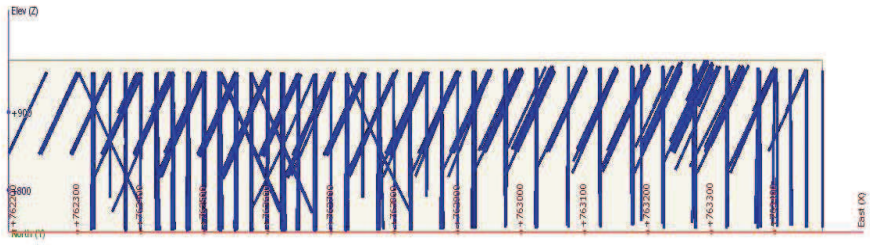


Figure 3-2: Drillhole traces – looking north

3.2 Sampling and Analysis

All RC samples are 1m in length with the RC samples being split down to 25% of the original sample size for dispatch to the laboratory. Diamond core is sampled on 1m intervals or by lithological contact with the diamond drill core being split with half the core being dispatched for analysis. All samples are analyzed at the Al Amri laboratory facility in Jeddah.

3.3 Standards

Ma'aden has introduced 8 different standards into the analysis sample stream. Each standard has been supplied by GEOSTATS Pty in Perth, Western Australia. The summary statistics of each sample are shown in Table 3-2. In total, 3,773 standard samples have been submitted for analysis of which 2,668 samples have been analyzed from the diamond drill holes and 1,105 samples have been analyzed from the RC drill holes.

Table 3-2: Summary statistics of the GEOSTATS standards

Standard	AU - Mean	Au-STDEV	Number of Samples – Diamond	Number of Samples – RC
G300-2	0.06	0.02	390	160
G301-1	0.85	0.05	386	157
G399-2	1.46	0.09	375	164
G901-1	2.58	0.13	366	158
G902-4	3.39	0.18	246	8
G904-3	13.66	0.62	379	147
G997-5	7.31	0.33	392	156
G999-8	3.42	0.19	134	155

Figure 3-3 to Figure 3-6 show the Au performance graphs for standard G301-1 and G901-1 for the diamond and RC sample streams. With the exception of a few outlier values, the results obtained for these standards are acceptable with the laboratory performing within the set limits.

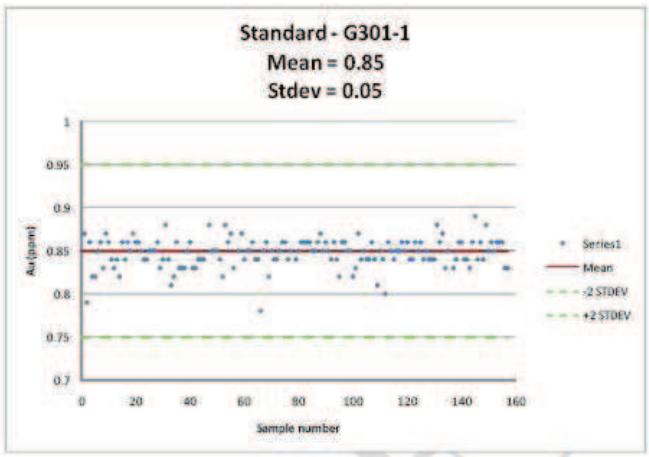


Figure 3-3: G301-1 — RC sample Stream

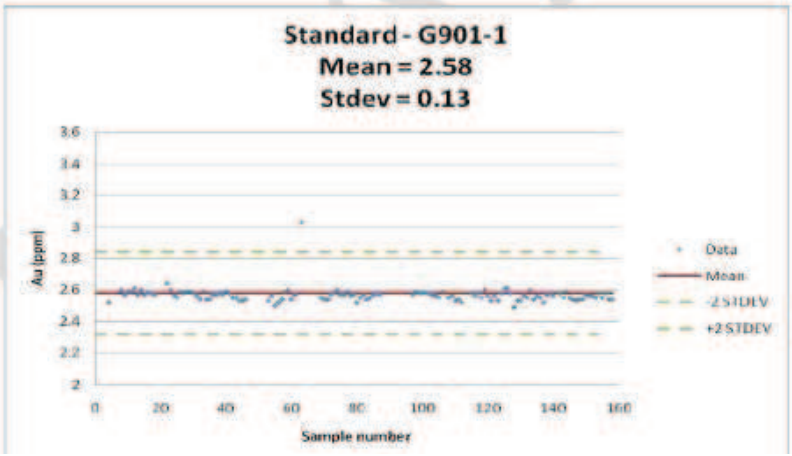


Figure 3-4: G901-1 – RC sample stream

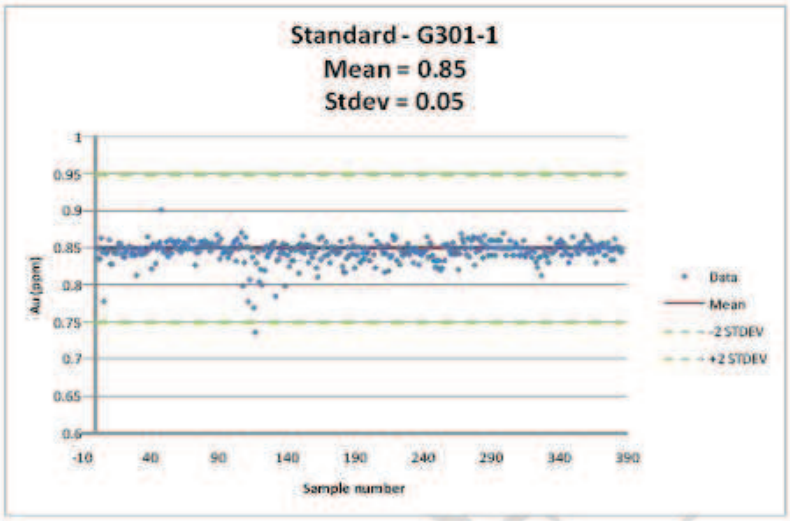


Figure 3-5: G301-1 – Diamond sample stream

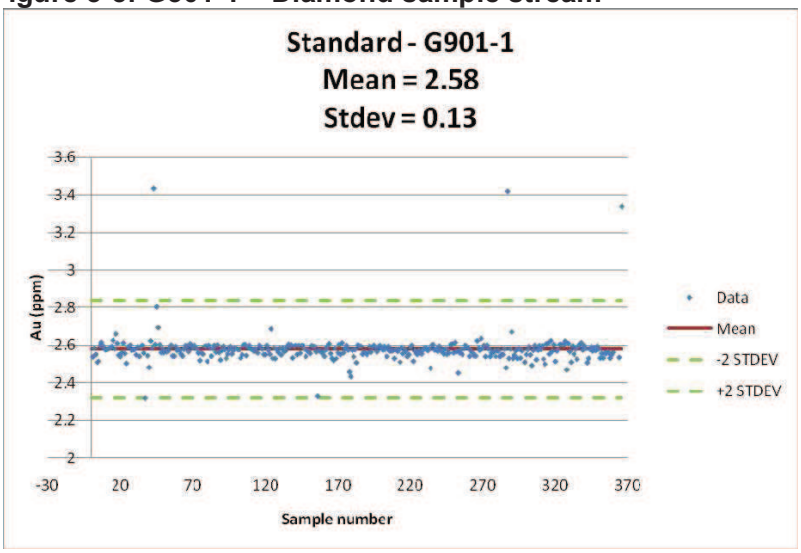


Figure 3-6: G901-1 – Diamond sample stream

4 Resource Estimation

Based on the data which we got from Exploration department for bulghah North we evaluated these data and observed the Ore which is disseminated (no zone) and low grade. The oxidization Ore limited by 20 m To 40 m below the surface.

4.1 Methodology

By using SURPAC SOFTWARE we made several sections by using interval distance 50 m between every section and deferent specific gravity 2.64 t/ m3 for weathered and 2.7 t/ m3 for fresh.

- Targeted the cut-off grade 0.3 g/ t and digitizing the mineralization.
- Create the Solid model by using polygons.
- To create the Block model follow these parameters:

TYPE	Y	X	Z
Minimum coordinates	2770300	762224	700
Maximum coordinates	2771000	763024	1000
User block size	5	5	5
Minimum block size	2.5	2.5	2.5
Total blocks	764225		
Storage efficiency	92.89%		

Table 4-1 : Block model Parameters

Inverse Distance Parameters

Max. search distance of major axis	30
Max. vertical search distance	10
Max. number of informing samples	15
Min. number of informing samples	3
Semi-major axis	1
Minor axis	3

Table 4.2:Inverse Distance Parameters

Definition of samples

Attributes	Definition
Au	**The gold assay**
Density Frsh	**The specific gravity of fresh rock**
Density wth	**The specific gravity of weathered rock**
Rock cod	**Rock type fresh or weathered**

Table 4-3 : Samples Definition

Geological department in Bulghah Mine run the SURPAC to estimate the Mineral Resource for West Zone from Bulghah North in different cut-off grade found the following Result:

Cut-off\ 0.3	**tonnes**	**Au**	**Oz**
0.0- 0.3	26,966,588	0.16	138,713
0.3-999	19,533,530	0.79	496,110
Cut-off\ 0.4			
0.0-0.4	33,272,395	0.19	203,239
0.4-999	13,227,722	1.00	425,261
Cut-off\ 0.5			
0.0-0.5	37,221,820	0.22	263,263
0.5-999	9,278,297	1.23	366,896
Cut-off\ 0.6			
0.0-0.6	39,494,081	0.24	304,729
0.6-999	7,006,036	1.46	328,848
Cut-off\ 0.7			
0.0-0.7	40,858,552	0.25	328,392
0.7-999	5,641,566	1.65	299,264

Table 4-4 : Resource Estimation by Geology Department.

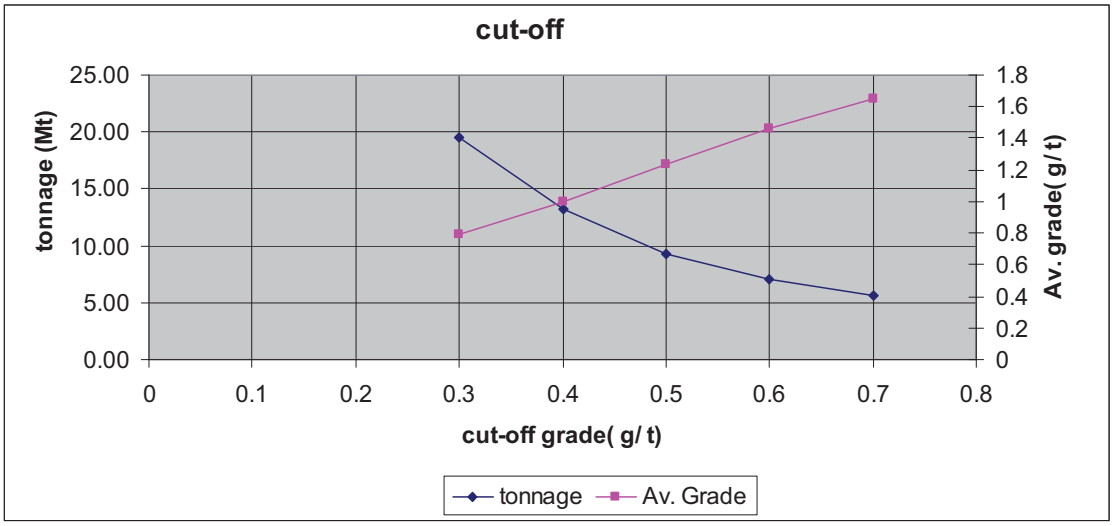


Figure 4-1 : Comparing Chart between Tonnage and Average Grade for Geological Department.

Figure 4-2 : Solid of mineralization ore

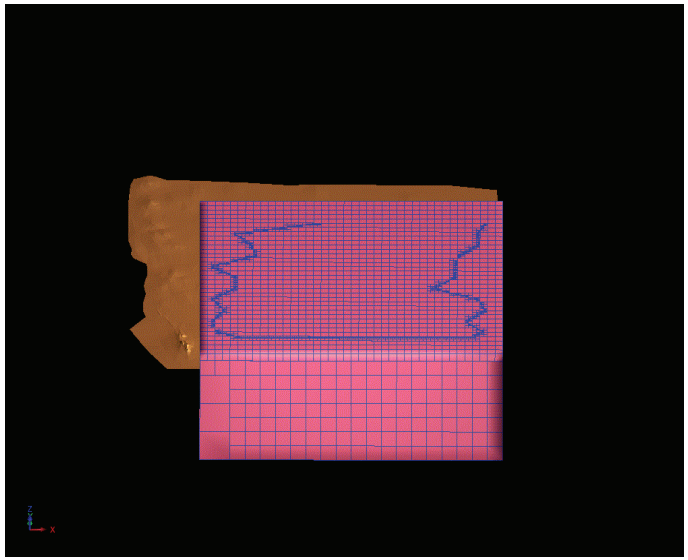
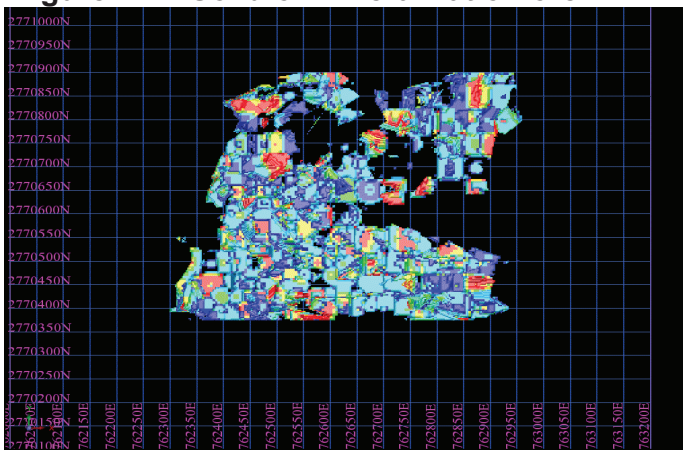


Figure 4-3 : Block Model With Topography



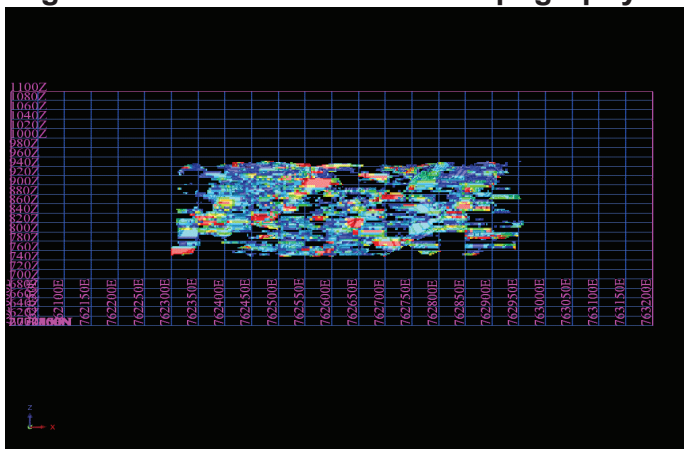


Figure 4-4 : Map and cross section

5 Mine design

5.1 Pit optimization

As it is already mentioned in the introduction of the Bulghah North block the block is still under conceptual stage, as such with the block model available for the mine in the Project department I, with the help of my co-coordinator tried to run Whittle to optimize the pit, but due to erroneous block model I could not be able to optimse the pit. However with the data obtained from Surpac software & data obtained from the project department of my company I have considered 22.62 million tones of ore with a cut off grade of 0.3 g/t of Au. As advised by my co-coordinator the study to be done in two options of stripping ratios. One on the optimistic side with a ratio of 1 : 4 & another on the pessimistic side with a ratio of 1 : 7. The other geo-mining parameters of the block is given as under

	Option-I	Option-II	Option-III
Reserve			
Weathered Ore Cut off 0.3 g/t of Au	**2.66 Mt**		
Fresh Ore Cut off 0.3 g/t of Au	**19.96 Mt**		
Total Reserve with Cut off 0.3 g/t of Au	**22.62 Mt**		
Grade			
Weathered Ore "g/t of Au"	**0.70**		
Fresh Ore Cut "g/t of Au"	**0.78**		
Waste	**31.67 Mt**	**31.67 Mt**	**38.45 Mt**
Stripping Ratio	**1.4**	**1.4**	**1.7**
Dilution	**5%**		
Mining Losses	**5%**		
Density weathered	**2.64 t/ m3**		
Density Fresh	**2.7 t/ m3**		
Gradient of the main Ramp	**1 in 10**		

Table 5-1 : Bulghah North Mining Parameters

5.1.1 Geotechnical Data

The parameters which will be used in bulghah north optimization and design are tabulated below:

Parameters	Value	Unit
Over all slope angle	45	degree
Bench slope angle	65	degree
Bench high	5	m
Berm high	5	m
Ramp Width	15	m

Table 5-2 : Bulghah North Pit Design Parameters

5.1.2 Economic Constraints

In this study I presented the mining and milling costs of Bulghah mine except the Ore transportation cost, which is considered to be higher as the ore is to be transported to the existing processing plant located at Bulghah Mine. The current transportation cost of the operating mine is 1.7 $ /te, while for the study the transportation cost of 2.5 $/te has been provisioned.

The estimated initial investment for the mine is only 0.8 million US Dollars. No additional capital provision is required as the existing processing plant will be used for processing of the ore produced from the mine and also the entire production from the proposed mine will be made be outsourcing.

Geological department provided me the original block model. It was very small in front off the Ore body depth and blocked to run the whittle software program.

Parameters	**Value**	**Unit**
Gold Price	850	$/ oz
	= 26.56	$/grams
Mining Cost		
Loading Cost of Ore & Waste	0.77	$/ t
Hauling Cost of Ore	2.5	$/ t
Hauling Cost of Waste	1.71	$/ t
Blasting Cost	0.32	$/ t
Drilling Cost	0.04	$/ t
Mining Cost of Ore	**3.64**	**$/ t**
Mining Cost of Waste	**2.85**	**$/ t**
Processing Cost		
Processing Cost(heap leach)	1.9	$/ t
General administration Cost	0.9	$/ t

Table 5-3 : Mining and Processing Cost

5.2 Mining

5.2.1 Introduction

Ma'aden Company has perspective to concentrate on Ore processing stages and submit the ore extracting to contractor to carry out the operations of drilling, blasting and hauling under direct supervision of mining department in the new open pit gold mines projects. In the old company projects like Bulghah gold mine has drilling machines and blasting crew for this reason the company still carry these operations by itself and the Contractor carries out the hauling. When the mining operation in Bulghah North will start the mining operation in Bulghah will be stop and the drilling machines, blasting crew and the contractor will transfer there.

5.2.2 Calendar Programme

The Calendar programme of Production for different options of study are given as under

Table 5-4 : Calendar programme for Option - I

Year	Production	Balance Reserve	Waste	Balance Waste	Gold Production (Metal)		
					Weathered Ore	Fresh Ore	Total
	Mt/an	Mt	Mt	Mt	Mgrams	Mgrams	Mgrams
0	0.00	22.56	0.00	31.67	0.00	0.00	0.00
1	3.00	22.56	4.20	31.67	0.28	0.95	1.24
2	3.00	19.56	4.20	27.47	0.28	0.95	1.24
3	3.00	16.56	4.20	23.27	0.28	0.95	1.24
4	3.00	13.56	4.20	19.07	0.28	0.95	1.24
5	3.00	10.56	4.20	14.87	0.28	0.95	1.24
6	3.00	7.56	4.20	10.67	0.00	1.16	1.16
7	3.00	4.56	4.20	6.47	0.00	1.16	1.16
8	1.56	1.56	2.27	2.27	0.00	0.60	0.60
Total	22.56		31.67		1.42	7.69	9.11

Table 5-5 : Calendar programme for Option - II

Year	Production	Balance Reserve	Waste	Balance Waste	Gold Production (Metal)		
					Weathered Ore	Fresh Ore	Total
	Mt/an	Mt	Mt	Mt	Mgrams	Mgrams	Mgrams
0	0.00	22.56	0.00	31.67	0.00	0.00	0.00
1	3.00	22.56	4.20	31.67	0.28	1.19	1.48
2	3.00	19.56	4.20	27.47	0.28	1.19	1.48
3	3.00	16.56	4.20	23.27	0.28	1.19	1.48
4	3.00	13.56	4.20	19.07	0.28	1.19	1.48
5	3.00	10.56	4.20	14.87	0.28	1.19	1.48
6	3.00	7.56	4.20	10.67	0.00	1.45	1.45
7	3.00	4.56	4.20	6.47	0.00	1.45	1.45
8	1.56	1.56	2.27	2.27	0.00	0.75	0.75
Total	22.56		31.67		1.42	9.61	11.03

Table 5-6 : Calendar programme for Option - III

Year	Production	Balance Reserve	Waste	Balance Waste	Gold Production (Metal)		
					Weathered Ore	Fresh Ore	Total
	Mt/an	Mt	Mt	Mt	Mgrams	Mgrams	Mgrams
0	0.00	22.56	0.00	38.45	0.00	0.00	0.00
1	3.00	22.56	5.10	38.45	0.28	1.19	1.48
2	3.00	19.56	5.10	33.35	0.28	1.19	1.48
3	3.00	16.56	5.10	28.25	0.28	1.19	1.48
4	3.00	13.56	5.10	23.15	0.28	1.19	1.48
5	3.00	10.56	5.10	18.05	0.28	1.19	1.48
6	3.00	7.56	5.10	12.95	0.00	1.45	1.45
7	3.00	4.56	5.10	7.85	0.00	1.45	1.45
8	1.56	1.56	2.75	2.75	0.00	0.75	0.75
Total	22.56		38.45		1.42	9.61	11.03

5.2.3 Drilling

The drilling will carry out by mine department. The drilling team consists from ten persons including drilling Forman. The work in the drilling field is eight hours per day, three shifts per day and seven days per week. The mine department has three types of drilling machines have diferent parameters. The specifications and parameters of the drilling machines find in the table below:

machine type	Company	Depth		Unit	Diameters		Unit
		Drill target	Max.		Drill target	Max.	
ROC L8	Atlas copco	5-10	25-54	m	125	110-178	mm
ROC D7	Atlas copco	5	28	m	105	64-115	mm
642	Atlas copco	5	25	m	89	64-102	mm

Table 5-7 : Specifications and Parameters of Drill Machines.

Drill Machine	ROC D7				ROC L8			
Rock Type	Weathered		Fresh		Weathered		Fresh	
Depth m	Spacing-m	Burden m	Spacing-m	Burden-m	Spacing-m	Burden-m	Spacing-m	Burden-m
5	4	4	3.5	3	5	4	4	4
10	3.5	3	No	NO	6	5	No	No

Table 5-8 : Drill hole parameters for Drill Machine.

- 642 drilling machine use for pre-split drill hole.
- The minimum drilling production hole is 100 holes and the maximum 150 with maximum blasted material 25,000 tones.

Drilling capacity

Hole diameter - Ore and waste 102 mm & 125 mm

		Weathered	Fresh	
The drilling pattern will be:	**S**	**5**	**3.5**	**m**
	B	**4**	**3.0**	**m**
Sub-drilling is:		**1.0**	**0.5**	**m**
Bench height is:		**5.0**	**5.0**	**m**
Total hole depth is:		**6.0**	**5.5**	**m**

Drilling capacity per	**weathered**	**Fresh**	
Operating hour is:	**25.0**	**20**	**m/ hr.**

Long-range Utilization: **60%**

Working time:

hours/ day = 24 Hrs
shift/ day = 3 Shifts
days/ year = 312 Days

capacity per day is :	360	288	m/ day
Capacity per year is :	112,320	89,856	m/ year

	Weathered	Fresh	
Rock density in situ is :	2.64	2.7	tonne/ m3
Yield per drill rig is :	53	28	tonne/ m

90% will be use as a true figure, due to narrow space and smaller blasts.

	Weathered	Fresh	
Yield per drill rig is :	48	25	tonne/ m
Annual capacity per drill rig (kt)	5391.36	2246.4	Kt/ yr.

The annual number for drilling machine required 2.0

5.2.4 Blasting

The mine department works to provide the necessary row material
For crushing plant and for the contractor equipments to avoid the standby equipments by blasting over the five days a week by blowing up one every day. The department has whole team for blasting jobs consists from seven persons including three blasters. To accomplish blasting jobs in standard time the company provided for the mine department by truck for ANFO explosive charging. There are stores for explosives in the mine enough for storage amounts of explosives for blasting for three months. Explosive materials purchase from a Saudi Company specialized in the manufacture of explosives. Blasting powder factor for weathered= 0.4 kg/ m3 Blasting powder factor for fresh = 0.3 – 0.4 kg/ m3

Figure 5-1 : Truck ANFO Explosive Charging.

5.2.5 Equipments selection and Hauling

The mining equipment has been chosen considering the selective mining demand, the annual production rate and also the type of rock encountered in the deposit. With a bench height of 5 m and an annual production of 3.0 Mtonne of rock. As I mentioned before the same contractor in Bulghah will carry out the Ore from Bulghah North to the crushing Plant by the same equipments. Find below the contractor equipments list:

Equipment	Quantity	Company	Capacity (ton)
Dump Truck 777	1	CAT	70 Ton
Dump Truck 775	5	CAT	50 Ton
Dump Truck 773	1	CAT	40 Ton
Dump Truck	5	HINO	23 Ton

Table 5-9 : Dump Truck Specifications

Equipment	Quantity	Company	Operating weight (kg)
Front Shovel 5080	4	CAT	74,000 volume of Bucket 5,2 $м^3$ Capacity of Bucket 14 Ton
Excavator 320	1	CAT	21,000 Volume of Bucket 1,6$м^3$ Capacity of Bucket 4.5 Ton
Excavator PC 220	1	HINO	
Bulldozer D9L,D9R	3	CAT	
Bulldozer D 155 A	1	Komatsu	
Wheel loader 980,988	2	CAT	
Wheel dozer C 824 G	1	CAT	
Wheel loader 470	1	Komatsu	
Grader G14	1	CAT	
Compactor	1	CAT	

Table 5-10 : Equipments Specifications

5.2.6 Auxiliary equipment

All heavy auxiliary equipment will be owned and operated by contractor.

One grader will be used for road maintenance. The service loader can be at hand to help maintain the road.

The road maintenance is essential to save the tires of the trucks. Badly maintained roads may also cause extra maintenance on the trucks as well as decreased speed resulting in loss of production.

The water truck will be used to fight the dust on the roads and also to keep the roads from deteriorating. It will also give a better environment for personnel and machines.

On the waste dump, one truck dozer will be used to keep an even surface. This will make it possible for the trucks to maintain a high speed and dump their loads without any delays due to uneven surface or blockage by waste rock piles.

Even if drilling and blasting operation is performed in a proper way, there will be oversize material, which has to be treated in the mine. For this purpose there will be a hydraulic hammer, mounted on an excavator, to break the boulders into pieces. This excavator can be equipped with a bucket for digging work or scaling of benches.

5.2.7 Working time

The crusher will be fed on a continuous working schedule for ore. This means 3 shifts per day, 7 days per week and 365 days per year. The mine will run on similar case for the crusher. During change the shift for the contractor the ore will be loaded from a dump near the crusher with a separate loader. This is in accordance with the crusher and leaching operation schedule. 12000 tones will the maximum dump capacity needed during the day.

5.3 Process design

5.3.1 Introduction

As Bulghah north is extended for Bulghah mine, the basis for the Extracted the ore is to integrate as much as possible conceptual Design of Bulghah heap cyanide leach Process and the process Facilities at Sukhaybarat, and to meet the requirement to cope with An annual Throughput of 3,0 Mtonnes of ore, containing in average 0.77 g gold per tonne of ore. The total ore reserve to be staked is Calculated to22 Mtonnes, giving an operations life 7 years. The Annual average Gold production will be approximately 1600 kg (1.6 t) at an overall Recovery of 60%.

As the geological of Bulghah north similar to Bulghah, there are three Types of ore will treat.

- Surface ore
- Weathered ore
- Fresh ore

5.3.2 Crushing plant

The size of the crushing plant is based on 6200 operation hours per Year corresponding to 71% availability. The plant will have a lowest capacity of 485 tonnes per hour, reducing the surface and weathered ore to a particle size measuring approximately to 13 mm. Surface and weathered ore will be crushed in four stages in closed circuit with vibrating screens. Mill department tried to increase the fresh Ore recovery, which require the particle size to be reduced to 6 mm for the achieving the recovery equivalent to weathered ore, where the recovery is in the range of 80%.

But main bottleneck of the system is the crushing capacity. In order to enhance the recovery one or two number of additional HP 5 cone crushers are required to inserted in the system. The matter was discussed with the representatives of METSO, in the presence of my co-coordinator to enhance the crushing capacity, as suggested by him additional two HP 5 cone crusher is required in the plant. That will not only enhance the crushing capacity but also the minimum particle size to 4mm. that will cost about 1.71 Million US Dollars for which provision has been made in the initial capital of Option – II & Option – III of this study. The recovery of 65% has been

considered with additional crushers, however a chemical analysis needs to be made before the modification the processing plant.

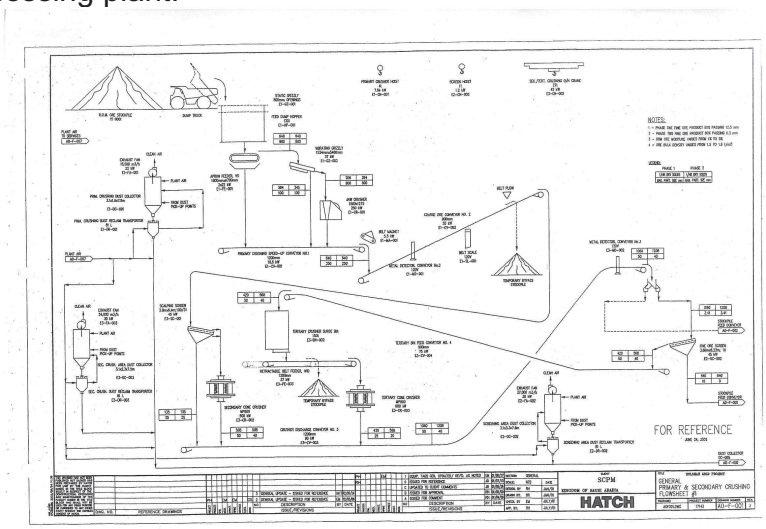


Figure 5.2 : Crushing Net Work

As briefed in the introduction that in order to improve the recovery of the final product from the produced fresh ore, the matter was discussed the representative of METSO. The crushing arrangement as proposed by METSO company is given as under

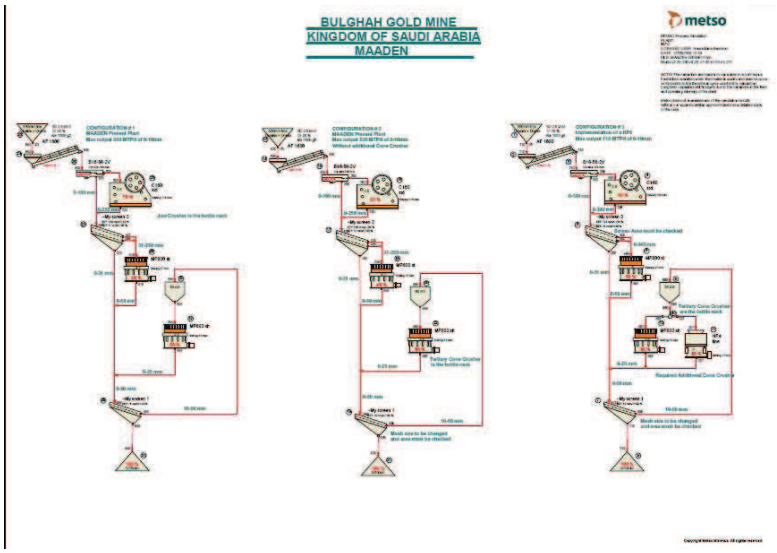


Figure 5.3 : The suggestion Configurations from Metso

This will not only enhance the crushing capacity of the plant but also the recovery of the final product from the fresh ore will be increased by at least 13%.

5.3.3 Agglomeration

In case Bulghah North has the same rock types of Bulghah Cement will be add for all ore types for **PH** control.

The cement addition rates are 4 kg/tonne surface ore, 1.2 kg/tonne Weathered ore and 2 kg/tonne fresh ore. The cement is added to the ore on the first conveyor after the crusher by a screw feeder. The cement is stored in a bin with a capacity of 120 tonnes. Barren solution will be used for the agglomeration. The solution will be distributed to 4 conveyors transfer point. The moisture content of the agglomerates will vary from 3 to 8 %, depending on the actual ore type to be treated.

5.3.4 Heap stacking

The heap leach conveying and stacking system will have a capacity of 485 tonnes per hour. This study is based on using a 30 inches conveyor System. Two overland conveyors will be used for transfer of ore from the Crushing plant to the pad area. A belt tripper car will be used for side discharge for transfer of the ore from the second overland conveyor to the The first ramp portable conveyors connecting to the stacking system at the Pads. The stacking system at the pads consists of five portable ramp conveyors and seven standard portable conveyors. A horizontal conveyor will be used to feed the ore from the portable conveyors to a telescoping radial Stacker.

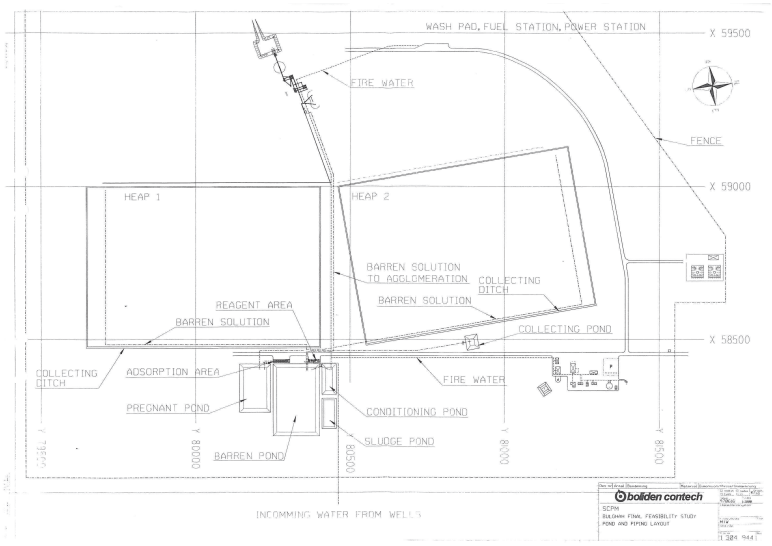


Figure 5.4 : Heap Leach Design Diagram

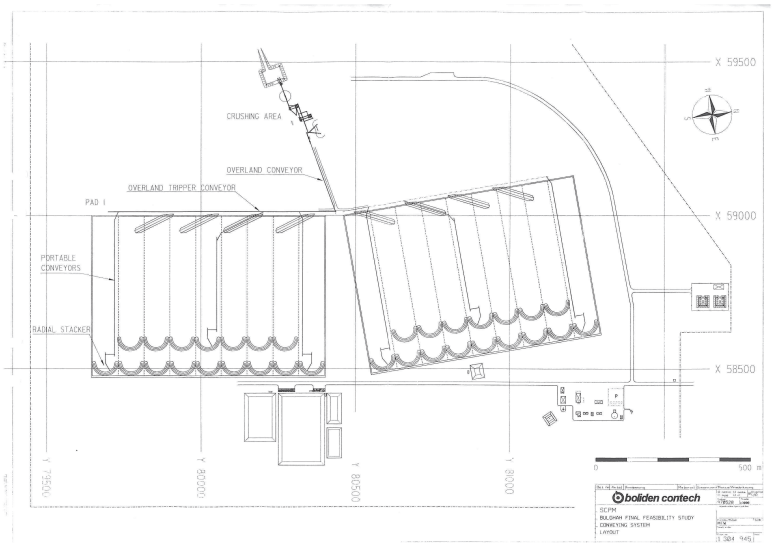


Figure 5.5 : Heap Leach Stacking

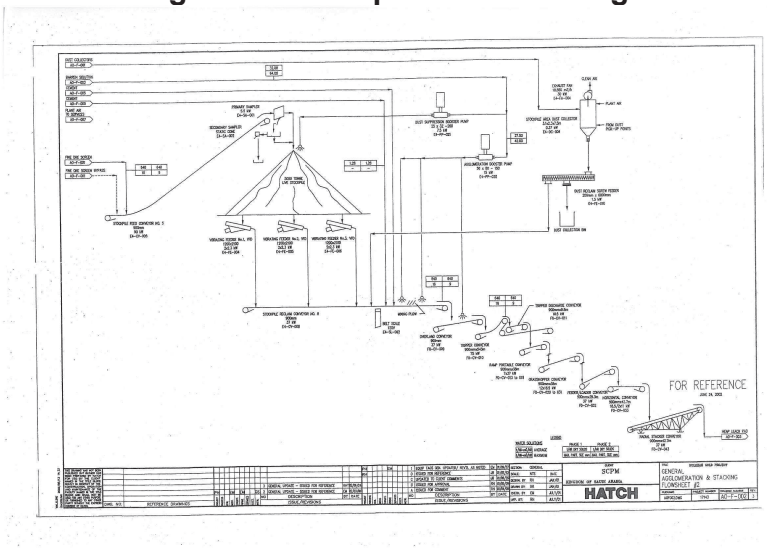


Figure 5.6 : Conveyor Arrangement

5.3.5 Leach pads and ponds

To accommodate the total volume of agglomerates in one lift on a single Leach pad an excessive volume of earthworks is required. The pad area has to be excavated and filled to create a minimum drainage slope of about one percent to ensure a free flow of pregnant solution. To minimize the earthworks, the natural slopes within the proposed area and a multi-lift system has been considered in the design. The number of lifts has been assumed to be six with an individual height of six meters, giving a total heap height of 36 m.

The heap area has been divided into two leach pads which will reduce the overall length of conveyors. Each pad slopes toward its solution pond.

The leach pads are assumed to be lined with 2.0 mm thick high density Polyethylene geo-membrane material which makes the pads impervious. The liner is protected on the underside by nominal 100 mm thick sand cushion, and above by an approximately 1.2 m thick protective layer of Crushed fresh/ weathered ore.

To assist the flow of solutions through the base of the heap to the collection drains, perforated polyethylene piping is placed immediately on top of the pad liner under the protective layer. The drainage network for the first pad is sloped uniformly to a collection pipe system which discharges to the pregnant solution pond. For the second pad the pipe system will discharge to the dedicated solution collection pond.

The operation of the heap in a single cycle mode requires ponds for pregnant, barren solutions and conditioning.

The pregnant pond has been sized to obtain a solution residence time of approximately 25-30 hours to smooth fluctuations in gold grades and pro-vide a reasonable surge and drain capacity. The maximum volume to be hold in the pregnant pond is 51,500 m3.

The barren pond has been sized to hold the reservoir volume required to start up a new irrigation area without running out of make-up water. The total momentary well capacity is much lower than “consumed” when starting up new area. Therefore the incoming raw water has to be continuously accumulated in a reservoir volume during stacking of new heap cells. In the design of the barren pond the number of stacking days, before starting up a new irrigation area has been assumed to be 36. By this assumptions the minimum pond volume required is 92,000 m3. The barren pond will contain a maximal volume of 123,000 m3, allowing for a drain surge volume of approximately 30,000 m3.

For the second leach pad a collecting pond will be constructed for collection of the pregnant solution drained from the heap. From there the collected solution is pumped over to the pregnant pond. The start up of the second pad has to be thoroughly planned. Most probably an overlapping operational period has to be considered to cope with the excess of drain volume from the first pad when switching from operating lift number 6 to lift number 1 on the second pad. The wells has to be shot down for a period and the drain volume from the first pad to be accumulated in the barren pond.

A conditioning pond constructed for softening the incoming raw water by lime addition in order to precipitate magnesium hydroxide and gypsum, which will initially be pumped to sludge pond. When the first pad has been terminated the sludge will be pumped to that area for disposal.

5.3.6 Process solution system

The solution from the barren solution pond is distributed on the top of the heap by an agriculture drip irrigation system. The solution is pumped by three centrifugal pumps. The pumps have an installed power of 132 KW each. A standby pump will also be installed. One pump in operation is rpm variable. The solution is pumped through 13 mm drip emitter pipes arranged on a 762 by 762 mm grid distributed from a sub-header system. The solution application rate will be 0.013 m3 per hour and m2. The total irrigated area will be 103,000 m2, giving a total solution flow rate of 1365 M3 per hour.

In order to prevent blockage of the drip emitters by suspended particles and scaling, the barren solution is filtered and treated with an anti-scalant reagent. The anti-scalant is added at a rate of 15 g/m3 to the barren solution directly from the delivered drum.

5.3.7 Carbon adsorption system

The gold in the pregnant solution will be recovered by adsorption on activated carbon. The carbon adsorption circuit has five columns in series. To load the carbon with 5000 g of gold per tonne at a pregnant solution grade of 0.20 g/m3 and a barren solution grade of 0.007 g/m3, each column has to contain about 11.5 tonnes of activated carbon at the actual flow rate of 1365 m3/h.

Pregnant solution from the pregnant solution pond is pumped to the column circuit by three centrifugal pumps with an installed power of 75 KW each. A standby pump will also be installed. The pregnant solution is fed into the first column via a stationary trash screen provided with a 28 mesh Cloth. The screen prevents trash material from entering the columns.

The diameter and height of the column is determined by the solution flow rate, carbon size and water temperature to allow a maximum bed expansion.

The 5 columns will have a dimension of 4.5 m Ø X 4 m h. The solution flows from column to column in series by gravity. The solution enters each column through a downcommer pipe and bottom distribution plate. The launders of each column are equipped with hand operated plugs over The down commer pipes which allow bypassing for inspection and maintenance purposes.

Loaded carbon from the first column is educated over a stationary sieve Bend equipped with 28 mesh stainless steel wedge wire cloth. The dewatered carbon is accumulated in a 3 m Ø X 3 m h. surge bin with minimum 3.5 tonnes capacity. This amount corresponds to a full elution batch at the sukhaybarat plant.

The loaded carbon is transferred by a big bag system to Sukhaybarat for stripping.

5.3.8 Carbon processing, electrowinning and smelting

The stripping of carbon is following by electro-winning, smelting and casting of doer bullions in the normal sequence. The existing facilities at sukhybarat for these processing will be utilized.

5.3.9 Water Supply

5.3.9.1 Raw water (low and high saline water)

Raw water supply for the start-up and initial phase is planned to be arranged through a pipe line from the well field at Wadi Raghwah. The field contains 6 wells connected to a main pipe to Bulghah site with a length of 17 km. including the connection pipes the total pipe length calculated with is 22km. This field is expected to give 60 to 90 m3/ h of saline water.

Incoming low saline water will partly be led to a 200 m3 tank that will be used as a buffer tank. From this tank the low saline water will be pumped and distributed via a piping system.

Main water lines from the water fields will be buried in order to minimize the water temperature. The water flows will be monitored and summarized by flow meters.

5.3.9.2 Potable Water

Potable water will be trucked from Sukhybarat mine water treatment to Bulghah mine.

5.3.9.3 Control system

Each well will be equipped with a small control system, which will supervise the operation of the diesel generator, submersible pump, booster pump etc. Each control system will communicate with the main control system in Bulghah enabling remote start and stop of each well. Communication is realized by a communication cable dug into the ground with the pipe system.

5.3.9.4 Power Supply and distribution

Power supplied for Bulghah plant by contractor installed of a diesel generator consisting of six generators of approximately 1000- 1200 kw each and with voltage 4.16 kv. The idea is to operate three or four generators continuously, to use one as a stand by and to allow one for maintenance. All generators feed the same buss-bar, enabling on-line switching of which generator to run and which to be in stand by. A ring line system had been chosen to distribute power in industrial area in Bulghah mine.

In case Bulghah Mine Department available simple commidation for the mine stuff, that possible beside the Exploration Camp and also the electricity and Water can draw from there.

5.3.9.5 Communications

All communications types available in Bulghah mine like land line, internet and visat. These services linked between all mines and head offices and facilitated every thing.

In the Bulghah mine and Bulghah north telecommunication using between the mine, maintenance and crushing plant. Every department has especial channel to connect in between.

6 FINANCE EVALUATION

6.1 Finance Evaluation Parameters

The details of the parameters used for the Financial Evaluation of the project are given as under

TECHNICAL PARAMETERS

The abstract of the Technical parameters utilized during the study are given in the following table

	Option-I	Option-II	Option-III
MINING PARAMETERS			
Annual Target of Waste	**4.2 Mt**	**4.2 Mt**	**5.1 Mt**
Annual Target for Ore	**3.00 Mt**		
Life of the Project	**7 Year**		
Working Days Per Year	**365**		
Dilution	**5.00%**		
Mining Losses	**5.00%**		
Reserve After Dilution & Mining Losses			
Weathered Ore Cut off 0.3 g/t of Au	**2.65 Mt**		
Fresh Ore Cut off 0.3 g/t of Au	**19.91 Mt**		
Total Reserve with Cut off 0.3 g/t of Au	**22.56 Mt**		
Grade After Dilution & Mining Losses			
Weathered Ore "g/t of Au"	**0.67**		
Fresh Ore Cut "g/t of Au"	**0.74**		
PLANT PARAMETERS			
Recovery for Weathered Ore	**80%**	**80%**	**80%**
Recovery for Fresh Ore	**52%**	**65%**	**65%**
Recoverable Metal			
Weathered Metal "Million Grams"	**1.42**	**1.42**	**1.42**
Fresh Metal "Million Grams"	**7.69**	**9.61**	**9.61**
Total Recoverable Metal "Million Grams"	**9.11**	**11.03**	**11.03**

Table 6.1 : Technical Parameters

FINANCIAL PARAMETERS

The abstract of the Financial parameters considered for the project are given as under

	Option-I	Option-II	Option-III
Equity	**40 %**		
Loan	**60 %**		
Interest Rate	**5%**		
Discount Rate	**12 %**		
Corporate Tax	**22 %**		
Period of Loan Repayment	**5 years**		
Period of Amortization of Initial Capital	**5 years**		
Loan Repayment start Year	**Year - 1**		
Amortization of Initial Capital start year	**Year - 1**		

Table 6.2 : Financial Parameters

ECONOMIC PARAMETERS

The abstract of the Economic parameters considered for the project are given as under

	Option-I	Option-II	Option-III
Initial Investment "Million US $"	**0.80**	**2.51**	**2.51**
Investment Phasing	**Entire investment in Year - 0**		
Selling Price	**850 $/Oz Au 26.56 $/grams Au**		
Annual Revenue "Million US $"	32.85	**39.19**	**39.19**
Annual Expenses "Million US $"	**31.26**	**31.26**	**33.82**
Annual Cash Flow "Million US $"	**1.59**	**7.92**	**5.36**
Margin Ratio	**4.84 %**	**20.22 %**	**13.69 %**
Capitalistic Intensity	**0.02**	**0.06**	**0.06**

Table 6.3 : Economic Parameters

6.2 FINANCE EVALUTION OF STUDY

The study has been made in three options. The details of which is given as under

- **Option – I**

  With Cut-off 0.3 of g/t of Au & limited investment of 0.8 Million US Dollars. In this case the stripping ratio of 1.4 has been assumed. With the existing processing plant the crushing capacity is the main bottleneck, which restricts recovery to only 52%.

- **Option – II**

  With Cut-off 0.3 of g/t of Au & with an additional investment of 2.51 Million US Dollars. With the existing processing plant the crushing capacity is the main bottleneck, which restricts recovery to only 52%. So in this case after a discussion with representative of METSO Company two additional crushers has been provided for a cost of 1.77 Million US Dollars to increase the fresh ore(≥ 65%). In this case also the stripping ratio of 1.4 has been assumed.

- **Option – III**

  This is a study to represent the Scenario of Option II if the stripping ratio becomes 1.7

6.3 ECONOMIC STUDYS & DIAGRAMS

Each Economic studies has been made with four considerations namely

- **Intrinsic** – In this case it has been considered that there will no Loan, taxes & Royalty as well as depreciation of initial capital

- **Taxes & Royalty** – Under this study impact of Taxes prevailing in my country & depreciation / Amortization of initial capital has been loaded in cash flow of the project. Period of amortization/depreciation of Initial capital has been assumed for a period of 5 years, from the year -1 of the project.

- **Loan** – Under this study it is considered it is considered that 40% of the initial capital will be in the form of Equity & balance 60% will be on loan at an interest rate of 5%. As because the life of the project is only seven years, the loan amortization period has been assumed for a period of 5 years & loan repayment will start from year – I of the project

- **Complete –** This is a study in which all aspects of Intrinsic, Taxes & Royality and Loan has been provisioned in the cash flow of the project.

ECONOMIC STUDY & ECONOMIC DIAGRAMS OF OPTION - I

		Intrensic	Taxes & Royality	Loan	Complete
Sum of Cash Flow	M$	5.71	4.14	5.64	4.08
Pay back period without Discounting	Year	0.50	0.39	0.18	0.22
Amortization Period	Year		5.00	5.00	5.00
Net Present Value	M$	4.28	3.14	4.36	3.24
Pay back period with Discounting	Year	0.56	0.70	0.24	0.31
Internal rate of Return	%	197.73%	157.58%	459.78%	362.94%
Margin Ratio	%	4.84%	4.84%	4.84%	4.84%
Capitalistic Intensity		0.02	0.02	0.02	**0.02**
Cash Break Even price	$/gr				25.93
Break Even price	$/gr				26.03

Table 6.4 : Financial Results Option - I

Details of the cash flows for all the studies have been placed in Appendix - A

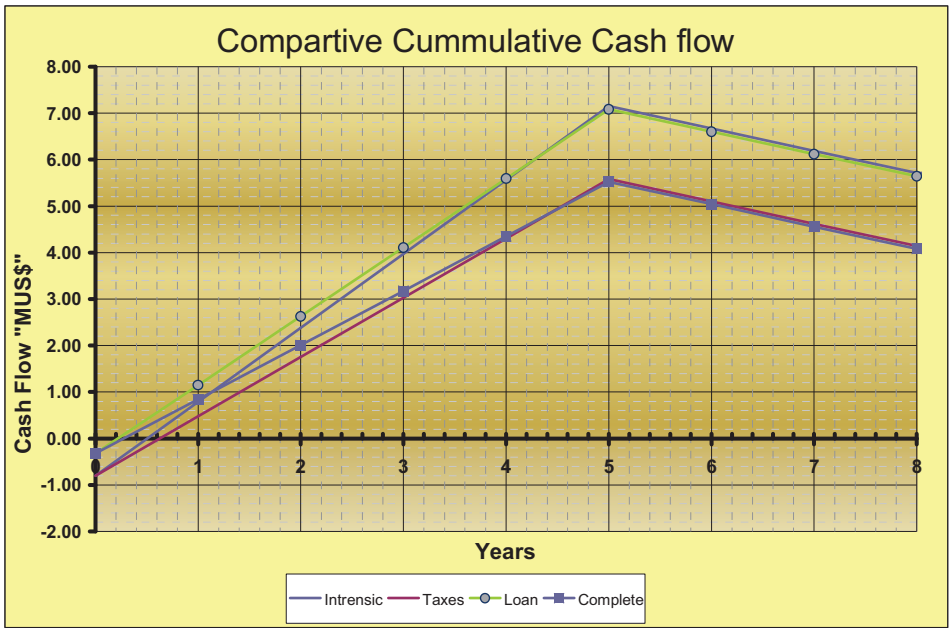


Figure 6.1 : Comparative Cummulative Cash Flow (Option – I)

The comparative cumulative cash flow indicates that the pay back period is lowest for loan , which is 0.18 years, while in case of taxes it is 0.39. The combination of the two in complete study the payback period is reduced to 0.22 years by taking the advantage of Labor effect. study.

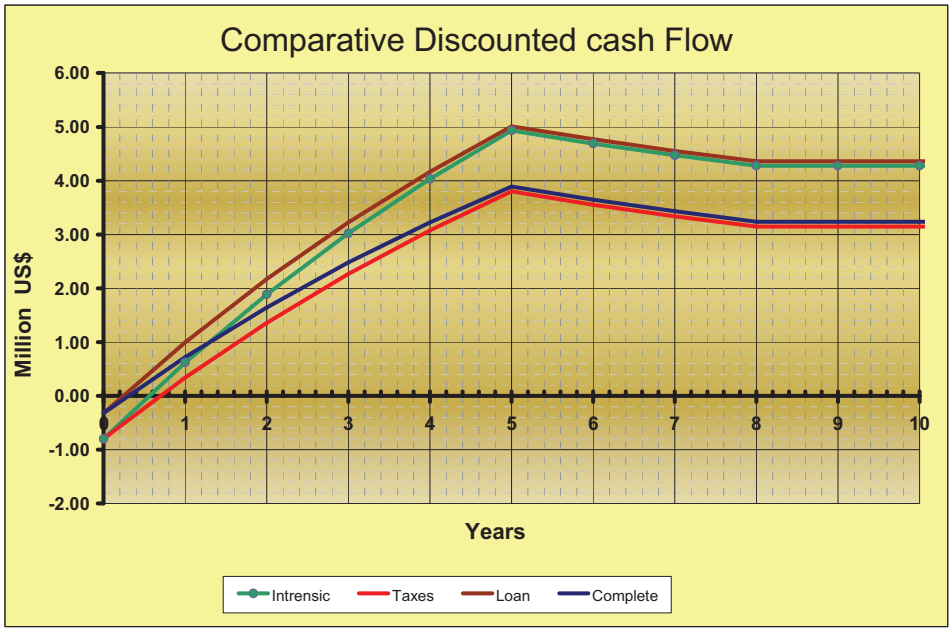


Figure 6.2 : Comparative Cummulative Discounted Cash Flow (Option – I)

The comparative cumulative discounted cash flow indicates that the pay back period is lowest for loan , which is 0.24 years, while in case of taxes it is 0.70. The combination of the two in complete study the payback period is reduced to 0.31. It indicates that the equity capital of the project will be paid back from the project even after discounting will be only 0.31 years.

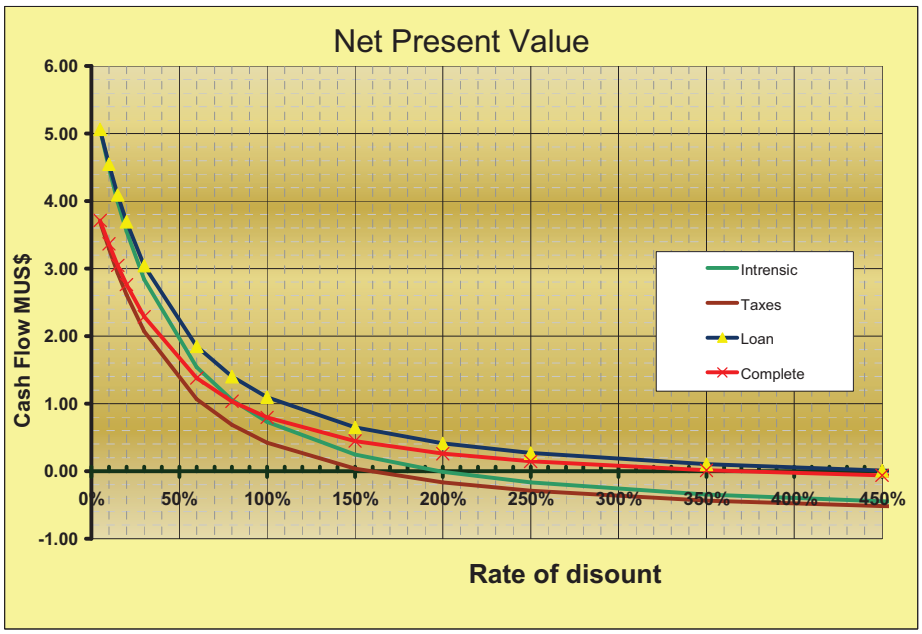


Figure 6.3 : Net Present Value (Option – I)

The comparative Net present values at different discount rate indicates the Internal rate of the project is improved to 362.94 % by taking the advantage of loan & disadvantage of Taxes. The above economic diagram indicates that the project will be having zero net present value at the discount rate of 362.94 % in the complete study.

ECONOMIC STUDY & ECONOMIC DIAGRAMS OF OPTION - II

		Intrensic	Taxes & Royality	Loan	Complete
Sum of Cash Flow	M$	55.07	42.96	54.85	42.78
Pay back period without Discounting	Year	0.32	0.29	0.12	0.14
Amortization Period	Year		5.00	5.00	5.00
Net Present Value	M$	34.40	26.68	34.65	26.96
Pay back period with Discounting	Year	0.35	0.45	0.15	0.19
Internal rate of Return	%	315.93%	250.78%	752.60%	591.47%
Margin Ratio	%	20.22%	20.22%	20.22%	20.22%
Capitalistic Intensity		0.06	0.06	0.06	**0.06**
Cash Break Even price	$/gr				21.36
Break Even price	$/gr				21.59

Table 6.5 : Financial Results Option - II

Details of the cash flows for all the studies have been placed in Appendix - B

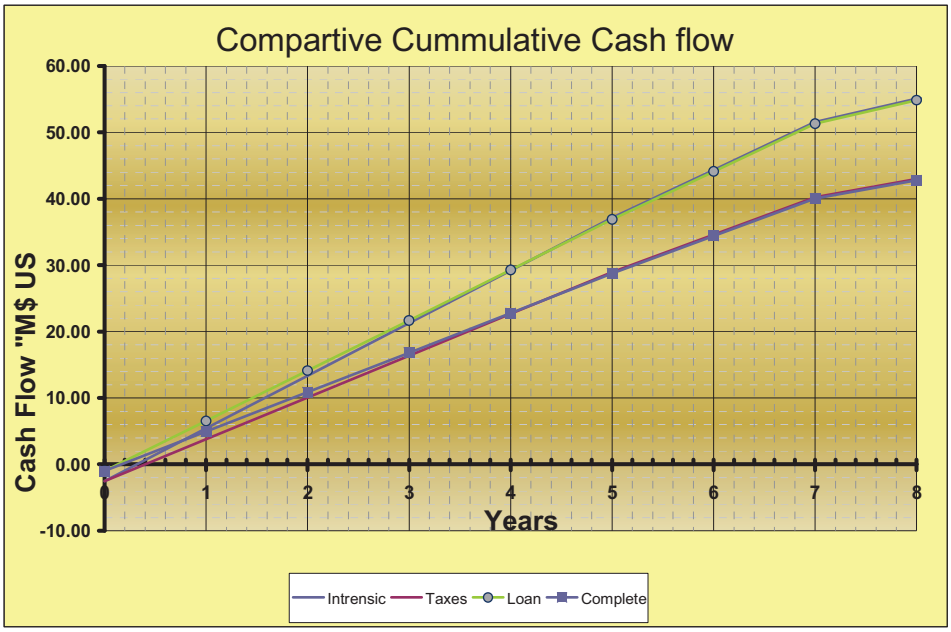


Figure 6.4 : Comparative Cummulative Cash Flow (Option – II)

The comparative cumulative cash flow indicates that the pay back period is for loan is 0.12 years while for taxes it is 0.29 years. For the complete study the project will have pay back period of 0.14 years.

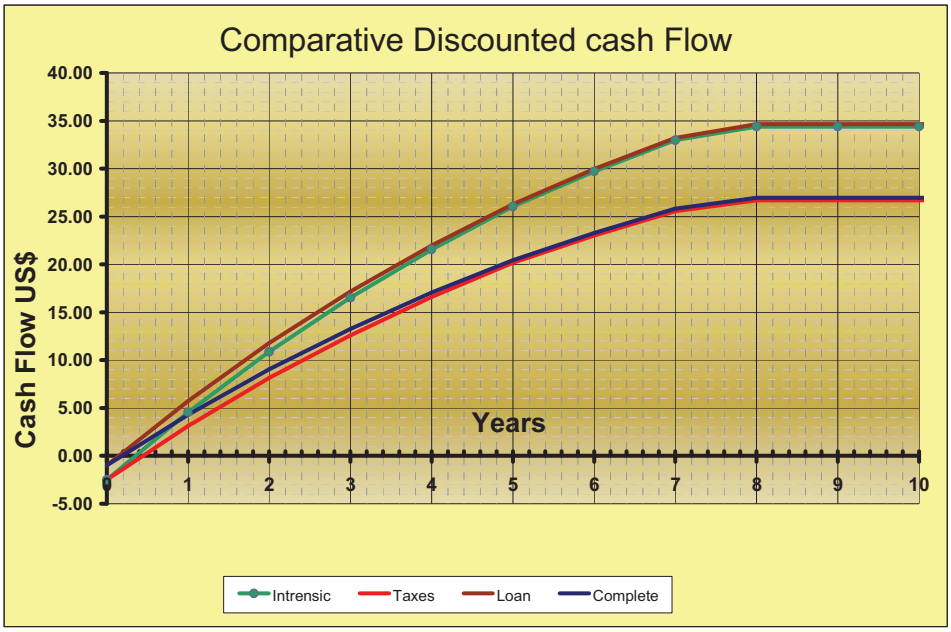


Figure 6.5 : Comparative Cummulative Cash Flow (Option – II)

The comparative cumulative cash flow indicates that the pay back period is for loan is 0.15 years while for taxes it is 0.45 years. For the complete study the project will have pay back period of 0.19 years.

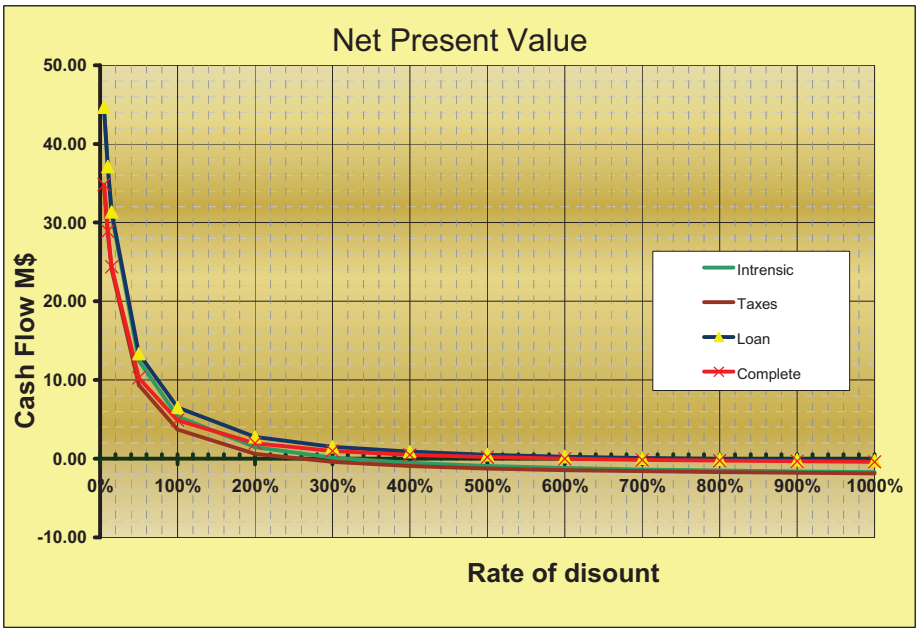


Figure 6.6 : Net Present Value (Option – II)

The comparative Net present values at different discount rate indicates the Internal rate of the project is improved to 591.47% by taking the advantage of loan & disadvantage of Taxes. The above economic diagram indicates that the project will be having zero net present value at the discount rate of 591.47%in the complete study. In this option the NPV & IRR is improved over Option by rationalizing the crushing system to improve the recovery from the Fresh Ore production to a level of 65% from 52 % considered in Option –I.

ECONOMIC STUDY & ECONOMIC DIAGRAMS OF OPTION - III

		Intrensic	Taxes & Royality	Loan	Complete
Sum of Cash Flow	M$	35.76	27.89	35.53	27.72
Pay back period without Discounting	Year	0.47	0.37	0.17	0.20
Amortization Period	Year		5.00	5.00	5.00
Net Present Value	M$	22.15	17.13	22.40	17.41
Pay back period with Discounting	Year	0.52	0.65	0.23	0.29
Internal rate of Return	%	213.70%	170.91%	497.37%	392.40%
Margin Ratio	%	13.69%	13.69%	13.69%	13.69%
Capitalistic Intensity		0.06	0.06	0.06	**0.06**
Cash Break Even price	$/gr				23.11
Break Even price	$/gr				23.35

Table 6.5 : Financial Results Option - III

Details of the cash flows for all the studies have been placed in Appendix – C

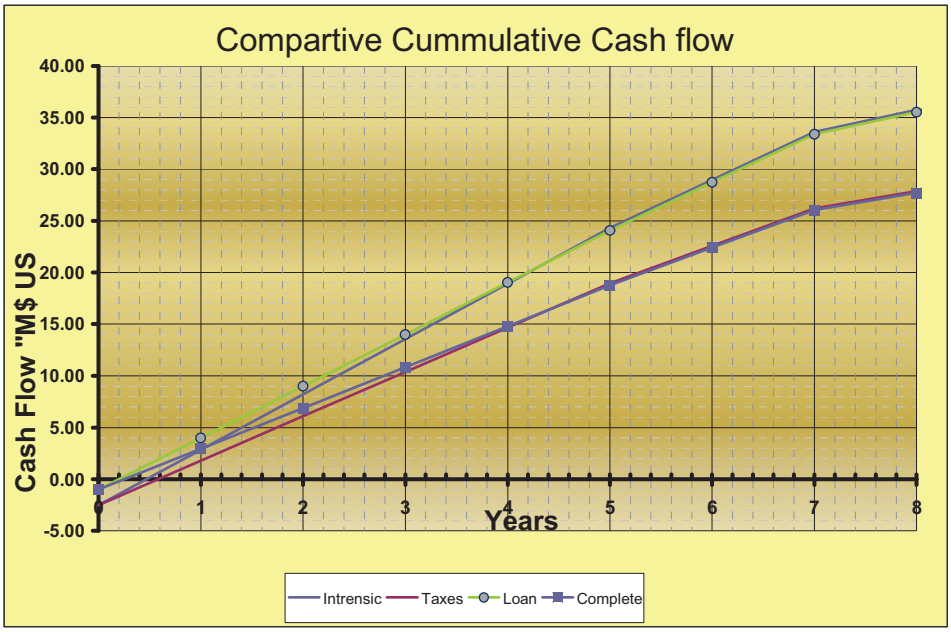


Figure 6.7 : Comparative Cummulative Cash Flow (Option – III)

The comparative cumulative cash flow indicates that the pay back period is for loan is 0.17 years while for taxes it is 0.37 years. For the complete study the project will have pay back period of 0.20 years.

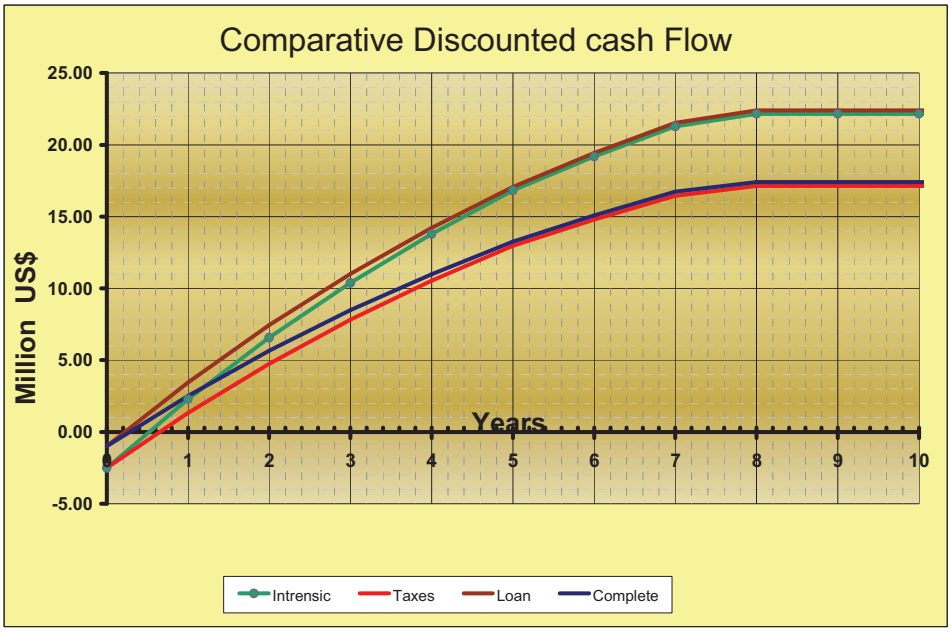


Figure 6.8 : Comparative Cummulative Cash Flow (Option – II)

The comparative cumulative cash flow indicates that the pay back period is for loan is 0.23 years while for taxes it is 0.65 years. For the complete study the project will have pay back period of 0.29 years.

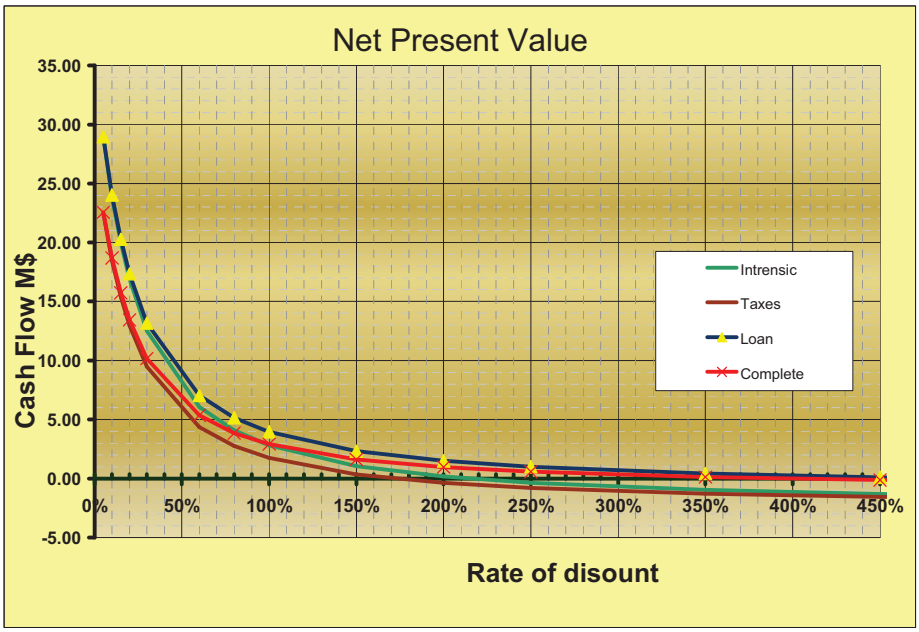


Figure 6.9 : Net Present Value (Option – III)

The comparative Net present values at different discount rate indicates the Internal rate of the project is improved to 392.40% by taking the advantage of loan & disadvantage of Taxes. The above economic diagram indicates that the project will be having zero net present value at the discount rate of 392.40% in the complete study. Basically this study is to look into the pessimistic side of the adverse stripping ratio of 1.7 with the other consideration similar to Option – II. Even with the adverse stripping ratio to the tune o 1.7 the project is likely to yield the IRR of 392.40% provided some modification is the crushing system is made to improve the recovery of the final product from the Fresh Ore to 65 % from the existing level of 52 % .

Sensitivity Analysis

Sensitivity analysis for the study has been done for 9 different factors & it may be inferred from the following diagrams that the project is extremely sensitivity to the variation in selling price, Grade of ore, Operating Cost & Recovery of Fresh ore. Rest other parameters are showing very little sensitivity to the variation.

Economic diagrams of sensitivity analysis for all the three options are as follows

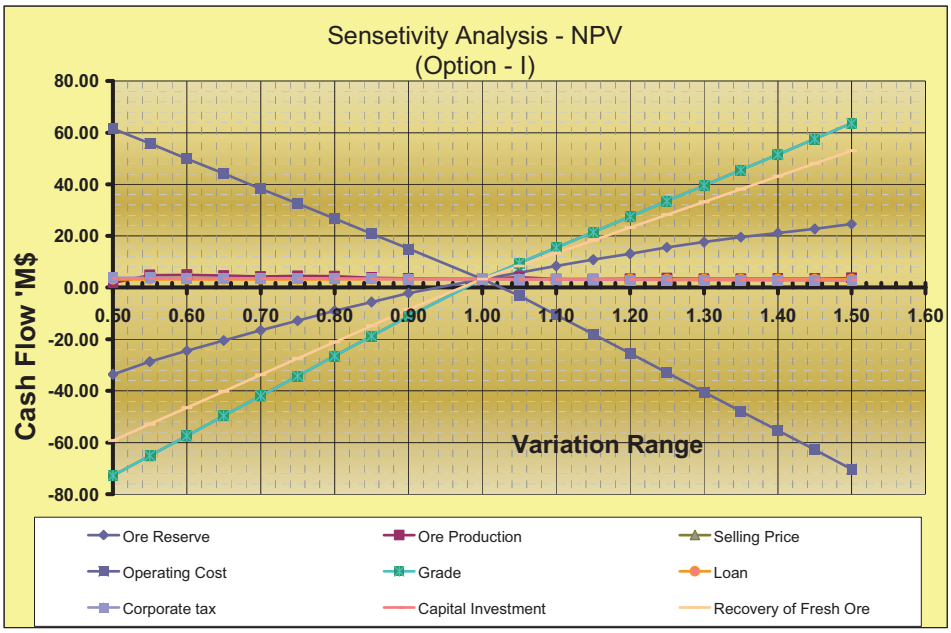


Figure 6.10 : Sensetivity on NPV (Option – I)

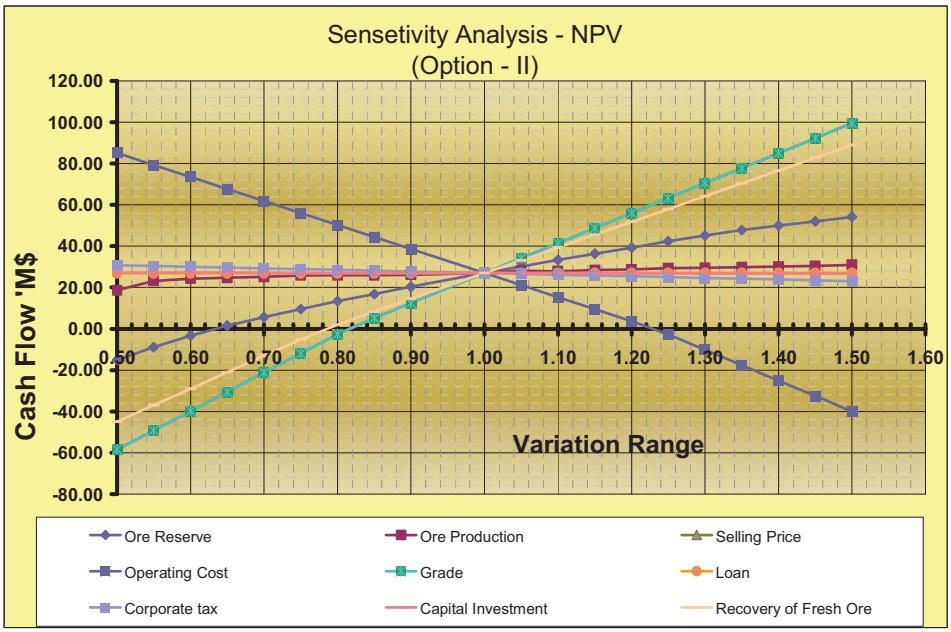


Figure 6.11 : Sensetivity on NPV (Option – II)

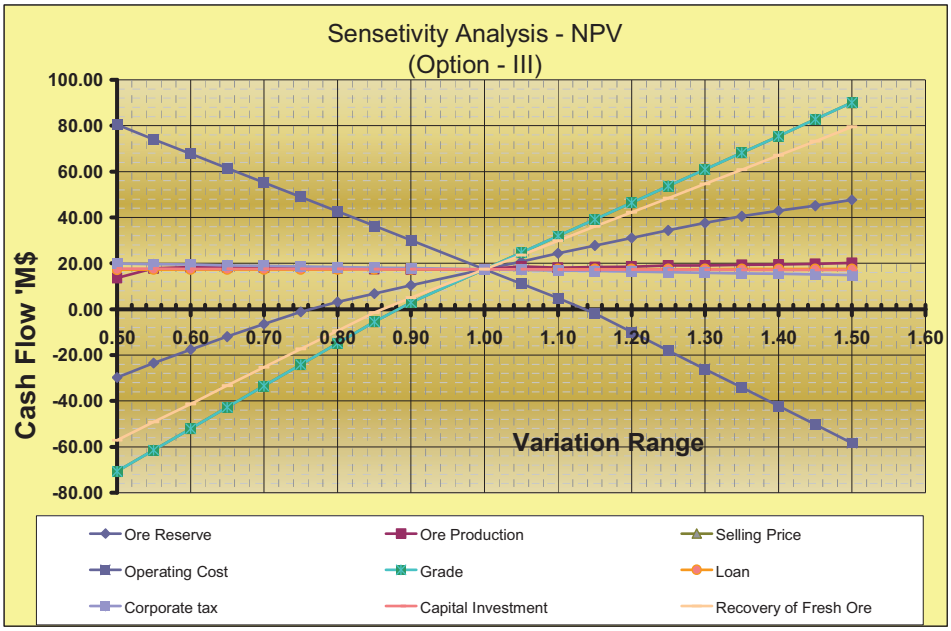


Figure 6.12 : Sensetivity on NPV (Option – III)

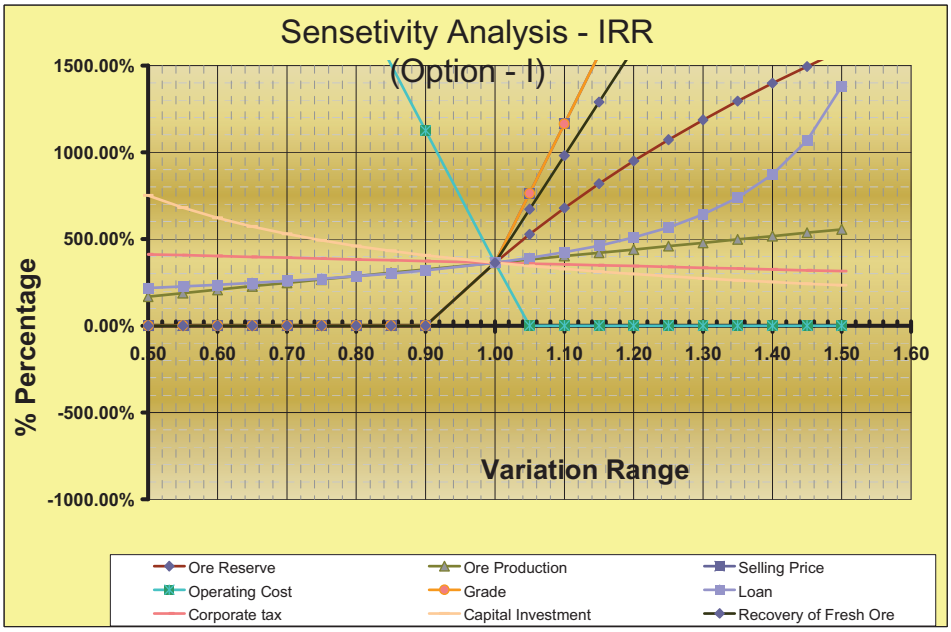


Figure 6.13 : Sensetivity on IRR (Option – I)

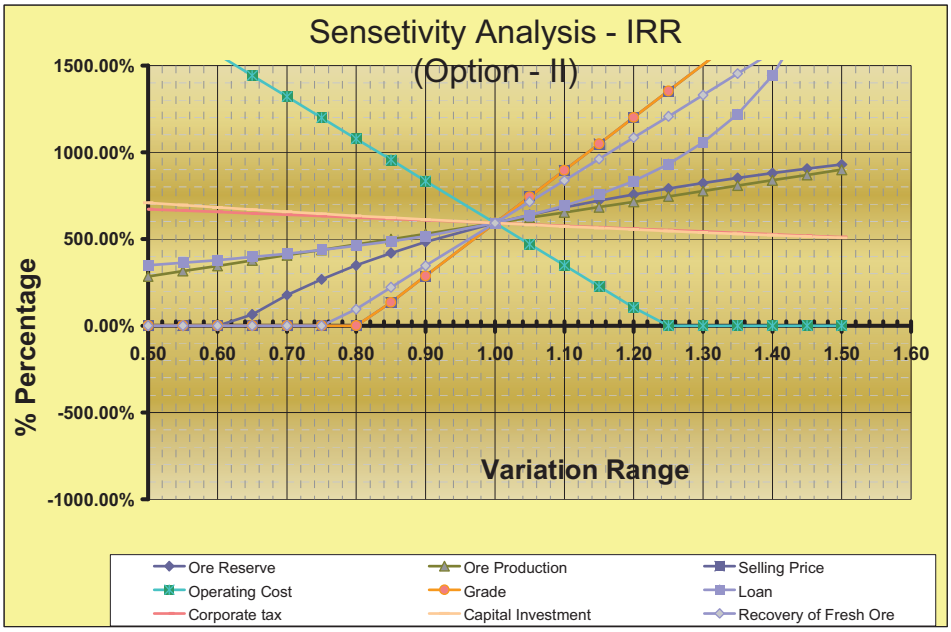


Figure 6.14 : Sensetivity on IRR (Option – II)

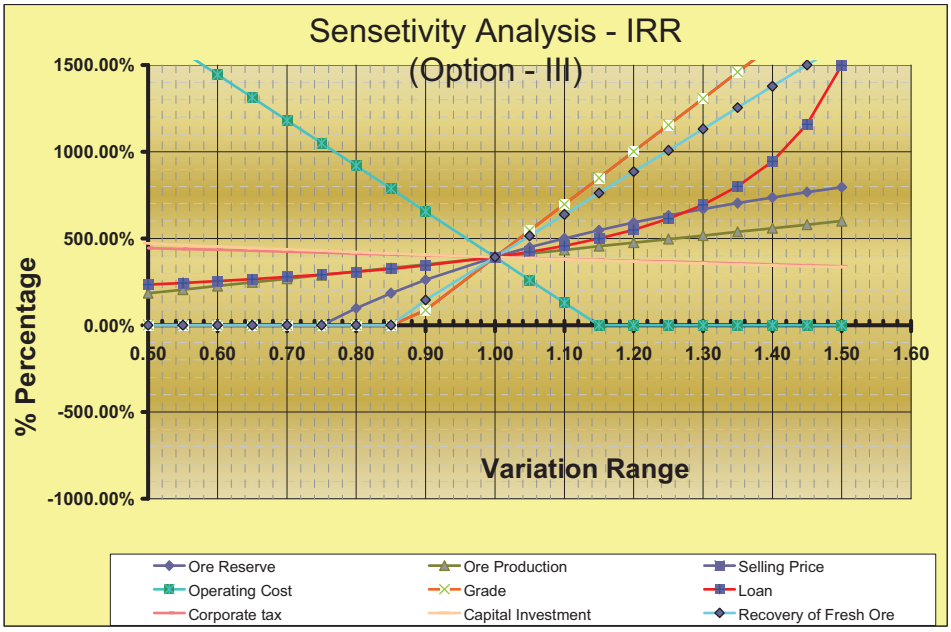


Figure 6.15 : Sensetivity on IRR (Option – III)

6.4 GOLD PRICE

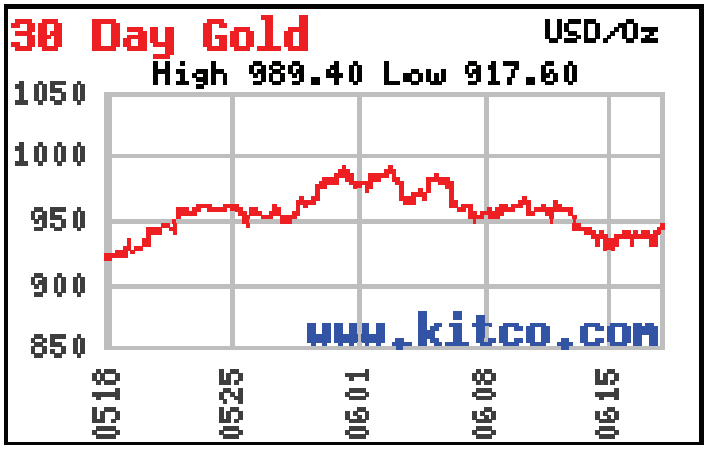


Figure 6.16 : Gold Price for 30 days back

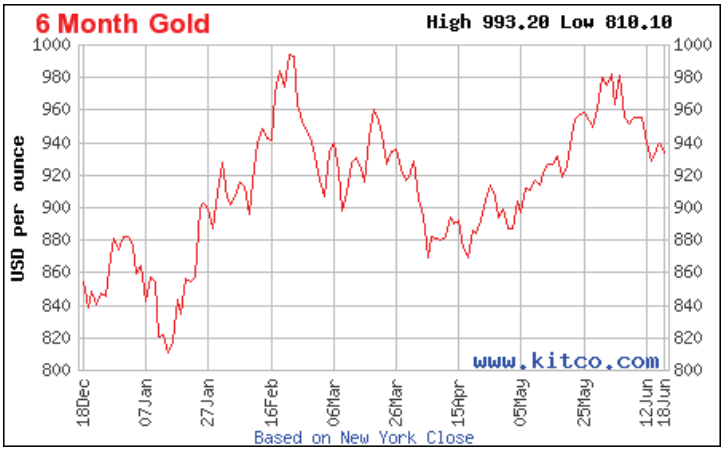


Figure 6.17 : Gold Price for six months back

Figure 6.18 : Gold Price for five years.

APPENDIX

7 RECOMMENDATIONS AND CONCLUSIONS

- All three studies shows Positive financial results. However the Option – I has been done with the stripping ratio of 1.4. As such little variation in the operating cost & selling price of gold or grade of gold may adversely affect the project.

- Improvement in recovery has an excellent impact upon the project. As such it is advisable to modify the crushing system for improvement of final product from the fresh ore production from the mine. For that as suggested by representative of METSO company one or two Hydrocone crusher (HP 5 or MP 800) will be excellent proposition for the mine.

- Improvement of crushing system will not only yield positive results for Option – II but for Option – III also and can cater wide range of variation in various factors affecting the operating cost of the mine.

- Recovery testing for deferent particle sizes for the final product necessary to know the maximum economic recovery for the project.

- Good dust suppression system is desired as the dust produced at different crushing steps & fine ore stockpiling point in particular leads to wastages of lot of gold, which will result into better the recovery of final product. It is advisable to put an fabricated elastic cone to retain the flying dust at the loading point.

- For better administrative & safety control it is advisable to have the mine office near to the project. An fully set up office for exploration camp of my company is already under operation near to the mine site, as such it is advisable to utilize the infrastructure available at the exploration camp, if needed a small office cabin for mine staff may be constructed.

8 REFERENCE

- Gold Strategic Business Unit “Ma’adend Company” - Projects Department.
- Bulghah Mine Department.
- Bulghah Project Feasibility Study.
- Deputy of ministry for Mineral Resource Web Site.
- Saudi Geology Survey web site.
- Caterpillar Web Site.
- Caterpillar Presentation.
- Atlas Copco Web site.

PROJECT OVERVIEW : COMPLETE STUDY

Year	Ore Production	Balance Reserve	Waste Production	Balance Waste	Metal Production	Sales Receipt	Loan	Investment	Operational Expenses	Repayment of Loan	Interest payment	Depriciation of Initial capital	Royality	Taxable Income	Taxes	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$
0	0.00	22.56	0.00	0.00	0.00	0.00	0.48	0.80	0.00	0.00	0.000	0.00	0.00	0.00	0.00	-0.32	-0.32	1.00	-0.32	-0.32
1	3.00	22.56	4.20	4.20	1.24	32.85	0.00	0.00	31.26	0.10	0.024	0.16	0.00	1.41	0.31	1.16	0.84	0.89	1.04	0.72
2	3.00	19.56	4.20	8.40	1.24	32.85	0.00	0.00	31.26	0.10	0.019	0.16	0.00	1.41	0.31	1.16	2.01	0.80	0.93	1.65
3	3.00	16.56	4.20	12.60	1.24	32.85	0.00	0.00	31.26	0.10	0.014	0.16	0.00	1.42	0.31	1.17	3.17	0.71	0.83	2.48
4	3.00	13.56	4.20	16.80	1.24	32.85	0.00		31.26	0.10	0.010	0.16	0.00	1.42	0.31	1.17	4.35	0.64	0.75	3.22
5	3.00	10.56	4.20	21.00	1.24	32.85	0.00		31.26	0.10	0.005	0.16	0.00	1.43	0.31	1.18	5.52	0.57	0.67	3.89
6	3.00	7.56	4.20	25.20	1.16	30.78	0.00		31.26	0.00	0.000	0.00	0.00	0.00	0.00	-0.48	5.04	0.51	-0.24	3.65
7	3.00	4.56	4.20	29.40	1.16	30.78	0.00		31.26	0.00	0.000	0.00	0.00	0.00	0.00	-0.48	4.56	0.45	-0.22	3.43
8	1.56	1.56	2.27	31.67	0.60	16.04	0.00		16.52	0.00	0.000	0.00	0.00	0.00	0.00	-0.48	4.08	0.40	-0.19	3.24
9	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	4.08	0.36	0.00	3.24
10	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	4.08	0.32	0.00	3.24
11	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	4.08	0.29	0.00	3.24
12	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	4.08	0.26	0.00	3.24
13	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	4.08	0.23	0.00	3.24
14	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	4.08	0.20	0.00	3.24
15	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	4.08	0.18	0.00	3.24
16	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	4.08	0.16	0.00	3.24
Total	**22.56**		**31.67**		**9.11**	**241.86**	**0.48**	**0.80**	**235.35**	**0.48**	**0.072**	**0.80**	**0.00**	**7.08**	**1.56**	**4.08**			**3.24**	

		Intrensic	With Income Taxes & Royality	With Loan	Complete - With Loan, Taxes & Royality
Sum of Cash Flow	M$	5.71	4.14	5.64	4.08
Pay back period without Discounting	Year	0.50	0.39	0.18	0.22
Amortization Period	Year		5.00	5.00	5.00
Net Present Value	M$	4.28	3.14	4.36	3.24
Pay back period with Discounting	Year	0.56	0.70	0.24	0.31
Internal rate of Return	%	197.73%	157.58%	459.78%	362.94%
Margin Ratio	%	4.84%	4.84%	4.84%	4.84%
Capitalistic Intensity		0.02	0.02	0.02	**0.02**

0.16

362.94%

PROJECT OVERVIEW : COMPLETE STUDY

Year	Ore Production	Balance Reserve	Waste Production	Balance Waste	Metal Production	Sales Receipt	Loan	Investment	Operational Expenses	Repayment of Loan	Interest payment	Depriciation of Initial capital	Royality	Taxable Income	Taxes	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$
0	0.00	22.56	0.00	0.00	0.00	0.00	1.50	2.51	0.00	0.00	0.000	0.00	0.00	0.00	0.00	-1.00	-1.00	1.00	-1.00	-1.00
1	3.00	22.56	4.20	4.20	1.48	39.19	0.00	0.00	31.26	0.30	0.075	0.50	0.00	7.35	1.62	5.93	4.93	0.89	5.30	4.29
2	3.00	19.56	4.20	8.40	1.48	39.19	0.00	0.00	31.26	0.30	0.060	0.50	0.00	7.36	1.62	5.94	10.87	0.80	4.74	9.03
3	3.00	16.56	4.20	12.60	1.48	39.19	0.00	0.00	31.26	0.30	0.045	0.50	0.00	7.38	1.62	5.96	16.83	0.71	4.24	13.27
4	3.00	13.56	4.20	16.80	1.48	39.19	0.00		31.26	0.30	0.030	0.50	0.00	7.39	1.63	5.97	22.79	0.64	3.79	17.06
5	3.00	10.56	4.20	21.00	1.48	39.19	0.00		31.26	0.30	0.015	0.50	0.00	7.41	1.63	5.98	28.77	0.57	3.39	20.45
6	3.00	7.56	4.20	25.20	1.45	38.47	0.00		31.26	0.00	0.000	0.00	0.00	7.21	1.59	5.63	34.40	0.51	2.85	23.30
7	3.00	4.56	4.20	29.40	1.45	38.47	0.00		31.26	0.00	0.000	0.00	0.00	7.21	1.59	5.63	40.02	0.45	2.54	25.85
8	1.56	1.56	2.27	31.67	0.75	20.05	0.00		16.52	0.00	0.000	0.00	0.00	3.53	0.78	2.76	42.78	0.40	1.11	26.96
9	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	42.78	0.36	0.00	26.96
10	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	42.78	0.32	0.00	26.96
11	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	42.78	0.29	0.00	26.96
12	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	42.78	0.26	0.00	26.96
13	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	42.78	0.23	0.00	26.96
14	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	42.78	0.20	0.00	26.96
15	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	42.78	0.18	0.00	26.96
16	0.00	0.00	0.00	31.67	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	42.78	0.16	0.00	26.96
Total	**22.56**		**31.67**		**11.03**	**292.93**	**1.50**	**2.51**	**235.35**	**1.50**	**0.226**	**2.51**	**0.00**	**54.85**	**12.07**	**42.78**			**26.96**	

		Intrensic	With Income Taxes & Royality	With Loan	Complete - With Loan, Taxes & Royality
Sum of Cash Flow	M$	55.07	42.96	54.85	42.78
Pay back period without Discounting	Year	0.32	0.29	0.12	0.14
Amortization Period	Year		5.00	5.00	5.00
Net Present Value	M$	34.40	26.68	34.65	26.96
Pay back period with Discounting	Year	0.35	0.45	0.15	0.19
Internal rate of Return	%	315.93%	250.78%	752.60%	591.47%
Margin Ratio	%	20.22%	20.22%	20.22%	20.22%
Capitalistic Intensity		0.06	0.06	0.06	**0.06**

0.16

591.47%

PROJECT OVERVIEW : COMPLETE STUDY

Year	Ore Production	Balance Reserve	Waste Production	Balance Waste	Metal Production	Sales Receipt	Loan	Investment	Operational Expenses	Repayment of Loan	Interest payment	Depriciation of Initial Capital	Royality	Taxable Income	Taxes	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$
0	0.00	22.56	0.00	0.00	0.00	0.00	1.50	2.51	0.00	0.00	0.000	0.00	0.00	0.00	0.00	-1.00	-1.00	1.00	-1.00	-1.00
1	3.00	22.56	5.10	5.10	1.48	39.19	0.00	0.00	33.82	0.30	0.075	0.50	0.00	4.79	1.05	3.93	2.93	0.89	3.51	2.51
2	3.00	19.56	5.10	10.20	1.48	39.19	0.00	0.00	33.82	0.30	0.060	0.50	0.00	4.80	1.06	3.95	6.88	0.80	3.15	5.65
3	3.00	16.56	5.10	15.30	1.48	39.19	0.00	0.00	33.82	0.30	0.045	0.50	0.00	4.82	1.06	3.96	10.83	0.71	2.82	8.47
4	3.00	13.56	5.10	20.40	1.48	39.19	0.00		33.82	0.30	0.030	0.50	0.00	4.83	1.06	3.97	14.80	0.64	2.52	10.99
5	3.00	10.56	5.10	25.50	1.48	39.19	0.00		33.82	0.30	0.015	0.50	0.00	4.85	1.07	3.98	18.78	0.57	2.26	13.25
6	3.00	7.56	5.10	30.60	1.45	38.47	0.00		33.82	0.00	0.000	0.00	0.00	4.65	1.02	3.63	22.41	0.51	1.84	15.09
7	3.00	4.56	5.10	35.70	1.45	38.47	0.00		33.82	0.00	0.000	0.00	0.00	4.65	1.02	3.63	26.04	0.45	1.64	16.73
8	1.56	1.56	2.75	38.45	0.75	20.05	0.00		17.90	0.00	0.000	0.00	0.00	2.15	0.47	1.68	27.72	0.40	0.68	17.41
9	0.00	0.00	0.00	38.45	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	27.72	0.36	0.00	17.41
10	0.00	0.00	0.00	38.45	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	27.72	0.32	0.00	17.41
11	0.00	0.00	0.00	38.45	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	27.72	0.29	0.00	17.41
12	0.00	0.00	0.00	38.45	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	27.72	0.26	0.00	17.41
13	0.00	0.00	0.00	38.45	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	27.72	0.23	0.00	17.41
14	0.00	0.00	0.00	38.45	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	27.72	0.20	0.00	17.41
15	0.00	0.00	0.00	38.45	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	27.72	0.18	0.00	17.41
16	0.00	0.00	0.00	38.45	0.00	0.00	0.00		0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	27.72	0.16	0.00	17.41
Total	**22.56**		**38.45**		**11.03**	**292.93**	**1.50**	**2.51**	**254.66**	**1.50**	**0.226**	**2.51**	**0.00**	**35.53**	**7.82**	**27.72**			**17.41**	

		Intrensic	With Income Taxes & Royality	With Loan	Complete - With Loan, Taxes & Royality
Sum of Cash Flow	M$	35.76	27.89	35.53	27.72
Pay back period without Discounting	Year	0.47	0.37	0.17	0.20
Amortization Period	Year		5.00	5.00	5.00
Net Present Value	M$	22.15	17.13	22.40	17.41
Pay back period with Discounting	Year	0.52	0.65	0.23	0.29
Internal rate of Return	%	213.70%	170.91%	497.37%	392.40%
Margin Ratio	%	13.69%	13.69%	13.69%	13.69%
Capitalistic Intensity	M$	0.06	0.06	0.06	**0.06**

0.16

392.40%

PROJECT OVERVIEW : INTRINSIC

Year	Ore Production	Balance Reserve	Waste Production	Balance Waste	Metal Production	Sales Receipt	Investment	Operational Expenses	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$
0	0.00	22.56	0.00	31.67	0.00	0.00	0.80	0.00	-0.80	-0.80	1.00	-0.80	-0.80
1	3.00	22.56	4.20	31.67	1.24	32.85	0.00	31.26	1.59	0.79	0.89	1.42	0.62
2	3.00	19.56	4.20	27.47	1.24	32.85	0.00	31.26	1.59	2.38	0.80	1.27	1.89
3	3.00	16.56	4.20	23.27	1.24	32.85	0.00	31.26	1.59	3.97	0.71	1.13	3.02
4	3.00	13.56	4.20	19.07	1.24	32.85	0.00	31.26	1.59	5.56	0.64	1.01	4.03
5	3.00	10.56	4.20	14.87	1.24	32.85		31.26	1.59	7.15	0.57	0.90	4.93
6	3.00	7.56	4.20	10.67	1.16	30.78		31.26	-0.48	6.67	0.51	-0.24	4.69
7	3.00	4.56	4.20	6.47	1.16	30.78		31.26	-0.48	6.19	0.45	-0.22	4.47
8	1.56	1.56	2.27	2.27	0.60	16.04		16.52	-0.48	5.71	0.40	-0.19	4.28
9	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	5.71	0.36	0.00	4.28
10	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	5.71	0.32	0.00	4.28
11	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	5.71	0.29	0.00	4.28
12	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	5.71	0.26	0.00	4.28
13	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	5.71	0.23	0.00	4.28
14	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	5.71	0.20	0.00	4.28
15	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	5.71	0.18	0.00	4.28
16	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	5.71	0.16	0.00	4.28
Total	22.56					241.86	0.80	235.35	5.71			4.28	

Sum of Cash Flow	M$	6
Pay back period without Discounting	Year	0.50
Net Present Value	M$	4.28
Pay back period with Discounting	Year	0.56
Internal rate of Return	%	197.73%
Margin Ratio	%	4.84%
Capitalistic Intensity		0.02

PROJECT OVERVIEW : INTRINSIC

Year	Ore Production	Balance Reserve	Waste Production	Balance Waste	Metal Production	Sales Receipt	Investment	Operational Expenses	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$
0	0.00	22.56	0.00	31.67	0.00	0.00	2.51	0.00	-2.51	-2.51	1.00	-2.51	-2.51
1	3.00	22.56	4.20	31.67	1.48	39.19	0.00	31.26	7.92	5.42	0.89	7.08	4.57
2	3.00	19.56	4.20	27.47	1.48	39.19	0.00	31.26	7.92	13.34	0.80	6.32	10.88
3	3.00	16.56	4.20	23.27	1.48	39.19	0.00	31.26	7.92	21.26	0.71	5.64	16.52
4	3.00	13.56	4.20	19.07	1.48	39.19	0.00	31.26	7.92	29.19	0.64	5.04	21.56
5	3.00	10.56	4.20	14.87	1.48	39.19		31.26	7.92	37.11	0.57	4.50	26.06
6	3.00	7.56	4.20	10.67	1.45	38.47		31.26	7.21	44.33	0.51	3.65	29.71
7	3.00	4.56	4.20	6.47	1.45	38.47		31.26	7.21	51.54	0.45	3.26	32.97
8	1.56	1.56	2.27	2.27	0.75	20.05		16.52	3.53	55.07	0.40	1.43	34.40
9	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	55.07	0.36	0.00	34.40
10	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	55.07	0.32	0.00	34.40
11	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	55.07	0.29	0.00	34.40
12	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	55.07	0.26	0.00	34.40
13	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	55.07	0.23	0.00	34.40
14	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	55.07	0.20	0.00	34.40
15	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	55.07	0.18	0.00	34.40
16	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	55.07	0.16	0.00	34.40
Total	22.56					292.93	2.51	235.35	55.07			34.40	

Sum of Cash Flow	M$	55
Pay back period without Discounting	Year	0.32
Net Present Value	M$	34.40
Pay back period with Discounting	Year	0.35
Internal rate of Return	%	315.93%
Margin Ratio	%	20.22%
Capitalistic Intensity		0.06

PROJECT OVERVIEW : INTRINSIC

Year	Ore Production	Balance Reserve	Waste Production	Balance Waste	Metal Production	Sales Receipt	Investment	Operational Expenses	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$
0	0.00	22.56	0.00	38.45	0.00	0.00	2.51	0.00	-2.51	-2.51	1.00	-2.51	-2.5
1	3.00	22.56	5.10	38.45	1.48	39.19	0.00	33.82	5.36	2.85	0.89	4.79	2.2
2	3.00	19.56	5.10	33.35	1.48	39.19	0.00	33.82	5.36	8.22	0.80	4.28	6.5
3	3.00	16.56	5.10	28.25	1.48	39.19	0.00	33.82	5.36	13.58	0.71	3.82	10.3
4	3.00	13.56	5.10	23.15	1.48	39.19	0.00	33.82	5.36	18.94	0.64	3.41	13.7
5	3.00	10.56	5.10	18.05	1.48	39.19		33.82	5.36	24.31	0.57	3.04	16.8
6	3.00	7.56	5.10	12.95	1.45	38.47		33.82	4.65	28.96	0.51	2.36	19.1
7	3.00	4.56	5.10	7.85	1.45	38.47		33.82	4.65	33.61	0.45	2.10	21.2
8	1.56	1.56	2.75	2.75	0.75	20.05		17.90	2.15	35.76	0.40	0.87	22.1
9	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	35.76	0.36	0.00	22.1
10	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	35.76	0.32	0.00	22.1
11	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	35.76	0.29	0.00	22.1
12	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	35.76	0.26	0.00	22.1
13	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	35.76	0.23	0.00	22.1
14	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	35.76	0.20	0.00	22.1
15	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	35.76	0.18	0.00	22.1
16	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	35.76	0.16	0.00	22.1
Total	22.56					292.93	2.51	254.66	35.76			22.15	

Sum of Cash Flow	M$	36
Pay back period without Discounting	Year	0.47
Net Present Value	M$	22.15
Pay back period with Discounting	Year	0.52
Internal rate of Return	%	213.70%
Margin Ratio	%	13.69%
Capitalistic Intensity		0.06

PROJECT OVERVIEW : LOAN ONLY

Year	Ore Production	Balance Reserve	Waste Production	Balance Waste	Metal Production	Sales Receipt	Loan	Investment	Operational Expenses	Repayment of Loan	Interest payment	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$		M$	M$
0	0.00	22.56	0.00	31.67	0.00	0.00	0.48	0.80	0.00	0.00	0.000	-0.32	-0.32	1.00	-0.32	-0.32
1	3.00	22.56	4.20	31.67	1.24	32.85	0.00	0.00	31.26	0.10	0.024	1.47	1.15	0.89	1.31	0.99
2	3.00	19.56	4.20	27.47	1.24	32.85	0.00	0.00	31.26	0.10	0.019	1.48	2.63	0.80	1.18	2.17
3	3.00	16.56	4.20	23.27	1.24	32.85	0.00	0.00	31.26	0.10	0.014	1.48	4.11	0.71	1.05	3.22
4	3.00	13.56	4.20	19.07	1.24	32.85	0.00		31.26	0.10	0.010	1.49	5.59	0.64	0.94	4.17
5	3.00	10.56	4.20	14.87	1.24	32.85	0.00		31.26	0.10	0.005	1.49	7.08	0.57	0.85	5.01
6	3.00	7.56	4.20	10.67	1.16	30.78	0.00		31.26	0.00	0.000	-0.48	6.60	0.51	-0.24	4.77
7	3.00	4.56	4.20	6.47	1.16	30.78	0.00		31.26	0.00	0.000	-0.48	6.12	0.45	-0.22	4.55
8	1.56	1.56	2.27	2.27	0.60	16.04	0.00		16.52	0.00	0.000	-0.48	5.64	0.40	-0.19	4.36
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.000	0.00	5.64	0.36	0.00	4.36
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.000	0.00	5.64	0.32	0.00	4.36
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.000	0.00	5.64	0.29	0.00	4.36
12	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	5.64	0.26	0.00	4.36
13	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	5.64	0.23	0.00	4.36
14	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	5.64	0.20	0.00	4.36
15	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	5.64	0.18	0.00	4.36
16	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	5.64	0.16	0.00	4.36
Total	22.56		31.67		9.11	241.86	0.48	0.80	235.35	0.48	0.072	5.64			4.36	

		With Loan
Sum of Cash Flow	M$	5.64
Pay back period without Discounting	Year	0.18
Amortization Period	Year	5.00
Net Present Value	M$	4.36
Pay back period with Discounting	Year	0.24
Internal rate of Return	%	459.78%
Margin Ratio	%	4.84%
Capitalistic Intensity		0.02

PROJECT OVERVIEW : LOAN ONLY

Year	Ore Production	Balance Reserve	Waste Production	Balance Waste	Metal Production	Sales Receipt	Loan	Investment	Operational Expenses	Repayment of Loan	Interest payment	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$		M$	M$
0	0.00	22.56	0.00	31.67	0.00	0.00	1.50	2.51	0.00	0.00	0.000	-1.00	-1.00	1.00	-1.00	-1.00
1	3.00	22.56	4.20	31.67	1.48	39.19	0.00	0.00	31.26	0.30	0.075	7.55	6.54	0.89	6.74	5.74
2	3.00	19.56	4.20	27.47	1.48	39.19	0.00	0.00	31.26	0.30	0.060	7.56	14.11	0.80	6.03	11.77
3	3.00	16.56	4.20	23.27	1.48	39.19	0.00	0.00	31.26	0.30	0.045	7.58	21.69	0.71	5.39	17.16
4	3.00	13.56	4.20	19.07	1.48	39.19	0.00		31.26	0.30	0.030	7.59	29.28	0.64	4.83	21.99
5	3.00	10.56	4.20	14.87	1.48	39.19	0.00		31.26	0.30	0.015	7.61	36.89	0.57	4.32	26.30
6	3.00	7.56	4.20	10.67	1.45	38.47	0.00		31.26	0.00	0.000	7.21	44.10	0.51	3.65	29.96
7	3.00	4.56	4.20	6.47	1.45	38.47	0.00		31.26	0.00	0.000	7.21	51.31	0.45	3.26	33.22
8	1.56	1.56	2.27	2.27	0.75	20.05	0.00		16.52	0.00	0.000	3.53	54.85	0.40	1.43	34.65
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.000	0.00	54.85	0.36	0.00	34.65
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.000	0.00	54.85	0.32	0.00	34.65
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.000	0.00	54.85	0.29	0.00	34.65
12	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	54.85	0.26	0.00	34.65
13	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	54.85	0.23	0.00	34.65
14	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	54.85	0.20	0.00	34.65
15	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	54.85	0.18	0.00	34.65
16	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	54.85	0.16	0.00	34.65
Total	22.56		31.67		11.03	292.93	1.50	2.51	235.35	1.50	0.226	54.85			34.65	

		With Loan
Sum of Cash Flow	M$	54.85
Pay back period without Discounting	Year	0.12
Amortization Period	Year	5.00
Net Present Value	M$	34.65
Pay back period with Discounting	Year	0.15
Internal rate of Return	%	752.60%
Margin Ratio	%	20.22%
Capitalistic Intensity	M$	0.06

PROJECT OVERVIEW : LOAN ONLY

Year	Ore Production	Balance Reserve	Waste Production	Balance Waste	Metal Production	Sales Receipt	Loan	Investment	Operational Expenses	Repayment of Loan	Interest payment	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$		M$	M$
0	0.00	22.56	0.00	38.45	0.00	0.00	1.50	2.51	0.00	0.00	0.000	-1.00	-1.00	1.00	-1.00	-1.00
1	3.00	22.56	5.10	38.45	1.48	39.19	0.00	0.00	33.82	0.30	0.075	4.99	3.98	0.89	4.45	3.45
2	3.00	19.56	5.10	33.35	1.48	39.19	0.00	0.00	33.82	0.30	0.060	5.00	8.99	0.80	3.99	7.44
3	3.00	16.56	5.10	28.25	1.48	39.19	0.00	0.00	33.82	0.30	0.045	5.02	14.00	0.71	3.57	11.01
4	3.00	13.56	5.10	23.15	1.48	39.19	0.00		33.82	0.30	0.030	5.03	19.03	0.64	3.20	14.21
5	3.00	10.56	5.10	18.05	1.48	39.19	0.00		33.82	0.30	0.015	5.05	24.08	0.57	2.86	17.07
6	3.00	7.56	5.10	12.95	1.45	38.47	0.00		33.82	0.00	0.000	4.65	28.73	0.51	2.36	19.43
7	3.00	4.56	5.10	7.85	1.45	38.47	0.00		33.82	0.00	0.000	4.65	33.38	0.45	2.10	21.53
8	1.56	1.56	2.75	2.75	0.75	20.05	0.00		17.90	0.00	0.000	2.15	35.53	0.40	0.87	22.40
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.000	0.00	35.53	0.36	0.00	22.40
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.000	0.00	35.53	0.32	0.00	22.40
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.000	0.00	35.53	0.29	0.00	22.40
12	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	35.53	0.26	0.00	22.40
13	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	35.53	0.23	0.00	22.40
14	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	35.53	0.20	0.00	22.40
15	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	35.53	0.18	0.00	22.40
16	0.00	0.00	0.00	0.00	0.00	0.00			0.00			0.00	35.53	0.16	0.00	22.40
Total	22.56		38.45		11.03	292.93	1.50	2.51	254.66	1.50	0.226	35.53			22.40	

		With Loan
Sum of Cash Flow	M$	35.53
Pay back period without Discounting	Year	0.17
Amortization Period	Year	5.00
Net Present Value	M$	22.40
Pay back period with Discounting	Year	0.23
Internal rate of Return	%	497.37%
Margin Ratio	%	13.69%
Capitalistic Intensity	M$	0.06

PROJECT OVERVIEW : TAXES & ROYALITY

Year	Ore Production	Balance Reserve	Waste Production	Cummulative Waste Production	Metal Production	Sales Receipt	Investment	Operational Expenses	Depriciation of Initial Capital	Royality	Taxable Income	Taxes	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$
0	0.00	22.56	0.00	0.00	0.00	0.00	0.80	0.00		0.00	0.00	0.00	-0.80	-0.80	1.00	-0.80	-0.80
1	3.00	22.56	4.20	4.20	1.24	32.85	0.00	31.26	0.16	0.00	1.43	0.31	1.28	0.48	0.89	1.14	0.34
2	3.00	19.56	4.20	8.40	1.24	32.85	0.00	31.26	0.16	0.00	1.43	0.31	1.28	1.75	0.80	1.02	1.36
3	3.00	16.56	4.20	12.60	1.24	32.85	0.00	31.26	0.16	0.00	1.43	0.31	1.28	3.03	0.71	0.91	2.26
4	3.00	13.56	4.20	16.80	1.24	32.85		31.26	0.16	0.00	1.43	0.31	1.28	4.30	0.64	0.81	3.08
5	3.00	10.56	4.20	21.00	1.24	32.85		31.26	0.16	0.00	1.43	0.31	1.28	5.58	0.57	0.72	3.80
6	3.00	7.56	4.20	25.20	1.16	30.78		31.26		0.00	0.00	0.00	-0.48	5.10	0.51	-0.24	3.56
7	3.00	4.56	4.20	29.40	1.16	30.78		31.26		0.00	0.00	0.00	-0.48	4.62	0.45	-0.22	3.34
8	1.56	1.56	2.27	31.67	0.60	16.04		16.52		0.00	0.00	0.00	-0.48	4.14	0.40	-0.19	3.14
9	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	4.14	0.36	0.00	3.14
10	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	4.14	0.32	0.00	3.14
11	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	4.14	0.29	0.00	3.14
12	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	4.14	0.26	0.00	3.14
13	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	4.14	0.23	0.00	3.14
14	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	4.14	0.20	0.00	3.14
15	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	4.14	0.18	0.00	3.14
16	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	4.14	0.16	0.00	3.14
Total	22.56				9.11	241.86	0.80	235.35	0.80		7.15	1.57	4.14			3.14	

Sum of Cash Flow	4
Pay back period without Discounting	0.39
Amortization Period	5.00
Net Present Value	3.14
Pay back period with Discounting	0.70
Internal rate of Return	157.6%
Margin Ratio	4.84%
Capitalistic Intensity	0.02

PROJECT OVERVIEW : WITH INCOME TAXES & ROYALITY

Year	Ore Production	Balance Reserve	Waste Production	Cummulative Waste Production	Metal Production	Sales Receipt	Investment	Operational Expenses	Depriciation of Initial Capital	Royality	Taxable Income	Taxes	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$
0	0.00	22.56	0.00	0.00	0.00	0.00	2.51	0.00		0.00	0.00	0.00	-2.51	-2.51	1.00	-2.51	-2.51
1	3.00	22.56	4.20	4.20	1.48	39.19	0.00	31.26	0.50	0.00	7.42	1.63	6.29	3.78	0.89	5.62	3.11
2	3.00	19.56	4.20	8.40	1.48	39.19	0.00	31.26	0.50	0.00	7.42	1.63	6.29	10.07	0.80	5.02	8.12
3	3.00	16.56	4.20	12.60	1.48	39.19	0.00	31.26	0.50	0.00	7.42	1.63	6.29	16.37	0.71	4.48	12.60
4	3.00	13.56	4.20	16.80	1.48	39.19		31.26	0.50	0.00	7.42	1.63	6.29	22.66	0.64	4.00	16.60
5	3.00	10.56	4.20	21.00	1.48	39.19		31.26	0.50	0.00	7.42	1.63	6.29	28.95	0.57	3.57	20.17
6	3.00	7.56	4.20	25.20	1.45	38.47		31.26		0.00	7.21	1.59	5.63	34.57	0.51	2.85	23.02
7	3.00	4.56	4.20	29.40	1.45	38.47		31.26		0.00	7.21	1.59	5.63	40.20	0.45	2.54	25.57
8	1.56	1.56	2.27	31.67	0.75	20.05		16.52		0.00	3.53	0.78	2.76	42.96	0.40	1.11	26.68
9	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	42.96	0.36	0.00	26.68
10	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	42.96	0.32	0.00	26.68
11	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	42.96	0.29	0.00	26.68
12	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	42.96	0.26	0.00	26.68
13	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	42.96	0.23	0.00	26.68
14	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	42.96	0.20	0.00	26.68
15	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	42.96	0.18	0.00	26.68
16	0.00	0.00	0.00	31.67	0.00	0.00		0.00		0.00	0.00	0.00	0.00	42.96	0.16	0.00	26.68
Total	22.56				11.03	292.93	2.51	235.35	2.51		55.07	12.12	42.96			26.68	

Sum of Cash Flow	43
Pay back period without Discounting	0.29
Amortization Period	5.00
Net Present Value	26.68
Pay back period with Discounting	0.45
Internal rate of Return	250.8%
Margin Ratio	20.22%
Capitalistic Intensity	0.06

PROJECT OVERVIEW : TAXES & ROYALITY

Year	Ore Production	Balance Reserve	Waste Production	Cummulative Waste Production	Metal Production	Sales Receipt	Investment	Operational Expenses	Depriciation of Initial Capital	Royality	Taxable Income	Taxes	Cash flows	Cummulative Cash Flow	Discounting Factor	Discounted Cash flow	Cummulative Discounted Cash Flow
	Mt/YR	Mt	Mt/YR	Mt	Mgrams	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$	M$
0	0.00	22.56	0.00	0.00	0.00	0.00	2.51	0.00		0.00	0.00	0.00	-2.51	-2.51	1.00	-2.51	-2.51
1	3.00	22.56	5.10	5.10	1.48	39.19	0.00	33.82	0.50	0.00	4.86	1.07	4.29	1.79	0.89	3.83	1.33
2	3.00	19.56	5.10	10.20	1.48	39.19	0.00	33.82	0.50	0.00	4.86	1.07	4.29	6.08	0.80	3.42	4.75
3	3.00	16.56	5.10	15.30	1.48	39.19	0.00	33.82	0.50	0.00	4.86	1.07	4.29	10.37	0.71	3.06	7.80
4	3.00	13.56	5.10	20.40	1.48	39.19		33.82	0.50	0.00	4.86	1.07	4.29	14.67	0.64	2.73	10.53
5	3.00	10.56	5.10	25.50	1.48	39.19		33.82	0.50	0.00	4.86	1.07	4.29	18.96	0.57	2.44	12.97
6	3.00	7.56	5.10	30.60	1.45	38.47		33.82		0.00	4.65	1.02	3.63	22.59	0.51	1.84	14.81
7	3.00	4.56	5.10	35.70	1.45	38.47		33.82		0.00	4.65	1.02	3.63	26.22	0.45	1.64	16.45
8	1.56	1.56	2.75	38.45	0.75	20.05		17.90		0.00	2.15	0.47	1.68	27.89	0.40	0.68	17.13
9	0.00	0.00	0.00	38.45	0.00	0.00		0.00		0.00	0.00	0.00	0.00	27.89	0.36	0.00	17.13
10	0.00	0.00	0.00	38.45	0.00	0.00		0.00		0.00	0.00	0.00	0.00	27.89	0.32	0.00	17.13
11	0.00	0.00	0.00	38.45	0.00	0.00		0.00		0.00	0.00	0.00	0.00	27.89	0.29	0.00	17.13
12	0.00	0.00	0.00	38.45	0.00	0.00		0.00		0.00	0.00	0.00	0.00	27.89	0.26	0.00	17.13
13	0.00	0.00	0.00	38.45	0.00	0.00		0.00		0.00	0.00	0.00	0.00	27.89	0.23	0.00	17.13
14	0.00	0.00	0.00	38.45	0.00	0.00		0.00		0.00	0.00	0.00	0.00	27.89	0.20	0.00	17.13
15	0.00	0.00	0.00	38.45	0.00	0.00		0.00		0.00	0.00	0.00	0.00	27.89	0.18	0.00	17.13
16	0.00	0.00	0.00	38.45	0.00	0.00		0.00		0.00	0.00	0.00	0.00	27.89	0.16	0.00	17.13
Total	22.56				11.03	292.93	2.51	254.66	2.51		35.76	7.87	27.89			17.13	

Sum of Cash Flow	28
Pay back period without Discounting	0.37
Amortization Period	5.00
Net Present Value	17.13
Pay back period with Discounting	0.65
Internal rate of Return	170.9%
Margin Ratio	13.69%
Capitalistic Intensity	0.06