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Mining District File Summary Sheet

DISTRICT	Rosebud
DIST_NO	4010
COUNTY If different from written on document	Pershing
TITLE If not obvious	LAC Minerals (USA), Inc. Rosebud Property, Dozer Hill Deposit, Pershing County, Nevada, Reserve audit & Conceptual Mine Plan, March 1991
AUTHOR	Stokes, W; Thomas, R; Beacon Hill Consultants Ltd
DATE OF DOC(S)	1991
MULTI_DIST Y / N? Additional Dist_Nos:	
QUAD_NAME	Sulphur 7½'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Lac Minerals (USA), Inc; Beacon Hill Consultants, Ltd; Dozer Hill Deposit Rosebud Property
COMMODITY If not obvious	gold; silver
NOTES	property report; reserves; flow chart; mine map; geology; cross-section; correspondence NOTE: Symposium article in back, copyrighted - do not scan. 166p

Keep docs at about 250 pages if no oversized maps attached (for every 1 oversized page (>11x17) with text reduce the amount of pages by ~25)

SS: DP 2/29/08
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LAC MINERALS (USA), INC.

ROSEBUD PROPERTY
DOZER HILL DEPOSIT

PERSHING COUNTY, NEVADA

RESERVE AUDIT & CONCEPTUAL MINE PLAN

BEACON HILL
CONSULTANTS LTD.

MINING ENGINEERS & GEOLOGISTS

MARCH 1991

LAC MINERALS (USA), INC.

ROSEBUD PROPERTY
DOZER HILL DEPOSIT

PERSHING COUNTY, NEVADA

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LAC MINERALS (USA), INC.
Rosebud Project

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SECTION 1

SUMMARY

1.1 Study Results

1.1.1 Conclusions

It is the opinion of Beacon Hill Consultants Ltd. that the probable and possible reserves as calculated by LAC Minerals (USA), Inc. for the Dozer Hill deposit are accurate and reasonable estimates at the current level of exploration and existing data. All procedures and calculations on which the reserve is based have been completed in a manner consistent with sound geologic and mining practice.

The conceptual mine plan as described in this report indicates that the 500 t/d milling rate is not viable based upon the estimated probable reserves of 1,146,000 tons at 0.24 oz Au/t and 2.0 oz Ag/t, a gold price of $375/oz, metallurgical recovery of 89% and the capital and operating cost estimates as derived in this study. It is reasonable to say that this case may, upon completion of further exploration and rock quality investigations, improve to a point where a +15% IRR can be achieved. This would require a minimum 10% improvement in mining grade and a mining method that would allow a 10% decrease in capital costs and a 20% decrease in operating costs.

The 1,000 t/d milling rate, which is also based on the above parameters but assumes the probable reserves will be doubled with further exploration, is viable and is indicated to be highly attractive should there be an improvement in mining grade and rock quality. Fourteen cases were investigated, only two of which produced a negative IRR: Case 6 incorporates a gold price of $325/oz, and the other, Case 14, is based on capital and operating costs increasing by 10% each, mining grade decreasing by 10% and a metallurgical recovery of 86%. The remaining cases have an IRR in the range of 1.08% to 33.77%, with seven in excess of 15%.

The above assumption of doubling the probable reserves is based on a careful review of current ore blocks and past drilling success that indicates a good probability the offset and infill drilling of the first phase program should add approximately 440,000 tons of relatively high grade rock into the probable category. Much of this new material would be in areas of Block B that were dropped from the "mineable" reserve but are considered very likely to occur. Additionally, the occurrence of important single intercepts beyond the current reserve, such as the 20 ft at 0.380 oz Au/t in hole No. RL145, provides strong encouragement that continued drilling around the Dozer Hill zone will identify additional ore blocks similar to those already defined. Two to four ore blocks aggregating a further 500,000 to 800,000 tons of probable and possible geologic reserves is considered a reasonable expectation. Grade is expected to be similar to that of the current reserve. This incremental tonnage, if found, would satisfy the reserve requirements for the 1,000 t/d case.

The financial analysis indicates that the project is most sensitive to mining grade and gold price changes, less sensitive to operating cost and least sensitive to capital cost.

The Rosebud property has been valued using two methods, Market Value Assessment and the Value of Potential Income. The Market Value Assessment indicates a value of $7.8 million, plus or minus 25%, based on 345,000 oz Au at $10 per oz and a property value of $500 per acre for 8,600 acres. The alternative

method, Value of Potential Income, indicates a value of $8.5 million based on the NPV of Case 30 (discounted 5%). These values, which are based on subjective opinion, indicate that the property ranges in value from $6.0 million to $10.0 million.

1.1.2 Recommendations

It is recommended that a program be developed to justify the change in reverse circulation to core drilling. A twin hole test is strongly recommended, designed so as to confirm or eliminate the concern of contamination and also to verify results obtained from hole No. 159, on which a significant part of the reserve quantity and quality estimate is based. It is also recommended that the reverse circulation holes be drilled vertically, reducing costs while at the same time providing equal if not better sample results than inclined holes.

Due to concern over the expected mechanical properties of the in situ rock types, the mining method selected in this report is the drift and fill system. Unfortunately, rock mechanics data are very limited, and in order to provide information for subsequent studies it is recommended that a rock mechanics study be implemented as part of and in conjunction with the next phase of the exploration program. It is obvious that the exploration program will take preeminence over the rock mechanics program, but for minimal effort and cost, invaluable information can be obtained at this time of data gathering. A description of the proposed work is included in the report prepared by Piteau Associates attached in Appendix A.

Metallurgical testwork, as proven from the results of the work completed to date, is critical to the project evaluation. An improvement in metallurgical recovery of a few percent can enhance the project substantially; conversely, a decrease in recovery can make the project non-viable. It is recommended that the test program as described in Section 5 be implemented.

1.2 Project Overview

Beacon Hill Consultants Ltd. was retained by LAC Minerals (USA), Inc. to complete a reserve audit, a property valuation, a conceptual mine plan and a financial analysis of the Dozer Hill deposit, Rosebud Project, located 40 miles north of Lovelock, Pershing County, Nevada.

The Rosebud property is an advanced exploration project controlled by Lac Minerals (USA), Inc. The property package is large but complex, involving multiple exploration agreements and underlying ownerships. The project consists of the extensively drilled Dozer Hill deposit held by a joint venture between Lac Minerals (USA), Inc. and Equinox Resources Ltd. and a number of variously defined and sampled exploration targets. The Dozer Hill drilling is incomplete, but the current drill hole density is adequate for calculation of what are commonly referred to as geologic reserves. LAC Minerals (USA), Inc. has classed these reserves as probable and possible under a set of definitions that are reasonable and have been consistently applied.

The reserve audit consisted of a careful review and spot check of all procedures and data comprising the data base from which the reserve was calculated. In addition, the measurements, calculations, assumptions and interpretations were carefully reviewed and spot checked.

In all cases the work has been done properly and is consistent with sound geologic and mining practice. Calculations are accurate, and the interpretations, though subject to alternatives, are reasonable and consistent with the available data. The number of samples and the numerous recent rechecks are

case, the mine would operate 5 days per week, 3 shifts per day, and produce 1,400 t/d. In both cases the mill would operate 7 days per week, 3 shifts per day, and be fed from a stockpile during the mine down days.

The project schedule for both cases indicates that production can be achieved early in Year 3, assuming that the Phase I exploration program is completed in Year -1, Phase II is completed in Year 1 and a production decision is made early in Year 2. There is little difference between the two schedules, but the 1,000 t/d alternative requires ongoing capital development much earlier than the 500 t/d scenario. In both cases the mine life is approximately seven years.

Based on the limited metallurgical work completed to date on the Dozer Hill mineralization, a CIL plant with gravity separation has been selected for ore processing. Metallurgical recovery rates of 86%, 89% and 92% have been used for the evaluation.

The site chosen for tailings disposal is to the southwest of the proposed millsite and mine portal and has been designed for sufficient storage of 3,000,000 tons of tailings, based on a mill throughput of 350,000 tons per year, requiring a total area of 1,530 acre-ft.

An overview of the environmental requirements for the project has been developed. The report prepared by Environmental Management Services Company (EMS) is generally considered to be realistic, comprehensive and reasonable. It is suggested, however, that the environmental aspects of the project be approached on the basis of a full Environmental Impact Statement (EIS), with a single document covering both the federal and state requirements.

A number of alternative cases were developed for the financial analysis of the project. In order to evaluate the various cases presented, a base case was established for each production rate based on two criteria: gold price $375/oz, and 89% metallurgical recovery. These criteria are considered reasonable when taking into account present market conditions and the metallurgy completed to date.

The results of the financial analysis are summarized in Table 1-1 for the 500 t/d production rate and in Table 1-2 for the 1,000 t/d case. The evaluations indicate that, based on the probable reserves, current grades, mining parameters and metallurgical recoveries and costs, the 500 t/d production rate is not viable. Each alternative investigated indicated a negative IRR with the exception of Cases 5-6, 5-9, 5-10 and 5-11. Case 5-6 uses a gold price of $475/oz. Case 5-9 decreases operating and capital costs by 10%, increases the mining grade by 10% and includes the highest recovery. This produces a 6.85% IRR, which remains below the level required to indicate that the production rate is viable. In Case 5-10 the gold price is increased to $425/oz with a resulting IRR of 17.10%, which is acceptable but optimistic. The remaining case decreases operating costs another 10% with a gold price of $375/oz, producing an IRR of 12.70%.

If the rock mechanical properties are determined in later investigations to be better than those established in this report, it is quite possible that capital costs could decrease by some 10% and operating costs by 10% to 20%. An improvement in grade is also considered possible. These improvements would still leave the 500 t/d milling rate in a marginal position, bearing in mind the downside of any mining venture.

The 1,000 t/d alternative indicates a positive IRR for all but two of the 14 cases analyzed. The base case, No. 2, which incorporates the $375/oz gold price and 89% metallurgical recovery criteria, gives a return of 12.06%. A 10% reduction in operating costs increases this to 18.11%. An improvement in grade is also possible; if a 10% improvement is assumed and is again combined with a 10% decrease in capital cost and operating costs and 92% recovery, the result is an IRR of 34.07%.

DOZER HILL INFILL AND OFFSET DRILLING

Phase	Reverse Circulation (ft)	Core (ft)
I	18,000	3,400
I (Incremental)	23,500	1,500
II	10,400	26,500
II (Incremental)	4,900	12,400
TOTAL	56,800	42,800

Due to the early stage of development of the Dozer Hill orebody, it is probable that further drilling will alter the geometry and distribution of individual blocks somewhat, but these changes are expected to be relatively small. It is likely that the next phase of drilling will expand rather than decrease the reserve. There is good potential for additional geologic reserves at Dozer Hill, both internally, on projections of currently identified ore blocks, and also to the north, south and east.

The mineable reserves for this study have been based on the geologic "cut" reserves calculated by LAC Minerals (USA), Inc. and an estimated cutoff grade of 0.12 oz Au/t. The reserves were developed by eliminating ore block sample values, using the LAC interpretation, below 0.12 oz Au/t at the margins of blocks. The resulting reserve amounted to 997,000 tons at a grade of 0.27 oz Au/t (cut), which compares to the mineable inventory estimated by LAC at 0.05 oz Au/t cutoff of 1,245,000 tons at a grade of 0.248 oz Au/t (cut). Mining dilution was assessed based on stoping heights and widths and on the mining method, and is equivalent to 15% of the in situ mineable tonnage. The estimated diluted mineable reserve used for this study is 1,146,000 tons at 0.24 oz Au/t and 2.0 oz Ag/t. The silver grade is based on information provided by LAC personnel.

The conceptual mine plan for the Dozer Hill deposit has been based on the drift and fill mining method, which was selected on the basis of the rock quality assessment and the configuration of the orebody. This approach to the mining method is considered conservative but reasonable, and it is possible that other, more productive and cost-effective methods can be considered as additional rock quality data are obtained.

The drift and fill system is highly selective and provides the most effective ground support; it will also ensure maximum ore recovery. The method involves driving 13 ft wide drifts in stopes developed longitudinally, separated by rib pillars of similar width. As each drift room is mined out it is filled with a low strength cemented rockfill. This allows the pillar to be removed, which in turn is filled with uncemented sand or rockfill. Each lift is mined out prior to the next lift, so that the floor of the drifts to be mined is the fill placed previously. Access to the drifts is via a ramp connected to the main haulage ramp/shaft surface access.

The mine plan is based on fully mechanized, diesel powered equipment, with hydraulic jumbos, LHD loaders and haul trucks utilizing ramp access during the initial years of production. A shaft has been developed to accommodate a second means of egress from the mine and production hoisting capability upon the truck haul distance becoming uneconomic.

Two production scenarios have been established, 500 t/d and 1,000 t/d (milling rate). The 500 t/d case incorporates 5 days per week, 2 shifts per day operations for mining, producing 700 t/d. In the 1,000 t/d

definitions of geologic probable and possible reserves. Thus the geologic reserve is considered accurate and reasonable within the constraints of the existing data. Important questions remain concerning the viability of the samples and the impact of sampling procedures and analytical errors on the degree to which individual analyses can be considered representative. The level of drilling and sample verifiability are not sufficient for a definitive feasibility study. *

The review carried out for the audit and feasibility evaluation has identified a number of areas where modification or expansion of procedures could substantially improve the accuracy and reliability of the data base and the efficiency of the next phases of work. These areas are summarized below:

1. Expanding the logging to include both geotechnical and structural/mineralization data will provide basic data to be used in orebody targeting studies, ore control interpretations and engineering design. Coupled with surface mapping, these data can also provide the basis for effective structural analysis, which will provide insight into the interrelationship between structural elements and mineralization (ore controls). Also, when using reverse circulation drilling in areas of unknown sampling characteristics, flushing the hole at every sample can substantially improve the chances of a good sample and reduce the risk of downhole contamination.

2. A properly designed verification and validation program is critical to the ability to upgrade the reserves. This includes a sampling/analysis validation study, which would address concerns about the effects on the accuracy of the data of the various sampling procedures, sample handling and preparation methods and sample analysis techniques. In addition, this study should provide answers to questions related to the possibility of gold washing out of core and the reasons for variances between the GSI and Bondar-Clegg laboratory results. It would also form the basis for an ongoing sample/analysis verification and check procedure. Twin hole and close spaced drilling programs and associated statistical studies can document critical orebody characteristics such as continuity and homogeneity.

3. There is a good chance that reverse circulation drilling can still be a useful and accurate sampling tool. Additionally, there is evidence that vertical holes may be just as effective, and possibly more so, than angle holes. This would serve to substantially reduce costs and improve the efficiency of the drilling program.

As part of the conceptual mining plan a drilling program suitable to upgrade the entire Dozer Hill resource to proven status was designed. The program was scheduled in two phases. Phase I would bring the reserve to a probable category and provide ore block definition on 100 ft centers. Phase II would bring the reserve to proven status by defining ore blocks on 50 ft centers and provide the basis for a definitive feasibility study.

The first run of the project economics, using diluted, "mineable" reserves developed by Beacon Hill Consultants Ltd., demonstrated the need for additional reserves. Assuming the additional ore blocks could be identified, the Proposed definition drilling program was modified. An incremental footage was extrapolated based on the initial program and was then added to the original footage to produce a new definition drilling program. The footages for each of these phases are as follows:

SUMLAC

March 8 1991

Table 1–1
Rosebud Project
Dozer Hill
500 TPD
Financial Analysis
Summary

Case	IRR %	Gold Price $	Recovery %	CapitalCost $(000)s	Op. Cost $	NPV $(000)s	Discounted NPV $(000)s 5%	10%	15%	20%	25%	Comments
5–1	–14.48%	$375.00	92.00%	$27,232.30	$69.85	($12,502.10)	($13,446.92)	($13,769.32)	($13,731.97)	($13,487.26)	($13,125.63)	Maximum expected recovery
5–2	–18.14%	$375.00	89.00%	$27,232.30	$69.85	($15,129.28)	($15,443.17)	($15,318.24)	($14,956.34)	($14,471.20)	($13,928.08)	Base Case
5–3	–22.04%	$375.00	86.00%	$27,232.30	$69.85	($17,758.69)	($17,444.41)	($16,873.71)	($16,188.02)	($15,462.72)	($14,738.06)	Minimum expected recovery
5–4	–7.67%	$375.00	89.00%	$27,232.30	$69.85	($7,028.22)	($9,264.38)	($10,507.23)	($11,141.24)	($11,396.45)	($11,414.08)	Grade increased by 10%
5–5	–4.35%	$425.00	89.00%	$27,232.30	$69.85	($4,083.44)	($6,997.67)	($8,726.94)	($9,717.99)	($10,240.74)	($10,462.57)	Gold Price $425/oz
5–6	6.23%	$475.00	89.00%	$27,232.30	$69.85	$6,391.28	$1,001.22	($2,491.01)	($4,766.94)	($6,245.85)	($7,192.74)	Gold Price $475/oz
5–7	–8.62%	$375.00	89.00%	$27,232.30	$62.87	($7,952.38)	($10,021.58)	($11,134.82)	($11,666.65)	($11,840.23)	($11,791.88)	Operating Cost reduced by 10%
5–8	–16.56%	$375.00	89.00%	$24,509.07	$69.85	($12,436.47)	($12,962.78)	($13,031.14)	($12,842.41)	($12,511.51)	($12,105.64)	Capital Cost reduced by 10%
5–9	6.38%	$375.00	92.00%	$24,509.07	$62.87	$5,907.99	$1,015.50	($2,156.03)	($4,224.45)	($5,569.93)	($6,432.74)	Gold Price $375/oz, Gold Grade increased by 10%, Operating and Capital Costs decreased by 10%, Met. Recovery 92%.
5–10	16.67%	$425.00	92.00%	$24,509.07	$62.87	$16,496.41	$9,154.98	$4,226.99	$869.77	($1,440.85)	($3,039.73)	Optimistic Case Gold Price $425/oz, Gold Grade increased by 10%, Operating and Capital Costs decreased by 10%, Met. Recovery 92%.
5–11	12.42%	$375.00	92.00%	$24,509.07	$55.88	$12,073.92	$5,720.51	$1,508.67	($1,317.67)	($3,226.84)	($4,516.74)	Gold Price $375/oz, Gold Grade increased by 10%, Operating Costs decreased by 20% and Capital Costs decreased by 10%, Met. Recovery 92%.

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Table 1–2
Rosebud Project
Dozer Hill
1000 TPD
Financial Analysis
Summary

Case	IRR %	Gold Price $	Recovery %	CapitalCost $(000)s	Op. Cost $	NPV $(000)s	Discounted NPV $(000)s 5%	10%	15%	20%	25%	Comments
1	15.16%	$375.00	92.00%	$35,232.30	$56.87	$21,231.71	$11,307.44	$4,649.20	$117.01	($2,998.01)	($5,148.81)	Maximum expected recovery
2	12.06%	$375.00	89.00%	$35,232.30	$56.87	$16,524.05	$7,693.29	$1,818.20	($2,140.12)	($4,825.93)	($6,649.75)	Base Case
3	8.71%	$375.00	86.00%	$35,232.30	$56.87	$11,617.23	$3,940.14	($1,112.13)	($4,469.80)	($6,707.90)	($8,191.70)	Minimum expected recovery
4	20.89%	$375.00	89.00%	$35,232.30	$56.87	$30,357.96	$18,326.56	$10,155.93	$4,513.35	$566.39	($2,219.16)	Grade increased by 10%
5	1.08%	$375.00	89.00%	$35,232.30	$56.87	$1,336.85	($3,890.15)	($7,201.26)	($9,292.53)	($10,590.11)	($11,362.17)	Grade decreased by 10%
6	–3.29%	$325.00	89.00%	$35,232.30	$56.87	($3,909.11)	($7,886.96)	($10,309.96)	($11,755.05)	($12,572.60)	($12,981.31)	Gold Price $325/oz
7	23.57%	$425.00	89.00%	$35,232.30	$56.87	$34,859.27	$21,783.97	$12,864.70	$6,672.97	$2,314.96	($783.90)	Gold Price $425/oz
8	33.64%	$475.00	89.00%	$35,232.30	$56.87	$52,935.77	$35,668.95	$23,743.03	$15,345.45	$9,336.15	$4,978.55	Gold Price $475/oz
9	18.29%	$375.00	89.00%	$35,232.30	$51.18	$26,373.44	$15,209.84	$7,673.12	$2,504.01	($1,082.35)	($3,588.52)	Operating Cost reduced by 10%
10	15.63%	$375.00	89.00%	$31,709.07	$56.87	$19,592.68	$10,594.20	$4,544.38	$416.27	($2,429.16)	($4,400.57)	Capital Cost reduced by 10%
11	4.43%	$375.00	89.00%	$35,232.30	$62.56	$5,595.85	($571.68)	($4,566.99)	($7,167.30)	($8,851.16)	($9,921.51)	Operating Cost increased by 10%
12	9.00%	$375.00	89.00%	$38,755.53	$56.87	$13,375.36	$4,731.24	($955.78)	($4,734.65)	($7,253.64)	($8,924.39)	Capital Cost increased by 10%
13	33.77%	$375.00	92.00%	$31,709.07	$51.18	$47,922.04	$32,308.64	$21,524.60	$13,930.85	$8,496.49	$4,555.48	Optimistic Case Gold Price $375/oz, Operating and Capital Costs decreased by 10%, Grade increased by 10%, Met. Recovery 92%
14	–16.10%	$375.00	86.00%	$38,755.53	$62.56	($19,038.28)	($19,868.49)	($21,020.02)	($21,725.00)	($22,134.01)	($22,342.38)	Pessimistic Case Gold Price $375/oz, Operating and Capital Costs increased by 10%, Grade decreased by 10%, Met. Recovery 86%.

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The above discussion indicates that the 1,000 t/d case is conceptually a viable mining plan for this deposit. With the potential for an improvement in both grade and underground rock conditions, a very advantageous operation could be achieved.

The Rosebud Project does not at present contain a mineable mineral inventory from which a discounted cash flow stream can be calculated or a net present value determined. It is an exploration property, and its value lies in the perception of the potential for mineable reserves and the value of those potential reserves to the valuer.

The method of valuing exploration properties has been approached in many ways over the years, none of which is particularly scientific and does not produce bankable results. A number of subjective measurements can be applied, however, to define a set of boundaries for the value of a given project. There are two broad approaches to a valuation. One is the market value, which is simply what a purchaser would be willing to pay for the project, and the second is the value of the potential income, which represents the true value to the owner if the project is not to be sold. The property has been valuated by both approaches, which together are considered to provide a means of determining a realistic value for the Rosebud Project.

The Rosebud Project was considered as two relatively distinct categories of property for the market valuation. First, there is the Dozer Hill reserve, which can be characterized as a partially drilled geologic reserve with good potential for being large enough to become a viable mine. Second, the remaining part of the project can be viewed as a large property package in a highly prospective area, near operating mines, with a number of very encouraging surface anomalies.

To complete the initial part of the market evaluation, *The Northern Miner, The Mining Record* and *The George Cross Newsletter* were reviewed for the past three to four months. Lists of transactions were made and the terms of the deals noted. Properties were categorized as operating (including ready to operate), drilled with reserves, or prospects. The value of each transaction was determined using cash payments (both actual and obligated) and stock prices valued near the date of the transaction where stock was involved. Where the reserves were the major asset (operating or drilled properties) they were converted to ounces or equivalent ounces of gold per ton and used as the basis of comparison. For prospects, the basis of comparison was the acreage under control. Work commitments were ignored since they contributed no tangible asset to the transaction. Royalties were generally small enough to be ignored considering the other broad approximations required. Transactions for which basic data could not be determined were not used.

It appears that in recent months the market has been valuing drilled but undeveloped reserves at between $5 and $15 per oz. Presumably, this range in value is due to the market's perception of the relative quality of the reserve and of its additional potential. In this context it is reasonable to assume that the 0.05 oz Au/t cutoff underground reserve (354,000 oz) determined by LAC Minerals (USA), Inc. can be used as a basis for valuation. Taking into account the strong possibility of reserve expansion with additional drilling, this quality of reserve should fall near the mid-point of the range. For the purpose of this valuation the Dozer Hill reserves as currently determined should therefore have a value of $10 per oz, or $3,540,000.
In recent months the range of values for prospects with no reserves has been from $8 to $900 per acre. Subjectively, Rosebud is as good as any of the prospects and should be in the middle to upper part of the range. For the purpose of this valuation, it is reasonable to use $500 per acre. The land package at Rosebud consists of approximately 8,600 acres, and it should therefore have a value of $4,300,000.

Combining the values for the reserves at Dozer Hill and the rest of the project yields $7,840,000 for the total current market value of the property. The range prediction on this number should be considered plus or minus 25% and possibly more.

The value of the potential income stream is derived from an economic model based on three fundamental assumptions:

1. The type of deposit, including tonnage and grade likely to be found.
2. The probability of this occurring.
3. The probable production characteristics (mining and milling, etc.) of the deposit.

Given these data, a probability weighted net present value can be calculated.

The fact that gold concentrations occur at Dreamland, Dozer Hill and the Hycroft property demonstrates that the district has potential for multiple areas of widespread, strong mineralization. It is reasonable to assume that any new deposits found would be similar in character to those already identified, that is, large, irregular, very non-homogenous areas of gold mineralization, each consisting of several tens of millions of tons with gold content averaging from 0.01 to 0.03 oz Au/t. Within these areas are higher grade pods ranging from a few thousand tons to a few million tons with gold content in the range of 0.1 to 0.4 oz Au/t. This assumption gains added weight when considered in the framework of other, similar deposits such as Aurora, Rawhide, Borealis and Bodie.

Through discussions with the staff of LAC Minerals (USA), Inc. and of Hycroft, as well as considerable review by Beacon Hill Consultants Ltd., a framework has been evolved for the probabilities and potentials of the Rosebud Project. These are summarized as follows:

ROSEBUD PROJECT ESTIMATES OF POTENTIAL

Category	Total Oz	Probability (%)	Estimator
Current Reserve	275,000	90-95	BHC (uneconomic)
High Probability Reserve	500,000	70-80	BHC
Good Probability Reserve	1,500,000	30-40	Consensus Estimate

The current work indicates that if orebodies are found, they will be at some depth below the surface. They will require underground mining and contain relatively high grades amenable to a crush, grind and cyanide leach recovery system similar to the conceptual mine plan developed by Beacon Hill Consultants Ltd. for Dozer Hill. There would likely be three separate mines with a shared mill and surface facility.

A financial analysis was developed on this basis with a mineable tonnage of 6,250,000 tons at 0.24 oz Au/t and 2 oz Ag/t, which, assuming a 35% chance of three deposits being delineated and a 75% chance of the reserves for the 1,000 t/d case being defined, gave a value of $8.5 million. By comparing the two values of $7.8 million and $8.5 million it was concluded that a value of $8.0 million was reasonable for the Rosebud property with a range of plus or minus 25%, i.e., $6.0 million to 10.0 million.

SECTION 2

INTRODUCTION

SECTION 2

INTRODUCTION

LAC Minerals (USA), Inc. is currently conducting exploration on the Rosebud property, located some 40 miles north of Lovelock in Pershing County, Nevada. A systematic surface drilling program in the Dozer Hill area, on ground owned by LAC Minerals (USA), Inc. and Equinox Resources Ltd., has outlined a generally tabular mineralized zone extending over a strike length of about 1,800 ft. Several other drill holes on adjacent parts of the property have also intersected gold mineralization; further work is planned in 1991 to test the potential of these areas.

LAC Minerals (USA), Inc. has completed an in-house geologic reserve study and a conceptual mine plan for the Dozer Hill zone, and requested Beacon Hill Consultants Ltd. to carry out an independent preliminary feasibility study. The objectives of the study were to review the reserves established by LAC Minerals (USA), Inc. and to determine if the project has a reasonable expectation of being a viable mining venture. The results of the preliminary study will assist in establishing future exploration objectives and will also identify additional information required to conduct a more definitive study.

This report is intended to

- audit the geologic reserves prepared by LAC Minerals (USA), Inc.,
- establish a conceptual mining plan,
- estimate the "mining" reserves,
- estimate preliminary capital and operating costs for a process plant and ancillary facilities, tailings disposal and site infrastructure,
- complete an economic analysis of the base case mining scenarios, and
- determine the net present value of the reserves.

In addition to the evaluation of the Dozer Hill reserve, an assessment has been completed of the other potential deposits on the property in order to establish a fair market value for the total project. This assessment has considered the present land position, existing exploration targets and the overall geologic potential of the area.

Mr. Peter Stokes, Mr. Bruce Briggs and Mr. Dave Shaddrick of Beacon Hill Consultants Ltd. met with Mr. Bob Thomas and Mr. Nate Brewer of LAC Minerals (USA), Inc. in Reno, Nevada, in early February 1991. The available project information and study data were presented by Mr. Brewer at this meeting. On the following day the Beacon Hill representatives, accompanied by Mr. Brewer, made a site visit to the Rosebud property.

A further meeting was held in early March at the offices of Beacon Hill Consultants Ltd. In Vancouver. Present were Mr. Bob Thomas, Mr. Nate Brewer and Mr. Hans de Rueter of LAC Minerals (USA), Inc.; Mr. John Wright and Mr. Bob Wicker of Equinox Resources Ltd.; and Mr. Peter Stokes, Mr. Bruce Briggs and Mr. Dave Shaddrick of Beacon Hill Consultants Ltd.

This report has been prepared based upon the data provided by LAC Minerals (USA), Inc. and the observations made during the site visit, and with the assistance of Gormely Process Engineering, Piteau Associates Engineering Ltd., Knight and Piesold Ltd., Hallam Knight Piesold Ltd. and Proton Engineering and Construction Ltd.

SECTION 3

GEOLOGY AND RESERVES

SECTION 3

GEOLOGY AND RESERVES

3.1 Introduction

The Rosebud Project is a large, volcanic hosted, epithermal gold system located in northern Pershing County, Nevada. The land package consists of 8,660 acres of patented and unpatented mining claims under six separate ownerships. LAC Minerals (USA), Inc. controls the property through direct ownership and five individual agreements with other land holders.

Mineralization is widespread and occurs in veins and veinlets localized by faults, shears and fracture zones. The property has been explored to the point where a zone of potentially mineable ore has been identified at Dozer Hill. There are also a number of additional targets on the property yet to be fully tested. The Dozer Hill reserve is classed as probable and possible under a set of definitions developed by project staff. No proven reserves have been developed on the property to date. A plan to bring the level of the reserves to industry standard proven or measured status has been developed and is included in this report.

This section of the report provides an audit of the geologic reserve developed at Dozer Hill.

3.2 Reserve Audit

This reserve audit represents a qualitative assessment of the validity of the Dozer Hill geologic reserve developed by LAC Minerals (USA), Inc. The reserve is considered neither proven nor mineable, rather as an in-place, probable and possible geologic reserve. The audit has been completed based on the foregoing and, in all cases, opinions and conclusions are made with reference to this level of reserve estimation. The results of the audit are based on a comprehensive review, on the property and in the office, of all geologic aspects of the project as well as on presentations by and discussions with LAC project staff.

A large data base, both hard copy and electronic, was available for evaluation as were the original drill core, cuttings, logs and maps. Numerous spot checks have been made of specific items, and in many cases independent calculation or interpretation was performed as an additional check.

The results of the reserve audit are presented in three main segments:

1. Data collection and analysis procedures
2. Assumptions and interpretations (deposit model)
3. Reserve calculations

3.2.1 Qualitative Assessment of Data Collection and Analysis Procedures

The basic building blocks of the reserve consist of observational and analytical data. This raw data consist of samples (drill, rock chip and soil), chemical analyses, survey measurements, geophysical readings and geologic observations. The evolution of a data base consists of the following steps:

(a) Generation of raw data through sampling, analyses, measurement and observation.
(b) Transfer of this data to a data base where it can be stored, retrieved and analyzed.
(c) Quality assurance procedures to identify and where possible correct sources of error or variance.

All of the above mentioned activities have been reviewed and, where possible, independently checked. No activity other than geologic mapping was in progress on the property at the time of the visit, and drilling and sampling equipment was not available for inspection. A clear picture of this equipment and the manner in which it was used has been developed through verbal descriptions coupled with sketches and photographs.

3.2.2 Raw Data Generation

Data collection has, as a general rule, been done exceptionally well and in a manner consistent with sound geologic and mining practice. Surface geologic mapping is excellent and underground mapping is adequate. Rock chip and soil sampling was done well. Equipment used for drilling and sampling, as well as for surveying hole locations and deflections, was adequate to do the job properly, and in many cases above the industry standard.

Analytical work was done originally by GSI Labs. The stated procedure for gold analyses (fire assay with AA finish) is excellent and provides fine results if done correctly. There have been significant oversights and procedural errors in the work done by GSI. Project personnel are aware of the problems, and many of the samples have been rechecked by another lab. This problem is discussed in greater detail in the section on quality assurance below.

A review of the data base and the engineering work for the preliminary feasibility study has identified several areas where additional data or modification of current procedures have a good chance of enhancing or expanding the data base:

(a) Future logging should include rock quality data. Some level of geotechnical logging should be incorporated into standard geologic logs in any area where strong mineralization has been identified.

(b) A significant amount of structural data is available in the underground workings and the core. A formal procedure to incorporate this in geologic mapping and logging should be started. Evaluation of this information will expand the understanding of the relationship between the various large and small-scale structural features and mineralization.

(c) There is a strong chance that reverse circulation drilling can still be an effective sampling method for this orebody. If reverse circulation drilling is used, the drilling should stop and the hole be flushed every 5 ft to reduce the probability of contamination and incomplete recovery. Also, wherever possible, reverse circulation holes should be vertical, particularly when water is encountered.

3.2.3 Data Transfer and Management

The data for Dozer Hill are maintained both electronically and in hard copy. The electronic data base manager is the PCXPLOR system. The data base includes geologic and sample maps, drill logs, chemical, engineering and metallurgical analyses of the samples, as well as location and orientation data.

The process of transforming analytical and observational data into a usable data base is one of the greatest potential sources of error in any program. Much of the analytical data was input into the electronic data base via a series of hard copy computer transfers physically carried out by personnel of GSI and LAC Minerals (USA), Inc. This provides an opportunity for significant error. Project personnel are aware of this concern, and electronic data transfer procedures are now in place, which will eliminate all hand transfers of analytical data.

All of the data are stored in the Reno office. The organization of the information is well above average, and for the most part it is easily accessible and retrievable. Numerous spot checks of all categories of data and comparisons of original documents or observations to those carried in the data base revealed no errors or omissions. There is a high degree of assurance that the data base accurately reflects the original observations, analyses and measurements and that the documentation is complete.

3.2.4 Quality Assurance

Procedures to verify the results of data collection and analysis must be established early in the evolution of a project and rigorously followed throughout. This aspect of the work is critical to establishing the reliability and accuracy of the basic data as well as of the resultant data base. Standard verification procedures such as sampling error studies, twin holes and close spaced sampling will often serve the added purpose of early validation or modification of interpretations and assumptions that make up the evolving deposit model. Ongoing verification of the data base is essential to the development of a high confidence level in the reserves.

Verification procedures initially consisted of spot rechecks of sample analyses, and validation of the electronic data base on two occasions. The spot rechecks were done on samples from holes No. 4, 23, 40, 41, 52, 55 and 57. This work indicated the need for a more rigorous procedure and a program consisting of multiple check assays with independent sample preparation was initiated on hole No. 97. In additioin, a procedure to submit blind analytical standards was begun with hole No. 104. This program is adequate to assure both the accuracy and the precision of the data analysis but will not provide information on variability due to sampling procedures, sample preparation and procedures, or the natural gold distribution in the rock.

There is, however, a large enough sample population of both the unchecked and the checked analyses to provide assurance that the overall average grade is representative of the actual grade of the deposit at a selected cutoff. This is considered sufficient for the current level of confidence of the geologic reserves. A significant improvement is required for a definitive feasibility study; a system of spot checks combined with statistical analysis should provide a suitable level of confidence for this purpose, although it is possible that the early, unchecked data may prove unusable for grade calculations.

Although several holes are, at least in part, quite close to each other, a rapid analysis intended to provide some assurance of repeatability within mineralized areas proved inconclusive.

It is important that the next phase of exploration at Dozer Hill produce high confidence data suitable for a definitive feasibility study. It is thus recommended that the following procedures and studies be done as soon as possible:

(a) Design an ongoing sample verification procedure to evaluate and quantify sampling, sample preparation and analytical variabilities. This will have the added value of isolating the natural variability and providing important insights for the refinement of the deposit model.

(b) Carry out carefully designed twin hole studies, including statistical studies, in at least two areas to confirm the repeatability of the sampling. This should also be designed to define the variability and relative accuracy of reverse circulation drilling versus core. One of the test areas should include a twin hole for hole No. 159, which would serve to verify the high grade and length of this intercept as well as to provide insight into the area of influence and homogeneity of high grade mineralization.

(c) Complete a comparative study on drill cores to determine the effects of various drilling and handling procedures on the accuracy of the final assay to answer the question of whether gold is lost during flushing of drill fluids or in the water cooling process used in sawing.

(d) Carry out a spot recheck of early samples (taken prior to the recheck procedure) included in the reserve and a geostatistical study designed to quantify variability and provide an understanding of the usability of these data for high confidence reserve calculations.

(e) Carefully select at least one and preferably two ore areas for close spaced drilling (25 ft spacing at most). This will provide hard data concerning the distribution and continuity of mineralization. If a zone with greater than 1.0 oz Au/t rock is included, this will serve the added purpose of helping to resolve the question of cutting high grade assays.

(f) Carefully designed geostatistical studies should complement and enhance (not direct) all of the above.

3.3 Assumptions and Interpretations (Deposit Model)

This portion of the work involves compiling and evaluating field and analytical data to develop a descriptive model of the deposit geology and ore distribution. This model serves as the basis for defining the ore blocks and is, therefore, the foundation of the reserve calculation.

Three interrelated fundamental assumptions or interpretations are required to define the deposit model:

1. CONTINUITY: The assumption of how far from a given sample or intercept the mineralization is likely to continue is the foundation of the reserve. It serves to define the size and the shape of the ore blocks. The principal technique for defining continuity is either continuous sampling of exposed ore or extremely close spaced drilling. Geostatistics is useful as a supplement, but cannot replace geologic observations and analyses.

2. HOMOGENEITY: An assumption concerning the degree of internal grade consistency for individual ore blocks is the underlying basis for grade and contained metal calculations. The degree of homogeneity is defined by the same procedures used to define continuity. This is supplemented by data from twin hole studies and sample variability studies as outlined under the quality assurance section of this report.

3. ORE CONTROLS: This is an interpretation, based on geologic evidence, that defines the shape, distribution and orientation of the mineralized zone and the ore blocks within it. This requires a thorough understanding of the local geology, primarily the stratigraphic and structural framework, and the relationship of the mineralization to this framework. The principal methods of defining the relationship of mineralization and geologic features are

   detailed mapping and sampling of exposed ore, detailed studies of drill core, and three-dimensional synthesis and analysis of geologic and mineralization data. Again, geostatistical analysis is an important aid in this study.

The assumptions, interpretations and resultant deposit model developed by LAC Minerals (USA), Inc. are, in all cases, consistent with the available data and geologically sound within the limitations of the current data base.

The fact that significantly different alternative interpretations and assumptions can still be supported is a strong indication that the data base is incomplete. There are no direct data in hand to help define the area of influence of a single intercept, nor is there information concerning the orientation of ore blocks. Additionally, the small-scale (single sample) distribution of gold remains unclear. In some cases, the basic data are available and answers will evolve from ongoing compilation and analysis; for example, structural analysis with an emphasis on the relationship of structural elements to mineralization could make a significant contribution to the understanding of ore controls. This may provide a highly effective targeting tool for additional ore as well as important insights about ore distribution.

For the most part, however, the Dozer Hill area has not been drilled or exposed in sufficient detail to uniquely define many of the above parameters. It is essential that the next phase of exploration be carefully designed to provide the data that will allow resolution of alternative interpretations. Such data, in conjunction with the quality assurance and verification procedures mentioned above, will provide a substantial increase in the confidence of the reserve.

3.4 Geologic Reserve Calculations

In this phase of the work both observational and analytical data are brought together with the interpretive geologic model to develop a realistic and verifiable estimate of the in-place ore reserve - commonly called a geologic reserve. This forms the base for the development of mining reserves and mining plans.

The reserve is classed as probable and possible under the definitions adopted by LAC Minerals (USA), Inc. from the "Dozer Hill Resource Estimate" of January 1991 (Nate Brewer). These definitions are quoted directly as follows:

1. PROBABLE ORE: Blocks projected on section 100' or 1/2 the distance from drill holes within favorable LBT host rock and/or along the projection of the South Ridge Fault. Isolated blocks in other rock types were generally given a 50' area of influence. The grade applied is the weighted composite grade of the drill hole intercept in each block. In a few cases where two holes nearly overlap only one block was drawn and the average grade applied.

2. POSSIBLE ORE: Blocks projected up to 100' beyond probable blocks on section, or between sections where potential continuity exists between probable blocks on different sections. The grades applied to these projected blocks are either 75% of the grade of the projected probable block on section or the average of probable grades in the adjacent blocks.

There are two distinct parts to the reserve calculations: determination of tonnage, and determination of grade. The following paragraphs consider each of these separately.

3.4.1 Tonnage Calculations

The procedure used by LAC Minerals (USA), Inc. to determine reserve tons was straightforward and consistent. Ore blocks were outlined by hand from the identified drill intercepts using continuity assumptions consistent with the deposit model. Ore outlines were developed using two cutoff grades, 0.02 and 0.05 oz Au/t. These outlines were then digitized and areas, volumes and tonnages calculated by the GEOMODEL software.

Tonnage factors for each ore type were determined by McClelland Labs. The total of 21 determinations provide adequate data for the calculation of geologic reserves. The stated procedure for density determinations (dried, lacquered core) is excellent for the determination of dry tonnage factors.

Spot checks of ore block measurements and tonnage calculations were done on a number of blocks. In addition Block B was completely recalculated from the basic data.

The reserve as outlined and calculated by project personnel is accurate and repeatable within acceptable limits (2% to 4% variance). In rare instances, small blocks calculated independently show a variance of 20% or more, but this is actually only a small number of tons and results from a difference of measurement no larger than a pencil line.

3.4.2 Grade Calculations

The grade of the reserve is taken directly from the weighted average of the sample analyses. Where rechecks have been run, the grade used in the reserve is the arithmetic average (referred to as the composite grade). No provision for external dilution has been made in the geologic reserve, but internal dilution was limited to 10 to 15 ft. Intercepts were identified and bounded using the ONE-D optimizer routine. Overall grade has been determined using two methods: first, a straight weighted average of all samples in an interval, and second, a weighted average with all samples grading above 1.0 oz Au/t cut to 1.0 oz Au/t.

The cuts of high grade to 1.0 oz Au/t have been made based on limited evaluations of metallurgical composites. Review of the data base and of sections within the reserve blocks shows that grades in excess of 1.0 oz Au/t seldom occur in intervals of more than one consecutive sample. This indicates that the distance the high grade can be projected is only a few feet, and since each sample represents at least 5 ft x 50 ft x 50 ft, or roughly 870 tons, it is unlikely that the entire block would average 1.0 oz Au/t. On the other hand, LAC Minerals (USA), Inc. personnel have stated that there is some evidence from the metallurgical test work that the weighted average grade of the deposit may be low. Also, there are some apparent correlations of high grade intercepts between two holes. The available data at present are insufficient to resolve this question, and the discussion only serves to highlight the need for the studies and verification procedures recommended above.

Many of the grade calculations have been rechecked by hand and the averages checked from the original data. In all cases the numbers are repeatable with the exception of an occasional rounding difference of plus or minus 0.001 oz Au/t. The methods used to determine intercepts and average grades are sufficient for geologic reserves. In particular, the direct averaging of multiple analyses of a single interval provides high confidence in the accuracy of the analysis.

3.5 Audit Opinion

It is the opinion of Beacon Hill Consultants Ltd. that the probable and possible geologic reserves developed by LAC Minerals (USA), Inc. at Dozer Hill are accurate and reasonable within the limitations of the current level of exploration and existing data. All procedures and calculations leading to the reserve have been done in a manner consistent with sound geologic and mining practice. The current data are not sufficient, in quantity or verifiability, for the calculation of proven or mineable reserves. Considerable additional drilling and the quality assurance procedures listed above are required to upgrade the confidence level of the Dozer Hill reserve.

The extensive review carried out for the reserve audit has highlighted two areas where a limited amount of work could provide a substantial improvement in sample quality, cost or speed. First, the change from reverse circulation to core drilling has not been justified by an objective evaluation. There is a strong chance that the difference in intercepts between holes No. RL5 and No. RL40C are simply a result of natural variability and locally reduced continuity. The twin hole test recommended above, if properly designed, should provide a definitive resolution to the question. Second, there is a good possibility that vertical holes will provide the same, or better, sampling results as the angle drilling and be significantly cheaper and faster. The current interpretation of ore block geometry and orientation, coupled with the assumption that the internal "grain" of mineralization is truly isotropic, supports the use of vertical rather than angle holes. Again, the work recommended above should provide definitive answers.

3.6 Dozer Hill Infill and Offset Drilling Program

At present Dozer Hill contains mixed probable and possible geologic reserves. As part of the conceptual mining plan it was necessary to design a drilling program that would upgrade the geologic reserves to proven status.

First, a set of working definitions was adopted using the currently demonstrated continuity and homogeneity of the deposit model. These definitions are as follows:

PROVEN ORE:	Ore blocks with at least two intercepts and defined by drilling on 50 ft centers.
PROBABLE ORE:	Ore blocks with at least one intercept and defined by drilling on 100 ft centers.

The infill and definition drilling to accomplish the reserve upgrade is presented in two phases. Phase I is designed to verify the assumptions and data quality, as discussed above, and to confirm internal continuity of each block. Additionally, this drilling will test projections of ore blocks on all sides and provide offsets of all intercepts on approximately 100 ft centers. The second phase is designed to adequately define ore blocks for stope development, and will provide drill penetrations of the ore blocks on approximately 50 ft centers.

As discussed above, the current understanding of continuity and homogeneity is based on limited data. There is a good probability that the drilling of Phase I, combined with the studies recommended above, will provide the necessary understanding of the deposit model to allow a more liberal set of reserve definitions. For example, it is likely that further work will demonstrate that proven ore can be defined by drilling on 100 ft x 50 ft centers rather than the 50 ft pattern currently envisioned. This would significantly reduce the required drill footage and therefore the capital costs.

The first run of the project economics, using diluted, "mineable" reserves developed by Beacon Hill Consultants Ltd. and a conceptual mine plan, demonstrated the need for additional reserves. The probability of finding these reserves was assessed and is discussed below.

Assuming these reserves to be identified, an estimate of the additional drilling required to bring them to the proven category was necessary. This incremental footage was extrapolated from the original Phase I and II programs. A summary of the drill footage for each phase is presented in Table 3-1.

TABLE 3-1

DOZER HILL INFILL AND OFFSET DRILLING

Phase	Reverse Circulation (ft)	Core (ft)
I	18,000	3,400
I (Incremental)	23,500	1,500
II	10,400	26,500
II (Incremental)	4,900	12,400
TOTAL	**56,800**	**42,800**

This drilling is designed to result in a proven mineable reserve of approximately 2.3 million tons.

3.7 Mineable Reserve Estimate

The geologic inventory compiled by LAC Minerals (USA), Inc. was used as the basis for estimating a preliminary mineable reserve on which to base the initial evaluation of the project. The geologic reserves developed by LAC were based on cutoff grades of 0.02 and 0.05 oz Au/t.

A preliminary assessment of the characteristics of the mineralized zones indicated that a fairly selective mining method would be needed to economically exploit this deposit. Based on this assessment and on initial projections of operating costs and recovery factors, it was estimated that a cutoff grade of 0.12 oz Au/t should be used as the basis for calculating the mineable reserve.

The procedure adopted to estimate this reserve did not, however, involve a complete re-interpretation of the ore blocks at the higher cutoff. The approach taken was simply to eliminate from an ore block any sample values below a 0.12 oz Au/t cutoff occurring on the margins, effectively reducing the width of the block and increasing the grade. The areas of low grade increments were determined on section and subtracted from the original block size to establish a revised tonnage and grade.

In all cases the block grades were calculated on the basis of cut grades, i.e., grades above 1.0 oz Au/t cut to 1.0 oz Au/t.

The undiluted mineable inventory previously compiled by LAC included all blocks classified as probable, as well as some classified as possible areas where good geologic continuity was assumed. In this current mineable reserve estimate, however, it was decided to include only probable blocks, even though it was recognized that some possible blocks, particularly a large, high grade block on 700 N, have a high probability of being upgraded after the next stage of drilling. Also, as in the case of LAC's mineable inventory, all isolated blocks were eliminated from this mineable reserve estimate.

The resulting undiluted reserve, as shown in Table 3-2, amounted to 997,000 tons at a grade of 0.270 oz Au/t (cut). This compares to the mineable inventory estimated by LAC at the 0.05 oz Au/t cutoff (which included some 55,000 tons of possible) of 1,245,000 tons at a grade of 0.248 oz Au/t (cut). Thus the result of increasing the cutoff at the ore block boundaries was to reduce the tonnage by about 20% but increase the grade by about 9%. If the possible blocks were removed from LAC's inventory, the effect of increased boundary cutoff would have been to reduce the mineable tonnage by 16% and increase the grade by some 12%.

Mining dilution was then assessed on the basis of the proposed mining method, stoping widths and anticipated ground conditions. On each section an estimate was made of the amount of wall rock dilution that might be expected under normal, controlled mining conditions. In all areas it was assumed that a selective mining method with consolidated fill would be used, enabling close control of dilution. It was estimated that in most cases the average amount of dilution from the footwall and hangingwall boundaries would be in the range of 2 to 3 ft of wall rock, depending upon the variability of the ore block thicknesses, the continuity of the zones and the expected ground conditions of the ore and surrounding wall rock.

The dilutant material was assessed a grade on each section by taking the arithmetic average of the sample values immediately outside the boundary of the block; the grade of the hanging wall and footwall dilution material was estimated separately.

The estimated mining dilution is equivalent to about 15% of the in situ mineable tonnage and has an average grade calculated at 0.035 oz Au/t. This results in a decrease of about 11% in the in situ geologic grade.

A summary of the diluted mineable reserves is shown in Table 3-2.

TABLE 3–2
ROSEBUD PROJECT – DOZER HILL

Mineable Reserve 0.12 oz Au/t Cutoff

Section	Geological		Dilution		Diluted Reserve		
	Tons	oz Au/t	Tons	oz Au/t	tons	oz Au/t	oz
Zone A							
000	46,346	0.221	9,600	0.035	55,946	0.189	10,570
100 N	27,439	0.166	7,000	0.048	34,439	0.142	4,882
200 N	26,020	0.218	5,600	0.041	31,620	0.187	5,903
300 N	26,035	0.167	4,500	0.045	30,535	0.149	4,555
400 N	65,393	0.199	10,000	0.010	75,393	0.174	13,099
500 N	21,887	0.191	6,000	0.027	27,887	0.156	4,342
Subtotal	213,120	0.197	42,700	0.032	255,820	0.169	43,351
Zone B							
600	38,589	0.322	8,400	0.043	46,989	0.273	12,825
700	–	–	–	–	–	–	
800	52,867	0.569	10,000	0.028	62,867	0.483	30,361
900	188,566	0.423	20,300	0.013	208,865	0.383	80,010
Subtotal	280,022	0.437	38,700	0.023	318,722	0.387	123,196
Zone C							
800	17,169	0.347	3,300	0.045	20,469	0.298	6,108
900	29,291	0.193	6,000	0.034	35,291	0.166	5,843
1000	16,627	0.325	4,000	0.049	20,627	0.272	5,603
Subtotal	63,087	0.270	13,300	0.041	76	0.230	17,554
Zone D							
1400	132,971	0.205	15,200	0.089	148,171	0.193	28,654
Zone E							
1500	77,202	0.221	10,500	0.022	87,707	0.197	17,294
1600	110,852	0.166	13,000	0.029	123,852	0.151	18,744
1700	120,475	0.213	14,900	0.024	135,375	0.192	26,025
Subtotal	308,534	0.198	38,400	0.025	346,934	0.179	621
TOTAL	997,734	0.270	148,300	0.035	1,146,034	0.240	274,818

Note: Based on all assays above 1.0 oz Au/t cut to 1.0 oz Au/t.

SECTION 4

CONCEPTUAL MINE PLAN

SECTION 4

CONCEPTUAL MINE PLAN

4.1 Introduction

The deposit at Dozer Hill consists of a number of shallow dipping, tabular ore zones of varying thickness and grade. The ore zones occur primarily within the Lower Bud Tuff unit, a sequence of volcanic and pyroclastic rocks of variable strength, degree of alteration and fracturing. In some areas varying degrees of silicification is evident, which tends to improve the competency of the rock, whereas other zones show argillic (clay) alteration, which results in lower rock strength characteristics.

Based upon the current geologic interpretation of these zones, it would appear at first glance that the orebody should be mineable by a variety of methods, including cut and fill, room and pillar, and possibly, in the thicker areas, sub-level open stoping. An examination of drill cores and some existing underground openings on the property, coupled with a very preliminary rock mechanics assessment, indicated that ground conditions would be quite variable throughout the deposit and that rock quality conditions are likely to be poor in many of the altered zones.

In view of this cursory assessment, and since virtually no geotechnical or geologic structural data were available, it was considered prudent at this phase of the project evaluation to base the mining plan on a stoping method that would provide for full support of the ground as it is mined and ensure that the structural integrity of the rock mass is maintained. Furthermore, selective mining practices will be required in those areas where localized variations in the dip and plunge of the ore zones are encountered in order to achieve maximum ore recovery and minimize grade dilution.

This may be a somewhat cautious approach to the mining plan, but as additional information is obtained from future exploration and development work, it is highly probable that ground conditions in some areas will prove to be generally more competent than currently envisaged, and that more productive, less costly mining methods can be utilized.

4.2 Rock Mechanics Assessment

A preliminary assessment of the rock mass quality and of the proposed mining plan was carried out by Piteau and Associates. The rock mass quality study was based on an examination of colour slides and core logs of the diamond drill cores from five holes cored through the ore zones on five separate sections in the project area. These slides were used to prepare preliminary estimates of RQD (modified core recovery), degree of breakage and degree of alteration. This information enabled a preliminary visual assessment of the rock quality in those areas, and indicated that the rock strength, degree of fracturing, degree of alteration and general rock competency can be expected to vary throughout the deposit. Some general comments on the expected rock mass quality are summarized as follows:

1. The Bud Tuff, as observed in the upper part of three holes, appears to be a generally good to excellent quality rock unit, including the altered zones.

2. The Lower Bud Tuff (the ore host) appears to vary in competency throughout the unit, with some good quality material in the upper sections. The rock competency generally

decreases in the lower sections, particularly near the South Ridge Fault.
The south end of Zone A as shown by Section 00, appears to be heavily altered and of poor quality. Cores in the Lower Bud Tuff on Section 600, 800, 900 and 1600 appear to be of fair to good quality, with occasional narrow zones of heavy altered, poor quality material.

3. There does not appear to be any clear relationship between rock quality and the ore zones.

4. The Dozer Tuff unit, below the South Ridge Fault, appears to be moderately to slightly altered and is expected to be of fair to good quality except near the South Ridge Fault.

Based on the limited data available concerning rock quality, geological structure and hydrogeology, Piteau prepared a preliminary assessment of allowable spans for the underground openings by applying empirical criteria using the NG1 Rock Mass Classification System. These assessments of allowable spans and possible ground support were prepared for each of the various grades of rock quality and alteration indicated from the drill core photograph examinations. These results are presented in Piteau's report in Appendix A.

The width of the ore zones generally appears to be greater than the allowable spans for the stopes, and thus it can be expected that the stoping areas may be developed by a variety of methods including room and pillar, longitudinal primary stopes separated by longitudinal rib pillars, or longitudinal drift and fill using low strength cemented rockfill for support of drift walls and backs.

The determination of optimum dimensions of the stopes and pillars will require information on the intact rock strength of rock joints and rock mass strength. Since little of this information is currently available, pillar dimensions cannot be determined at this time. However, as an initial approximation, to provide support and enable subsequent mining of rib pillars, it was recommended that pillar dimensions be the same as the transverse stope spans on room openings in each mining area.

If a longitudinal drift and fill method is used, it is expected that stope block abutments could be subjected to significant mining induced stress. In addition, stress on the cemented fill could cause compression of the fill and deformation of the back. The extent and significance of such deformations should be addressed in the detailed design studies.

4.3 Mining Method

As previously discussed, the conceptual mining plan for the Dozer Hill deposit has been developed on the basis of utilizing in each of the zones a highly selective mining method that would provide the most effective ground support and carry the least risk in areas of poor rock quality. Although the method is perhaps the most expensive, it will ensure maximum ore extraction and provide a high level of assurance that wall rock dilution will be kept to a minimum.

For the purpose of this study the method proposed involves the development of longitudinal primary stopes (rooms) approximately 13 ft wide separated by longitudinal rib pillars of similar width. The stopes would be developed along strike, with mining proceeding upwards from the lowest level of each mining block. As the rooms are mined out they would be progressively tight filled with a low strength cemented rockfill, thereby allowing the intermediate ribs to be excavated once mining and filling of the primary stopes have been completed. The secondary stopes, developed when mining the rib pillars, would be filled with an uncemented sand or rockfill to provide overall ground support as well as a working floor for mining of

subsequent lifts. In this manner each lift would be completely mined out and filled before the next lift commences. The concept as it might be applied to a portion of Zone A is illustrated in Figures BH3, BH4 and BH5.

4.4 Mine Development

The initial development of the mine will be via a 13 ft x 12 ft decline driven at -15% grade from a surface portal at 5,050 ft elevation near the proposed plant site, as shown on Figure BH7. The ramp will be driven underneath Zone A as far as 300 N section and then continue as a level drift at 4,700 ft elevation. The drift will subsequently follow the ore through the upper portion of Zone B and extend over the top of Zones D and E to the existing limit of the reserve at approximately 1800 N (see Figures BH1 and BH2).

This development will be utilized as a diamond drill drift from which the ore zones will be defined in the Phase I exploration program referred to in Section 3. Crosscuts will be driven as required in order to achieve the best drill coverage for each of the zones, and a bulk ore sample will be obtained for metallurgical test purposes.

On completion of the final phase of exploration and project feasibility, the pre-production development phase will commence with the driving of an extension of the 4,700 ft exploration drift to a location beyond the north limit of the ore zones, from which an 8 ft diameter return ventilation raise and an 8 ft diameter hoisting shaft will be excavated to surface. The hoisting shaft would also serve as a second means of egress from the mine.

After the ventilation circuit has been established, ramps will be driven to access the Zone A and Zone B orebodies to prepare the stoping blocks for production. The ramp to Zone B will be driven to the bottom of the block at about 4,500 ft elevation, where a sump and pumping facility will be established. A ventilation/manway raise will also be driven to provide an escapeway to the 4,700 ft drift.

It is proposed that Zones A and B be mined concurrently in the initial phase of mining, since this will result in a higher than average mine grade and provide sufficient mining faces to achieve the required level of production. The mine will subsequently be developed via a ramp extension to the lower ore zones and the ventilation raise and hoisting shaft extended to 4,300 ft elevation.

4.5 Mining Equipment

Room and pillar mining will be carried out using mechanized drifting equipment. A two-boom hydraulic jumbo is planned for drilling all production faces, and a 3-1/2 cubic yard scooptram would be used for mucking and hauling to an ore pass located on the access ramp (see Figure BH2). The ore from Zones A and B will be hauled in 16 ton trucks from ore pass chutes on the main access/haul ramp or drift to the shaft loading pocket on 4,700 ft level. Ore from the lower zones will subsequently be either fed to 4,300 ft via ore passes and hauled to the shaft on that level or trucked down the access/haul ramp to the shaft.

4.6 Filling

It is proposed that the stopes be filled with a low strength cemented rockfill in order to be able to recover the rib pillars after the completion of primary extraction on each mining lift. The fill medium will consist of crushed rock or gravel with a maximum particle size of 2" and containing about 5% cement. After being stockpiled on surface, the crushed material will be fed via a backfill hole to a storage bin excavated

underground at a suitable location in the vicinity of the initial mining blocks. Below the bin will be a backfill mixing station where the crushed waste and cement will be mixed in a small pug mill.

The backfill mix will be fed to a slingerbelt truck, which will haul the material into the stope and discharge it by means of the slinger mechanism. The rooms will be filled tight to the back, providing the necessary support for mining the adjacent rib pillar and the subsequent lift above. Details of the slingerbelt stowing method are provided in a technical paper reproduced in Appendix B.

4.7 Development and Production Schedules

In deciding on an appropriate production rate on which to evaluate the Dozer Hill deposit, a number of factors were considered, including the following:

- size of the known reserve
- orebody configuration and spatial distribution of the various zones
- mining method
- availability of mining faces
- LAC Minerals (USA), Inc.'s minimum production criteria.

On the basis of the above factors, it was decided to evaluate a base case production rate of 500 t/d and an alternative case of 1,000 t/d (milling rate). It was realized that in order for the 1,000 t/d rate to be practical, additional ore reserves would need to be delineated.

In the 500 t/d case, the mine would operate 5 days/week, 2 shifts/day, producing 700 t/d. The mill would operate 7 days/week, 3 shifts/day, being fed from a surface crushed ore stockpile on weekends. In the 1,000 t/d scenario, the mine would operate 3 shifts/day, 5 days/week, producing 1,400 t/d to accommodate the increased equipment and ventilation requirements. In either of the production options, the mine pre-production development would take almost 12 months to complete, following the underground exploration phase and a period of project evaluation. Ore produced from stope development would be stockpiled on surface to provide initial mill feed during the plant commissioning period.

4.8 Ventilation

The total fresh air requirements have been estimated at about 150,000 cfm for the 500 t/d production rate and at approximately 220,000 cfm for the 1,000 t/d case. This is based on the use of all diesel equipment for stope production mucking, hauling, ongoing development and servicing. Allowances have been made for miscellaneous requirements and system losses.

Fresh air will enter the mine via the main access ramp and exhaust through the return air raise where the main fan will be situated. Production rooms will be ventilated with the use of auxiliary fans and ducting.

4.9 Hoisting

The proposed hoisting system will consist of a 60" x 48" double drum hoist with a single 4 to 5 ton skip operating in balance with a counterweight. In the case of the 500 t/d schedule, the hoisting capacity will be 50 t/h requiring a 150 hp hoist motor, while in the 1,000 t/d case the required capacity is 100 t/h with a 300 hp motor.

The hoisting system will be equipped with the necessary safety features to accommodate emergency hoisting of personnel.

4.10 Alternative Mining Methods

If ground conditions prove to be more competent than have been postulated in this study, and if it is possible to open up more ground before filling, it is quite likely that a more conventional room and pillar system can be employed. This could significantly improve the efficiency of the mining and filling cycles and reduce direct operating costs. The potential savings would be in the range of $5/t. If some form of bulk mining could be employed in the better ground areas, the reduction in cost could be as much as $10/t.

SECTION 5

METALLURGY AND PROCESS PLANT

SECTION 5

METALLURGY AND PROCESS PLANT

5.1 Introduction

The following information was provided for review by LAC Minerals (USA), Inc. and has been used to design the conceptual plant as described in this section:

"Petrography & Ore Microscopy of Selected Samples from Drill Hole RE-5", Schurer & Fuchs, July 1989

"Hydrothermal Alteration and Mineralization of Selected Samples from Rosebud, Nevada", Bond Gold Exploration Geochemistry Department, August 9, 1990

Hope Memo, March 8, 1990 (Round 1)

McLelland Lab Report, March 5, 1990 (Round 1)

Rosebud Project Metallurgy - Round 2. Bottle Rolls RL-88 & RL-100

Rosebud Project Metallurgy - Round 3. Agitated Leach RL-100 & RL-104

Rosebud Project Metallurgy - Round 4. Carbon in Leach & Gravity Tests RL-100 & RL-104

Memo, Brosnahan and Beane to Brittan: Mineralogy of Rosebud Metallurgical Composites

5.2 Discussion

The testing shows a progression from an area where processing to a high recovery of gold was relatively easy (the RL-40, 41, 52 and 55 composite) to deeper feed that was more difficult (particularly RL100-C). The presence of a nugget effect was noted by the Bond Gold Exploration Geochemistry Department, in that using an automated microprobe search routine, they were unable to locate sufficient precious metals to account for the assays of the drill hole intervals examined. This was stated to indicate potential sampling problems at Rosebud. It was possible to produce a gravity concentrate, again suggesting the presence of some coarse gold. Thus, a circuit should include gravity separation to remove coarse gold in the grinding circuit to avoid losses due to insufficient residence time in the leach.

Samples from the area of holes 40, 41, 52 and 55 were readily leached with simple bottle roll techniques, while it was found that samples from RL100-C required the addition of carbon in the leach. In these tests, sparging of 100% oxygen appears to have been used. This technique has been shown to provide economic benefits in some circumstances. Due to power requirements the oxygen is costly to produce, however, and so it ought not to be considered unless a marked processing advantage can be demonstrated.

RL100-C appears to be refractory. However, addition of activated carbon to agitated leaches of RL-100C resulted in a major improvement in gold extraction, from 48.7% to 85.5%. Cyanide consumption also increased from 2.71 lb/t to 4.21 lb/t. McLelland speculates that preg-robbing is occurring by clays that are

present. Whatever the reason, it appears that a CIL circuit should be able to give an acceptable extraction from this material and that occlusion by sulphides is not the problem.

The examination by Brosnahan and Beane highlights the selective leaching of antimony in RL-100C and suggests that cyanide consumption by antimony may be a cause of poor recovery. The test results do show higher cyanide consumption with this material, and antimony has been shown to accumulate in solution. The chemistry by which antimony could react with cyanide is not known; antimony does not seem to have any identified cyanide complexes of any strength. What could be happening is that the antimony oxidizes and leaches as antimonate or thioantimonate (which was the operative chemistry in the Equity Silver leach process). Associated sulphur may come into solution as sulphide or other reduced sulphur species, which would react with cyanide to form thiocyanate. Thus, the dissolution of antimony results in consumption of cyanide indirectly by making sulphur available for thiocyanate formation.

Brosnahan and Beane have indicated that the clays should not be preg-robbers, and so the carbon in a CIL approach may act by minimizing the requirement for active cyanide to keep gold in solution, which would be important in a situation of relatively high cyanide consumption. It might also function by adsorbing some unidentified component that inhibits gold leaching.

Presence of clay was noted both in the mineralogical examinations and in the testing, where it was found necessary to operate at reduced pulp densities for adequate performance. If anything, plant operation would be expected to be more sensitive to clay than lab testing, owing especially to the effect of viscosity on screening in CIL circuits. Viscous pulp in the grinding circuit could adversely affect gravity separation.

The metallurgical results summarized in Table 5-1 are based on tests selected to represent processing results on the various ore types, with approximate weighting by estimated tonnage used to arrive at predicted results. There are insufficient testing and exploration results to give much credence to the calculated results, but they provide the best prediction available at present.

TABLE 5-1

SUMMARY OF METALLURGICAL TESTING RESULTS

	Test:	Round 1	Round 2	Round 4	Round 4	
		Btl 200 m	Btl 200 m	CIL	CIL	
	Hole:	Comp	RL-88C	RL-100C	RL-104C	Weighted
	Date:	5/03/90	15/11/90	10/02/91	10/02/91	Averages
Weighting		50%	7%	30%	13%	100%
NaCN	lb/t	0.44	0.16	4.21	2.71	1.85
CaO	lb/t	6.20	7.50	11.90	11.80	8.73
Au extn %		96.60	87.60	85.50	81.90	90.73
Ag extn %		59.70	74.40	53.40	79.20	61.37

In particular, it is noted that one-half of the tonnage is represented by a bottle roll test that gave a very high extraction and where the tailing assay was low enough that its reliability for precise extraction calculations can be questioned. On the other hand, it would appear at this point that the process will involve a carbon circuit in an agitation leach, which might be expected to provide better results than a bottle roll. Overall,

allowing for further testing developments that may improve results on the more refractory materials, it is considered that extraction should be handled by means of a sensitivity study in the financial analysis, with the levels of 86%, 89% and 92% being examined. These calculations will provide useful benchmarks against which to judge future testing results.

5.3 Summary of Metallurgical Testing

From a review of the data provided, it is concluded that the hypothetical plant design should be a carbon-in-leach circuit with a gravity concentrator installed on the grinding circuit circulating load. The gravity concentrator would probably aim at making a smaller quantity of higher grade concentrate, which could be sold to a smelter or refinery on reasonable terms, or smelted in the site dore furnace. Concentrate weight fractions demonstrated to date would result in a concentrate stream of rather significant proportions.

Although testing has been conducted with oxygen sparging, a requirement for this has not been established, and it is not included in the future metallurgical testwork recommended below. Pulp density for leaching will be set at 25% solids, determined by the lab to be necessary to avoid viscosity problems in agitation, aeration and screening.

CIL has been shown capable of raising the recovery significantly from RL100-C, and it should be incorporated into the design at this point.

5.4 Process Plant Costs

5.4.1 Capital Costs

Two process plant estimates were developed, one for 500 t/d, the other for 1000 t/d. A flowsheet for the 1,000 t/d option is shown in Figure BH8. The 500 t/d flowsheet differed in that a jaw crusher and conventional ball mill were substituted for a SAG mill at this lower tonnage. A SAG mill might be considered for the smaller plant as well, especially given the probable sticky nature of the feed. At this stage in the engineering, detailed balances and sizing calculations were not completed; the 1000 t/d equipment list is patterned on that from a study of a plant of similar size, which was adjusted downwards for the 500 t/d estimate. Equipment lists for the 500 t/d and 1,000 t/d plants are included with the capital cost discussion in Section 9. The purchased equipment costs determined from the equipment lists were factored into a capital cost for each plant.

5.4.2 Operating Costs

The operating costs for the 500 t/d and 1,000 t/d plants are summarized in Section 9. For both plants, the labour force consists of 18 operating personnel, 12 maintenance personnel and 8 supervisors.

Sodium cyanide and lime are used at the rates indicated in Table 5-1. Sodium cyanide is priced at $ 0.70/lb and lime at $80/ton. After discussions with Mike Brittan, it was decided not to include costs for cyanide destruction, assuming that a negative water balance would result and that a sub-aerial tailings deposition approach would permit cyanide contaminated pulp to be discharged to tailings.

Maintenance supplies are allowed for at the rate of 3.5% of purchased equipment. Grinding steel is allowed for at the rate of 0.12 lb/kWh for balls ($0.40/lb) and 0.02 lb/kWh ($1.00/lb) for liners.

Power for the mill was calculated from the connected load using a factor of 0.9 to allow for underloaded drives and installed spares. In the case of the 1,000 t/d plant, the SAG mill seemed oversized. This load was therefore split out and factored by 0.75 rather than 0.9.

5.5 Future Metallurgical Testwork

5.5.1 Proposed Test Program

The test program conducted to date illustrates the importance of continuously characterizing new potential ore as it is encountered in exploration. The first samples indicated a material that was relatively easy to process, whereas the more recent work indicated that more effort would be required to process some of the material. Thus, as exploration proceeds the samples should be subjected to routine amenability testing in the manner that has been pursued up to the present. This would consist initially of bottle roll cyanide leaches. Where this technique is unable to demonstrate high extractions, more elaborate testing will need to be designed to investigate the impact of particular process options such as preoxidation, other types of preprocessing, use of activated carbon and oxygen, and addition of reagents that may be able to facilitate improved performance. If a significant quantity of particularly difficult material is encountered, considerable effort may need to be expended, even though the final result may be to reject the material from consideration as ore reserves.

A process concept should emerge from this approach as the deposit is defined. The next step would be to conduct continuous pilot plant tests on a bulk sample. The objective of pilot testing is to simulate the commercial process as closely as possible in continuous operation. It is therefore necessary to have a well-defined concept before embarking on the program. Concerns to be addressed include the folllowing:

(a) Effect of recycles on process chemistry and ultimate performance at steady-state. Demonstration of design extractions at selected design parameters will be important for the feasibility study.

(b) Effect of scale on test results. For cyanide processes, the uncertainty in this area is fairly low, and adequate simulation can usually be obtained in bench-scale (5 to 10 liter) apparatus.

(c) Effect of variability of ore on process performance. This may necessitate bulk sampling from more than one area.

(d) Production of waste stream samples for environmental testing.

(e) Development of engineering data (filtration rates, settling rates, reagent consumptions, etc.) necessary for the feasibility study and detailed design.

(f) Factors specific to the selected process configuration.

5.5.2 Costs for Metallurgical Testing

The following information was provided by Mike Brittan, based on the testing conducted for Rosebud to date. The cyanide leach and gravity tests include the cost of report preparation.

Test	Cost per Sample
Sample preparation and head assay	$ 75.00
Mechanically agitated cyanide leach	$ 500.00
Gravity concentration	$ 360.00
Carbon in leach	$ 630.00
Bottle roll (estimated)	$ 360.00

The total cost for the concept-definition phase will depend on the degree of variability encountered and the number of holes drilled. Exactly what samples were submitted for testing from each hole would be a joint metallurgical/mining decision, determined by the variability in mineralogy and grade as well as the probable ability to segregate ore types while mining.

The pilot phase costs would again depend on the process complexity and the number of distinct samples that were to be tested. Assuming a 10 day run is necessary to achieve steady state and take replicate samples on a CIL circuit, the cost would be in the order of $40,000.

SECTION 6

TAILINGS DISPOSAL

SECTION 6

TAILINGS DISPOSAL

6.1 Description of Facility

The site chosen for prefeasibility design is the valley immediately to the southwest of the proposed millsite and mine portal. An initial embankment to elevation 4,950 ft would be constructed from material borrowed from within the storage area. The basin would be trimmed and shaped, then lined with a single 60 mil HDPE liner. Tailings deposition would be from the embankment crest with a supernatant pond forming at the northern end of the basin. A floating decant barge would decant supernatant and precipitation run-off from the facility and return it to the mill. A substantial drain would be constructed along the upstream toe of the initial embankment to ensure that the tailings deposit in the vicinity of the embankment is completely drained. This will enable upstream construction of subsequent stages of the embankment. An eventual crest elevation of 4,995 ft will provide sufficient storage for 3,000,000 tons of tailings.

A general arrangement for the facility is shown on Drawing No. 1100/2.001. The storage characteristics of the facility are shown on Figure 6-1 overleaf.

6.2 Design Data

The tailings storage facility has been designed to meet the following criteria:

Tonnage	3,000,000 t
Throughput	350,000 t/a
Tailings Density	90 pcf
Required Total Storage	1,530 acre-ft

BEACON HILL CONSULTANTS

ROSEBUD PROJECT

TAILINGS STORAGE FACILITY

STORAGE CHARACTERISTICS

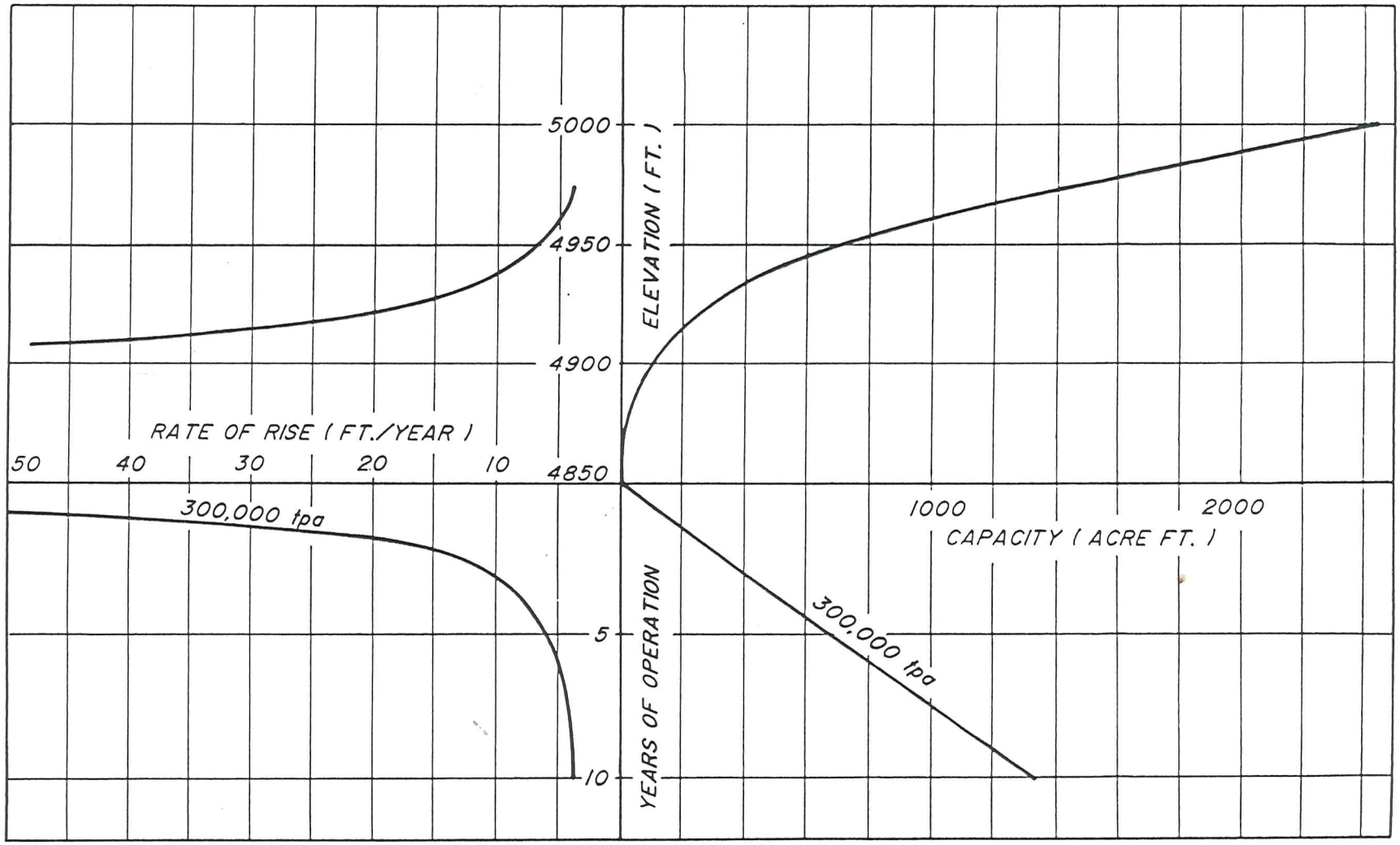

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FIGURE 6-1

SECTION 7

ENVIRONMENTAL

SECTION 7

ENVIRONMENTAL

7.1 Introduction

The estimate of probable costs for regulatory permitting of the Rosebud Project in Pershing County, Nevada, has been completed by review of the following documents by Hallam Knight Piesold Ltd. in conjunction with advice from Ms. Barbara Filas of the Denver Knight Piesold Ltd. offices and in-house knowledge of the permitting process in Nevada:

(a) Rosebud Project Permitting Strategy, prepared by Thomas E. Gast of Environmental Management Services Company (EMS), Fort Collins, Colorado, January 1991.

(b) Water Resources Evaluation and Permitting Database Planning, Rosebud Project, Prepared by Hydro-Search Inc., Reno, Nevada, December 1990.

The review is based primarily on the EMS report, since the Hydro-Search report deals only with the permitting aspects of water development and disposal. The EMS report deals with the permitting requirements for expanded exploration and full development.

7.2 Comments

In essence the approach and strategy presented by EMS is realistic, comprehensive and reasonable. However, the following comments are applicable:

(a) Since the project involves BLM Lands, the Bureau of Land Management will almost certainly be designated the lead agency. Whereas EMS feels that the project can be approved on the basis of an Environmental Evaluation, it is the opinion of Hallam Knight Piesold Ltd. that the proponent should approach project permitting on the basis of a full Environmental Impact Statement (EIS). All new projects in Nevada, regardless of size, are now being forced to an EIS.

It is understood that LAC Minerals (USA), Inc. (Bond Gold Exploration Inc.) has experience in this regard and may be cognizant of the recent trend in Nevada.

(b) The BLM will be required to submit the proponent's application (EIS) to the State Clearing House for comment. Principal agencies such as the Nevada Department of Environmental Protection (NDEP), which administers the reclamation, water and air permits, have their own set of requirements under NEPA. Consequently, it would be advisable to prepare a single comprehensive EIS document covering both the federal and state requirements.

(c) Baseline studies should be expanded to include the installation of on-site meteorological and hydrological monitoring facilities. This information will be essential for preparing a site-specific hydrometeorological scenario for the project area. It has been found in the past that site-specific data are required to supplement the regional data base.

(d) EMS does not provide a contingency for what are commonly termed fatal flaws, such as the following:

- The possibility of encountering and interfering with cultural resources.
- The possibility of encountering rare or endangered species.
- The potential for acid generating waste.

Any or all three of these have the potential to result in an upset in scheduling and budget estimating due to the possible need for extensive additional study. It should be noted that it is now a responsibility of the proponent to complete its own air quality modelling, whereas the state formerly undertook this work. Nevertheless, it is believed that the project is located in an Air Quality Attainment Area, and this should not be a significant hurdle.

(e) EMS does not include a budget estimate for public hearings or any contingency for appeals. In the experience of Knight Hallam Piesold Ltd., the project will most likely be subject to a public hearing, and appeals are a likely outcome of the public review process.

(f) The estimated range of costs prepared by EMS ($241,000 to $416,000) is considered to be fair but high. The same scope of work for similar projects is estimated to range from $150,000 to $350,000. However, since costs for possible additional study, public hearings and appeals are not included, the EMS budget estimate is believed to be fairly representative. The EMS upper estimate, while high, should therefore be used for project feasibility studies.

SECTION 8

PROJECT SCHEDULE

SECTION 8

PROJECT SCHEDULE

Project schedules have been derived for the 500 t/d and 1,000 t/d alternatives and are shown on Figures 8-1 and 8-2 in this section. Year -1 has been shown as an period during which Phase I exploration is completed, with a decision to proceed with the project made at the end of that year. The next phase of the exploration would result in underground development, thus the resultant high cost. It is expected that the decision to proceed with bringing the project to a production stage would be made in Year 2, but since the Phase II exploration includes the access ramp, it is expected that initial processing of the ore is achievable early in Year 3.

The main difference between the 500 t/d and the 1,000 t/d alternatives is that the ongoing capital development to sustain production occurs much earlier in the 1,000 t/d operation.

In both cases, mine life is approximately seven years.

FIGURE 8-1

ROSEBUD PROJECT - DOZER HILL
MINE DEVELOPMENT & PRODUCTION SCHEDULE

500 t/d Existing Reserves

	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
SURFACE EXPLORATION PHASE I										
UNDERGROUND EXPLORATION PROGRAM PHASE II										
- Mobilization/Set Up										
- Ramp & Drifts										
- Diamond Drilling										
- Bulk Sample & Metallurgical Testwork										
PROJECT EVALUATION										
DECISION TO PROCEED			*							
MINE PRE-PRODUCTION DEVELOPMENT Phase										
- Mobilization/Set Up										
- Zone A Access Ramps										
- Zone B Access/Haul Ramp										
- Return Air Raise 4700-Surf										
- Hoisting Shaft 4700-Surf										
- Zone A Ore Passes										
STOPE DEVELOPMENT										
- Zone A										
- Zone B										
ONGOING MINE DEVELOPMENT (Phase II)										
- Ramp Extension to Zone E										
- Return Air Raise 4300-4700 El.										
- Hoisting Shaft 4300-4700 El.										
- Loading Pocket & Shaft Changeover										
- Stope Access Ramps Zones C, D, E										
- Stope Development										
PRODUCTION Tons x ('000)										
- Zones A & B Tons & Grade			12.0 0.290	155.0 0.29	175.0 0.290	175.0 0.29	57.54 0.29			
- Zones C, D & E Tons & Grade							117.46 0.189	175.0 0.189	175.0 0.189	104.032 0.189
- Total Tons & Grade			12.0 0.290	155.0 0.290	175.0 0.290	175.0 0.290	175.0 0.222	175.0 0.189	175.0 0.189	104.032 0.189

FIGURE 8-2

ROSEBUD PROJECT - DOZER HILL
MINE DEVELOPMENT & PRODUCTION SCHEDULE

1,000 t/d Extended Reserves

	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
PHASE I EXPLORATION							
PHASE II EXPLORATION PROGRAM							
- Mobilization/Set Up							
- Ramp & Drifts							
- Diamond Drilling							
- Bulk Sample & Metallurgical Testwork							
PROJECT EVALUATION							
DECISION TO PROCEED			*				
MINE PRE-PRODUCTION DEVELOPMENT Phase I							
- Mobilization/Set Up							
- Zone A Access Ramps							
- Zone B Access/Haul Ramp							
- Return Air Raise 4700-Surf							
- Hoisting Shaft 4700-Surf							
- Zone A Ore Passes							
STOPE DEVELOPMENT							
- Zone A							
- Zone B							
ONGOING MINE DEVELOPMENT (Phase II)							
- Ramp Extension to Zone E							
- Return Air Raise 4300-4700 El.							
- Hoisting Shaft 4300-4700 El.							
- Loading Pocket & Shaft Changeover							
- Stope Access Ramps Zones C, D, E							
- Stope Access Development							
PRODUCTION Tons x ('000)							
- Zones A & B Tons & Grade			15.0 0.290	299.0 0.290	260.54 0.29		
- Zones C, D & E Tons & Grade					89.46 0.189	350.0 0.189	132.0 0.189
- Total Tons & Grade			15.0 0.290	299.0 0.290	350.0 0.264	350.0 0.189	132.0 0.189

SECTION 9

CAPITAL AND OPERATING COSTS

SECTION 9

CAPITAL AND OPERATING COSTS

9.1 Capital Costs

Schedules of capital expenditure over the life of the project are presented on Tables 9-1 and 9-2 for the 500 t/d and 1,000 t/d scenarios, respectively, considered in this study. Details of the capital cost estimate are provided on Tables 9-3 to 9-15. The estimate was based on the assumptions outlined below.

9.1.1 Mining and General

- 500 t/d and 1,000 t/d milling rates.
- Current US dollars, 15% contingency.
- Mine development estimates based on contractor rates and expected performance. Allowances made for rockbolting and screening the entire length of development drifts/ramps, with shotcrete also included in 20% of drift footages. Costs also assume no significant water inflows that might cause delays.
- Exploration and preproduction development costs and schedules based on 3 shifts/day, 7 days/week operation.
- Mine equipment cost estimates are derived for new equipment based on vendor budget prices and in-house records. Allowances have been made for freight and insurance (6%) and Nevada sales taxes (6%).
- No cost has been included for establishing a power line to the property. The cost of the power line plus transformer will be to the account of Sierra Pacific.
- Exploration drilling costs are based on recent budget quotes and estimates from contractors familiar with the site.

9.1.2 Process Plant

Two process plant estimates were developed, one for a 500 t/d milling rate and the other for a 1,000 t/d milling rate. A flowsheet for the 1,000 t/d option is shown in Figure BH8. The 500 t/d flowsheet differs in that a jaw crusher and conventional ball mill are substituted for the SAG mill. At this stage in the engineering, detailed balances and sizing calculations were not completed; the 1,000 t/d equipment list is patterned on a study of a plant of similar size and was adjusted downwards for the 500 t/d estimate. A detailed equipment list for the 500 t/d plant is given in Table 9-11 and for the 1,000 t/d plant in Table 9-12.

The purchased equipment costs were factored into a capital cost for each plant shown in Table 9-10.

9.2 Operating Costs

The operating cost estimate, summarized on Tables 9-16 to 9-20, was based on the following assumptions:

9.2.1 Mining

- Costs for the 500 t/d schedule were based on mining 5 days/week, 2 shifts/day, and producing 700 tons per mine day.

TABLE 9-9

PERMANENT UNDERGROUND FACILITIES - 500 t/d AND 1,000 t/d CASES

Shaft Loading Pocket Installation	$	100,000
Main Pumping System		148,000
Backfill Raise		50,000
Underground Backfill Plant Installation		210,000
Underground Electrical Distribution		225,000
TOTAL	$	733,000

TABLE 9-10

SUMMARY OF MILL CAPITAL COSTS

	Cost ($) 500 t/d	1,000 t/d
Process Plant	$2,311,000	$3,719,000
Total Purchased Equipment	2,311,000	3,719,000
Installation at 25%	577,750	929,750
Total Installed Equipment	$2,888,750	$4,648,750
- Piping @ 15%	433,313	697,313
- Electrical @ 15%	433,313	697,313
- Instrumentation @ 7%	202,213	325,413
- Buildings, Struct. @ 30%	866,625	1,394,625
Total Plant	$ 4,824,213	$7,763,413
Capital Spares @ 5%	122,681	185,950
Start-up and Commissioning @ 2%	74,380	74,380
TOTAL	$5,021,274	$8,023,743

- Costs for 1,000 t/d were based on 5 days/week, 3 shifts/day, and producing 1,400 tons per mine day.

- The mill primary crusher will operate 5 days/week and provide a crushed stockpile from which ore can be fed to the mill 7 days/week.

- Labour rates used were based on an underground mine currently operating in Nevada and are considered typical of the rates expected to be paid at the Rosebud property. A payroll burden of 38% for hourly labour and 35% for salaried labour has been included.

- Allowances for overtime and production bonus have also been made.

- Materials and supply costs were based on selected local Nevada sources and in-house experience and records. The electrical power cost of 5 cents per kWh was provided by Sierra Pacific.

9.2.2 Process Plant

Operating cost estimates for the 500 t/d and the 1,000 t/d plant are summarized in Table 9-16. The labour force for both plants consists of 18 operating personnel, 12 maintenance personnel and 8 supervisors. The hourly rate for mill operators is $15.70, utility operators $14.26 and maintenance trades $17.26. Supervision is based on $40,000/year. These personnel costs include fringe benefits of 38%. The rates are based on a current Nevada operation as noted above. An overtime allowance of 10% is included for mill operators and of 25% for maintenance personnel.

Sodium cyanide and lime are used at the rates indicated in Table 5-1 of Section 5; sodium cyanide is priced at $0.70/lb, lime at $80/ton.

Maintenance supplies are allowed for at the rate of 3.5% of purchased equipment. Grinding steel is allowed for at the rate of 0.12 lb/kWh for balls ($0.40/lb) and 0.02 lb/kWh ($1.00/lb) for liners.

Power for the mill was calculated based on the connected load using a factor of 0.9 to allow for underloaded drives and installed spares. In the case of the 1,000 t/d plant, the SAG mill seemed oversized. This load was therefore split out and factored by 0.75 rather than 0.9.

9.2.3 General

Costs assume that all personnel are housed off site at their own expense. No living or travel expenses have been allowed for in labour rates.

SUML

March 8 1991

TABLE 9–1
Dozer Hill Deposit
500 TPD
Schedule of Capital Expenditures
$(000)s

Description												
Year	–1	1	2	3	4	5	6	7	8	9	10	Total
Initial Capital												
Phase I Exploration	$384.10											
Phase II Exploration		$3,804.30										
Pre–Production Development			$4,708.30									
Mobile Equipment			$4,358.50									
Mine Underground & Surface Plant			$3,219.40									
Process/Tailings/Infrastructure			$9,872.20									
Permitting/Metallurgy/Feasibility Study	$100.00	$635.50	$150.00									
Sub–Total	$484.10	$4,439.80	$22,308.40	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$27,232.30
On–Going Capital												
Mine Development Phase II												
–Ramp to Zone E – 2000 ft.								$994.00				
–RAR & Shaft 4300–4700 El.								$170.00	$400.00			
–Loading Pocket/Changeover									$100.00			
–Access Ramps to Stopes – 2000 ft.									$994.00			
–Stope Development – 1000 ft.									$440.00			
Tailings Construction							$412.50	$707.50	$287.70	$151.80	$155.70	
Sub–Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$412.50	$1,871.50	$2,221.70	$151.80	$155.70	$4,813.20
Total	$484.10	$4,439.80	$22,308.40	$0.00	$0.00	$0.00	$412.50	$1,871.50	$2,221.70	$151.80	$155.70	$32,045.50

Beacon Hill Consultants Ltd.

SUML

March 8 1991

TABLE 9–2
Dozer Hill Deposit
1000 TPD
Schedule of Capital Expenditures
$(000)s

Description												
Year	–1	1	2	3	4	5	6	7	8	9	10	Total
Initial Capital												
Phase I Exploration	$821.10											
Phase II Exploration		$5,191.10										
Pre–Production Development			$5,246.50									
Mobile Equipment			$5,612.00									
Mine Underground & Surface Plant			$3,385.30									
Process/Tailings/Infrastructure			$14,090.80									
Permitting/Metallurgy/Feasibility Study	$100.00	$635.50	$150.00									
Sub–Total	$921.10	$5,826.60	$28,484.60	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$35,232.30
On–Going Capital												
Mine Development Phase II												
–Ramp to Zone E – 2000 ft.								$994.00				
–RAR & Shaft 4300–4700 El.								$170.00	$400.00			
–Loading Pocket/Changeover									$100.00			
–Access Ramps to Stopes – 2000 ft.									$994.00			
–Stope Development – 2000 ft.									$880.00			
Tailings Construction							$412.50	$269.50	$287.70	$151.80	$155.70	
Sub–Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$412.50	$1,433.50	$2,661.70	$151.80	$155.70	$4,815.20
Total	$921.10	$5,826.60	$28,484.60	$0.00	$0.00	$0.00	$412.50	$1,433.50	$2,661.70	$151.80	$155.70	$40,047.50

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TABLE 9-3

SUMMARY OF CAPITAL COSTS

	500 t/d	1,000 t/d
Phase I Exploration Program	$ 334,000	$ 714,000
Phase II Exploration Program		
- Development	$ 2,500,000	$ 3,327,000
- Drilling	808,100	1,187,000
Subtotal	**$ 3,308,100**	**$ 4,514,000**
Pre-production Development	4,094,200	4,562,200
Mobile Equipment	3,790,000	4,880,000
Mine Surface Plant	1,812,000	1,943,000
Underground Permanent Facilities	733,000	733,000
Process Plant	5,149,000	7,864,000
Tailings Disposal	1,530,000	1,825,000
Site Infrastructure	1,125,000	1,450,000
Subtotal	**$ 21,875,300**	$ 28,485,200
Environmental & Permitting	420,000	420,000
Metallurgical Testing	150,000	150,000
Feasibility Studies	200,000	200,000
Engineering Procurement & Construction Management @ 10% of Fixed Plant/Equipment	1,035,000	1,381,500
Subtotal	**$ 23,680,300**	**$ 30,636,700**
15% Contingency	3,552,000	4,595,500
TOTAL	**$ 27,232,300**	$ 35,232,200

TABLE 9-4

EXPLORATION PROGRAM

A.	**500 t/d BASE CASE**		
	Phase I Surface Program		
	- RCR drilling 18,000 ft @ $14/ft	$	252,000
	- Core drilling 2,400 ft @ $34/ft		334,000
	TOTAL PHASE I PROGRAM	$	334,000
	Phase II Underground - Surface Program		
	Underground Development		
	- Mobilization		150,000
	- Portal		50,000
	- Ramp excavation, 13' x 12', 2,260 ft @ $465/ft		1,050,000
	- Drift to 1800 N, 1,500 ft @ $440/ft		660,000
	- Drill stations and crosscuts, 1,000 ft @ $440/ft		440,000
	- Allowance for shotcrete, 20% of ramp & drifts footage @ $160/ft		150,000
	Subtotal	$	2,500,000
	Drilling		
	- Surface RCR, 10,400 ft @ $14/ft	$	145,600
	- Underground core, 26,500 @ $25/ft		662,500
	Subtotal	$	808,100
	TOTAL	$	3,308,100
B.	**1,000 t/d EXTENDED RESERVE CASE**		
	Phase I Surface Program		
	- RCR drilling, 41,500 ft @ $14/ft	$	581,000
	- Core drilling 3,900 ft @ $34/ft		133,000
	TOTAL PHASE I PROGRAM	$	714,000
	Phase II Underground - Surface Program		
	Underground Development		
	- Mobilization	$	150,000
	- Portal		50,000
	- Ramp excavation 13' x 12', 2,260 ft @ $465/ft		1,050,000
	- Drift to 1800 N, 1,500 ft @ $440/ft		660,000
	- Drill stations & crosscuts 1,000 ft @ $440/ft		440,000
	- Additional drifts and crosscuts, 1,750 ft @ $440/ft		770,000
	- Allowance for shotcrete, 20% of ramp and drift footage @ $160/ft		208,000
	Subtotal	$	3,327,000
	Drilling		
	- Surface RCR, 15,300 ft @ $14/ft	$	214,000
	- Underground core, 38,900 ft @ $25/ft		973,000
	Subtotal	$	1,187,000
	TOTAL	$	4,514,000

TABLE 9-5

PRE-PRODUCTION DEVELOPMENT - 500 t/d CASE

Heading	Dev (ft)	Size (ft)	Cost ($/ft)	Total Cost ($)
Mobilization				$ 100,000
Zone A Ramp Excavation	1,900	13 x 12	$ 465	883,500
Zone B Access/Haul Ramp	1,700	13 x 12	465	790,500
RAR & Shaft Access Drifts	350	13 x 12	440	154,000
Mobilization and Set-up Raise Borer for RAR				40,000
RAR Excavation 4,700-Surface	600	8 ft dia.	350	210,000
Shaft Excavation 4,700-Surface	600	8 ft dia.	640	384,000
Equipment Shaft, Guides, etc.			300	180,000
Station and Loading Pocket Excavation				50,000
Timbered Vent Raise 4,700-4,500 Elevation	200	7 x 11	600	120,000
Sump Excavations	30	13 x 12	440	13,200
Zone A & B Ore Passes	400	7 x 9	450	180,000
Zone A Vent Raise/Manway	200	7 x 11	600	120,000
Miscellaneous Development	200	13 x 12	440	88,000
Stope Development, 1st Cut Crosscuts and Drifts in Ore	900	13 x 12	440	396,000
Shotcrete Allowance on 20% of Drifting (excl. stope dev.)				135,000
Ore Pass Chutes				50,000
Miscellaneous Construction				200,000
TOTAL	7,080 ft			$ 4,094,200

TABLE 9-6

PRE-PRODUCTION DEVELOPMENT - 1,000 t/d CASE

Heading	Dev (ft)	Size (ft)	(Cost ($/ft)	Total Cost ($)
Mobilization				$ 100,000
Zone A Ramp Excavation	1,900	13 x 12	$ 465	883,500
Zone B Access/Haul Ramp	1,700	13 x 12	465	790,500
RAR & Shaft Access Drifts	350	13 x 12	440	154,000
Mobilization and Set-up Raise Borer for RAR				40,000
RAR Excavation 4,700-Surface (Alimak)	600	8 ft dia.	350	210,000
Shaft Excavation 4,700-Surface	600	8 ft dia.	640	384,000
Equipment Shaft, Guides, etc.			300	180,000
Station and Loading Pocket Excavation				50,000
Timbered Vent Raise 4,700-4,500 Elevation	200	7 x 11	600	120,000
Sump Excavations	30	13 x 12	440	13,200
Zone A & B Ore Passes	400	7 x 9	450	180,000
Zone A Vent Raise/Manway	200	7 x 11	600	120,000
Miscellaneous Development	250	13 x 12	440	110,000
Stope Development, 1st Cut Crosscuts and Drifts in Ore	1,800	13 x 12	440	792,000
Shotcrete Allowance on 20% of Drifting (Excl. stope dev.)				135,000
Ore Pass Chutes				50,000
Miscellaneous Construction				250,000
TOTAL	8,030 ft			$ 4,562,200

TABLE 9-8

MINE SURFACE PLANT

	Cost ($) 500 t/d	1,000 t/d
Hoist Double Drum - 60 in. LC 40" 150 hp	$ 950,000	$ -
Hoist Double Drum - 60 in. LC 40" 300 hp	-	1,000,000
Headsheaves 60" dia	19,000	19,000
Hoistroom 2,000 sq ft	220,000	220,000
Hoist Ropes 1" F S	12,000	12,000
Skips 4 ton plus counterweight	35,000	-
5 ton plus counterweight	-	41,000
Dump Plates/Scrolls	6,000	6,000
Headframe, incl. Ore/Waste Bins	415,000	415,000
Surface Ventilation Fan		
- 72" dia 250 hp	155,000	-
- 84" dia 600 hp	-	270,000
TOTAL	$ 1,812,000	$ 1,943,000

TABLE 9-7

MOBILE EQUIPMENT

Item	Unit Cost	500 t/d No. Req'd	500 t/d Cost ($)	1,000 t/d No. Req'd	1,000 t/d Cost ($)
3 1/2 cu yd LHD Units	$ 170,000	3	$ 510,000	5	$ 850,000
2 1/2 cu yd LHD Units (Development)	125,000	1	125,000	2	250,000
16 T Haul Trucks	170,000	2	340,000	3	510,000
2 Boom Hydraulic Jumbo	388,000	2	776,000	2	776,000
1 Boom Hydraulic Jumbo	271,000	1	271,000	1	271,000
Slinger Trucks	200,000	3	600,000	4	800,000
Utility Vehicle	110,000	1	110,000	1	110,000
Anfo Truck	110,000	1	110,000	1	110,000
Anfo Loaders	1,500	6	9,000	10	15,000
Grader	80,000	1	80,000	1	80,000
Personnel Vehicles	42,000	1	42,000	2	84,000
Jacklegs/Stopers	2,000	10	20,000	18	36,000
Air Pumps	6,000	4	24,000	8	48,000
Auxiliary Fans	6,000	8	48,000	15	90,000
Diamond Drill	80,000	1	80,000	1	80,000
Surface Haul Truck (30 T)	125,000	1	125,000	1	125,000
Surface Loader	125,000	1	125,000	1	125,000
Surface Pick-ups & Misc. Vehicles		L.S.	50,000	L.S.	75,000
Miscellaneous & Spares, 10% Allowance			345,000		445,000
TOTAL			**$ 3,790,000**		**$ 4,880,000**

TABLE 9-11

EQUIPMENT COSTS FOR 500 t/d PROCESS PLANT

Item No.	No Req.	Description	HP/Unit	Conn. HP	Purchased Cost
1	1	Primary Jaw Crusher 21" x 36"	75	75	$ 51,000
2	1	Shorthead crusher 5100	125	125	198,000
3	1	Vibrating screen 1/2", 4' x 8'	10	10	51,000
4	1	Apron Feeder 30"	15	15	62,000
5	4	Conveyor 18" x 150'	15	60	205,000
6	1	Belt feeder 24"	10	10	10,000
7	2	Cyclone feed pumps 4"	40	80	8,000
8	2	Cyclones 15"	0	0	4,000
9	1	Duplex jig 24" x 36"	5	5	32,000
10	1	Transfer pump 2"	3	3	2,000
11	1	Shaking table	5	5	10,000
12	1	Ball mill 10' x 13'	700	700	609,000
13	1	Trash screen 3" x 6'	3	3	21,000
14	1	Grinding thickener mech.	5	5	72,000
15	1	Grinding thickener tank 73'	0	0	80,000
16	2	Underflow pump 3"	8	15	6,000
17	1	Mill solution tank 17' x 19'	0	0	17,000
18	2	Mill solution pumps 3"	8	15	6,000
19	6	CIL tanks c/w EPAC, 24' x 26'	0	0	203,000
20	6	Agitators	25	150	105,000
21	6	Carbon transfer pumps 2"	3	18	18,000
22	2	Blowers 900 cfm	75	150	29,000
23	1	Safety screen 3' x 6'	3	3	21,000
24	2	Tailings pumps 3"	15	30	6,000
25	2	Reclaim water pumps 2"	5	10	6,000
26	2	CN destruct tanks 9' x 9'	0	0	9,000
27	2	Agitators	3	6	7,000
28	1	Blower 100 cfm	8	8	5,000
29	1	Acid wash tank, frp 5' x 13'	0	0	4,000
30	1	Pressure strip vessel, ss, 4' x 10'	0	0	10,000
31	1	Heat exchanger	0	0	5,000
32	1	Direct fired soln. heater	0	0	5,000
33	1	Carbon reagent kiln	250	250	140,000
34	1	Quench tank 6' x 6'	0	0	4,000
35	1	Carbon screen 4' x 4'	5	5	15,000
36	1	Reagent carbon tank 6' x 6'	0	0	4,000
37	1	Barren eluate tank 12' x 14'	0	0	9,000
38	1	Agitator	3	3	4,000
39	1	Loaded eluate tank 12' x 14'	0	0	9,000
40	2	Transfer pumps 1"	3	6	3,000
41	1	Electrowinning cell c/w rect., 125 a	4	4	8,000
42	1	Acid treat tank 3' x 4'	0	0	1,000
43	1	Press feed pump 1" ss	3	3	3,000
44	1	Filter press 1' x 1' x 10 plate	0	0	6,000
45	1	Mercury retort	0	0	15,000
46	1	Smelting furnace, 125 kW	170	170	123,000
47	1	Fume scrubber c/w fan	10	10	10,000
48	1	Carbon transfer water system	25	25	15,000
49	1	Reagent prep area	20	20	21,000
50	2	Sump pumps 3"	10	20	8,000
51	1	Lime silo c/w screw conv., 30 t	3	3	36,000
TOTAL				2,019 HP	$ 2,311,000

TABLE 9-12

EQUIPMENT COSTS FOR 1,000 t/d PROCESS PLANT

Item No.	No Req.	Description	HP/Unit	Conn. HP	Purchased Cost
1	1	Primary Jaw Crusher 25" x 40"	100	100	$ 142,000
2	1	Feeder 42"	25	25	76,000
3	2	Conveyor 24" x 150'	25	50	101,000
4	1	Feeder 30"	15	15	61,000
5	1	SAG mill 18' x 6'	700	700	903,000
6	2	Cyclone feed pumps 6"	30	60	11,000
7	2	Primary Cyclones 20"	0	0	8,000
8	2	Cyclone feed pumps 6"	40	80	11,000
9	1	Secondary cyclopac 4" x 15"	0	0	2,000
10	1	Duplex jig 48" x 72"	10	10	51,000
11	1	Transfer pump 2"	3	3	2,000
12	1	Shaking Table	5	5	15,000
13	1	Secondary ball mill 10' x 13'	700	700	600,000
14	1	Trash screen 4' x 8'	5	5	35,000
15	1	Grinding thickener mech.	5	5	86,000
16	1	Grinding thickener 101'	0	0	134,000
17	2	Underflow pump 4"	15	30	8,000
18	1	Mill solution tank 22' x 24'	0	0	28,000
19	2	Mill solution pumps 4"	15	30	4,000
20	6	CIL tanks c/w EPAC, 30' x 32'	0	0	449,000
21	6	Agitators	50	300	182,000
22	6	Carbon transfer pumps 3"	5	30	30,000
23	2	Blowers 1300 cfm	125	250	40,000
24	1	Safety screen 4' x 8'	5	5	35,000
25	2	Tailings pumps 4"	25	50	4,000
26	2	Reclaim water pumps 3"	10	20	10,000
27	2	CN destruct tanks 12' x 12'	0	0	16,000
28	2	Agitators	3	6	7,000
29	1	Blower 200 cfm	5	10	8,000
30	1	Acid wash tank, frp 5' x 13'	15	15	7,000
31	1	Pressure strip vessel, ss, 5' x 13'	0	0	4,000
32	1	Heat exchanger	0	0	10,000
33	1	Direct fired soln heater	0	0	5,000
34	1	Carbon reagent kiln	0	0	5,000
35	1	Quench tank 6' x 6'	0	0	4,000
36	1	Carbon screen 4' x 4'	500	500	227,000
37	1	Reagent carbon tank 6' x 6'	0	0	4,000
38	1	Barren eluate tank 14' x 16'	5	5	15,000
39	1	Agitator	0	0	4,000
40	1	Loaded eluate tank 14' x 16'	0	0	12,000
41	2	Transfer pumps 1"	3	6	3,000
42	1	Electrowinning cell c/w rect., 250 a	7	7	14,000
43	1	Acid treat tank 3' x 4'	0	0	1,000
44	1	Press feed pump 1" ss	3	3	3,000
45	1	Filter press 1' x 1' x 10 plate	0	0	6,000
46	1	Mercury retort	0	0	15,000
47	1	Smelting furnace, 125 kW	170	170	123,000
48	1	Fume scrubber c/w fan	10	10	10,000
49	1	Carbon transfer water system	25	25	15,000
50	1	Reagent prep area	20	20	21,000
51	2	Sump pumps 3"	10	20	8,000
52	1	Lime silo c/w screw conv., 30 t	3	3	36,000
53	1	Liner machine	0	0	103,000
TOTAL				3,270 HP	$ 3,719,000

TABLE 9-13

TAILINGS DISPOSAL CAPITAL COST
500 t/d CASE

Item	Quantity	Unit	Unit Rates ($)	Cost ($)
INITIAL CAPITAL				
Stage 1 - Pre-Production				
Embankment Fill	250,000	cu yd	$ 3.50	$ 875,000
Basin Liner	800,000	sq ft	$ 0.60	480,000
Drainage System	L.S.			50,000
Tailings Pipeline	L.S.			75,000
Reclaim Pipeline	L.S.			50,000
TOTAL				$1,530,000
ON-GOING CAPITAL				
Stage 2 - Production Year 3				
Embankment Fill	100,000	cu yd	$ 3.50	$ 350,000
Basin Liner	500,000	sq ft	$ 0.60	300,000
Tailings Pipework	L.S.			20,000
Engineering and Construction Supervision	L.S.			37,500
TOTAL				$ 707,500

Note: Engineering and construction supervision for Stage I is included in Capital Cost Summary tables.

TABLE 9-14

TAILINGS DISPOSAL CAPITAL COST
1,000 t/d CASE

Item	Quantity	Unit	Unit Rates ($)	Cost ($)
INITIAL CAPITAL				
Stage 1 - Pre-Production				
Embankment Fill	300,000	cu yd	$ 3.50	$1,050,000
Basin Liner	1,000,000	sq ft	$ 0.60	600,000
Drainage System	L.S.			50,000
Tailings Pipeline	L.S.			75,000
Reclaim Pipeline	L.S.			50,000
TOTAL				$1,825,000
ON-GOING CAPITAL				
Stage 2				
Embankment Fill	50,000	cu yd	$ 3.50	$ 175,000
Basin Liner	300,000	sq ft	$ 0.60	180,000
Tailings Pipework	L.S.			20,000
Engineering and Construction Supervision	L.S.			37,500
TOTAL				$ 412,500
Stage 3				
Embankment Fill	30,000	cu yd	$ 3.50	$ 105,000
Basin Liner	200,000	sq ft	$ 0.60	120,000
Tailings Pipework	L.S.			20,000
Engineering and Construction Supervision	L.S.			24,500
TOTAL				$ 269,500

TABLE 9-14 (continued)

TAILINGS DISPOSAL CAPITAL COST
1,000 t/d CASE

Item	Quantity	Unit	Unit Rates ($)	Cost ($)
INITIAL CAPITAL				
Stage 4				
Embankment Fill	33,000	cu yd	$ 3.50	$ 115,500
Basin Liner	210,000	sq ft	$ 0.60	126,000
Tailings Pipework	L.S.			20,000
Engineering and Construction Supervision	L.S.			26,150
TOTAL				$ 287,650
Stage 5				
Embankment Fill	14,000	cu yd	$ 3.50	$ 49,000
Basin Liner	115,000	sq ft	$ 0.60	69,000
Tailings Pipework	L.S.			20,000
Engineering and Construction Supervision	L.S.			13,800
TOTAL				$ 151,800
Stage 6				
Embankment Fill	15,000	cu yd	$ 3.50	$ 52,500
Basin Liner	115,000	sq ft	$ 0.60	69,000
Tailings Pipework	L.S.			20,000
Engineering and Construction Supervision	L.S.			14,150
TOTAL				$ 155,650
GRAND TOTAL				$3,284,600

Note: Engineering and construction supervision for Stage I is included in Capital Cost Summary tables.

TABLE 9-15

SITE INFRASTRUCTURE COSTS

		Cost ($)	
		500 t/d	1,000 t/d
1.	Site Development, Roads, etc.	$ 200,000	$ 250,000
2.	Water Supply, Sewage Treatment	250,000	300,000
3.	Power Supply - By Sierra Pacific	N/C	N/C
4.	Ancillary Buildings, Shop, Offices, etc.		
	- 6,000 sq ft incl. equipment	675,000	
	- 8,000 sq ft incl. equipment		900,000
TOTAL		$1,125,000	$1,450,000

TABLE 9-16

OPERATING COST SUMMARY

		Cost $/Ton	
		500 t/d	1,000 t/d
MINING			
-	Hourly Labour	$ 18.05	$ 16.26
-	Staff Labour	3.54	2.20
-	Equipment Operation/Repair	6.37	6.26
-	Stoping & Development Supplies	11.30	11.30
-	Fill Material	3.74	3.74
-	General Mine Supplies	2.20	1.53
-	Power	1.43	1.26
Subtotal		$ 46.63	$ 42.55
MILLING			
-	Hourly Labour	$ 9.95	$ 4.98
-	Supervision	2.52	1.26
-	Reagents	1.64	1.64
-	Operating/Maintenance Supplies	3.07	2.40
-	Power	3.26	2.45
Subtotal		$ 20.44	$ 12.73
ADMINISTRATION		2.78	1.59
TOTAL		$ 69.85	$ 56.87

TABLE 9-17

MINE OPERATING COST DETAILS - 500 t/d CASE

PRODUCTION RATE - 700 t/d
5 DAYS/WEEK, 2 SHIFTS/DAY

1. HOURLY LABOUR

Classification	No. Req'd	Rate/Manday ($)	Cost/Day ($)
(a) Production			
Miners/Scooptram Operators	16	$ 240.56	$ 3,848.96
Truck Drivers	3	240.56	721.68
Fill Truck Operators	6	240.56	1,443.36
Subtotal	25		$ 6,014.00
(b) Operating Development			
Miners	2	$ 240.56	$ 481.12
Subtotal	2		$ 481.12
(c) Mine General			
Hoistmen	2	$ 217.36	$ 434.72
Skip Tenders	2	182.72	365.44
Drymen	2	129.84	259.68
Diamond Drillers	2	197.04	394.08
Timbermen/Pipefitters	2	182.72	365.44
Supply Men	2	182.72	365.44
Surface Truck Driver	2	182.72	365.44
Loader Operator (Surface)	2	182.72	365.44
Subtotal	16		$ 2,915.68
(d) Maintenance			
Underground Mechanics	8	$ 217.36	$ 1,738.88
Electricians	2	217.36	434.72
Bit Sharpener	1	182.72	182.72
Drill Doctors	2	217.36	434.72
Surface Mechanics	2	217.36	434.72
Subtotal	15		$ 3,225.76
TOTAL	56		$12,636.56
		Cost/Ton	$18.05

TABLE 9-17 (continued)

MINE OPERATING COST DETAILS - 500 t/d CASE

2. SALARIED LABOUR

	No. Req'd	Annual Salary ($)	Cost/Yr ($)
Supervision			
- Mine Manager	1	$ 65,000	$ 65,000
- Shift Bosses	3	42,000	126,000
- Maintenance Foreman	1		42,000
	5		$ 233,000
Engineering/Geology			
- Mine Engineer	1	$ 45,000	$ 45,000
- Surveyor	1	29,000	29,000
- Survey Helper	1	24,000	25,000
- Draftsman/Technician	1	25,000	25,000
- Mine Geologist	1	45,000	45,000
- Grade Control Technician	1	29,000	29,000
- Clerical	1		20,000
	7		$ 216,000
Subtotal	12		$ 449,000
Benefits @ 35%			171,000
TOTAL			$ 620,000
		Cost/Ton	$3.54

3. EQUIPMENT OPERATION/REPAIR

	Operating Cost/Hr	Operating Hrs/Day	Cost/Day
3 1/2 cu yd Scooptram	$ 37.00	30	$1,110.00
16 ton Truck	20.00	19	380.00
Fill Truck	30.00	36	1,080.00
Utility Vehicles	10.00	10	100.00
2 1/2 cu yd Scooptram	25.00	10	250.00
Production Drill Jumbo	12.50	25	310.00
- Drills	$0.20/ft	3,500 ft	700.00
Jacklegs/Stopers	$0.10/ft	400 ft	40.00
Personnel Vehicles	8.00	10	80.00
Anfo Truck	10.00	8	80.00
Development			
- Drill Jumbo	10.00	12	120.00
- Drills	$0.20/ft	800 ft	160.00
Fans	0.50	100	50.00
TOTAL			$4,460.00
		Cost/Ton	$6.37

TABLE 9-17 (continued)

MINE OPERATING COST DETAILS - 500 t/d CASE

4. STOPING & DEVELOPMENT SUPPLIES

Typical 13' x 12' stope production room excavation and development heading.

		Cost/ft Advance
Drill Bits/Steel		$ 29.71
Explosives		28.75
Ventilation Duct		12.00
Rockbolts		12.00
Service Lines		10.82
Hoses, Tools		6.00
Misc. Drift Materials		6.59
TOTAL		$ 105.47
Advance per day - Production rooms	65 ft	
- Development	10 ft	
	75 ft	
	Cost/Day	$ 7,910.25
	Cost/Ton	$ 11.30

5. FILL MATERIAL

Backfill preparation from development waste and mining of local gravel deposits - $2.00/yd equivalent to $1.06/ton of ore mined. Cement cost, based on a 20:1 fill:cement ratio, is $3.75/ton fill, or $2.68/ton of ore mined.

Cost/ton $ 3.74

6. GENERAL MINE SUPPLIES

		Cost/Yr ($)
Hoisting	- Hoist Maintenance	$ 15,000
	- Rope Replacement	5,000
	- Conveyances, etc.	5,000
	- Loading Pocket	5,000
	- Shaft General	10,000
Subtotal		$ 40,000
Headframe, Bins, etc.		$ 10,000
General Mine Operating Supplies		80,000
Drift Maintenance		50,000
Ventilation: Bulkheads & Fans		15,000
Backfill Plant Operating/Maintenance		20,000
Pumping		10,000
Diamond Drilling 70 ft/day @ $8.00/ft		140,000
Surface Mobile Equipment Operation		15,000
Compressors		5,000
TOTAL		$385,000
	Cost/Ton	$2.20

TABLE 9-17 (continued)

MINE OPERATING COST DETAILS - 500 t/d CASE

7. MINE POWER

	Connected hp	Demand	Hrs Open Per Month	kWh Per Month
Hoist	150	0.75	380	32,000
Compressors	150	0.70	380	30,000
Surface Fan	350	1.0	720	180,000
Diamond Drill	50	0.8	140	4,200
U/G Vent Fans	150	1.0	720	80,000
Main Pumps	100	0.9	360	24,000
Misc. Pumps	50	0.9	360	12,000
Mine Misc.	100	0.9	500	34,000
Surface Misc.	100	1.0	300	22,000
TOTAL	1,200			418,000
			Cost/kWh	$ 0.05
			Cost/Month	$ 20,910
			Cost/Ton	$ 1.43

8. ADMINISTRATION COSTS

LABOUR

- Secretary/Receptionist	1	$ 20,000
- Warehouse/Purchasing	1	35,000
- Safety/Security Supervisor	1	40,000
- Security	4	80,000
- Payroll/Accounting	1	30,000
	8	$ 205,000
- Fringe Benefits @ 35%		72,000
Subtotal		$ 277,000

EXPENSE

- Communication	$ 25,000
- Permits, Fees, etc.	30,000
- Insurance	100,000
- Testing Services	20,000
- Safety Supplies/Mine Rescue	25,000
- Travel Expenses	10,000
Subtotal	$ 277,000
TOTAL	$ 487,000
Cost/Ton	$2.78

TABLE 9-18

MINE OPERATING COST DETAILS - 1,000 t/d CASE

PRODUCTION RATE - 1,400 t/d
5 DAYS/WEEK, 3 SHIFTS/DAY

1. HOURLY LABOUR

Classification	No. Req'd	Rate/Manday ($)	Cost/Day ($)
(a) Production			
Miners/Scooptram Operators	32	$ 240.56	$ 7,697.92
Truck Drivers	6	240.56	1,443.36
Fill Truck Operators	12	240.56	2,886.72
Subtotal	50		$12,028.00
(b) Operating Development			
Miners	4	$ 240.56	$ 962.24
Subtotal	4		$ 962.24
(c) Mine General			
Hoistmen	3	$ 217.36	$ 652.08
Skip Tenders	3	182.72	548.16
Drymen	2	129.84	259.68
Diamond Drillers	4	197.04	788.16
Timbermen/Pipefitters	4	182.72	730.88
Supply Men	4	182.72	730.88
Surface Truck Driver	3	182.72	548.16
Loader Operator (Surface)	3	182.72	548.16
Subtotal	26		$ 4,806.16
(d) Maintenance			
Underground Mechanics	14	$ 217.36	$ 3,043.04
Electricians	3	217.36	652.08
Bit Sharpener	1	182.72	182.72
Drill Doctors	2	217.36	434.72
Surface Mechanics	3	217.36	652.08
Subtotal	23		$ 4,964.64
TOTAL	103		$22,761.04
		Cost/Ton	$16.26

TABLE 9-18 (continued)

MINE OPERATING COST DETAILS - 1,000 t/d CASE

2. SALARIED LABOUR

	No. Req'd	Annual Salary ($)	Cost/Yr ($)
Supervision			
- Mine Manager	1	$ 65,000	$ 65,000
- Shift Bosses	4	42,000	168,000
- Maintenance Foreman	1	42,000	42,000
	6		$ 275,000
Engineering/Geology			
- Mine Engineer	1	$ 45,000	$ 45,000
- Planning/Layout	1	36,000	36,000
- Surveyor	1	29,000	29,000
- Survey Helper	1	24,000	25,000
- Draftsman/Technician	1	25,000	25,000
- Mine Geologist	1	45,000	45,000
- Grade Control Technician	2	29,000	58,000
- Clerical	1	20,000	20,000
	9		$ 283,000
Subtotal	15		$ 558,000
Benefits @ 35%			212,000
TOTAL			$ 770,000
		Cost/Ton	$2.20

3. EQUIPMENT OPERATION/REPAIR

	Operating Cost/Hr	Operating Hrs/Day	Cost/Day
3 1/2 cu yd Scooptram	$ 37.00	60	$2,220.00
16 ton Truck	20.00	38	760.00
Fill Truck	30.00	72	2,160.00
Utility Vehicles	10.00	15	150.00
2 1/2 cu yd Scooptram	25.00	20	500.00
Production Drill Jumbo	12.50	50	620.00
- Drills	$0.20/ft	7,000 ft	1,400.00
Jacklegs/Stopers	$0.10/ft	800 ft	80.00
Personnel Vehicles	8.00	15	120.00
Anfo Truck	10.00	12	120.00
Development			
- Drill Jumbo	10.00	24	240.00
- Drills	$0.20/ft	1,600 ft	320.00
Fans	0.50	150	75.00
TOTAL			$8,765.00
		Cost/Ton	$6.26

TABLE 9-18 (continued)

MINE OPERATING COST DETAILS - 1,000 t/d CASE

4. STOPING & DEVELOPMENT SUPPLIES

Typical 13' x 12' stope production room excavation and development heading.

	Cost/ft Advance
Drill Bits/Steel	$ 29.71
Explosives	28.75
Ventilation Duct	12.00
Rockbolts	12.00
Service Lines	10.82
Hoses, Tools	6.00
Misc. Drift Materials	6.59
TOTAL	$ 105.47

Advance per day	- Production rooms	130 ft	
	- Development	20 ft	
		150 ft	
		Cost/Day	$ 15,820.50
		Cost/Ton	$ 11.30

5. FILL MATERIAL

Backfill preparation from development waste and mining of local gravel deposits - $2.00/yd equivalent to $1.06/ton of ore mined. Cement cost, based on a 20:1 fill:cement ratio, is $3.75/ton fill, or $2.68/ton of ore mined.

Cost/ton $ 3.74

6. GENERAL MINE SUPPLIES

		Cost/Yr ($)
Hoisting	- Hoist Maintenance	$ 20,000
	- Rope Replacement	5,000
	- Conveyances, etc.	5,000
	- Loading Pocket	7,000
	- Shaft General	10,000
Subtotal		$ 47,000
Headframe, Bins, etc.		$ 10,000
General Mine Operating Supplies		120,000
Drift Maintenance		75,000
Ventilation: Bulkheads & Fans		15,000
Backfill Plant Operating/Maintenance		30,000
Pumping		10,000
Diamond Drilling 70 ft/day @ $8.00/ft		200,000
Surface Mobile Equipment Operation		22,000
Compressors		7,000
TOTAL		$536,000
	Cost/Ton	$1.53

TABLE 9-18 (continued)

MINE OPERATING COST DETAILS - 1,000 t/d CASE

7. MINE POWER

	Connected hp	Demand	Hrs Open Per Month	kWh Per Month
Hoist	300	0.75	380	64,000
Compressors	250	0.70	380	50,000
Surface Fan	700	1.0	720	360,000
Diamond Drill	50	0.8	140	8,400
U/G Vent Fans	250	1.0	720	133,000
Main Pumps	100	0.9	360	24,000
Misc. Pumps	100	0.9	360	24,000
Mine Misc.	150	0.9	500	51,000
Surface Misc.	100	1.0	300	22,000
TOTAL	1,200			736,400
			Cost/kWh	$ 0.05
			Cost/Month	$ 36,820
			Cost/Ton	$ 1.26

8. ADMINISTRATION COSTS

LABOUR

- Secretary/Receptionist	1	$ 20,000
- Warehouse/Purchasing	1	40,000
- Safety/Security Supervisor	1	40,000
- Security	4	80,000
- Payroll/Accounting	1	30,000
	8	$ 205,000
- Fringe Benefits @ 35%		72,000
Subtotal		$ 277,000

EXPENSE

- Communication	$ 25,000
- Permits, Fees, etc.	30,000
- Insurance	150,000
- Testing Services	25,000
- Safety Supplies/Mine Rescue	35,000
- Travel Expenses	15,000
Subtotal	$ 280,000
TOTAL	$ 557,000
Cost/Ton	$1.59

TABLE 9-19

UNDERGROUND MANPOWER SUMMARY

	500 t/d	1,000 t/d
Production Labour		
- Stoping, Mucking & Hauling	19	38
- Filling	6	12
Subtotal	**25**	**50**
Operating Development	2	4
Mine General		
- Hoisting	4	6
- Supply & Services	4	8
- Diamond Drillers	2	4
- Surface	6	8
Subtotal	**16**	**26**
Maintenance	15	23
Supervision	5	6
Engineering/Geology	7	9
TOTAL	**70**	**118**
Overall Tons/Manshift	10.0	11.86

TABLE 9–20
LABOUR RATES

Salaries

Description	Base Rate/y	Fringes	Total
Mine Manager	$65,000.00	$22,750.00	$87,750.00
Shift Boss	$42,000.00	$14,700.00	$56,700.00
Sr. Mine Eng.	$55,000.00	$19,250.00	$74,250.00
Mine Eng.	$45,000.00	$15,750.00	$60,750.00
Jr.Mine Eng.	$36,000.00	$12,600.00	$48,600.00
Surveyor	$29,000.00	$10,150.00	$39,150.00
Helper	$24,000.00	$8,400.00	$32,400.00

Wages

Description	Base Rate/hr	Bonus/hr	Overtime	Fringes	Cost/Hr	Rate/y
Miner	$15.75	$5.00	$1.04	$8.28	$30.07	$59,892.97
Scoop Op	$15.75	$5.00	$1.04	$8.28	$30.07	$59,892.97
Truck Op	$15.75	$5.00	$1.04	$8.28	$30.07	$59,892.97
Utility	$14.26	$1.50	$0.79	$6.29	$22.84	$45,489.79
Labourer	$13.00	$1.50	$0.73	$5.79	$21.01	$41,852.92
Mech/Elec	$17.25	$1.50	$0.94	$7.48	$27.17	$54,120.15
Hoistman	$17.25	$1.50	$0.94	$7.48	$27.17	$54,120.15
Helper	$13.00	$1.50	$0.73	$5.79	$21.01	$41,852.92
Surface Labourer	$11.20		$0.56	$4.47	$16.23	$32,327.77
Diamond Driller	$15.00	$2.00	$0.85	$6.78	$24.63	$49,068.94

SECTION 10

FINANCIAL ANALYSIS

SECTION 10

FINANCIAL ANALYSIS

10.1 Introduction

The Dozer Hill deposit of the Rosebud Project has been evaluated using the discounted cashflow method whereby projected cash outflows such as operating and capital costs, royalties and taxes are subtracted from annual revenues, with the differences discounted back to the date of valuation. In this study two production rates have been evaluated, with sensitivities on grade, gold price, capital cost and operating cost being analyzed. The purpose of the analysis was to determine if the estimated mineable reserve could sustain a viable mining operation and, if not, to determine the amount of reserves needed for the operation to be viable.

The results from this study will also provide the basis for establishing exploration objectives for the property, enabling in turn a decision on the next phase of the exploration program.

The components of the financial analysis are reviewed below, followed by a summary of the results and detailed cashflow statements.

10.2 Production Schedule and Reserves

The project has been evaluated at two production levels, 500 t/d and 1,000 t/d. The 500 t/d milling rate is based on probable reserves estimated at 1,146,000 tons with 0.24 oz Au/t and 2.0 oz Ag/t. This reserve represents a seven year production life. The 1,000 t/d case is based on doubling these reserves to 2,292,000 tons at the same grade. In order to achieve this reserve base, the possible reserves will require firming and additional reserves will have to be outlined. The 1,000 t/d case has also a seven year mine life.

It became evident in the early stages of the analysis and based on the mining scenario established in this report that the 500 t/d case was not a viable operation; thus greater emphasis was placed on the analysis of the 1,000 t/d case.

10.3 Gold Price

The 500 t/d case was evaluated using gold prices ranging from $375/oz to $475/oz in $50 increments. Beacon Hill Consultants Ltd. considered that little was to be gained by using any lower prices. The 1,000 t/d case was analyzed on prices ranging from $325/oz to $475/oz.

10.4 Capital Cost

The initial capital costs for the production cases are as follows:

		500 t/d $(000)s		1,000 t/d $(000)s
Phase I Exploration	$	$384.10	$	821.10
Phase II Exploration		3,804.30		5191.10
Pre-Production Development		4,708.30		5,246.50
Mobile Equipment		4,358.50		5,612.00
Mine Underground and Surface Plant		3,219.40		3,385.30
Process/Tailings/ Infrastructure		9,872.20		14,090.80
Permitting/Metallurgy/ Feasibility Study		885.50		885.50
Total	$	27,232.30	$	35,232.30

Working capital equivalent to two months of operating costs was included in the first year of production.

Ongoing capital costs of $3,805,500 for the 500 t/d case and of $4,815,200 for the 1,000 t/d case were included to allow for ongoing development and tailings construction.

10.5 Operating Cost

The operating costs used in the analysis are as follows:

		500 t/d $(000)s		1,000 t/d $(000)s
Mining	$	46.63	$	$42.55
Milling		20.44		12.73
Administration		2.78		1.59
Total	$	$69.85	$	$56.87

10.6 Taxes

10.6.1 Federal Taxes

The calculation of Federal Tax has been based on the greater of the Federal Income Tax and the Alternative Minimum Tax, which incorporates the depreciation rates shown below:

Year	Federal Income Tax	Alternative Minimum Tax Depreciation Rate
1	14.29%	7.5%
2	24.49%	13.88%
3	17.49%	11.79%
4	12.49%	10.02%
5	8.93%	8.74%
6	8.93%	8.74%
7	8.93%	8.74%
8	4.45%	8.74%
9	0	8.74%
10	0	8.74%
11	0	4.37%

Amortization of exploration and development expenditures have been based on the following rates:

Year	Rate
1	70.0%
2	4.5%
3	6.6%
4	6.3%
5	6.3%
6	6.3%

Depletion has been based on Percentage Depletion of 15% of the gross income to a maximum of the taxable income.

The following tax rates are used:

Federal Income Tax	34%
Alternative Minimum Tax	20%

10.6.2 State Taxes

State taxes have been based on a Net Proceeds Tax, which is calculated on gross revenues less direct mining cost, transportation and marketing cost, milling/refining cost, production royalties and depreciation, and a 5% tax rate if the foregoing is greater than $6.0 million. If less than $6.0 million net proceeds, then the rate is graduated from 2.5% to 5%. In this study 5% and 3.5% have been used, respectively.

SUMLAC

March 8 1991

Table 10–1
Rosebud Project
Dozer Hill
500 TPD
Financial Analysis
Summary

Case	IRR %	Gold Price $	Recovery %	CapitalCost $(000)s	Op. Cost $	NPV $(000)s	Discounted NPV $(000)s 5%	10%	15%	20%	25%	Comments
5–1	–14.48%	$375.00	92.00%	$27,232.30	$69.85	($12,502.10)	($13,446.92)	($13,769.32)	($13,731.97)	($13,487.26)	($13,125.63)	Maximum expected recovery
5–2	–18.14%	$375.00	89.00%	$27,232.30	$69.85	($15,129.28)	($15,443.17)	($15,318.24)	($14,956.34)	($14,471.20)	($13,928.08)	Base Case
5–3	–22.04%	$375.00	86.00%	$27,232.30	$69.85	($17,758.69)	($17,444.41)	($16,873.71)	($16,188.02)	($15,462.72)	($14,738.06)	Minimum expected recovery
5–4	–7.67%	$375.00	89.00%	$27,232.30	$69.85	($7,028.22)	($9,264.38)	($10,507.23)	($11,141.24)	($11,396.45)	($11,414.08)	Grade increased by 10%
5–5	–4.35%	$425.00	89.00%	$27,232.30	$69.85	($4,083.44)	($6,997.67)	($8,726.94)	($9,717.99)	($10,240.74)	($10,462.57)	Gold Price $425/oz
5–6	6.23%	$475.00	89.00%	$27,232.30	$69.85	$6,391.28	$1,001.22	($2,491.01)	($4,766.94)	($6,245.85)	($7,192.74)	Gold Price $475/oz
5–7	–8.62%	$375.00	89.00%	$27,232.30	$62.87	($7,952.38)	($10,021.58)	($11,134.82)	($11,666.65)	($11,840.23)	($11,791.88)	Operating Cost reduced by 10%
5–8	–16.56%	$375.00	89.00%	$24,509.07	$69.85	($12,436.47)	($12,962.78)	($13,031.14)	($12,842.41)	($12,511.51)	($12,105.64)	Capital Cost reduced by 10%
5–9	6.38%	$375.00	92.00%	$24,509.07	$62.87	$5,907.99	$1,015.50	($2,156.03)	($4,224.45)	($5,569.93)	($6,432.74)	Gold Price $375/oz, Gold Grade increased by 10%, Operating and Capital Costs decreased by 10%, Met. Recovery 92%.
5–10	16.67%	$425.00	92.00%	$24,509.07	$62.87	$16,496.41	$9,154.98	$4,226.99	$869.77	($1,440.85)	($3,039.73)	Optimistic Case Gold Price $425/oz, Gold Grade increased by 10%, Operating and Capital Costs decreased by 10%, Met. Recovery 92%.
5–11	12.42%	$375.00	92.00%	$24,509.07	$55.88	$12,073.92	$5,720.51	$1,508.67	($1,317.67)	($3,226.84)	($4,516.74)	Gold Price $375/oz, Gold Grade increased by 10%, Operating Costs decreased by 20% and Capital Costs decreased by 10%, Met. Recovery 92%.

Beacon Hill Consultants Ltd

SUMLAC

March 8 1991

Table 10–2
Rosebud Project
Dozer Hill
1000 TPD
Financial Analysis
Summary

Case	IRR %	Gold Price $	Recovery %	CapitalCost $(000)s	Op. Cost $	NPV $(000)s	Discounted NPV $(000)s 5%	10%	15%	20%	25%	Comments
1	15.16%	$375.00	92.00%	$35,232.30	$56.87	$21,231.71	$11,307.44	$4,649.20	$117.01	($2,998.01)	($5,148.81)	Maximum expected recovery
2	12.06%	$375.00	89.00%	$35,232.30	$56.87	$16,524.05	$7,693.29	$1,818.20	($2,140.12)	($4,825.93)	($6,649.75)	Base Case
3	8.71%	$375.00	86.00%	$35,232.30	$56.87	$11,617.23	$3,940.14	($1,112.13)	($4,469.80)	($6,707.90)	($8,191.70)	Minimum expected recovery
4	20.89%	$375.00	89.00%	$35,232.30	$56.87	$30,357.96	$18,326.56	$10,155.93	$4,513.35	$566.39	($2,219.16)	Grade increased by 10%
5	1.08%	$375.00	89.00%	$35,232.30	$56.87	$1,336.85	($3,890.15)	($7,201.26)	($9,292.53)	($10,590.11)	($11,362.17)	Grade decreased by 10%
6	–3.29%	$325.00	89.00%	$35,232.30	$56.87	($3,909.11)	($7,886.96)	($10,309.96)	($11,755.05)	($12,572.60)	($12,981.31)	Gold Price $325/oz
7	23.57%	$425.00	89.00%	$35,232.30	$56.87	$34,859.27	$21,783.97	$12,864.70	$6,672.97	$2,314.96	($783.90)	Gold Price $425/oz
8	33.64%	$475.00	89.00%	$35,232.30	$56.87	$52,935.77	$35,668.95	$23,743.03	$15,345.45	$9,336.15	$4,978.55	Gold Price $475/oz
9	18.29%	$375.00	89.00%	$35,232.30	$51.18	$26,373.44	$15,209.84	$7,673.12	$2,504.01	($1,082.35)	($3,588.52)	Operating Cost reduced by 10%
10	15.63%	$375.00	89.00%	$31,709.07	$56.87	$19,592.68	$10,594.20	$4,544.38	$416.27	($2,429.16)	($4,400.57)	Capital Cost reduced by 10%
11	4.43%	$375.00	89.00%	$35,232.30	$62.56	$5,595.85	($571.68)	($4,566.99)	($7,167.30)	($8,851.16)	($9,921.51)	Operating Cost increased by 10%
12	9.00%	$375.00	89.00%	$38,755.53	$56.87	$13,375.36	$4,731.24	($955.78)	($4,734.65)	($7,253.64)	($8,924.39)	Capital Cost increased by 10%
13	33.77%	$375.00	92.00%	$31,709.07	$51.18	$47,922.04	$32,308.64	$21,524.60	$13,930.85	$8,496.49	$4,555.48	Optimistic Case Gold Price $375/oz, Operating and Capital Costs decreased by 10%, Grade increased by 10%, Met. Recovery 92%
14	–16.10%	$375.00	86.00%	$38,755.53	$62.56	($19,038.28)	($19,868.49)	($21,020.02)	($21,725.00)	($22,134.01)	($22,342.38)	Pessimistic Case Gold Price $375/oz, Operating and Capital Costs increased by 10%, Grade decreased by 10%, Met. Recovery 86%.

Beacon Hill Consultants Ltd

BEACON HILL CONSULTANTS LTD.
MINING ENGINEERS

Suite 860 - 789 West Pender St., Vancouver, B.C. V6C 1H2 Phone: (604) 681-4100 Fax: (604) 681-8663

March 30, 1991

LAC Minerals (USA), Inc.
Sparks, Nevada
USA 89431

Attention: **Mr. R. Thomas.**

Subject: **Rosebud Project.**

Dear Bob,

I enclose two copies of the report "**Reserve Audit and Conceptual Plan**" for the Dozer Hill Deposit, Rosebud Project, located in Pershing County, Nevada. I have also distributed copies to Mr. P. Walford, Mr. Craig Nelson and Mr. Hans de Reuter of LAC, and Mr R. J. Beaty, Equinox Resources Ltd.

In addition to wording adjustments in the enclosed report, compared to the previously distributed draft report, there are also minor changes to the financial analysis for cases 5-9 through to 5-11, 500 t/d alternative, and cases 9 through to 14, 1000 t/d. These modifications reflect minor adjustments to working capital and taxes and do not affect the conclusions or the recommendations of the study whatsoever.

I would like to thank you for the opportunity to work on this study and look forward to seeing the results from the next phases of work and the project move to a full feasibility.

If you or associates should require any clarification of the report or any additional services I will be only to pleased to oblige.

Yours truly,

W.P. Stokes P.Eng.
Principal
Beacon Hill Consultants Ltd.

cc: Distribution List.

500 T/D
Alternative Cases

Case	Description
5-1	Maximum expected recovery
5-2	Base Case
5-3	Minimum expected recovery
5-4	Grade increased by 10%
5-5	Grade decreased by 10%
5-6	Gold Price $475/oz
5-7	Operating Cost reduced by 10%
5-8	Capital Cost reduced by 10%
5-9	Gold Price $375/oz, Gold Grade increased by 10%, Operating and Capital Costs decreased by 10%, Met. Recovery 92%
5-10	Optimistic Case Gold Price $425/oz, Gold Grade increased by 10%, Operating and Capital Costs decreased by 10%, Met. Recovery 92%
5-11	Gold Price $375/oz, Gold Grade increased by 10%, Operating Costs decreased by 20% and Capital Costs decreased by 10%, Met. Recovery 92%

1,000 T/D
Alternative Cases

Case	Description
1	Maximum expected recovery
2	Base Case
3	Minimum expected recovery
4	Grade increased by 10%
5	Grade decreased by 10%
6	Gold Price $325/oz
7	Gold Price $425/oz
8	Gold Price $475/oz
9	Operating Cost reduced by 10%
10	Capital Cost reduced by 10%
11	Operating Cost increased by 10%
12	Capital Cost increased by 10%
13	Optimistic Case Gold Price $375/oz, Operating and Capital Costs decreased by 10%, Grade increased by 10%, Met. Recovery 92%
14	Pessimistic Case Gold Price $375/oz, Operating and Capital Costs increased by 10%, Grade decreased by 10%, Met. Recovery 86%

LACROS11

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 1
$(000)s

Description Year	-1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				89111.20	93380.00	93380.00	71484.00	60858.00	60858.00	36167.04	0.00	505238.24
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$34,752.70	$36,417.50	$36,417.50	$28,206.50	$24,221.75	$24,221.75	$14,394.64	$0.00	$198,632.34
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$15,758.12	$16,513.00	$16,513.00	$8,302.00	$4,317.25	$4,317.25	$2,565.68	$0.00	$68,286.30
State Income Taxes				$645.71	$672.13	$672.13	$311.87	$145.24	$145.24	$145.24	$0.00	$2,737.54
Federal Income Taxes				$873.48	$2,218.65	$2,545.85	$999.22	$304.39	$304.39	$67.36	$0.00	$7,313.36
Revenue Before Capital Exp.				$14,238.93	$13,622.22	$13,295.02	$6,990.91	$3,867.62	$3,867.62	$2,353.08	$0.00	$58,235.40
Capital Expenditures												
– Exploration/Eng.	$921.10	$5,826.60										$6,747.70
– Development/Construction			$28,484.60									$28,484.60
– On-Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$10,921.52	$13,622.22	$11,861.52	$4,329.21	$3,867.62	$3,867.62	$5,670.50	$2,323.81	$21,231.71
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$9,434.42	$11,207.03	$9,293.81	$3,230.53	$2,748.64	$2,617.76	$3,655.25	$1,426.62	$11,307.44
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$8,205.50	$9,304.16	$7,365.07	$2,443.73	$1,984.70	$1,804.27	$2,404.84	$895.93	$4,649.20
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$7,181.07	$7,788.55	$5,897.27	$1,871.64	$1,453.98	$1,264.33	$1,611.91	$574.41	$117.01
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$6,320.32	$6,569.36	$4,766.88	$1,449.84	$1,079.38	$899.48	$1,098.98	$375.31	($2,998.01)
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$5,591.82	$5,579.66	$3,886.78	$1,134.88	$811.10	$648.88	$761.08	$249.52	($5,148.81)

Rate of Return 15.16%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 92%

Beacon Hill Consultants Ltd.

LACROS12

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 2
$(000)s

Description Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				86205.40	90335.00	90335.00	69153.00	58873.50	58873.50	34987.68	0.00	488763.08
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$33,663.03	$35,275.63	$35,275.63	$27,332.38	$23,477.56	$23,477.56	$13,952.38	$0.00	$192,454.16
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$14,668.45	$15,371.13	$15,371.13	$7,427.88	$3,573.06	$3,573.06	$2,123.42	$0.00	$62,108.12
State Income Taxes				$607.57	$632.16	$632.16	$268.16	$145.24	$145.24	$145.24	$0.00	$2,575.77
Federal Income Taxes				$695.86	$1,960.47	$2,287.67	$806.04	$127.28	$127.28	$0.00	$0.00	$6,004.61
Revenue Before Capital Exp.				$13,365.01	$12,778.49	$12,451.29	$6,353.68	$3,300.55	$3,300.55	$1,978.18	$0.00	$53,527.74
Capital Expenditures												
− Exploration/Eng.	$921.10	$5,826.60										$6,747.70
− Development/Construction			$28,484.60									$28,484.60
− On−Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$10,047.60	$12,778.49	$11,017.79	$3,691.98	$3,300.55	$3,300.55	$5,295.60	$2,323.81	$16,524.05
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$8,679.49	$10,512.89	$8,632.73	$2,755.01	$2,345.64	$2,233.94	$3,413.59	$1,426.62	$7,693.29
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$7,548.91	$8,727.88	$6,841.18	$2,084.02	$1,693.70	$1,539.73	$2,245.85	$895.93	$1,818.20
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$6,606.46	$7,306.14	$5,477.79	$1,596.14	$1,240.80	$1,078.95	$1,505.34	$574.41	($2,140.12)
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$5,814.58	$6,162.47	$4,427.80	$1,236.44	$921.12	$767.60	$1,026.32	$375.31	($4,825.93)
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$5,144.37	$5,234.07	$3,610.31	$967.83	$692.17	$553.74	$710.76	$249.52	($6,649.75)

Rate of Return 12.06%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%

Beacon Hill Consultants Ltd.

LACROS13

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 3
$(000)s

Description Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				83299.60	87290.00	87290.00	66822.00	56889.00	56889.00	33808.32	0.00	472287.92
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$32,573.35	$34,133.75	$34,133.75	$26,458.25	$22,733.38	$22,733.38	$13,510.12	$0.00	$186,275.97
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$13,578.77	$14,229.25	$14,229.25	$6,553.75	$2,828.88	$2,828.88	$1,681.16	$0.00	$55,929.93
State Income Taxes				$569.43	$592.20	$592.20	$224.45	$145.24	$145.24	$145.24	$0.00	$2,413.99
Federal Income Taxes				$518.25	$1,734.42	$2,029.50	$612.86	$0.00	$0.00	$0.00	$0.00	$4,895.02
Revenue Before Capital Exp.				$12,491.10	$11,902.64	$11,607.56	$5,716.44	$2,683.64	$2,683.64	$1,535.92	$0.00	$48,620.92
Capital Expenditures												
− Exploration/Eng.	$921.10	$5,826.60										$6,747.70
− Development/Construction			$28,484.60									$28,484.60
− On−Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$9,173.68	$11,902.64	$10,174.06	$3,054.74	$2,683.64	$2,683.64	$4,853.34	$2,323.81	$11,617.23
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$7,924.57	$9,792.33	$7,971.64	$2,279.49	$1,907.21	$1,816.39	$3,128.51	$1,426.62	$3,940.14
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$6,892.32	$8,129.66	$6,317.29	$1,724.32	$1,377.13	$1,251.94	$2,058.29	$895.93	($1,112.13)
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$6,031.84	$6,805.37	$5,058.30	$1,320.65	$1,008.88	$877.29	$1,379.62	$574.41	($4,469.80)
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$5,308.84	$5,740.08	$4,088.73	$1,023.03	$748.95	$624.13	$940.61	$375.31	($6,707.90)
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$4,696.92	$4,875.32	$3,333.84	$800.78	$562.80	$450.24	$651.40	$249.52	($8,191.70)

Rate of Return 8.71%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 86%

Beacon Hill Consultants Ltd.

LACROS14

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 4
$(000)s

Description Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.32	0.32	0.32	0.24	0.21	0.21	0.21	0.00	0.26
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				94825.94	99368.50	99368.50	76068.30	64760.85	64760.85	38486.45	0.00	537639.388
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$36,895.73	$38,663.19	$38,663.19	$29,925.61	$25,685.32	$25,685.32	$15,264.42	$0.00	$210,782.77
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$17,901.15	$18,758.69	$18,758.69	$10,021.11	$5,780.82	$5,780.82	$3,435.46	$0.00	$80,436.73
State Income Taxes				$720.71	$750.73	$750.73	$397.82	$185.81	$185.81	$145.24	$0.00	$3,136.84
Federal Income Taxes				$1,226.86	$2,726.40	$3,053.60	$1,379.14	$638.93	$638.93	$274.37	$0.00	$9,938.24
Revenue Before Capital Exp.				$15,953.57	$15,281.56	$14,954.36	$8,244.15	$4,956.08	$4,956.08	$3,015.85	$0.00	$67,361.65
Capital Expenditures												
− Exploration/Eng.	$921.10	$5,826.60										$6,747.70
− Development/Construction			$28,484.60									$28,484.60
− On−Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$12,636.15	$15,281.56	$13,520.86	$5,582.45	$4,956.08	$4,956.08	$6,333.27	$2,323.81	$30,357.96
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$10,915.58	$12,572.18	$10,593.95	$4,165.71	$3,522.19	$3,354.47	$4,082.48	$1,426.62	$18,326.56
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$9,493.73	$10,437.51	$8,395.39	$3,151.15	$2,543.25	$2,312.05	$2,685.92	$895.93	$10,155.93
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$8,308.48	$8,737.28	$6,722.26	$2,413.45	$1,863.17	$1,620.15	$1,800.31	$574.41	$4,513.35
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$7,312.59	$7,369.58	$5,433.73	$1,869.55	$1,383.15	$1,152.63	$1,227.43	$375.31	$566.39
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$6,469.71	$6,259.33	$4,430.52	$1,463.40	$1,039.37	$831.49	$850.04	$249.52	($2,219.16)

Rate of Return 20.89%

Notes:

1. Double Probable Reserves 4. Gold Grade +10%
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%

Beacon Hill Consultants Ltd.

LACROS15

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 5
$(000)s

Description Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.26	0.26	0.26	0.20	0.17	0.17	0.17	0.00	0.22
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				77584.86	81301.50	81301.50	62237.70	52986.15	52986.15	31488.91	0.00	439886.772
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$30,430.32	$31,888.06	$31,888.06	$24,739.14	$21,269.81	$21,269.81	$12,640.34	$0.00	$174,125.54
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$11,435.74	$11,983.56	$11,983.56	$4,834.64	$1,365.31	$1,365.31	$811.38	$0.00	$43,779.50
State Income Taxes				$494.42	$513.60	$513.60	$145.24	$145.24	$145.24	$145.24	$0.00	$2,102.57
Federal Income Taxes				$160.50	$1,368.37	$1,521.75	$285.76	$0.00	$0.00	$0.00	$0.00	$3,336.39
Revenue Before Capital Exp.				$10,780.81	$10,101.59	$9,948.22	$4,403.63	$1,220.07	$1,220.07	$666.14	$0.00	$38,340.54
Capital Expenditures												
− Exploration/Eng.	$921.10	$5,826.60										$6,747.70
− Development/Construction			$28,484.60									$28,484.60
− On−Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$7,463.40	$10,101.59	$8,514.72	$1,741.93	$1,220.07	$1,220.07	$3,983.56	$2,323.81	$1,336.85
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$6,447.16	$8,310.61	$6,671.51	$1,299.86	$867.08	$825.79	$2,567.84	$1,426.62	($3,890.15)
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$5,607.36	$6,899.52	$5,286.97	$983.28	$626.09	$569.17	$1,689.42	$895.93	($7,201.26)
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$4,907.31	$5,775.62	$4,233.32	$753.09	$458.67	$398.84	$1,132.38	$574.41	($9,292.53)
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$4,319.10	$4,871.52	$3,421.87	$583.37	$340.50	$283.75	$772.04	$375.31	($10,590.11)
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$3,821.26	$4,137.61	$2,790.10	$456.64	$255.87	$204.69	$534.66	$249.52	($11,362.17)

Rate of Return 1.08%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%
4. Gold Grade −10%

Beacon Hill Consultants Ltd.

LACROS51

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5–1
$(000)s

Description Year	–1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				44555.60	46690.00	46690.00	35742.00	30429.00	30429.00	18083.52	0.00	252619.12
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$17,376.35	$18,208.75	$18,208.75	$14,103.25	$12,110.88	$12,110.88	$7,197.32	$0.00	$99,316.17
Operating Costs				$11,664.95	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$7,264.40	$0.00	$80,048.10
Revenue Before Taxes				$5,711.40	$5,985.00	$5,985.00	$1,879.50	($112.88)	($112.88)	($67.08)	$0.00	$19,268.07
State Income Taxes				$339.89	$353.57	$353.57	$110.00	$110.00	$110.00	$110.00	$0.00	$1,487.02
Federal Income Taxes				$0.00	$489.35	$516.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,005.35
Revenue Before Capital Exp.				$5,371.51	$5,142.08	$5,115.43	$1,769.50	($222.88)	($222.88)	($177.08)	$0.00	$16,775.69
Capital Expenditures												
– Exploration/Eng.	$484.10	$4,439.80										$4,923.90
– Development/Construction			$22,308.40									$22,308.40
– On–Going Capital						$1,871.50	$1,934.00					$3,805.50
Working Capital Change				$2,037.29						($2,037.29)	$0.00	$0.00
Salvage											($1,760.01)	($1,760.01)
Net Cashflow	($484.10)	($4,439.80)	($22,308.40)	$3,334.22	$5,142.08	$3,243.93	($164.50)	($222.88)	($222.88)	$1,860.21	$1,760.01	($12,502.10)
Discounted NCF 5%	($484.10)	($4,228.38)	($20,234.38)	$2,880.23	$4,230.40	$2,541.71	($122.75)	($158.39)	($150.85)	$1,199.11	$1,080.49	($13,446.92)
Discounted NCF 10%	($484.10)	($4,036.18)	($18,436.69)	$2,505.05	$3,512.11	$2,014.23	($92.86)	($114.37)	($103.97)	$788.91	$678.56	($13,769.32)
Discounted NCF 15%	($484.10)	($3,860.70)	($16,868.36)	$2,192.30	$2,940.00	$1,612.81	($71.12)	($83.79)	($72.86)	$528.79	$435.05	($13,731.97)
Discounted NCF 20%	($484.10)	($3,699.83)	($15,491.94)	$1,929.53	$2,479.78	$1,303.66	($55.09)	($62.20)	($51.83)	$360.52	$284.25	($13,487.26)
Discounted NCF 25%	($484.10)	($3,551.84)	($14,277.38)	$1,707.12	$2,106.20	$1,062.97	($43.12)	($46.74)	($37.39)	$249.67	$188.98	($13,125.63)

Rate of Return –14.48%

Notes:

1. Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 92%

Beacon Hill Consultants Ltd.

LACROS52

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5–2
$(000)s

Description Year	–1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				43102.70	45167.50	45167.50	34576.50	29436.75	29436.75	17493.84	0.00	244381.54
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$16,831.51	$17,637.81	$17,637.81	$13,666.19	$11,738.78	$11,738.78	$6,976.19	$0.00	$96,227.08
Operating Costs				$11,664.95	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$7,264.40	$0.00	$80,048.10
Revenue Before Taxes				$5,166.56	$5,414.06	$5,414.06	$1,442.44	($484.97)	($484.97)	($288.21)	$0.00	$16,178.98
State Income Taxes				$312.65	$325.02	$325.02	$110.00	$110.00	$110.00	$110.00	$0.00	$1,402.69
Federal Income Taxes				$0.00	$203.13	$424.65	$0.00	$0.00	$0.00	$0.00	$0.00	$627.78
Revenue Before Capital Exp.				$4,853.92	$4,885.91	$4,664.39	$1,332.44	($594.97)	($594.97)	($398.21)	$0.00	$14,148.51
Capital Expenditures												
– Exploration/Eng.	$484.10	$4,439.80										$4,923.90
– Development/Construction			$22,308.40									$22,308.40
– On–Going Capital						$1,871.50	$1,934.00					$3,805.50
Working Capital Change				$2,037.29						($2,037.29)	$0.00	$0.00
Salvage											($1,760.01)	($1,760.01)
Net Cashflow	($484.10)	($4,439.80)	($22,308.40)	$2,816.63	$4,885.91	$2,792.89	($601.56)	($594.97)	($594.97)	$1,639.08	$1,760.01	($15,129.28)
Discounted NCF 5%	($484.10)	($4,228.38)	($20,234.38)	$2,433.11	$4,019.65	$2,188.30	($448.90)	($422.83)	($402.70)	$1,056.57	$1,080.49	($15,443.17)
Discounted NCF 10%	($484.10)	($4,036.18)	($18,436.69)	$2,116.17	$3,337.14	$1,734.17	($339.57)	($305.31)	($277.56)	$695.13	$678.56	($15,318.24)
Discounted NCF 15%	($484.10)	($3,860.70)	($16,868.36)	$1,851.98	$2,793.53	$1,388.56	($260.07)	($223.67)	($194.50)	$465.93	$435.05	($14,956.34)
Discounted NCF 20%	($484.10)	($3,699.83)	($15,491.94)	$1,629.99	$2,356.24	$1,122.40	($201.46)	($166.05)	($138.37)	$317.66	$284.25	($14,471.20)
Discounted NCF 25%	($484.10)	($3,551.84)	($14,277.38)	$1,442.11	$2,001.27	$915.17	($157.70)	($124.77)	($99.82)	$219.99	$188.98	($13,928.08)

Rate of Return –18.14%

Notes:

1. Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%

Beacon Hill Consultants Ltd.

LACROS53

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5-3
$(000)s

Description Year	-1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				41649.80	43645.00	43645.00	33411.00	28444.50	28444.50	16904.16	0.00	236143.96
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$16,286.68	$17,066.88	$17,066.88	$13,229.13	$11,366.69	$11,366.69	$6,755.06	$0.00	$93,137.99
Operating Costs				$11,664.95	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$7,264.40	$0.00	$80,048.10
Revenue Before Taxes				$4,621.72	$4,843.13	$4,843.13	$1,005.38	($857.06)	($857.06)	($509.34)	$0.00	$13,089.89
State Income Taxes				$285.40	$296.47	$296.47	$110.00	$110.00	$110.00	$110.00	$0.00	$1,318.35
Federal Income Taxes				$0.00	$0.00	$252.44	$0.00	$0.00	$0.00	$0.00	$0.00	$252.44
Revenue Before Capital Exp.				$4,336.32	$4,546.65	$4,294.22	$895.37	($967.06)	($967.06)	($619.34)	$0.00	$11,519.10
Capital Expenditures												
- Exploration/Eng.	$484.10	$4,439.80										$4,923.90
- Development/Construction			$22,308.40									$22,308.40
- On-Going Capital						$1,871.50	$1,934.00					$3,805.50
Working Capital Change				$2,037.29						($2,037.29)	$0.00	$0.00
Salvage											($1,760.01)	($1,760.01)
Net Cashflow	($484.10)	($4,439.80)	($22,308.40)	$2,299.03	$4,546.65	$2,422.72	($1,038.63)	($967.06)	($967.06)	$1,417.95	$1,760.01	($17,758.69)
Discounted NCF 5%	($484.10)	($4,228.38)	($20,234.38)	$1,985.99	$3,740.54	$1,898.26	($775.04)	($687.27)	($654.55)	$914.02	$1,080.49	($17,444.41)
Discounted NCF 10%	($484.10)	($4,036.18)	($18,436.69)	$1,727.29	$3,105.42	$1,504.32	($586.28)	($496.26)	($451.14)	$601.35	$678.56	($16,873.71)
Discounted NCF 15%	($484.10)	($3,860.70)	($16,868.36)	$1,511.65	$2,599.56	$1,204.52	($449.03)	($363.55)	($316.13)	$403.07	$435.05	($16,188.02)
Discounted NCF 20%	($484.10)	($3,699.83)	($15,491.94)	$1,330.46	$2,192.64	$973.64	($347.83)	($269.89)	($224.91)	$274.81	$284.25	($15,462.72)
Discounted NCF 25%	($484.10)	($3,551.84)	($14,277.38)	$1,177.10	$1,862.31	$793.88	($272.27)	($202.81)	($162.25)	$190.31	$188.98	($14,738.06)

Rate of Return -22.04%

Notes:

1. Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 86%

Beacon Hill Consultants Ltd.

LACROS54

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5–4
$(000)s

Description Year	–1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.32	0.32	0.32	0.24	0.21	0.21	0.21	0	0.26
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				47412.97	49684.25	49684.25	38034.15	32380.43	32380.43	19243.22	0.00	268819.694
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$18,447.86	$19,331.59	$19,331.59	$14,962.81	$12,842.66	$12,842.66	$7,632.21	$0.00	$105,391.39
Operating Costs				$11,664.95	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$7,264.40	$0.00	$80,048.10
Revenue Before Taxes				$6,782.91	$7,107.84	$7,107.84	$2,739.06	$618.91	$618.91	$367.81	$0.00	$25,343.29
State Income Taxes				$393.46	$409.71	$409.71	$110.00	$110.00	$110.00	$110.00	$0.00	$1,652.89
Federal Income Taxes				$0.00	$693.43	$695.66	$51.74	$0.00	$0.00	$0.00	$0.00	$1,440.83
Revenue Before Capital Exp.				$6,389.45	$6,004.70	$6,002.48	$2,577.32	$508.91	$508.91	$257.81	$0.00	$22,249.57
Capital Expenditures												
– Exploration/Eng.	$484.10	$4,439.80										$4,923.90
– Development/Construction			$22,308.40									$22,308.40
– On–Going Capital						$1,871.50	$1,934.00					$3,805.50
Working Capital Change				$2,037.29						($2,037.29)	$0.00	$0.00
Salvage											($1,760.01)	($1,760.01)
Net Cashflow	($484.10)	($4,439.80)	($22,308.40)	$4,352.16	$6,004.70	$4,130.98	$643.32	$508.91	$508.91	$2,295.10	$1,760.01	($7,028.22)
Discounted NCF 5%	($484.10)	($4,228.38)	($20,234.38)	$3,759.56	$4,940.08	$3,236.73	$480.05	$361.67	$344.45	$1,479.44	$1,080.49	($9,264.38)
Discounted NCF 10%	($484.10)	($4,036.18)	($18,436.69)	$3,269.84	$4,101.29	$2,565.01	$363.14	$261.15	$237.41	$973.35	$678.56	($10,507.23)
Discounted NCF 15%	($484.10)	($3,860.70)	($16,868.36)	$2,861.62	$3,433.21	$2,053.83	$278.12	$191.32	$166.36	$652.41	$435.05	($11,141.24)
Discounted NCF 20%	($484.10)	($3,699.83)	($15,491.94)	$2,518.61	$2,895.78	$1,660.15	$215.45	$142.03	$118.36	$444.81	$284.25	($11,396.45)
Discounted NCF 25%	($484.10)	($3,551.84)	($14,277.38)	$2,228.31	$2,459.53	$1,353.64	$168.64	$106.73	$85.38	$308.04	$188.98	($11,414.08)

Rate of Return –7.67%

Notes:

1. Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%
4. Gold Grade +10%

Beacon Hill Consultants Ltd.

LACROS55

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5-5
$(000)s

Description Year	-1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				43102.70	45167.50	45167.50	34576.50	29436.75	29436.75	17493.84	0.00	244381.54
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$425.00	$425.00	$425.00	$425.00	$425.00	$425.00	$425.00	$425.00	$425.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$18,986.65	$19,896.19	$19,896.19	$15,395.01	$13,210.62	$13,210.62	$7,850.88	$0.00	$108,446.15
Operating Costs				$11,664.95	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$7,264.40	$0.00	$80,048.10
Revenue Before Taxes				$7,321.70	$7,672.44	$7,672.44	$3,171.26	$986.87	$986.87	$586.48	$0.00	$28,398.05
State Income Taxes				$327.28	$339.56	$339.56	$110.00	$110.00	$110.00	$110.00	$0.00	$1,446.40
Federal Income Taxes				$0.00	$803.45	$826.66	$127.20	$0.00	$0.00	$0.00	$0.00	$1,757.30
Revenue Before Capital Exp.				$6,994.42	$6,529.43	$6,506.22	$2,934.07	$876.87	$876.87	$476.48	$0.00	$25,194.35
Capital Expenditures												
- Exploration/Eng.	$484.10	$4,439.80										$4,923.90
- Development/Construction			$22,308.40									$22,308.40
- On-Going Capital						$1,871.50	$1,934.00					$3,805.50
Working Capital Change				$2,037.29						($2,037.29)	$0.00	$0.00
Salvage											($1,760.01)	($1,760.01)
Net Cashflow	($484.10)	($4,439.80)	($22,308.40)	$4,957.12	$6,529.43	$4,634.72	$1,000.07	$876.87	$876.87	$2,513.77	$1,760.01	($4,083.44)
Discounted NCF 5%	($484.10)	($4,228.38)	($20,234.38)	$4,282.15	$5,371.78	$3,631.42	$746.27	$623.17	$593.50	$1,620.40	$1,080.49	($6,997.67)
Discounted NCF 10%	($484.10)	($4,036.18)	($18,436.69)	$3,724.36	$4,459.69	$2,877.79	$564.51	$449.97	$409.07	$1,066.09	$678.56	($8,726.94)
Discounted NCF 15%	($484.10)	($3,860.70)	($16,868.36)	$3,259.39	$3,733.23	$2,304.27	$432.36	$329.65	$286.65	$714.57	$435.05	($9,717.99)
Discounted NCF 20%	($484.10)	($3,699.83)	($15,491.94)	$2,868.71	$3,148.84	$1,862.59	$334.92	$244.72	$203.93	$487.19	$284.25	($10,240.74)
Discounted NCF 25%	($484.10)	($3,551.84)	($14,277.38)	$2,538.05	$2,674.46	$1,518.70	$262.16	$183.89	$147.11	$337.39	$188.98	($10,462.57)

Rate of Return -4.35%

Notes:

1. Probable Reserves
2. Gold Price $425/Oz.
3. Metallurgical Recovery 89%

Beacon Hill Consultants Ltd.

LACROS56

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5–6
$(000)s

Description Year	–1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				43102.70	45167.50	45167.50	34576.50	29436.75	29436.75	17493.84	0.00	244381.54
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$475.00	$475.00	$475.00	$475.00	$475.00	$475.00	$475.00	$475.00	$475.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$21,141.78	$22,154.56	$22,154.56	$17,123.84	$14,682.46	$14,682.46	$8,725.57	$0.00	$120,665.23
Operating Costs				$11,664.95	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$7,264.40	$0.00	$80,048.10
Revenue Before Taxes				$9,476.83	$9,930.81	$9,930.81	$4,900.09	$2,458.71	$2,458.71	$1,461.17	$0.00	$40,617.13
State Income Taxes				$402.71	$418.60	$418.60	$167.14	$110.00	$110.00	$110.00	$0.00	$1,737.06
Federal Income Taxes				$195.74	$1,171.56	$1,337.28	$441.78	$32.32	$32.32	$0.00	$0.00	$3,211.00
Revenue Before Capital Exp.				$8,878.38	$8,340.65	$8,174.93	$4,291.16	$2,316.39	$2,316.39	$1,351.17	$0.00	$35,669.07
Capital Expenditures												
– Exploration/Eng.	$484.10	$4,439.80										$4,923.90
– Development/Construction			$22,308.40									$22,308.40
– On–Going Capital						$1,871.50	$1,934.00					$3,805.50
Working Capital Change				$2,037.29						($2,037.29)	$0.00	$0.00
Salvage											($1,760.01)	($1,760.01)
Net Cashflow	($484.10)	($4,439.80)	($22,308.40)	$6,841.09	$8,340.65	$6,303.43	$2,357.16	$2,316.39	$2,316.39	$3,388.47	$1,760.01	$6,391.28
Discounted NCF 5%	($484.10)	($4,228.38)	($20,234.38)	$5,909.59	$6,861.87	$4,938.90	$1,758.95	$1,646.21	$1,567.82	$2,184.23	$1,080.49	$1,001.22
Discounted NCF 10%	($484.10)	($4,036.18)	($18,436.69)	$5,139.81	$5,696.78	$3,913.93	$1,330.56	$1,188.67	$1,080.61	$1,437.04	$678.56	($2,491.01)
Discounted NCF 15%	($484.10)	($3,860.70)	($16,868.36)	$4,498.13	$4,768.79	$3,133.92	$1,019.07	$870.82	$757.23	$963.21	$435.05	($4,766.94)
Discounted NCF 20%	($484.10)	($3,699.83)	($15,491.94)	$3,958.97	$4,022.30	$2,533.21	$789.41	$646.46	$538.72	$656.71	$284.25	($6,245.85)
Discounted NCF 25%	($484.10)	($3,551.84)	($14,277.38)	$3,502.64	$3,416.33	$2,065.51	$617.92	$485.78	$388.63	$454.79	$188.98	($7,192.74)

Rate of Return 6.23%

Notes:

1. Probable Reserves
2. Gold Price $475/Oz.
3. Metallurgical Recovery 89%

Beacon Hill Consultants Ltd.

LACROS57

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5–7
$(000)s

Description / Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				43102.70	45167.50	45167.50	34576.50	29436.75	29436.75	17493.84	0.00	244381.54
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$16,831.51	$17,637.81	$17,637.81	$13,666.19	$11,738.78	$11,738.78	$6,976.19	$0.00	$96,227.08
Operating Costs				$10,498.46	$11,001.38	$11,001.38	$11,001.38	$11,001.38	$11,001.38	$6,537.96	$0.00	$72,043.29
Revenue Before Taxes				$6,333.06	$6,636.44	$6,636.44	$2,664.81	$737.41	$737.41	$438.23	$0.00	$24,183.79
State Income Taxes				$370.97	$386.14	$386.14	$110.00	$110.00	$110.00	$110.00	$0.00	$1,583.25
Federal Income Taxes				$0.00	$618.01	$620.23	$36.89	$0.00	$0.00	$0.00	$0.00	$1,275.13
Revenue Before Capital Exp.				$5,962.09	$5,632.29	$5,630.07	$2,517.92	$627.41	$627.41	$328.23	$0.00	$21,325.41
Capital Expenditures												
– Exploration/Eng.	$484.10	$4,439.80										$4,923.90
– Development/Construction			$22,308.40									$22,308.40
– On–Going Capital						$1,871.50	$1,934.00					$3,805.50
Working Capital Change				$1,833.56						($1,833.56)	$0.00	$0.00
Salvage											($1,760.01)	($1,760.01)
Net Cashflow	($484.10)	($4,439.80)	($22,308.40)	$4,128.52	$5,632.29	$3,758.57	$583.92	$627.41	$627.41	$2,161.79	$1,760.01	($7,952.38)
Discounted NCF 5%	($484.10)	($4,228.38)	($20,234.38)	$3,566.37	$4,633.70	$2,944.94	$435.73	$445.89	$424.65	$1,393.51	$1,080.49	($10,021.58)
Discounted NCF 10%	($484.10)	($4,036.18)	($18,436.69)	$3,101.82	$3,846.93	$2,333.77	$329.61	$321.96	$292.69	$916.81	$678.56	($11,134.82)
Discounted NCF 15%	($484.10)	($3,860.70)	($16,868.36)	$2,714.57	$3,220.28	$1,868.67	$252.45	$235.87	$205.10	$614.52	$435.05	($11,666.65)
Discounted NCF 20%	($484.10)	($3,699.83)	($15,491.94)	$2,389.19	$2,716.19	$1,510.48	$195.55	$175.10	$145.91	$418.97	$284.25	($11,840.23)
Discounted NCF 25%	($484.10)	($3,551.84)	($14,277.38)	$2,113.80	$2,306.99	$1,231.61	$153.07	$131.58	$105.26	$290.15	$188.98	($11,791.88)

Rate of Return −8.62%

Notes:

1. Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%
4. Operating Cost −10%

Beacon Hill Consultants Ltd.

LACROS58

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5–8
$(000)s

Description Year	–1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				43102.70	45167.50	45167.50	34576.50	29436.75	29436.75	17493.84	0.00	244381.54
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$16,831.51	$17,637.81	$17,637.81	$13,666.19	$11,738.78	$11,738.78	$6,976.19	$0.00	$96,227.08
Operating Costs				$11,664.95	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$12,223.75	$7,264.40	$0.00	$80,048.10
Revenue Before Taxes				$5,166.56	$5,414.06	$5,414.06	$1,442.44	($484.97)	($484.97)	($288.21)	$0.00	$16,178.98
State Income Taxes				$307.21	$319.59	$319.59	$99.00	$99.00	$99.00	$99.00	$0.00	$1,342.39
Federal Income Taxes				$0.00	$454.23	$468.81	$0.00	$0.00	$0.00	$0.00	$0.00	$923.04
Revenue Before Capital Exp.				$4,859.35	$4,640.24	$4,625.66	$1,343.44	($583.97)	($583.97)	($387.21)	$0.00	$13,913.54
Capital Expenditures												
– Exploration/Eng.	$435.69	$3,995.82										$4,431.51
– Development/Construction			$20,077.56									$20,077.56
– On–Going Capital						$1,684.35	$1,740.60					$3,424.95
Working Capital Change				$2,037.29						($2,037.29)	$0.00	$0.00
Salvage											($1,584.01)	($1,584.01)
Net Cashflow	($435.69)	($3,995.82)	($20,077.56)	$2,822.06	$4,640.24	$2,941.31	($397.16)	($583.97)	($583.97)	$1,650.08	$1,584.01	($12,436.47)
Discounted NCF 5%	($435.69)	($3,805.54)	($18,210.94)	$2,437.80	$3,817.54	$2,304.60	($296.37)	($415.02)	($395.25)	$1,063.66	$972.44	($12,962.78)
Discounted NCF 10%	($435.69)	($3,632.56)	($16,593.02)	$2,120.25	$3,169.35	$1,826.32	($224.19)	($299.67)	($272.43)	$699.80	$610.70	($13,031.14)
Discounted NCF 15%	($435.69)	($3,474.63)	($15,181.52)	$1,855.55	$2,653.07	$1,462.35	($171.70)	($219.54)	($190.90)	$469.06	$391.54	($12,842.41)
Discounted NCF 20%	($435.69)	($3,329.85)	($13,942.75)	$1,633.13	$2,237.77	$1,182.05	($133.01)	($162.98)	($135.81)	$319.80	$255.83	($12,511.51)
Discounted NCF 25%	($435.69)	($3,196.66)	($12,849.64)	$1,444.89	$1,900.64	$963.81	($104.11)	($122.47)	($97.97)	$221.47	$170.08	($12,105.64)

Rate of Return –16.56%

Notes:

1. Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%
4. Capital Cost –10%

Beacon Hill Consultants Ltd.

LACROS59

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5–9
$(000)s

Description Year	–1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Grade Au Oz/ton				0.32	0.32	0.32	0.24	0.21	0.21	0.21	0.00	0.26
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				49011.16	51359.00	51359.00	39316.20	33471.90	33471.90	19891.87	0.00	277881.032
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$19,047.19	$19,959.63	$19,959.63	$15,443.58	$13,251.96	$13,251.96	$7,875.45	$0.00	$108,789.39
Operating Costs				$10,498.46	$11,001.38	$11,001.38	$11,001.38	$11,001.38	$11,001.38	$6,537.96	$0.00	$72,043.29
Revenue Before Taxes				$8,548.73	$8,958.25	$8,958.25	$4,442.20	$2,250.59	$2,250.59	$1,337.49	$0.00	$36,746.10
State Income Taxes				$363.13	$377.46	$377.46	$152.03	$99.00	$99.00	$99.00	$0.00	$1,567.08
Federal Income Taxes				$179.36	$1,057.75	$1,208.19	$404.70	$35.51	$35.51	$0.00	$0.00	$2,921.01
Revenue Before Capital Exp.				$8,006.25	$7,523.04	$7,372.60	$3,885.46	$2,116.08	$2,116.08	$1,238.49	$0.00	$32,258.01
Capital Expenditures												
– Exploration/Eng.	$435.69	$3,995.82										$4,431.51
– Development/Construction			$20,077.56									$20,077.56
– On–Going Capital						$1,684.35	$1,740.60					$3,424.95
Working Capital Change				$1,833.56						($1,833.56)	$0.00	$0.00
Salvage											($1,584.01)	($1,584.01)
Net Cashflow	($435.69)	($3,995.82)	($20,077.56)	$6,172.69	$7,523.04	$5,688.25	$2,144.86	$2,116.08	$2,116.08	$3,072.05	$1,584.01	$5,907.99
Discounted NCF 5%	($435.69)	($3,805.54)	($18,210.94)	$5,332.20	$6,189.23	$4,456.89	$1,600.53	$1,503.86	$1,432.25	$1,980.27	$972.44	$1,015.50
Discounted NCF 10%	($435.69)	($3,632.56)	($16,593.02)	$4,637.63	$5,138.34	$3,531.95	$1,210.72	$1,085.88	$987.17	$1,302.85	$610.70	($2,156.03)
Discounted NCF 15%	($435.69)	($3,474.63)	($15,181.52)	$4,058.64	$4,301.32	$2,828.06	$927.28	$795.51	$691.75	$873.27	$391.54	($4,224.45)
Discounted NCF 20%	($435.69)	($3,329.85)	($13,942.75)	$3,572.16	$3,628.01	$2,285.98	$718.31	$590.56	$492.13	$595.38	$255.83	($5,569.93)
Discounted NCF 25%	($435.69)	($3,196.66)	($12,849.64)	$3,160.42	$3,081.44	$1,863.93	$562.26	$443.77	$355.02	$412.32	$170.08	($6,432.74)

Rate of Return 6.38%

Notes:

1. Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 92%
4. Operating Cost –10%
5. Capital Cost –10%
6. Gold Grade +10%

Beacon Hill Consultants Ltd.

LACROS60

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5–10
$(000)s

Description Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Grade Au Oz/ton				0.32	0.32	0.32	0.24	0.21	0.21	0.21	0.00	0.26
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				49011.16	51359.00	51359.00	39316.20	33471.90	33471.90	19891.87	0.00	277881.032
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$425.00	$425.00	$425.00	$425.00	$425.00	$425.00	$425.00	$425.00	$425.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$21,497.74	$22,527.58	$22,527.58	$17,409.39	$14,925.56	$14,925.56	$8,870.05	$0.00	$122,683.44
Operating Costs				$10,498.46	$11,001.38	$11,001.38	$11,001.38	$11,001.38	$11,001.38	$6,537.96	$0.00	$72,043.29
Revenue Before Taxes				$10,999.29	$11,526.20	$11,526.20	$6,408.01	$3,924.18	$3,924.18	$2,332.09	$0.00	$50,640.15
State Income Taxes				$448.90	$467.34	$467.34	$250.32	$126.13	$126.13	$99.00	$0.00	$1,985.16
Federal Income Taxes				$578.80	$1,568.24	$1,788.81	$839.15	$424.43	$424.43	$184.72	$0.00	$5,808.57
Revenue Before Capital Exp.				$9,971.60	$9,490.63	$9,270.06	$5,318.54	$3,373.62	$3,373.62	$2,048.36	$0.00	$42,846.42
Capital Expenditures												
– Exploration/Eng.	$435.69	$3,995.82										$4,431.51
– Development/Construction			$20,077.56									$20,077.56
– On–Going Capital						$1,684.35	$1,740.60					$3,424.95
Working Capital Change				$1,833.56						($1,833.56)	$0.00	$0.00
Salvage											($1,584.01)	($1,584.01)
Net Cashflow	($435.69)	($3,995.82)	($20,077.56)	$8,138.03	$9,490.63	$7,585.71	$3,577.94	$3,373.62	$3,373.62	$3,881.93	$1,584.01	$16,496.41
Discounted NCF 5%	($435.69)	($3,805.54)	($18,210.94)	$7,029.94	$7,807.96	$5,943.60	$2,669.91	$2,397.57	$2,283.40	$2,502.32	$972.44	$9,154.98
Discounted NCF 10%	($435.69)	($3,632.56)	($16,593.02)	$6,114.23	$6,482.22	$4,710.13	$2,019.65	$1,731.20	$1,573.82	$1,646.32	$610.70	$4,226.99
Discounted NCF 15%	($435.69)	($3,474.63)	($15,181.52)	$5,350.89	$5,426.30	$3,771.44	$1,546.84	$1,268.27	$1,102.84	$1,103.49	$391.54	$869.77
Discounted NCF 20%	($435.69)	($3,329.85)	($13,942.75)	$4,709.51	$4,576.88	$3,048.53	$1,198.24	$941.51	$784.60	$752.34	$255.83	($1,440.85)
Discounted NCF 25%	($435.69)	($3,196.66)	($12,849.64)	$4,166.67	$3,887.36	$2,485.68	$937.94	$707.50	$566.00	$521.02	$170.08	($3,039.73)

Rate of Return 16.67%

Notes:

1. Probable Reserves
2. Gold Price $425/Oz.
3. Metallurgical Recovery 92%
4. Operating Cost −10%
5. Capital Cost −10%
6. Gold Grade +10%

Beacon Hill Consultants Ltd.

LACROS61

March 8 1991

Rosebud Project
Dozer Hill Deposit
500 TPD
Financial Analysis
Case 5–11
$(000)s

Description Year	–1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Mill Recovery % Au				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Grade Au Oz/ton				0.32	0.32	0.32	0.24	0.21	0.21	0.21	0.00	0.26
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				49011.16	51359.00	51359.00	39316.20	33471.90	33471.90	19891.87	0.00	277881.032
Oz Ag				167000.00	175000.00	175000.00	175000.00	175000.00	175000.00	104000.00	0.00	1146000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$19,047.19	$19,959.63	$19,959.63	$15,443.58	$13,251.96	$13,251.96	$7,875.45	$0.00	$108,789.39
Operating Costs				$9,331.96	$9,779.00	$9,779.00	$9,779.00	$9,779.00	$9,779.00	$5,811.52	$0.00	$64,038.48
Revenue Before Taxes				$9,715.23	$10,180.63	$10,180.63	$5,664.58	$3,472.96	$3,472.96	$2,063.93	$0.00	$44,750.91
State Income Taxes				$403.95	$420.24	$420.24	$213.15	$103.57	$103.57	$99.00	$0.00	$1,763.73
Federal Income Taxes				$369.49	$1,264.00	$1,484.57	$674.85	$324.71	$324.71	$120.90	$0.00	$4,563.24
Revenue Before Capital Exp.				$8,941.78	$8,496.38	$8,275.81	$4,776.57	$3,044.68	$3,044.68	$1,844.03	$0.00	$38,423.93
Capital Expenditures												
– Exploration/Eng.	$435.69	$3,995.82										$4,431.51
– Development/Construction			$20,077.56									$20,077.56
– On–Going Capital						$1,684.35	$1,740.60					$3,424.95
Working Capital Change				$1,629.83						($1,629.83)	$0.00	$0.00
Salvage											($1,584.01)	($1,584.01)
Net Cashflow	($435.69)	($3,995.82)	($20,077.56)	$7,311.94	$8,496.38	$6,591.46	$3,035.97	$3,044.68	$3,044.68	$3,473.86	$1,584.01	$12,073.92
Discounted NCF 5%	($435.69)	($3,805.54)	($18,210.94)	$6,316.33	$6,989.99	$5,164.58	$2,265.49	$2,163.80	$2,060.76	$2,239.28	$972.44	$5,720.51
Discounted NCF 10%	($435.69)	($3,632.56)	($16,593.02)	$5,493.57	$5,803.14	$4,092.78	$1,713.73	$1,562.40	$1,420.37	$1,473.26	$610.70	$1,508.67
Discounted NCF 15%	($435.69)	($3,474.63)	($15,181.52)	$4,807.72	$4,857.83	$3,277.12	$1,312.54	$1,144.61	$995.31	$987.49	$391.54	($1,317.67)
Discounted NCF 20%	($435.69)	($3,329.85)	($13,942.75)	$4,231.45	$4,097.41	$2,648.96	$1,016.74	$849.71	$708.10	$673.26	$255.83	($3,226.84)
Discounted NCF 25%	($435.69)	($3,196.66)	($12,849.64)	$3,743.72	$3,480.12	$2,159.89	$795.86	$638.52	$510.81	$466.25	$170.08	($4,516.74)

Rate of Return 12.42%

Notes:

1. Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 92%
4. Operating Cost –20%
5. Capital Cost –10%
6. Gold Grade +10%

Beacon Hill Consultants Ltd.

LACROS16

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 6
$(000)s

Description Year	-1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				86205.40	90335.00	90335.00	69153.00	58873.50	58873.50	34987.68	0.00	488763.08
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$325.00	$325.00	$325.00	$325.00	$325.00	$325.00	$325.00	$325.00	$325.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$29,352.76	$30,758.88	$30,758.88	$23,874.73	$20,533.89	$20,533.89	$12,203.00	$0.00	$168,016.00
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$10,358.18	$10,854.38	$10,854.38	$3,970.23	$629.39	$629.39	$374.04	$0.00	$37,669.96
State Income Taxes				$456.71	$474.08	$474.08	$145.24	$145.24	$145.24	$145.24	$0.00	$1,985.81
Federal Income Taxes				$0.00	$1,184.31	$1,266.44	$138.81	$0.00	$0.00	$0.00	$0.00	$2,589.56
Revenue Before Capital Exp.				$9,901.47	$9,195.99	$9,113.86	$3,686.17	$484.15	$484.15	$228.80	$0.00	$33,094.58
Capital Expenditures												
– Exploration/Eng.	$921.10	$5,826.60										$6,747.70
– Development/Construction			$28,484.60									$28,484.60
– On-Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$6,584.05	$9,195.99	$7,680.36	$1,024.47	$484.15	$484.15	$3,546.21	$2,323.81	($3,909.11)
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$5,687.55	$7,565.56	$6,017.77	$764.48	$344.08	$327.69	$2,285.92	$1,426.62	($7,886.96)
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$4,946.69	$6,280.98	$4,768.90	$578.29	$248.45	$225.86	$1,503.94	$895.93	($10,309.96)
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$4,329.12	$5,257.83	$3,818.50	$442.91	$182.01	$158.27	$1,008.06	$574.41	($11,755.05)
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$3,810.21	$4,434.79	$3,086.57	$343.09	$135.12	$112.60	$687.28	$375.31	($12,572.60)
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$3,371.03	$3,766.68	$2,516.70	$268.56	$101.53	$81.23	$475.96	$249.52	($12,981.31)

Rate of Return -3.29%

Notes:

1. Double Probable Reserves
2. Gold Price $325/Oz.
3. Metallurgical Recovery 89%

Beacon Hill Consultants Ltd.

LACROS17

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 7
$(000)s

Description Year	-1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				86205.40	90335.00	90335.00	69153.00	58873.50	58873.50	34987.68	0.00	488763.08
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$425.00	$425.00	$425.00	$425.00	$425.00	$425.00	$425.00	$425.00	$425.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$37,973.30	$39,792.38	$39,792.38	$30,790.03	$26,421.24	$26,421.24	$15,701.76	$0.00	$216,892.31
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$18,978.72	$19,887.88	$19,887.88	$10,885.53	$6,516.74	$6,516.74	$3,872.80	$0.00	$86,546.27
State Income Taxes				$758.43	$790.25	$790.25	$441.04	$222.60	$222.60	$145.24	$0.00	$3,370.41
Federal Income Taxes				$1,470.50	$2,981.71	$3,308.91	$1,570.18	$801.57	$801.57	$378.46	$0.00	$11,312.90
Revenue Before Capital Exp.				$16,749.78	$16,115.92	$15,788.72	$8,874.30	$5,492.57	$5,492.57	$3,349.11	$0.00	$71,862.96
Capital Expenditures												
– Exploration/Eng.	$921.10	$5,826.60										$6,747.70
– Development/Construction			$28,484.60									$28,484.60
– On–Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$13,432.37	$16,115.92	$14,355.22	$6,212.60	$5,492.57	$5,492.57	$6,666.52	$2,323.81	$34,859.27
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$11,603.38	$13,258.60	$11,247.69	$4,635.94	$3,903.46	$3,717.58	$4,297.30	$1,426.62	$21,783.97
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$10,091.94	$11,007.39	$8,913.46	$3,506.85	$2,818.55	$2,562.32	$2,827.26	$895.93	$12,864.70
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$8,832.00	$9,214.33	$7,137.08	$2,685.88	$2,064.86	$1,795.53	$1,895.04	$574.41	$6,672.97
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$7,773.36	$7,771.95	$5,769.04	$2,080.59	$1,532.87	$1,277.40	$1,292.02	$375.31	$2,314.96
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$6,877.37	$6,601.08	$4,703.92	$1,628.60	$1,151.87	$921.50	$894.77	$249.52	($783.90)

Rate of Return 23.57%

Notes:

1. Double Probable Reserves
2. Gold Price $425/Oz.
3. Metallurgical Recovery 89%

Beacon Hill Consultants Ltd.

LACROS18

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 8
$(000)s

Description Year	-1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				86205.40	90335.00	90335.00	69153.00	58873.50	58873.50	34987.68	0.00	488763.08
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$475.00	$475.00	$475.00	$475.00	$475.00	$475.00	$475.00	$475.00	$475.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$42,283.57	$44,309.13	$44,309.13	$34,247.68	$29,364.91	$29,364.91	$17,451.15	$0.00	$241,330.46
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$23,288.99	$24,404.63	$24,404.63	$14,343.18	$9,460.41	$9,460.41	$5,622.19	$0.00	$110,984.42
State Income Taxes				$909.29	$948.33	$948.33	$473.32	$369.79	$369.79	$177.88	$0.00	$4,196.73
Federal Income Taxes				$2,445.05	$4,002.95	$4,330.15	$2,382.13	$1,452.12	$1,452.12	$783.71	$0.00	$16,848.23
Revenue Before Capital Exp.				$19,934.64	$19,453.34	$19,126.14	$11,487.73	$7,638.50	$7,638.50	$4,660.60	$0.00	$89,939.46
Capital Expenditures												
– Exploration/Eng.	$921.10	$5,826.60										$6,747.70
– Development/Construction			$28,484.60									$28,484.60
– On-Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$16,617.23	$19,453.34	$17,692.64	$8,826.03	$7,638.50	$7,638.50	$7,978.01	$2,323.81	$52,935.77
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$14,354.59	$16,004.31	$13,862.65	$6,586.12	$5,428.54	$5,170.04	$5,142.70	$1,426.62	$35,668.95
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$12,484.77	$13,286.89	$10,985.74	$4,982.06	$3,919.76	$3,563.42	$3,383.46	$895.93	$23,743.03
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$10,926.10	$11,122.51	$8,796.37	$3,815.74	$2,871.60	$2,497.04	$2,267.85	$574.41	$15,345.45
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$9,616.45	$9,381.43	$7,110.28	$2,955.82	$2,131.77	$1,776.47	$1,546.19	$375.31	$9,336.15
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$8,508.02	$7,968.09	$5,797.53	$2,313.69	$1,601.91	$1,281.53	$1,070.79	$249.52	$4,978.55

Rate of Return 33.64%

Notes:

1. Double Probable Reserves
2. Gold Price $475/Oz.
3. Metallurgical Recovery 89%

Beacon Hill Consultants Ltd.

LACROS19

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 9
$(000)s

Description Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				86205.40	90335.00	90335.00	69153.00	58873.50	58873.50	34987.68	0.00	488763.08
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$33,663.03	$35,275.63	$35,275.63	$27,332.38	$23,477.56	$23,477.56	$13,952.38	$0.00	$192,454.16
Operating Costs				$17,095.12	$17,914.05	$17,914.05	$17,914.05	$17,914.05	$17,914.05	$10,646.06	$0.00	$117,311.44
Revenue Before Taxes				$16,567.90	$17,361.58	$17,361.58	$9,418.33	$5,563.51	$5,563.51	$3,306.32	$0.00	$75,142.72
State Income Taxes				$674.05	$701.83	$701.83	$367.68	$174.94	$174.94	$145.24	$0.00	$2,940.51
Federal Income Taxes				$1,005.47	$2,410.52	$2,737.71	$1,245.93	$590.91	$590.91	$243.63	$0.00	$8,825.08
Revenue Before Capital Exp.				$14,888.38	$14,249.23	$13,922.03	$7,804.71	$4,797.66	$4,797.66	$2,917.44	$0.00	$63,377.13
Capital Expenditures												
− Exploration/Eng.	$921.10	$5,826.60										$6,747.70
− Development/Construction			$28,484.60									$28,484.60
− On−Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$2,985.68						($2,985.68)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$11,902.70	$14,249.23	$12,488.53	$5,143.01	$4,797.66	$4,797.66	$5,903.12	$2,323.81	$26,373.44
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$10,282.00	$11,722.88	$9,785.09	$3,837.80	$3,409.61	$3,247.25	$3,805.20	$1,426.62	$15,209.84
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$8,942.68	$9,732.42	$7,754.40	$2,903.10	$2,461.96	$2,238.15	$2,503.50	$895.93	$7,673.12
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$7,826.22	$8,147.04	$6,209.01	$2,223.47	$1,803.62	$1,568.36	$1,678.03	$574.41	$2,504.01
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$6,888.14	$6,871.74	$5,018.86	$1,722.39	$1,338.94	$1,115.78	$1,144.06	$375.31	($1,082.35)
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$6,094.18	$5,836.49	$4,092.24	$1,348.21	$1,006.14	$804.91	$792.30	$249.52	($3,588.52)

Rate of Return 18.29%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%
4. Operating Cost −10%

Beacon Hill Consultants Ltd.

LACROS20

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 10
$(000)s

Description Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				86205.40	90335.00	90335.00	69153.00	58873.50	58873.50	34987.68	0.00	488763.08
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$33,663.03	$35,275.63	$35,275.63	$27,332.38	$23,477.56	$23,477.56	$13,952.38	$0.00	$192,454.16
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$14,668.45	$15,371.13	$15,371.13	$7,427.88	$3,573.06	$3,573.06	$2,123.42	$0.00	$62,108.12
State Income Taxes				$598.15	$622.74	$622.74	$278.48	$130.71	$130.71	$130.71	$0.00	$2,514.27
Federal Income Taxes				$865.37	$2,111.97	$2,406.45	$889.59	$199.59	$199.59	$25.29	$0.00	$6,697.84
Revenue Before Capital Exp.				$13,204.92	$12,636.41	$12,341.93	$6,259.80	$3,242.76	$3,242.76	$1,967.42	$0.00	$52,896.01
Capital Expenditures												
− Exploration/Eng.	$828.99	$5,243.94										$6,072.93
− Development/Construction			$25,636.14									$25,636.14
− On−Going Capital						$1,290.15	$2,395.53					$3,685.68
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,091.43)	($2,091.43)
Net Cashflow	($828.99)	($5,243.94)	($25,636.14)	$9,887.51	$12,636.41	$11,051.78	$3,864.27	$3,242.76	$3,242.76	$5,284.84	$2,091.43	$19,592.68
Discounted NCF 5%	($828.99)	($4,994.23)	($23,252.73)	$8,541.20	$10,396.01	$8,659.36	$2,883.58	$2,304.57	$2,194.83	$3,406.65	$1,283.96	$10,594.20
Discounted NCF 10%	($828.99)	($4,767.22)	($21,186.89)	$7,428.63	$8,630.84	$6,862.29	$2,181.28	$1,664.05	$1,512.77	$2,241.29	$806.34	$4,544.38
Discounted NCF 15%	($828.99)	($4,559.95)	($19,384.60)	$6,501.20	$7,224.91	$5,494.69	$1,670.63	$1,219.07	$1,060.06	$1,502.28	$516.97	$416.27
Discounted NCF 20%	($828.99)	($4,369.95)	($17,802.87)	$5,721.94	$6,093.95	$4,441.46	$1,294.14	$904.99	$754.16	$1,024.24	$337.78	($2,429.16)
Discounted NCF 25%	($828.99)	($4,195.15)	($16,407.13)	$5,062.40	$5,175.87	$3,621.45	$1,013.00	$680.06	$544.04	$709.32	$224.57	($4,400.57)

Rate of Return 15.63%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%
4. Capital Cost −10%

Beacon Hill Consultants Ltd.

LACROS21

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 11
$(000)s

Description Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				86205.40	90335.00	90335.00	69153.00	58873.50	58873.50	34987.68	0.00	488763.08
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$33,663.03	$35,275.63	$35,275.63	$27,332.38	$23,477.56	$23,477.56	$13,952.38	$0.00	$192,454.16
Operating Costs				$20,894.04	$21,894.95	$21,894.95	$21,894.95	$21,894.95	$21,894.95	$13,011.86	$0.00	$143,380.64
Revenue Before Taxes				$12,768.99	$13,380.68	$13,380.68	$5,437.42	$1,582.61	$1,582.61	$940.52	$0.00	$49,073.51
State Income Taxes				$541.09	$562.50	$562.50	$168.64	$145.24	$145.24	$145.24	$0.00	$2,270.43
Federal Income Taxes				$386.25	$1,596.10	$1,837.63	$383.56	$0.00	$0.00	$0.00	$0.00	$4,203.54
Revenue Before Capital Exp.				$11,841.65	$11,222.08	$10,980.55	$4,885.23	$1,437.37	$1,437.37	$795.29	$0.00	$42,599.54
Capital Expenditures												
– Exploration/Eng.	$921.10	$5,826.60										$6,747.70
– Development/Construction			$28,484.60									$28,484.60
– On–Going Capital						$1,433.50	$2,661.70					$4,095.20
Working Capital Change				$3,649.16						($3,649.16)	$0.00	$0.00
Salvage											($2,323.81)	($2,323.81)
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$8,192.49	$11,222.08	$9,547.05	$2,223.53	$1,437.37	$1,437.37	$4,444.44	$2,323.81	$5,595.85
Discounted NCF 5%	($921.10)	($5,549.14)	($25,836.37)	$7,076.98	$9,232.43	$7,480.36	$1,659.23	$1,021.52	$972.87	$2,864.93	$1,426.62	($571.68)
Discounted NCF 10%	($921.10)	($5,296.91)	($23,540.99)	$6,155.14	$7,664.83	$5,927.96	$1,255.12	$737.60	$670.55	$1,884.88	$895.93	($4,566.99)
Discounted NCF 15%	($921.10)	($5,066.61)	($21,538.45)	$5,386.70	$6,416.26	$4,746.57	$961.29	$540.36	$469.88	$1,263.39	$574.41	($7,167.30)
Discounted NCF 20%	($921.10)	($4,855.50)	($19,780.97)	$4,741.02	$5,411.88	$3,836.74	$744.66	$401.14	$334.29	$861.36	$375.31	($8,851.16)
Discounted NCF 25%	($921.10)	($4,661.28)	($18,230.14)	$4,194.56	$4,596.56	$3,128.38	$582.88	$301.44	$241.15	$596.52	$249.52	($9,921.51)

Rate of Return 4.43%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%
4. Operating Cost +10%

Beacon Hill Consultants Ltd.

LACROS22

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 12
$(000)s

Description Year	-1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.00	0.24
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				86205.40	90335.00	90335.00	69153.00	58873.50	58873.50	34987.68	0.00	488763.08
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$33,663.03	$35,275.63	$35,275.63	$27,332.38	$23,477.56	$23,477.56	$13,952.38	$0.00	$192,454.16
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$11,828.96	$0.00	$130,346.04
Revenue Before Taxes				$14,668.45	$15,371.13	$15,371.13	$7,427.88	$3,573.06	$3,573.06	$2,123.42	$0.00	$62,108.12
State Income Taxes				$616.99	$641.58	$641.58	$257.84	$159.76	$159.76	$159.76	$0.00	$2,637.27
Federal Income Taxes				$526.35	$1,862.05	$2,168.90	$722.49	$55.82	$55.82	$0.00	$0.00	$5,391.43
Revenue Before Capital Exp.				$13,525.11	$12,867.50	$12,560.65	$6,447.55	$3,357.48	$3,357.48	$1,963.66	$0.00	$54,079.41
Capital Expenditures												
– Exploration/Eng.	$1,013.21	$6,409.26										$7,422.47
– Development/Construction			$31,333.06									$31,333.06
– On-Going Capital						$1,576.85	$2,927.87					$4,504.72
Working Capital Change				$3,317.42						($3,317.42)	$0.00	$0.00
Salvage											($2,556.19)	($2,556.19)
Net Cashflow	($1,013.21)	($6,409.26)	($31,333.06)	$10,207.69	$12,867.50	$10,983.80	$3,519.68	$3,357.48	$3,357.48	$5,281.07	$2,556.19	$13,375.36
Discounted NCF 5%	($1,013.21)	($6,104.06)	($28,420.01)	$8,817.79	$10,586.12	$8,606.09	$2,626.44	$2,386.10	$2,272.47	$3,404.23	$1,569.28	$4,731.24
Discounted NCF 10%	($1,013.21)	($5,826.60)	($25,895.09)	$7,669.19	$8,788.67	$6,820.07	$1,986.77	$1,722.92	$1,566.29	$2,239.69	$985.52	($955.78)
Discounted NCF 15%	($1,013.21)	($5,573.27)	($23,692.29)	$6,711.72	$7,357.03	$5,460.89	$1,521.66	$1,262.20	$1,097.57	$1,501.21	$631.85	($4,734.65)
Discounted NCF 20%	($1,013.21)	($5,341.05)	($21,759.07)	$5,907.23	$6,205.39	$4,414.14	$1,178.73	$937.01	$780.84	$1,023.51	$412.84	($7,253.64)
Discounted NCF 25%	($1,013.21)	($5,127.41)	($20,053.16)	$5,226.34	$5,270.53	$3,599.17	$922.66	$704.11	$563.29	$708.81	$274.47	($8,924.39)

Rate of Return 9.00%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%
4. Capital Cost +10%

Beacon Hill Consultants Ltd.

LACROS23

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 13
$(000)s

Description Year	-1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Grade Au Oz/ton				0.32	0.32	0.32	0.24	0.21	0.21	0.21	0.00	0.26
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				98022.32	102718.00	102718.00	78632.40	66943.80	66943.80	39783.74	0.00	555762.064
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$38,094.37	$39,919.25	$39,919.25	$30,887.15	$26,503.93	$26,503.93	$15,750.90	$0.00	$217,578.77
Operating Costs				$17,095.12	$17,914.05	$17,914.05	$17,914.05	$17,914.05	$17,914.05	$10,646.06	$0.00	$117,311.44
Revenue Before Taxes				$20,999.25	$22,005.20	$22,005.20	$12,973.10	$8,589.88	$8,589.88	$5,104.84	$0.00	$100,267.34
State Income Taxes				$819.73	$854.94	$854.94	$428.24	$336.58	$336.58	$162.33	$0.00	$3,793.34
Federal Income Taxes				$2,209.40	$3,611.93	$3,906.41	$2,158.44	$1,323.60	$1,323.60	$715.26	$0.00	$15,248.64
Revenue Before Capital Exp.				$17,970.12	$17,538.33	$17,243.85	$10,386.43	$6,929.70	$6,929.70	$4,227.25	$0.00	$81,225.36
Capital Expenditures												
– Exploration/Eng.	$828.99	$5,243.94										$6,072.93
– Development/Construction			$25,636.14									$25,636.14
– On–Going Capital						$1,290.15	$2,395.53					$3,685.68
Working Capital Change				$2,985.68						($2,985.68)	$0.00	$0.00
Salvage											($2,091.43)	($2,091.43)
Net Cashflow	($828.99)	($5,243.94)	($25,636.14)	$14,984.44	$17,538.33	$15,953.70	$7,990.90	$6,929.70	$6,929.70	$7,212.92	$2,091.43	$47,922.04
Discounted NCF 5%	($828.99)	($4,994.23)	($23,252.73)	$12,944.12	$14,428.83	$12,500.14	$5,962.93	$4,924.81	$4,690.29	$4,649.51	$1,283.96	$32,308.64
Discounted NCF 10%	($828.99)	($4,767.22)	($21,186.89)	$11,258.03	$11,978.92	$9,905.99	$4,510.65	$3,556.03	$3,232.75	$3,058.98	$806.34	$21,524.60
Discounted NCF 15%	($828.99)	($4,559.95)	($19,384.60)	$9,852.51	$10,027.60	$7,931.81	$3,454.68	$2,605.13	$2,265.33	$2,050.36	$516.97	$13,930.85
Discounted NCF 20%	($828.99)	($4,369.95)	($17,802.87)	$8,671.55	$8,457.91	$6,411.43	$2,676.13	$1,933.95	$1,611.63	$1,397.91	$337.78	$8,496.49
Discounted NCF 25%	($828.99)	($4,195.15)	($16,407.13)	$7,672.03	$7,183.70	$5,227.71	$2,094.77	$1,453.26	$1,162.61	$968.10	$224.57	$4,555.48

Rate of Return 33.77%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 92%
4. Operating Cost –10%
5. Capital Cost –10%
6. Gold Grade +10%

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LACROS24

March 8 1991

Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Case 14
$(000)s

Description Year	−1	1	2	3	4	5	6	7	8	9	10	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Mill Recovery % Au				0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Grade Au Oz/ton				0.26	0.26	0.26	0.20	0.17	0.17	0.17	0.00	0.22
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				74969.64	78561.00	78561.00	60139.80	51200.10	51200.10	30427.49	0.00	425059.128
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	208000.00	0.00	2292000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$29,449.62	$30,860.38	$30,860.38	$23,952.43	$20,600.04	$20,600.04	$12,242.31	$0.00	$168,565.17
Operating Costs				$20,894.04	$21,894.95	$21,894.95	$21,894.95	$21,894.95	$21,894.95	$13,011.86	$0.00	$143,380.64
Revenue Before Taxes				$8,555.58	$8,965.42	$8,965.42	$2,057.47	($1,294.91)	($1,294.91)	($769.55)	$0.00	$25,184.53
State Income Taxes				$403.03	$417.38	$417.38	$159.76	$159.76	$159.76	$159.76	$0.00	$1,876.84
Federal Income Taxes				$0.00	$817.92	$823.99	$0.00	$0.00	$0.00	$0.00	$0.00	$1,641.91
Revenue Before Capital Exp.				$8,152.54	$7,730.13	$7,724.06	$1,897.71	($1,454.67)	($1,454.67)	($929.31)	$0.00	$21,665.78
Capital Expenditures												
− Exploration/Eng.	$1,013.21	$6,409.26										$7,422.47
− Development/Construction			$31,333.06									$31,333.06
− On−Going Capital						$1,576.85	$2,927.87					$4,504.72
Working Capital Change				$3,649.16						($3,649.16)	$0.00	$0.00
Salvage											($2,556.19)	($2,556.19)
Net Cashflow	($1,013.21)	($6,409.26)	($31,333.06)	$4,503.38	$7,730.13	$6,147.21	($1,030.16)	($1,454.67)	($1,454.67)	$2,719.85	$2,556.19	($19,038.28)
Discounted NCF 5%		($6,409.26)	($29,841.01)	$4,084.70	$6,677.57	$5,057.32	($807.15)	($1,085.50)	($1,033.81)	$1,840.90	$1,647.74	($19,868.49)
Discounted NCF 10%		($6,409.26)	($28,484.60)	$3,721.80	$5,807.76	$4,198.63	($639.65)	($821.13)	($746.48)	$1,268.83	$1,084.07	($21,020.02)
Discounted NCF 15%		($6,409.26)	($27,246.14)	$3,405.21	$5,082.68	$3,514.69	($512.17)	($628.90)	($546.87)	$889.12	$726.63	($21,725.00)
Discounted NCF 20%		($6,409.26)	($26,110.88)	$3,127.35	$4,473.45	$2,964.51	($414.00)	($487.17)	($405.97)	$632.55	$495.41	($22,134.01)
Discounted NCF 25%		($6,409.26)	($25,066.45)	$2,882.17	$3,957.82	$2,517.90	($337.56)	($381.33)	($305.07)	$456.31	$343.09	($22,342.38)

Rate of Return −16.10%

Notes:

1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 86%
4. Operating Cost +10%
5. Capital Cost +10%
6. Gold Grade −10%

Beacon Hill Consultants Ltd.

SECTION 11

PROPERTY VALUATION

SECTION 11

PROPERTY VALUATION

11.1 Introduction

The Rosebud Project does not at present contain a mineable mineral inventory from which a discounted cash flow stream can be calculated or a net present value determined. It is an exploration property, and its value lies in the perception of the potential for mineable reserves and the value of those potential reserves to the party doing the value assessment.

The problem of valuing exploration properties has been approached in many ways over the years, none of which are particularly scientific and do not produce bankable results. There are a number of measurements that, although completely subjective, can be applied, at least to define a set of boundaries for the value of a given project. There are two broad approaches to a valuation. One is the market value, which is simply what a purchaser would be willing to pay for the project, and the second is the value of the potential income, which represents the true value to the owner if the project is not to be sold. The following sections examine both approaches and together are considered to provide a means of determining a realistic value for the Rosebud Project.

11.2 Market Value Assessment

Since the market value of a property is the price a purchaser is actually willing to pay for it, the most representative measure of value, at least in the context of sale/purchase, would be a market study that considers recent transactions on similar properties. Unfortunately, it is exceedingly rare to have access to all the parameters of a deal and equally rare for the properties in question to be very similar. In addition, a number of intangible considerations are usually included in every deal, which reflect value but are impossible to quantify. A mathematically precise evaluation is not possible, but generalized observations can be made about apparently similar property characteristics and transactions.

The Rosebud Project can be considered as two relatively distinct categories of property when trying to establish similarities. First, there is the Dozer Hill reserve, which can be characterized as a partially drilled, geologic reserve with good potential for being large enough to become a viable mine. Second, the remaining part of the project can be viewed as a large property package in a highly prospective area, near operating mines, with a number of very encouraging surface anomalies.

The Northern Miner, The Mining Record and *The George Cross Newsletter* were reviewed for the past three to four months. Lists of transactions were made and the terms of the deals noted. Properties were categorized as operating (including ready to operate), drilled with reserves, or prospects. The value of each transaction was determined using cash payments (both actual and obligated) and stock prices valued near the date of the transaction where stock was involved. Where the reserves were the major asset (operating or drilled properties) they were converted to ounces or equivalent ounces of gold per ton and used as the basis of comparison. For prospects, the basis of comparison was the amount of land controlled (acres). Work commitments were ignored since they contributed no tangible asset to the transaction. Royalties were generally small enough to be ignored considering the other broad approximations required. Transactions for which these basic data could not be determined were not used. The results of this survey are presented in Table 11-1.

TABLE 11-1

TABULATION OF MINING PROPERTY TRANSACTIONS

Name	Seller/Buyer	Category	Units	Price $(000)s	Price Unit
Robinson	Kennecot/Magma	Operating	oz Au	$ 10,500	$ 16.82
Robinson	Echo Bay/Alta	Operating	oz Au	2,000	6.94
Royal Mt. King	FMC/Falconbridge	Operating	oz Au	9,400	98.68
Tonkin Springs	US Gold/Homestake	Operating	oz Au	4,700	40.16
Silver Bute	GCN/Formosa	Operating	equiv. oz	350	13.29
Mt. Polley	Corona/Imperial	Drilled Reserves	equiv. oz	$ 6,000	$ 7.37
Castle Mt.	Viceroy/MK Gold	Drilled Reserves	oz Au	17,500	157.56
Goldboro Gold	Ores/Minnova	Drilled Reserves	oz Au	5,000	7.02
Elkhorn	Mont. West/Newmont	Drilled Reserves	oz Au	410	8.27
Launay-Privat	Messeguay/Am.Barck.	Drilled Reserves	oz Au	210	4.67
Leckie	Corona/Stroud	Drilled Reserves	oz Au	500	14.06
Tache Lake	Greenstone/Teck	Drilled Reserves	equiv. oz	200	4.72
Hislop	Chevron/Athabaska	Drilled Reserves	oz Au	3,200	11.01
Blue Moon	Colony Pacific/Lac	Drilled Reserves	equiv. oz	11,000	9.05
Snow Bird	X-Cal/Cominco	Prospect	acres	$ 400	$ 44.45
Engineering Pass	Ackright/Cold.Pond	Prospect	acres	30	25.64
Near Copperstone	/Silver Talon	Prospect	acres	180	900.00
Humbolt Co. NV.	/Miramar	Prospect	acres	55	36.10
Summit Claims	/Quattro	Prospect	acres	220	293.34
Wild Rose (Rosebud)	Equinox/X-Cal	Prospect	acres	130	8.13

Note: Gold equivalent determined using $365.88 gold, $3.81 silver, $1.25 copper, $0.55 zinc.

With the exception of the anomalously high value for the Castle Mountain transaction, it appears that in recent months the market has been valuing drilled but undeveloped reserves at between $5 and $15 per oz. It is interesting to contrast this to the $13 to $99 range for operating properties. The very low Echo Bay/Alta transaction is not included because there are an unusual number of intangible and unknown factors affecting the deal.

Presumably, the range in value for drilled reserves is due to the market's perception of the relative quality of the reserve and the additional potential. In this context it is reasonable to assume that the 0.05 oz Au/t cutoff underground reserve (354,000 oz) determined by LAC Minerals (USA), Inc. can be used as a basis for valuation. This reserve is only partially drilled but has a good chance of being expanded on additional

drilling. This quality of reserve should fall near the mid-point of the range, and for the purpose of this valuation the Dozer Hill reserves as currently determined should therefore have a value of $10 per oz, or $3,540,000.

In recent months the range of values for prospects with no reserves has been from $8 to $900 per acre. Clearly, a great deal of speculation is involved in the prices of many of these properties. It is interesting to note that the lowest price was for properties near Rosebud. There is no information in hand to indicate the reason for this, but it is safe to assume that it is not a reflection of the market's perception of the value of the Rosebud Project.

Subjectively, Rosebud is as good as any of the prospects on the list, and better than most, and speculation about the project has increased considerably as a result of the Dozer Hill announcements and the proximity to the Hycroft operation. The value of the Rosebud Project, exclusive of Dozer Hill, should be in the middle to upper part of the range, and for the purpose of this evaluation, it is reasonable to use $500 per acre.

The land package at Rosebud consists of approximately 8,600 acres and it should, therefore, have a value of $4,300,000. Combining the values for the reserves at Dozer Hill and the rest of the project yields $7,840,000 for the total current market value of the property. The range prediction on this number should be considered plus or minus 25% and possibly more.

11.3 Valuation of Potential Income Stream

The value of the potential income stream is derived from an economic model based on three fundamental assumptions:

(a) The type of deposit, including tonnage and grade likely to be found.
(b) The probability of this occurring.
(c) The probable production characteristics (mining and milling, etc.) of the deposit.

Given these data, a probability weighted net present value can be calculated. The logic used to develop these assumptions is detailed in the following sections.

11.3.1 Deposit Type

This discussion is, of necessity, very generalized. Although many geologic considerations come into play, it is necessary to consider only the most basic parameters of probable size and grade. These are determined by the district ore controls and the perceived strength of the system, which are in turn reflected in the mineralization already identified.

The fact that gold concentrations occur at Dreamland, Dozer Hill and the Hycroft property demonstrates that the district has potential for multiple areas of widespread, strong mineralization. It is reasonable to assume that any new deposits found would be similar in character to those already identified, that is, large, irregular, very non-homogenous areas of gold mineralization, each consisting of several tens of millions of ore tons with gold content averaging from 0.01 to 0.03 oz Au/t. Within these areas are higher grade pods ranging from a few thousand ore tons to a few million ore tons with gold content in the range of 0.1 to 0.4 oz Au/t. This assumption gains added weight when considered in the framework of other, similar deposits such as Aurora, Rawhide, Borealis and Bodie.

The surface of the Rosebud Project area has been extensively prospected and recently sampled. This work has substantially reduced the probability that a large, near-surface deposit will be found. The actual character of the deposit does not change with depth, but the manner in which it must be mined, and therefore the mineable reserve, is directly determined by depth. All other considerations aside, the Hycroft mine at depth would become a Dozer Hill at best, and possibly a Dreamland, or worse. Conversely, Dozer Hill at the surface would become something like the Hycroft mine.
Any additional reserves found at Rosebud would it is probably be in one to three zones of multiple ore blocks similar to the current Dozer Hill reserve. Grades can also be expected to be similar to those currently known in Dozer Hill.

11.3.2 Probability of Occurrence

Many methods and tricks have been used over the years to quantify the probabilities of various potentials for a district or deposit. Only a limited number of "facts" can be applied to this kind of assessment, and most of these are empirical observations that are difficult or impossible to quantify. For the purpose of this evaluation, two of these empirical facts are significant. First, there is a finite size to all deposits or districts, and second, there are substantially more small deposits or districts than large ones. Additionally, the probability of finding incremental ores is limited by the observed fact that if the district in question is large (high past production or reserves) the probability that it will be much larger (double the size, for instance) is relatively low. On the other hand, if the district is small the probability that it will be much larger is relatively high.

The best way to evaluate the potential in a district is by consensus, which simply means collecting the impressions and opinions of geologists familiar with the district and the deposit type to identify areas of agreement as well as upper and lower boundaries for potentials and probabilities.

Through discussions with the staff of LAC Minerals (USA), Inc. and of Hycroft, as well as considerable review by Beacon Hill Consultants Ltd., a framework has been evolved for the probabilities and potentials of the Rosebud Project. These are summarized in Table 11-2.

TABLE 11-2

ROSEBUD PROJECT ESTIMATES OF POTENTIAL

Category	Total Oz	Probability (%)	Estimator
Current Reserve	275,000	90-95	BHC (uneconomic)
High Probability Reserve	500,000	70-80	BHC
Good Probability Reserve	1,500,000	30-40	Consensus Estimate

11.3.3 Production Characteristics

The current work indicates that if orebodies are found, they will be at some depth below the surface. They will require underground mining and contain relatively high grades amenable to a crush, grind and cyanide leach recovery system similar to the conceptual mine plan developed by Beacon Hill Consultants Ltd. for Dozer Hill. There would likely be three separate mines with a shared mill and surface facility.

11.3.4 Potential Income Valuation

The foregoing discussions provide the basis for an economic model using the same general operating parameters as developed by Beacon Hill Consultants Ltd. for the high tonnage case at Dozer Hill. The resultant net present value must be cut significantly, however, to provide a more realistic assessment by using the probability of occurrence as a cutting factor.

Although it is clear that potential income has some value, there is a wide variety of opinions on how to assess that value. The foregoing discussion provides a framework intended to serve as a starting point for an assessment of value.

11.4 Economic Model

The hypothetical series of events discussed in the preceding paragraphs has been assumed to have a 35% probability of occurring, whereas the 1,000 t/d production case with a reserve of approximately 2.3 million tons established in this study has a 75% probability of occurring.

The conceptual mine plan and financial analysis carried out in the foregoing sections have provided a base for the capital and operating costs of a viable operation. These costs can also be used as a basis for estimating the parameters of an economic model for project potential. For the model it is assumed that the Dozer Hill reserve is drilled off and that the other two deposits are identified and drilled off over the next five years. Construction and excavation at Dozer Hill would begin in Year 2 or 3, and first production would be achieved in Year 4. The other mines would be developed in sequence to maintain production at 1,000 t/d.

Capital costs have been adjusted to eliminate the cost of the mill and other surface structures. Operating costs have been considered to be the same as those for the 1,000 t/d case, and all other criteria have been considered to be the same.

Given the above, a financial analysis Case 30, shown on Table 11-3, was developed for 6,250,000 tons at 0.24 oz Au/t and 2 oz Ag/t, which gives a NPV discounted at 5% of $32.3 million. The discount percentage has been used to correct for inflation. Assuming a 35% chance of this occurring plus a 75% chance of the reserves for the 1,000 t/d case being delineated, the value of the property would be 35% x 75% of $32.3 million, or $8.5 million.

11.5 Comparison of Two Methods of Valuation

The two methods give a value for the property of between $8.5 and $7.8 million. Thus it would be fair to say that the value of the property is $8.0 million with a range of plus or minus 25%, or $6 million to $10 million.

LACROS30

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TABLE 11-3
Rosebud Project
Dozer Hill Deposit
1000 TPD
Financial Analysis
Hypothetical Only
Case 30
$(000)s

Description / Year	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Production Tons/Year				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	316000.00	6250000
Mill Recovery % Au				0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Grade Au Oz/ton				0.29	0.29	0.29	0.222	0.189	0.189	0.189	0.29	0.29	0.29	0.22	0.19	0.19	0.19	0.29	0.29	0.29	0.22	0.11
Grade Ag Oz/ton				2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Mill Recovery % Ag				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oz Au				86205.40	90335.00	90335.00	69153.00	58873.50	58873.50	58873.50	90335.00	90335.00	90335.00	69153.00	58873.50	58873.50	58873.50	90335.00	90335.00	90335.00	62435.28	1362867.88
Oz Ag				334000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	350000.00	316000.00	6250000
Selling Price $/Oz Au				$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00	$375.00
Selling Price $/Oz Ag				$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
Gross Revenue				$33,663.03	$35,275.63	$35,275.63	$27,332.38	$23,477.56	$23,477.56	$23,477.56	$35,275.63	$35,275.63	$35,275.63	$27,332.38	$23,477.56	$23,477.56	$23,477.56	$35,275.63	$35,275.63	$35,275.63	$24,677.23	$536,075.38
Operating Costs				$18,994.58	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$19,904.50	$17,970.92	$355,437.50
Revenue Before Taxes				$14,668.45	$15,371.13	$15,371.13	$7,427.88	$3,573.06	$3,573.06	$3,573.06	$15,371.13	$15,371.13	$15,371.13	$7,427.88	$3,573.06	$3,573.06	$3,573.06	$15,371.13	$15,371.13	$15,371.13	$6,706.31	$180,637.88
State Income Taxes				$607.57	$632.16	$632.16	$268.16	$145.24	$145.24	$145.24	$607.57	$632.16	$632.16	$268.16	$145.24	$145.24	$145.24	$607.57	$632.16	$632.16	$268.16	$7,291.59
Federal Income Taxes				$797.03	$1,960.47	$2,287.67	$806.04	$127.28	$127.28	$307.12	$3,412.21	$885.40	$2,099.94	$479.16	$0.00	$105.97	$105.97	$2,594.04	$1,960.47	$2,287.67	$560.71	$20,904.44
Revenue Before Capital Exp.				$13,263.84	$12,778.49	$12,451.29	$6,353.68	$3,300.55	$3,300.55	$3,120.71	$11,351.34	$13,853.56	$12,639.02	$6,680.55	$3,427.82	$3,321.86	$3,321.86	$12,169.52	$12,778.49	$12,451.29	$5,877.44	$152,441.85
Capital Expenditures	$921.10	$5,826.60	$28,484.60	$0.00	$0.00	$0.00	$1,283.60	$6,942.35	$18,810.55	$151.80	$155.70	$412.50	$1,433.50	$2,661.70	$151.80	$155.70	$412.50	$1,433.50	$2,661.70	$151.80	$155.70	$72,206.70
- Exploration/Eng.																						$0.00
- Development/Construction																						$0.00
- On-Going Capital																						$0.00
Working Capital Change				$3,317.42																	($3,317.42)	$0.00
Salvage																						$0.00
Net Cashflow	($921.10)	($5,826.60)	($28,484.60)	$9,946.43	$12,778.49	$12,451.29	$5,070.08	($3,641.80)	($15,510.00)	$2,968.91	$11,195.64	$13,441.06	$11,205.52	$4,018.85	$3,276.02	$3,166.16	$2,909.36	$10,736.02	$10,116.79	$12,299.49	$9,039.16	$80,235.15
Discounted NCF 5%	($877.24)	($5,284.90)	($24,606.07)	$8,182.95	$10,012.28	$9,291.34	$3,603.21	($2,464.92)	($9,997.89)	$1,822.65	$6,545.86	$7,484.49	$5,942.53	$2,029.79	$1,575.82	$1,450.45	$1,269.34	$4,461.04	$4,003.56	$4,635.55	$3,244.54	$32,324.39
Discounted NCF 10%	($837.36)	($4,815.37)	($21,400.90)	$6,793.54	$7,934.44	$7,028.43	$2,601.75	($1,698.93)	($6,577.76)	$1,144.64	$3,924.00	$4,282.74	$3,245.84	$1,058.29	$784.25	$689.05	$575.60	$1,930.97	$1,654.18	$1,828.24	$1,221.47	$11,367.10
Discounted NCF 15%	($800.96)	($4,405.75)	($18,729.09)	$5,686.90	$6,353.17	$5,383.04	$1,906.03	($1,190.51)	($4,408.91)	$733.87	$2,406.43	$2,512.23	$1,821.21	$567.98	$402.61	$338.35	$270.35	$867.53	$710.86	$751.50	$480.26	$1,657.09
Discounted NCF 20%	($767.58)	($4,046.25)	($16,484.14)	$4,796.70	$5,135.39	$4,169.91	$1,414.97	($846.97)	($3,005.94)	$479.49	$1,506.80	$1,507.50	$1,047.31	$313.01	$212.63	$171.25	$131.13	$403.26	$316.66	$320.82	$196.48	($3,027.56)
Discounted NCF 25%	($736.88)	($3,729.02)	($14,584.12)	$4,074.06	$4,187.26	$3,264.03	$1,063.27	($610.99)	($2,081.72)	$318.78	$961.70	$923.66	$616.03	$176.75	$115.26	$89.12	$65.51	$193.40	$145.80	$141.80	$83.37	($5,322.92)

Rate of Return 16.39%

Notes:
1. Double Probable Reserves
2. Gold Price $375/Oz.
3. Metallurgical Recovery 89%

Beacon Hill Consultants Ltd.

SECTION 12

CONCLUSIONS AND RECOMMENDATIONS

SECTION 12

CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

12.1.1 Reserve Audit

The reserve audit completed in this study represents a qualitative assessment of the validity of the Dozer Hill geologic reserve developed by LAC Minerals (USA), Inc. The reserve is classed as an in-place probable and possible geologic reserve. The conclusions derived herein are referenced to this level of reserve estimation.

It is the opinion of Beacon Hill Consultants Ltd. that the probable and possible reserves as calculated by LAC Minerals (USA), Inc. for the Dozer Hill deposit are accurate and reasonable estimates at the current level of exploration and existing data. All procedures and calculations on which the reserve is based have been completed in a manner consistent with sound geologic and mining practice.

12.1.2 Property Valuation

The Rosebud property has been valued using two methods, Market Value Assessment and the Value of Potential Income. The Market Value Assessment indicates a value of $7,840,000, plus or minus 25%, based on 345,000 oz Au at $10 per oz and a property value of $500 per acre for 8,600 acres.

The alternative method, Value of Potential Income, indicates a value of $8.5 million based upon a 75% chance of the reserves for the 1,000 t/d case being delineated and a 35% probability of an additional two similar deposits occuring on the property.

The above values, which are based on subjective opinion, indicate a property value of $8.0 million and a range in value of $6.0 million to $10.0 million. A suggested asking price, if the property was put up for sale, is $10.0 million.

12.1.3 Financial Analysis

The conceptual mine plan as described in this report indicates that the milling rate of 500 t/d is not viable based upon the estimated probable reserves of 1,146,000 tons at 0.24 oz Au/t and 2.0 oz Ag/t, a gold price of $375 per oz, metallurgical recovery of 89% and the capital and operating cost estimates derived in this study. It is reasonable to say that this alternative may, upon completion of further exploration and rock quality investigations, improve to a point where a +15% IRR can be achieved. This would require a minimum 10% improvement in mining grade and a mining method that would allow a 10% decrease in capital costs and a 20% decrease in operating costs.

The 1,000 t/d milling rate, which is also based on the above parameters but assumes the probable reserves will be doubled with further exploration, is viable and is indicated to be highly attractive should there be an improvement in mining grade and rock quality. Fourteen financial analysis cases have been investigated, only two of which indicate a negative IRR: Case 6 incorporates a gold price of $325 per oz, and the other,

Case 14, is based on capital and operating costs increasing by 10% each, mining grade decreasing by 10% and a metallurgical recovery of 86%. The remaining cases produce IRRs in the range of 1.08% to 33.77%, with seven in excess of 15%.

The financial analysis indicates that the project is most sensitive to mining grade and gold price changes, less sensitive to operating cost and least sensitive to capital cost.

12.2 Recommendations

It is recommended the following programs be completed:

- Design an ongoing sample verification procedure to evaluate and quantify sampling, sample preparation and analytical variabilities. This will have the added value of isolating the natural variability and providing important insights for the refinement of the deposit model.

- Carry out carefully designed twin hole studies, including statistical studies, in at least two areas to confirm the repeatability of the sampling. This is to be designed to define the variability and relative accuracy of reverse circulation drilling versus core. One of the test areas recommended is a twin hole for hole No. 159, which would serve to verify the high grade and length of this intercept as well as to provide insight into the area of influence and homogeneity of high grade mineralization.

- Complete a comparative study on drill cores to determine the effects of various drilling and handling procedures on the accuracy of the final assay to answer the question of whether gold is lost during flushing of drill fluids or in the water cooling process used in sawing.

- Carry out a spot recheck of early samples (taken prior to the recheck procedure) included in the reserve and a geostatistical study designed to quantify variability and provide an understanding of the usability of these data for high confidence reserve calculations.

- Carefully select at least one and preferably two ore areas for close spaced drilling (25 ft spacing at most). This will provide hard data concerning the distribution and continuity of mineralization. If a zone with greater than 1.0 oz Au/t rock is included, this will serve the added purpose of helping to resolve the question of cutting high grade assays.

- A significant amount of structural data is available in the underground workings and the core. A formal procedure to incorporate this in geologic mapping and logging is needed. Evaluation of this information will expand the understanding of the relationship between the various large- and small-scale structural features and mineralization.

- Carefully design geostatistical studies to complement and enhance (not direct) all of the above.

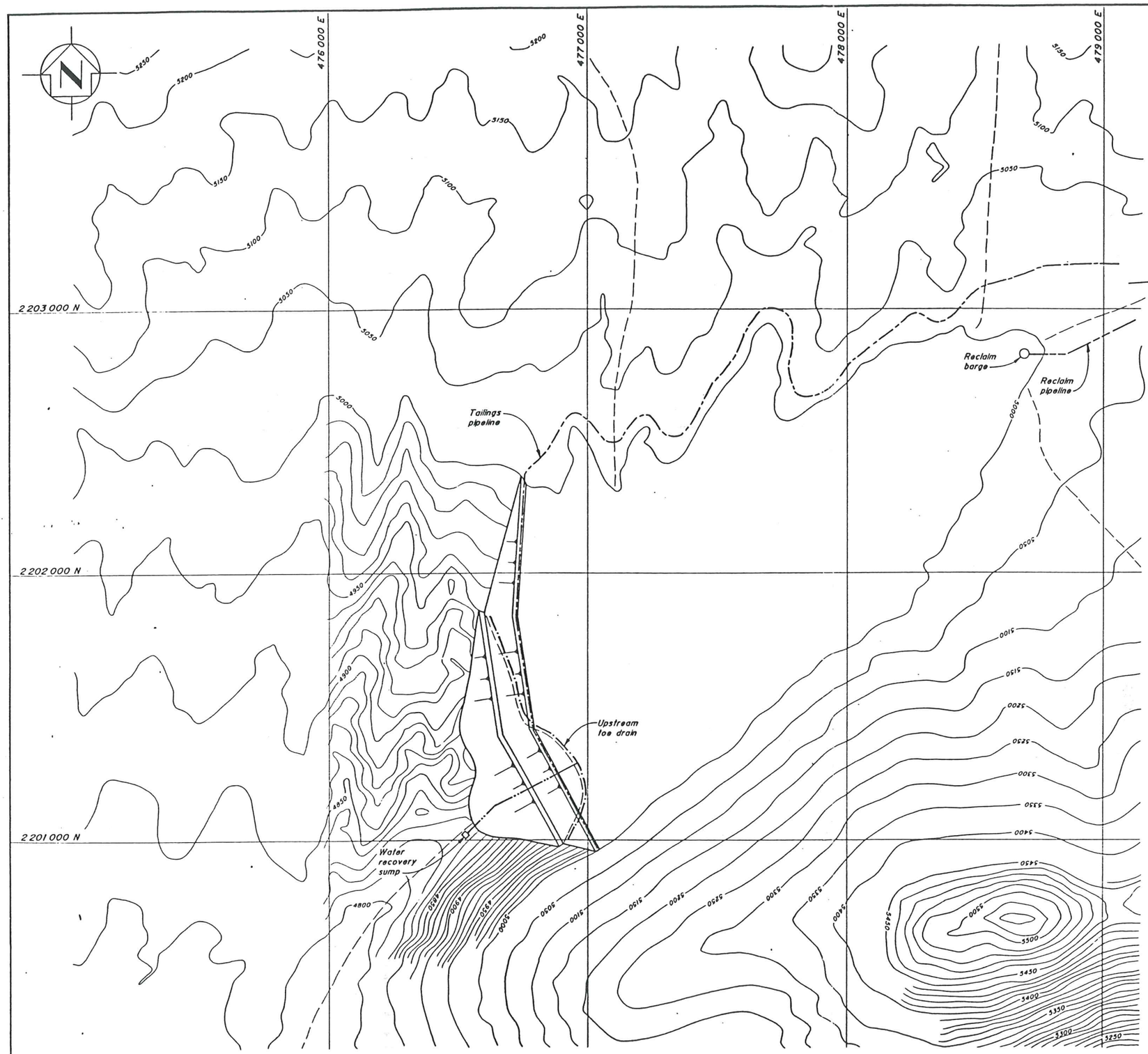
- Due to concern about the expected mechanical properties of the in situ rock types, the mining method selected in this report is the drift and fill system. Unfortunately, rock mechanics data are very limited, and in order to provide information for subsequent studies it is recommended that a rock mechanics study be implemented as part of and in conjunction with the next phase of the exploration program. It is obvious that the

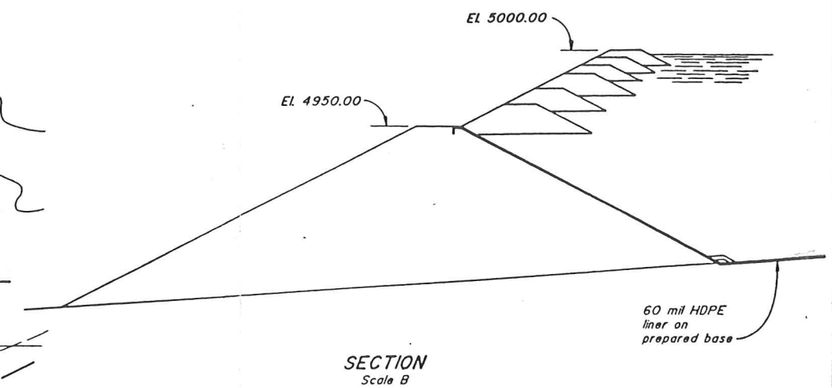
exploration program will take preeminence over the rock mechanics program, but for minimal effort and cost, invaluable information can be obtained at this time of data gathering. A description of the proposed work is included in the report prepared by Piteau Associates attached in Appendix A.

- Metallurgical testwork, as proven in the results obtained from the work completed to date, is critical to the project evaluation. An improvement in metallurgical recovery of a few percent can enhance the project substantially; conversely, a decrease in recovery can make the project non-viable. It is recommended that the test program as described in Section 5 be implemented.

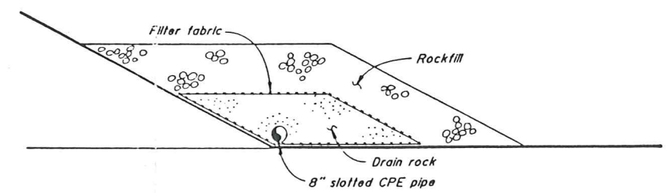
SECTION 13

DRAWINGS





SECTION
Scale B



UPSTREAM TOE DRAIN
Scale C

C 3 0 3 6 9 12 15 Feet
B 50 0 50 100 150 200 250 Feet
A 200 100 0 200 400 600 800 1000 Feet

DRG NO.	DESCRIPTION	REV.	DATE	DESCRIPTION	APPROVED	REV.	DATE	DESCRIPTION	APPROVED
REFERENCE DRAWINGS		REVISIONS				REVISIONS			

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

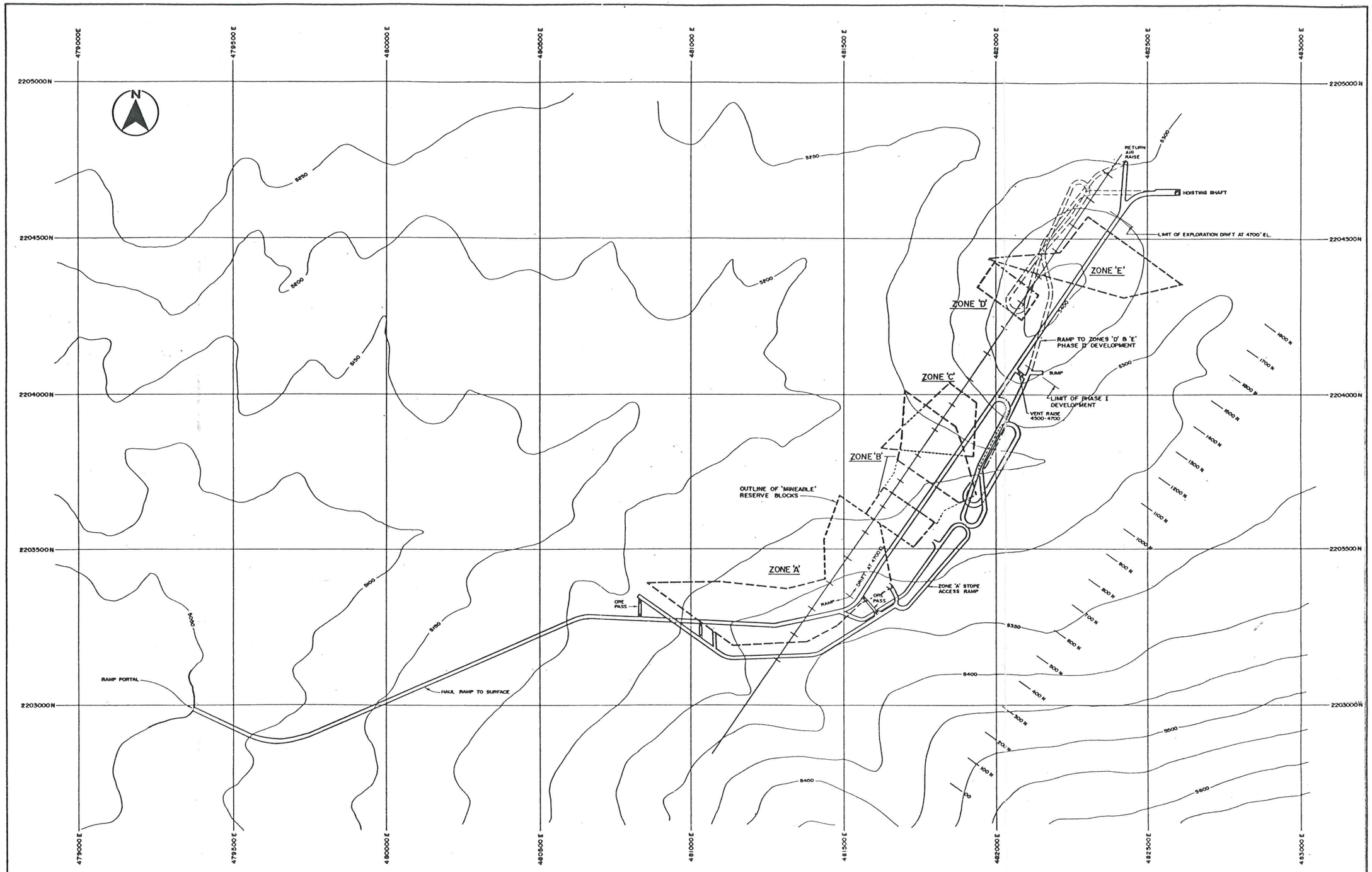
DESIGNED BSB
DRAWN RDT
CHECKED
APPROVED

BEACON HILL CONSULTANTS

ROSEBUD PROJECT

TAILINGS STORAGE FACILITY

DATE | SCALE AS SHOWN | DRG. NO. 1100/2.001 | REV.

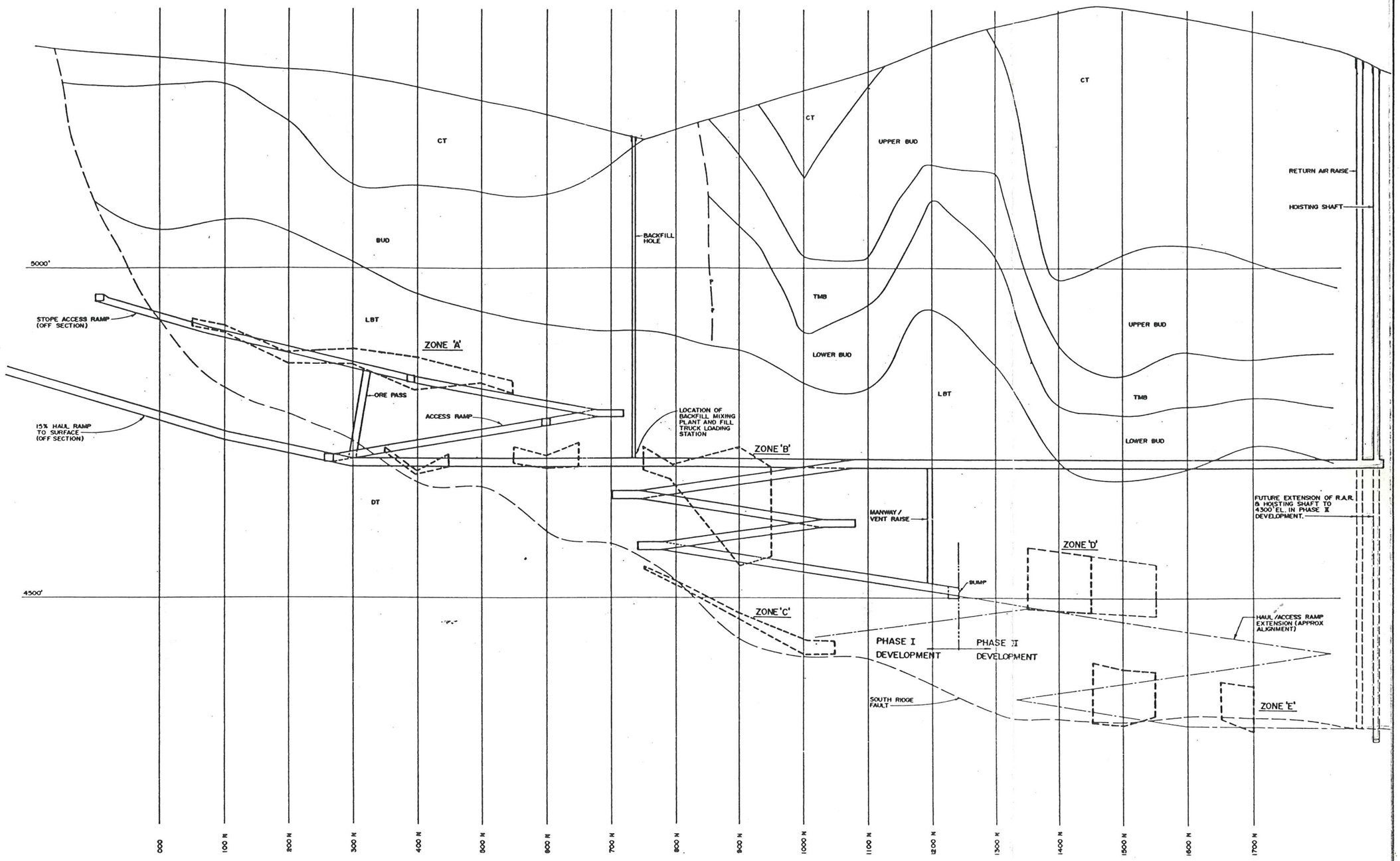


LAC MINERALS U.S.A. INC.
ROSEBUD PROJECT

DOZER HILL DEPOSIT
MINE DEVELOPMENT PLAN

BEACON HILL CONSULTANTS LTD.
Mining Engineers

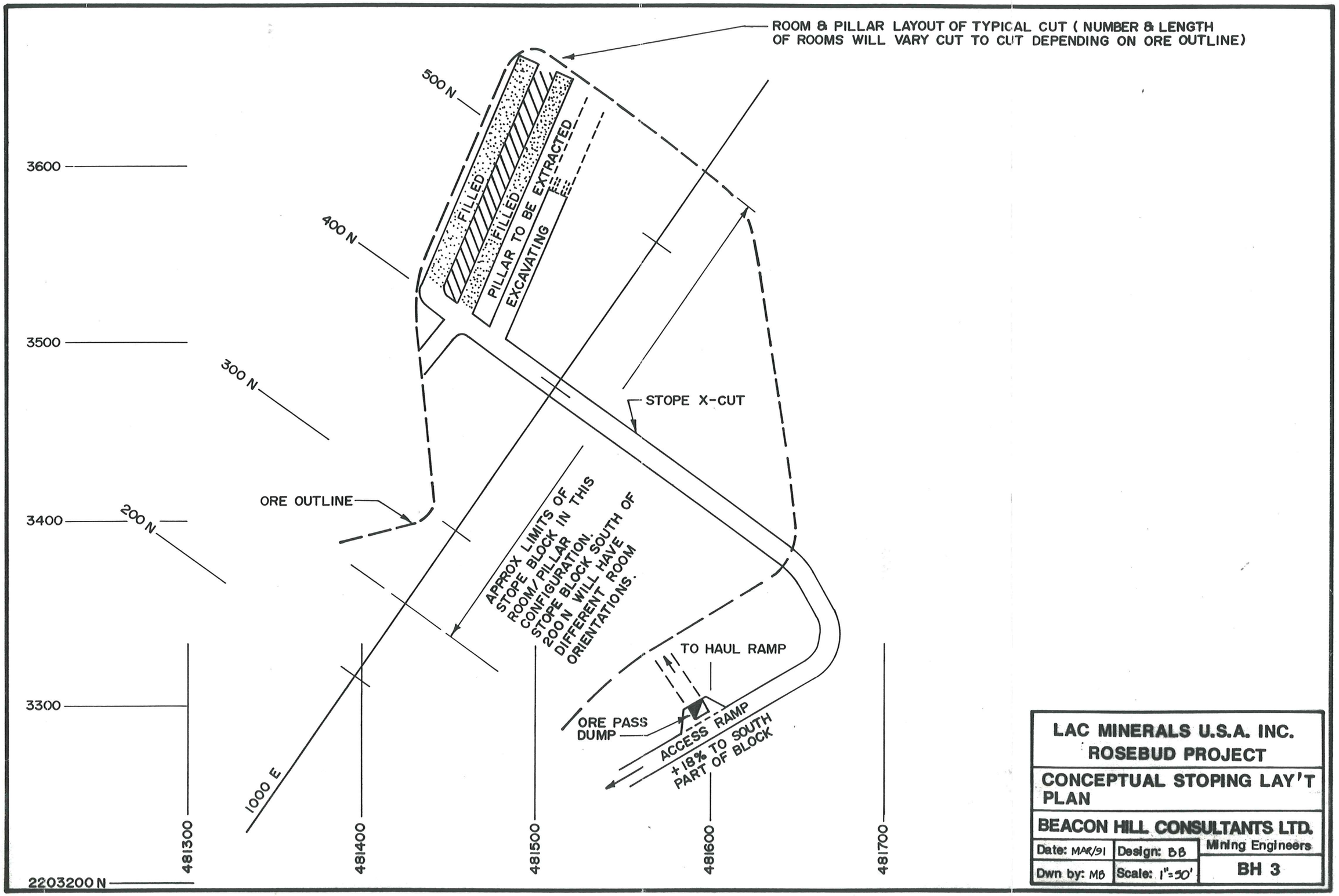
Date: MARCH '91	Design: BB	BH 1
Dwn by: BLISS	Scale: 1"=100'	

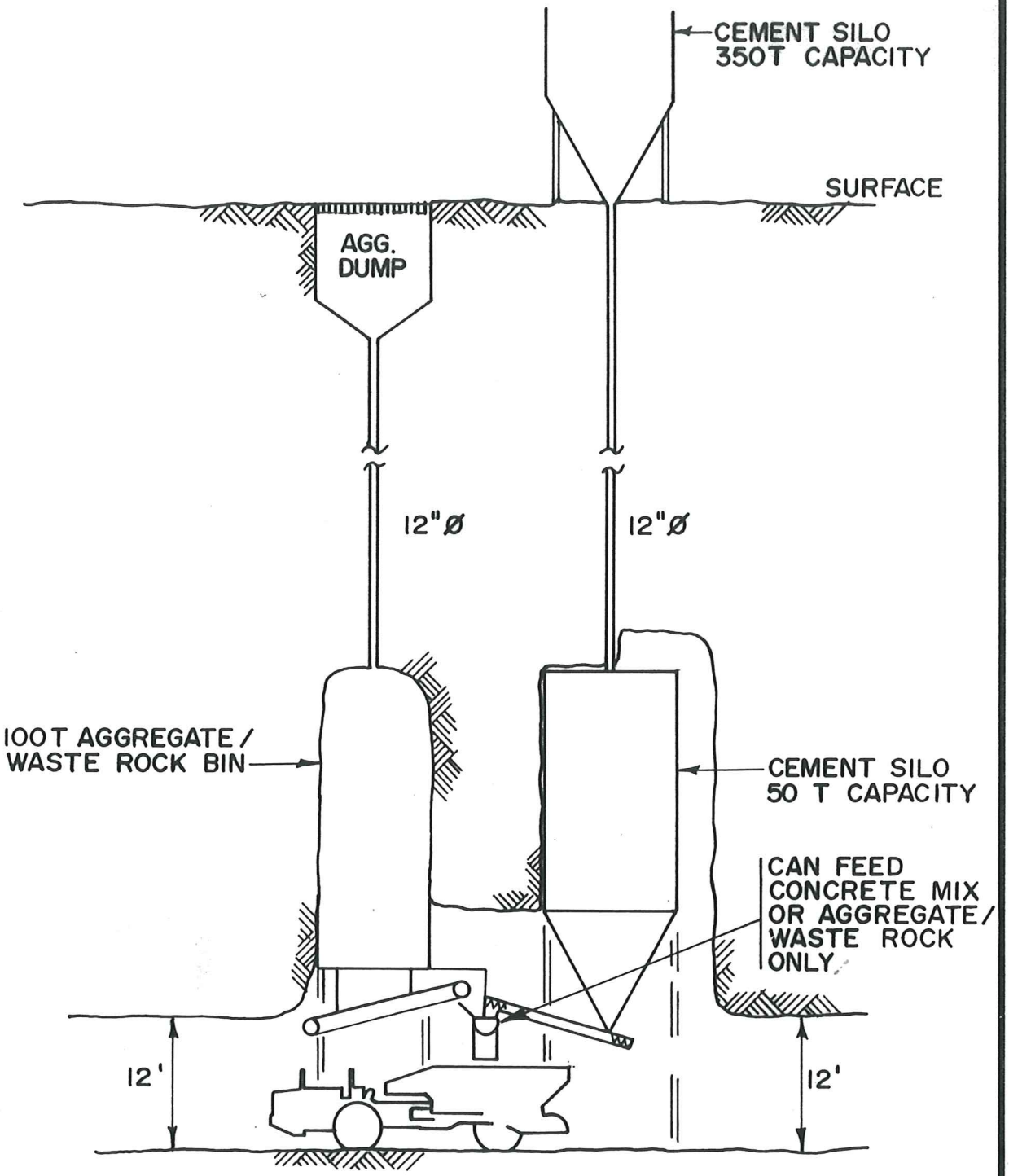


LONGITUDINAL SECTION AT 1000 E

0 100 200 FT

LAC MINERALS U.S.A. INC. ROSEBUD PROJECT	
DOZER HILL – MINE DEVELOPMENT – LONGITUDINAL SECTION	
BEACON HILL CONSULTANTS LTD.	Mining Engineers
Date: MARCH '91 / Design: D.B.	BH 2
Dwn by: G.L.S.S. / Scale: 1"=50'	


ROOM & PILLAR LAYOUT OF TYPICAL CUT (NUMBER & LENGTH OF ROOMS WILL VARY CUT TO CUT DEPENDING ON ORE OUTLINE)
500 N
400 N
300 N
200 N
3600
3500
3400
3300
2203200 N
FILLED
FILLED
PILLAR TO BE EXTRACTED
EXCAVATING
STOPE X-CUT
ORE OUTLINE
APPROX LIMITS OF STOPE BLOCK IN THIS ROOM/PILLAR CONFIGURATION. STOPE BLOCK SOUTH OF 200 N WILL HAVE DIFFERENT ROOM ORIENTATIONS.
TO HAUL RAMP
ORE PASS DUMP
ACCESS RAMP
+18% TO SOUTH PART OF BLOCK
1000 E
481300
481400
481500
481600
481700
LAC MINERALS U.S.A. INC.
ROSEBUD PROJECT
CONCEPTUAL STOPING LAY'T PLAN
BEACON HILL CONSULTANTS LTD.
Mining Engineers
Date: MAR/91
Design: BB
Dwn by: MB
Scale: 1"=50'
BH 3



SCHEMATIC ONLY

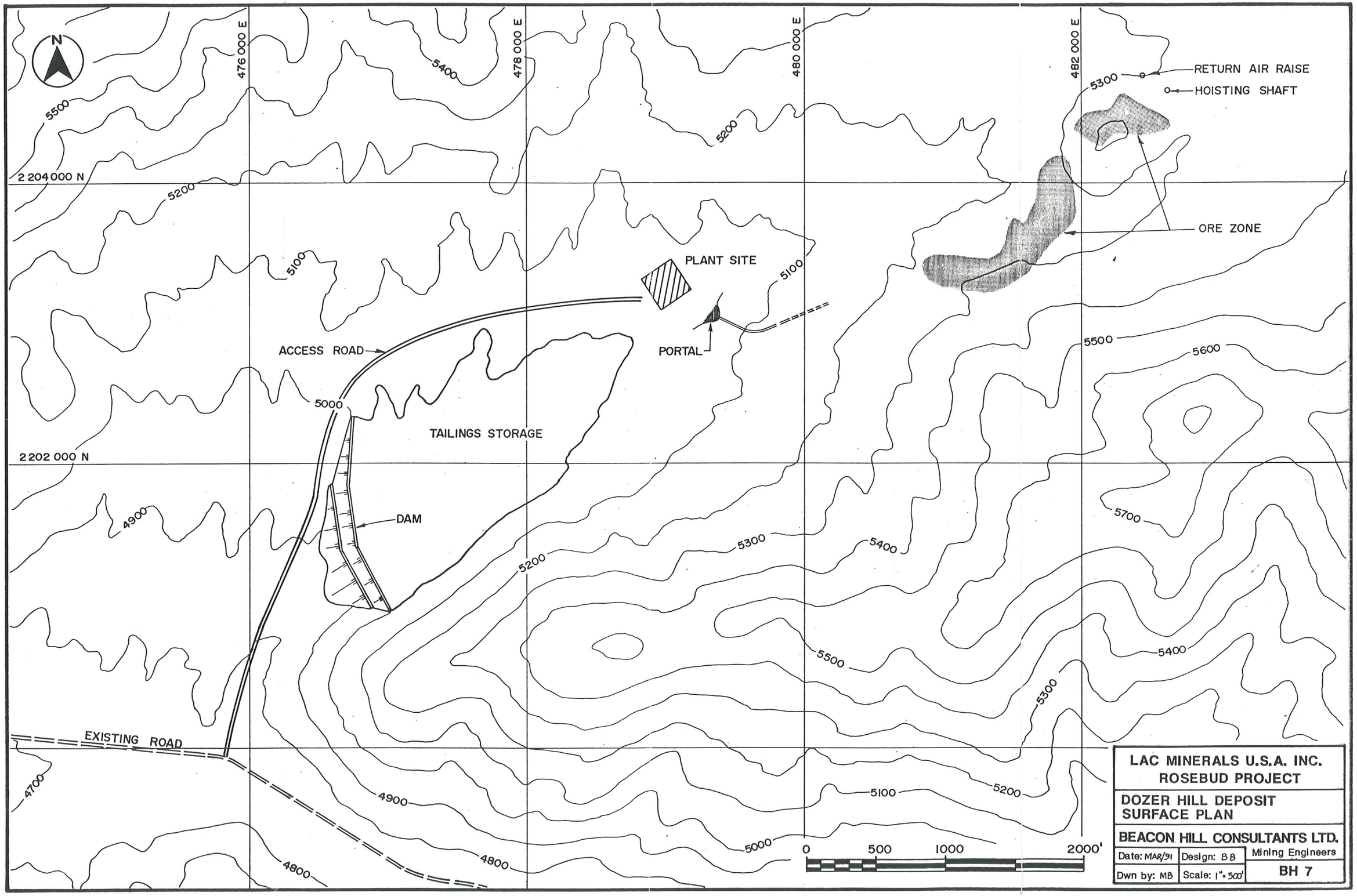
LAC MINERALS U.S.A. INC. **ROSEBUD PROJECT**		
DOZER HILL DEPOSIT **BACKFILL MIX SYSTEM**		
BEACON HILL CONSULTANTS LTD.		
Date: MAR/91	Design: P.S.	Mining Engineers
Dwn by: MB	Scale: NTS	**BH 6**

LAC MINERALS U.S.A. INC.
ROSEBUD PROJECT

CONCEPTUAL STOPING LAY'T
ZONE 'A' – SECTION AT 1000E

BEACON HILL CONSULTANTS LTD.
Mining Engineers

Date: MAR/91	Design: BB	BH 5
Dwn by: MB	Scale: 1"=50'	


N
476 000 E
478 000 E
480 000 E
482 000 E
2 204 000 N
2 202 000 N
RETURN AIR RAISE
HOISTING SHAFT
ORE ZONE
PLANT SITE
PORTAL
ACCESS ROAD
TAILINGS STORAGE
DAM
EXISTING ROAD
5500
5400
5300
5200
5100
5000
4900
4800
4700
5600
5700
0
500
1000
2000'
LAC MINERALS U.S.A. INC.
ROSEBUD PROJECT
DOZER HILL DEPOSIT
SURFACE PLAN
BEACON HILL CONSULTANTS LTD.
Mining Engineers
Date: MAR/91
Design: BB
Dwn by: MB
Scale: 1" = 500'
BH 7

APPENDIX A

PRELIMINARY ROCK MECHANICS ASSESSMENTS

PITEAU ASSOCIATES
GEOTECHNICAL AND
HYDROGEOLOGICAL CONSULTANTS

215 - 260 WEST ESPLANADE
NORTH VANCOUVER, BC
CANADA V7M 3G7
TELEPHONE (604) 986-8551
FAX (604) 985-7286

Our file: 91-358

February 15, 1991

DENNIS C. MARTIN
R. ALLAN DAKIN
ALAN F. STEWART
FREDERIC B. CLARIDGE
TADEUSZ L. DABROWSKI

Mr. W. Peter Stokes, P. Eng.
Beacon Hill Consultants Limited
860 - 789 West Pender Street
Vancouver, B.C.
V6C 1H2

Dear Peter:

Re: Rosebud Project - Preliminary Rock Mechanics Assessments

As requested, Piteau Associates Engineering Ltd. (PAEL) has conducted a preliminary assessment of the geological information provided by Mr. W.P. Stokes of Beacon Hill Consultants Limited on February 8, 1991. The information reviewed consists of two geological assessment reports, a plan and sections showing the basic geology and interpretation of ore zone blocks prepared by Lac Minerals USA Inc. We have also examined colour slides of the rock cores, which have proved useful in preparing a preliminary assessment of rock quality.

This letter report summarizes the assessments which have been conducted, and provides preliminary rock mechanics recommendations for the prefeasibility studies currently being conducted by Beacon Hill Consultants Limited. It is important to note that detailed assessments of rock cores or rock mechanics testing have not been conducted.

ENGINEERING GEOLOGY AND ROCK QUALITY

We understand the current geological interpretation is that the deposit consists of a number of tabular orebodies of varying thickness and grade, which dip shallowly to moderately to the east or west. Figures 1 to 5 show the general distribution of the various rock types and ore zones, as interpreted by Lac Minerals personnel. The orebodies occur primarily within the Lower Bud Tuff, a sequence of Miocene volcanic and pyroclastic rocks which have variable strength, degree of alteration and fracturing. Alteration assemblages including variable silicification, argillic (clay alteration) and bleaching, with lesser evidence of chlorite, glauconite, calcite and other alteration minerals. Silicification tends to improve the strength and competency of the rock mass, whereas bleaching and argillic alteration result in reduced strength and competency.

The bottom of the Lower Bud Tuff is defined by the South Ridge Fault, a low angle thrust fault which is generally recognized by a zone of intensely sheared and altered rock of low quality, which ranges in thickness from 2 to 30 feet. Rocks below the South Ridge Fault consist of the Dozer Tuff, which

is generally less altered and more competent than rocks in the Lower Bud Tuff or near the main fault zones. The Lower Bud Tuff is overlain by the Bud Tuff, a generally more competent and less altered unit of volcanic and pyroclastic rocks.

Preliminary assessments of rock mass quality have been based on an examination of colour slides of diamond drill cores from five holes cored through the ore zones, on five separate sections in the project area. The colour slides were used to prepare preliminary estimates of the following rock mechanics parameters:

i) RQD (modified core recovery)
ii) Degree of Breakage
iii) Degree of Alteration

A description of the core logging technique as it would normally be applied to field logging of core is given in Appendix A. Information obtained from examining the photographs was compiled and plotted along the drillholes on the geological sections, to enable a preliminary visual assessment of the rock quality in those areas, as shown in Figs. 1 to 5.

The information given in Figs. 1 to 5 indicates that the rock strength, degree of fracturing, degree of alteration and general rock competency can be expected to vary throughout the deposit. Although detailed predictions are not possible, some general comments on rock mass quality can be made, based on the information available to date, as follows:

i) Rock cores in the Bud Tuff (as observed in photographs of the upper part of three holes) generally indicate good to excellent quality rock, and little reduction in rock competency due to alteration.

ii) Rock cores in the Lower Bud Tuff indicate that rock competency varies throughout the unit. Rocks in the upper sections of this unit appear to be of generally good quality with occasional 10 foot intersections of lower quality rock. Core competency generally decreases in the lower sections of the unit, particularly within 20 to 100 feet of the South Ridge Fault.

iii) All cores in Lower Bud Tuff on Section 00 appeared to be of very poor to poor quality, and significantly altered. Rock cores in Lower Bud Tuff on Sections 600, 800, 900, and 1600 appeared to be moderately to slightly altered, fair to good quality with occasional 10 to 20 foot zones of heavy alteration and poor quality. Rock cores within about 50

to 75 feet of the South Ridge Fault on Sections 600 and 1600 appeared to be moderately to heavily altered and of poor quality.

iv) There does not appear to be any clear relationship between rock quality and ore zones, although some ore zones are associated with higher degree of alteration, which can result in a lower competency of the rock mass.

v) Rocks cores from the Dozer Tuff are moderately to slightly altered, and are expected to have fair to good quality except in areas near the South Ridge Fault.

vi) Groundwater conditions along the faults or within the rock mass are unknown. We understand that the regional water table encountered in the exploration drillholes is generally about 200 feet below the existing ground surface.

PRELIMINARY ROCK MECHANICS ASSESSMENT OF MINING PLANS

We understand that the proposed mining concept involves possible room and pillar, conventional cut and fill and/or drift and fill mining of the tabular orebodies. Access would be obtained via the footwall, and the stopes would be developed along strike with mining proceeding upwards from the lowest levels of the mine. Based on the limited data available concerning rock quality, geological structure and hydrogeology, we have prepared a preliminary assessment of allowable spans by applying empirical criteria using the NGI Rock Mass Classification System (see Appendix B). The NGI System enables a preliminary rock mass quality, Q, to be determined based on a number of parameters including RQD (modified core recovery), number of joint sets, joint roughness, alteration, ground stress and groundwater conditions. The Q value can then be related to maximum unsupported spans and support requirements for various operating spans, based on experience at other underground sites in similarly rated rock masses.

Preliminary assessments of allowable spans and possible ground support requirement assessments have been prepared, using the NGI System, for each of the various grades of rock quality and alteration indicated from the examination of core photographs at Rosebud. Results are presented for temporary mine openings with an Excavation Support Ratio (ESR) of 3 in Table I. Allowable spans for permanent mine openings (ESR = 1.6) would be approximately one-half the width indicated for temporary mine openings. The location and orientation of possible major discontinuities such as faults, joints or bedding has not been considered, because no information has been provided regarding these structures in the mine area.

The preliminary spans indicated in Table I are suitable for conceptual planning the size of development openings and stopes and ground support requirements for the prefeasibility study.

The width of the orebodies generally appears to be greater than the allowable spans for the stopes, as indicated in Table I. Therefore, it is expected that stoping areas may be developed by a variety of methods, including room and pillar, longitudinal primary stopes separated by longitudinal rib pillars, or longitudinal drift and fill using a low strength concrete fill for support of the sidewalls of the drifts and backs.

Determination of the optimum dimensions of pillars requires a knowledge of the strength of the intact rock, strength of the rock joints and the rock mass strength. The pillar design procedure used will also depend on the mining method. For example, for room and pillar mining, it may be advisable to design pillars with a width to height ratio of 1 or greater to provide sufficient confinement of the pillar cores to carry the likely overburden loads. If a system of longitudinal rib pillars is to be developed and subsequently mined, it will be important to design the pillars with sufficient width such that they are not transected by major faults or combinations of faults, which could lead to instability by sliding along these features. If this approach is adopted, cemented rockfill or cemented sandfill will be required in the primary stopes to support the side walls when mining the rib pillars. It may not be necessary to use cemented fill in the secondary stopes which are developed when mining the rib pillars. However, the secondary stopes would probably have to be backfilled with sand or rock fill to provide global support and control subsidence.

As there is little information concerning the orebody geometry, structural geology and strength parameters, pillar dimensions cannot be determined at this time. As a first approximation, to provide support as well as to enable possible subsequent mining of rib pillars, it is recommended that the pillar dimensions be approximately the same as the transverse stope spans or room openings in each mining area.

Depending on the distribution of the ore grade rocks, it may be feasible to lay out stopes and permanent regional pillars in areas of low grade or barren rock, to provide improved support throughout the mine. In locating stopes and pillars, the mine plan must also take into account the location of any major faults and the orientation of throughgoing discontinuities, such as joints or bedding. Wherever possible, pillars should be laid out so that they are not

transected by such features which could lead to instability by sliding on individual structures, or combinations of structures.

If the longitudinal drift and fill mining method is used, it is to be expected that the abutments of a stoping block could be subjected to significant mining induced stress. In addition, stress on the cemented fill could cause compression of the fill and deformation of the back. The extent and significance of such deformations should be addressed in detailed design studies.

ONGOING GEOTECHNICAL STUDIES

The assessments and rock mechanics parameters presented in this preliminary evaluation must be confirmed by additional investigation, testing, analyses and interaction with mine planning personnel as the feasibility and detailed design level studies proceed. The following steps are strongly recommended:

i) Prepare a detailed geological map of the orebodies showing the distribution of the various rock types, alteration grades, major faults and other geological structures (joints, bedding, etc.). A structural analysis of discontinuity populations will also be required to assess mechanisms of instability of stope backs, wall and pillars. At this stage, additional geological information can be obtained from geotechnical logging of the existing cores, and logging the lithology and alteration of the reverse circulation samples. Logging of alteration in the reverse circulation samples will be very useful in preparing a more accurate assessment of the distribution of alteration throughout the deposit.

ii) The core logging and geotechnical mapping will have to be enhanced by detailed mapping of all exploration and development openings as the project proceeds. The information from these openings and additional drilling will help to refine the stope layouts and conduct rational analyses of the kinematically possible modes of instability.

iii) Rock mechanics testing should be conducted on selected fresh cores or samples of the various rock types and alteration grades. Typical tests could consist of point load index tests to estimate unconfined compressive strength, and direct shear tests to estimate discontinuity strength. Depending on the results of these simple tests, detailed testing of rock strength, potential for swelling minerals, etc. may be required.

iv) The geotechnical mapping, logging and testing data should be used to more accurately determine the geotechnical properties of the rock mass, and to determine the controls on stability of individual stopes and pillars as well as the global stability of the mine. A reasonably detailed mine plan will be required showing the layout of orebodies and stope locations, stope geometries, mining schedule, etc.

v) The results of the rock mechanics studies should be presented in a format that provides a data base for ongoing assessments and design as mining proceeds, and additional data is collected from development workings, stopes, etc. Ideally, the mine will develop a rock mechanics program to assist with day-to-day planning as well as long term design of stopes and access openings throughout mine life.

SUMMARY

The results of this preliminary rock mechanics investigations may be used for the prefeasibility studies currently being conducted for the Rosebud Project. It must be appreciated that the results and recommendations are based on limited geotechnical information. The geotechnical data base should be expanded and detailed rock mechanics assessment should be conducted during the feasibility and detailed design studies.

Piteau Associates would be pleased to assist with any detailed geotechnical work as the project proceeds.

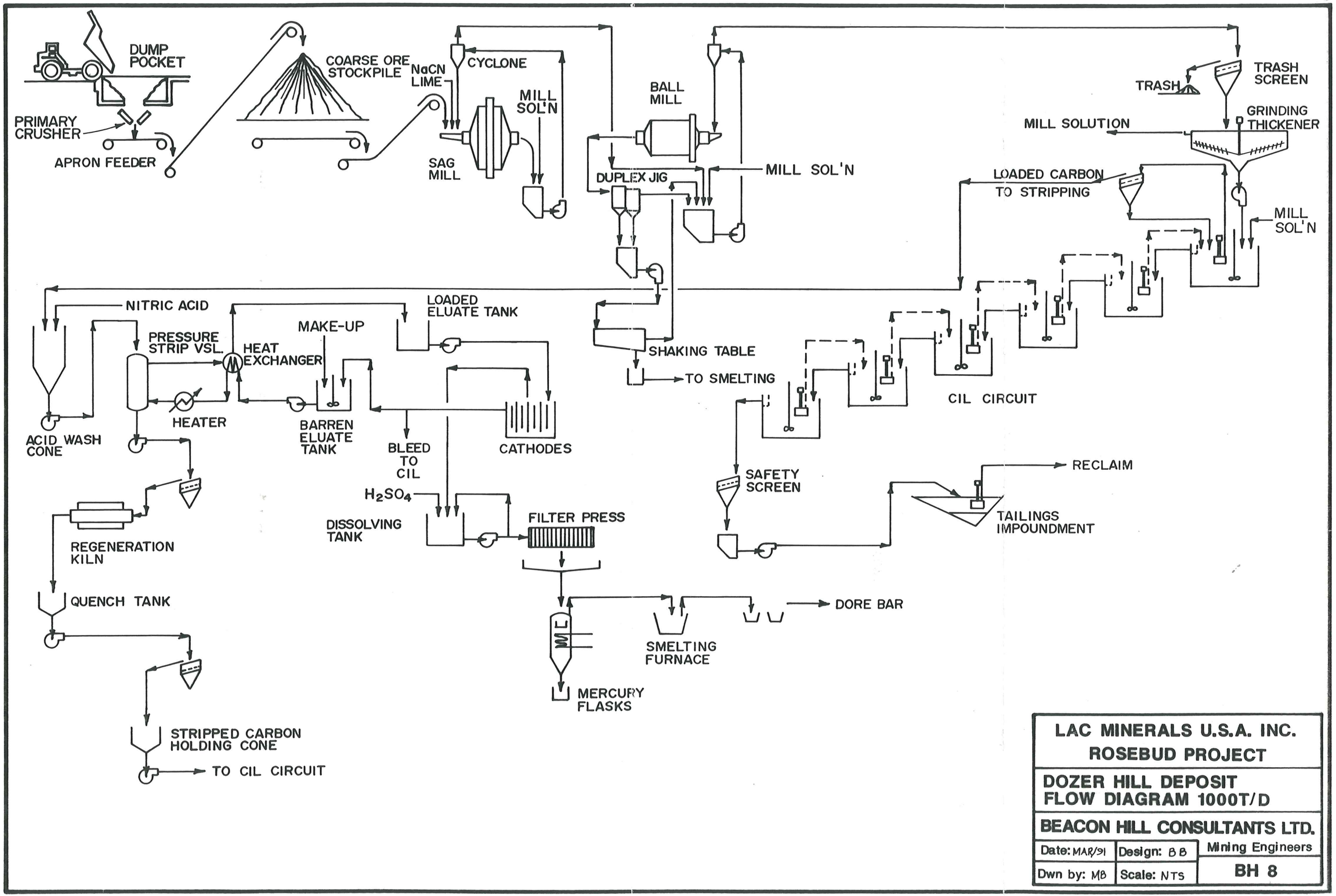
Sincerely yours,

PITEAU ASSOCIATES ENGINEERING LTD.

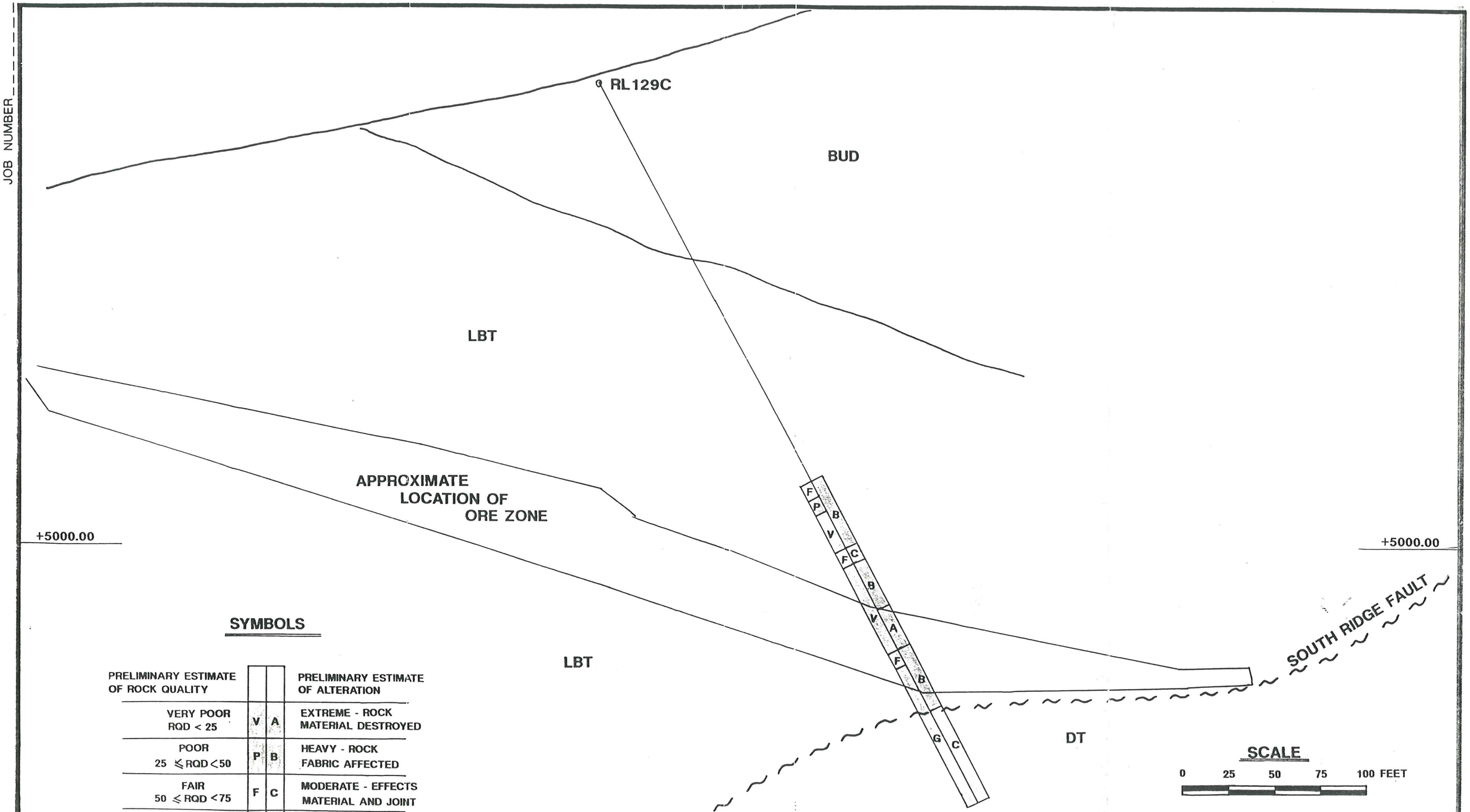
Dennis Martin

Dennis C. Martin, P.Eng.

Att.


DUMP POCKET
PRIMARY CRUSHER
APRON FEEDER
COARSE ORE STOCKPILE
NaCN
LIME
CYCLONE
MILL SOL'N
SAG MILL
BALL MILL
DUPLEX JIG
MILL SOL'N
TRASH
TRASH SCREEN
GRINDING THICKENER
MILL SOLUTION
LOADED CARBON TO STRIPPING
MILL SOL'N
NITRIC ACID
PRESSURE STRIP VSL.
HEAT EXCHANGER
MAKE-UP
LOADED ELUATE TANK
HEATER
BARREN ELUATE TANK
ACID WASH CONE
BLEED TO CIL
CATHODES
SHAKING TABLE
TO SMELTING
CIL CIRCUIT
SAFETY SCREEN
RECLAIM
TAILINGS IMPOUNDMENT
H_2SO_4
DISSOLVING TANK
FILTER PRESS
REGENERATION KILN
QUENCH TANK
DORE BAR
SMELTING FURNACE
MERCURY FLASKS
STRIPPED CARBON HOLDING CONE
TO CIL CIRCUIT
LAC MINERALS U.S.A. INC.
ROSEBUD PROJECT
DOZER HILL DEPOSIT
FLOW DIAGRAM 1000T/D
BEACON HILL CONSULTANTS LTD.
Date: MAR/91
Design: BB
Mining Engineers
Dwn by: MB
Scale: NTS
BH 8

JOB NUMBER



SYMBOLS

PRELIMINARY ESTIMATE OF ROCK QUALITY			PRELIMINARY ESTIMATE OF ALTERATION
VERY POOR RQD < 25	V	A	EXTREME - ROCK MATERIAL DESTROYED
POOR 25 ≤ RQD < 50	P	B	HEAVY - ROCK FABRIC AFFECTED
FAIR 50 ≤ RQD < 75	F	C	MODERATE - EFFECTS MATERIAL AND JOINT
GOOD 75 ≤ RQD ≤ 90	G	D	SLIGHT - ALTERATION ON JOINTS ONLY
EXCELLENT RQD > 90	E	E	NONE

NOTE:
ROCK UNIT NAMES AND SYMBOLS ARE BASED ON NOMENCLATURE PREPARED BY LAC MINERALS USA INC.

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BY:	DATE:
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APPROVED:	DWG: FIG. 1

JOB NUMBER_____

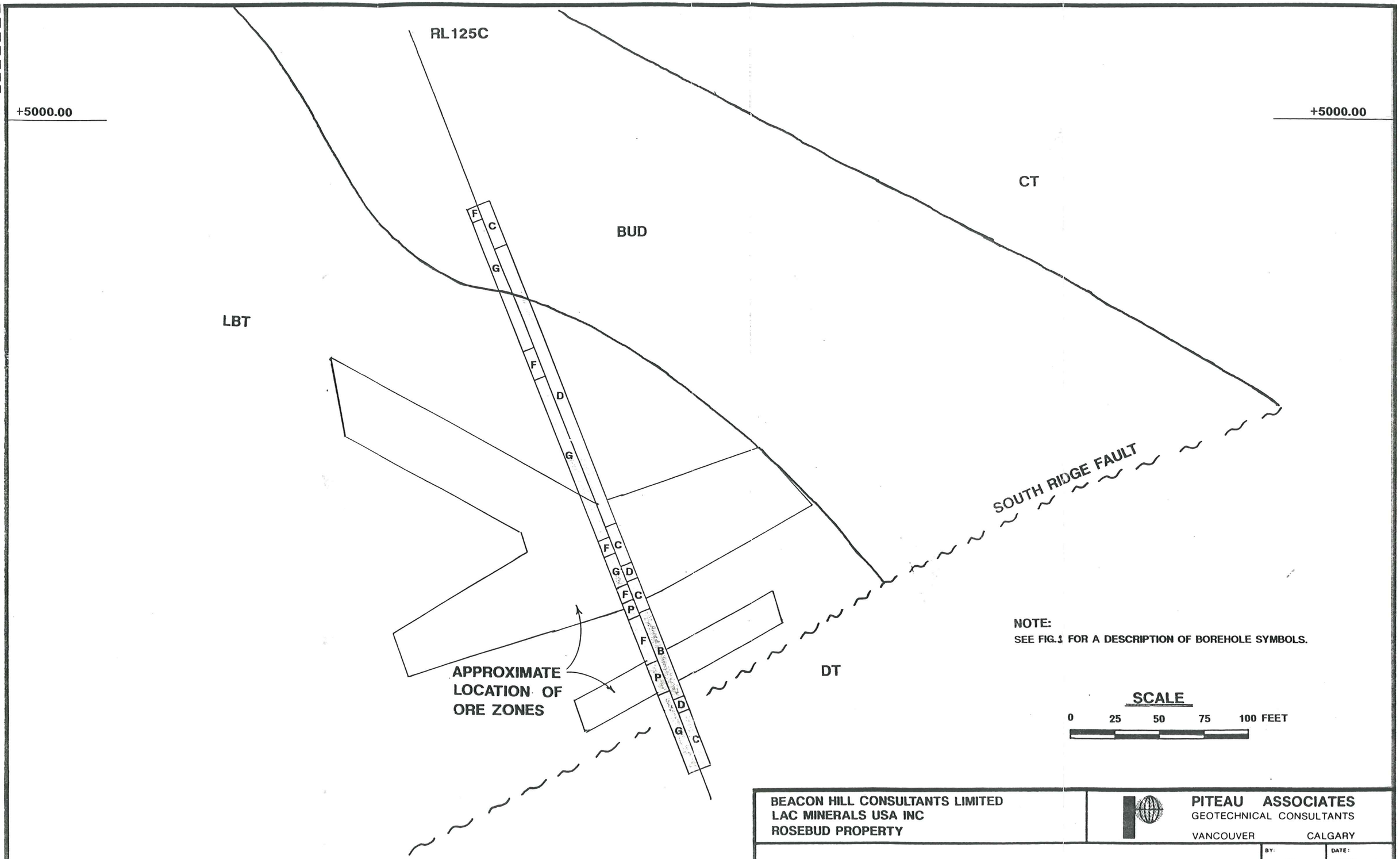

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	FIG. 2

JOB NUMBER_____

RL 123C

BUD

TMB

BUD

G D E C G F G D E G C F P B A V

APPROXIMATE LOCATION OF ORE ZONES

LBT

SOUTH RIDGE FAULT

NOTE:
SEE FIG. 1 FOR A DESCRIPTION OF BOREHOLE SYMBOLS

DT

SCALE

0 25 50 75 100 FEET

+4500.00

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APPROVED:	DWG: FIG. 3

JOB NUMBER

RL 159C

E D C G E D G C D E G C F P B F C P B D G C E G E G D F V F C G E G D P C G D F C G D

APPROX. LOCATION OF ORE ZONE

LBT

BUD

TMB

BUD

APPROXIMATE LOCATION OF ORE ZONE

APPROX. LOCATION OF ORE ZONES

DT

SOUTH RIDGE FAULT

NOTE:
SEE FIG. 1 FOR A DESCRIPTION OF BOREHOLE SYMBOLS.

SCALE

0 25 50 75 100 FEET

+4500.00

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BY:	DATE:
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APPROVED:	DWG: FIG. 4

JOB NUMBER

RL 100C

LOWER BUD

UPPER BUD

TMB

SOUTH RIDGE FAULT

+4500.00

+4500.00

LBT

APPROXIMATE LOCATION OF ORE ZONE

APPROX. LOCATION OF ORE ZONE

DT

TRANS

D G C B F C P G B P G C E D G F C G F G D

NOTE:
SEE FIG. 1 FOR A DESCRIPTION OF BOREHOLE SYMBOLS.

SCALE

0 25 50 75 100 FEET

APPROX. LOCATION OF ORE ZONE

JTR

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BY: BL

DATE: FEB.91

APPROVED:

DWG: FIG. 5

Table 1. Descriptions and Ratings for the Parameters RQD, J_n, and J_r

1.	ROCK QUALITY DESIGNATION	(RQD)	
A.	Very poor	0— 25	Note: (i) Where RQD is reported or measured as $\leqq 10$ (including 0) a nominal value of 10 is used to evaluate Q in Eq. (1) (ii) RQD intervals of 5, i. e. 100, 95, 90, etc. are sufficiently accurate
B.	Poor	25— 50	
C.	Fair	50— 75	
D.	Good	75— 90	
E.	Excellent	90—100	
2.	JOINT SET NUMBER	(J_n)	
A.	Massive, no or few joints	0.5—1.0	
B.	One joint set	2	
C.	One joint set plus random	3	
D.	Two joint sets	4	
E.	Two joint sets plus random	6	
F.	Three joint sets	9	
G.	Three joint sets plus random	12	Note: (i) For intersections use ($3.0 \times J_n$) (ii) For portals use ($2.0 \times J_n$)
H.	Four or more joint sets, random, heavily jointed, "sugar cube", etc.	15	
J.	Crushed rock, earthlike	20	
3.	JOINT ROUGHNESS NUMBER	(J_r)	
	(a) *Rock wall contact* and (b) *Rock wall contact before 10 cms shear*		
A.	Discontinuous joints	4	Note: (i) Add 1.0 if the mean spacing of the relevant joint set is greater than 3 m (ii) $J_r = 0.5$ can be used for planar slickensided joints having lineations, provided the lineations are favourably orientated
B.	Rough or irregular, undulating	3	
C.	Smooth, undulating	2	
D.	Slickensided, undulating	1.5	
E.	Rough or irregular, planar	1.5	
F.	Smooth, planar	1.0	
G.	Slickensided, planar	0.5	
	(c) *No rock wall contact when sheared*		
H.	Zone containing clay minerals thick enough to prevent rock wall contact	1.0 (nominal)	
J.	Sandy, gravelly or crushed zone thick enough to prevent rock wall contact	1.0 (nominal)	

Table 2. Descriptions and Ratings for the Parameters J_a and J_w

4.	JOINT ALTERATION NUMBER	(J_a)	φ_r (approx.)	
	(a) *Rock wall contact*			
A.	Tightly healed, hard, non-softening, impermeable filling i. e. quartz or epidote	0.75	(—)	Note: (i) Values of $(\varphi)_r$ are intended as an approximate guide to the mineralogical properties of the alteration products, if present
B.	Unaltered joint walls, surface staining only	1.0	(25°—35°)	
C.	Slightly altered joint walls. Non-softening mineral coatings, sandy particles, clay-free disintegrated rock etc.	2.0	(25°—30°)	
D.	Silty-, or sandy-clay coatings, small clay-fraction (non-softening)	3.0	(20°—25°)	

Table 2. Continued

E.	Softening or low friction clay mineral coatings, i. e. kaolinite, mica. Also chlorite, talc, gypsum and graphite etc., and small quantities of swelling clays. (Discontinuous coatings, 1—2 mm or less in thickness)	4.0	(8°—16°)
	(b) *Rock wall contact before 10 cms shear*		
F.	Sandy particles, clay-free disintegrated rock etc.	4.0	(25°—30°)
G.	Strongly over-consolidated, non-softening clay mineral fillings (Continuous, < 5 mm in thickness)	6.0	(16°—24°)
H.	Medium or low over-consolidation, softening, clay mineral fillings. (Continuous, < 5 mm in thickness)	8.0	(12°—16°)
J.	Swelling clay fillings, i. e. montmorillonite (Continuous, < 5 mm in thickness). Value of J_a depends on percent of swelling clay-size particles, and access to water etc.	8.0—12.0	(6°—12°)
	(c) *No rock wall contact when sheared*		
K, L, M.	Zones or bands of disintegrated or crushed rock and clay (see G, H, J for description of clay condition)	6.0, 8.0 or 8.0—12.0	(6°—24°)
N.	Zones or bands of silty- or sandy clay, small clay fraction (non-softening)	5.0	
O, P, R.	Thick, continuous zones or bands of clay (see G, H, J for description of clay condition)	10.0, 13.0 or 13.0—20.0	(6°—24°)

5.	JOINT WATER REDUCTION FACTOR	(J_w)	Approx. water pressure (kg/cm²)	
A.	Dry excavations or minor inflow, i. e. < 5 l/min. locally	1.0	< 1	Note: (i) Factors C to F are crude estimates. Increase J_w if drainage measures are installed (ii) Special problems caused by ice formation are not considered
B.	Medium inflow or pressure occasional outwash of joint fillings	0.66	1.0— 2.5	
C.	Large inflow or high pressure in competent rock with unfilled joints	0.5	2.5—10.0	
D.	Large inflow or high pressure, considerable outwash of joint fillings	0.33	2.5—10.0	
E.	Exceptionally high inflow or water pressure at blasting, decaying with time	0.2—0.1	> 10.0	
F.	Exceptionally high inflow or water pressure continuing without noticeable decay	0.1—0.05	> 10.0	

TABLE I

PRELIMINAY OPENING SIZES
BASED ON ASSESSMENT OF CORE PHOTOGRAPHS [1]

ROCK QUALITY (RQD) [2]	DEGREE OF ALTERATION [2]	PROBABLE Q VALUE [1]	ALLOWABLE TEMPORARY MINE OPENING SPANS (m) [3]		
			UNSUPPORTED SPAN (m)	ROCKBOLTS AND MESH	ROCKBOLTS, MESH AND SHOTCRETE [4]
VERY POOR (0 to 25)	ALTERED	0.02	1.5	—	3
POOR (25 to 50)	ALTERED	0.02 to 0.04	1.5 to 1.8	—	6
FAIR (50 to 75)	ALTERED	0.08 to 0.12	2.4 to 2.7	—	6 to 8
	UNALTERED	0.5 to 1.5	5 to 7.5	9 to 12 [4]	9 to 12 [4]
GOOD (75 to 90)	ALTERED	0.6 to 0.7	4 to 6	-	8 to 10 [4]
	UNALTERED	4.5 to 5.4	12	21 to 24 [4]	21 to 24 [4]
EXCELLENT (90 to 100)	UNALTERED	5.4 to 6.3	12 to 14	24	24 [4]

NOTES

1. Based on application of the NGI classification Scheme as outlined in Appendix B.
2. Rock quality and Alteration grades are based on the Symbols in Fig. 1.
3. Spans of permanent mine openings should be approximately one-half of the spans indicated for temporary mine openings.
4. Shotcrete may not be required for openings in unaltered ground depending on the strength and orientation of the fractures.

Table 3. Descriptions and Ratings for the Parameter *SRF*

6.	STRESS REDUCTION FACTOR			(*SRF*)
	(a) *Weakness zones intersecting excavation, which may cause loosening of rock mass when tunnel is excavated*			
A.	Multiple occurrences of weakness zones containing clay or chemically disintegrated rock, very loose surrounding rock (any depth)			10.0
B.	Single weakness zones containing clay, or chemically disintegrated rock (depth of excavation ≤ 50 m)			5.0
C.	Single weakness zones containing clay, or chemically disintegrated rock (depth of excavation > 50 m)			2.5
D.	Multiple shear zones in competent rock (clay free), loose surrounding rock (any depth)			7.5
E.	Single shear zones in competent rock (clay free) (depth of excavation ≤ 50 m)			5.0
F.	Single shear zones in competent rock (clay free) (depth of excavation > 50 m)			2.5
G.	Loose open joints, heavily jointed or "sugar cube" etc. (any depth)			5.0
	(b) *Competent rock, rock stress problems*	σ_c/σ_1	σ_t/σ_1	
H.	Low stress, near surface	> 200	> 13	2.5
J.	Medium stress	200—10	13—0.66	1.0
K.	High stress, very tight structure (Usually favourable to stability, may be unfavourable to wall stability)	10—5	0.66—0.33	0.5—2.0
L.	Mild rock burst (massive rock)	5—2.5	0.33—0.16	5—10
M.	Heavy rock burst (massive rock)	< 2.5	< 0.16	10—20
	(c) *Squeezing rock;* plastic flow of *incompetent rock under the influence of high rock pressures*			
N.	Mild squeezing rock pressure			5—10
O.	Heavy squeezing rock pressure			10—20
	(d) *Swelling rock; chemical swelling activity depending on presence of water*			
P.	Mild swelling rock pressure			5—10
R.	Heavy swelling rock pressure			10—15

Note:
(i) Reduce these values of *SRF* by 25—50% if the relevant shear zones only influence but do not intersect the excavation

(ii) For strongly anisotropic stress field (if measured): when $5 \leq \sigma_1/\sigma_3 \leq 10$, reduce σ_c and σ_t to $0.8\,\sigma_c$ and $0.8\,\sigma_t$; when $\sigma_1/\sigma_3 > 10$, reduce σ_c and σ_t to $0.6\,\sigma_c$ and $0.6\,\sigma_t$ where: σ_c = unconfined compression strength, σ_t = tensile strength (point load), σ_1 and σ_3 = major and minor principal stresses

(iii) Few case records available where depth of crown below surface is less than span width. Suggest *SRF* increase from 2.5 to 5 for such cases (see H)

Notes on the Use of Tables 1, 2 and 3

When making estimates of the rock mass quality (Q) the following guidelines should be followed, in addition to the notes listed in Tables 1, 2 and 3:

1. When borecore is unavailable, *RQD* can be estimated from the number of joints per unit volume, in which the number of joints per metre

for each joint set are added. A simple relation can be used to convert this number to *RQD* for the case of clay-free rock masses (Palmström, 1974),

$$RQD = 115 - 3.3\,J_v \text{ (approx.)} \tag{2}$$

where

J_v = total number of joints per m³
($RQD = 100$ for $J_v < 4.5$)

2. The parameter J_n representing the number of joint sets will often be affected by foliation, schistocity, slatey cleavage or bedding etc. If strongly developed these parallel "joints" should obviously be counted as a complete joint set. However, if there are few "joints" visible, or only occasional breaks in bore core due to these features, then it will be more appropriate to count them as "random joints" when evaluating J_n in Table 1.

3. The parameters J_r and J_a (representing shear strength) should be relevant to the *weakest significant joint set or clay filled discontinuity* in a given zone. However, if the joint set or discontinuity with the minimum value of (J_r/J_a) is favourably orientated for stability, then a second, less favourably orientated joint set or discontinuity may sometimes be of more significance, and its higher value of (J_r/J_a) should be used when evaluating Q from Eq. (1).

4. When a rock mass contains clay, the factor *SRF* appropriate to *loosening loads* should be evaluated (Table 3, 6a). In such cases the strength of the intact rock is of little interest. However, when jointing is minimal and clay is completely absent, the strength of the intact rock may become the *weakest link*, and the stability will then depend on the ratio rock-stress/rock-strength (Table 3, 6b). A strongly anisotropic stress field is unfavourable to stability and is roughly accounted for as in note (ii), Table 3.

5. In general the compressive and tensile strengths (σ_c and σ_t) of the intact rock should be evaluated in the direction that is unfavourable for stability. This is especially important in the case of strongly anisotropic rocks. In addition, the test samples should be saturated if this condition is appropriate to present or future in situ conditions. A very conservative estimate of strength should be made for those rocks that deteriorate when exposed to moist or saturated conditions.

When the rock mass quality varies markedly from place to place it will obviously be desirable to map and classify these zones separately. In general the rock mass quality Q will be evaluated separately in two adjacent zones if it is considered that a change in support will be justified in practice. (A four-fold increase or reduction in Q, caused by a change in joint frequency, roughness or degree of alteration etc., will normally qualify for changed support). However, if the variable zones intersect the excavations for only a few metres, it will normally be most economical to map the overall quality, and estimate a compromise value of Q, for eventual design of compromise support. It is normally uneconomic to change support measures over very short tunnel lengths, and in any case the overall stability has to be assured.

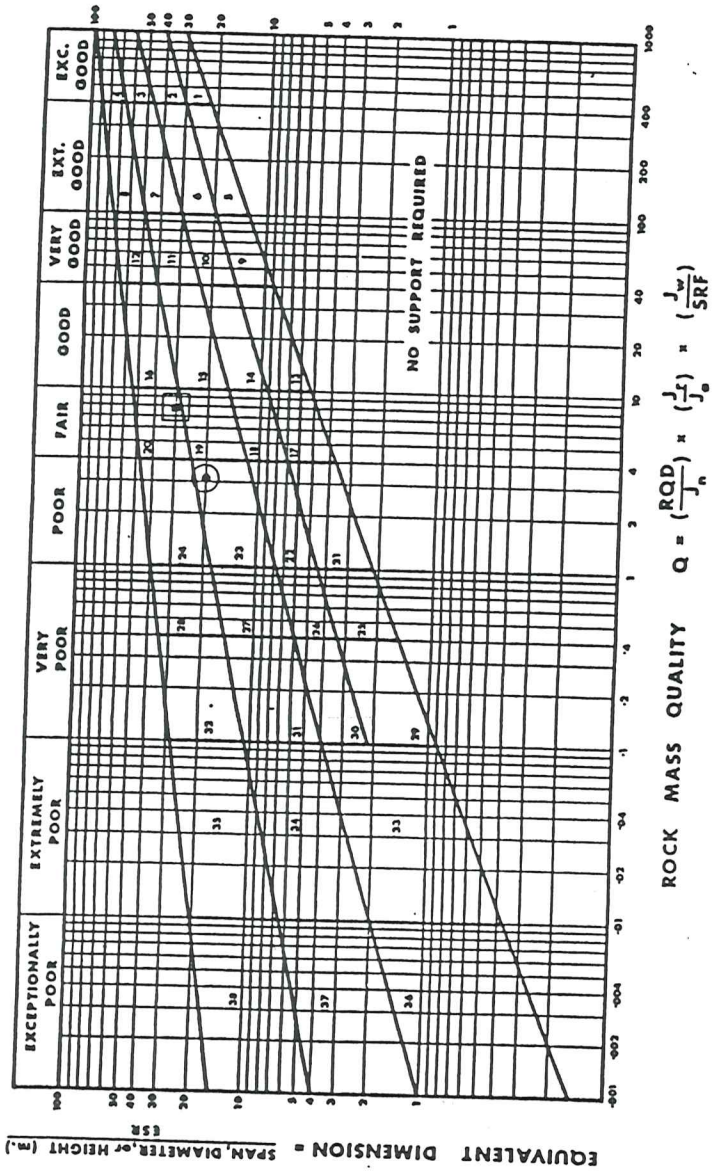

Fig. 5. Tunnel support chart showing the box numbering for 38 categories of support. The two plotted points refer to the worked example given on page 230.
● = roof ■ = wall

Diagramm, welches die 38 Ausbaukategorien veranschaulicht. Die beiden markierten Punkte beziehen sich auf das Arbeitsbeispiel, Seite 230
● = Gewölbe ■ = Wand

Graphique montrant 38 catégories de soutènements. Les deux points marqués se réfèrent à l'exemple de travail reproduit à la page 230
● = voûte ■ = paroi

Design of Support Based on Case Records

(A) Tunnel Support Chart for Analysis of Case Records

The method of classifying a rock mass for its quality Q was developed by successive re-analysis of case records, until a consistent relationship was obtained between Q, the excavation dimension, and the support actually used. These three variables were inter-related by means of a support chart. The final version of this chart is given in Fig. 5. It was arrived at after several alterations and re-analyses of the case records. The box numbering 1 to 38 is used as a reference to the *support category*. Support measures that are appropriate to each category are tabulated later.

Table 7. The Excavation Support Ratio (*ESR*) Appropriate to a Variety of Underground Excavations

	Type of excavation	*ESR*	No. of cases
A.	Temporary mine openings etc.	ca. 3—5?	(2)
B.	Vertical shafts: (i) circular section	ca. 2.5?	(0)
	(ii) rectangular/square section	ca. 2.0?	(0)
C.	Permanent mine openings, water tunnels for hydro power (exclude high pressure penstocks), pilot tunnels, drifts and headings for large excavations etc.	1.6	(83)
D.	Storage rooms, water treatment plants, minor road and railway tunnels, surge chambers, access tunnels, etc. (cylindrical caverns?)	1.3	(25)
E.	Power stations, major road and railway tunnels, civil defence chambers, portals, intersections etc.	1.0	(79)
F.	Underground nuclear power stations, railway stations, sports and public facilities, factories etc.	ca. 0.8?	(2)

The left-hand axis of the support chart gives the equivalent dimension (D_e), which is a function of the size and purpose of the excavation. The span or diameter are used as dimensions when analysing roof support, and the diameter or height for wall support. The excavation support ratio (*ESR*) which modifies these dimensions, reflects construction practice in that the degree of safety and support demanded by an excavation is determined by the purpose of the excavation, the presence of machinery, personell etc.

The list of *ESR* values given in Table 7 was developed through trial and error as the most workable solution to the problem of variable support practice. The number of case records relevant to each class of construction are given in brackets. The degree of confidence in these figures will be roughly in proportion to the number of relevant case records, hence the question marks.

Table 11. Support Measures for Rock Masses of "Exceptional", "Extremely Good", "Very Good", and "Good" Quality (Q range: 1000—10)

Support category	Q	Conditional factors RQD/J_n	J_r/J_a	$SPAN/ESR$ (m)	P kg/cm² (approx.)	$SPAN/ESR$ (m)	Type of support	Note see p. 229
1*	1000—400	—	—	—	<0.01	20—40	sb (utg)	—
2*	1000—400	—	—	—	<0.01	30—60	sb (utg)	—
3*	1000—400	—	—	—	<0.01	46—80	sb (utg)	—
4*	1000—400	—	—	—	<0.01	65—100	sb (utg)	—
5*	400—100	—	—	—	0.05	12—30	sb (utg)	—
6*	400—100	—	—	—	0.05	19—45	sb (utg)	—
7*	400—100	—	—	—	0.05	30—65	sb (utg)	—
8*	400—100	—	—	—	0.05	48—88	sb (utg)	—
9	100—40	≧20	—	—	0.25	8.5—19	sb (utg)	—
		<20	—	—			B (utg) 2.5—3 m	—
10	100—40	≧30	—	—	0.25	14—30	B (utg 2—3 m	—
		<30	—	—			B (utg) 1.5—2 m +clm	—
11*	100—40	≧30	—	—	0.25	23—48	B (tg) 2—3 m	—
		<30	—	—			B (tg) 1.5—2 m +clm	—
12*	100—40	≧30	—	—	0.25	40—72	B (tg) 2—3 m	—
		<30	—	—			B (tg) 1.5—2 m +clm	—
13	40—10	≧10	≧1.5	—	0.5	5—14	sb (utg)	I
		≧10	<1.5	—			B (utg) 1.5—2 m	I
		<10	≧1.5	—			B (utg) 1.5—2 m	I
		<10	<1.5	—			B (utg) 1.5—2 m +S 2—3 cm	I
14	40—10	≧10	—	≧15	0.5	9—23	B (tg) 1.5—2 m +clm	I, II
		<10	—	≧15			B (tg) 1.5—2 m +S (mr) 5—10 cm	I, II
		—	—	<15			B (utg) 1.5—2 m +clm	I, III
15	40—10	>10	—	—	0.5	15—40	B (tg) 1.5—2 m +clm	I, II, IV
		≦10	—	—			B (tg) 1.5—2 m +S (mr) 5—10 cm	I, II, IV
16* See note XII	40—10	>15	—	—	0.5	30—65	B (tg) 1.5—2 m +clm	I, V, VI
		≦15	—	—			B (tg) 1.5—2 m +S (mr) 10—15 cm	I, V, VI

* Authors' estimates of support. Insufficient case records available for reliable estimation of support requirements.

The type of support to be used in categories 1 to 8 will depend on the blasting technique. Smooth wall blasting and thorough barring-down may remove the need for support. Rough-wall blasting may result in the need for single applications of shotcrete, especially where the excavation height is >25 m. Future case records should differentiate categories 1 to 8.

Key to Support Tables:

sb = spot bolting
B = systematic bolting
(utg) = untensioned, grouted

Table 12. Support Measures for Rock Masses of "Fair" and "Poor" Quality (Q range: 10—1)

Support category	Q	Conditional factors RQD/J_n	J_r/J_a	$SPAN/ESR$	P Kg/cm² (approx.)	$SPAN/ESR$ (m)	Type of support	Note See p. 229
17	10—4	>30	—	—	1.0	3.5—9	sb (utg)	I
		≧10, ≦30	—	—			B (utg) 1—1.5 m	I
		<10	—	≧6 m			B (utg) 1—1.5 m +S 2—3 cm	I
		<10	—	<6 m			S 2—3 cm	I
18	10—4	>5	—	≧10 m	1.0	7—15	B (tg) 1—1.5 m +clm	I, III
		>5	—	<10 m			B (utg) 1—1.5 m +clm	I
		≦5	—	≧10 m			B (tg) 1—1.5 m +S 2—3 cm	I, III
		≦5	—	<10 m			B (utg) 1—1.5 m +S 2—3 cm	I
19	10—4	—	—	≧20 m	1.0	12—29	B (tg) 1—2 m +S (mr) 10—15 cm	I, II, IV
		—	—	<20 m			B (tg) 1—1.5 m +S (mr) 5—10 cm	I, II
20* See note XII	10—4	—	—	≧35 m	1.0	24—52	B (tg) 1—2 m +S (mr) 20—25 cm	I, V, VI
		—	—	<35 m			B (tg) 1—2 m +S (mr) 10—20 cm	I, II, IV
21	4—1	≧12.5	≦0.75	—	1.5	2.1—6.5	B (utg) 1 m +S 2—3 cm	I
		<12.5	≦0.75	—			S 2.5—5 cm	I
		—	>0.75	—			B (utg) 1 m	I
22	4—1	>10, <30	>1.0	—	1.5	4.5—11.5	B (utg) 1 m+clm	I
		≦10	>1.0	—			S 2.5—7.5 cm	I
		<30	≦1.0	—			B (utg) 1 m +S (mr) 2.5—5 cm	I
		≧30	—	—			B (utg) 1m	I
23	4—1	—	—	≧15 m	1.5	8—24	B (tg) 1—1.5 m +S (mr) 10—15 cm	I, II, IV, VII
		—	—	<15 m			B (utg) 1—1.5 m +S (mr) 5—10 m	I
24* See note XII	4—1	—	—	≧30 m	1.5	18—46	B (tg) 1—1.5 m +S (mr) 15—30 cm	I, V, VI
		—	—	<30 m			B (tg) 1—1.5 m +S (mr) 10—15 cm	I, II, IV

* Authors' estimates of support. Insufficient case records available for reliable estimation of support requirements.

(tg) = tensioned, (expanding shell type for competent rock masses, grouted post-tensioned in very poor quality rock masses; see Note XI)
S = shotcrete
(mr) = mesh reinforced
clm = chain link mesh
CCA = cast concrete arch
(sr) = steel reinforced

Bolt spacings are given in metres (m). Shotcrete, or cast concrete arch thickness is given in centimetres (cm).

Table 13. Support Measures for Rock Masses of "Very Poor" Quality (Q range: 1.0—0.1)

Support category	Q	Conditional factors RQD/J_a	J_r/J_a	SPAN/ESR (m)	P kg/cm² (approx.)	SPAN/ESR (m)	Type of support	Note See p. 229
25	1.0—0.4	> 10	> 0.5	—	2.25	1.5—4.2	B (utg) 1 m + mr or clm	I
		≤ 10	> 0.5	—			B (utg) 1 m + S (mr) 5 cm	I
		—	≤ 0.5	—			B (tg) 1 m + S (mr) 5 cm	I
26	1.0—0.4	—	—	—	2.25	3.2—7.5	B (tg) 1 m + S (mr) 5—7.5 cm	VIII, X, XI
		—	—	—			B (utg) 1 m + S 2.5—5 cm	I, IX
27	1.0—0.4	—	—	≥ 12 m	2.25	6—18	B (tg) 1 m + S (mr) 7.5—10 cm	I, IX
		—	—	< 12 m			B (utg) 1 m + S (mr) 5—7.5 cm	I, IX
		—	—	> 12 m			CCA 20—40 cm + B (tg) 1 m	VIII, X, XI
		—	—	< 12 m			S (mr) 10—20 cm + B (tg) 1 m	VIII, X, XI
28* See note XII	1.0—0.4	—	—	≥ 30 m	2.25	15—38	B (tg) 1 m + S (mr) 30—40 cm	I, IV, V, IX
		—	—	≥ 20, < 30			B (tg) 1 m + S (mr) 20—30 cm	I, II, IV, IX
		—	—	< 20 m			B (gr) 1 m + S (mr) 15—20 cm	I, II, IX
		—	—	—			CCA (sr) 30—100 cm + B (tg) 1 m	IV, VIII, X, XI
29*	0.4—0.1	> 5	> 0.25	—	3.0	1.0—3.1	B (utg) 1 m + S 2—3 cm	—
		≤ 5	> 0.25	—			B (utg) 1 m + S (mr) 5 cm	—
		—	≤ 0.25	—			B (tg) 1 m + S (mr) 5 cm	—
30	0.4—0.1	≥ 5	—	—	3.0	2.2—6	B (tg) 1 m + S 2.5—5 cm	IX
		< 5	—	—			S (mr) 5—7.5 cm	IX
		—	—	—			B (tg) 1 m + S (mr) 5—7.5 cm	VIII, X, XI
31	0.4—0.1	> 4	—	—	3.0	4—14.5	B (tg) 1 m + S (mr) 5—12.5 cm	IX
		≤ 4, ≥ 1.5	—	—			S (mr) 7.5—25 cm	IX
		< 1.5	—	—			CCA 20—40 cm + B (tg) 1 m	IX, XI
		—	—	—			CCA (sr) 30—50 cm + B (tg) 1 m	VIII, X, XI
32 See note XII	0.4—0.1	—	—	≥ 20 m	3.0	11—34	B (tg) 1 m + S (mr) 40—60 cm	II, IV, IX, XI
		—	—	< 20 m			B (tg) 1 m + S (mr) 20—40 cm	III, IV, IX, XI
		—	—	—			CCA (sr) 40—120 cm + B (tg) 1 m	IV, VIII, X, XI

Table 14. Support Measures for Rock Masses of "Extremely Poor" and "Exceptionally Poor" Quality (Q range: 0.1—0.001)

Support category	Q	Conditional Factors RQD/J_a	J_r/J_a	SPAN/ESR (m)	P Kg/cm² (approx.)	SPAN/ESR (m)	Type of support	Note See p. 229
33*	0.1—0.01	≥ 2	—	—	6	1.0—3.9	B (tg) 1 m + S (mr) 2.5—5 cm	IX
		< 2	—	—			S (mr) 5—10 cm	IX
		—	—	—			S (mr) 7.5—15 cm	VIII, X
34	0.1—0.01	≥ 2	≥ 0.25	—	6	2.0—11	B (tg) 1 m + S (mr) 5—7.5 cm	IX
		< 2	≥ 0.25	—			S (mr) 7.5—15 cm	IX
		—	< 0.25	—			S (mr) 15—25 cm	IX
		—	—	—			CCA (sr) 20—60 cm + B (tg) 1 m	VIII, X, XI
35 See note XII	0.1—0.01	—	—	≥ 15 m	6	6.5—28	B (tg) 1 m + S (mr) 30—100 cm	II, IX, XI
		—	—	≥ 15 m			CCA (sr) 60—200 cm + B (tg) 1 m	VIII, X, XI, II
		—	—	< 15 m			B (tg) 1 m + S (mr) 20—75 cm	IX, XI, III
		—	—	< 15 m			CCA (sr) 40—150 cm + B (tg) 1 m	VIII, X, XI, III
36*	0.01—0.001	—	—	—	12	1.0—2.0	S (mr) 10—20 cm	IX
		—	—	—			S (mr) 10—20 cm + B (tg) 0.5—1.0 m	VIII, X, XI
37	0.01—0.001	—	—	—	12	1.0—6.5	S (mr) 20—60 cm	IX
		—	—	—			S (mr) 20—60 cm + B (tg) 0.5—1.0 m	VIII, X, XI
38 See note XIII	0.01—0.001	—	—	≥ 10 m	12	4.0—20	CCA (sr) 100—300 cm	IX
		—	—	≥ 10 m			CCA (sr) 100—300 cm + B (tg) 1 m	VIII, X, II, XI
		—	—	< 10 m			S (mr) 70—200 cm	IX
		—	—	< 10 m			S (mr) 70—200 cm + B (tg) 1 m	VIII, X, III, XI

* Authors' estimates of support. Insufficient case records available for confident prediction of support requirements.

Supplementary Notes for Support Tables

I. For cases of heavy rock bursting or "popping", tensioned bolts with enlarged bearing plates often used, with spacing of about 1 m (occasionally down to 0.8 m). Final support when "popping" activity ceases.

II. Several bolt lengths often used in same excavation, i. e. 3, 5 and 7 m.

III. Several bolt lengths often used in same excavation, i. e. 2, 3 and 4 m.

IV. Tensioned cable anchors often used to supplement bolt support pressures. Typical spacing 2—4 m.

V. Several bolt lengths often used in some excavations, i. e. 6, 8 and 10 m.

VI. Tensioned cable anchors often used to supplement bolt support pressures. Typical spacing 4—6 m.

VII. Several of the older generation power stations in this category employ systematic or spot bolting with areas of chain link mesh, and a free span concrete arch roof (25—40 cm) as permanent support.

VIII. Cases involving swelling, for instance montmorillonite clay (with access of water). Room for expansion behind the support is used in cases of heavy swelling. Drainage measures are used where possible.

IX. Cases not involving swelling clay or squeezing rock.

X. Cases involving squeezing rock. Heavy rigid support its generally used as permanent support.

XI. According to the authors' experience, in cases of swelling or squeezing, the temporary support required before concrete (or shotcrete) arches are formed may consist of bolting (tensioned shell-expansion type) if the value of RQD/J_a is sufficiently high (i. e. > 1.5), possibly combined with shotcrete. If the rock mass is very heavily jointed or crushed (i. e. $RQD/J_a < 1.5$, for example a "sugar cube" shear zone in quartzite), then the temporary support may consist of up to several applications of shotcrete. Systematic bolting (tensioned) may be added after casting the concrete (or shotcrete) arch to reduce the uneven loading on the concrete, but it may not be effective when $RQD/J_a < 1.5$, or when a lot of clay is present, unless the bolts are grouted before tensioning. A sufficient length of anchored bolt might also be obtained using quick setting resin anchors in these extremely poor quality rockmasses. Serious occurrences of swelling and/or squeezing rock may require that the concrete arches are taken right up to the face, possibly using a shield as temporary shuttering. Temporary support of the working face may also be required in these cases.

XII. For reasons of safety the multiple drift method will often be needed during excavation and supporting of roof arch. Categories 16, 20, 24, 28, 32, 35 (*SPAN/ESR* > 15 m only).

XIII. Multiple drift method usually needed during excavation and support of arch, walls and floor in cases of heavy squeezing. Category 38 (*SPAN/ESR* > 10 m only).

APPENDIX B

SLINGER BELT STOWING TECHNIQUE
FOR CEMENTED BACKFILL

Proceedings of the International Symposium on Mining with Backfill / Luleå / 7-9 June 1983

Slinger belt stowing technique for cemented backfill at the Meggen mine

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SYNOPSIS: Due to varying dipping conditions different mining methods are in use in the Meggen mine: sublevel-shrinkage mining, room-and-pillar mining or cross-cut-mining, the two latter methods combined with cemented backfill. All development and stoping faces are equipped with LHD-units. The backfill work started with pneumatic stowing and changed over to slinger belt stowing because of higher performance and lower overall costs derived from this backfill method. A cost comparison between rockfill, pneumatic fill and slinger belt fill is presented.

GEOLOGY,ORE RESERVES AND OVERALL PRODUCTION FIGURES

The mineral deposit at Meggen is a complex mixed sulphide orebody which contains iron pyrites, sphalerite and galena. As a result of volcanic activities in Devonian times, the ore was deposited on the sea-bed between limestone as hanging and sandy shales as footwall country rock. Subsequently these marine sediments were violently tilted and folded against a strong barrier formed by calcareous reef beds.

The strike length of the orebody is about 3 km (see Fig.1) and the deposit has a strong dip variation from vertical to horizontal (see Fig.2). The width varies between 1 m and 6 m, average 3.5 m.

Mining activities in the Meggen district began in the late 19th century. Today there are some 12 mio. tons of proven reserves left. The actual production is 1 mio. tons of run-of-mine ore per year and about 80.000 tons of waste rock out of development drifts.

Since 1972 trackless diesel-driven equipment has been used underground for loading, hauling and dumping (LHD), for ore transportation, drilling and other service work. Today we have road access for these mobile vehicles from the surface to every point of the mine through the Walter Ramp (illustrated in Fig. 1).

MINING METHODS

Due to varying dipping conditions of the deposit different mining methods are in use. In steep dipping districts a combined sublevel-shrinkage stoping method is practiced (see Fig.3). Flat lying parts are mined by room and pillar (see Fig.4a) or cross-cut stoping methods (Fig.4b), both systems combined with backfill.Semi-steep parts are extracted by a cut-and-fill method.

Due to the long striking length of the orebody, the variations in metal content and the necessary production of 1 mio.tons of run-of-mine ore per year, some 40 stoping faces have to be in production. Today more than 25% of these stoping faces are situated in flat lying or semi-steep dipping parts and must be backfilled. Furthermore, these faces are distributed over the whole striking length of the orebody and over levels 8, 10, 11 and 12. During the next year a backfill stope will be installed on level 9 as well.

SELECTION OF THE BACKFILL METHOD

When starting with backfill mining six years ago naturally the application of the most common backfill method, the hydraulic filling was discussed. In general the following requirements for economical

backfilling with hydraulic material must be met:
- the economical disposition of preparation plant tailings or sand fill material with a high enough dewatering ratio
- horizontal and vertical tubes which are able to provide an efficient fill transport to various stoping points; in the case of the Meggen mine more than one level (see Sect."Mining methods") must be supplied over a distance of some 3.000 m adaptable for different mining methods
- drifts below the backfilled rooms to pump off the percolated water.

Since the above mentioned conditions do not exist in the Meggen mine, their realisation would mean such a high investment that hydraulic fill cannot be applied economically in the mine. Only dry placement methods are in use: rockfill out of development drifts (5%) and slinger belt stowing with cleaned rock fill (95%). The latter method is a newly developed one, after having started with pneumatic stowing at rather high overall backfill costs.

BACKFILL QUALITY

Backfill quality depends on the characteristics of the fill material and backfill procedure.

Fill material characteristics

Backfill material from development drifts is limestone or sandy shales with no definite grain size distribution. Here and especially when backfilling with cleaned waste from our heavy media plant cement is added so that we generally build up a consolidated backfill.

The above mentioned cleaned waste consists of more than 50% limestone with compressive strength values of about 1000 daN/cm². The rest of the material has strength values of about 500 daN/cm². Fig. 5 illustrates the grain size distribution of our material and beside this a derivation of an optimum size distribution with minimum pore volume. (Fuller distribution). It can be seen that the cleaned waste rock material has no optimum but a usable characteristic as to the grain size. Essential for the use of slinger belt stowing machines is a grain size of not more than 50 mm.

The cement additive is about 50 kg per m³ backfill material. Based on laboratory tests and practical knowledge this amount of cement is sufficient for a support strong enough to allow a complete extraction of the ore as well as a good enough safety margin for the miners and machines doing stoping work. We do not yet know the effects of our confined backfill mining upon possible surface damage. We hope however that a newly started research programme will deliver computable values to answer these questions.

Backfill procedure

The backfill procedure should guarantee a sufficient mechanical compaction of the fill material and a complete filling of the mined out rooms even in the flat parts of the mineral deposit.

The compaction of fill material by the slinger belt system is comparative to pneumatic stowing and provides a surplus of compressive strength compared e.g. with rockfill performed by LHD-units.

The complete filling of a mined out room in a flat lying deposit can only be achieved with pneumatic or slinger belt stowing.

The early support over a relatively large area by backfill material ensures sufficient safety for men and machines, a reduction of roof support (e.g. timbering, bolts or concrete) and of dilution by rockfall especially from the hanging wall.

SLINGER BELT STOWING

The slinger belt stowing machine is illustrated in Fig.6. It consists of a feed cone from which the cleaned waste fill flows over a proportioning bucket wheel to the fast running slinger belt. This belt is driven by a 15 kW electric motor at speeds up to 20 m/sec. The material can be thrown about 8 m high and over a distance of 14 m. The whole machine is generally installed near the stoping points and can be transported to the faces by 2 cubic-yard LHD-units. The slinger belt may as well be fed by these LHD-units.

A more effective slinger belt stowing system is shown in Fig.7. The diesel-mobile vehicle operates as follows:

The truck is equipped with articulated steering. The truck body is shaped like a trough with a sliding blade being moved by a hydraulic cylinder. The electrically driven slinger belt machine (see Fig.6) is attached under the rear end of the truck body. In order to adapt it to this type of mounting, the feed cone has been shortened and the foundation structure eliminated.

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Another possibility
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A photograph of the
belt truck is shown in
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10m³ capacity.
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BACKFILL COSTS

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material would have t
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this amount can be en
side.
The backfill distri
sumption of 100.000 m
in Fig.10. On levels
rock flows directly f
chute to the slinger
having automatically
cement); on level 10
transported by railwa
1500 m to shorter chu
fill is dumped and th
slinger belt trucks.
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ructure eliminated.

There is an opening in the bottom of the truck body allowing the waste fill to be fed at an even rate onto the slinger belt by the sliding blade pushed forward by the hydraulic cylinder.

Another possibility of discharging the truck is by closing the above mentioned opening automatically and by unblocking the slewable rear port. Now the fill material will be pushed out by means of the sliding shield without passing the slinger belt.

A photograph of the 6m³-capacity slinger-belt truck is shown in Fig.8. The vehicle was built by Messrs. Hermann Paus, Emsbühren, based on drawings of Sachtleben Bergbau GmbH, both in West Germany. Today five of these machines are employed underground in Meggen, the latest one of 10m³ capacity.

Charging of the slinger belt trucks is shown in Fig.9. The fill material flows from a chute over a vibrating trough to the truck after the proper amount of cement has automatically been mixed into the waste fill. The cement is stored in a 6m³ bin near the chute and is transported to this point pneumatically out of a bigger bin on the surface.

BACKFILL COSTS

As mentioned above the backfill material consists mainly of cleaned was e rock from the heavy media plant on the surface. Today the total amount of waste rock produced in the separator is transported into the backfill chute by means of a 30m-long conveyor belt. Otherwise this material would have to be trucked to a waste deposit at the respective cost of 3.20 DM per m³, so that with backfill this amount can be entered on the credit side.

The backfill distribution for a consumption of 100.000 m³ per year is shown in Fig.10. On levels 8 and 9 the waste rock flows directly from the main waste chute to the slinger belt trucks (after having automatically been mixed with cement); on level 10 the material is transported by railway over 600 m and 1500 m to shorter chutes, where the backfill is dumped and then charged to the slinger belt trucks. The average one-way transport distance from the chutes to the stoping faces is about 350 m.

On the one hand the personnel cost for backfilling depends on the time consumption for the filling procedure. Here you can determine fixed times for the slinger-work (1 min/m³), the positioning of the truck (5 min/cycle) and filling of the truck (4 min/cycle). The transport time is determined by the hauling distance and quality of the road. In the Meggen mine we calculate with 1 min/100 m on the average. Based on these figures it takes 22 min/cycle for a 6m³-slinger belt truck to backfill a room over a distance of 350 m. Furthermore, the capacity of one 6m³-truck is 106m³ per drift (6.5 productive hours), with one driver.

On the other hand personnel cost must include maintenance work for the diesel-mobile vehicles and other service work at the faces (backfill) and at the filling stations.

Including this, on an average there will be a performance of 60m³ backfill per manshift based on 6m³-trucks and thereof personnel cost of 4.- DM per m³.

Expenses for material are mainly for the slinger belt machine, the acticulated trucks and cement (50kg/m³ backfill) at an amount of 8,- DM per m³.

The amortization is derived from the investment for the slinger belt truck and for the filling station. With an average filling volume of 60.000 m³ material being supplied by one filling station and a lifetime of 10.000 working hours of the backfill truck one can calculate with 3.- DM per m³ investment cost.

In Fig.11 the above derived figures are summarized and illustrated in a column diagram (procedure No.9). In Fig.11 altogether nine backfill procedures are illustrated. Nos. 1 and 2 are pneumatic stowing methods of 30m³/h capacity machines and 150m³/h units respectively. On the very right hand side of the Figure the performance in m³ per manshift is written down as a basis for personnel cost calculation. The total cost can be seen on the left hand side of the Figure in the column-diagram.

The rockfill methods (Nos.3, 4, and 5) are calculated on the basis of employing 6t, 10t and 15t normal trucks, hauling the material from the filling station into the neighbourhood of the stopes to be filled. From there 1.5 m³-capacity LHD units backfill the rooms.

The slinger belt stowing procedures Nos. 6 - 8 are based on the employment of trucks (see rockfill methods) and LHD-units charging the slinger belt illustrated in Fig.6. The No.9 procedure is the slinger belt truck as described above of a capacity of 6m³ per cycle. Performance calculated in m³ backfill per manshift can be seen at the right hand side of Fig.11 and the total costs are presented once more in the column diagram.

The lowest costs can be attributed to the slinger belt truck backfill procedure with roughly 15.- DM/m³. This is mainly due to low personnel costs because of the relatively high performance of 60 m³ backfill per manshift. The costs of material are comparable to those of other backfill procedures whereas the investment costs are much lower.

The low investment costs are due to the fact that the slinger belt truck backfill method can be integrated into the existing trackless mining system without difficulties. For example there are no additional expenses for the preparation of backfill stopes contrary to the pneumatic stowing systems. Experiences with this system have shown that e.g. additional development drifts were necessary even in the host rock to ensure a straight installation and the shortest distances possible of the pneumatic stowing tubes.

Furthermore, the slinger belt truck system allows to react with great flexibility to influences created by other stoping work. This criterion of a backfill method is extremely important when a small amount of backfill material per stoping point has to be stowed and the number of stoping faces is low because of the nature of the mineral deposit. Especially in this case the backfill has to push rather than lag behind the remaining work sequences, otherwise the mining costs will be too high to reasonably implement a stoping method based on backfill.

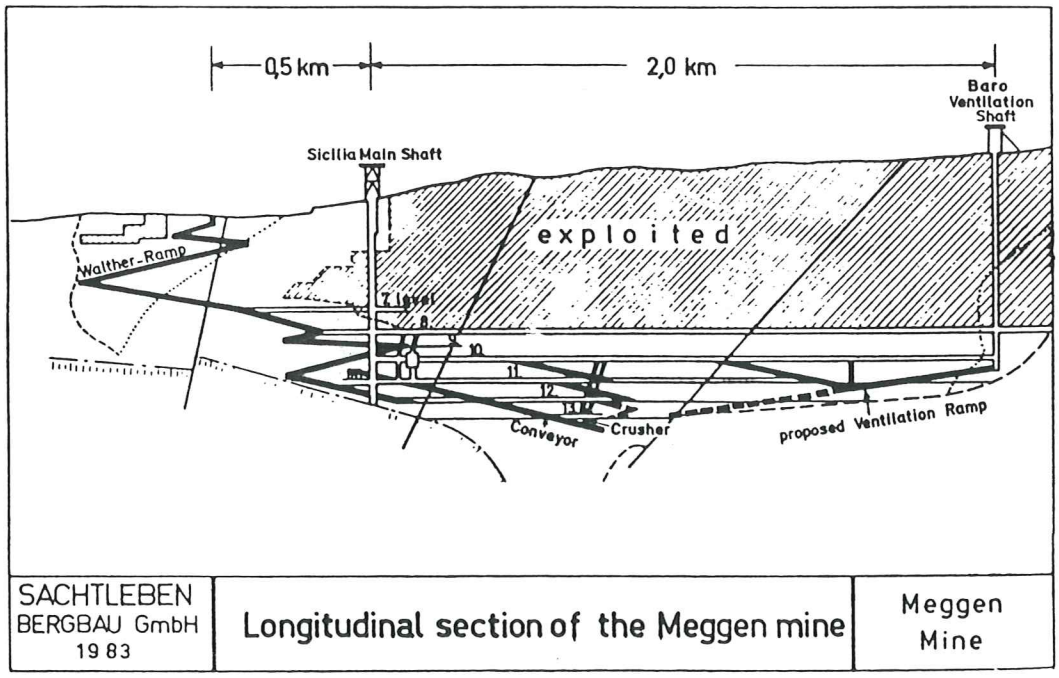
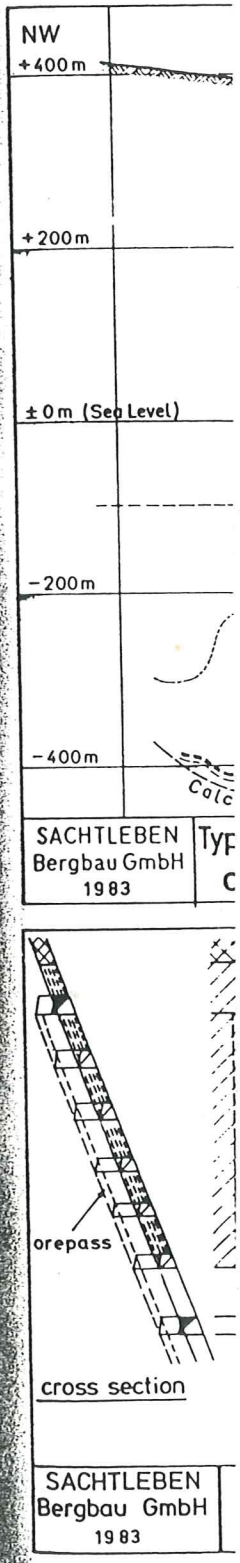
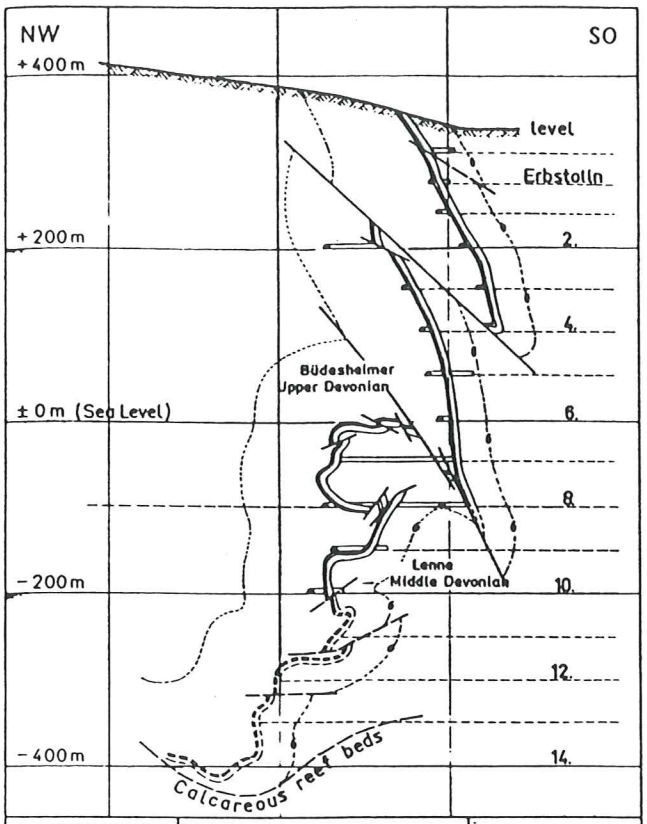


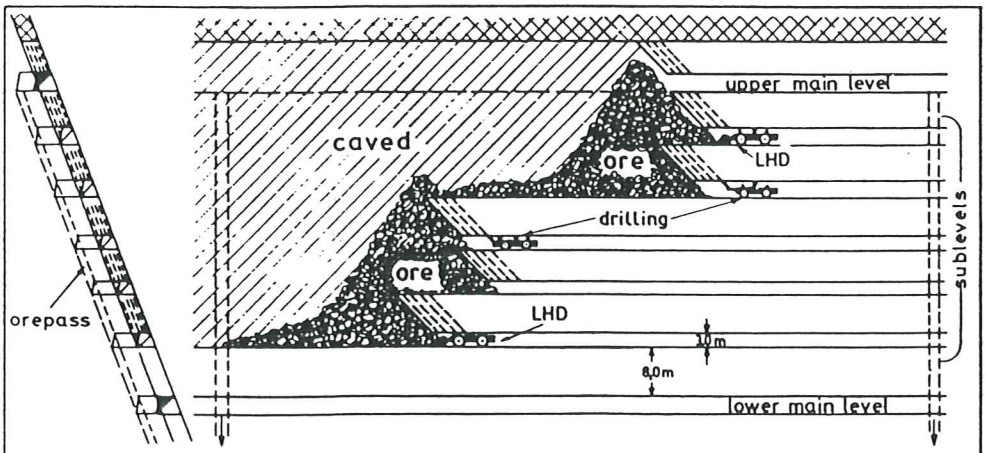
fig. 1





SACHTLEBEN Bergbau GmbH 1983	Typical cross section of the orebody	Meggen Mine

fig. 2



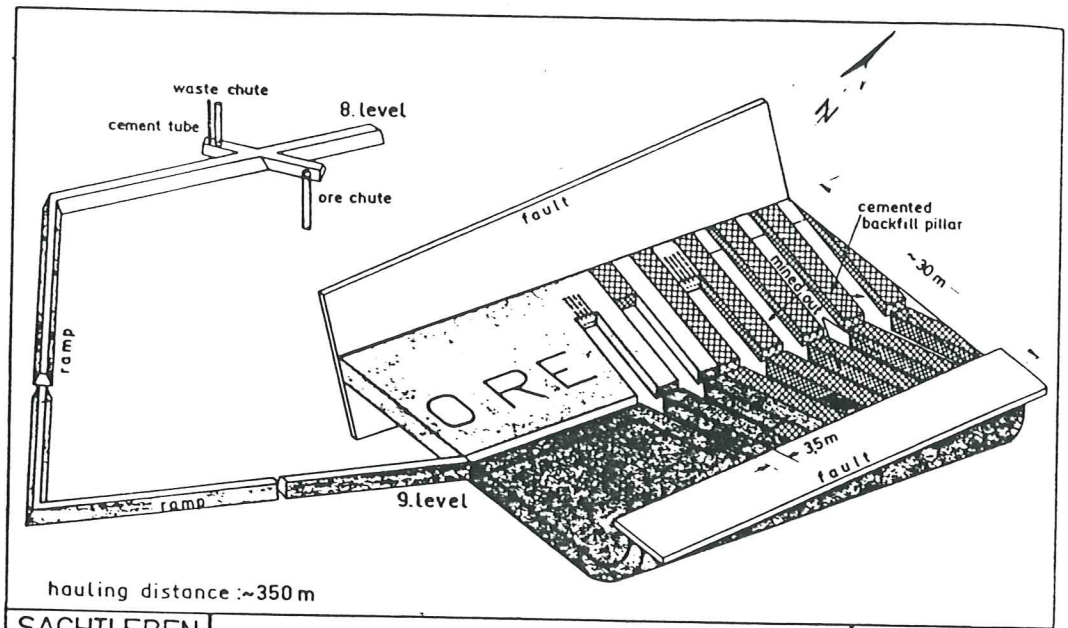
cross section

pillar extraction
performance : 60-100 t/mshift

development-work
performance : 40-60 t/mshift

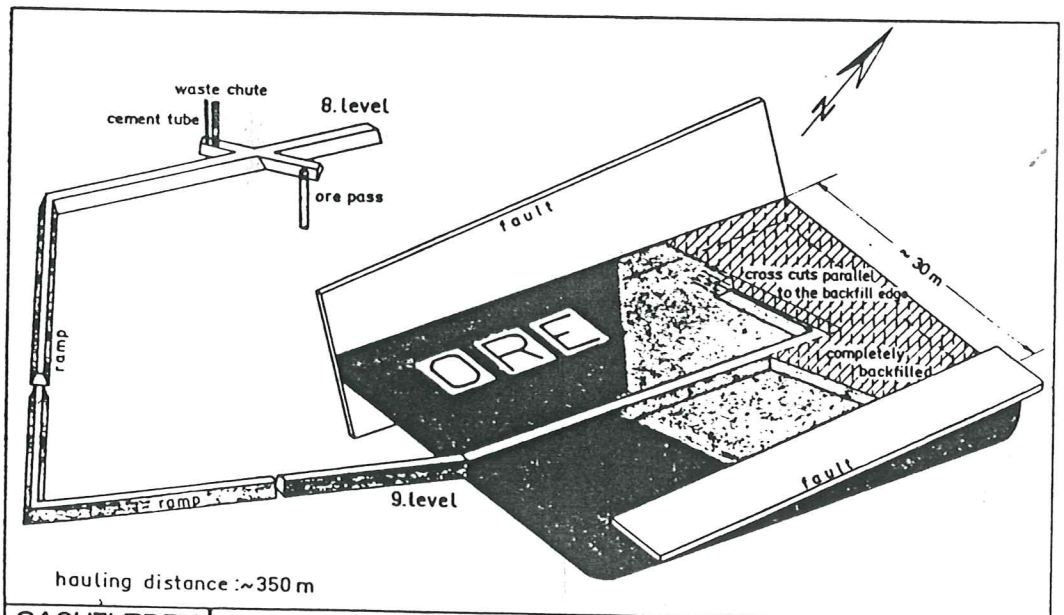
SACHTLEBEN Bergbau GmbH 1983	Sublevel shrinkage stoping method	Meggen Mine

fig.3



SACHTLEBEN BERGBAU GmbH 1983	room-and - pillar mining	Meggen Mine

fig. 4a



SACHTLEBEN BERGBAU GmbH 1983	cross cut mining with backfill	Meggen Mine

fig. 4 b

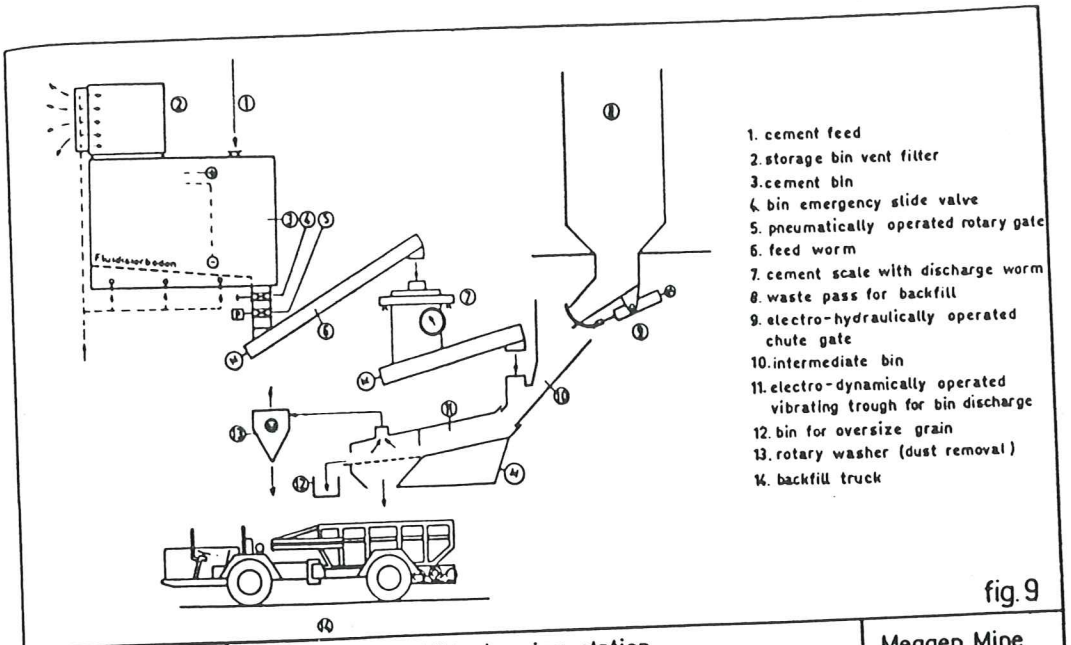
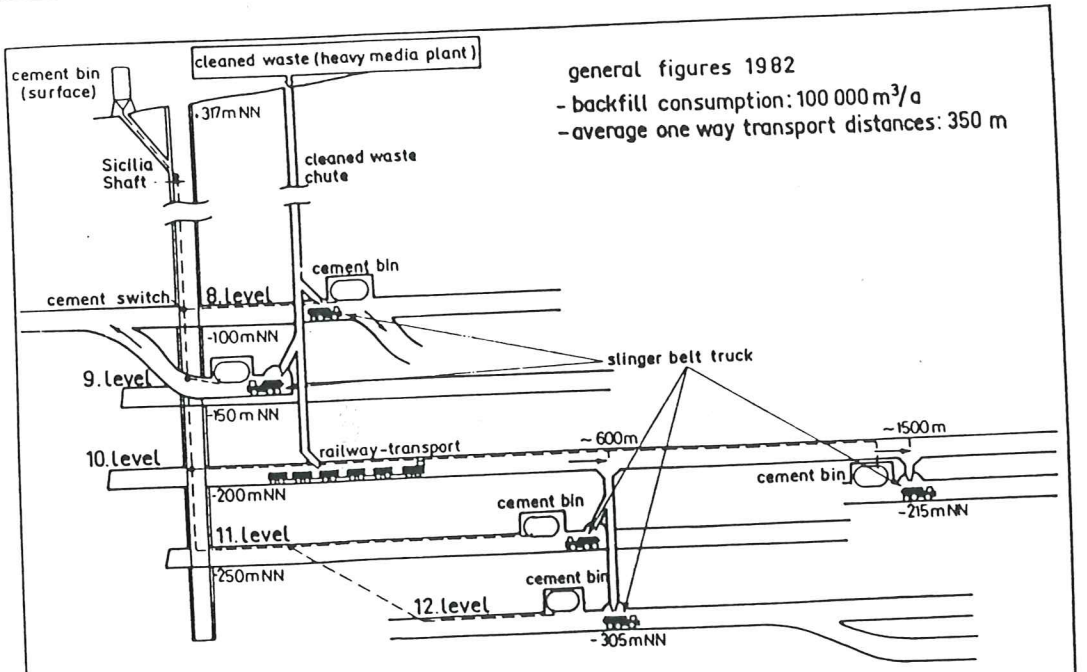


fig. 9

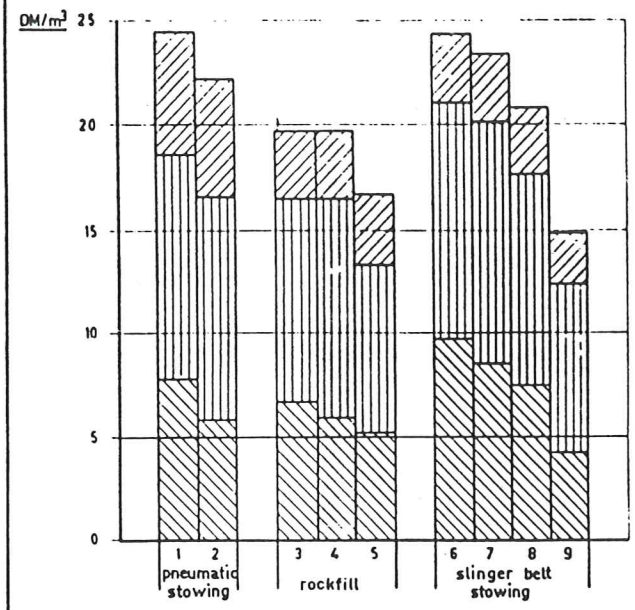
SACHTLEBEN Bergbau GmbH. 1983	backfill charging station	Meggen Mine



general figures 1982
- backfill consumption: 100 000 m^3/a
- average one way transport distances: 350 m

fig. 10

SACHTLEBEN BERGBAU GmbH 1983	Backfill distribution in the Meggen mine	Meggen Mine



investment costs
material costs
personnel costs

wh working hour
msh manshift

No.	procedures	performance
	pneumatic stowing	m^3/msh
1	stowing : 30 m^3/wh	31
2	machine : 150 m^3/wh	41
	rockfill	
3	LHD 1,5 m^3, Truck 6 t	35
4	LHD 1,5 m^3, Truck 10 t	40
5	LHD 1,5 m^3, Truck 15 t	46
	slinger belt stowing	
6	as 3 a. slinger belt	24
7	as 4 a. slinger belt	28
8	as 5 a. slinger belt	32
9	slinger belt truck	60

SACHTLEBEN Bergbau GmbH. 1983	Backfill costs fill volume 60.000 m^3 per backfill charging station	Meggen Mine

fig. 11

PROFESSIONAL
PROVINCE
OF
W. P. STOKES
BRITISH
COLUMBIA
ENGINEER