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DEVELOPMENT PROGRAM

for

KINSLEY MARBLE DEPOSIT  
WESTERN MARBLE COMPANY, LTD.  
ELKO-WHITE PINE COUNTIES, NEVADA

by

W. Don Quigley  
Consulting Geologist  
Salt Lake City, Utah

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See also map files  
- 2 map

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WESTERN MARBLE COMPANY, LTD.  
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INTRODUCTION

The Kinsley marble deposit is located on the southern end of the Kinsley Mountains in eastern Nevada on the boundary between Elko and White Pine Counties. The deposit is easily accessible by a third class road which follows a dry wash for a short distance westward from the area and then swings northwestward and connects with Highway No. 50 at Boone Springs. The distance from the highway to the deposit is about seven miles.

The author visited the deposit on September 29, 1966, for a brief inspection and geologic reconnaissance of the prospect. The impression of the deposit and its potential received during this visit was extremely favorable. There can be no doubt as to its merit and worth for development and exploitation. The geologic conditions surrounding the occurrence, the physical position of the deposit and general topography of the area are all satisfactory and beneficial to easy development. The geologic conditions in particular are such as to provide a wide range of marble colors and products. This feature is unusual and thus makes the deposit highly attractive and meritorious.

Most marble deposits have a single, specific color and thus are limited in appeal and use. The subject deposit has colors ranging from pure white to dark mottled and varved grays, including pinks, browns, tans, lavenders, greens, blues, and reds, thus providing a color range within the same deposit which can hardly be duplicated by any of the other known deposits in the world.

Since the area of the deposit has been developed and exploited to some extent in the past for minerals, primarily copper, silver, lead, and zinc, considerable information concerning the geology has been obtained over the years and a number of maps and reports on mine workings and mineral occurrences have been prepared. Most

of these appear quite accurate and well done and can be of considerable assistance in the future work. Consequently, the geologic details will not be discussed herein except in a general manner where applicable to the specific problem of getting the development program underway, and to the nature and quality of the marble.

### GENERAL GEOLOGY

The quality of marble is dependent to a large degree on the extent of metamorphism which has taken place which in turn is dependent on the extensiveness of igneous intrusive rocks and attendant heat and pressure which are distributed fairly evenly along with hot mineralizing gases and solutions through out the limestone rocks which ultimately are altered to marble. Consequently, this process is much more thorough where there are numerous dikes and sills of the intrusive rock and solutions extending laterally into the limestone away from the main mass of the intruded igneous body. Such was the case with the Kinsley deposit. A batholithic mass of quartz monzonite has been intruded into the limestone beds of the Pogonip series of Ordovician-Cambrian age which were fractured providing openings for lateral dikes and sills extending radially for a distance of more than 1/4 mile in numerous directions away from the main body of monzonite. Of course, these dikes are more numerous and extensive along the strike of the limestone beds which is generally north-east parallel to the axis of Kinsley mountain. These geologic circumstances are responsible for the metamorphism of the limestone into marble; and the various dikes, sills, shear zones and associated mineralizing solutions and gases have provided the wide range of colors found in the marble in adjacent areas.

The general geology of the area as determined from a study of the rocks exposed on the surface is shown on the attached geologic map prepared by R. A. Paige and W. M. Haglund. This map clearly shows the intruded quartz-monzonite mass and attendant dikes. The intrusive mass is circular, relatively small, being approximately one mile in diameter, and is probably Laramide in age. The map shows the area near the numerous quartz-monzonite dikes on the southern edge and northeastern edge of intruded body as being more highly marblized. However, much of the designated limestone on the south-

western and western edges is metamorphosed for at least 300 feet away from the contact and is commercial marble capable of taking a high polish and resistant to wear. The surface exposures are slightly arenaceous; but this is believed to be only a surface condition which would disappear within a few feet below the surface. This is quite apparent in the cores taken from the holes drilled in the area of the Diane shaft on the southwestern edge of the intrusion. Blocks of marble are evident in the monzonite along the contact and obviously have been carried up with the intrusive mass.

From examination of the cores taken in the area of the Diane shaft marblization is fairly complete between the monzonite dikes and sills. Immediately adjacent to some of the dikes and sills for a distance of about 6 feet, the marble is highly fractured and mixed with iron gossan and gouge. In other cases, there is practically no fracturing and little contamination of the adjacent marble. Old fractures can be seen in the marble cores, but most all of these have been sealed and healed by the recrystallization. Vertical and angular breaks in the cores are quite rare. Most of the breaks are perpendicular to the axis of the core and usually occur at points where changes in composition take place.

A spectacular array of colors is present in the Kinsley marble as shown by the cores taken from the area around the Diane shaft. These colors vary from pure white, to grays, browns, tans, pinks, reds, blues, and greens in various shades and intensity. Such a color range is most unusual and is due to the numerous quartz monzonite dikes and sills with associated mineralizing solutions. Comparison of the cores taken around the Diane shaft with those taken around the Morning Star shaft, indicates that the degree of marblization is more extensive and intense with fewer monzonite dikes and sills in the cores in the area of the Morning Star shaft; however, the color ranges in the marble are fewer.

#### RESERVES AND QUALITY

There can be no doubt about the reserves of marble being sufficiently large to sustain a large quarry operation and associated products of chips, small blocks, and pre-fabricated slabs of moderate dimensions. The dimensions of the Kinsley deposit which can be observed on the surface are extremely large and the vertical dimension is unknown.

At least 300 feet of vertical section has been proven by the core holes. The surface dimensions of over 2500 feet by 4000 feet together with over 300 feet of thickness suggest an overall tonnage of more than 250 million tons. Reserves of marble in certain specific colors are unknown since the amount of drilling is small compared to the size of the deposit; but in most all colors the indicated tonnage is sufficient to remove any risk in soliciting a market. The greatest quantity will be in the white and grey colors, but most other colors are present in large quantities.

The marble appears to be of excellent quality and well above the required limits of crystallization, density, water absorption, hardness, solubility, resistance to wear and chemical deterioration and change, and ability to take and keep a high polish. Numerous tests have been performed by the owners and interested buyers on samples of the marble for many of the above qualities and the results have all been satisfactory. Consequently, quality and grade of the marble are excellent and thus can compete with any other marbles now being exploited.

The ability of marble to block and resistance to breakage in large blocks is always an unknown quality, until actual attempts to block are undertaken. The operators of the Kinsley deposit, Western Marble Company, Ltd., have been working during the past several weeks to ascertain this unknown factor. A trial block about 12 feet x 6 feet x 3 feet in dimensions was actually outlined by drilling, jacked-up, and removed intact without any sign of fracturing or splitting. This block was removed from an area on a ridge less than two feet below the weathered surface of the marble. The surface appeared highly fractured in blocks about 6-inches square with right angle fractures. This is only a surface condition apparently due to freezing water and snow, and which does not continue deeper than a foot or so below the surface. Thus the suitability of the marble to block, and to be removed in large dimensions has been demonstrated.

#### MARKET

As with any mining operation, the most important factor is a proper evaluation of the marketability of the product and costs involved to supply such a product. A very comprehensive and excellent evaluation of the market situation and prospects has been made by economist John de Wolf of Vancouver, B.C. According to this study,

certain marble colors and products are in high demand. A market for a sizable tonnage of certain marble products is immediately available with probable markets for other products that can be broken into and acquired as the project progresses. The lower transportation costs, wider range of colors, and quality of the marble are listed as factors which would assist in penetrating and capturing a portion of this market.

Details on the market and wide range of products possible can be obtained from this referenced study entitled "The Nevada Marble Project - an Economic Assessment" by John de Wolf dated May 1966. Suffice it to say here that the market with attractive prices for the marble products does appear to exist and for quantities sufficient to support an operation of sizeable economic proportions. The immediate market is for colored marble chips for the preparation of terrazzo, floor tile, roofing aggregate, landscaping, and exterior rough or polished aggregate panels. Consequently, the project program should be planned to take advantage of this immediate market as soon as possible. Other phases of the project can be planned and developed as the operation progresses and the market is acquired.

#### DEVELOPMENT PROGRAM

The development of a relatively new project (new for the western states) should be planned carefully and separated into various phases with attention being paid toward minimizing the capital investment until the initial phases have been completed and can help support additional expansion and development. Unforeseen problems invariably occur which require slight alteration of the program as the project progresses and which sometimes destroy the feasibility or decrease the anticipated economic returns of the project. Consequently, the following recommended program is designed to proceed cautiously but determinedly toward full scale development and full utilization of all potential products from the Kinsley marble deposit:

##### PHASE I - TRIAL MARBLE BLOCK

Initially, in order to determine the suitability of the marble for large dimension products, it is necessary to quarry a trial block of

sizeable dimensions, at least 5 feet x 5 feet x 8 feet. The necessary equipment, personnel, and camp facilities were procured by Western Marble Company, Ltd., for this purpose and work has been underway for the past several weeks. As of last week -, October 20, 1966 a block measuring approximately 12 feet x 6 feet x 3 feet, was successfully removed, thus demonstrating the suitability of the marble for large dimension products. The first phase of development is therefore completed and subsequent phases can be undertaken with a high degree of confidence.

#### PHASE 2 - REJUVENATION OF DIANE MINE

As indicated above, the most urgent need now is the extraction of colored marble chips and small dimension blocks. The most likely location for this development (and probably will require less time and expense than any other location at present) is the Diane shaft. The coring which has already been accomplished here has established the presence of the marble in the desired colors. Several quartz-monzonite dikes and sills are present which probably enhance the color range. The Diane shaft, or more properly designed as an "incline", is of unknown depth but appears to be large enough for reasonably efficient operation initially. Accordingly, Phase 2 consists primarily of rejuvenation of the Diane incline and the commencement of drifts at various levels in certain directions. A rough diagram of the planned development of the Diane incline is shown on the attached Map No. 2.

#### ESTIMATE OF COSTS for REJUVENATION OF DIANE MINE

The following is a rough estimate of the costs involved and time required to recondition and reactivate the Diane mine in the Kinsley mining district in White Pine County, Nevada. These estimates may have to be revised as the operation progresses due to changes required by different conditions than those assumed at present. However,



these estimates are near enough for planning purposes.

Equipment:

The equipment plus costs which will be needed to put the Diane mine into operation for the extraction of colored marble chips are listed below:

Hoist - (50 H.P. equipped with motor, clutch, & brakes)	\$ 5,000.00
Cable - 3/4 in - 6x37 wire-flexible-fibre core) 500 ft.	260.00
Rail - (20 lb. 1 ft.) - 2000 ft.	2,500.00
Mucker - (12B - 4½ to 6 cu. ft. bucket)	2,250.00
Ventilation Blower with A.C. motor	400.00
Ventilation Duct (12-in plastic tubing) 400 ft.	320.00
Ore Bunker (12 ft. diameter x 10 ft. high)	1,500.00
Mine Car (43 cu. ft. - 24" w track)	200.00
Hoist shed (sheet metal 12 x 12)	750.00
Concrete base & foundation	150.00
Drill, Atlas Copco 7/8" with air leg	550.00
Miscellaneous (Picks, shovels, lumber, supplies, electric wire and fixtures, etc.)	<u>1,000.00</u>
Total Cost	\$ 14,880.00

The above prices are based on used equipment in first class condition.

Work:

In addition to the equipment costs there will be considerable labor and time involved in re-opening and rejuvenation of the Diane shaft and opening drifts at various levels up and down the shaft. This work will be done in sequence and certain times and costs are estimated as follows:

- (A) Inspection of the shaft for the first 100 feet to ascertain the condition of the walls and slope. It is being assumed that the incline has a slope of about 45° and follows the quartz monzonite dike. If this premise is wrong, then some alteration of the incline may be necessary.

1 day - - - - - 150.00

- (B) Level and grade location for Hoist shed. Remove some of the material in front of the portal to decrease slope of incline.

8 hrs. cat work - - -150.00

- (C) Lay platform and foundation for hoist shed.

1 day - (2 men) - - 75.00

- (D) Install hoist, build shed, build incline portal, and lay surface track for mine car.

4 days (3 men) - - 300.00

- (E) Scale walls of incline, level floor and lay track down to 150-ft. level. Rig up ventilation blower, hang ventilation duct, and wire for lights. Prepare side platforms and loading docks for 50 foot level and 150-ft. levels.

10 days (3 men) - - 750.00

- (F) Build and/or install ore bunker on surface and extend track to bunker.

5 days (2 men) - - 250.00

- (G) Start drift 8 ft. x 8 ft. heading N. 45° E. at 50 foot level. Start drift, 8 ft. x 8 ft., heading N. 60° E. at 150 ft. level.

4 days (3 men) - - 225.00

- (H) Continue to scale walls, and cleanup incline (and deepen if necessary) down to 300-ft. level, extending track, ventilation duct, and lights as needed.

8 days (3 men) - - 600.00

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Total Labor Costs \$ 2,500.00

which has been very helpful in evaluating the prospect and in forming plans for its development.

There can be no doubt as to the reserves and quality of the marble sufficient to sustain a large quarry operation for many years to come. A quantity of over 250 million tons is indicated at the present time. Tests have been made on the marble establishing its high quality and suitability for most purposes for which it is normally used.

The favorability of a market for Kinsley marble products has been established by a very comprehensive and excellent study made by economist John de Wolf of Vancouver, B. C. This study indicates a large demand for the products and outlines the economic potential of the prospect which justifies the necessary capital expenditure for its development.

A recommended development program for the deposit consists of several different phases. These phases plus estimated costs and time involved to complete each phase are as follows:

Phase 1 - Trial Marble Block - already successfully completed.		
Phase 2 - Rejuvenation of Diane Mine Equipment costs	14,880.00	
Labor Costs	2,500.00	
Technical Supervision	500.00	
Total	\$	17,880.00
Time - - -	35 days	
Phase 3 - Installation of Crusher Plant		
Extra equipment	8,500.00	
Labor, trucking, and crane rental	9,625.00	
Total	\$	18,125.00
Time - - -	50 days	
Phase 4 - Building Permanent Camp		
Extra Equipment and buildings	20,000.00	
Labor	4,500.00	
Total	\$	24,500.00
Time - - -	30 days	

In the process of accomplishing the above work, some technical supervision will be required. Certain information may be uncovered which will necessitate alteration of the plans. The slope of the present incline is a critical point. The slope appears much steeper than the 45° indicated on the drawings. However, this slope can be changed quite easily if it is steeper than the estimated 45°. Technical supervision costs are estimated at - - - - - \$500.00

Total Costs:

The total estimated costs and time to rejuvenate the Diane mine and begin the extraction of colored marble for marble chips are as follows:

Equipment costs	\$14,880.00
Labor costs	2,500.00
Technical supervision	500.00
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Total	\$ 17,880.00

The amount of time involved to get the mine reconditioned and extraction started is estimated to be approximately 35 working days, 8 hours each, providing no delays in waiting for equipment or other reasons are encountered. Of course, some of the work can be accomplished concurrent with other phases of the operation by employing more men, thus decreasing the estimated time required.

PHASE 3 - INSTALLATION OF CRUSHER PLANT

Concurrent with the work on rejuvenation of the Diane mine, preparation and work on the installation of the crushing and screening plant should begin. It is understood that a mill has been purchased by Western Marble Company in Blythe, California, which can be disassembled, transported, and reassembled at the quarry site. This mill includes

crushers, conveyors, screens, and feeders which will be adequate for the needs of the operation at present. (This mill also includes a sink-float plant which cannot be used in the initial work at the quarry; but which could be re-sold or kept for a possible future application in an expanded program.)

The following steps are recommended for the completion of this phase (Phase #3) of the operation: The estimated time and money necessary to complete these steps are also listed:

- (A) Inspection of the crushing plant at Blythe and make arrangements for its disassembling into shippable units.  

2 days

300.00
- (B) Disassemble crushing plant and make ready for shipment to quarry site.  

1 Crane - 5 men - 14 days

2,550.00
- (C) Load and transport equipment to quarry site. Some of the units will probably be larger and wider than could be transported by truck directly and therefore will have to be cut in pieces and then welded together again at the quarry site. However, much of the miscellaneous equipment can be transported in tact by the company truck.  

2 weeks

3,500.00
- (D) Select and level site for crushing plant at quarry. (It should be noted here that a site at the quarry has already been chosen; but it is believed that this site could well be in the way of future expanded workings of the quarry and therefore an alternate site should be chosen.) The site must

be so chosen as to take advantage of topography for gravity feed to most units of the plant. There should be about 100 feet of elevation change between the hopper to the jaw crusher at the top and the bottom of the storage bins at the lower end of the assembly.

1 cat - 1 man - 5 days 600.00

- (E) Reassemble and erect crushing plant. Certain alterations will undoubtedly have to be made to adapt the plant to the specific use and sizing the marble chips which will take time and incur certain expense. Additional equipment and miscellaneous parts will be required. Certain repairs and reconditioning may also be needed, such as new bearings, new motors, new screens, etc.

1 crane - 5 men - 15 days 2,675.00

Extra equipment, repairs, and miscellaneous 8,500.00

TOTAL COSTS OF PHASE 3:

The total costs and time estimated for the completion of Phase 3 is as follows:

(A)	Inspection of Blythe Plant - 2 days	300.00
(B)	Disassembling Plant 14 days	2,550.00
(C)	Transporting Plant 14 days	3,500.00
(D)	Preparation of mill site 5 days	600.00
(E)	Reassembling crushing plant 15 days	2,675.00
	Extra equipment - -	8,500.00
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	Totals 50 days	\$ 18,125.00

#### PHASE 4 - BUILDING PERMANENT CAMP AND REPAIR SHOPS

The building of a permanent camp which would include a bunk house capable of bunking up to 20 men, a cook house and mess hall with the necessary refrigeration equipment, and machine shops containing hoists, moderate size lathes, drill presses, forge and associated tools, should begin as soon as possible. One of the shops should be large enough to handle big trucks, loaders, cats, etc., to permit repair in bad weather. A power generator house is needed for the electrical generating equipment at the quarry. - Direct electrical power should be available for the permanent camp in the near future.

It is understood that much of this equipment and buildings are associated with the mill equipment already purchased. Other items will have to be added and purchased to meet the specific needs. The buildings can be sheet metal and can be pre-fabricated or custom made. It is very roughly estimated that the basic camp and initial needs of the camp and repair shops could be satisfied by the Blythe equipment and buildings, plus an additional expenditure of about \$20,000.00 for other tools and buildings.

The work on the camp and facilities can run concurrent with Phases 2 and 3. It is estimated that it may require approximately 30 days for 6 men to set up the camp and shops. The present four trailers can be utilized for housing in the future. The camp site should be chosen so as not to impede any future expansion operations of the quarry. The present site is much too close and would probably be in the way of future open pit quarrying for the deeper colored marble. The camp site should have good drainage and be removed from the path of dust from the quarrying and crushing operations. Since other phases of the full scale program would be more efficient if erected near the highway, it is deemed advisable to consider selecting the site for the permanent camp at or near the highway around Boone Springs.

#### TOTAL COSTS:

The total costs and time involved for the initial building of the permanent camp are estimated as follows:

Labor -- 6 men -- 30 days	\$ 4,500.00
Extra equipment, buildings and tools	20,000.00

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Totals for Phase 4	\$ 24,500.00
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#### PHASE 5 - EXTRACTION OF DIMENSION STONE

The present demand for dimension marble is large and should be utilized as soon as possible. This demand is primarily for floor tile, furniture-fireplace slabs, and split face bricks. However, this phase must proceed cautiously and be dependent on a relatively firm market of certain proportions. A full scale cutting, grinding, and polishing plant is a major undertaking and will cost well over  $\frac{1}{2}$  million dollars. The plant should really be relegated to the expansion phases of the program, but since getting any quantity of this type of product on the market entails all the various processes which can only be accomplished by such a plant, it almost becomes an integral part of the program. There are no custom cutting and polishing plants. All such plants are owned and operated by competitive marble companies.

This phase of extraction of dimension stone should begin as soon as the market for a specific size, quantity, and color is established. Since this phase has already been started experimentally, it should not be difficult to begin the operation on a limited scale. Certain additional equipment will be required for the quarry work. The additional equipment would include the following:

1 - new quarry bar --	\$ 1,500.00
1 - 25-ton crane - This can be rented at a rate of \$2,500 per month which includes 2 operators. 6 months rental	15,000.00
4 - additional drills with steel	3,000.00
Miscellaneous equipment	5,000.00
Total equipment costs	\$ 23,500.00



A five-man crew can reasonably extract a 9' x 5' x 6' block of marble in about 4 hours, which would produce two such blocks per crew per 8-hr. shift. Initially one crew would be sufficient to begin a stockpile of blocks while waiting for the construction of the cutting and polishing plant. On this scale labor costs will amount to approximately \$2500.00 per month.

#### PHASE 6 - INSTALLATION OF FINISHED DIMENSION PRODUCT PLANT

As noted above, the installation of a finished dimension product is a major undertaking and entails considerable capital. Initially the plant should be so designed to incorporate approximately 10 gang saws with attendant grinding and polishing facilities, until demand required expansion of the facilities. The initial assembling lines and machinery, as well as the plant must be designed with this expansion in mind.

The process of sizing, cutting, facing, and polishing the marble blocks is unique and requires special saws, grinding, honing, and polishing machinery. The technique is also special and requires certain procedures for each of the different products. This is explained in detail in the previously referenced de Wolf report on the project.

Selection of the site for the dimension product plant is most important. The plant site should be adjacent to main roads and transportation facilities as well as to public electrical power facilities and water supplies. A location near the highway at Boone Springs might be quite satisfactory. Land costs should be much less here than in Ely, or in Wendover. A spur line could be run to the Nevada Northern railroad at a point south of Currie. Water wells might have to be drilled to supply the necessary water for the plant and permanent camp.

Estimation of costs of such a plant are quite unreliable and as normal would probably be shy of the actual costs. The de Wolf report estimates a cost of \$700,000. This is probably as close as any. Perhaps the estimated cost for land is too high but the cost of equipment and buildings may be too low. Consequently, an estimated cost of approximately \$750,000 should be reasonably close. A period of at least 9 months would be required to construct the plant.

### OTHER PHASES

Other phases may be initiated from time to time as the need arises. It is believed that additional drilling may be required as the operation progresses. Enough drilling has been accomplished to date to establish the presence of large quantities of high quality marble and a wide variety of colors. Eventually additional drilling may be required to find further reserves of certain colors or to confirm or disprove certain fracture patterns which may be encountered in the quarrying operations. Additional drilling will probably be required to insure extension of the drifts in right direction in the underground mining operations as mining progresses. A certain quality of marble may be required for a specific purpose which will necessitate additional drilling.

There is a definite possibility that the colored marble chips may become of such demand that it will be more practical to convert the underground mining operation at the Diane mine into an open pit operation. This could be done quite easily by starting a bank or bench in the area of the present camp and working it northward toward the Diane portal. This procedure would expose the deeper colors near the base of the cut and the upper colors in the upper benches near the Diane portal. The presence of the colors in the area of the camp would, of course, have to be established by drilling prior to the commencement of the conversion program.

Other plants for the development of other products may become expedient and necessary as the development progresses. Plants for the production of ground products such as powdered white lime for chemical purposes, paint additives, granules for sand blasting, etc. These products and plants can be added gradually if the market warrants their addition.

### CONCLUSION AND SUMMARY

The Kinsley marble deposit is definitely unique and has unusual merit. The color range of marble within this single deposit is unmatched by any other known deposits being exploited at the present time. Accessibility to the deposit is quite easy and the topography is ideal for quarry operations.

The intrusion of a body of quartz-monzonite into the Pogonip limestone is responsible for the metamorphism producing the marble. Mineralization along dikes and sills extending laterally into the limestone has been explored and exploited to some degree by prior mining and coring operations. These operations have supplied considerable information.

Phase 5 - Extraction of Dimension Stone	
Equipment	23,500.00
Labor - \$2500/month for 5 man crew (6 months)	15,000.00
Total (6 months initial operation)	\$ 38,500.00
Phase 6 - Installation of Finished Dimension Product Plant	
Equipment, buildings, and Labor for Minimum Scale Operation - - - - - (?)	750,000.00
Time - - - - - 9 months.	

#### OTHER PHASES

It is quite probable that additional coring will be required as the project progresses. This coring may be required to outline further reserves of specific colors or patterns, to determine if undesirable fractures and jointing patterns are present in certain areas, and to outline positions of the monzonite dikes and sills at depth. It may become expedient to market other marble products which would necessitate additions and changes in the initial facilities. These changes may not be required for some time, but could become essential early in the progress of the project.

The above program calls for minimum operations and equipment for the initial "breaking-in" period of approximately 6 months. All major items of equipment are rented where such equipment is available on a rental basis. These items can eventually be purchased later when the project is well underway and beyond the "breaking-in" period. Most all mining projects require a certain amount of alteration in the plans as development progresses. Certain unforeseen obstacles and problems are encountered which increase costs and cause delays. For this reason it is highly recommended that not less than one million dollars be allocated to accomplish the work and development program outlined herein.

*W. Don Quigley*  
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Consulting Geologist