

GENERAL
 PHYSICAL
 COMPOSITION
 HISTORY
 LOCATION
 FORESHORE
 GENERAL
 DESCRIPTION
 PREVIOUS
 TOPOGRAPHY
 GEOLOGY

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Page

"THE ILOCOS NORTE MANGANESE DEPOSITS AND ESPECIALLY
THE SIEC GROUP OF THE ILOCOS MANGANESE MINING COMPANY
LOCATED IN THE COMMONWEALTH OF THE PHILIPPINES"

A THESIS

Submitted to the Faculty of the College of Engineering
 and of the Mackay School of Mines of the University of
 Nevada, located in Reno, Nevada, in Candidacy for the
 Advanced Degree of Engineer of Mines.

by

Norman John Ericson

APPENDIX I.

1939

APPENDIX II.

PLATE I.

PLATE II.

Property of the Ilocos Manganese Mining Co.,
 Group 3, Site 3, Ilocos Norte, P. I.



I N D E X

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PLATE I. Diriqui Inlet and Proposed Mill Site.

PLATE II. Property of the ILOCOS MANGANESE MINING CO.,
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the property; third, to give as accurate a valuation as possible to the property, consonant with the amount of development work accomplished subject to the known economic value of manganese and its accompanying gangue minerals in the United States markets; fourth, to show the net profit to the investors in the enterprise after mining costs, milling costs, transportation and

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"THE ILOCOS NORTE MANGANESE DEPOSITS AND ESPECIALLY THE SIEC GROUP OF THE ILOCOS MANGANESE MINING COMPANY LOCATED IN THE COMMONWEALTH OF THE PHILIPPINES" by NORMAN JOHN ERICSON.

due to the strategic value of its manganese deposits.

The property of the Ilocos Manganese Mining Company, located at Sitio Siec, Barrio of Burgos, Province of Ilocos

Norte, Island of Luzon, Commonwealth of the Philippines was

carefully examined by the author. The time consumed in making

this examination in the field was twenty one days - from July

12, 1936 to August 2, 1936. The original report was written

primarily for evaluation purposes for the Insular Treasurer

of the Commonwealth of the Philippines. The author has author-

ity to make such reports in the Commonwealth of the Philippines

due to the fact that he is licensed as a mining engineer and

geologist under the laws of the Commonwealth by examination.

His license number is No. 79 which is on record at the Bureau

of Mines, Commonwealth of the Philippines, at the Bureau of

Science Building located in Manila.

Since the original report was written primarily for

evaluation purposes the following factors were taken as of

primary importance: first, to show the character and size of

the property; second, to show the then present development of

the property; third, to give as accurate a valuation as possible

to the property, consonant with the amount of development work

accomplished subject to the known economic value of manganese

deposits accompanying gangue minerals in the United States markets;

fourth, to show the net profit to the investors in the enter-

prise after mining costs, milling costs, transportation and

CONCLUSIONS AND RECOMMENDATIONS

overhead expenses, etc., have been deducted; fifth, to show the importance of the Philippine Islands to the United States due to the strategic value of its manganese deposits.

All obtainable information bearing on the enterprise has been carefully weighed and assigned to its proper place in this report, with the idea of obtaining as close an approximation to fact as is consistent with the available data.

The present tendency of the Philippine Government is to give encouragement to the development of worthwhile enterprises. Particular encouragement is given those financed by local capital, the products of which may be exported to the United States markets on a non-competitive basis with like products (such as sugar cane) of the Philippines. In other words products which are not grown, produced or manufactured to any great extent in continental United States. Substitutes such as sugar beets not being taken into account. Due to this reasoning which admittedly is controversial in nature, the Commonwealth of the Philippines have built a good third class road, some seven kilometers long, from the Port of Diriqui to the mines at Siec at no cost to the mines. 108,084 tons

CONCLUSIONS AND RECOMMENDATIONS

This property at the time of examination in 1936 showed promise of becoming a major manganese producer in the Philippine Islands. Actual procedure along the lines suggested in the original report have brought this property into being as an actual manganese producer which is now supplying manganese

to the United States at a good profit to the stockholders.

The following points are given as some of the reasons for the success of the property:

There is a tariff of \$11.50 U. S. Cy. per long ton which foreign manganese has to pay in order to enter the markets of the United States. Philippine manganese is exempted from the payment of this tariff. This more than pays the ocean freight charges to Atlantic ports, which is approximately \$5.00 U. S. Cy. per long ton.

The grade of manganese acceptable to the steel producers is 35% metallic manganese or better, with 3% or less of silica and less than 0.30% phosphorus. The majority of the manganese ores of the Philippines, especially in the section under discussion, comes within these limits. In the particular case of the deposits considered we find the following;

1. Average grade of commercial washed ore = 39.95% metallic manganese.
2. 108,024 tons of positive crude ore developed, grade given only as washed ore in No. 3, since meaningless in unwashed ore.
3. 51,570 tons of washed ore of 39.95% metallic manganese.
4. Ratio washed ore to crude ore = 47,427 tons to 108,024 tons or 43.90%. (Note: Not 51,570 tons as deductions were made for ore already washed and in stock piles).
5. Total net profit on present proven washed ore according to a trial shipment is P12.00 per long ton. For this report P10.00 per long ton net profit was taken as the base, giving a total net profit for 51,570 tons of washed ore as P515,700.00.

The following points were recommended and later carried out with gratifying results:

1. This property should be systematically sampled as there are many areas upon which no test pits were sunk. Much more commercial ore should be proven when this is done.

2. A modern washing plant should be erected in order that a cleaner product can be shipped to the markets.

3. Hand methods of mining will be cheaper at the present time than either power shovels or drag lines. The character of the deposit does not lend itself readily to mechanical methods of mining.

4. Widening and surfacing of the road to Diriqui is recommended at the present time rather than the erection of an aerial tramway.

HISTORY OF THE PROPERTY

In 1906, Mr. F. D. Burdetter (an experienced miner according to reports) of the Ilocos Mining Company, had done some work at Punta Negra which is approximately eight kilometers in a northerly direction from Siec. No record of their production can be found. In 1916, the property at Siec was put into production and shipped 3000 tons of unwashed manganese ore valued at P30,000 to Japan. (All monetary units in this paper unless stated otherwise will be in Philippine pesos, the conversion factor to United States Currency is two to one. This is kept at this factor by the treasury of the United States.) In 1918, 650 tons of unwashed ore valued at P900 was mined

at Siec, but there are no records to show that this ore was ever disposed of. Traces of these early mining operations can still be seen. As far as is known, no further work was attempted on these properties until the Ilocos Manganese Mining Company acquired the Siec and Punta Negra Groups by purchase. Details of this acquisition will appear later in this paper.

LOCATION AND ACCESSIBILITY

As per the request of the sponsors of this examination the Siec Group only was investigated. Therefore all data given will refer to that group alone and not to the Punta Negra Group of manganese claims.

The Siec Group may be reached by a newly constructed third class road from Davila on the Manila North Road to the mines at Siec, a distance of 6.7 kilometers. Three tenths of a kilometer from Davila south on the Manila North Road is the Port of Diriqui of which more information will be given later in this section. The road to Siec from Davila is a provincial undertaking put in primarily to aid the mines at Siec. However it was later extended another seven kilometers to the sitio of Agaga where the mines get many of their common laborers. The road has no bad grades and but few curves and is metalled with crushed limestone giving it an all weather surfacing. It is being used by two ton trucks during all weather, excluding typhoons only.

In case of heavy traffic it would be best to make this a one way road with telephone control at each end of the road. Washed ore from Siec has been hauled over this road for P1.50 per ton.

Davala is, as stated above, on the Manila North Road and is some 500 kilometers from Manila. The Manila North Road is oil surfaced along its entire distance and excellent bus service exists between these points.

A foreshore lease No. 1768 has been granted the Ilocos Manganese Mining Company at Diriqui Inlet and a sufficient area is available for a washing or beneficiating plant and ore storage at this point. See sketch map of Diriqui Inlet in appendix. Water rights amounting to 100 liters per second were applied for from the Insular Government and granted.

Diriqui Inlet, latitude 18° 27' N., 120° 34' E., affords a good anchorage for small craft during the northeast monsoon. The basin is about 300 meters in diameter and is sheltered from all winds except those from the southwest. Soundings are between twelve and four fathoms, the

four fathom sounding being less than 200 meters from shore. A dock can be erected at a small cost at this point.

Diriqui Inlet is 4.3 kilometers from the mine at Siec by airline. At a relatively small cost a cableway can be constructed from mine to harbor, this will cut transportation costs to a minimum if a large tonnage is handled.

DESCRIPTION OF THE PROPERTY

The property consists of twenty legally located lode claims of approximately nine hectares each (300 meters by 300 meters square - no extralateral rights in the Philippines). These claims are situated at sitio Siec, barrio of Burgos, Province of Ilocos Norte, Island of Luzon in the Commonwealth of the Philippines. All are regularly registered with the provincial recorder at Laoag, Ilocos Norte. These claims with their locations and the dates of recording are, to wit:

- | | | | |
|-----|--------------------------|---------------|--|
| 1. | The Gattaran Lode Claim, | Jan. 29, 1934 | |
| 2. | " Enrile | " " " " | |
| 3. | " Langangan | " " " " | |
| 4. | " Cabagan | " " " " | |
| 5. | " Lemery | " " " " | by (L. Quintero (M. Velasco (B. S. Gerado (J. J. Rafferty |
| 6. | " Rosario | " " " " | |
| 7. | " Cuenca | " " " " | |
| 8. | " Santo Tomás | " " " " | |
| 9. | " Balayan | " " " " | |
| 10. | " Batac | " " " " | |
| 11. | " Salsoma | " " " " | |
| 12. | " Nueva Era | " " " " | |
| 13. | " Badoc | " " " " | |
| 14. | " Vintar | " " " " | |
| 15. | " San Pablo | " " " " | |
| 16. | " Texas | " " " " | |
| 17. | " California | " " " " | |
| 18. | " Colorado | " " " " | |
| 19. | " Nevada | " " " " | |
| 20. | " Alabama | " " " " | |

Assessment work amounting to P200 annually per claim has been kept up and affidavits are filed to this effect with the mining recorder of Ilocos Norte at Laoag. These claims were sold by M. Velasco, L. Quintero and B. S. Gerado, all of Ilocos Norte, through the power of attorney held by J. J. Rafferty, of Siec, Burgos, Ilocos Norte, to Alfonso Z. Sy Cip, of

129 Juan Luna, Manila, as per deed of sale registered August 16, 1934 at the Mining Recorder's Office at Laoag, Ilocos Norte as full purchase price had been paid. It is felt that a corporation was then formed by Alfonso Z. Sy Cip called the Ilocos Manganese Mining Company of 129 Juan Luna, Manila, Philippines. Said company being registered with the Insular Treasurer. He allowing shares to the par value of P200,000 for the purpose of developing the property at Siec. No notice of conflict has been filed nor any other notice filed as to any irregularity as to the legal rights of the claim owners to the above described property. The Grawfus Mining Company of Manila, Philippines is being organized in order to purchase the Siec group of twenty lode claims from the Ilocos Manganese Mining Company for the sum of P810,000. Payment to be made in common stock of the new company at par. The Grawfus Mining Company is to be capitalized at P1,500,000. PREVIOUS REPORTS ON THE SIEC GROUP The only available public report on the property known to the writer is that written by Enrique Ostrea, assistant metallurgist of the Division of Mines, Department of Agriculture and Commerce, dated June 22, 1934. Other reports have been made by privately engaged engineers for their principals, copies of which are unavailable. An investigation was made of the property by J. W. Karsten, of 129 Juan Luna, Manila, Philippines, for the purpose

of determining the kind of equipment needed for the beneficiation of the ore; this report is dated December 31, 1935, but as the gentleman is not a mining engineer or geologist, it is felt that it would be superflous to include it in the present report.

TOPOGRAPHY

There are no good topographical maps of the Siec Group. These will be very necessary in order to be able to plan intelligently the future cycle of mining operations.

The topography from Diriqui Inlet to the mine property consists of about three kilometers of coastal plain rising gradually to a limestone ridge averaging approximately 300 meters above sea level, thence into Siec Valley. Siec Valley is itself a rolling country with some abrupt hills of limestone. Limestone outcrops are numerous on the hills. Siec Creek flows at the bottom of a synclinal formation running south-westward through the claims and then lost in an underground channel which is approximately one kilometer long, discharging finally into the Diriqui River near the outlet of the underground channel. Small flats of different elevations are a feature of the topography and are important as they contain residual manganese, most of which can be commercially recovered. Disposal of waste and tailings will be a problem as there are no good sites available. Back filling seems to be the best solution of this problem at present.

GEOLOGY

As one leaves the coastal plain and starts towards the manganese deposits of the Ilocos Manganese Mining Company at Siec, one immediately meets moderately high hills of limestone, the configuration of which shows that they must have been cliffs in the old shore line. This limestone generally shows solution cavities and sometimes manganese nodules. The road goes over these limestone hills into the camp at Siec where the residual manganese deposits are found. Under this limestone at Siec is found a layer of sedimentary manganese between one foot and four foot thick. Below this sedimentary manganese is found a soft calcareous sandstone. Along the creek at Siec where the deposits are located, the structure is definitely synclinal. The ridge of hills behind Siec is also made up of this limestone.

Below the limestone is found a layer of sedimentary manganese between one and four feet thick as mentioned above. This layer of sedimentary or lacustrine manganese may or may not be ore and has not been considered as ore in this paper. In places it could probably be mined where the percentage of metallic manganese is high, but where it is low it could not be beneficiated profitably. Below this manganese is a soft calcareous sandstone; this sandstone, the manganese layer and the limestone will be conformable on each other. The

limestone in many places contains nodules of manganese which were probably formed after the deposition of the limestone with the aid of carbonate or sulphate waters. The original manganese which gave rise to these nodules may have been the layer of manganese below the limestone. At any rate the present ore of manganese is residual, made up of nodules of manganese mixed with clay and resting just below the surface to a depth of three to ten feet. This has naturally accumulated in the depressions, but a great deal of it has also remained as residual deposits on the hillsides after the erosion and solution of the limestone. Much of this ore can be washed to produce a clean ore of about 42% metallic manganese. Some of the ore on the hillsides being mixed with limestone gravel will have to be picked by hand. The size of the manganese nodules vary between one eighth of an inch up to four inches in diameter and occasionally much greater. The average size would be about one half inch in diameter, a good size to work with and wash.

WATER SUPPLY

In Siec Valley there is sufficient water to run a 100 ton beneficiating plant for about six months of the year. During the other six months there is to be found just sufficient water for domestic purposes. The Diriqui River could be tapped by a six to eight kilometer pipe

CLIMATE

line but is not feasible as prior water rights have been

The climate in this section is mild, clear and healthy, being kept so by the sea winds which have a clear sweep over the area. Rainfall is moderate during the entire year. Two to three times a year rarely more, a typhoon will hit this area. These typhoons last from two days to three weeks and during the period of their duration has been given to the Ilocos Manganese Mining Company the right to use 100 liters of water per second from Diriqui River which would be sufficient for the final wash.

The possibility of constructing dams to trap the flood waters of the rainy season was investigated at

Siec. This was found to be impractical as the character of the ground precludes this possibility. The water impounded behind dams would sink into and through the porous limestone.

TIMBER SUPPLY

The property of the Ilocos Manganese Mining Company at Siec is but sparsely wooded. This is no drawback, however, since very little timber will be needed for mining purposes. Private concessionaires would supply at a reasonable price, forty peses per thousand board feet, all of the timber that would be necessary of whatever grade of wood that would be required.

CLIMATE

The climate in this section is mild, clear and this healthy, being kept so by the sea winds which have a clear sweep over the area. Rainfall is moderate during the seasons. entire year. Two to three times a year rarely more, a typhoon will hit this spot. These typhoons last from two days to three weeks and during the period of their duration it is practically impossible to do any work. Roads will be closed by slides during these periods and oftentimes bridges will be swept away. The Insular Government keeps men constantly at work during these typhoons in order to try to keep the roads open.

All in all, the climate at Siec can be beaten which by no other in the Philippines. The Baguio district not excepted.

LABOR

Common labor is plentiful in the surrounding in the barrios and is of the best filipino quality. As the work at Siec consists principally of open stripping operations, no specialized laborers nor underground miners will be needed. From here the ore is taken to a stock pile as a final. Wages for common labor averages eighty centavos a day. Good quarters are provided and there is an infirmary run by the Company at Siec.

POWER

consequently a greater milling cost would be met with by using mechanical equipment. Hydro-electric power is out of the question in this district. Steam power would not be practical due to the cost of fuel and the scarcity of water during the dry seasons. This leaves power by internal combustion engines as the best solution. Diesel engines as noted later in this paper would probably be used.

MINING AND MILLING PROCEDURE AS PRACTICED AT PRESENT

Mining is done at present by hand labor in open pits using picks, shovels and wheelbarrows only. As the cost of labor is low and the class of labor here above the average, the material is mined very cheaply.

The ore is hand sorted and then washed in boxes which consist of units three meters by one meter in area and with sides three tenths of a meter high. At the head end of these units an eight mesh screen is placed over which the wash water flows. The material to be washed is first dumped in the bottom of the box and sluiced by water. Here most of the slimes are eliminated. The concentrates are then taken to the screen end by shovels where fresh water is applied and the ore scrubbed. From here the ore is taken to a stock pile as a finished product. A fairly clean concentrate is obtained in this manner. The chief objection to this method is its slowness. Only a half ton per man shift can be treated and

of ore; however, as the blocks were small they were deemed consequently a greater milling cost obtains than would be sufficient. Outcrops of limestone were omitted from the met with by using mechanical equipment.

Transportation is by means of wheelbarrows from the excavated areas to the washing plants and from the washing plants to the stock piles. From the stock piles two-ton auto trucks take the finished products to the shipping point at Diriqui. At Diriqui the material is loaded into "cascos" or lighters and thence into ocean going freighters.

VALUATION

At Siec the material to be sampled consisted of a surface layer of residual manganese embedded in a ferrous clay formation, varying from a few centimeters to several meters in thickness. Underlying the material to be sampled is found a layer of calcareous sandstone. The material to be sampled is very consistent in its uniformity over small areas, therefore it was deemed sufficient to take samples at the maximum points of consistency which varied from twenty to forty meters. As there were innumerable test trenches and pits on the property it was deemed advisable to use them for sampling where possible, thereby saving new excavations for test pits. As these trenches and pits were put in, in order to facilitate mining rather than sampling they were found to be irregularly located. This gave odd shaped blocks

1. Sample weighed and assayed;
2. Sample washed and dried to determine moisture content and weighed;
3. Assay sample cut by weighing and quartering from washed sample;
4. Ratio of recoverable washed ore computed for each test;
5. Weighted average assay computed for each ore block;
6. Weighted average tonnage computed for each ore block;

10. Gross value of ore block determined by latest assay of ore; however, as the blocks were small they were deemed sufficient. Outcrops of limestone were omitted from the

11. Costs of following computed (as 10,000 tons of crude

ore per month): development, mining, washing, transportation from site to Diriqui, loading to ships, points together with the ore blocks delineated by these ocean freight to Atlantic coast ports of the United States. The area, tonnage of crude ore, tonnage of washed ore and per cent of recoverable metallic manganese

12. Net profit determined. The plan included

with this paper does not show all of this but does give an

outline of the manganese areas which were sampled.

The following inventory of buildings and equipment

was found to be correct:
As assaying the unwashed ore would give no results which could be used for estimating the economic value of the ground it was found necessary to reduce each sample and block to recoverable washed ore. This was done as follows:

- 1 assay office of wood construction
 - 1 powder magazine (strong materials to comply with the law)
 - 1 company house (wood construction - two stories; first floor office, bedchamber and kitchen, second floor, living quarters for staff)
 - 1 water system for company house.
- Approximate value of the above = P4,000.00
1. Sample cut the depth of deposit and measured;
 2. Channel of 0.20 X 0.25 meters for each sample;
 3. Volume computed of unwashed sample in place;
 4. Unwashed sample weighed;
 5. Sample washed and dried to former moisture content and weighed;
 6. Assay sample cut by coning and quartering from washed sample;
 7. Ratio of recoverable washed ore computed for each test;
 8. Weighted average assay computed for each ore block;
 9. Weighted average tonnage computed for each ore block;

10. Gross value of ore block determined by latest manganese quotations;
11. Costs of following computed (at 10,000 tons of crude ore per month): development, mining, washing, transportation from Siec to Diriqui, loading to ships, ocean freight to Atlantic coast ports of the United States;
12. Net profit determined.

INVENTORY OF BUILDINGS AND EQUIPMENT

The following inventory of buildings and equipment was found to be correct:

- 10 grass houses for laborers (with wooden floor)
- 1 grass bodega or warehouse
- 1 grass hospital (with wood floor)
- 1 assay office of wood construction
- 1 powder magazine (strong materials to comply with the law)
- 1 company house (wood construction - two stories; first floor office, bodega and kitchen, second floor, living quarters for staff)
- 1 water system for company house.

Approximate value of the above = P4,000.00

Other items of equipment include:

- 1 Anvil, steel, 100 lb.
- 2 pipe threading sets
- 1 axe, 4 lb.
- 1 axe, 8 lb.
- 11 bars, wrecking

| | |
|------------------|--------|
| Metallie Mm. | 42.42% |
| SiO ₂ | 7.53% |
| Phosphorous | 0.036% |

Costs of this shipment per ton = P10.55 (total costs, mining, washing, shipping to Manila, overhead, etc. Ocean freight was paid by buyer)

- 13 bars, crow
- 1 cutter, pipe, No. 2
- 200 kilos, steel, drill
- 1 hammer, riveting
- 1 hammer, ball peon
- 1 hammer, cross pin
- 34 hammers, 8 lb.
- 6 hatchets
- 38 hoes
- 4 wrenches, pipe 14", 18", 24"
- 2 wrenches, monkey
- 116 picks, R. R.
- 48 picks, drift
- 13 picks, geologists
- 51 rakes
- 4 bundles, rope, Manila
- 1 pr. shears, tin
- 176 shovels, short handled
- 18 wheel barrows
- 200 empty 5 gal. tins
- 35 screens, wire, 8 mesh
- 35 pans, Galvanized Iron
- 1 complete set laboratory apparatus and equipment
- 1 Abney hand level, drafting instruments, level and stadia rods, tapes, and triangles.

RECORD OF TRIAL SHIPMENT

A trial shipment was made to Frank Semmel Co., at Harrisburg, Pa., in October 1935 as follows:

1,168,800 lb. manganese ore
 161,879 lb. moisture @ 13.85%
 This 1,006,921 lb. actual ore

42.427% metallic manganese at 29¢ a unit = \$12.3038 per long ton.
 Less allowance account low Mn and high SiO₂ 1.00
 1,006,921 lbs. @ or 457.69 long tons 11.3038 = \$5,081.27
 Less 1/2 cost of sampling and analysis 40.00
 Amount paid to Ilocos Manganese Mining Co. \$5,041.27

Analysis as per Andrew S. McCreath & Son, 236-242 Liberty Street, Harrisburg, Pa., Oct. 28, 1935.

@ 212° F. moisture = 13.850%
 Contained dried at 212° F. Metallic Mn. 42.427%
 SiO₂ 7.525%
 Phosphorous 0.036%

Costs of this shipment per ton = P10.55 (total costs, mining, washing, shipping to Manila, overhead, etc. Ocean freight was paid by buyer)

Total recovered per ton = P22.61. This less P10.55 gives a net profit per ton of P12.06 or \$6.03 U. S. Cy.

MINING AND MILLING PROCEDURE AS RECOMMENDED

Hand labor, because of its cheapness and because of the character of the oredeposits (broad and shallow with little or no overburden), is the most economical method of mining this deposit. Power shovels, drag lines, or other mechanical methods would not be satisfactory except in a few isolated instances. The initial investment for such equipment would not be warranted at this time, at least until more is known of the deposit. The ore bodies should be worked from the valleys and flats up to the top of the hills in a systematic manner. A central point would have to be decided upon for the convergence of all ore mined so that transportation to Diriqui could be simplified. Auto trucks will be used to Diriqui until such time as the quantity of ore handled warrants the installation of a double track aerial tramline. This tramline would be 4.3 kilometers long and would not exceed P100,000 installed cost. This is recommended rather than auto trucks if the unwashed ore is hauled to Diriqui since the daily volume to be handled would be approximately 250 tons per day for a 100 ton concentrating plant situated at Diriqui. At present, however, auto trucks are used as the road is of sufficient width and grade to allow such use. A few places in the road would have to be widened for heavy

traffic. The road is seven kilometers from mine to port.

Local transportation at the mine could be accomplished by barrows to bins and by two wheeled wagons (type used for pouring concrete aggregates) to the central ore pile.

This will eliminate the purchasing of mine cars and steel rail. Tracks would be unsatisfactory as they would have to be constantly shifted in order to keep up with mining operations.

A mechanical log washing plant is recommended and should be installed at Diriqui in order to be assured of water

at all seasons. The following equipment is recommended for mining and milling purposes. Costs have been acquired through various firms in Manila and are close enough for estimation purposes.

New Supplies and Equipment Needed for Mining at Siec

| | |
|---|--------------|
| 1 Double log washer with motor | 3,200.00 |
| 1 Vibrating screen with motor | 2,400.00 |
| 1 Vibrating belt 30' x 16" with motor | 2,000.00 |
| 1 Water tank, 5000 gal. capacity | 1,000.00 |
| <u>New Supplies and Equipment Needed for Mining at Siec</u> | |
| 1 100 H.P. Diesel with generator set, switch | 3,000.00 |
| Scaffolding | 480.00 |
| Housing for equipment | 4,800.00 |
| 150 Picks with handles | P 360.00 |
| 150 shovels with handles | 4,500 216.00 |
| 20 2 wheeled dump wagons (concrete type) | 2,000.00 |
| Super Lumber for track ways, 5000 bd. ft. | 300.00 |
| Lumber for receiving bunkers 20' x 10' x 16', 3500 bd. ft. | 210.00 |
| Hardware for same, bolts and nails | 165.00 |
| 1 portable forge and 1 - 100 lb. anvil | 40.00 |
| 2 sets, forge tools | 62.00 |
| 1 surveying transit | 750.00 |
| | P 4,103.00 |

Optional Aerial Cableway:

| | | |
|-------|---|-------------------|
| Total | Manila Machinery & Supply Co., bid ----- | P39,980.00 |
| | 15% customs duty ----- | 6,000.00 |
| | Arrastre charges ----- | 600.00 |
| | 40 wooden towers, 32' above ground, complete with splice bars, bolts, washers, 160 cu. yd. concrete ----- | 12,400.00 |
| | 140 cu. yd. concrete for cable stations ----- | 3,640.00 |
| | Tension wts. and boxes ----- | 960.00 |
| | Transportation to site of towers ----- | 1,740.00 |
| | Erection of towers, stations & cableways ---- | 19,800.00 |
| | Topographical survey and plans, 1:1000 ----- | 2,700.00 |
| | G. I. roofing over stations and roof girders----- | 2,400.00 |
| | | <u>P90,220.00</u> |
| | Supervision, etc., 10% ----- | 9,022.00 |
| | | <u>P99,242.00</u> |

Washing Station at Diriqui:

| | | |
|---|--|-------------------|
| | Lumber for ore bin 20' x 20' x 26' ----- P | 600.00 |
| 1 | Double log washer with motor ----- | 3,200.00 |
| 1 | Dewatering screen ----- | 1,200.00 |
| 1 | Vibrating screen with motor ----- | 2,400.00 |
| 1 | Sorting belt 30' x 16" with motor ----- | 2,000.00 |
| 1 | Water tank, 5000 gal. capacity ----- | 1,000.00 |
| 2 | 2" centrifugal pumps with motors ----- | 3,000.00 |
| 1 | 100 H.P. Diesel with generator set, switch - board, etc. ----- | 20,000.00 |
| | Scaffolding ----- | 3,000.00 |
| | Concrete foundations for motors & diesels --- | 480.00 |
| | Housing for equipment ----- | 4,800.00 |
| | Transportation of machinery, material & equip. from Manila to Diriqui ----- | 4,500.00 |
| | | <u>P46,180.00</u> |
| | Supervision, etc., 10% ----- | 4,618.00 |
| | | <u>50,798.00</u> |

Grand total, less cableway ----- P54,901.00

Grand total, plus cableway ----- P154,143.00

Hence there is P19.88 per long ton actual payment, less P6.21 gives a net profit (excluding taxes and depreciation) of P13.67 per long ton. In order to cover contingencies the figure of P10.00 per long ton net profit has been used in this paper.

Mining and Milling Costs per month, estimated.

| | |
|--|-------------------|
| Total cost machinery & equipment, less aerial tram = P54,901.00 @ 10% interest ----- | P 5490.10 |
| 5% amortization on P54,901.00 ----- | 2745.05 |
| Crude oil, 6 tons @ P50.00 +----- | 300.00 |
| Lub. oil for Diesel ----- | 95.00 |
| Lub. oil for machinery ----- | 40.00 |
| Grease, etc. ----- | 80.00 |
| 2 mechanics @ P40.00 ----- | 80.00 |
| 1 helper @ P30.00 ----- | 30.00 |
| 2 blacksmiths @P45.00 ----- | 90.00 |
| 200 laborers at Siec @ P20.80 ----- | 4160.00 |
| 10 laborers at washing plant @ P20.80 ----- | 208.00 |
| 10 laborers at picking table @ P15.60 ----- | 156.00 |
| Materials: steel for picks, iron, coke, etc. - | 200.00 |
| Repairs: screens, etc. +----- | 300.00 |
| Administration and overhead ----- | 2000.00 |
| Total monthly cost ----- | <u>P15,974.15</u> |

To deliver 10,000 tons crude ore per month of 26 days or 4977 tons washed ore. There is 49.77% washed ore to crude ore. The cost per ton of washed ore ready for shipment at Diriqui is therefore P3.21.

| | |
|-------|------------------------------------|
| Hence | Mining and milling costs = P3.21 |
| | Trans. to Diriqui = 1.50 |
| | Trans. to Manila = 1.50 |
| | Total cost per ton = <u>P6.21.</u> |

Analysis: There are no wharfage fees to pay and the ocean freight is paid by consignee as the protective tariff is figured to more than offset this item.

The average grade of commercial ore is 38.24%. The U. S. quotation per long ton = 26¢, or 52¢ Philippine currency. (Prices at date of writing original report).

Hence there is P19.88 per long ton actual payment, less P6.21 gives a net profit (excluding taxes and depletion) of P13.67 per long ton. In order to cover contingencies the figure of P10.00 per long ton net profit has been used in this paper.

many of these products would be developed and their products sold at a profit in the United States and other world markets.

The Page twenty three reported for consumption in the

GENERAL DATA CONCERNING MANGANESE 1 long tons containing 189,256

The following classification of manganese ores has been adopted by the United States Bureau of Mines: "Metallurgical-grade ores, under which have been classified manganese ores containing 35% or more of manganese - used in the manufacture of iron and steel, ferruginous manganese ores containing 10 to 35% of manganese, manganiferous iron ore containing 5 to 10% of manganese, and manganiferous zinc residuum; (2) battery ore; (3) fluxing ores, under which are classified ores that may contain a few ounces of silver and are rich enough in manganese to make them valuable chiefly for fluxing purposes in nonferrous smelters; and (4) miscellaneous ores, under which are classified the ores shipped to brick manufacturers, glass makers, and manufacturers of manganese chemicals." United States would do well to in-

Analysis of foreign manganese ores consumed in the United States

| Source of ore | Manganese | Iron | Silica | Alumina | Phosphorus |
|---------------|-----------|-------|--------|---------|------------|
| Philippines | 42.43% | 3.00% | 7.52% | | 0.036% |
| Gold Coast | 46.70% | 6.22% | 3.15% | 4.10% | 0.14% |
| India | 50.51% | 6.22% | 8.28% | 1.83% | 0.09% |
| Brazil | 48.70% | 4.40% | 4.60% | 2.95% | 0.12% |
| Chile | 48.70% | 0.73% | 9.40% | 1.69% | 0.008% |
| Russia | 49.19% | 0.64% | 7.85% | 1.57% | 0.22% |

found. As can be seen above the Philippine manganese ores compare favorably with those of other countries from which the United States buys its manganese. Manganese is found in many places in the Philippines and although not all of it is as good as that under discussion in this paper, still many of the deposits could be developed and their products sold at a profit in the United States and other world markets.

The manganese ore imported for consumption in the United States amounted to 383,501 long tons containing 189,256 tons of manganese and valued at \$4,208,769 in 1935 compared with 341,339 tons containing 165,840 tons of manganese and valued at \$3,529,182 in 1934. Of the total ore imported for consumption in 1935, 39.9% was from the U.S.S.R. (Russia), 24.8% from the Gold Coast, 14.8% from India, 11.5% from Cuba and 8% from Brazil. These imports were made in spite of the fact that these countries pay a high tariff in order to get their manganese into the United States. In case of a world crisis many of these sources of manganese would be closed to the United States, hence the importance of developing the manganese deposits of the Commonwealth of the Philippines.

It is therefore the opinion of the writer that the Government of the United States would do well to investigate the manganese situation in the Philippines and at the same time to look into the chromite deposits of the same country. Chromite has not been included within the scope of this paper but it is nevertheless under development in these Islands and many likely deposits have been found.

In view of what is known of the Philippine mining industry, it would not be amiss for the United States to extend aid and encouragement to these growing Philippine mineral industries.

Respectfully submitted,

Norman John Ericson
 NORMAN JOHN ERICSON

APPENDIX II.

Tonnage and Evaluation Summary.

| Block | Sample | % Mn | Tonnage | Corrected tonnage | Tonnage Metal. Mn. |
|-------|--------|-------|---------|-------------------|--------------------|
| I | 17 | 41.78 | 185 | 185 | 77.29 |
| II | 1 | 36.71 | 362 | 362 | 132.89 |
| | 7 | 39.36 | 459 | 459 | 180.66 |
| III | 52 | 38.63 | 78 | 78 | 30.13 |
| | 54 | 35.50 | 146 | 146 | 51.83 |
| | 18 | 36.69 | 334 | 335 | 122.91 |
| | 53 | 34.02 | 394 | 394 | 134.04 |
| | 20 | 37.41 | 423 | 422 | 157.87 |
| VII | 21 | 39.18 | 630 | 630 | 246.83 |
| | 26 | 38.43 | 255 | 255 | 98.00 |
| | 25 | 38.18 | 97 | 97 | 37.03 |
| IV | 41 | 38.06 | 842 | 842 | 357.50 |
| VIII | 40 | 39.06 | 762 | 763 | 298.03 |
| | 42 | 41.34 | 594 | 595 | 245.56 |
| IX | 81 | 36.37 | 234 | 235 | 85.47 |
| X | 39 | 37.14 | 750 | 749 | 278.18 |
| V | 78 | 45.39 | 338 | 337 | 152.96 |
| | 33 | 46.58 | 1128 | 1128 | 525.42 |
| XI | 73 | 41.20 | 800 | 800 | 329.60 |
| | 74 | 29.78 | 387 | 387 | 115.25 |
| | 75 | 34.92 | 186 | 186 | 64.95 |
| XII | 32 | 37.96 | 779 | 778 | 295.33 |
| XIII | 79 | 27.88 | 781 | 783 | 218.30 |
| | 29 | 34.40 | 696 | 695 | 239.08 |
| | 30 | 46.02 | 1095 | 1094 | 503.46 |
| | 72 | 39.62 | 370 | 370 | 146.59 |
| | 71 | 44.27 | 1422 | 1421 | 629.08 |
| | 31 | 45.96 | 471 | 471 | 216.47 |
| | 69 | 43.91 | 308 | 308 | 135.24 |
| | 58 | 33.32 | 569 | 569 | 189.59 |
| | 59 | 24.62 | 836 | 835 | 205.58 |
| XIV | 68 | 32.09 | 352 | 352 | 112.96 |
| | 61 | 42.69 | 565 | 565 | 241.20 |
| | 65 | 40.90 | 372 | 372 | 152.15 |
| | 64 | 8.18 | 176 | 176 | 14.40 |
| | 63 | 42.22 | 541 | 541 | 228.41 |
| XV | 62 | 35.21 | 700 | 700 | 246.47 |
| | 90 | 43.53 | 390 | 387 | 168.46 |
| | 67 | 43.91 | 156 | 156 | 68.50 |
| | 66 | 41.33 | 521 | 521 | 215.33 |
| | 98 | 34.46 | 631 | 631 | 217.44 |
| | 89 | 45.14 | 387 | 387 | 174.69 |

| Block | Sample | % Mn | Tonnage | Corrected tonnage | Tonnage Metal. Mn. |
|-------------|--------|-------|---------|-------------------|--------------------|
| V (cont) | 92 | 37.21 | 84 | 84 | 31.26 |
| | 191 | 28.07 | 179 | 179 | 50.25 |
| | 93 | 28.45 | 189 | 188 | 53.49 |
| | 188 | 42.83 | 362 | 362 | 155.04 |
| | 194 | 48.27 | 126 | 125 | 60.34 |
| | 97 | 46.30 | 156 | 156 | 72.23 |
| | 95 | 43.09 | 310 | 310 | 133.58 |
| VI | 85 | 42.02 | 729 | 729 | 306.33 |
| | 84 | 39.14 | 316 | 316 | 123.68 |
| | 83 | 35.89 | 287 | 287 | 103.00 |
| | 82 | 34.07 | 124 | 124 | 42.25 |
| | 87 | 34.28 | 129 | 129 | 44.22 |
| VII | 137 | 43.02 | 209 | 209 | 89.91 |
| | 138 | 42.66 | 267 | 267 | 113.90 |
| | 136 | 41.36 | 342 | 342 | 141.45 |
| | 135 | 32.36 | 794 | 794 | 256.94 |
| VIII | 143 | 36.74 | 481 | 481 | 176.72 |
| | 142 | 37.53 | 974 | 973 | 365.17 |
| X | 124 | 42.65 | 760 | 761 | 370.45 |
| | 123 | 54.72 | | | |
| XI | 121 | 39.75 | 670 | 661 | 246.75 |
| | 122 | 34.91 | | | |
| XII | 125 | 37.39 | 212 | 213 | 79.64 |
| XIII | 109 | 43.93 | 1228 | 1227 | 539.02 |
| | 108 | 28.66 | 1191 | 1192 | 341.34 |
| | 118 | 41.38 | 775 | 775 | 320.70 |
| | 107 | 37.96 | 1192 | 1194 | 453.24 |
| | 117 | 31.69 | 708 | 710 | 225.00 |
| | 114 | 37.55 | 430 | 439 | 164.84 |
| | 115 | 40.17 | 206 | 206 | 82.75 |
| | 116 | 34.43 | 335 | 335 | 115.24 |
| XIV | 131 | 54.28 | 238 | 238 | 129.19 |
| | 132 | 38.03 | 161 | 161 | 61.23 |
| | 133 | 47.93 | 121 | 121 | 58.00 |
| | 134 | 44.18 | 335 | 334 | 147.56 |
| XV | 102 | 45.36 | 458 | 458 | 207.75 |
| | 103 | 37.10 | 338 | 337 | 125.03 |
| | 104 | 34.68 | 244 | 244 | 84.62 |

| | | | | | Tonnage |
|----------------------|--------|-------|---------|-------------------|------------|
| Bloxx | Sample | % Mn | Tonnage | Corrected Tonnage | Metal. Mn. |
| XVI | 100 | 38.17 | 905 | 905 | 328.61 |
| | 99 | 34.46 | | | |
| (a) | 139 | 40.56 | 834 | 834 | 338.27 |
| (b) | 140 | 40.09 | 3310 | 3310 | 1326.98 |
| Total tonnages ----- | | | | 42,909 | 16,407.20 |

NB: (a) Stock piles at Siec.
 (b) Stock piles at Diriqui Inlet.

This gives a proven tonnage of manganese ore after being washed of 42,909 metric tons at an average grade of 38.24% metallic manganese. This figure will not check with that given in Appendix I since here some manganese ore of less than 35% metallic manganese was included since it would have to be mined in order to obtain the higher grade ore surrounding it.

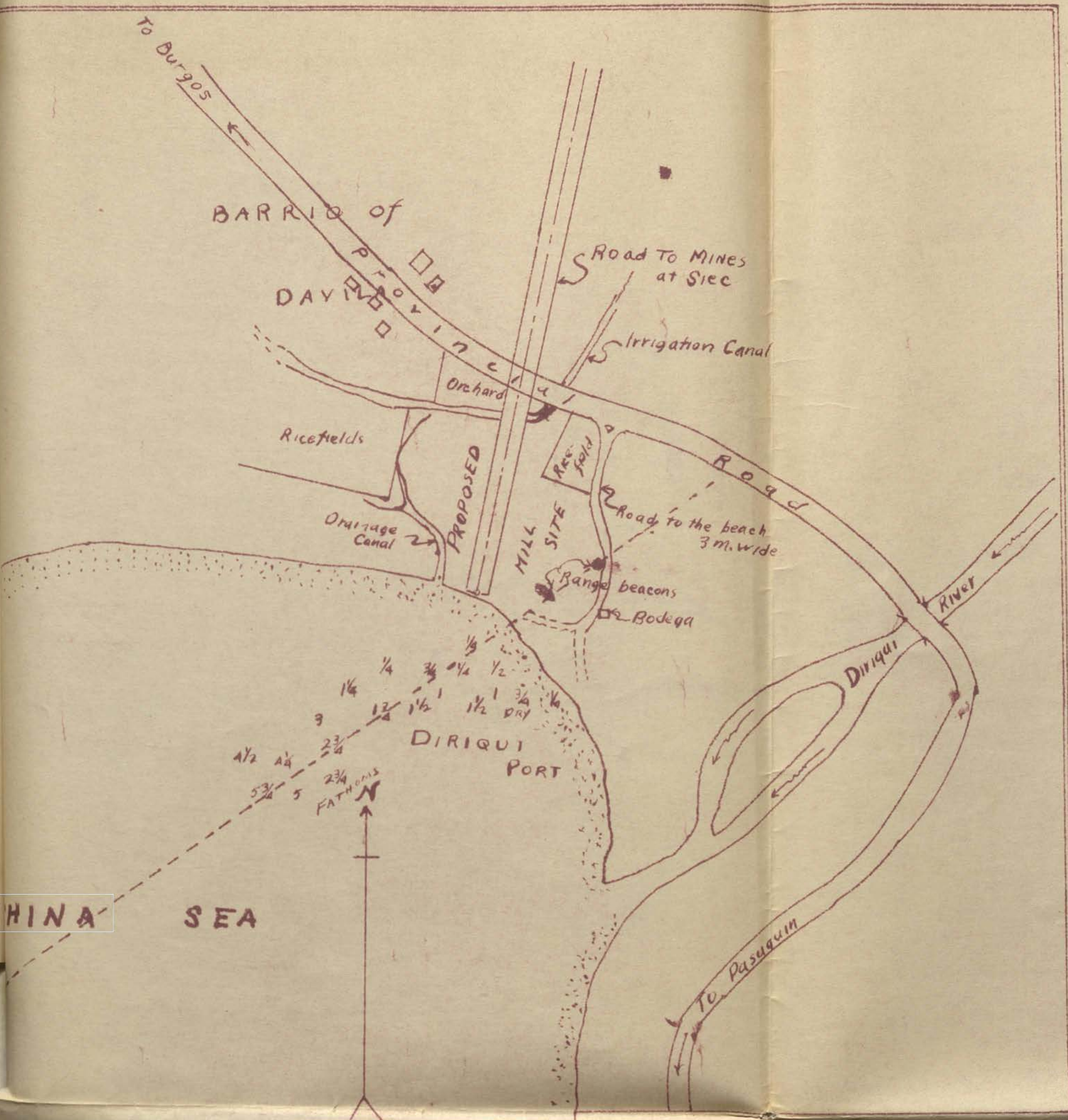
To But

| No. of SAMPLE | CHARACTER OF ORE, OVERBURDEN, ETC | DEPTH OF SAMPLE MTS. | WT. CRUDE SAMPLE HGS | WT. CRUDE SAMPLE / CU. MT. M. TONS | VOL. CRUDE SAMPLE CU. MTS | WT. WASHED SAMPLE HGS | WT. WASHED / CU. MT. M. TONS | % Mn | M. TONS CRUDE ORE | M. TONS WASHED ORE | WT. MET. MN Mt. TONS | AREA SQ. MTS | VOL. CU. MTS | SHIPPING ORE LONG TONS | WT. MET. MN. LONG TONS |
|---------------|---|----------------------|----------------------|------------------------------------|---------------------------|-----------------------|------------------------------|-------|-------------------|--------------------|----------------------|--------------|--------------|------------------------|------------------------|
| 31 | NODULES + MnO ₂ CRYSTALS IN CLAY, CaCO ₃ OVERBURDEN | 1.50 | 96.5 | 1.285 | 0.075 | 40.5 | 0.540 | 45.96 | 1121 | 471 | 216.47 | 581 | 872 | 469 | 213.01 |
| 32 | " " " " " " MnO ₂ BOULDERS CaCO ₃ OVERBURDEN " BOULDERS | 2.30 | 159.5 | 1.385 | 0.115 | 59.5 | 0.518 | 38.10 | 2080 | 778 | 296.42 | 653 | 1502 | 766 | 291.68 |
| 33 | NODULES IN CLAY, CaCO ₃ OVERBURDEN, CaCO ₃ BOULDERS | 2.00 | 130.0 | 1.300 | 0.100 | 90.5 | 0.905 | 46.58 | 1620 | 1128 | 525.42 | 623 | 1296 | 1110 | 517.01 |
| 34 | " " " " " " NO OVERBURDEN " " | 2.30 | 139.5 | 1.170 | 0.115 | 67.0 | 0.584 | 34.60 | 1445 | 721 | 248.00 | 537 | 1235 | 709 | 244.03 |
| 35 | " " " " " " " " " " | 0.90 | 59.5 | 1.320 | 0.045 | 29.0 | 0.533 | 18.09 | 1399 | 548 | 98.00 | 1136 | 1022 | 535 | 96.00 |
| 36 | " " " " " " " " " " | 0.90 | 53.0 | 1.180 | 0.045 | 21.5 | 0.478 | 22.27 | 1039 | 418 | 95.00 | 973 | 876 | 412 | 93.00 |
| 37 | " " " " " " NO " " | 1.70 | 110.0 | 1.298 | 0.085 | 47.5 | 0.559 | 13.13 | 3486 | 1501 | 147.00 | 1580 | 2686 | 1475 | 194.00 |
| 38 | " " " " " " " " " " | 1.60 | 123.0 | 1.538 | 0.080 | 63.0 | 0.788 | 37.40 | 1898 | 972 | 363.53 | 771 | 1239 | 956 | 357.71 |
| 39 | " " " " " " " " " " | 1.35 | 92.0 | 1.332 | 0.0675 | 42.0 | 0.622 | 37.19 | 1609 | 749 | 278.18 | 892 | 1209 | 737 | 273.73 |
| 40 | " " " " " " " " " " | 1.80 | 96.5 | 1.062 | 0.090 | 45.5 | 0.506 | 41.90 | 1600 | 763 | 319.70 | 837 | 1507 | 751 | 314.58 |
| 41 | " " " " " " " " " " | 1.65 | 79.0 | 0.898 | 0.0825 | 33.0 | 0.394 | 38.06 | 1919 | 842 | 357.50 | 1295 | 2137 | 829 | 351.78 |
| 42 | " " " " " " " " " " | 1.30 | 95.0 | 1.459 | 0.065 | 38.5 | 0.594 | 41.39 | 1459 | 595 | 245.56 | 770 | 1001 | 586 | 271.63 |
| 43 | " " " " " " " " " " | 1.40 | 56.5 | 0.805 | 0.070 | 30.0 | 0.428 | 36.80 | 1197 | 635 | 233.68 | 1060 | 1484 | 6.25 | 233.68 |
| 44 | " " " " " " " " " " | 1.65 | 76.5 | 0.930 | 0.0825 | 36.0 | 0.436 | 26.85 | 689 | 321 | 86.00 | 496 | 736 | 316 | 85.00 |
| 45 | " " " " " " " " " " | 1.50 | 60.5 | 0.809 | 0.0750 | 33.5 | 0.497 | 19.68 | 849 | 466 | 92.00 | 695 | 1043 | 458 | 91.00 |
| 46 | " " " " " " " " " " | 1.60 | 41.0 | 1.333 | 0.030 | 19.0 | 0.635 | 22.59 | 1053 | 1335 | 113.00 | 1314 | 2102 | 493 | 111.00 |
| 47 | " " " " " " " " " " | 0.67 | 36.0 | 1.037 | 0.0335 | 16.0 | 0.478 | 11.72 | 1002 | 462 | 59.00 | 1442 | 966 | 455 | 53.00 |
| 48 | " " " " " " " " " " | 0.72 | 58.0 | 1.610 | 0.0360 | 19.0 | 0.528 | 26.20 | 1059 | 345 | 90.39 | 907 | 653 | 340 | 88.94 |
| 49 | " " " " " " " " " " | 0.68 | 28.0 | 0.825 | 0.0390 | 18.0 | 0.529 | 23.12 | 694 | 381 | 88.00 | 1059 | 720 | 375 | 87.00 |
| 50 | " " " " " " " " " " | 0.72 | 29.5 | 0.819 | 0.0360 | 14.0 | 0.388 | 33.50 | 556 | 263 | 88.12 | 941 | 678 | 259 | 86.71 |
| 51 | " " " " " " " " " " | 0.88 | 75.0 | 1.709 | 0.044 | 27.0 | 0.615 | 34.40 | 1293 | 466 | 150.30 | 861 | 758 | 458 | 157.74 |
| 52 | " " " " " " " " " " | 0.26 | 17.0 | 1.305 | 0.013 | 5.5 | 0.423 | 38.63 | 248 | 78 | 30.13 | 711 | 185 | 77 | 29.65 |
| 53 | " " " " " " " " " " | 1.00 | 53.0 | 1.060 | 0.050 | 20.5 | 0.410 | 39.02 | 1020 | 394 | 134.04 | 960 | 960 | 388 | 131.90 |
| 54 | " " " " " " " " " " | 0.37 | 23.0 | 1.292 | 0.0185 | 8.0 | 0.432 | 35.50 | 419 | 146 | 51.83 | 914 | 338 | 144 | 51.00 |
| 55 | " " " " " " CaCO ₃ BOULDERS | 0.95 | 37.0 | 0.778 | 0.0475 | 13.0 | 0.274 | 24.00 | 649 | 229 | 664.00 | 880 | 836 | 2258 | 655.00 |
| 56 | " " " " " " " " " " | 0.85 | 50.0 | 1.178 | 0.0425 | 21.0 | 0.494 | 27.88 | 524 | 220 | 61.00 | 523 | 445 | 217 | 60.00 |
| 57 | " " " " " " NO " " | 0.85 | 43.0 | 1.010 | 0.0425 | 22.0 | 0.518 | 41.00 | 703 | 360 | 147.60 | 818 | 695 | 354 | 145.24 |
| 58 | " " " " " " CaCO ₃ " " | 0.90 | 58.0 | 1.290 | 0.0450 | 24.5 | 0.545 | 45.21 | 1398 | 569 | 257.24 | 1160 | 1044 | 580 | 253.12 |
| 59 | " " " " " " NO " " | 2.00 | 145.0 | 1.450 | 0.100 | 60.0 | 0.600 | 46.30 | 2188 | 835 | 386.61 | 696 | 1292 | 822 | 380.42 |
| 60 | " " " " " " CaCO ₃ " " | 0.35 | 21.0 | 1.202 | 0.0175 | 7.0 | 0.400 | 40.03 | 423 | 141 | 56.44 | 1005 | 352 | 139 | 55.54 |

| F | No OF SAMPLE | CHARACTER OF ORE, OVERBURDEN, ETC. | DEPTH OF SAMPLE MTS. | WT. CRUDE SAMPLE KGS | WT. CRUDE SAND /CU. MT. MT. TONS | VOL. CRUDE SAMPLE CU. MTS. | WT. WASHED SAMPLE KGS | WT. WASHED /CU. MT. M. TONS | % MN | M. TONS CRUDE ORE | M. TONS WASHED ORE | WT. MET. MN. MT. TONS | AREA SQ. MTS. | VOL. CU. MTS. | SHIPPING ORE LONG TONS | WT. MET. MN. LONG TONS |
|----|--------------|--|----------------------|----------------------|----------------------------------|----------------------------|-----------------------|-----------------------------|-------|-------------------|--------------------|-----------------------|---------------|---------------|------------------------|------------------------|
| E | 61 | NOODULES INCLAY, CaCO ₃ OVERBURDEN, NO BOULDERS | 2.50 | 100.0 | 0.800 | 0.125 | 44.5 | 0.356 | 92.69 | 4972 | 565 | 291.20 | 635 | 1588 | 556 | 237.39 |
| | 62 | " " " " " " | 1.76 | 84.0 | 0.988 | 0.085 | 36.5 | 0.430 | 38.98 | 1605 | 700 | 268.80 | 956 | 1625 | 689 | 269.50 |
| | 63 | " " " " " CaCO ₃ " | 1.85 | 98.0 | 1.055 | 0.925 | 47.0 | 0.515 | 42.22 | 1180 | 541 | 228.91 | 568 | 1051 | 532 | 224.76 |
| | 64 | " " " " " " " | 0.75 | 37.0 | 0.988 | 0.0375 | 13.0 | 0.347 | 39.47 | 498 | 176 | 69.47 | 675 | 506 | 173 | 68.36 |
| | 65 | " " " " " " " | 0.75 | 56.0 | 1.495 | 0.0375 | 17.0 | 0.459 | 40.90 | 1225 | 372 | 152.15 | 1092 | 819 | 366 | 144.72 |
| | 66 | " " " " " " " | 1.70 | 93.0 | 1.090 | 0.085 | 38.0 | 0.498 | 43.50 | 1265 | 521 | 226.64 | 684 | 1163 | 513 | 223.01 |
| | 67 | " " " " " NO " | 0.30 | 22.0 | 1.465 | 0.015 | 8.5 | 0.567 | 43.91 | 403 | 156 | 68.50 | 918 | 275 | 1535 | 67.90 |
| | 68 | " " " " " " " | 0.60 | 44.5 | 1.985 | 0.030 | 15.5 | 0.518 | 38.26 | 1010 | 352 | 134.68 | 1132 | 679 | 346 | 132.53 |
| | 69 | " " " " " CaCO ₃ " | 1.00 | 45.5 | 0.910 | 0.050 | 23.5 | 0.470 | 43.91 | 697 | 308 | 135.24 | 656 | 656 | 303 | 133.08 |
| | 70 | " " " " " " " | 1.10 | 56.0 | 1.018 | 0.055 | 27.0 | 0.492 | 44.50 | 820 | 396 | 176.22 | 731 | 804 | 390 | 173.90 |
| | 71 | " " " " " NO " | 1.35 | 112.0 | 1.598 | 0.0675 | 63.5 | 0.445 | 44.27 | 2420 | 1421 | 629.08 | 1114 | 1509 | 1399 | 619.01 |
| | 72 | " " " " " CaCO ₃ " | 0.60 | 51.0 | 1.700 | 0.030 | 25.0 | 0.833 | 34.62 | 755 | 370 | 146.59 | 740 | 444 | 369 | 144.24 |
| | 73 | " " " " " NO " | 1.30 | 143.0 | 2.200 | 0.065 | 59.0 | 0.408 | 41.20 | 1940 | 800 | 329.60 | 678 | 881 | 787 | 324.33 |
| | 74 | " " " " " " " | 1.30 | 75.0 | 1.159 | 0.065 | 33.5 | 0.515 | 31.80 | 868 | 387 | 123.07 | 578 | 751 | 381 | 121.10 |
| | 75 | " " " " " CaCO ₃ " | 0.50 | 29.0 | 0.960 | 0.025 | 12.0 | 0.480 | 37.60 | 373 | 186 | 69.94 | 775 | 388 | 183 | 69.80 |
| | 76 | " " " " " " " | 0.66 | 32.0 | 0.970 | 0.033 | 17.5 | 0.533 | 35.32 | 708 | 389 | 137.39 | 1105 | 729 | 383 | 135.19 |
| | 77 | " " " " " " " | 0.82 | 44.0 | 1.075 | 0.041 | 27.0 | 0.659 | 21.20 | 622 | 380 | 80.56 | 702 | 576 | 374 | 79.27 |
| | 78 | " " " " " NO " | 0.90 | 64.0 | 1.420 | 0.045 | 21.0 | 0.467 | 45.39 | 1025 | 337 | 152.96 | 802 | 722 | 332 | 150.51 |
| | 79 | " " " " " " " | 0.95 | 79.0 | 1.660 | 0.0475 | 36.0 | 0.758 | 34.30 | 1710 | 783 | 268.57 | 1087 | 1033 | 771 | 264.27 |
| | 80 | " " " " " NO " | 0.80 | 39.0 | 0.850 | 0.040 | 12.0 | 0.300 | 17.60 | 503 | 178 | 31.00 | 740 | 592 | 175 | 30.00 |
| CA | 81 | " " " " " " " | 0.50 | 22.0 | 0.880 | 0.025 | 11.5 | 0.460 | 36.37 | 449 | 235 | 85.47 | 1020 | 510 | 231 | 84.10 |
| LE | 82 | " " " " " " " | 0.40 | 23.5 | 1.175 | 0.020 | 12.0 | 0.600 | 34.07 | 242 | 124 | 42.25 | 576 | 206 | 122 | 41.57 |
| | 83 | " " " " " CaCO ₃ " | 0.70 | 36.0 | 1.030 | 0.035 | 23.5 | 0.672 | 35.89 | 440 | 287 | 103.00 | 610 | 427 | 283 | 101.35 |
| | 84 | " " " " " CaCO ₃ " | 0.66 | 35.0 | 1.060 | 0.033 | 17.0 | 0.515 | 39.14 | 650 | 316 | 123.68 | 929 | 613 | 311 | 121.70 |
| | 85 | " " " " " NO " | 1.60 | 104.0 | 1.300 | 0.080 | 50.0 | 0.625 | 42.02 | 1516 | 729 | 306.33 | 729 | 1166 | 718 | 301.43 |
| | 86 | " " " " " CaCO ₃ " | 0.55 | 24.5 | 0.892 | 0.0275 | 15.0 | 0.545 | 29.62 | 206 | 126 | 37.00 | 420 | 231 | 124 | 36.00 |
| | 87 | " " " " " " " | 0.60 | 27.0 | 0.900 | 0.030 | 16.5 | 0.550 | 34.28 | 211 | 129 | 44.22 | 290 | 234 | 127 | 43.51 |
| | 88 | " " " " " NO " | 0.85 | 67.5 | 1.585 | 0.0425 | 28.5 | 0.672 | 42.83 | 1065 | 362 | 155.04 | 634 | 529 | 356 | 152.56 |
| | 89 | " " " " " " " | 1.05 | 62.5 | 1.191 | 0.0525 | 28.0 | 0.539 | 45.14 | 864 | 387 | 174.69 | 690 | 725 | 381 | 171.89 |
| | 90 | NOODULES + FORMS MN INCLAY | 0.50 | 35.0 | 1.400 | 0.0250 | 17.0 | 0.680 | 43.53 | 802 | 390 | 168.46 | 1145 | 573 | 389 | 165.76 |

| No. of Sample | CHARACTER OF ORE, OVERBURDEN, ETC. | DEPTH OF SAMPLE MTS | WT. CRUDE SAMPLE KGS | WT. CRUDE SAMP. / CU. MT. MT. TONS | VOL. CRUDE SAMP. CU. MTS | WT. WASHED SAMPLE KGS. | WT. WASHED / CU. MT. MT. TONS | % MN | M. TONS CRUDE ORE | M. TONS WASHED ORE | WT. MET. MN. MT. TONS | AREA SQ. MTS | VOL. CU. MTS | SHIPPING ORE LONG TONS | WT. MET. MN. LONG TONS |
|---------------|---|---------------------|----------------------|------------------------------------|--------------------------|------------------------|-------------------------------|-------|-------------------|--------------------|-----------------------|--------------|--------------|------------------------|------------------------|
| 121 | NODULES IN CLAY, NO OVERBURDEN, NO BOULDERS | 0.50 | 52.5 | 2.000 | 0.025 | 21.0 | 0.840 | 42.70 | 1767 | 661 | 256.53 | 1320 | 924 | 651 | 252.43 |
| 122 | " " " " " " " | 0.90 | 82.0 | 1.825 | 0.045 | 26.5 | 0.590 | 34.91 | | | | | | | |
| 123 | " " " " " " CaCO ₃ | 0.60 | 33.0 | 1.100 | 0.030 | 13.0 | 0.433 | 54.72 | 2039 | 761 | 370.53 | 2100 | 1470 | 749 | 364.60 |
| 124 | " " " " " " NO | 0.80 | 67.0 | 1.675 | 0.040 | 24.0 | 0.600 | 42.65 | | | | | | | |
| 125 | " " " " " " CaCO ₃ | 0.65 | 38.0 | 1.170 | 0.0325 | 15.0 | 0.962 | 37.39 | 538 | 213 | 79.64 | 707 | 460 | 210 | 78.37 |
| 126 | " " " " " " CaCO ₃ | 0.70 | 48.0 | 1.370 | 0.035 | 22.5 | 0.642 | 40.30 | 678 | 318 | 128.15 | 707 | 495 | 313 | 126.10 |
| 127 | " " " " " " NO | 0.70 | 56.0 | 1.800 | 0.035 | 24.5 | 0.700 | 39.60 | 1964 | 756 | 312.61 | 1680 | 1267 | 716 | 307.61 |
| 128 | " " " " " " CaCO ₃ | 0.75 | 50.0 | 1.300 | 0.0385 | 19.0 | 0.499 | 43.10 | | | | | | | |
| 129 | " " " " " " CaCO ₃ | 0.60 | 34.0 | 1.133 | 0.030 | 17.0 | 0.567 | 37.30 | 480 | 240 | 89.52 | 707 | 424 | 237 | 88.09 |
| 130 | " " " " " " " | 0.70 | 58.0 | 1.655 | 0.035 | 21.5 | 0.615 | 35.00 | 819 | 304 | 106.40 | 707 | 495 | 300 | 104.70 |
| 131 | " " " " " " " | 0.60 | 38.0 | 1.267 | 0.030 | 21.0 | 0.700 | 54.28 | 431 | 238 | 129.19 | 567 | 340 | 234 | 127.12 |
| 132 | " " " " " " " | 0.70 | 36.0 | 1.030 | 0.035 | 19.5 | 0.414 | 38.03 | 400 | 161 | 61.23 | 555 | 388 | 158 | 60.25 |
| 133 | " " " " " " NO | 0.50 | 37.0 | 1.481 | 0.025 | 11.0 | 0.440 | 47.93 | 409 | 121 | 58.00 | 551 | 276 | 119 | 57.07 |
| 134 | " " " " " " " | 0.90 | 59.0 | 1.310 | 0.045 | 24.0 | 0.534 | 44.18 | 820 | 334 | 147.56 | 696 | 626 | 329 | 145.20 |
| 135 | " " " " " " CaCO ₃ | 1.80 | 127.0 | 1.410 | 0.090 | 53.0 | 0.590 | 32.36 | 1896 | 794 | 256.94 | 747 | 1345 | 781 | 252.83 |
| 136 | " " " " " " NO | 0.75 | 48.0 | 1.275 | 0.0385 | 25.0 | 0.650 | 41.36 | 671 | 342 | 141.45 | 701 | 526 | 337 | 139.19 |
| 137 | " " " " " " CaCO ₃ | 0.65 | 47.0 | 1.445 | 0.0325 | 14.5 | 0.446 | 43.02 | 676 | 209 | 89.91 | 720 | 468 | 206 | 88.47 |
| 138 | " " " " " " " | 0.56 | 49.0 | 1.961 | 0.025 | 17.0 | 0.680 | 42.66 | 771 | 267 | 113.90 | 785 | 393 | 263 | 112.08 |
| 139 | STOCK PILES AT SIEC, JULY 30, 1936 | | | | | | | 40.56 | | 834.2 | 338.27 | | | 821 | 332.83 |
| 140 | " " " " " " " " " " " " | | | | | | | 40.09 | | 3309.56 | 1326.98 | | | 3257 | 1305.75 |
| 141 | NODULES IN CLAY, NO OVERBURDEN, NO BOULDERS | 1.30 | 91.0 | 1.400 | 0.065 | 37.5 | 0.557 | 45.50 | 2541 | 1047 | 476.84 | 1396 | 1815 | 1030 | 224.00 |
| 142 | " " " " " " " | 0.80 | 85.0 | 2.125 | 0.040 | 39.0 | 0.975 | 37.53 | 2121 | 973 | 365.17 | 1248 | 998 | 958 | 359.33 |
| 143 | " " " " " " " | 1.00 | 89.0 | 1.780 | 0.050 | 39.0 | 0.680 | 36.74 | 1258 | 481 | 176.72 | 707 | 707 | 473 | 173.89 |
| TOTALS | | | | | | | | | 86221 | 49535 | 17,415.26 | | | 37517 | 17,684.78 |

SHIPPING GRADE TOTALS ONLY Mn AVE = 39.10%
 AT P10.00/TON PROFIT = P445,347.60



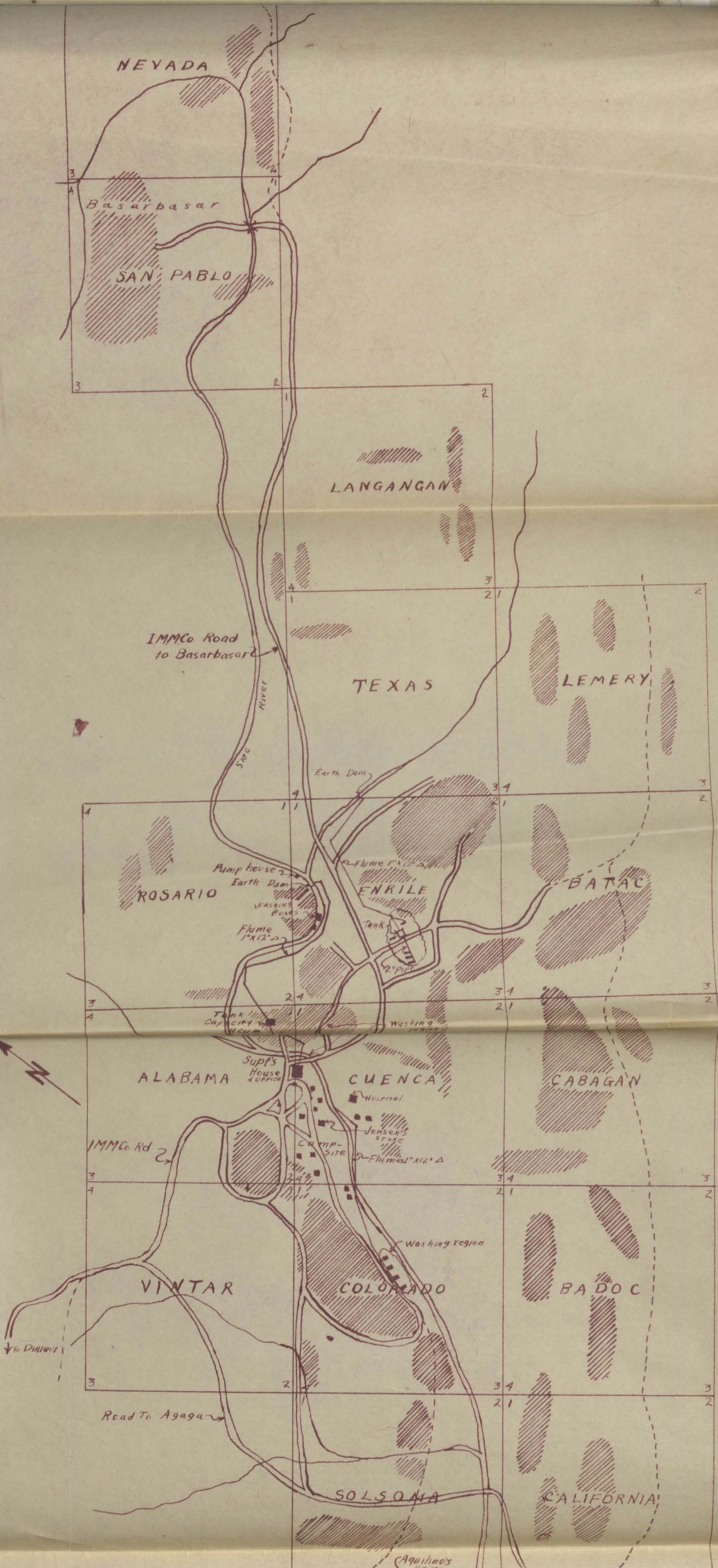
ILOCOS MANGANESE MINING CO.
BURGOS, ILOCOS NORTE

SKETCH PLAN of
PROPOSED MILL SITE

(Reference: Plan of Sounding
Survey of Diriqui Inlet
& Actual Sketch of Site)
Scale: - 1" = 2500
Date: - June 16, 1936

Prepared by: - N.V. ERICSON, MINING ENG. LICENSE No. 79
Note: - Soundings in fathoms of
mean lower low water.

M. Co. HAS FORESHORE LEASE No. 1768
THIS TERRITORY



Road to Agaña



PROPERTY OF THE
 ILOCOS MANGANESE
 MINING CO., INC.
 GROUP 2, SITIO SIEC
 BURGOS, ILOCOS NORTE, P.I.
 Scale: 1:4000 May 20, 1936
 By: N.J. ERICSON, MINING ENG.
 License No. 79

