224 New Customhouse
Denver, Colorado

June 12, 1951

Memorandum

To: Coordinating Committee, Defense Minerals Administration

From: DMA Field Team, Region IV

Subject: DMA 362, Metal Producers, Inc., your memorandum dated May 17, 1951

Herewith are copies of comments by the U. S. Geological Survey and Bureau of Mines examiners regarding reconciliation of inferred reserve estimates and comments by the Chief, Mining Division, Region IV, Bureau of Mines. Since differences of opinion have not been reconciled, the arguments submitted by each are presented for your consideration.

The Summary, Conclusions and Recommendations have been revised to include the views of both examining agencies and should replace copies originally submitted.

Pan T Allsman
P. T. Allsman, Alternate

A. H. Koschmann
A. H. Koschmann

Attachments

PTA/cl
copy to DMA files, Koschmann, Allsman, Roberts, Zimmerley and Wilson

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

By David S. Arnold[1] M. H. Hewett[2] W. F. Boehholtz[3] C. M. Schaefer[3]

Metal Producers, Inc., lessee of the Horn Silver mine, Beaver county, Utah, has made application to the Federal Government for a loan of $55,000 to complete an underground exploratory project on zinc-oxide ores. The proposed program is part of the company's plan of a full-scale mining and milling operation on the property. Personnel of the Bureau of Mines and Geological Survey examined the property during February and March 1951. This report and the attached metallurgical report were prepared as a result of the examination by Bureau of Mines engineers.

The major primary ore bodies of the Horn Silver mine are found in breccia zones associated with the northerly striking Horn Silver fault. Removal of zinc from the primary ore bodies and subsequent secondary deposition in the breccia zones of the footwall limestone has formed irregular bodies containing zinc carbonate and other oxide zinc minerals. This mineralization has been disclosed in drill holes and underground openings, but the ore bodies have not been completely outlined.

Bureau of Mines engineers, using sample data of Metal Producers, Inc., estimate that 93,300 tons of inferred ores averaging 12.4 percent zinc is present between the 650- and 1,000-foot levels.

The Geological Survey member of the field examiners, using sample data furnished by Metal Producers, Inc., estimates a reserve of 8,800 tons of indicated ore averaging 5.65 percent zinc, and 189,000 tons of inferred ore averaging 10.0 percent zinc.

The objective of the proposed program is more complete exploration of the oxide ore bodies to outline sufficient ore reserves to justify mill expansion and possible processing plant construction. The leasing company has proposed that exploration consist of drifting, raising, long-hole percussion drilling, and diamond drilling at a total cost of $55,000.

It is concluded that a profitable mining and milling operation on zinc-oxide ore bodies of the Horn Silver mine will depend upon disclosure of sufficient tonnage of ores, development of ore dressing and processing methods for recovery of zinc, and a higher price for contained zinc in the concentrate.

Recommendations are made that approval of the requested exploratory loan for the Horn Silver mine be withheld pending a higher price for contained zinc in oxide ores and a greater market for the product than exists locally.

It appears reasonable that a full scale, 400-ton per day mining and milling operation can be established on the Horn Silver property if the above conditions are in force and the expected tonnage of ores is outlined by the proposed exploration.

1/ Geologist, U. S. Geological Survey
2/ Mining Engineer, Bureau of Mines
3/ Metallurgist, Bureau of Mines

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

By David C. Arnold[1], M. H. Howes[2], H. F. Buckholtz[2], C. H. Schack[3]

Metal Producers, Inc., lessee of the Horn Silver mine, Beaver County, Utah, has made application to the Federal Government for a loan of $55,000 to complete an underground exploratory project on zinc-oxide ores. The proposed program is part of the company's plan for a full-scale mining and milling operation on the property. Personnel of the Bureau of Mines and Geological Survey examined the property during February and March 1951. This report and the attached metallurgical report were prepared as a result of the examination by Bureau of Mines engineers.

The major primary ore bodies of the Horn Silver mine are found in breccia zones associated with cross faults related to the northerly striking Horn Silver fault. Removal of zinc from the primary ore bodies and subsequent secondary deposition in the breccia zones of the footwall limestone has formed irregular bodies containing zinc carbonate and other oxide zinc minerals. This mineralization has been disclosed in drill holes and underground openings, but the ore bodies have not been completely outlined.

The Geological Survey member of the field examiners, using sample data furnished by Metal Producers, Inc., estimates a reserve of 8,800 tons of indicated ore averaging 5.65 percent zinc, and 189,000 tons of inferred ore averaging 10.0 percent zinc.

The objective of the proposed program is more complete exploration of the oxide ore bodies to outline sufficient ore reserves to justify mill expansion and possible processing plant construction. The leasing company has proposed that exploration consist of drifting, raising, long-hole percussion drilling, and diamond drilling at a total cost of $55,000.

It is concluded that a profitable mining and milling operation on zinc-oxide ore bodies of the Horn Silver mine will depend upon disclosure of sufficient tonnage of ores, development of ore dressing and processing methods for recovery of zinc, and a higher price for contained zinc in the concentrate.

Recommendations are made that approval of the requested exploratory loan for the Horn Silver mine be withheld pending a higher price for contained zinc in oxide ores and a greater market for the product than exists locally.

It appears reasonable that a full scale, 400-ton per day mining and milling operation can be established on the Horn Silver property if the above conditions are in force and the expected tonnage of ores is outlined by the proposed exploration.

1/Geologist, U. S. Geological Survey
2/Mining Engineer, Bureau of Mines
3/Metallurgist, Bureau of Mines

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Mining Division
Date Rec'd.
JUN 1951
BUREAU OF MINES
Denver, Colorado

1600 EAST FIRST SOUTH STREET
SALT LAKE CITY 1, UTAH

June 4, 1951

Memorandum

To: DMA Field Team, Region IV
(Through P. T. Allsman)

From: Chief, Utah-Wyoming Branch, Mining Division

Subject: DMA Docket 262, Metal Producers, Inc., Horn Silver mine, Beaver County, Utah. Your memorandum of May 28, 1951.

We have discussed the ore reserve estimates, as shown in the subject report, with members of the Geological Survey, but have not been able to reconcile the difference in total tonnage. However, an explanation of the method used in estimating the reserves should serve to clarify the problem.

The Bureau and the Survey men concur in general in their opinions of secondary zinc deposition and structural control on the property, but differ in their methods of estimating reserves. Both estimates are based on assay data made available by Metal Producers, Inc., as a result of diamond drill and percussion drill holes on the 650-, 800-, and 1,000-foot levels. This drilling has not completely explored the areas involved, but has indicated the presence of oxidized zinc ores assaying from 1 to 25 percent.

It is agreed that zones of brecciation in the footwall limestone of the Horn Silver fault beneath the primary ore bodies, are receptive to secondary zinc deposition. It is reasonable to assume that the brecciated zones are present over the horizontal and vertical extent of the fault and that deposition of zinc leached from the primary ore bodies has occurred in these zones below the full length of the leached ore channel.

The ore areas in plan on the 650-, 800-, and 1,000-foot levels as outlined by the Bureau and the Survey, are in essential agreement. The difference in total estimated tonnages as calculated by the Bureau and Survey men, is the result of different methods in projection of the areas to form blocks. There are few or no assay data available between the 650- and 800-foot levels and the 800- and 1,000-foot levels to indicate otherwise, thus the Bureau engineers believe that deposition of secondary zinc followed somewhat the same erratic pattern vertically as is shown by the results horizontally on the 650-, 800-, and 1,000-foot levels. The Bureau men therefore projected the areas outlined on the three levels upward and downward in the form of pyramids and wedges for distances, which in their judgment appear to be reasonable. This resulted in an inferred estimate of 93,300 tons averaging 12.4 percent zinc. The Survey men projected their areas from one level to another on the assumption that the structures which controlled the secondary zinc deposition are continuous from level to level. Their inferred estimate is 189,300 tons assaying 10.05 percent zinc.

The Bureau of Mines estimate is undoubtedly conservative, but is believed to be reasonable in view of the limited amount of data available. A large part of the Horn Silver workings are inaccessible. Probably less than 20 percent of the favorable footwall limestone is exposed in the areas explored by Metal Producers, Inc. on the 650-, 800-, and 1,000-foot levels. Considering the Bureau of Mines estimate of 93,300 tons to be reasonable for the explored area, it follows that a more complete exploratory program may disclose a much larger tonnage, possibly 500,000 tons.

Stephen R. Wilson

Stephen R. Wilson

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY Room 307, 320 South Main
Salt Lake City 1, Utah
5 June 1951

Memorandum

To: DMA Field Team, Region IV

From: P. E. Hotz and David C. Arnold through Ralph J. Roberts, Acting District Supervisor, U. S. Geological Survey, Utah-Nevada District.

Subject: DMA Docket 262, Metal Producers Inc., Horn Silver Mine, Beaver County, Utah

In reply to your memorandum dated May 28, 1951, concerning the difference between Geological Survey and Bureau of Mines reserve tonnage figures at the Horn Silver mine, Beaver County, Utah:

The suggestion has been made that the Survey geologists and Bureau engineers endeavor to reconcile the difference between the reserve figures calculated by each. In the report by the Survey geologists the ore reserves were computed to be 189,000 of oxidized zinc ore containing 10.0 percent zinc. The Bureau engineers, on the other hand, computed the reserves to be 93,000 tons of ore containing 12.5 percent zinc.

Informal meetings between Survey geologists and Bureau engineers have failed to reconcile these differences. For this reason it was decided that separate statements giving reasons for the discrepancies would be preferable to a joint statement.

The discrepancy in reserve figures largely results from differences in methods of calculation used by the Survey geologists and the Bureau of Mines engineers. Essentially the same drill hole and assay data, furnished by the mine operators, were used by the geologists and engineers. The area of the ore blocks on the levels used by the geologists and engineers to calculate the reserves is very similar as indicated by the following table:

Level	Area (sq. ft.) Geological Survey	Area (sq. ft.) Bureau of Mines
650	1,965	1,880
800	6,408	4,486
1,000	7,844	7,146
Total	16,217	13,512

Bureau of Mines area factor is .833 of the Geological Survey

A factor of 12 cu. ft. per ton was used by both the geologists and engineers to convert volume to tons. The tonnage figures calculated by the Survey geologist involved slightly larger blocks and the grade was correspondingly lower, i.e. 10.5 percent zinc as compared to 12 percent zinc. This accounts for about 17 percent of the discrepancy, but the major difference is due to the fact that the Survey geologists considered the ore blocks to have continuity between levels and, therefore, computed the reserves on this basis.

The zinc ore bodies at the Horn Silver mine occur in limestone and generally follow persistent brecciated zones associated with cross faults. The width of the brecciation is variable along the zones, but the ore is clearly localized by the brecciation. The ore minerals were brought in by solutions and were deposited in open spaces. In general, the more intense the brecciation, the larger the ore body.

The ore exposed on the levels is spotty, but this was fully taken into consideration when the reserve tonnages were calculated. Similarly, it is expected that between the levels the ore will be spotty. This does not mean, however, that the existence of ore between levels is in doubt; there is every reason to expect that the ore will contain about the same percentage of zinc if sampled vertically between levels as horizontally along levels.

For this reason the ore bodies were considered by the Survey geologists to be pipe-like bodies and chimneys along favorable structures that are continuous. The Bureau engineers have stated on page 10 of their report that "It appears logical to assume that the brecciated limestone which undoubtedly influenced deposition of secondary zinc on the 550-, 800-, and 1000-foot levels exists between levels. It also appears logical to assume erratic distribution of secondary zinc between levels as indicated by sampling on the levels". Their reserve calculations were not made in accordance with this interpretation, however, but instead they calculated the ore bodies as wedges and pyramids, ending them a short distance above and below levels. This interpretation completely ignores the structural controls of the ore. Perhaps this could be true if there were a strong horizontal stratigraphic control, but there is no evidence of such a control.

It seems appropriate to point out that although the engineering report gives a figure of 93,000 tons for the inferred reserve, it is stated in addition that there may be 500,000 tons or more of ore with an average grade of 10 percent Zn. No data are given to support this assumption. One Bureau engineer stated, however, that part of this 500,000 tons of ore would be between the levels in the area now under discussion. The remainder of the 500,000 tons is supposed to be in another part of the mine. The 500,000 ton figure was pulled out of the air, and is just a "hunch" based on the past production.

It may well be that additional tonnage can be discovered by carefully planned exploratory work somewhere on Horn Silver ground. The problem at hand at the moment, however, is to evaluate the oxidized zinc tonnage in a certain clearly-defined block. Reference to 500,000 tons of "possible ore" is confusing and irrelevant. It is recommended that all references to this figure in the Horn Silver report be deleted.

It should also be called to the attention of the field team that prior to the field examination and transmittal of the report, it was agreed in conference with Mr. East and Mr. Koschmann at the Geological Survey offices in Salt Lake City that the calculation of indicated and inferred reserves where geologic interpretations were involved was the responsibility of the Geological Survey members of the examination team. In the Summary, Conclusions and Recommendations, which presumably were prepared at Denver, the reserve figures from the engineering report were quoted, but the reserve data from the geologic report were not mentioned. It is suggested that the reserve figures calculated by the Geological Survey be quoted in the section on Summary, Conclusions, and Recommendations. If the Bureau engineers wish to register a dissent, an additional paragraph explaining their reasons should be attached.

A revised version of the section on Summary, Conclusions, and Recommendations is attached.

cc: Rove

Preston E. Hess
David T. Arnold

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Mining Division
Region IV

224 NEW CUSTOMHOUSE
DENVER 2, COLORADO

May 22, 1951

Memorandum

To: DMA Field Team, Region IV

From: Chief, Mining Division

Subject: DMA 262, Metals Producers, Inc., Hornsilver mine, Beaver county, Utah. Memorandum of Coordinating Committee, May 17, 1951.

First, I agree with the Committee that my reasoning for reversing the investigators should have been presented. Before going into that, it should be pointed out that the "discrepancies" in the inferred reserves probably are very small when both tonnage and grade are considered, that is, 93,000 tons at 12.4 percent zinc against 189,000 at 10 percent zinc. Visual inspection of the tonnage and grade in various blocks in each estimate indicates tonnages would be about the same if either estimate was changed to correspond to the other in grade. Therefore, resubmission of the report to the investigators for reconciliation of the "differences" does not appear justifiable.

Whether or not the exploration should be approved or disapproved depends first upon policy. Because of the fact that early applications were considered as direct loans, the investigators have been inclined to be ultra conservative. Since the exploration program became established and because of the participation by the operator, I believe the attitude should be changed and that we should be optomistic, liberal and take a long-range viewpoint. Judging from correspondence from Washington dealing with numerous other applications, it appears that this is the Washington viewpoint.

There is reason to believe that there are substantial reserves of low grade - 10 to 15 percent plus - zinc in numerous areas of the west. No one has been interested in developing them because of the lack of a process and no one has been interested too much in developing a process because so little is known about the tonnages, grade and physical characteristics. I believe solution of the problem should start with establishing the reserves and since the Hornsilver mine contains potentially a large reserve, it would seem wise to encourage exploration there. Sufficient reserves will establish an incentive to work out the metallurgy and there is no reason to believe a more favorable price-cost relation will not result when zinc becomes tighter.

Admittedly this is looking into the future, but why not?

PTE

Paul T. Allsman

P. T. Allsman

Attachment
2 copies to Coordinating Committee

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

Air Mail

REGIONAL DIRECTOR'S OFFICE
REGION IV
MAY 21 1951
BUREAU OF MINES
DENVER, COLORADO

May 17, 1951

Memorandum

To: DMA Field Team, Region IV

From: Coordinating Committee

Subject: DMA-262, Metal Producers, Inc., Field Team Report

We transmit herewith, a copy of a memorandum of May 9 from the Lead-Zinc Branch of DMA to the Coordinating Committee, relative to the Field Team's report of April 25 on Docket DMA-262.

The Lead-Zinc Branch calls attention to discrepancies in the inferred ore reserves estimated by the Bureau of Mines engineer and the Survey's geologist. It is noted also that the examining engineer and geologist both recommended withholding the exploratory loan pending a higher market price for the zinc and better facilities for recovery of the zinc from the oxidized ore.

We think that the examining engineer and geologist should, in general, reconcile any differences they have in regard to ore reserves or other phases of a joint examination, before they submit their report. If they cannot reconcile their differences they should indicate clearly reasons why they differ.

We recognize the right of the Bureau and Survey members of the Regional Field Teams to overrule the recommendation made by their examining staff as Allsman and Koschman have done in this case. In such cases, however, they should present more specific reasons and data in support of their adversative opinions. In this connection we call attention to the last two sentences in the next to the last paragraph of the Lead-Zinc Branch's memorandum. The Bureau's examining engineer suggests his belief in the possibility that exploratory work might eventually discover as much as 500,000 tons of ore or more with an assay value of 10% zinc. Are we to assume that the Regional Field Team believes that the chances are good that this tonnage could be developed and if it was developed that it would be adequate enough in tonnage and grade to warrant the installation of a local mill and smelting plant for recovery of the zinc from oxidized ores. If they are not of this opinion, then what is the basis on which they recommend continued exploration for additional ore reserves that cannot now be treated economically?

Sam Lyon
Chairman

Lowell B. Moon
Bureau of Mines

Geological Survey

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

May 9, 1951

Memorandum

To: Coordinating Committee

From: Lead-Zinc Branch, D.M.A.

Subject: Docket DMA-262
Metal Producers, Inc.
Field Team Report

The subject docket was reviewed by the Lead-Zinc Branch on 1/31/51 and referred to the field team for consideration of the proposal. A joint examination was made by representatives of the Bureau of Mines and the Geological Survey and their reports are contained in the attached docket material.

The report presents discrepancies between the examining engineer and geologist, and between the recommendations of the field examiners and the field team. No attempt has been made to explain the differences in the interpretation of basic data. Likewise, no attempt has been made to explain why the field team did not accept the recommendations of the examining engineer and geologist.

The ore reserves are estimated by the Bureau engineer as 93,300 tons of 12.4% Zn. The Survey geologists estimates 189,300 tons of 10.0% Zn. The basic data used in arriving at these tonnage estimates were those furnished by the Metal Producers, Incorporated. These two estimates show a discrepancy of almost 100,000 tons of ore. The final figures used in the recommendation were the ones compiled by the Bureau of Mines, yet an explanation of this obvious difference was not included. This conflict in ore estimates may have been compromised in the field but the evidence is not presented in the report.

The examining engineer and geologist in their joint report, page 2, recommend that approval of the exploratory loan be withheld pending a higher market price for contained zinc and a better market for the product than exists locally. These conclusions are based on an investigation of ore dressing techniques and facilities for marketing the product. The ore dressing and metallurgical processes for these oxidized ores are not yet fully developed, therefore, under present conditions the ores cannot be mined profitably.

The covering memorandum from P. T. Allsman overrides the field examiner's recommendation ~~and~~ by recommending approval of the exploration loan. The merits of the veto are not discussed. It is not make clear how the exploration program can help solve the mining

and metallurgical problems involved. What is the value to the defense effort of large tonnages of metal that cannot be utilized?

Before this application can be processed further, it is necessary that the discrepancies that exist in the field report be compromised and the recommendations be resubmitted with adequate explanations for changing the field examiner's opinions.

Otto Herres

Otto Herres, Chief
Lead-Zinc Branch

Attachment

CONFIDENTIAL

April 25, 1951

Memorandum

To: Lambert Strobel, Executive Secretary, Defense Minerals Administration

From: DMA Field Team, Region IV

Subject: DMA Docket 262, Metal Producers, Inc., Rare Silver mine, Beaver county, Utah

We are enclosing the original and two copies of the geological engineering and metallurgical reports on the above application.

It is recommended that the Defense Minerals Administration enter into a contract with the operator on a revolving fund basis to accomplish the proposed exploration.

F. T. Allsman, Alternate

A. H. Koschmann

Copy to:
DMA files
Koschmann
Allsman
Roberts
S. R. Zimmerley
PTA/el

Attachments:
One copy by air mail
Two copies of regular mail
Original brochure

METAL PRODUCERS, INC., MORN SILVER MINE

BEAVER COUNTY, UTAH

DEFENSE MINERALS ADMINISTRATION REPORT

DMA DOCKET 262

APPROVED:

F. T. Allsman, Alternate

A. H. Koschmann

United States Department of the Interior
Defense Minerals Administration
James Boyd, Administrator

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Mining Division
Region IV

224 NEW CUSTOMHOUSE
DENVER 2, COLORADO

April 25, 1951

Memorandum

To: DMA Field Team, Region IV

From: Chief, Mining Division

Subject: DMA Docket 262, Metal Producers, Inc., Hornsilver mine, Beaver county, Utah

The engineering, geological and metallurgical reports on the above application have been reviewed. It is noted that the reserves are inadequate and grade of zinc too low for ecnomic mining; that a metallurgical process to treat the oxidized ore has not been worked out; and no adequate outlet for a potential zinc oxide concentrate is available. It is also noted that the proposed work is exploration, for which a direct loan would not apply.

In spite of the drawbacks noted, it is my opinion that any encouragement that can be given to the operators that may promote discovery of additional ore reserves and solve the problems of mining and treatment is a worthwhile undertaking. It is therefore recommended that the Defense Minerals Administration enter into a contract with the operators on a matching fund basis to accomplish the proposed exploration.

P. T. Allsman

Attachments

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
1600 EAST FIRST SOUTH STREET
SALT LAKE CITY 1, UTAH

Mining Division
Date Rec'd.
APR 23 1951
BUREAU OF MINES
Denver, Colorado

April 20, 1951

Memorandum

To: Paul T. Allsman, Chief, Mining Division, Region IV

From: Chief, Utah-Wyoming Branch, Mining Division

Subject: DMA. 262
Metal Producers, Inc., Horn Silver mine, Beaver County, Utah. Report on proposed development under Defense Production Act.

Attached are 12 copies of the subject report with maps and 12 copies of the metallurgical report prepared by C. H. Schack.

The exploration request included in the Metal Producers, Inc. application was investigated and details concerning this request are given in the present report. Further recommendations on possible mining and milling operations should await discovery of sufficient ore and development of ore dressing procedures on representative samples.

The application submitted by Metal Producers, Inc. is enclosed.

Stephen R. Wilson

Stephen R. Wilson

METAL PRODUCERS, INC., HORN SILVER MINE, BEAVER COUNTY, UTAH

REPORT ON PROPOSED DEVELOPMENT UNDER DEFENSE PRODUCTION ACT

CONTENTS

	Page
Summary, conclusions and recommendations	2
Engineering report:	
Introduction	3
Acknowledgments	4
Location, topograph and climate	4
History and production	5
Ownership and extent	6
Description of the deposits	6
Reserves of zinc-oxide ore	7
Present status	13
Exploration and development	13
Mine plant	13
Proposed exploration	14
Proposed financing	16
Conclusions	17
Recommendations	18

TABLES

No.		
1	Analyses of air drill hole samples	7
2	Comparison of samples	10
3	Items of exploration	15
4	Daily cost of exploration	15
5	Bureau of Mines cost estimate	16

ILLUSTRATIONS

Figures No.		Follows Page
1	Location map, Horn Silver mine, Beaver County, Utah	4
2	Sample plan of 650-foot level north	7
3	Sample plan of 800-foot level north	7
4	Sample plan of 1,000-foot level north	7
5	Section A-A'	6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

By David C. Arnold[1] M. H. Hewett[2] H. F. Bunhalter[3] G. M. Schaub[3]

Metal Producers, Inc., lessee of the Horn Silver mine, Beaver county, Utah, has made application to the Federal Government for a loan of $55,000 to complete an underground exploratory project on zinc-oxide ores. The proposed program is part of the company's plan of a full-scale mining and milling operation on the property. Personnel of the Bureau of Mines and Geological Survey examined the property during February and March 1951. This report and the attached metallurgical report were prepared as a result of the examination by Bureau of Mines engineers.

The major primary ore bodies of the Horn Silver mine are found in breccia zones associated with the northerly striking Horn Silver fault. Removal of zinc from the primary ore bodies and subsequent secondary deposition in the breccia zones of the footwall limestone has formed irregular bodies containing zinc carbonate and other oxide zinc minerals. This mineralization has been disclosed in drill holes and underground openings, but the ore bodies have not been completely outlined.

Bureau of Mines engineers, using sample data of Metal Producers, Inc., estimate that 93,300 tons of inferred ores assaying 12.4 percent zinc is present between the 650- and 1,000-foot levels.

insert A

The objective of the proposed program is more complete exploration of the oxide ore bodies to outline sufficient ore reserves to justify mill expansion and possible processing plant construction. The leasing company has proposed that exploration consist of drifting, raising, long-hole percussion drilling, and diamond drilling at a total cost of $55,000.

It is concluded that a profitable mining and milling operation on zinc-oxide ore bodies of the Horn Silver mine will depend upon disclosure of sufficient tonnage of ores, development of ore dressing and processing methods for recovery of zinc, and a higher price for contained zinc in the concentrate. ~~A more complete exploratory program may outline ore bodies totalling 500,000 tons or more, with an assay value of 10 percent zinc.~~

Recommendations are made that approval of the requested exploratory loan for the Horn Silver mine be withheld pending a higher price for contained zinc in oxide ores and a greater market for the product than exists locally.

It appears reasonable that a full scale, 400-ton per day mining and milling operation can be established on the Horn Silver property if the above conditions are in force and the expected tonnage of ores is outlined by the proposed exploration.

1/ Geologist, U. S. Geological Survey
2/ Mining Engineer, Bureau of Mines
3/ Metallurgist, Bureau of Mines

Metal Producers, Inc.
Horn Silver Mine
Beaver County, Utah

By M. H. Howes and H. F. Buckholtz 1/

Engineering

Engineering Report

1/ Mining Engineers, Bureau of Mines, Salt Lake City, Utah

ENGINEERING REPORT ON THE HORN SILVER MINE

METAL PRODUCERS, INC.

BEAVER COUNTY, UTAH

INTRODUCTION

Metal Producers, Inc., has made application to the Federal Government for a loan of $55,000 to complete an exploration program on the Horn Silver mine, Beaver County, Utah. The objective of the proposed program is to block out sufficient oxidized zinc ores to approximately 10 percent zinc content to warrant full-scale mining and milling, and the possible building of a reduction plant to process the concentrates. The Horn Silver mine was examined on February 28 and March 1, 1951 by Bureau of Mines engineers and Geological Survey geologists, and the Metal Producers, Inc. mill was examined on February 28, 1951 by a Bureau of Mines metallurgist, to determine the feasibility of such an exploration program.

ACKNOWLEDGMENTS

Information necessary to complete this report was obtained by an examination of the property by mining engineers and a metallurgist of the Bureau of Mines, by geologists of the Geological Survey, and from various other sources. U. S. Geological Survey Professional Paper 80 by B. S. Butler, and Bureau of Mines unpublished War Minerals Report of Horn Silver mine, Beaver County, Utah (Lead-Zinc-Silver), February 1944, provided considerable information.

Metal Producers officials, George Gleason and D. C. Peacock, were especially helpful in furnishing maps, assay results, costs, and other data pertinent to the property and proposed exploration project.

LOCATION, TOPOGRAPHY, AND CLIMATE

The Horn Silver mine is in the San Francisco mining district, 16 miles west of Milford, Utah, adjacent to the old Frisco townsite (fig. 1). The property lies on the rather rugged east slope of the San Francisco Mountains at the base of Grampian Hill and is connected to State Highway 21 by one mile of good graveled road. Metal Producers, Inc. mill is approximately 5 miles west of Milford and 1/4 mile north of the highway.

The climate is temperate, not being subject to extremes of either heat or cold. The precipitation is usually under 12 inches annually, a large part of which generally occurs in early spring and late summer. Moderately heavy snowstorms occur in winter but the snow usually melts rapidly. The problem of keeping the roads open is not great, and the mine is accessible all year.

HISTORY AND PRODUCTION

The outcropping ore deposits of the Horn Silver mine were discovered in 1875. From the time of discovery to 1928, a total of 962,694 tons of ore, slag, and tailings produced 189,501 tons of lead, 18,468 tons of zinc, 18,700 ounces of gold, 17,051,225 ounces of silver, and 8,356,499 pounds of copper. The Tintic Lead Co. of Salt Lake City acquired the property in 1928 and through 1931 produced 3,418 tons of lead, 2,395 tons of zinc, 322,921 ounces of silver, 1,817 ounces of gold, and 257,810 pounds of copper from 39,749 tons of ore. The Horn Silver Mines Co. was incorporated in 1932. During 1942 and 1943 lessees shipped 13,300 tons of dump ores which produced 525 tons of lead, 30,000 ounces of silver, 422 ounces of gold, and 55,170 pounds of copper. About 1933 the main working shaft caved below the 300-foot level. During 1944 Metal Producers, Inc. reopened the mine by rehabilitating the old King David shaft and driving a 1,200-foot crosscut from the shaft easterly to connect with the 850-foot level of the Horn Silver mine. The leasing company conducted an intensive development campaign and reopened many of the old levels. About 500 railroad carloads of lead-zinc ores were mined and shipped during the period of the Premium Price Plan.

From 1875 to the present time a total of more than 1,000,000 tons of ores, slag, and tailings has produced 193,439 tons of lead, 21,453 tons of zinc, 17,494,144 ounces of silver, 20,959 ounces of gold, and 9,639,479 pounds of copper with a gross value in excess of $54,000,000.[2/]

2/ Production of Horn Silver mine from 1875 to 1943 obtained from Bureau of Mines unpublished War Minerals Report on Horn Silver Mine, Beaver County, Utah (Lead-Zinc-Silver), February 1944.

OWNERSHIP AND EXTENT

The Tintic Lead Co., Salt Lake City, Utah, is the parent company of Horn Silver Mines Co., which owns and controls 20 patented and 9 unpatented claims.

Metal Producers, Inc., Los Angeles, Calif., obtained a long-term operating lease on the Horn Silver mine in 1944. The present lease will be in force until 1970. The corporation owns the mill outright.

DESCRIPTION OF THE DEPOSITS

The major primary lead-zinc-silver ore bodies of the Horn Silver mine occur in brecciated zones associated with the northerly-striking Horn Silver fault zone and lesser faults intersecting this zone. Intense silicification of the breccia and other country rocks has masked the original characters making identification difficult.

Removal of zinc from the primary ore bodies and subsequent secondary deposition in breccia zones in the footwall limestone has resulted in irregular bodies containing zinc carbonate and other oxide zinc minerals (fig. 5). These bodies have been disclosed by company sampling on the 650-, 800-, and 1,000-foot levels. The secondary mineralization consists of iron-oxide stained, porous limestone with zinc minerals. Gypsum and quartz are present in veinlets. The color of the mineralized limestone ranges from brown to red depending upon the content of limonite and hematite.

The zinc-oxide bodies encountered in the exploration to date appear to be extremely irregular in size and shape. The leasing company has proposed shrinkage stoping for mining the ores. Considerable dilution undoubtedly will result and a lower average assay value than shown in preliminary samples may be expected. It is probable that more economical

methods for mining the ores will be developed as the deposits are opened and more information is obtained.

RESERVES OF ZINC-OXIDE ORE

Metal Producers, Inc. has sampled numerous exposures on the 650-, 800-, and 1,000-foot levels and obtained cores and sludges from diamond drill and air drill holes (figs. 2, 3, and 4, and table 1). Analyses of the samples indicate erratic distribution of the zinc, with determinations varying from 1 to 25 percent.

Table 1.—Analyses of air drill hole samples

Hole No.	Footage From	Footage To	Percent zinc
1	0	34	10.0
	34	50	6.2
17	0	6	5.0
	6	12	14.3
	12	18	2.7
	18	24	11.0
	24	30	9.1
	30	36	6.2
	36	42	11.5
18	0	6	1.8
	6	12	2.1
	12	18	1.4
	25	30	1.5
	30	40	1.0
26	0	12	1.3
	12	18	1.0
	18	24	1.0
	24	30	1.0
	30	36	1.0
	36	42	1.0
	42	55	1.0

Hole No.	Footage From	Footage To	Percent zinc
27	1	12	2.0
	12	18	1.0
	18	24	1.0
	24	30	1.5
	30	36	1.5
28	1	12	1.0
	12	18	1.7
	18	24	1.5
	24	30	1.0
	30	36	1.0
	36	42	1.0
29	1	12	5.0
	12	18	9.5
	18	24	5.6
	24	30	6.7
	30	36	2.3
	36	42	6.5
	42	44	6.0
30	1	6	1.5
	6	12	1.2
	12	18	1.8
	18	24	4.0
	24	30	3.5
	30	36	1.5
31	1	12	10.8
	12	18	4.0
	18	24	3.0
	24	30	3.5
	30	36	3.9
32	1	12	8.5
	12	18	5.1
	18	24	4.5
	24	36	2.0
	36	42	1.5
33	1	6	3.9
	6	12	1.3
	12	18	1.0
	18	24	1.1
	24	30	1.5
	30	36	1.5
	36	42	1.5

Hole No.	Footage From	Footage To	Percent zinc
34	0	12	2.2
	12	18	1.5
	18	24	1.0
	24	30	1.6
	30	36	1.5
35	0	12	1.2
	12	18	1.0
	18	24	1.6
	24	30	2.0
	30	36	1.5
36	0	6	3.1
	6	12	2.0
	12	18	1.5
	18	24	3.5
	24	30	2.2
	30	36	1.6
37	1	6	3.0
	6	12	3.1
	12	18	2.9
	18	24	1.5
	24	30	1.0
38	0	12	1.5
	12	18	1.5
	18	24	1.5
	24	30	1.0
39	0	6	1.4
	6	12	1.1
	12	18	1.6
	18	24	2.0
	24	30	1.8
40	0	12	1.2
	12	18	1.0
	18	24	2.0
	24	30	1.0

Bureau of Mines engineers checked channel samples obtained by the company in several exposures taken at random in the mineralized zone. The results are compared in table 2.

Table 2.—Comparison of samples

Bureau of Mines		Metal Producers, Inc.	
Sample	Percent zinc	Sample	Percent zinc
3	6.15	61	4.2
4	2.5	60	1.0
5	23.5	58	19.5
6	3.05	74	11.6
7	5.0	77	15.5
8	15.0	79	15.5

Bureau of Mines samples 3, 4, 5, and 8 check reasonably close with Metal Producers, Inc. samples 61, 60, 58, and 79, but samples 6 and 7 assay considerably less than samples 74 and 77 taken in the same location by the company. No samples were taken by the company between the 650- and 800-foot levels or between the 800- and 1,000-foot levels. It appears logical to assume that the brecciated limestone which undoubtedly influenced deposition of secondary zinc on the 650-, 800-, and 1,000-foot levels exists between levels. It also appears logical to assume erratic distribution of secondary zinc between levels as indicated by sampling on the levels.

Bureau of Mines engineers have made an estimate of zinc-oxide ore reserves on the basis of data supplied by Metal Producers, Inc. Analyses of samples obtained from workings, diamond drill holes, and air drill holes were used in estimating a total of 95,500 tons of oxide ores in the blocks as shown in figures 2, 3, and 4. The average assay values were

determined by weighting the samples included in each block. A factor of 12 cubic feet per ton was used in the tonnage calculations. The total tonnage is estimated as inferred ore because of the erratic assay values and sufficient information to permit only limited projections beyond exposures on the 650-, 800-, and 1,000-foot levels. The individual ore blocks were calculated as follows:

Block A

This block has a triangular shaped plan of 612 square feet on the 650-foot level at 300 W. between 200 and 300 N. It was projected as a two-pointed pyramid 50 feet above and below the 650-foot level and contains 1,700 tons of ore with a weighted assay of 6.7 percent zinc.

Block B

Block B has a rectangular shaped plan of 400 square feet between coordinates 100 and 200 N. and 200 and 300 W. It was projected as wedges 50 feet above and below the 650-foot level. The block contains 1,650 tons which has a weighted assay of 10.9 percent zinc.

Block C

This block has an irregular shaped plan on the 650-foot level of 524 square feet at coordinates 200 W. between 400 and 500 N. It has a rectangular shaped plan of 1,197 square feet on the 800-foot level between coordinates 400 and 500 N. and 100 and 200 W. The block was projected as a wedge 50 feet below the 800-foot level and 20 feet above the 650-foot level. It contains 13,700 tons having a weighted assay of 18.3 percent zinc.

Block D

Block D has a rectangular shaped plan of 594 square feet on the 800-foot level at coordinates 400 N. and 100 W. The block was projected as a wedge 100 feet below and 50 feet above the level and contains 3,700 tons having a weighted assay of 13.4 percent zinc.

Block E

This block has a rectangular shaped plan of 710 square feet on the 800-foot level at coordinates 300 N. between 0 and 100 W. It has been projected as a double wedge to a depth and height of 50 feet. The block contains 2,950 tons having a weighted assay of 12.9 percent zinc.

Block F

Block F has a rectangular shaped plan of 2,116 square feet on the 800-foot level at coordinates 300 N. and 200 W., and an irregular shaped plan of 3,571 square feet on the 1,000-foot level at coordinates 300 N. between 100 and 200 W. The block was projected below the 1,000-foot level as a pyramid for a depth of 20 feet and above the 800-foot level as a wedge for a distance of 100 feet. The total of the block is 36,400 tons having a weighted assay of 11.9 percent zinc.

Block G

This block has a triangular shaped plan of 3,657 square feet on the 1,000-foot level at coordinates 0 N. between 200 and 300 W. The block was projected downward as a pyramid to a depth of 50 feet and upward as a pyramid a distance of 80 feet. It contains 15,260 tons having a weighted assay of 8.9 percent zinc.

The combined total tonnage of inferred ores estimated from the sample data of Metal Producers, Inc. is 93,300 tons averaging 12.4 percent zinc.

PRESENT STATUS

Exploration and Development

A large part of the old Horn Silver mine workings are inaccessible, because of caving or filling. The rehabilitated King David shaft, situated about 1,000 feet northwest of the Horn Silver mine in the footwall limestone, is being used as the main working shaft. The shaft is 840 feet deep and has two hoisting compartments and a manway compartment. The 800-foot level at the shaft is the main working level. This level is equivalent to the 650-foot level of the Horn Silver workings, the two areas being connected by a 1,200-foot crosscut. A two-compartment winze extends from the 650- to the 1,000-foot level. Portions of the 600-, 650-, 700-, 800-, 900-, and 1,000-foot levels are accessible at this time.

Long hole percussion drilling is presently used by the company to explore the oxide zinc zones. Many of the holes have been drilled from 25 to 50 feet horizontally through the zones on the 650- and 800-foot levels. A few holes have been core drilled with a diamond drill on the 650-, 800-, and 1,000-foot levels. A total of 695 feet of percussion drilling and 2,278 feet of diamond drilling has been completed by Metal Producers to date. Many of the diamond drill holes were drilled in exploration for sulfide ore bodies before the presence of the oxide bodies was known.

Mine Plant

Structures at the King David shaft include a 60-foot, wood headframe, hoist and compressor building, carpenter and blacksmith shops, office, warehouse, and ore bins.

An electric-driven, 400-cubic feet compressor serves all air-driven equipment in the mine. A double-drum electric hoist at the shaft handles two 3-ton, Kimberly type, self-dumping skips in balance. The skips, loaded from a 200-ton skip pocket equipped with air-operated gates at the 650-foot level, dump into a hopper at the surface where conveyer belts and feeder transfer ores to the bins. Two 1-1/2-ton Mancha trammers and eight 2-ton, rocker dump cars are used to transport ores on the 650-foot level.

A 50-h.p., electric hoist serves the winze from the 650- to the 1,000-foot level. A light cage in the winze is built to carry the 3/4-ton mine cars of which there are a large number in the mine.

Other equipment includes two small (12B) Eimco loaders, and a large assortment of air drills, small air hoists, hose, drill steel, picks, and shovels.

PROPOSED EXPLORATION

The leasing company has proposed that the oxide zinc deposits be further explored to outline sufficient reserves to justify mill expansion and possible processing plant construction. Exploration will be accomplished by drifting, raising, long-hole percussion drilling, and diamond drilling. The company has estimated that $55,000 will be required for the exploration as shown in tables 3 and 4.

Table 3.—Items of exploration

Raising	250 feet
Drifting	150 feet
Diamond drilling	2,000 feet
Percussion drilling	5,500 feet

Table 4.—Daily cost of exploration

Labor, exclusive of diamond drill crew, 16 men at $16	$ 256
20 feet of diamond drilling at $5	100
Power and supplies	100
Assay, 2 men and supplies	44
Estimated total for 1 day	500
100 days estimated for completion 100 x 500	50,000
Office expense for 4 months	5,000
Total	$55,000

The company is presently using percussion drilling in exploring the zinc-oxide bodies. The holes are driven 25 to 50 feet through the mineralized zones. Analyses of cuttings from the holes show the majority to be low in zinc content. The leasing company believes the low assay values may be caused by loss of the heavier zinc minerals in rock cavities in the holes. However, a study of the assay results does not justify this conclusion, but does indicate spotty deposition of zinc in the zone. The company proposes to check the air drill hole sampling by drifting on representative holes.

Bureau of Mines engineers estimate that 500,000 tons of low-grade oxide zinc ores may be developed by drifting, raising, long-hole percussion drilling and diamond drilling. It is suggested that 300 feet of drifts and 300 feet of raises be driven to open levels above and between the 650-, 800-, and 1,000-foot levels to make the zinc ore areas accessible for drill hole exploration.

It is estimated that 4,000 feet of percussion drilling and 2,000 feet of diamond drilling will be necessary to thoroughly explore the ore occurrences. Percussion drill holes should be drilled approximately 50 feet in depth, either horizontally or slightly upward, and spaced about 50 feet apart in the ore areas. Where deeper holes, exploratory holes between levels, or checks against percussion drill holes are required, diamond drilling should be used.

A breakdown of estimated costs for the proposal, as suggested by the Bureau of Mines engineers, is shown in table 5.

Table 5.--Bureau of Mines cost estimate

Purchase of 1 long feed automatic drifter	$ 1,000
Raising, 300 feet at $40 per foot	12,000
Drifting, 300 feet at $30 per foot	9,000
Diamond drilling, 2,000 feet at $5 per foot	10,000
Percussion drilling, 4,000 feet at $1.50 per foot	6,000
Assaying, 1,500 samples at $5 per sample	7,500
Power, supplies, overhead	9,500
Total cost	$55,000

Access roads from the mine to mill and mill to Milford are adequate for any proposed mining and milling operation.

Manpower for the proposed exploration program will be available from present skeleton crew miners available in the area, and contract diamond drillers from the Salt Lake area.

PROPOSED FINANCING

Metal Producers, Inc., lessee of the Horn Silver mine, has requested a loan of $55,000 to further explore and delineate oxide zinc ore bodies of sufficient tonnage and grade to warrant a mining and milling operation. Exploration to date has disclosed mineralized areas in

drifts, raises, and in air and diamond drill holes, but has not been complete enough for determination of maximum tonnage.

The requested loan appears adequate to determine the extent of the oxide zinc bodies. If results are favorable, money would be returned to the government from concentrate sales, after establishment of a producing mine.

Metal Producers, Inc. has expended considerable money in equipping the Horn Silver mine and flotation mill. It is believed the company is capable of providing exploration funds on a matching basis with the government.

CONCLUSIONS

A profitable mining and milling operation on zinc-oxide ore deposits of the Horn Silver mine will depend upon disclosure of sufficient tonnage of ores, development of ore dressing and processing methods for recovery of the zinc, and a higher price for zinc-oxide concentrate. Present smelter capacities in the area are insufficient for processing a large tonnage of zinc-oxide concentrate, thus additional facilities will be necessary to utilize zinc concentrate from the proposed mining and milling operation.

The present local price for zinc-oxide concentrate assaying 25 percent zinc is approximately 7 cents per pound of contained zinc. A commercial mining and milling operation will require a price of at least 12 cents per pound of zinc as suggested by the company.

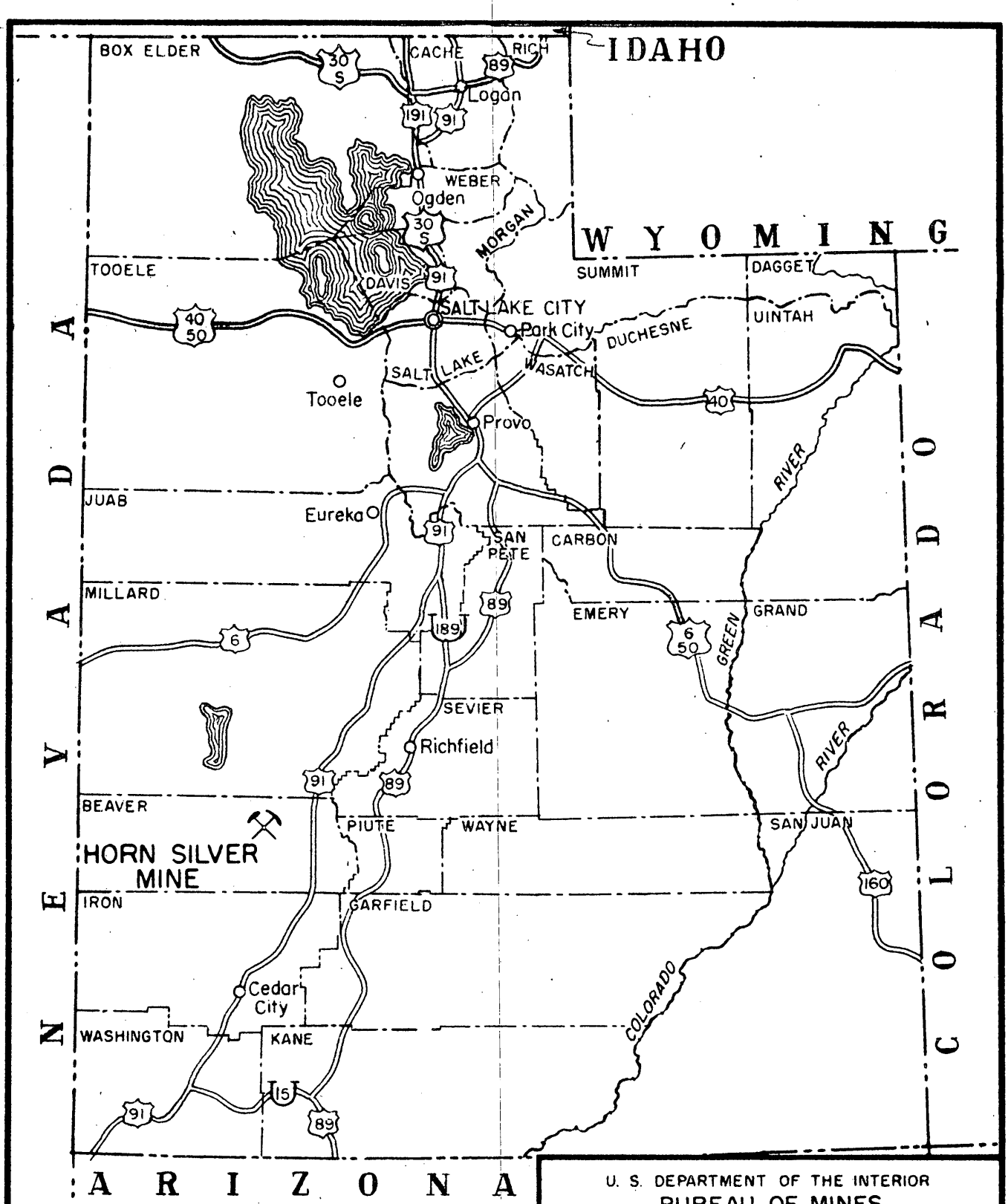
Bureau of Mines engineers, using sample data provided by Metal Producers, Inc., have estimated 93,500 tons of inferred ores assaying 12.4 percent zinc are present on the 580-, 800-, and 1,000-foot levels. This estimate is based on drift samples and samples obtained from diamond drill and percussion drill holes. A more complete exploratory program may disclose ore bodies totaling 500,000 tons or more, with an assay value of 10 percent zinc.

Metal Producers, Inc. is a mining concern of considerable successful operating experience. It is believed the officials of the company are capable of conducting the proposed project to completion. The company is financially able to provide exploratory funds on a matching basis with the government.

RECOMMENDATIONS

Recommendations are made that approval of the requested exploratory loan for the Horn Silver mine be withheld pending a higher price for contained zinc in oxide ores and a greater market for the product than exists locally.

It appears reasonable that a full scale, 400-tons per day mining and milling operation can be established on the Horn Silver property if the above conditions are in force and the expected tonnage of ores is outlined by the proposed exploration.



U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Fig. 1 Project No.

Location Map
HORN SILVER MINE
BEAVER COUNTY, UTAH

ENGINEER: M.H. HOWES & H.E.B. DATE: APRIL 11, 1951
TRACED: APR., 1951; BY: A.P.T.S.
CHECKED:

1500-1047-E

Geology

GEOLOGIC REPORT ON THE
HORN SILVER MINE, MILFORD, UTAH

by

David C. Arnold

U. S. Geological Survey

March 28, 1951

Table of Contents

	Page
General geology	1
Ore deposits	2
Ore Reserves	3
Conclusions and recommendations	5

Illustrations

Mine maps

650 level showing reserve blocks

800 level showing reserve blocks

1000 level showing reserve blocks

GEOLOGIC REPORT ON THE

HORN SILVER MINE, MILFORD, UTAH

GENERAL GEOLOGY

The discussion of the geology of the San Francisco district has been taken from Professional Paper 80 (B. S. Butler).

The stratified rocks of the region range from Cambrian to Triassic in age. Although there is some doubt as to the exact age of a few of the formations, probably all periods from Cambrian to Triassic are represented. Early to middle Tertiary volcanic rocks and tuff are very extensive. These volcanics consist mainly of quartz latite flows but a small part is represented by tuff, rhyolite, dacite, andesite, and basalt. Irregular stocks of quartz monzonite have intruded both the sediments and the volcanics. Aplite and mafic dikes comprise the youngest igneous rocks of the region.

The region has been cut by many faults. The largest of these faults trend generally north-south; smaller east-west faults have been recognized throughout the region.

The main geologic feature in the vicinity of the Horn Silver mine is the Horn Silver fault which strikes north-south and in general dips steeply to the east. This structure is essentially a fault zone consisting of three or four north-south trending faults separated by areas of extreme brecciation. The eastern side of the fault is downthrown and has placed Tertiary volcanics in contact with the Grampian limestone of Cambrian(?) and Ordovician age. Three cross-faults that trend east-west have cut the Horn Silver fault in the vicinity of the mine. At the surface these faults have a horizontal displacement ranging from 40 feet to 225 feet. The horizontal displacement

decreases with depth and in the lower levels of the mine displacement appears to be negligible.

Ore deposits

Localization of the Horn Silver deposits appears to have been controlled more by openings provided by brecciation than by the lithology of the host rock. Both limestone and fragments of volcanic rock have been found in the ore. A few small ore bodies have been mined from the limestone footwall. Intense silicification of the breccia and country rock near the deposit has made identification of the surrounding rock extremely difficult.

From the surface down the deposit may be divided into three zones: the oxidized zone, the enriched sulfide zone, and the primary sulfide zone. Removal of zinc, copper and iron from the oxidized zone formed a high grade lead-silver ore. The main ore mineral in this zone was the lead sulfate, anglesite. Redeposition of the zinc and copper below the oxidized zone in the form of wurtzite and chalcocite produced an enriched sulfide zone that began near the 500 foot level of the mine and extended downward to the 900 foot level. The zones of enriched zinc sulfides were confined to the east-west trending cross faults, indicating that the additional brecciation provided channelways for descending meteoric solutions which transported the zinc downward probably in the form of a sulfate. With the exception of the secondary enriched zones along the cross faults, most of the ore below the 700 foot level consisted of primary sulfides.

Recently, secondary zinc mineralization has been recognized in the old workings within the footwall limestone. The U. S. Bureau of Mines is reported to have identified the zinc mineral as ferruginous smithsonite ($ZnCO_3$). In

general appearance the material resembles vuggy, iron-oxide stained limestone, and because of its high porosity the specific gravity is not noticeably greater than that of the country rock. On close examination small veinlets of gypsum and silica can be seen. The color ranges from brown to red due to iron oxide in the form of limonite and hematite. Intense coloration by the iron oxide made megascopic identification of the ore mineral impossible.

Underground mapping shows that the zinc carbonate mineralization occurs near the intersection of two or more faults. Many of the old drifts follow faults, thus a large part of the secondary zinc mineralization probably has been intersected by these workings.

Ore reserves

Although the assay maps which accompanied the loan application were used to calculate the grade of ore in the mine, it is believed that these assays show a higher zinc content than is present beyond the workings. The drifts cutting the secondary zinc mineralization have been open over 38 years. Most of the assays shown on the maps were cut from the wall of the old drifts. Over a period of 38 years it is reasonable to assume that migration and deposition of zinc on the drift walls would increase the zinc content. Assays of sulfate efflorescence on the 1000 foot level of the mine show a 11 percent to 12 percent zinc content.

Computed tonnages of secondary zinc in the mine have been classified as indicated and inferred reserves. Because of limited exploration, the largest calculated reserves are necessarily classified as inferred. As shown on the included maps the indicated reserves have been explored by both drifts and air drill holes while reserves classified as inferred have been explored by only one drift or one diamond drill hole.

A factor of 12 cubic feet per ton has been used to convert volume measurements to tonnage. This is the same tonnage factor used by the applicant.

The zinc content of each block and the zinc content of the total reserves in the mine as shown in the reserve estimate are weighted averages calculated from cut samples and drill hole data taken from the assay maps that accompanied the loan application.

Indicated Reserves

Block	Description	Tons	Percent zinc
I	18' by 31' vertical extent from 600' to 700'	4,600	5.10
II	10' by 50' vertical extent from 600' to 700'	4,200	5.79
	Total indicated reserves	8,800	5.65 Average

Inferred Reserves

Block	Description	Tons	Percent zinc
III	Prism 40' by 70' by 90' vertical extent 600' to 700'	11,700	9.15
IV	20' by 38' vertical extent 600' to 850'	15,800	14.50
V	91' by 35' vertical extent 700' to 900'	53,100	11.60
VI	102' by 25' vertical extent 750' to 850'	21,200	8.85
VII	50' by 75' vertical extent 900' to 1050'	47,000	11.20
VIII	Prism 78' by 90' by 115' vertical extent 950' to 1050'	40,500	5.74
	Total inferred reserves	189,300	10.05 Average

Conclusions and Recommendations

Although the samples cut from the drift walls by the applicant have been used to calculate the grade of secondary zinc in the mine, thus giving a slightly higher tenor or ore than is actually present, it is believed that the tonnage and grade of ore calculated by the U. S. Geological Survey could be produced by selective mining. Undoubtedly the large blocks of secondary zinc mineralization outlined by the applicant could not be mined without lowering the ore grade below the limit required to support an economical operation; however, the parts of the blocks that contain the highest zinc content could be mined by employing the same mining methods outlined in the loan application.

The approval of a loan is therefore based on the metallurgy of the ore and the sale price of the concentrates. Mr. Schack of the U. S. Bureau of Mines states that the market price for a 25 percent oxide zinc is approximately 7 cents per pound of contained zinc. At this price the operation outlined by Metal Producers, Inc. would not be profitable.

In view of the foregoing facts it is recommended that an exploration loan be withheld pending a higher market price for secondary zinc. If a market for oxidized zinc is developed which would support a profitable mining and milling operation while the DMA program is in force, it is recommended that an exploration loan be granted.

Metal Producers, Inc.
Horn Silver Mine
Beaver County, Utah

By C. H. Schaok 1/

Metallurgical
Report

1/ Metallurgist, Salt Lake City Branch, Metallurgical Division, Bureau of Mines, Salt Lake City, Utah

Metallurgy

CONFIDENTIAL

METAL PRODUCERS, INC., HORN SILVER MINE, BEAVER COUNTY, UTAH

METALLURGICAL REPORT UNDER DEFENSE PRODUCTION ACT

DMA-282

By C. H. Schack[1/]

CONTENTS

	Page
Introduction	2
Location and facilities	2
Milling plant	3
Metallurgical problems	4

1/ Metallurgist, Salt Lake City Branch, Metallurgical Division, Bureau of Mines, Salt Lake City, Utah.

INTRODUCTION

The ore-dressing mill of the Metal Producers, Inc. was examined by a metallurgist of the Salt Lake Experiment Station on February 28, 1951, and the proposed beneficiation of the oxidized zinc ore was discussed with George W. Clemson, president, and R. V. Thompson, metallurgist, of the company, who were very cordial in showing the plant and helpful in outlining their thoughts on the concentration of the ore. It is pertinent, however, to mention that both men considered a serious review of the metallurgical problems that might be involved in this project as premature. They rightly acknowledge, until the initial proposed mine exploration is completed, that insufficient data are available for estimating the grade and nature of the ore that will have to be treated in the proposed plant, and that such testing and research as has been completed are based on ore which is now available, but which may not be representative of ore that will be mined if the proposed exploration is successful.

LOCATION AND FACILITIES

The ore-dressing mill, shops, and offices of the company are located 5 miles west of Milford, Utah, a railroad town on the main line of the Union Pacific Railroad. The Horn Silver mine is 12 miles west of the mill and is accessible throughout the year to the mill and Milford over paved and 1 mile of graveled road, except for temporary closing of the road by infrequent winter storms.

Water for the ore-dressing plant is obtained from a 500-foot deep well equipped with a pump capable of delivering 300 gallons per minute. Additional water could be obtained by drilling a second well or installing a larger pump in the present well.

Electric power is obtained from lines of the Telluride Power Co. through a 325-kv-a. bank of transformers. An auxiliary 300-kv-a. Diesel electric plant is part of the mill equipment and can be used as a standby power unit to supplement power obtained from the Telluride Power Co.

MILLING PLANT

The ore-dressing mill is a virtually new flotation plant capable of crushing, grinding, and floating 300 to 400 tons of sulfide lead-zinc ore per day. It is built on the sloping side of a deep wash so that gravity flow of ore is possible after the initial elevation of the ore to the top of the mill building. The essential sections of the milling plant comprise coarse crushing, secondary crushing, fine grinding, and classification, flotation, thickening, and filtration and tailing-disposal sections.

Coarse crushing is done by a 15- by 28-inch jaw crusher located about 200 yards from the mill building, and so situated that ore trucks can dump ore over a grizzly into the crusher bin. The crusher delivers the ore into an elevated loading bin at the bottom of a dry wash, from which trucks bring the ore to the top of the draw where the crushed ore is stock piled. The mill feed is moved from the stock piles by bulldozing the ore into underground ore bins placed over conveyors that elevate the ore to a cone crusher at the top of the mill building.

The cone crusher discharges on a vibrating screen, which previously sized the ore dry with oversize falling to a sink-float unit and the undersize falling into the ball mill. The sink-float unit has been removed from the mill and sold, but the space it occupied is available for installation of a new sink-float unit. The grinding and classification circuit consists of a 7- by 5-foot Marcy grate discharge ball mill and a 48-inch by 30-foot Akins classifier. This unit is capable of grinding a minimum of 300 tons of feed per day to average flotation size. The flotation section contains six Denver Sub A and six Fagergren flotation machines which can be arranged in various combinations for one or two product flotation and cleaning. Thickening and filtering are done in a 16-foot diameter thickener and a 4-leaf, 6-foot diameter American filter. Tailings are disposed by pumping into the large dry wash below the mill building. The mill also contains several conditioning tanks, a bank of reagent feeders, concentrate storage bins, an assay laboratory, mill office, pump room, and miscellaneous control equipment.

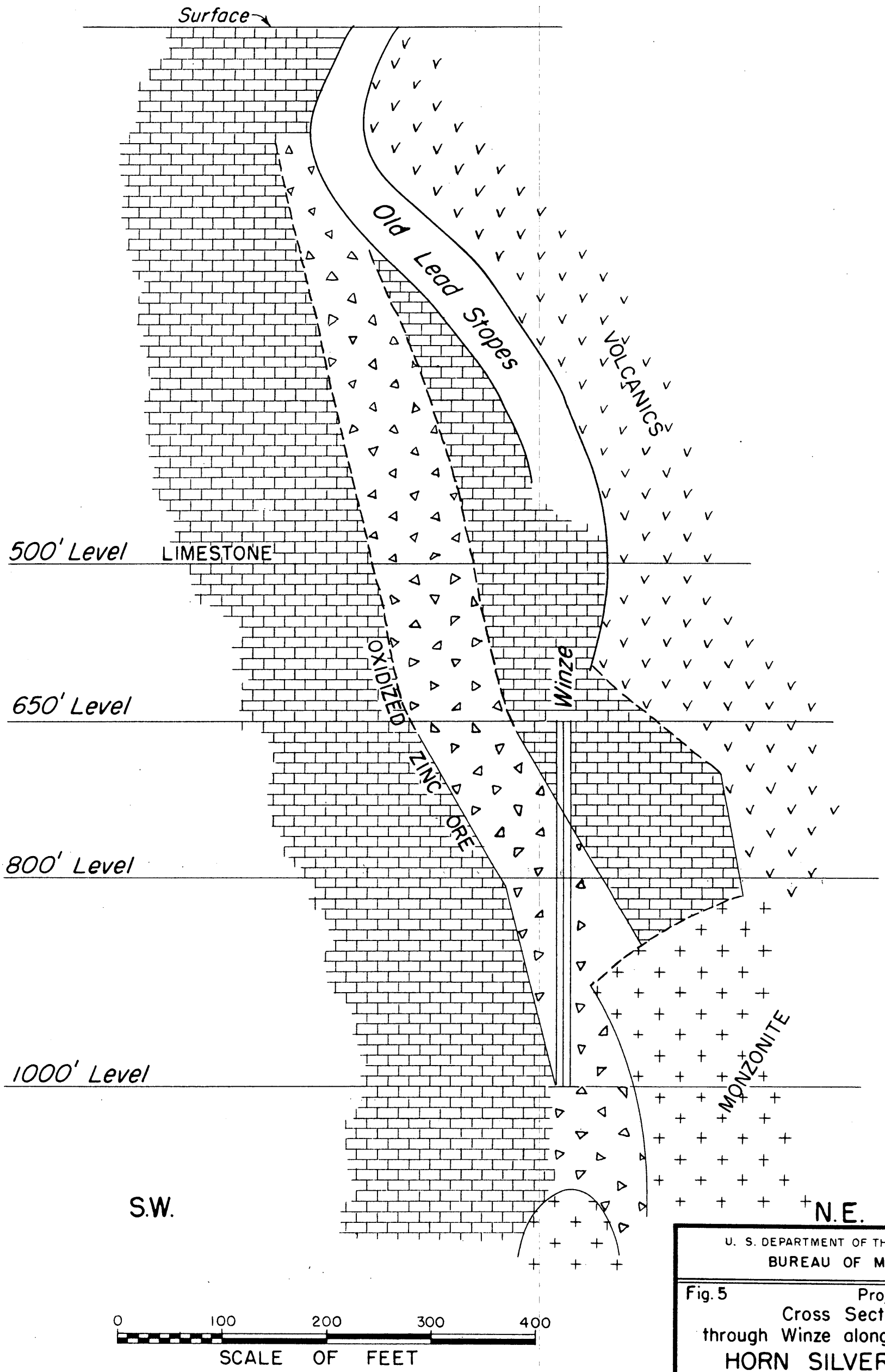
METALLURGICAL PROBLEMS

The proposed ore beneficiation method outlined in DMA Docket 262 includes sink-float treatment of the course-size portion and flotation of the fine-size portion after crushing the ore to minus 3/4 inch. Such a process will require some changes and alteration in the present flow sheet as well as a few additional items of equipment. The principal equipment items needed are a new sink-float unit, ore feeders, additional flotation cells, probably another thickener, a larger double-deck vibrating screen, and miscellaneous equipment for moving, disposing,

and storing of products from the proposed sink-float operation. The needed equipment probably can be purchased and installed for about $100,000.

The metallurgical test data given in DMA Docket 262 are insufficient to judge the feasibility of the proposed processing of the ore. As previously mentioned, fully representative samples of the ore, as it will be mined, are not available and cannot be obtained until the proposed exploration program is complete and more information is available on the grade and physical nature of the ore. The test data given on pages 25 and 26 of Docket 262 are only indicative in that ore assaying 12 or more percent zinc was used in the tests, whereas present estimates place the grade of ore at 8 percent zinc (page 20). Further, complete data concerning sink-float treatment of the coarse portion of the ore and flotation of the fine portion of the ore are not given. For instance, no data are presented on the relative portions of the crude ore that will be treated respectively by sink-float and by flotation. No information is given on the amount of "fines" that after screening will adhere to the coarse ore fraction and, therefore, enter the sink-float circuit and possibly lead to operating difficulties in maintaining the sink-float media at a constant high density. No discussion of the flotation method that will be employed is given other than the statement, a new method will be used. Without detailed test data on representative ore samples, it is impossible to estimate the grade of concentrate and recovery of zinc that may be obtained by the proposed process.

The question also arises as to the market or utility of a concentrate assaying 25 percent zinc in oxidized form. About 30 tons per day of such a zinc concentrate could be marketed to the zinc fuming plant of the International Smelting & Refining Co., Tooele, Utah. The delivered price paid for such a concentrate would be about $0.07 per pound of contained zinc. This price is considerably lower than the sale price suggested by the company (page 27). Also, this market could use only a fraction of the proposed production of the Metal Producers, Inc., From these facts it is evident that an essential phase of this proposal is the development of a market or use for oxidized zinc concentrates assaying 25 percent zinc.



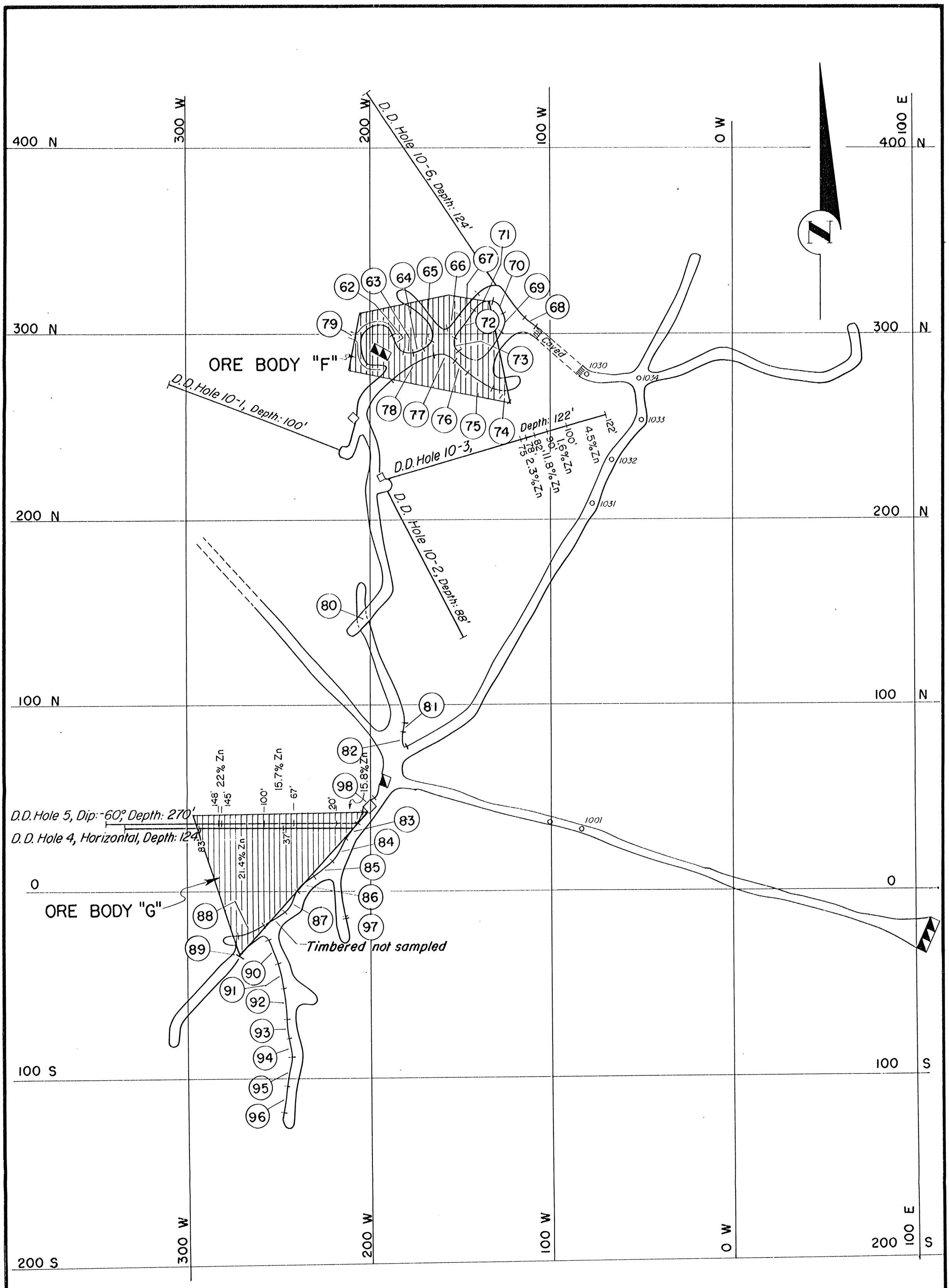
DATA TRACED FROM CO. MAP.

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Fig. 5 Project No.

Cross Section
through Winze along Line A-A'
HORN SILVER MINE
BEAVER COUNTY, COLORADO

ENGINEER:	DATE: MAR. 23, 1951
TRACED: MAR., 1951; A.P.T.S.	1500-1042-E
CHECKED:	



SAMPLE LIST					
SAMPLE NO.	LENGTH OF CUT	PERCENTAGE OF Zn	SAMPLE NO.	LENGTH OF CUT	PERCENTAGE OF Zn
62	16'	14.6%	81	8'	2.3%
63	10'	3.0%	82	8'	1.0%
64	10'	3.8%	83	10'	3.6%
65	10'	3.7%	84	16'	2.2%
66	10'	8.9%	85	14'	5.2%
67	10'	14.3%	86	12'	10.8%
68	8'	14.7%	87	12'	1.5%
69	12'	1.5%	88	12'	24.4%
70	10'	1.5%	89	14'	4.0%
71	12'	25.7%	90	13'	2.3%
72	12'	19.9%	91	14'	1.8%
73	12'	11.1%	92	16'	2.4%
74	6'	11.6%	93	10'	2.0%
75	16'	6.1%	94	11'	1.4%
76	8'	3.3%	95	16'	1.9%
77	10'	15.5%	96	14'	1.7%
78	29'	5.4%	97	2'	2.0%
79	45'	15.5%	98	8'	1.5%
80	–	6.5%			

LEGEND

ORE BODY

(35) SAMPLE NO.

NOTE

DATA TRACED FROM CO. MAP.

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

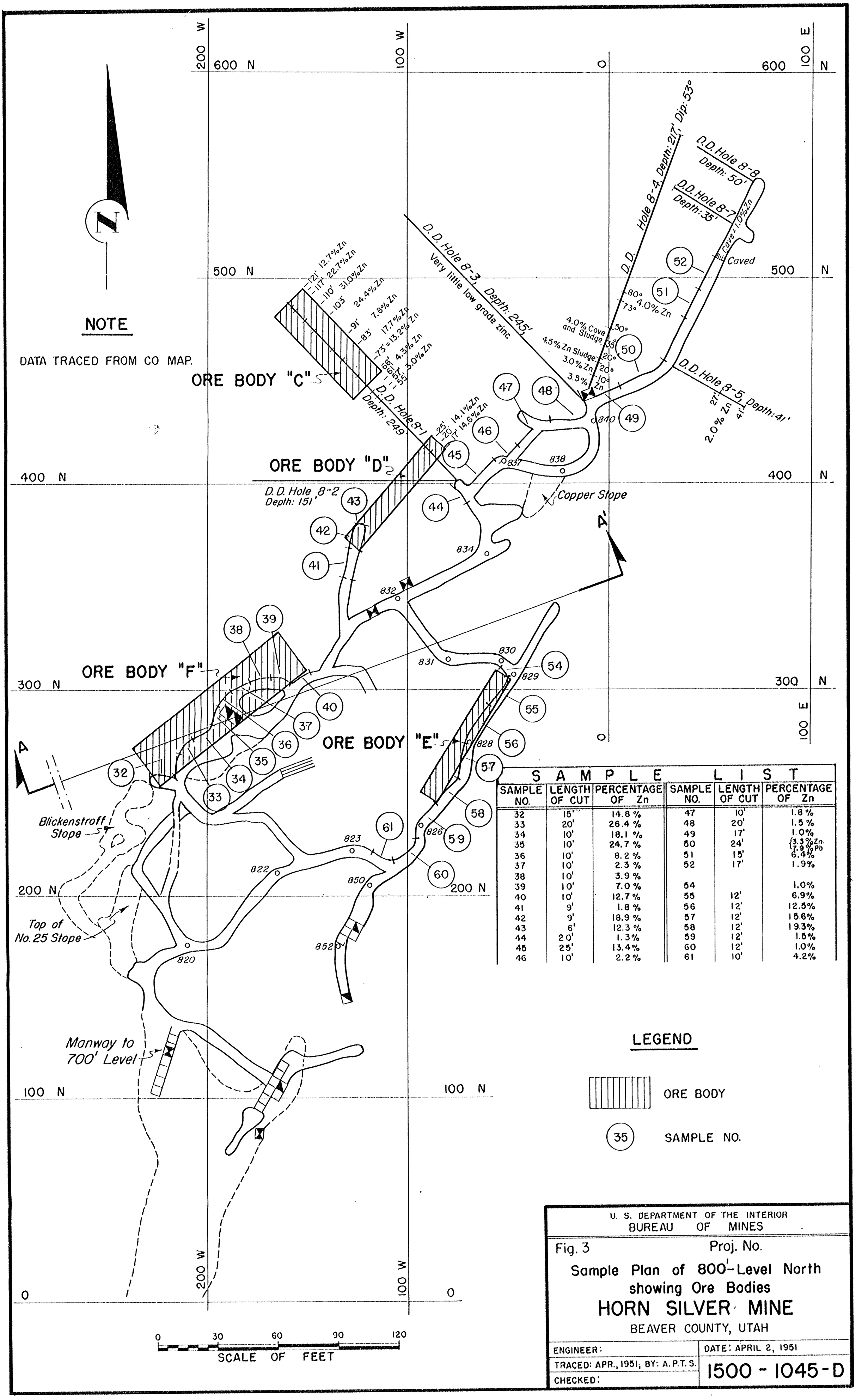
Fig. 4 Proj.

Sample Plan of 1000'-Level North showing Ore Bodies

HORN SILVER MINE

BEAVER COUNTY, UTAH

ENGINEER:	DATE: APRIL 3, 1951
TRACED: APR., 1951; BY: A.P.T.S.	1500 - 1046 - C
CHECKED:	



SAMPLE LIST

SAMPLE NO.	LENGTH OF CUT	PERCENTAGE OF Zn	SAMPLE NO.	LENGTH OF CUT	PERCENTAGE OF Zn
32	15'	14.8 %	47	10'	1.8 %
33	20'	26.4 %	48	20'	1.5 %
34	10'	18.1 %	49	17'	1.0%
35	10'	24.7 %	50	24'	{3.3% Zn. 7.9% Pb
36	10'	8.2 %	51	15'	6.4%
37	10'	2.3 %	52	17'	1.9%
38	10'	3.9 %			
39	10'	7.0 %	54		1.0%
40	10'	12.7 %	55	12'	6.9%
41	9'	1.8 %	56	12'	12.5%
42	9'	18.9 %	57	12'	15.6%
43	6'	12.3 %	58	12'	19.3%
44	20'	1.3%	59	12'	1.5%
45	25'	13.4%	60	12'	1.0%
46	10'	2.2 %	61	10'	4.2%

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Fig. 3 Proj. No.

Sample Plan of 800'-Level North showing Ore Bodies

HORN SILVER MINE

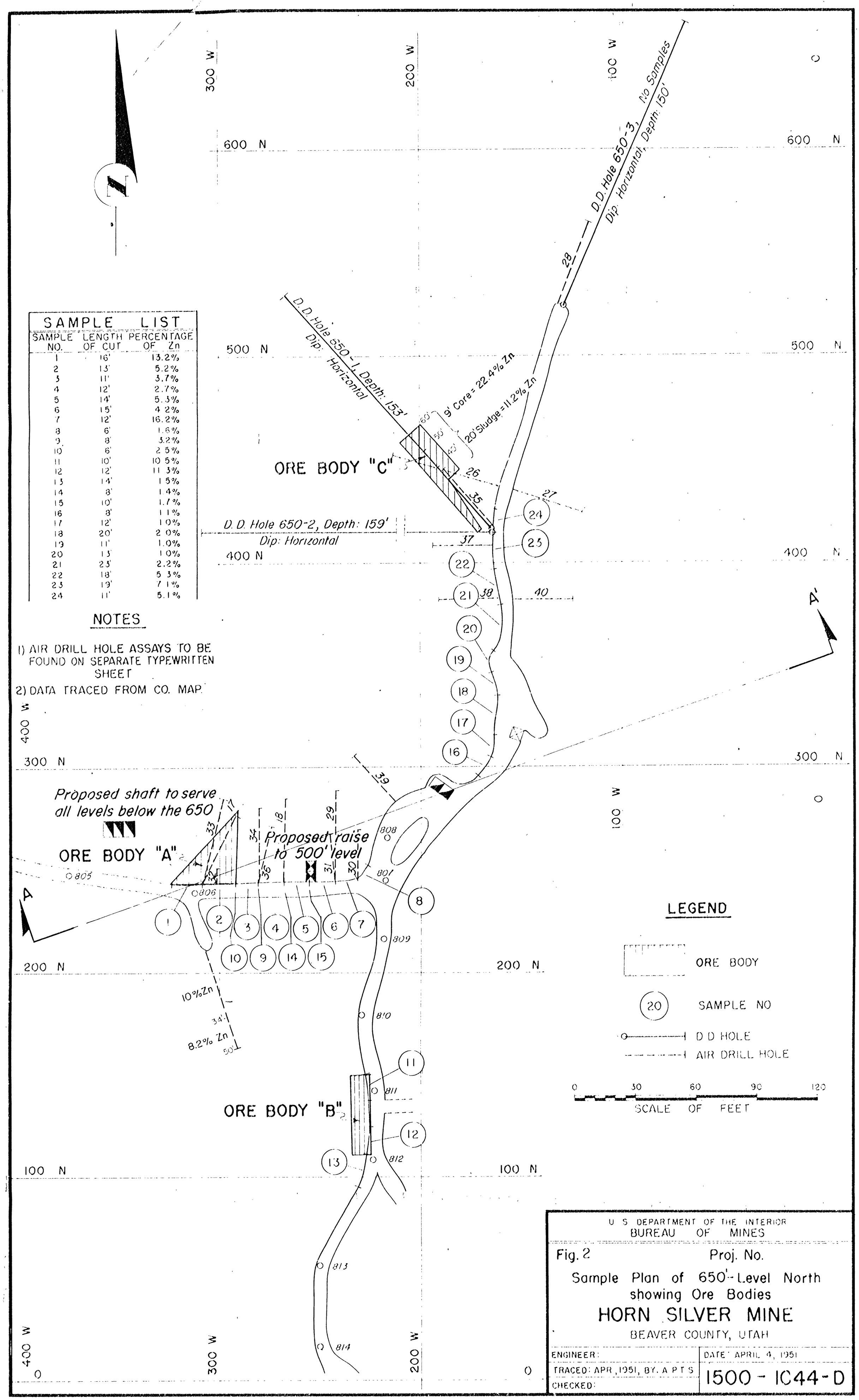
BEAVER COUNTY, UTAH

ENGINEER: DATE: APRIL 2, 1951

TRACED: APR., 1951; BY: A.P.T.S.

CHECKED:

1500 - 1045 - D



SAMPLE LIST

SAMPLE NO.	LENGTH OF CUT	PERCENTAGE OF Zn
1	16'	13.2%
2	13'	5.2%
3	11'	3.7%
4	12'	2.7%
5	14'	5.3%
6	15'	4 2%
7	12'	16.2%
8	6'	1.6%
9	8'	3.2%
10	6'	2 5%
11	10'	10 5%
12	12'	11 3%
13	14'	1 5%
14	8'	1.4%
15	10'	1.7%
16	8'	1 1%
17	12'	1 0%
18	20'	2 0%
19	11'	1.0%
20	13'	1 0%
21	23'	2.2%
22	18'	5 3%
23	19'	7 1%
24	11'	5.1%

NOTES

1) AIR DRILL HOLE ASSAYS TO BE FOUND ON SEPARATE TYPEWRITTEN SHEET
2) DATA TRACED FROM CO. MAP

U S DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

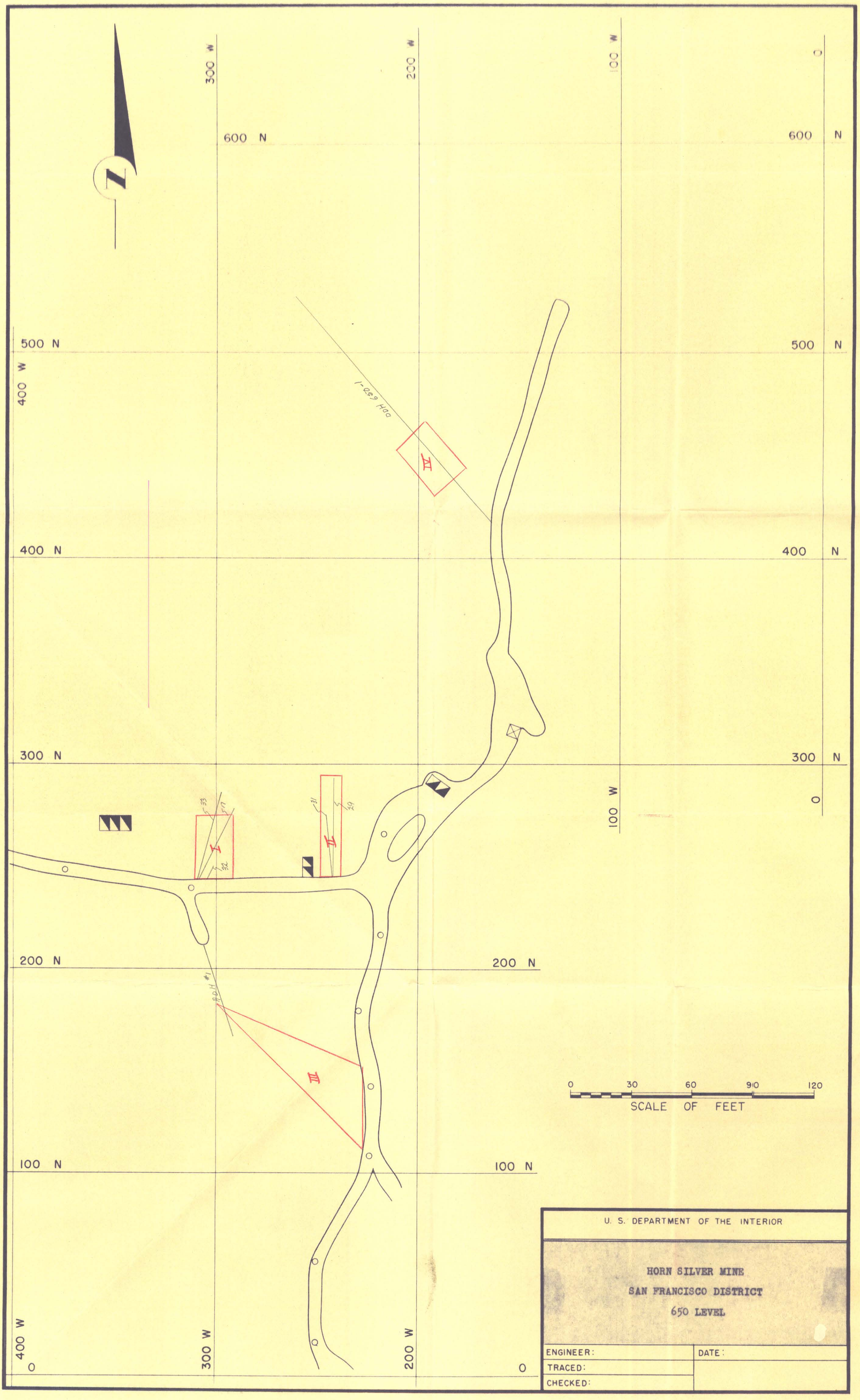
Fig. 2 Proj. No.

Sample Plan of 650'-Level North showing Ore Bodies

HORN SILVER MINE

BEAVER COUNTY, UTAH

ENGINEER:	DATE: APRIL 4, 1951
TRACED: APR, 1951, BY. A P T S	1500 - 1C44-D
CHECKED:	



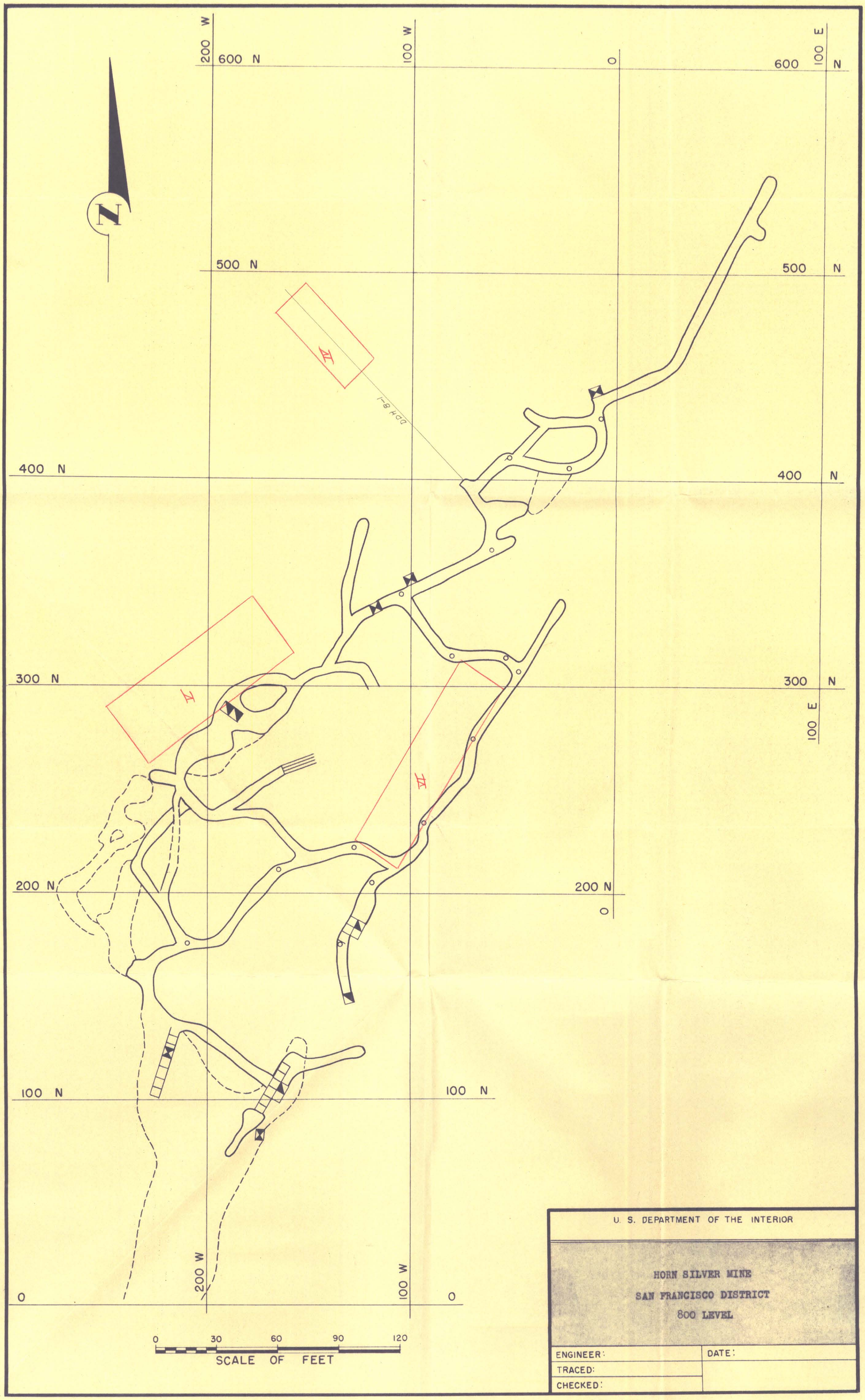
U. S. DEPARTMENT OF THE INTERIOR

HORN SILVER MINE
SAN FRANCISCO DISTRICT
650 LEVEL

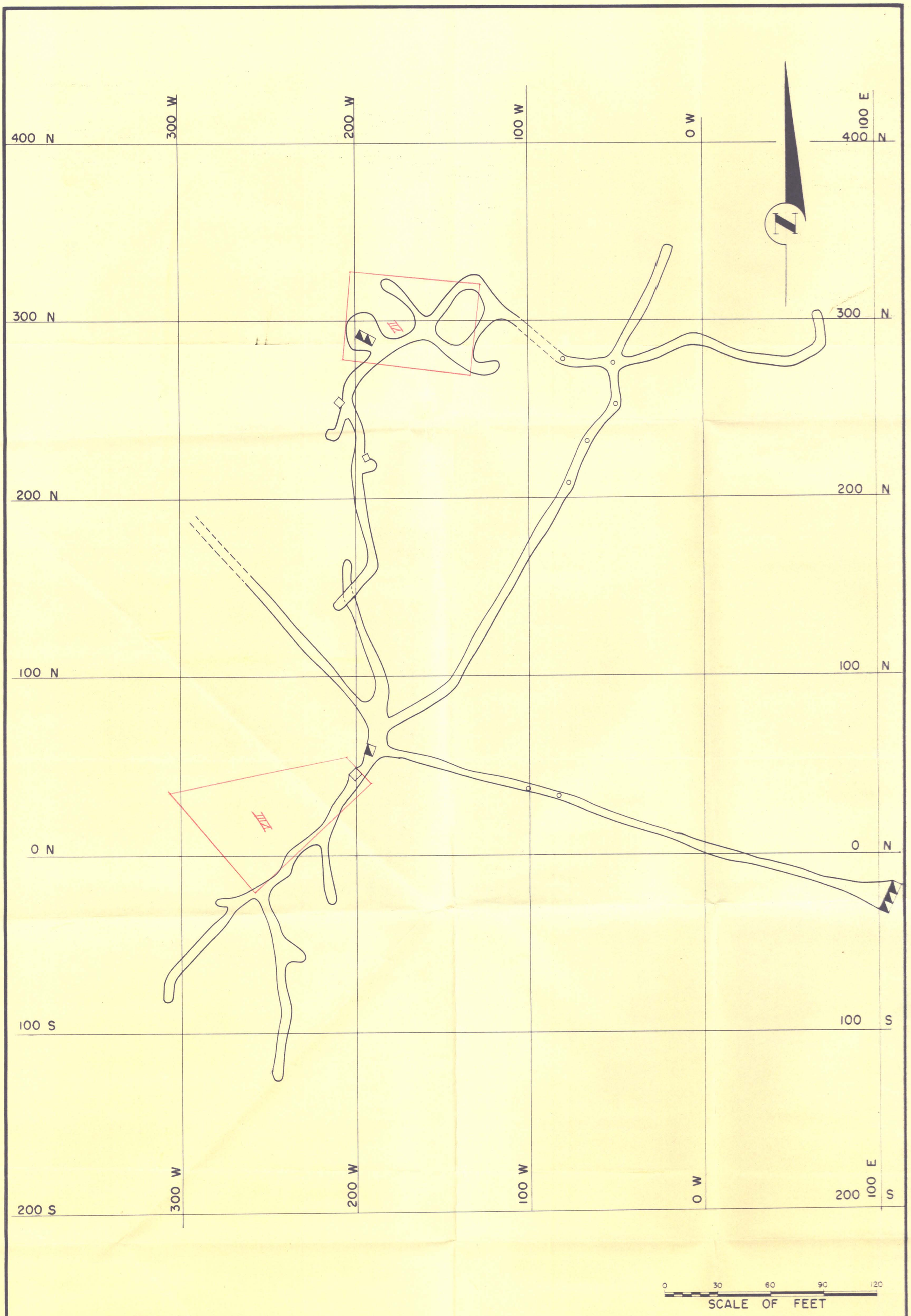
ENGINEER:	DATE:
TRACED:	
CHECKED:	

WORKING TIME HOURS BY A.P.T.S.

WORKINGTIME: 4 HOURS BY: A. P. T. S.



WORKINGTIME: 4 HOURS BY: A. P. T. S.



U. S. DEPARTMENT OF THE INTERIOR

HORN SILVER MINE
SAN FRANCISCO DISTRICT
1000 LEVEL

ENGINEER:	DATE:
TRACED:	
CHECKED:	