Geological Procedures at Nickel Plate Mine

This essay is submitted in partial fulfillment of the entrance requirements for the Third Year of Applied Science at the University of British Columbia

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Presentation 32/35
Eng 30

1966 West Third Avenue
Vancouver, B. C.
15 November, 1948

The Faculty of Applied Science
University of British Columbia
Vancouver, British Columbia

Gentlemen:

I am submitting to you this essay, Geological Procedures at Nickel Plate Mine, in order to complete the requirements for entrance into the Third Year of Applied Science as listed on page 281 of the 1948 - 1949 Calendar.

Yours very truly,

R. A. Stuart
R. A. Stuart

RAS/AOR

Index

List of Illustrations

Introduction

The purpose of this essay is to give the reader an idea of the methods used by the geological staff at Nickel Plate Mine in the various phases of mine geology. No attempt is made to describe the geology of the mine in detail, but a very general description of the main structures in the mine is given, with the hope that it will help the reader to understand why some of these methods are necessary.

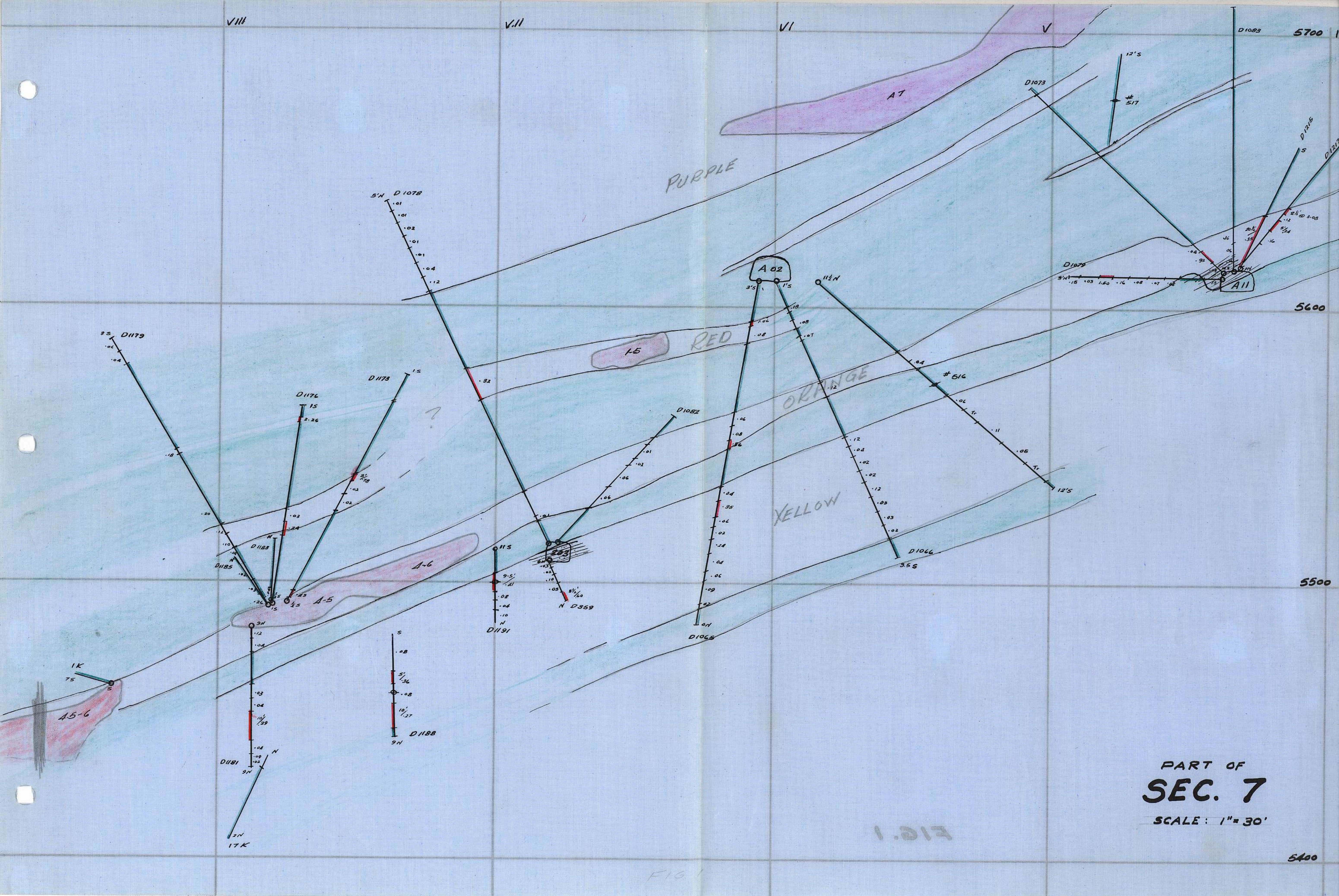
The information contained in the essay was obtained during the year from September 1947 to September 1948 while the writer was employed as mine surveyor at Nickel Plate Mine.

The writer wishes to express here his appreciation of the assistance of the geological staff of the mine, A. E Buller, E. R. Lea, and Wm. Hogg in the collection of the material presented in this essay; and of the permission of the Kelowna Exploration Company to present this material and to reproduce the maps included in the essay.

GEOLOGICAL PROCEDURES AT NICKEL PLATE MINE

I General

Nickel Plate Gold Mine is located near Hedley, B. C., in the Osoyoos Mining District. It has been in almost continuous operation since 1904 at an average rate of over 200 tons per day. The mine is situated on the Nickel Plate formation, a series of sedimentary beds striking north to north-east and dipping westerly at about 25 degrees. These beds are underlain by the Sunnyside limestone and intruded by numerous porphyry sheets which for the most part conform with the bedding, and are known as sills. The whole formation is folded in broad, gentle folds, with localized smaller folds and tight crumples, and is cut by numerous faults and dykes. One fault and one dyke are of particular importance; the fault because it offsets the ore beds, and the dyke because it is one of the main ore controls. This dyke and the porphyry sills form a framework for the ore bodies, which are usually found in the sediments near the



VIII
VII
VI
V
5700
5600
5500
5400
PURPLE
RED
ORANGE
YELLOW
A7
A 02
A11
1-5
A-6
A-5
4.5-6
D1078
D1179
D1173
D1176
D1185
D1183
D1082
D1079
D1073
D1083
D1216
D1066
D1065
D1191
D359
D1181
D1188
#616
#517
12'S
17K
PART OF
SEC. 7
SCALE: 1" = 30'
FIG. 1

intersections of the dyke and the sills.

The mine has been developed by two inclined shafts; the Dickson Incline, a 1600-foot 30 degree shaft, and the Morning Incline, a 950-foot 50 degree shaft. The geological procedures are slightly different in the two shafts and this essay considers only those used in the Dickson Incline, although the main differences in the procedures used in the Morning will be mentioned.

II Section Grids

The nature of the ore occurrences at Nickel Plate are such that the geology of the mine has always been of great importance in the discovery and efficient mining of the ore, and has, consequently, been extensively studied. In recent years however, the geology has been studied in far greater detail than ever before. The ore problem is essentially a three-dimensional one, and the geology had to be shown in three dimensions if this study was to be successful. Vertical section grids were therefore drawn up to show the third dimension.

In the Dickson Incline there are two sets of sections: the "cross" or "transverse" sections which run N37E, more or less parallel to the strike of the beds; and the "longitudinal" or "long" sections which run N53W, along the direction of the dip of the beds. (Fig. 1) These sections are drawn on a scale of 1 in = 30 ft at intervals of 25 feet, and are designed to show to best advantage the geological structures in this part of the mine.

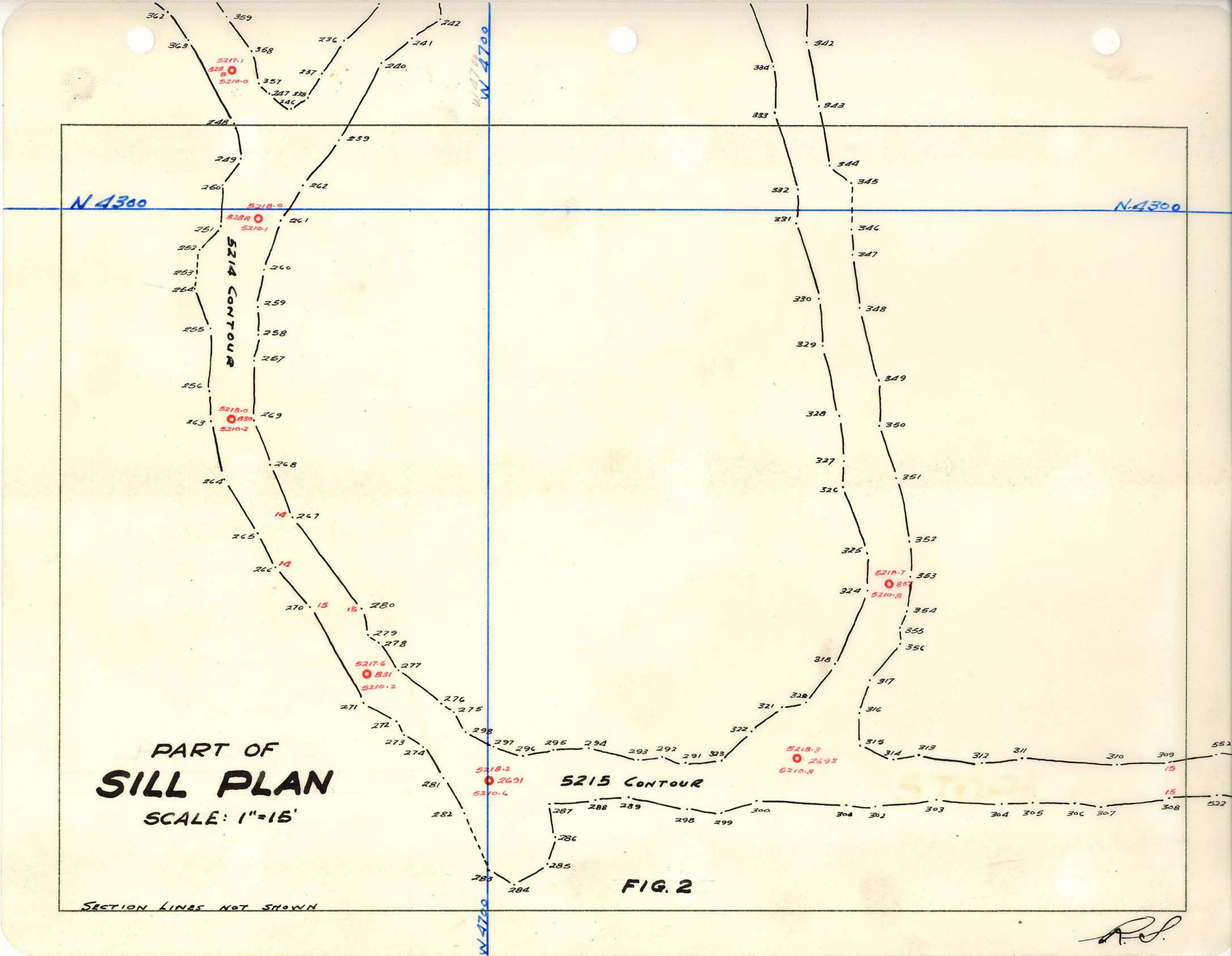
In the Morning Incline the geological picture is different from that in the Dickson, and therefore a different section grid was drawn up. The ore in the Morning is usually found in folds whose axial planes strike roughly N-S. It was felt that under these conditions the difficulty in drawing up and interpreting a set of sections parallel to the strike of these axial planes would not be justified by its usefulness. Consequently only longitudinal sections are kept. These long sections run E-W and are drawn on a scale of 1 in = 30 ft at intervals of 30 feet.

These three sets of sections have ~~paid~~ played an important part in the geological study of the mine because data obtained by mapping and diamond drilling have been correlated on them.

III Geological Mapping

A. Preliminary Surveys

At Nickel Plate Mine, levels, raises, and stopes are mapped geologically on a scale of 1 in =15 ft. Before the mapping is begun the walls are washed free of accumulated dirt and are surveyed by transit and tape with an accuracy of plus or minus one-half foot. The survey points are marked



PART OF SILL PLAN

SCALE: 1"=15'

FIG. 2

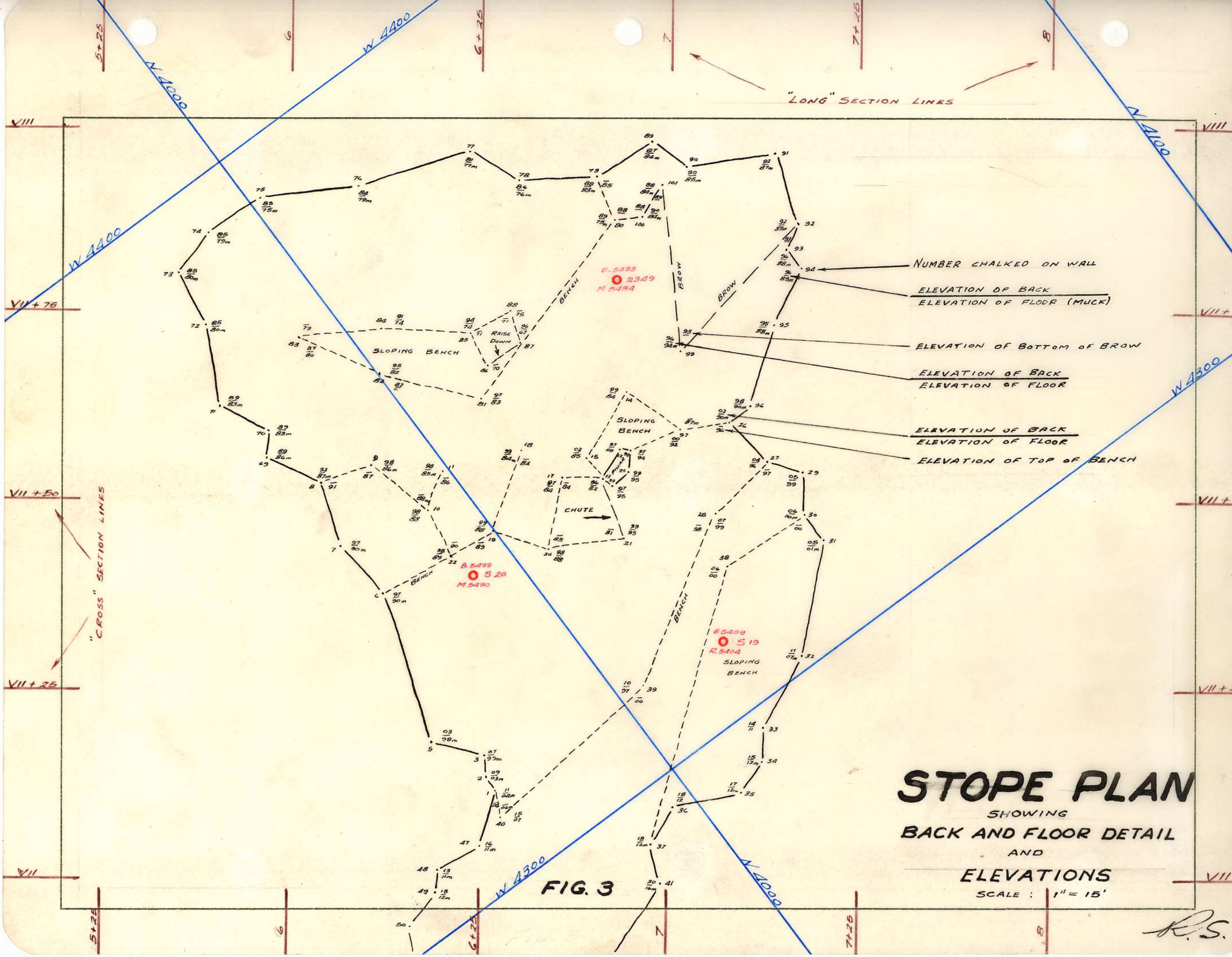


FIG. 3

STOPE PLAN
SHOWING
BACK AND FLOOR DETAIL
AND
ELEVATIONS
SCALE : 1" = 15'

R.S.

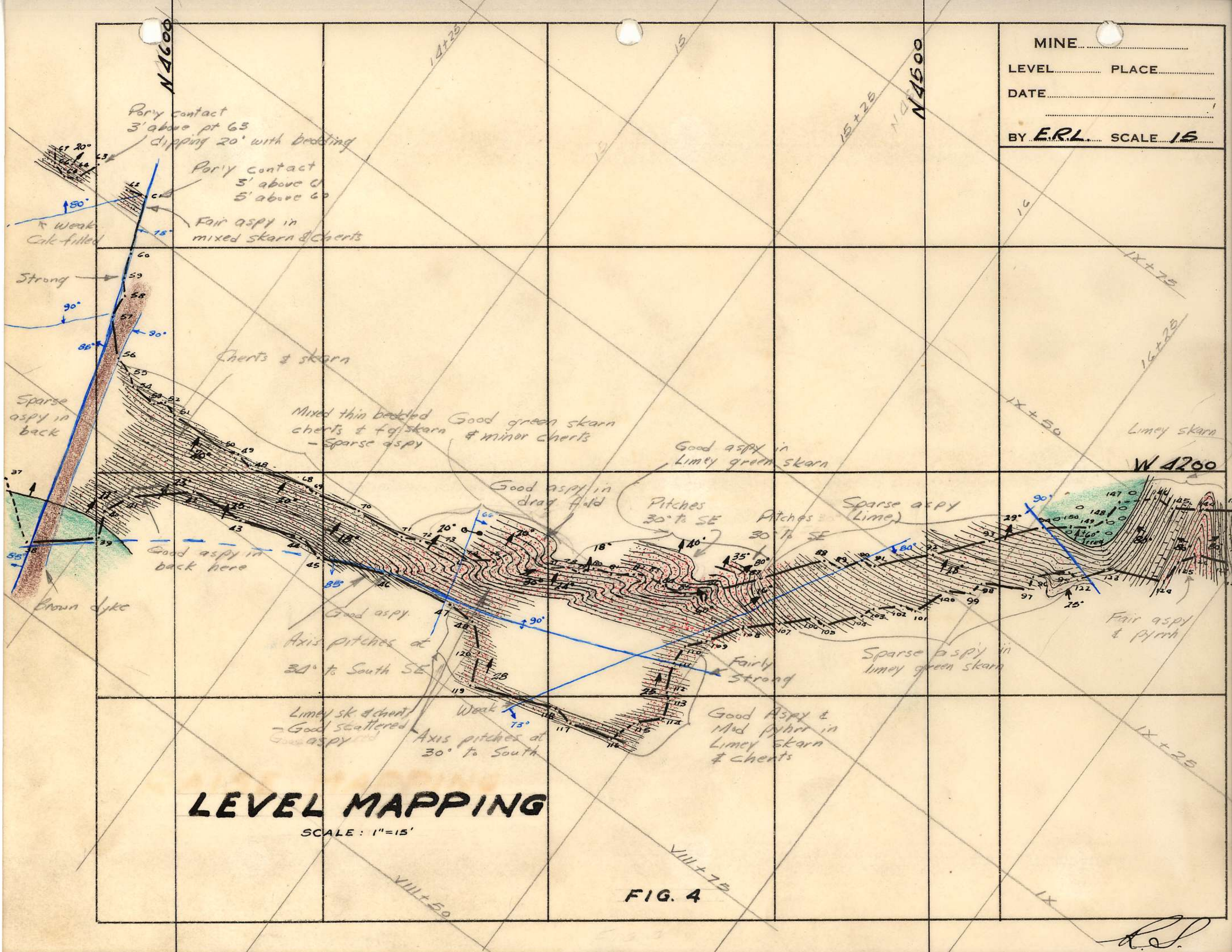
on the walls and numbered as they are surveyed; and are used as reference points in the mapping. In addition, they are used in the accurate correlation of the geological information obtained in the various parts of the mine.

On the surveys of the levels, or "sill" surveys, the points are marked on the walls at waist-height, and the elevation of the horizontal plane su defined is noted on the sill plan drawn up from the points. (Fig. 2) In stopes and raises the points are taken without regard to their height above the floor, the distance to the back and floor is measured, and the elevation of the bauk and floor at eaoh point is noted on the plan. (Fig. 3)

B. Drift Mapping

The procedure followed in geological mapping is more or less routine, although the routine varies slightly depending on whether a drift, raise, or stope is being mapped. In all cases a reconnaisance of the working to be mapped is made, and a general picture of the geological structure in the area is obtained before the mapping is begun.

In the Dickson Incline drifts are mapped in a horizontal plane at waist-height, (Fig. 4) but in the Morning Incline they are mapped in a horizontal plane at the elevation of the back. Otherwise the mapping procedures are the same in the two shafts. When the reconnaisance is completed, the faults and the contacts between sediments, sills, and dykes are plotted. Their strikes are plotted directly on the

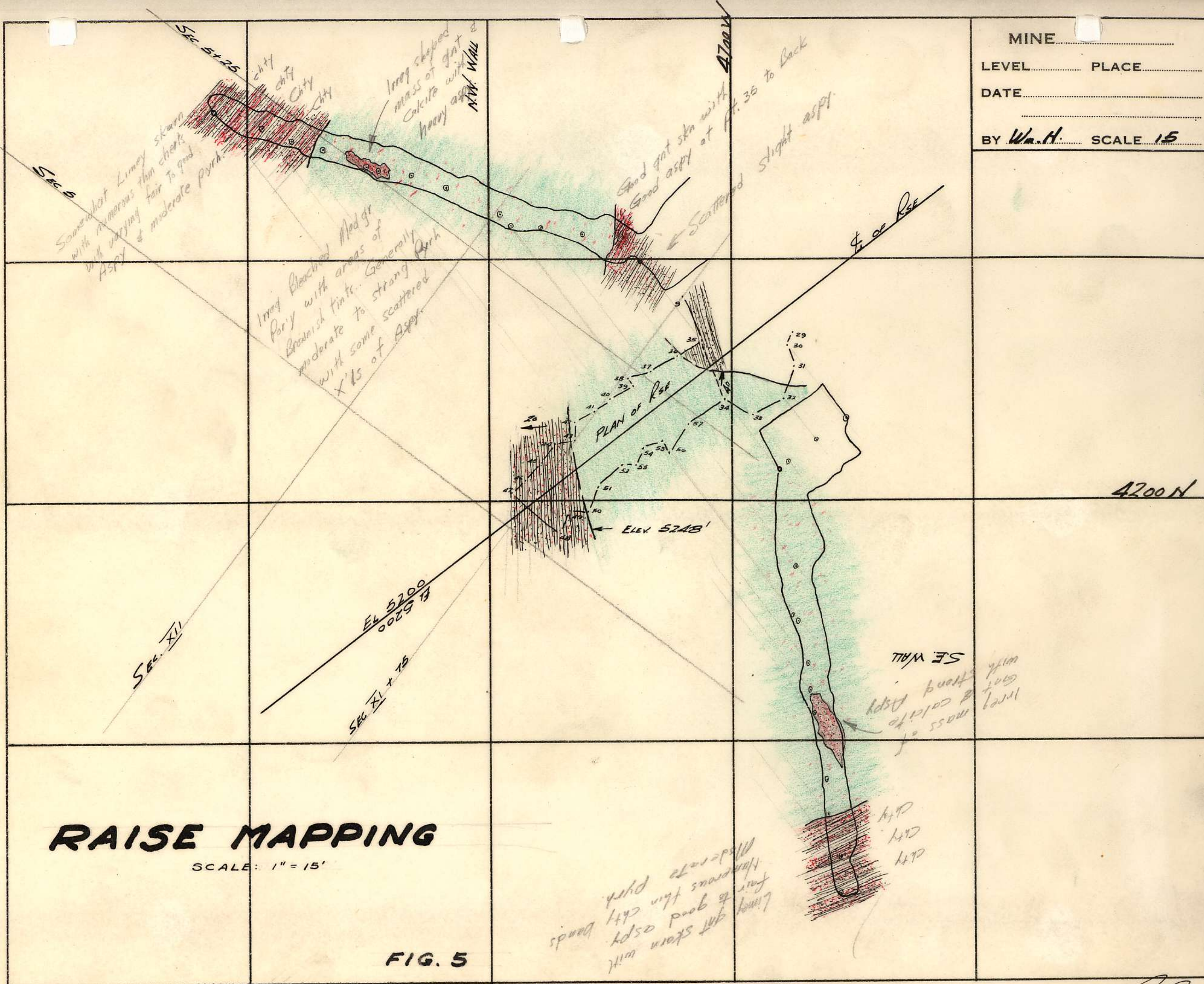


LEVEL MAPPING

SCALE : 1" = 15'

FIG. 4

MINE
LEVEL PLACE
DATE
BY Wm. H. SCALE 15



RAISE MAPPING

SCALE: 1" = 15'

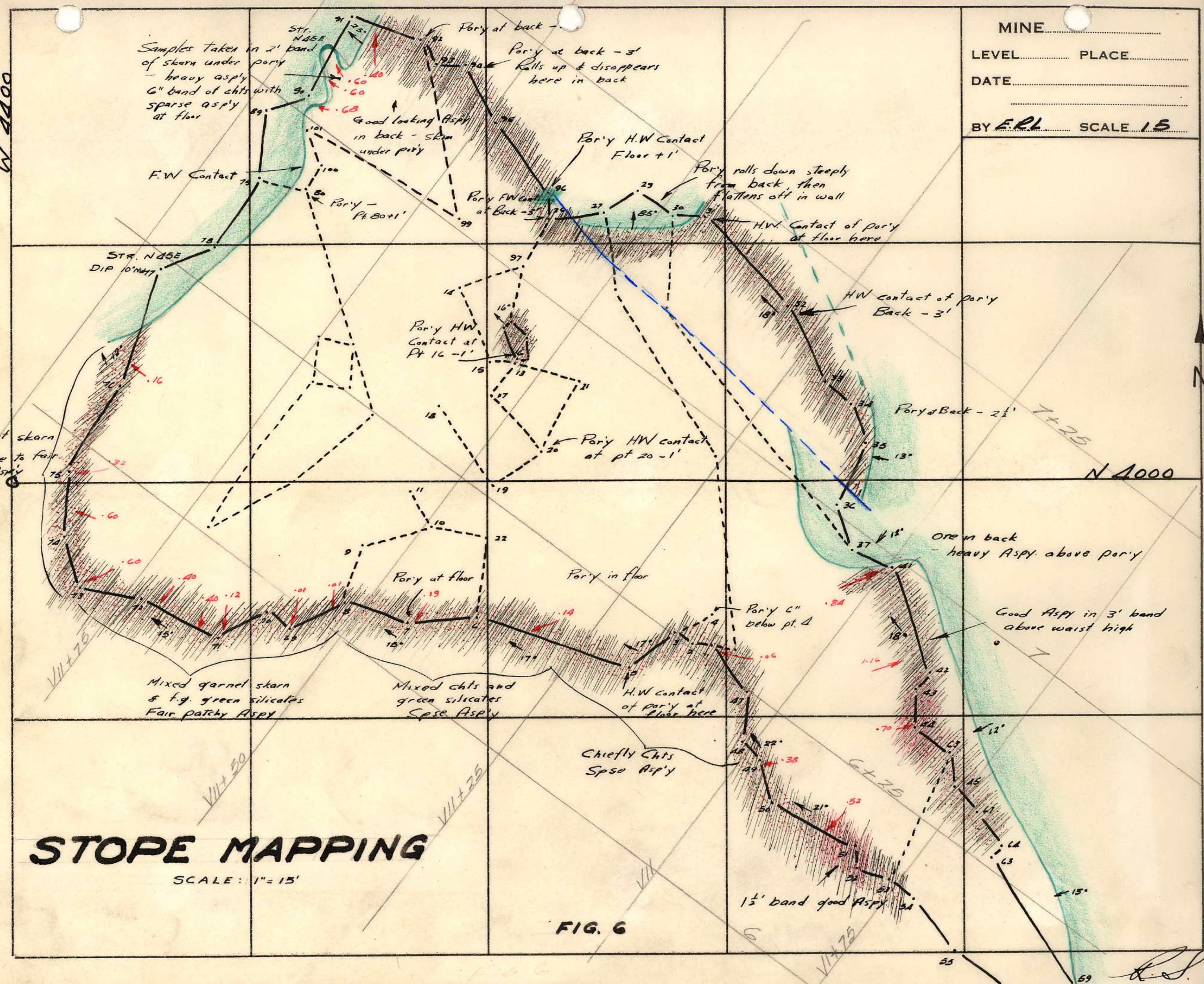
FIG. 5

work sheets and their dips are noted on them. In the case of the faults, the strength, displacement, if it can be determined, and pitch of striae, if any can be seen, are also noted. The strikes of the sediments are next plotted and their dips are noted. Finally, complete notes are made on the types of rock occurring and the type and intensity of mineralization if any. If structures are encountered that cannot be clearly and accurately represented on a plan, a detailed section of that part of the wall is drawn.

C. Raise Mapping

In raises the procedure is similar, but the mapping is done on a section instead of a plan. (Fig. 5) A section of one or both sides of the raise, showing only the survey points in the raise, is first drawn up. Later, in the raise, the distance to the back and floor at each point is measured and plotted to complete the section. The raise is then mapped in the same manner as as a drift, except that traces on the walls of the raise of faults, contacts, and strata are plotted and both strikes and dips are noted. If the raise is not too steep it may be mapped on plan also, in which case the strikes are plotted on the plan and only the dips are noted.

If, as is often the case in day-to-day mapping of new raises, no recent survey has been made, the raise is surveyed with a Brunton compass and a measuring tape before it is mapped. For this type of survey the tape is stretched taut at a uniform slope along the back of the raise and offsets are



STOPE MAPPING

SCALE: 1" = 15'

FIG. 6

taken to irregularities in the back, walls, and floor. The slope of the tape is measured with the Brunton, and the bearing is determined by a deflection angle from a known base line. A plan and section are then drawn and the raise is mapped.

D. Stope Mapping

Stope mapping is slightly different again. The geology is mapped at waist-height as in drifts, but the points used are not in one horizontal plane, and the waist-high elevation at each point must be determined from the floor elevation at that point as shown on the stope plan. (Fig. 6 and Fig. 3) As in drifts, true strikes are plotted for faults and bedding, but sometimes the traces on the stope walls of sill contacts are plotted. Where necessary to give an accurate picture of the geology, detailed sections are drawn of parts of the walls.

E. Transfer to Sections

Data obtained by this detailed mapping are plotted on the master sections. Traces on the plane of the section of all structures are shown; the apparent angles required are obtained from Lahee's table of corrections for dip in directions not perpendicular to strike. Only the part of the map that is actually cut by the section plane is plotted on the section except when important structures pass between sections. In this event the structures are projected, along the dip on the long sections and along the strike on the cross sections, to their point of intersection with the section plane.

Geology mapped on the levels is traced from the work sheets to 15-scale sill plans and pantographed to 30-scale linen plans to facilitate the transposition to the 30-scale sections.

IV. Diamond Drilling

In the undeveloped parts of the mine diamond drill holes are the only source of geological information. Diamond drill holes are divided into two groups at Nickel Plate; those which are drilled primarily for geological information and those which are drilled primarily to test for new ore or to check, and, if possible, extend the boundaries of known ore blocks.

A. Laying Out.

The laying out of a diamond drill hole requires the use of all plans, sections, and ore-bed sheets for the area to be drilled. The hole is laid out tentatively, and then is checked against known information to ensure that there is no repetition of previous drilling and that the hole will not run into mined out areas or known structures that might obscure desirable information. Where possible the hole is drilled on or parallel to a section line to avoid projection when the hole is plotted on the sections. This is important

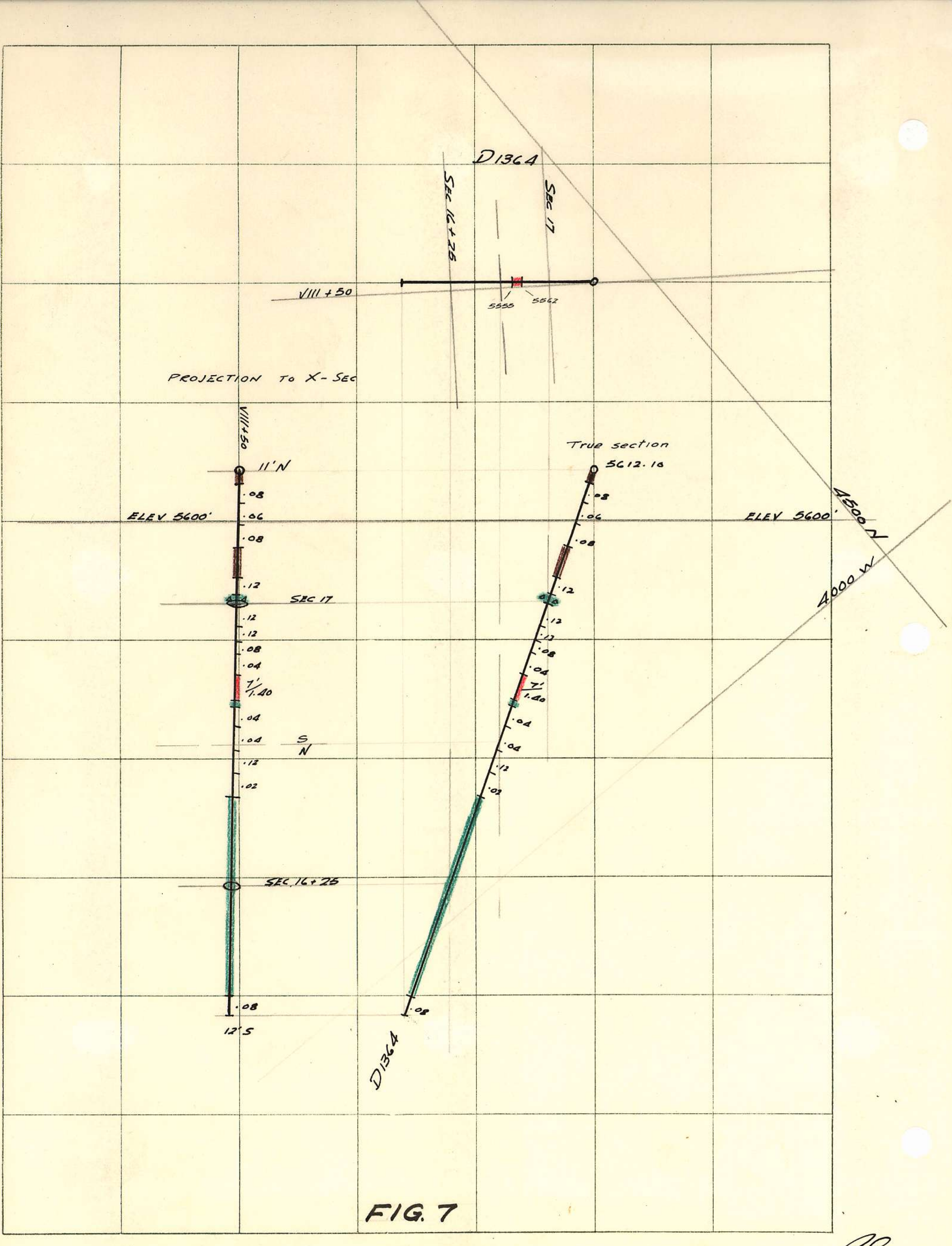

D1364
SEC 16+25
SEC 17
VIII+50
5555
5562
PROJECTION TO X-SEC
VIII+50
11'N
True section
5612.10
ELEV 5600'
ELEV 5600'
4500 N
4000 W
SEC 17
7'
1.40
S
N
SEC 16+25
12'S
D1364

FIG. 7

DIAMOND DRILL HOLE No. D1364

MINE N.P. — POSITION N. 4487.98 W 4100.73

LOCATION Adit: A06 Drift — COLLAR ELEVATION 5612.10

BEARING S39°20'W — INCLINATION -70°45'

REMARKS To test Upper & Lower Purple beds North of 1-4N. Stope

0 TO 1½		BED. ANG.	SAMPLE FROM	TO	No.	OUNCE FEET	GOLD OUNCES
	Casing						
3	Brown Dike - Lower contact ±45°.		3	8	1		.08
20	F.G. cherty siliceous seds. - Scattered			14	2		.06
	to patchy Aspy + mod. pyrrho.			20	3		.08
	Bedding 70° @ 4½' 50° @ 9½' 40° @ 15'.						
28	Brown Dike - Upper & Lower contacts		28	32½	4		.12
	irreg. & indef.						
32½	F.G. siliceous seds. - fair scattered Aspy		35	41	5		.12
	+ pyrrho. - no beds.			45	6		.12
35.	Chert Breccia - sp'se pyrrho.			48	7		.08
41	Mixed cherts & f.g. green silicates			54	8		.04
	- fair scattered Aspy - sp'se pyrrho.			61	9	7' / 1.40	1.40
	Bedding ±60° @ 38'.						
45	F.G. cherty seds - Sp'se Aspy - no beds.		62½	68	10		.04
48	Med. gr. limey skarn - fair to good			74	11		.04
	Aspy. - no beds.			80	12		.12
54.	F.G. Siliceous seds. - sp'se Aspy.			87	13		.02
61.	Mixed f.g. siliceous seds + limey skarn						
	- fair to good Aspy - scattered. - bedding		140½	146	14		.08
	obscure.						

FIG. 7

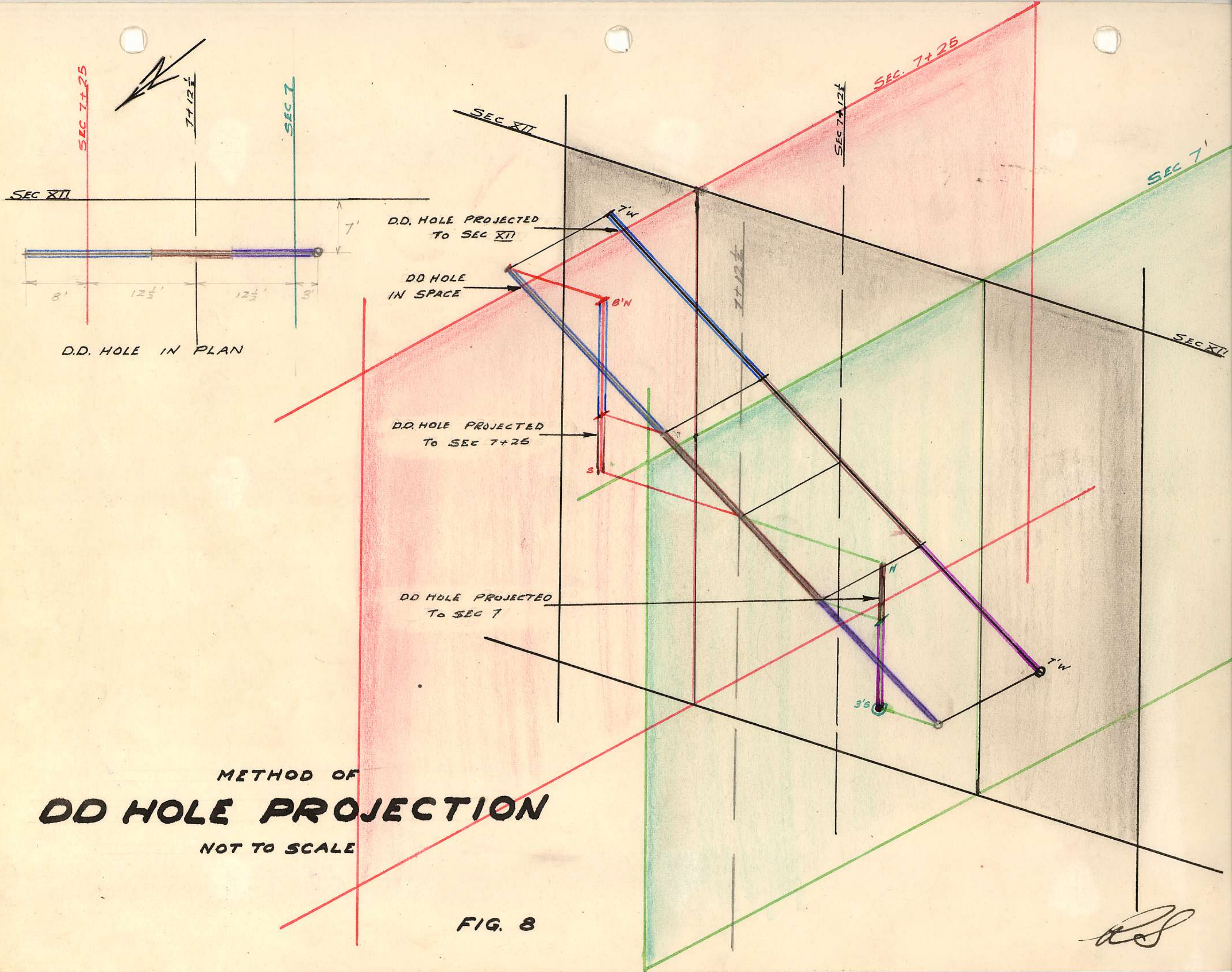
SIGNED E.R.L. — HOLE No.

~~because~~ as projections have been found to be unreliable in many cases because of the generally complicated nature of the ground. The dip of the hole is determined by the elevation of the collar and the elevation at which the hole is required to intersect given section planes. Where other factors permit the dip is chosen so that the hole is perpendicular to or sharply cross-cutting the bedding.

When its position is finally determined, the hole is laid out underground with a Brunton by deflection angles from a known base line, usually two survey stations.

B. Logging and Plotting

As the hole is drilled the core is logged and a 30 - scale plan and true section of the hole is drawn.(Fig. 7) When the hole is completed it is surveyed, and plotted on a 30-scale hard plan of the level from which it was drilled. The plan of the hole from the log is then placed coincident with the plan on the hard plan, and the coordinates and section lines are traced to the log plan. The hole is then projected to, and plotted on, the master sections. If the hole is parallel to a long section line the true section from the log is transferred directly to the nearest long section, and projections are drawn for the cross sections through which the hole passes. Similarly, if the hole is parallel to a cross section line its true section is transferred directly to the nearest cross section, and projections are drawn for the long sections. If the hole crosses both sets of section lines it



METHOD OF

DD HOLE PROJECTION

NOT TO SCALE

FIG. 8

must be projected to both sets.

The projections are made horizontally, and the distance from the section of each end of the hole is noted on the section. (Fig. 8 and Fig. 1) When structures are drawn on the sections from information in the holes, allowance is made for the distance off section of each part of each hole, and the information is projected along the dip or along the strike of the structure to its proper place on the section.

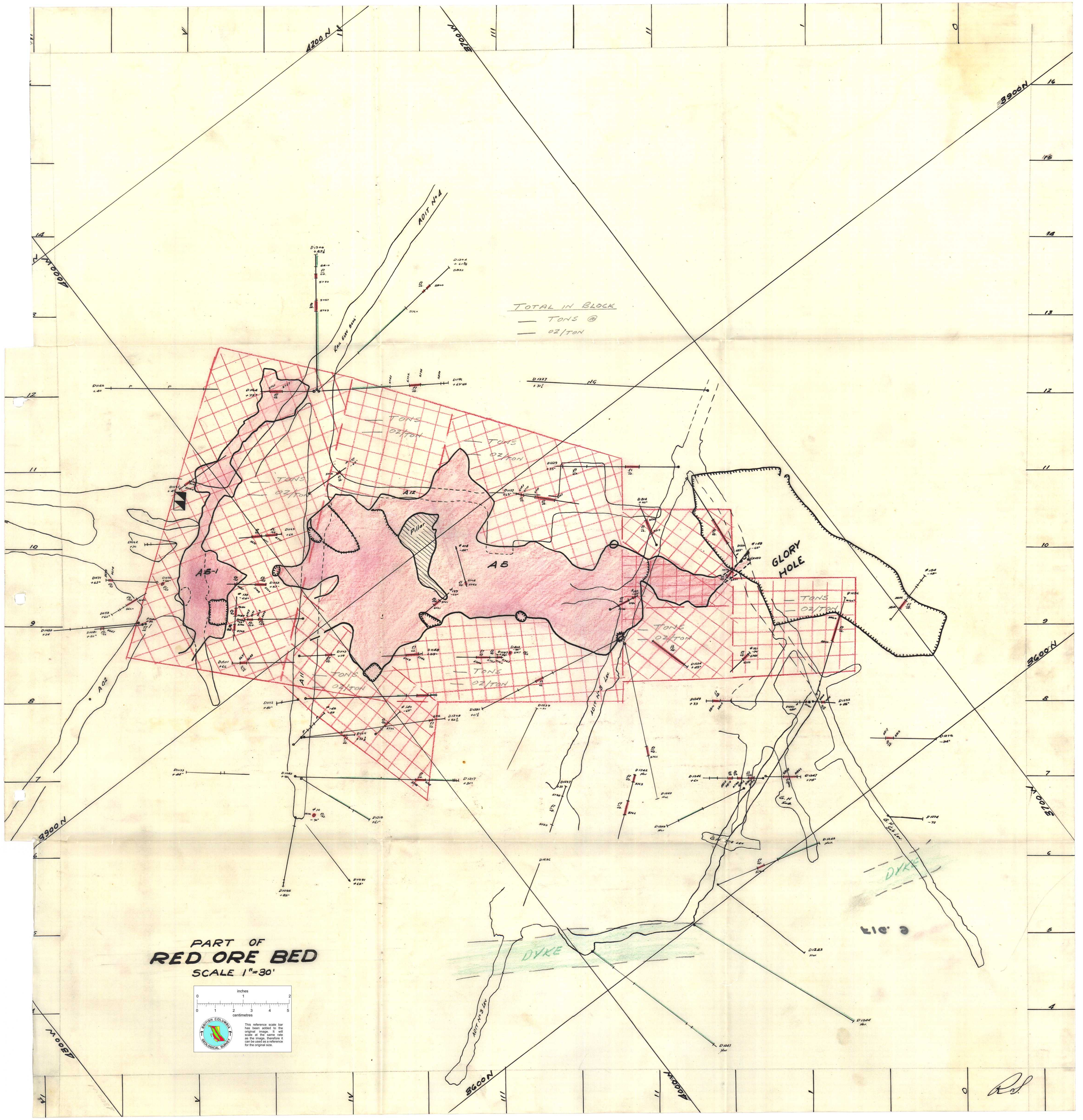
V. Applications

A. Ore-bed Sheets

An important use of the known geology of Nickel Plate Mine is in the preparation of ore-bed sheets. (Fig. 9) Ore-bed sheets are used mainly for determining and showing ore reserves, but they are also used, in conjunction with plans and sections, for laying out diamond drill programs in favorable areas.

The ore beds occur in the sediments between the porphyry sills, and are designated by colors: Upper Purple Bed, Lower Purple Bed, Red Bed, etc. An ore-bed sheet is kept for each of these beds in order to avoid difficulties in interpretation due to the overlapping of the beds. The sheet for each bed is revised every year to show the total ore reserve in that bed.

Each ore-bed sheet is built up from a plan of all

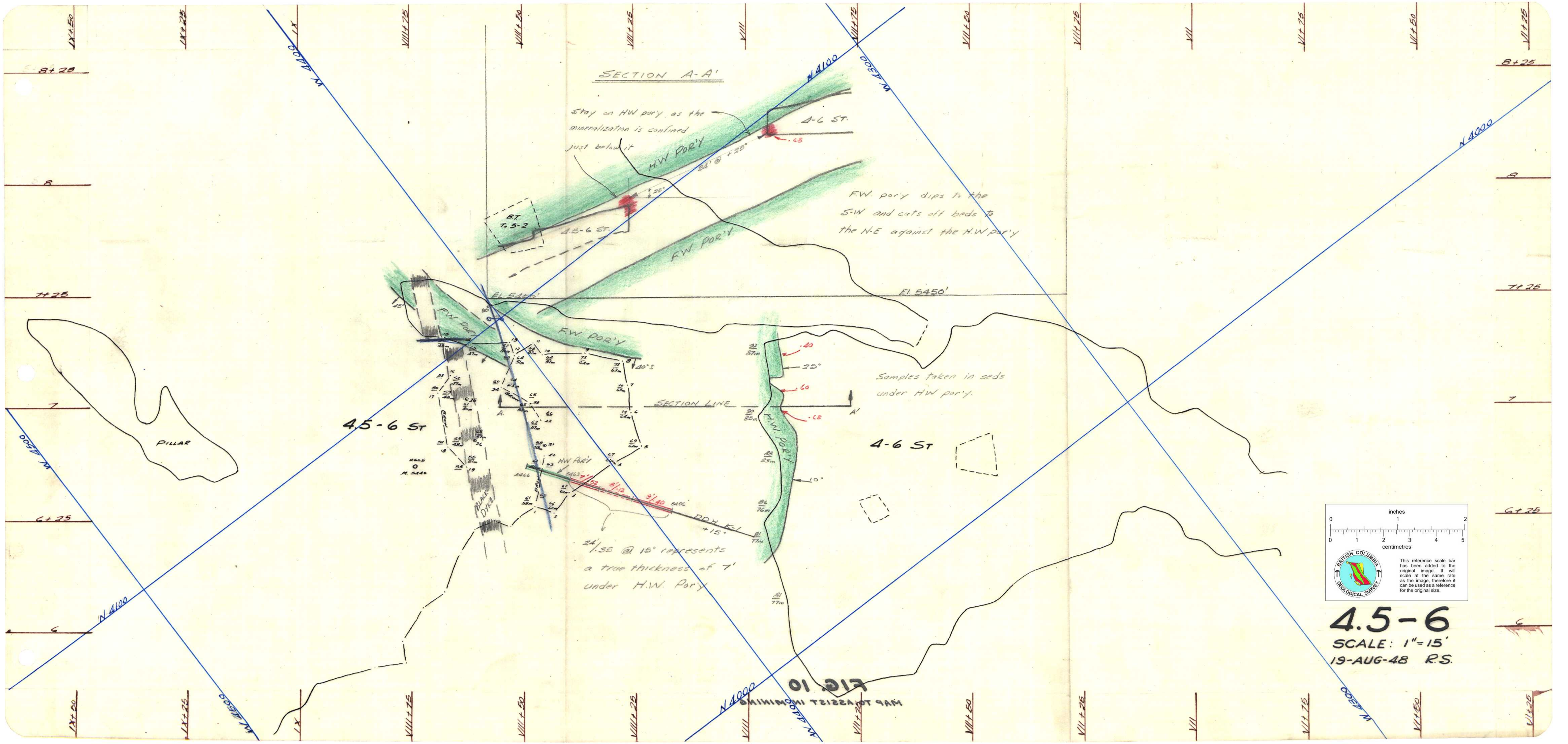


PART OF
RED ORE BED
SCALE 1" = 30'

stopes and diamond drill intersections in the bed. Any ore intersections in the diamond drill holes are marked with the length of the intersection, the grade of the ore, and the elevation of the hanging wall and foot wall of the ore. Ore reserves are blocked out on the basis of these ore intersections. The number of intersections required to block out an ore-body depends to a large extent on knowledge of the steadiness of values, etc., gained in the mining of adjacent ore blocks in the same bed. The volume of each ore block is calculated from the width of the ore block as shown on the ore-bed sheet, and the length and thickness as shown on the sections. The tonnage is then determined from the volume, on the assumption that ten cubic feet of unbroken ore weigh one ton. The grade of the ore block as indicated by the diamond drill intersections is calculated, and the ratio of calculated grade and actual mined grade of ore from stopes adjacent to the block is determined. From these two factors the overall grade of the block is determined. If the ore block is large it is divided into smaller blocks to assist in this determination of the grade.

B. Mining

The known geology of the mine is also very useful in the actual mining of the ore. The geological department, in cooperation with the mining department, makes frequent examinations of stope and development faces as they are advanced. Any geological irregularities in the path of the


SECTION A-A'
Stay on HW por'y as the mineralization is confined just below it
H.W. POR'Y
4-6 ST.
4.5-6 ST.
B.T. To 5-2
F.W. POR'Y
F.W. por'y dips to the S-W and cuts off beds to the N-E against the H.W. por'y
El. 5450'
F.W. POR'Y
SECTION LINE
A
A'
4.5-6 ST
4-6 ST
PILLAR
Samples taken in seds under H.W. por'y.
H.W. POR'Y
HW Por'y
BLACK DYKE
DDH K-1 +15°
24'/.35 @ 15° represents a true thickness of 7' under H.W. Por'y
N 4100
N 4000
W 4500
W 4400
W 4300
4.5-6
SCALE: 1"=15'
19-AUG-48 R.S.
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
BRITISH COLUMBIA GEOLOGICAL SURVEY
inches
centimetres

advance that are liable to cause difficulty in the mining are made note of, and the information is passed on to those in charge of the mining. In some cases a map of a recent survey of the working, showing the principal geological features in plan and section, is drawn up for the mining department. (Fig. 10) On this plan and section the irregularities are explained as simply as possible.

The geological studies carried on at Nickel Plate Mine may be considered by many to be much too detailed and expensive. However, these studies are largely responsible for the mine reaching and maintaining an excellent position, both in production and reserves, after once having been considered a worked out mine.