Cruising and Mapping, to put a large holding under Sustained Yield, as performed by a Consultant Forestry Firm

By

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[redacted]

Professor of Forestry ~~Engineering~~

2 copies
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INTRODUCTION

With the passing of time and the reduction of our stands of virgin timber, more and more companies have realized that if they are to stay in business they must do something to insure themselves a continued supply of merchantable timber. The acquisition of new lands is becoming more difficult and the purchase of government timber incurs bidding on a highly competitive market. Because of this the lumber industry is realizing that unless they wish to purchase timber from a continually tougher competitive market, they must begin to practice forestry themselves; that is, they must put their lands on some sort of sustained yield, so as to insure a continued supply of timber.

Many logging companies, even the larger ones, do not carry a staff capable or complete enough to undertake an operation of this sort. Hence they must secure the services of someone skilled in this line. The company with which this report is concerned sought the services of a consultant forestry firm. It was thought that this would prove satisfactory and less expensive than if they composed a staff themselves to undertake the job.

This report will show how the consultant firm went about securing the information that the company desired. To present this material clearly the report will be divided into three parts, discussing in order: the preliminary reconnaissance and field work; the actual job, and the report turned over to the company. It is not intended to be a study of inventory and mapping methods, rather it is a comprehensive review of all that was necessary to actually perform

the job. Since it reports on an actual case, for the protection of the landowners, any names or land designations used are fictitious.

PART I

GENERAL DESCRIPTIVE INFORMATION

To enable the reader to more readily understand the problems encountered on this job, a few words will be given to describe the company holdings.

The Area

The company owns approximately 18,000 acres of land which are contained in one township of extremely rugged country in the Cascade Mountains of Oregon. Most of the land not owned by them is cutover or burned over land. Any of the lands with timber on them have been spoken for and they are included in the company's long range cutting plans. The land ranges in elevation from 1800 to 5000 feet, the higher portions of which are rocky bluffs. A very extensive drainage pattern divides the land into definite units, but to the cruiser going in for the development of a road system, this is a great hindrance.

Development

Roads built for year round use have been constructed up the main stream canyons, and in the more gentle central portions of the land these roads have been extended to the ridgetops. In some of the area the road network is so extensive that the crews could drive to the starting points; whereas in others up to two hours had to be used in walking to this point. One section was so remote that it was decided to camp out for two weeks to cover this ground.

Timber

This area, though extremely rugged, contained some of the finest stands of old growth Douglas-fir left in the Northwest. Douglas-fir is the principal species, but enough hemlock, cedar and various white firs

were present to merit coverage in the report. Decay in the area is very prevalent, so much so that about 50 per cent of the timber should be considered cull. Even with this large rot factor and the usual breakage per cent, the lands still netted about 50,000' B.M. per acre over the entire timbered area. For the most part the trees were old growth, with a few scattered second-growth and pole stands. Individual trees were as large as 90 in. D.B.H. and eight 32' logs tall. The average would be a 52" D.B.H., five or six log tree.

INITIAL RECONNAISSANCE

Before any work could be done on the project all available information had to be gathered. Because of the relative remoteness of the area, few maps had been made of it. The only one with reliable accuracy was a United States Government aerial survey map on a scale of two inches per mile, with a 100 foot contour interval. From various state, county and federal land offices it was possible to get some information on the various section and township lines. The South township line had been run and permanent hubs had been established at each section corner and quarter corner. Some confusion was entailed here, as this South boundary line was about three-eighths of a mile off of the North boundary of the North line of the next township. Some reliance could be had in the corners and lines run by earlier cruisers.

On the entire area as a whole, there had been two cruises run, one in 1895 and the other in 1921. On some smaller areas more recent cruises had been run. One of the reasons for running a cruise of the intensity chosen was because of the wide discrepancy in the values arrived at in the two earlier cruises.

With all the available data before them it was then possible to

formulate a general plan and inform the company as to the fee that would be charged, so that they could place any restrictions on the work they felt necessary in order to stay within an operation budget. The fee decided on was a basic $50.00 per working day charge plus all the operation expenses incurred during the day.

From the map and all information gathered it was possible to make a fairly accurate reference topographic map. All new cultural improvements were placed on the map, as well as an outline of all the cutover lands. This information was gained from recent aerial photos. Each crew carried one of these maps for reference as well as any available aerial photos. A study was also made of the old cruises and with some growth checks it was possible to b r ing these up to date. This information helped to formulate a local volume table and later served as a reliable check to the accuracy of the cruising.

PRELIMINARY FIELD WORK

While the above mentioned work was being carried on, other men were gathering material and performing tasks that would put the area in readiness for the actual job. This was the compiling of a local volume table and the running of control lines to which the cruise and map strips could be tied.

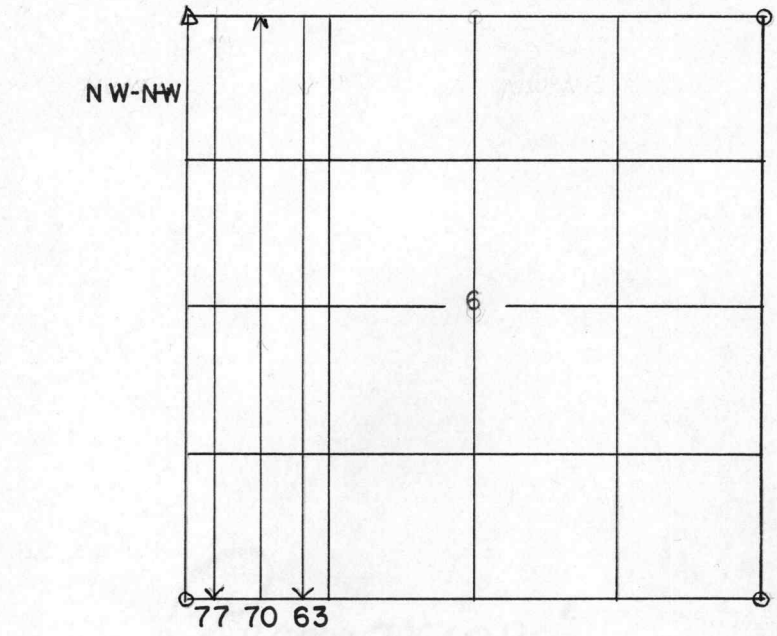
The Local Volume Table

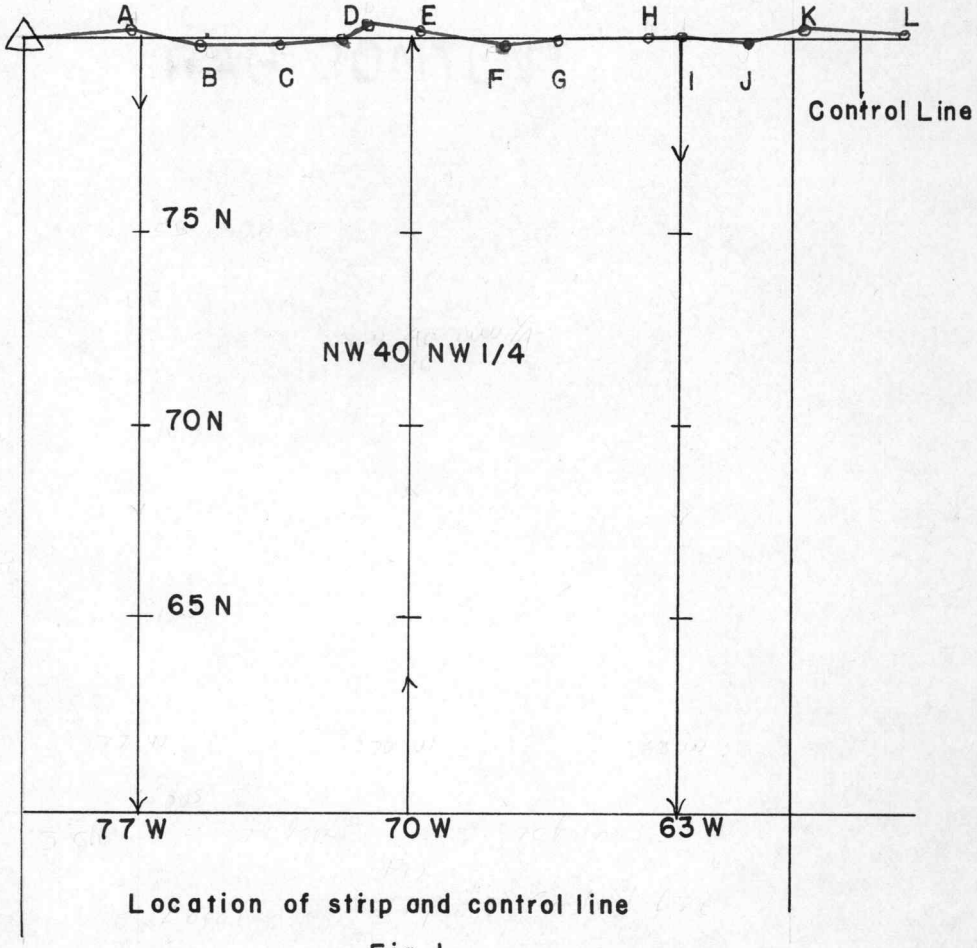
The information found in the earlier cruises that were run helped considerable in the making of a volume table for the area. Along with this, measurements were taken of windfalls, down timber in recently cut areas both on the company land and on adjoining lands. The results of the woods scale were checked with the mill scale and the table itself was based on the actual mill recovery of wood. The

site classification was considered to average No. III. From the above material a local volume table was constructed based on the D.B.H. and the number of 32 foot logs the tree contained. From a careful study of taper the volume of each log was determined and the volume table noted this, along with the total volume of the tree. This was done for the Douglas-fir only. The hemlock, cedar, white fir and second-growth on the area by diameter classes only. A uniform height was assumed for each diameter.

The Control

Before the work could commence, a network of control lines had to be laid down. All of the control lines were tied together so that a uniform elevation could be had. To get this elevation, the control had to be run in several miles from a United States Geological Survey benchmark. When at all possible this line was run with its axis parallel to the ridges and streams. This was so the cruise could be run across the drainage -- a more accurate method. In the beginning these lines were run down the centers of the sections, but later this was found to be unnecessary as sufficient accuracy could be gained by running the lines down the section line. Figure 1 illustrates the strip and control layout.





Location of strip and control line

Fig. 1

The line itself was run by a transit crew, using a steel tape. Rather than following the Section line, the line was of the meandering type and followed the line of least resistance though never getting off more than 100 feet. A station was established at each turning point. This was a wooden stake with hub tack. A tree was blazed on four sides and lettered alphabetically, i.e. (A, B, C - X, Y, Z, AA, BB, etc.). Stationing was begun anew at each Section line.

After running this line, the crew would plot their course on a sheet on which the true section line was also shown. This was necessary because of the many misshapen sections in this township. Few were of the conventional 80 chains square type.

Much of the area was covered in the above mentioned way, but later it was decided that the added expense for such high accuracy was not necessary, and besides the cruising parties continually caught up with the control work. To do faster work and still maintain close accuracy a crew was set up that made use of a staff compass for direction, and two Abney levels for vertical control. A steel tape was used for measuring. With this system the control crew set the cruising strip starting points.

METHOD OF MAPPING AND CRUISING

Cruising

The plot system was considered for this job, but because of the nature of the terrain it never seemed applicable and so it was decided to use the strip method. The cruise itself sampled 10 per cent of all trees over 16 inches D.B.H. to a 12 inch top. This was accomplished by running three strips, 44' (2/3 chain) across each

"forty" (Figure 1). These strips were spaced seven chains apart. The first strip in each section would be 3 chains in, and the last would be 77 chains, meaning that there was only 6 chains between the last strip of one section and the first of the next section. This was done so that the spacing between strips would be an even distance and thus easily plotted on the maps. Very little confusion resulted from this practice. As each strip was run each tally or 5 chains would be referenced. A new innovation was used in doing this. A tree was blazed on four sides, but instead of writing the location with keel on the tree, an aluminum tag (Figure 3) was attached to the tree, which would serve as a more permanent marker. This could be used later in check cruising, by road locating crews, or during the actual harvesting and would serve as excellent guides for forming cutting lines.

Mapping

To assist in planning future operations a detailed topographic map was desired. This map was to be field drawn on a scale of 16" to the mile. To facilitate matters each map sheet would show the 3 runs through each two forties in line. This would allow the mapper an easier job in tying the contours together. The map was to have a 25 contour interval and show all detail such as streams, roads, rock outcrops and cultural improvements. The horizontal control was to be carried with a steel tape, while vertical control and slope connection was to be taken from a single Abney level reading.

TIMBER CRUISE TALLY

Tier 11S
Range 1E
Sec. 6
40 NW-NW

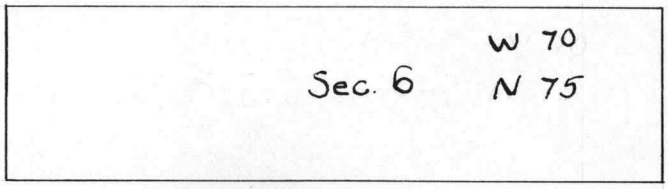
Strip 77W Run S Chains 20ch
" 70W " N " 20ch
" " " "
" " " "

Plot Size 44'
" Acres
Tbr. "
Factor
Tbr. Type O.C.

Cruise by RNN
For Highball
Owner H
Date 7-23-47
Sheet 1 of 1

STRIP NO.	PLOT NO.	Sp.	Dia.	Lg	NET VOL.	CULL VOL.	Net hem	Vol. ced	STRIP NO.	PLOT NO.	Sp.	Lg.	Dia	NET VOL.	CULL VOL.	Net hem	Vol. ced
		D.F.					2				D.F.						
77W	75N	F	52	4	—	35	41		70W	60N	F	52	4	—	35	18	26
			44	4	—	25	25									48	7
			36	4	—	20	4									18	2
			48	4	30	(-223)	8									18	9
			52	4	35											13 4	4
			44	4	25											13 18	7
			64	5	60											4 2	7
			36	3	15				70W	65N	F	52	4	19	16	2	3
			40	4	20	(-233)						44	4	—	23		
			48	4	30												
			52	4	—	35			70W	70N							
			60	5	—	55											
			32	3	10												
77 63W	70N	F	40	4	~~20~~ 9	11	2	9									
			48	4	30		4	4									
			64	5	—	60	4	16									
			76	5	80	(2-233)	4										
			40	3	—	20	2										
77 ~~63W~~	65N	F	64	6	70												
			48	4	—	30	4	4									
			52	4	—	35	4	35									
			56	5	—	50	4										
			60	5	55		2										
			68	5	65												
77 ~~63W~~	60N	F	68	5	—	65	4	26									
			60	5	55		2										
			52	4	19	(-C 16 33)											

Fig. 2



Aluminum location tag

Fig. 3

Strip	Sta.	N	S	E	W
77w	A	—	20'	25'	—
70w	E	—	22'	—	20'
63w	I	—	—	2'	—

Offsets from control line

Fig. 4

PART II

OPERATING PROCEDURE

The preliminary research and work had been done during the winter and spring, but the actual mapping and cruising was not begun until summer. This was partly due to adverse weather that made the area quite inaccessible, but principally because it was decided to use College Forestry students. With a week's training on the job it was felt that the students could perform the work satisfactorily. For the cruising, senior students who had some training if not actual experience in cruising, were chosen, and under-classmen who had proven proficient in mapping and compass work were chosen for the mapping job.

Except for the actual procedure of doing the work, all else was left up to the discretion of the crew member so long as the required amount of work was accomplished daily. All members lived in the city some fifty miles from the job. Transportation was furnished by the organization, and unless working in the same area, the control crew and the cruising crews used two different cars.

After working a six-day week for awhile and doing about one mile of strip per day, per crew, it was observed that a considerable period of time was spent walking out after each mile was run. In this very rugged country this sometimes amounted to two or three hours. This extra time consumed each day resulted in the crews frequently not getting back to town until after 6:00 P.M. What with leaving town at 5:00 A.M., this resulted in a long and arduous work day and week. It also placed a great inconvenience on the crews inasmuch that it was hard to get to stores before they closed. To remedy this situation

it was suggested that perhaps two miles could be run a day. This was tried and it was found that by leaving town an hour earlier and getting back later it was possible most of the time. This meant a long hard work day, but doing this it was necessary to work only three days a week. This appealed to the crew because it added to their free time and to the organization because it removed three days transportation from expenses. The only question was as to the accuracy and efficiency but this was found not to be affected at all by the long work day.

CONTROL LINE PROCEDURE

The general method of running the control line was given in Part I, as much of it was run before starting on the cruising and mapping work. However it was also run during the entire job by a crew that would alternate between that job and cruising. It was previously mentioned how this line was plotted. After plotting the perpendicular offsets from the transit stations to the strip, starting points were calculated and a list of these was given to the cruising parties.

MAPPING PROCEDURE

The mapper and cruiser work as a pair, but for the purposes of this discussion they will be taken up separately.

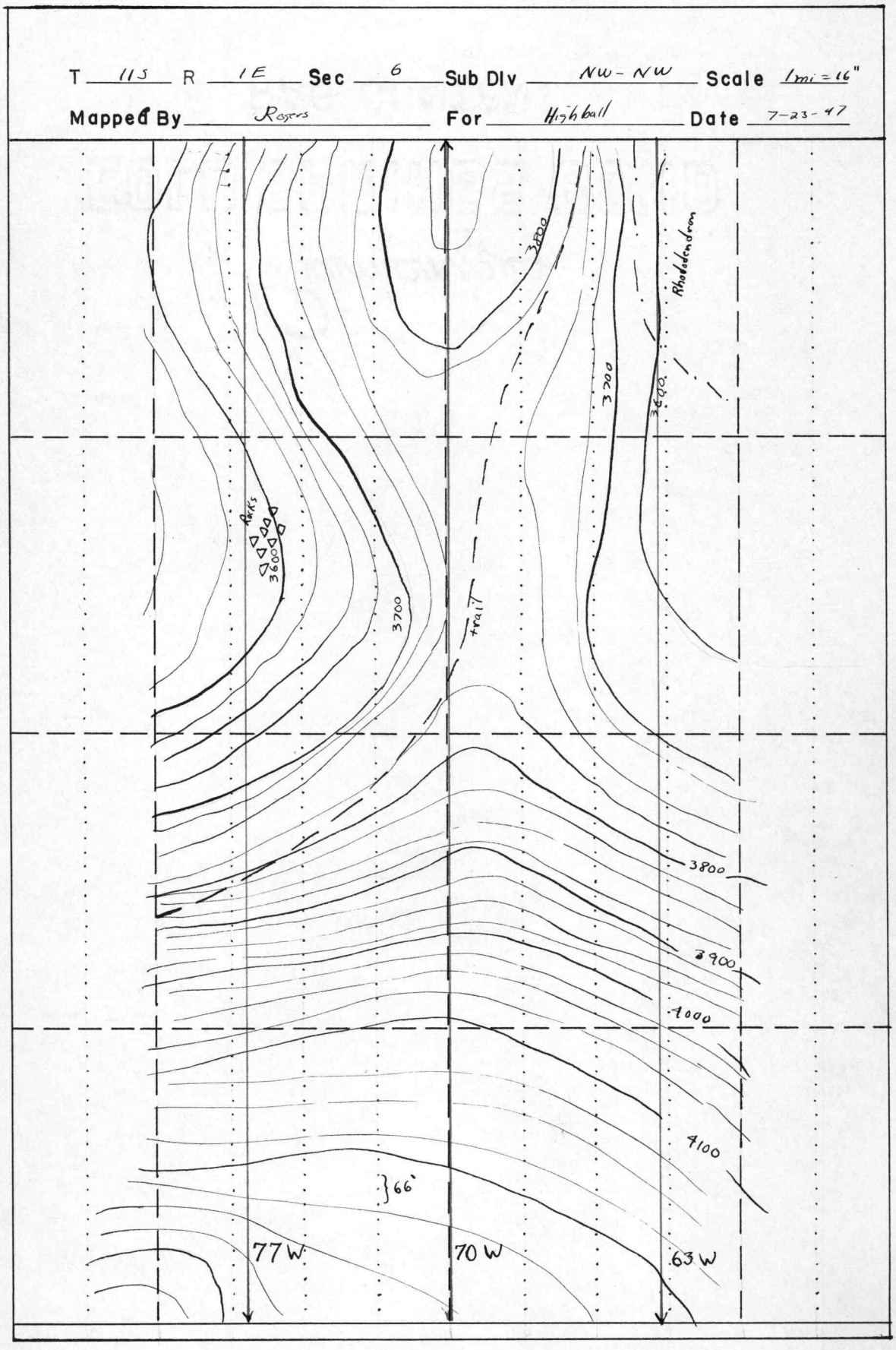
Equipment carried by the mapper was a lensatic compass for direction, a 200 ft. chain for horizontal control, a hand axe for cutting brush and blazing trees, and a metal tatum. In the tatum sheet was contained map sheets, note sheets and a table of horizontal and vertical corrections.

Since nearly each day a new strip was begun, the first duty of the mapper was to locate the starting point along the true section line. This was done by referring to the offset notes prepared by the control crew. At this point a stake was driven and a nearby tree blazed on four sides. An aluminum tag (Figure 3) was inscribed thus -

Sec 1 N-0
W-63.

Before starting he headed his map and note sheets (Figure 5) to insure against any error in identity. After taking a compass shot he starts off on his course blazing enough trees on each side along the line so that it can be easily followed by others. For the vertical control and slope correction the cruiser who acts as rear chainman gives the mapper an Abney level reading. The mapper records his chaining figures and Abney readings so that later he and the office men can check the work. On reaching 330 feet (5 chains) another aluminum tag was placed and a nearby tree blazed. At this point a large scuff was made and a stick placed. This procedure was carried on until the mile was run. During this time he drew his contour map, noted all streams, swamps, etc. and at the cruiser's suggestion he mapped in any reproduction, pole stands or other distinctive forest type encountered. Tags were also placed each time a road was crossed.

On running the full mile it was necessary to tie to some established point. Seldom was a transit line run down both section lines, so it was generally necessary to find a section or quarter corner. If we assume that we have run strip 77 W and 70 W, we tie with perpendicular distances to the end of strip 70 W, which was tied to 77 W, which was in turn tied to the section corner. It has been mentioned that two miles were often run a day. If this were



Map Sheet

Fig.5

done and there were not established points to tie to at the end of the first mile, an offset was made to the next strip which was run back to the transit line and tied to the nearest station.

In the above, the mapper has been singled out to do all of the blazing and tag establishing. This was not always true, for if the timber was light the cruiser would easily keep up with the mapper and be able to do this job if it speeded up the operation.

CRUISING PROCEDURE

When using the two-man strip method of cruising and mapping, the cruiser is generally considered the chief of the party. As has been pointed out, he frequently helps the mapper and seldom is the case when the situation is reversed. On this job though the timber was so dense and the terrain so rugged that generally the mapper had to wait for the cruiser to catch up.

The principal duty of the cruiser is, of course, to take an inventory of the area under investigation. On this job a 10 per cent cruise was made. Rather than using the standard one chain wide strip, a strip 2/3 chain wide was used. This was done because of the high volume per acre and the extremely steep slopes encountered. It was believed that the cruiser would have had a difficult time estimating the true width of the strip. It was much easier on a 44 foot strip to determine whether a borderline tree was in or not, than if the strip had been 66 feet wide.

The Data Sheet

Figure 2 shows an example of the form on which the cruise data were gathered, with some sample entries. In the first column

is the strip designation, for example, West-63. The second column limits the trees cruised to the 5 chain plot, along the strip, in which it is enclosed. In other words, a plot labeled N-75, lists all trees in the five chain section between a point 75 chains north of the south section line and north section line. The species in all cases was Douglas-fir, whose diameter was taken in 4" increment and length as the number of 32 ft. logs. The net volume and cull volume are recorded in hundreds of board feet. Every fifth tree which had some merchantable material was graded. This was entered in the Cull Column. A sample entry might appear like this: 2-C33 - meaning that the first log is a No. 2 peeler, the second is cull, and the third and fourth are No. 3. saw logs. No. 1 saw logs were considered as peelers, and woods logs were excluded. Trees four logs high had the first three graded. The fourth was figured to break in felling. In all trees with more than five logs, only the first four were graded. The remaining should break in felling. Hemlock and white firs were treated as the same and with the cedar were tabulated with volumes only.

General Procedure

The cruiser carried a diameter with which he measured all trees that were easily accessible. In all cases trees over 60" were measured as an error of only one diameter class would mean one of 500 board feet, or 5000 feet when the factor of 10 was figured in. An exception was the culls, whose volume was not as important. He estimated the height by eye, and frequently checked himself with the Abney level. As he was checking the diameter he would carefully check the ground and tree for any signs of rot or damage.

Treatment of Defect and Damage

There was not any definite rule as to the method of deducting for rotten and other unmerchantable wood. The trees were judged on a basis of pre-war recovery and not on the present boom market where anything that holds together is considered merchantable. In this respect the area was cruised with a low net recovery, and a large overrun should be expected on the cruise tally of any logs cut during the present good market.

If conks were distributed over the entire tree, even though it be only on one face, the entire tree was cull. For fewer conks it was more or less left to the discretion of the cruiser, who would hit one tree hard and the next easy. In general though the rot was considered to run twelve feet in both directions from the point of entry. If a logs ends were this distance from a conk it was considered good. If more than two-thirds the volume of the tree was rotten, it was a cull. Roughness, crookedness, taper branching and whether it was accessible were factors also considered. The Volume Table gave the volume for each log, so in determining the good and bad logs the true volumes could be entered. The hemlock and cedar, except with extremely large trees, were considered either good or cull. On large trees any per cent of the full volume, decided, was entered.

Recording the Data

The cruiser would use a new tally sheet each time he entered a new forty. In areas where the timber was very light it was sometimes possible to put the three runs through a forty on one page. However, this was seldom the case and generally it required four or possibly five sheets for each mile of cruising. This was done so that the sum volumes of each forty acres could be easily tabulated.

OFFICE WORK

The duties of the office staff were twofold. One was the checking of all material, and the other was the compilation of all the map data into the finished map, and the totaling of the cruise data in various ways.

Checking

Before any further work could be done everything had to be checked. The use of electric calculators speeded up this operation. All calculations used by the mapper were checked as were the cruiser's notes. Less could be done with the latter, but it could be seen if he used the right volumes for each tree.

The Map

After checking all the data, the mapper adjusted each map as to how it checked out when being tied in. This was done by calculating the bearings of the course actually run, rather than the true NS or EW line. Considerable adjustment had to be done to get the various maps to fit together. With this done, each section was put on a separate sheet.

Cruise Data Summation

First of all the sheets were arranged into the forties of their respective quarter sections. The totals of all columns were made for each forty. The factor was applied to these figures and from this was subtracted the deductions for hidden defect and breakage. This figure was then totaled for each section. From the grade data a chart was made showing the per cent of each grade of log in the section. In the final form each species, the cull, and each grade of log was shown as a per cent of the gross volume of the section.

Shortly after the end of the summer the field work was completed, and soon after all the material had been tabulated and assembled. It was then possible to write the report that was to be presented to the company.

PART III

One of the most difficult of the tasks encountered on this project was the making of a report. It had to be clear, concise and adequate so that parties who had never seen the area could, from it, formulate their plans. The report itself is two sections, the more important being the written one.

THE MAP PORTFOLIO

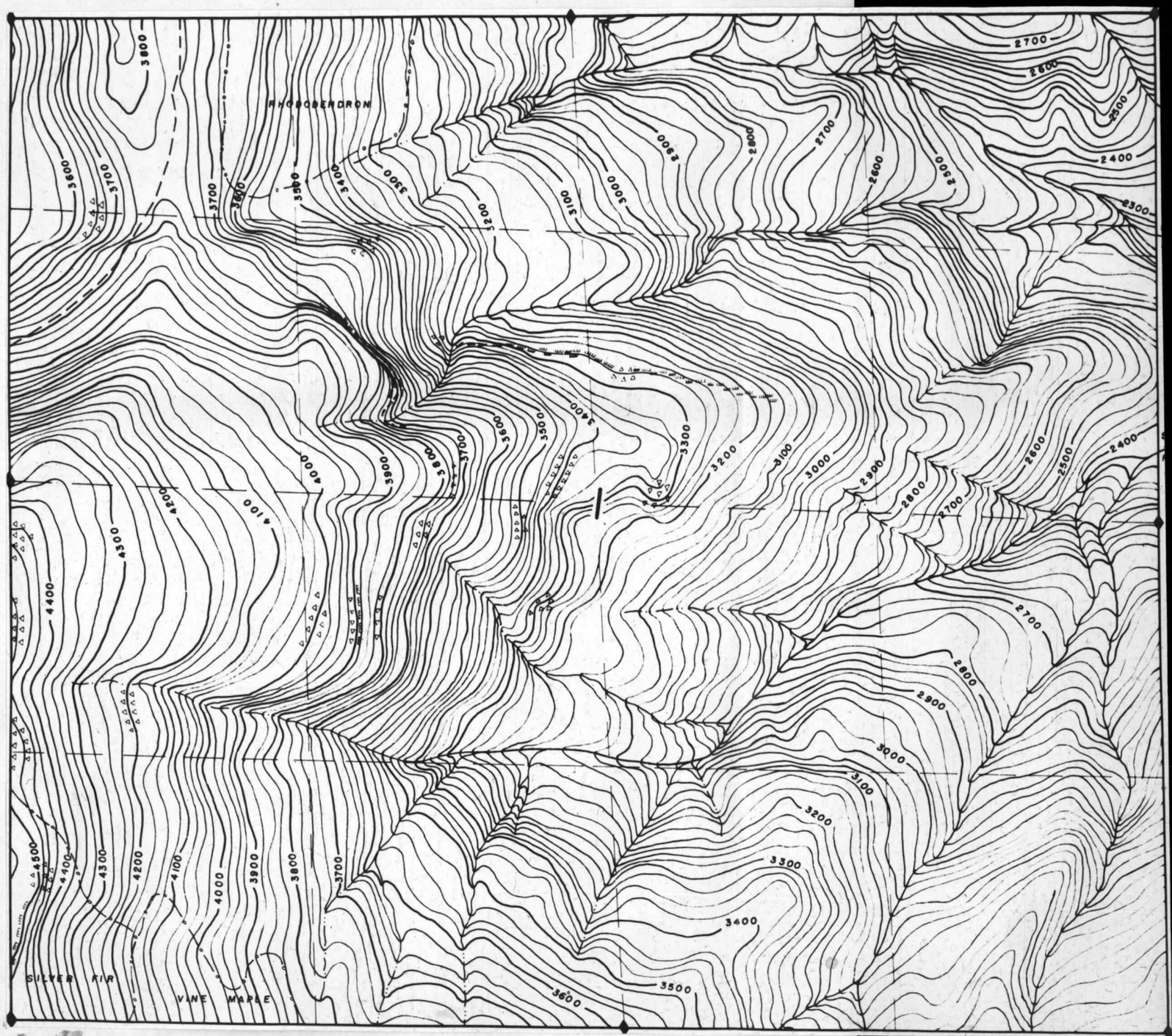
The other section was a bound volume of maps of which Figure 6 is one. On completion of the field and office work, finished maps of each section were drawn, as well as a large map of the entire area. The former was on a scale of 16 inches to the mile and the latter at 8 inches to the mile.

THE WRITTEN REPORT

It has been mentioned that the cruise data were assembled first in forties and then sections. Figure 7 shows how this was assembled for the report, and Figure 8 shows how the compilation of the section was accomplished.

Other than these data, there is given a description of the area as a whole and the general over-all picture. When the individual sections are under discussion, a rough logging plan is proposed as well as the general location of roads through the section. It is also possible to give an approximate cost of construction in the area. The following is what was said about Section 1 (Figure 6); Logging Factor:

> "Section 1 is primarily a high lead show, but there are some possible cat shows. The most feasible road is one coming in from the southeast on a contour below 3600'. Timber in the west one-half of the section could be taken over this road and it could be



Finished section map

Fig. 6

extended through the pass in the NW¼ NW¼ to tap timber in Sections 2 and 11. Timber in the east part will be difficult to move. It will either have to be brought up to the road mentioned above by means of a double swing, or a road will have to be built down the east drainage."

TIMBER CRUISE SUMMARY (M'B.M.)

Sec. 6 T 11 S, R 4 E

FORTY	D.F	Hem.	Ced.	Total	D.F. Cull	% Of Grades In D.F.				Remarks	Acres
						1&2P	3P	2S	3 S		
NE NW	1030	20	40	1090	570	15	15	40	30	4 Acres 2nd. Growth	38
NW NW											
SW NW											
SE NW											
NE NE											
Etc.											
TOTAL											

Fig. 7
Summary of Forty's in a Section, with Sample Entry

NET VOLUME OF TIMBER ON TRACT
(M' B.M.)

Sec.	Acreage Tbr'd.	Acreage Total	D.F. Old Gr.	Hem.	Ced.	Noble F.	D.F. 2nd.	Total	D.F. Cull	% D.F. Peelers
T11S R4E	582	612	27,200	7,600	300	1,310	150	36,560	10,690	35%
1										
2										
3										
4										
Etc.										
T10S R4E										
23										
Total										

Fig. 8

Final Compilation Sheet, with Sample Entry

APPENDIX

THE STAFF

	Member	Duties	Wage per day
A.	Management	Supervise, Control Work	$50.00
B.	Control Party		
	1. Chief of Party	Instrument man, notekeeper	$13.50
	2. Head Chainman	Chain, Rod, Determine sta. Cut Brush	11.00
	3. Rear Chainman	Chain, Cut Brush	11.00
			$34.50
C.	Mapping and Cruising		
	1. Cruiser	Chief of Party, cruise rear chain, abney	$12.50
	2. Mapper	Head chain, topographer, blaze line, mark stations	11.00
			23.50
		Two Crews	$47.00
D.	Office		
	1. Mapper	Construct map, check field work	$11.00
	2. Statistician	Total cruise figures, check	11.00
			$22.00

COST OF OPERATION

Daily Charges (approximate)

Management Fees	$ 50.00
Control Party	34.50
Cruising and Mapping	47.00
Office Work	22.00
Total Daily Charge	$153.50

Using 100 full even days, $153.50 x 100 = $15,350

There was 18,500 acres of ground covered, so the costs amounted on an average to $1.25 per acre.

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