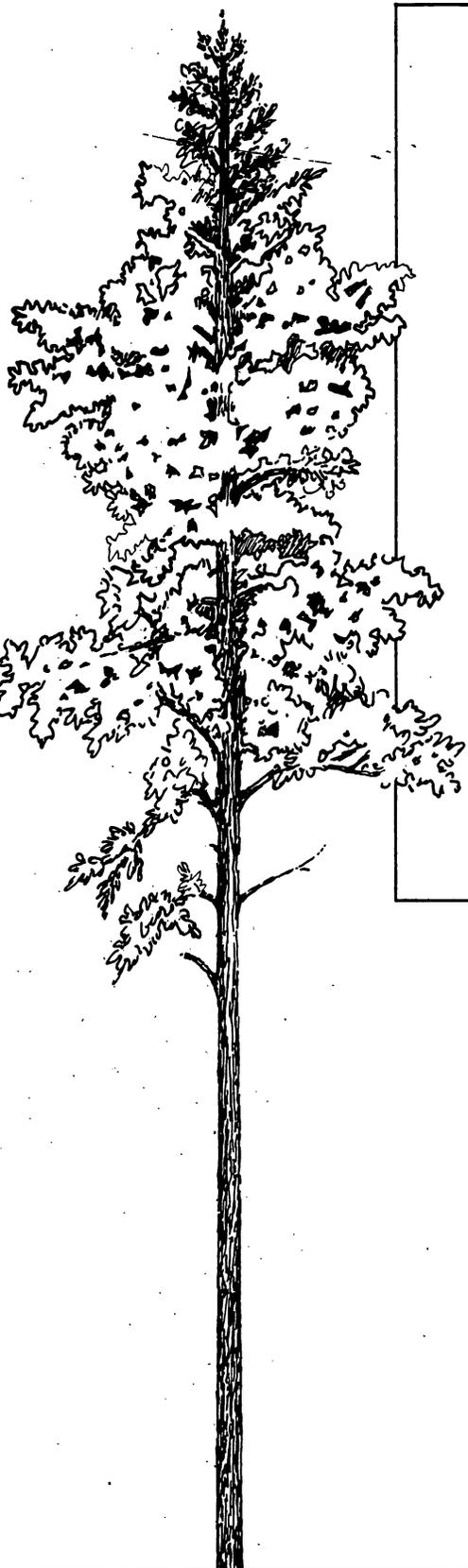
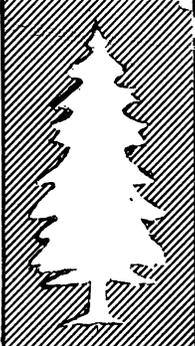


Robert N. Stone,
Project Leader
Forest Survey



INSTRUCTIONS FOR THE
THIRD MINNESOTA FOREST SURVEY
August 1960
North Central Forest Experiment Station
St. Paul, Minnesota

200 cells of
Group A1144 in
Tullahoma, Tenn. 12/20/11

MICHIGAN AND WISCONSIN SPECIES GROUPS

<u>Species Group</u>	<u>Species Codes</u>
1 White pine	129
2 Red pine	125
3 Jack pine	105
4 White spruce	094
5 Black spruce	095
6 Balsam fir	012
7 Black hemlock	261
8 Tamarack	071
9 Cedar	088, 241
10 Other <u>eastern</u> softwoods	110, 122, 202, 130, 133, 096, 097, 098
11 White white oak	802, 825, 826, 808, 804, 823
12 Select red oak	833, 813, 834
13	822, 832, 835, 836, 838
14 Other red oaks	806, 812, 817, 837, 831, 830, 828, 820, 827, 809
15 Hickory	405, 407, 409, 401 402, 403, 404
16 Yellow birch	371
17 Hard maple	314, 318
18 Soft maple	313, 316, 317
19 Beech	531
20 Ash	541, 543, 544, 545, 546
21 Cottonwood, Balsam Poplar	742, 744, 745, 747, 741
22 Paper birch	372, 373, 375, 379
23 Aspen, Quaking	388 , 746
24 Balsam poplar Aspen, big tooth	388 , 743
25 Basswood	951, 952
26 Black walnut	602
27 Black cherry	762
28 Elm	971, 972, 974, 975, 977
29 Other hardwoods	331, 332, 921, 373, 375, 379, 431, 462, 571, 581, 928, 601, 682, 683, 681, 680, 682, 681, 611, 693, 694, 691, 731, 621, 482, 372, 491, 821, 852, 591, 641, 961, 421, 461
30 Noncommercial species	999

98 Soft Spruce
125 Red Pine
91 Norway Spruce
126 Pitch Pine
European Larch
Japanese Larch
110 Sitka Spruce
127 White Spruce
130 Scotch Spruce
208 Red Spruce
097 Red Spruce
096 White Spruce

TABLE OF CONTENTS

	<u>Page</u>
I. <u>INTRODUCTION</u> -----	1
A. Previous forest surveys in Minnesota -----	1
B. Resurveys planned at 10-year intervals -----	1
C. Cooperation for expediting the survey and providing county estimates -----	2
D. General plan for third Minnesota forest survey -----	2
II. <u>FOREST INVENTORY</u> -----	4
A. Sampling blocks -----	4
B. Status of aerial photography -----	4
C. Determining the area of forest land -----	4
D. Determining area in each forest cover class -----	8
E. Measuring timber volume and timber cut -----	13
1. Establishing permanent plots -----	16
2. Temporary plots -----	17
F. Measuring growth and mortality -----	17
G. Generalized forest cover mapping -----	17
H. Accuracy goals and the job-load -----	18
III. <u>TIMBER PRODUCTION SURVEYS AND UTILIZATION STUDIES</u> -----	20
A. Production reports from industry -----	20
1. Sawmills -----	20
2. Pulp, veneer, cooperage mills, etc. -----	21
3. Poles and piling -----	22
4. Round and split mine material -----	22
5. Fuelwood and fence posts -----	22
6. Forecast of contacts required -----	23
7. Sampling accuracy -----	23
B. Stump tallies on forest survey plots -----	24
C. Cutting reports from various classes of owners -----	25
D. Study of forest products utilization factors -----	26
E. Mill residues resulting from processing logs and bolts- -----	25
IV. <u>A STUDY OF COST AND FEASIBILITY OF DETERMINING AREA CONDITION CLASSES BY SIZE OF OWNERSHIP</u> -----	27
V. <u>FORM CLASS AND BARK THICKNESS STUDY</u> -----	28
VI. <u>COMPUTING PLAN</u> -----	28

TABLE OF CONTENTS

	<u>Page</u>
I. <u>INTRODUCTION</u> -----	1
A. Previous Forest Surveys in Minnesota-----	1
B. Resurveys Planned at 10-year Intervals-----	1
C. Cooperation for Expediting the Survey and Providing County Estimates-----	2
D. General Plan for Third Minnesota Forest Survey----	2
II. <u>FOREST INVENTORY</u> -----	4
A. Sampling Blocks-----	4
B. Status of Aerial Photograph-----	4
C. Determining the Area of Forest Land-----	4
D. Determining Area in Each Forest Cover Class-----	8
E. Measuring Timber Volume and Timber Cut-----	13
1. Establishing permanent plots-----	16
2. Temporary plots-----	17
F. Measuring Growth and Mortality-----	17
G. Generalized Forest Cover Mapping-----	17
H. Accuracy Goals and the Job Load-----	18
III. <u>TIMBER PRODUCTION SURVEYS AND UTILIZATION STUDIES</u> -----	20
A. Production Reports from Industry-----	20
1. Sawmills-----	20
2. Pulp, veneer, cooperage mills, etc.-----	21
3. Poles and piling-----	22
4. Round and split mine material-----	22
5. Fuelwood and fence posts-----	22
6. Forecast of contacts required-----	23
7. Sampling accuracy-----	23
B. Stump Tallies on Forest Survey Plots-----	24
C. Cutting Reports from Various Classes of Owners----	25
D. Study of Forest Products Utilization Factors-----	25
E. Mill Residues Resulting from Processing Logs and Bolts-----	25
IV. <u>A STUDY OF COST AND FEASIBILITY OF DETERMINING AREA CONDITION CLASSES BY SIZE OF OWNERSHIP</u> -----	27
V. <u>FORM CLASS AND BARK THICKNESS STUDY</u> -----	28
VI. <u>COMPUTING PLAN</u> -----	28

	<u>Page</u>
<u>APPENDIX</u>	<u>31</u>
<u>I. AREA CLASSIFICATION</u>	<u>31</u>
A. Land Area	31
1. Forest land area	32
a. Commercial forest land	32
b. Noncommercial forest land	32
2. Nonforest land	33
3. Land use trend	33
4. County codes	33
5. Land ownership	34
B. Forest Stand Classification	35
1. Frequency index sampling	35
2. Stocking classes	40
3. Stand-size classes	41
4. Forest cover types	41
5. Area condition classes	44
6. Recommended stand treatment	45
7. Stand-age	46
8. Site classification	46
9. Site index	48
10. Basal area	48
11. Total height	48
12. Map type	50
13. Previous ground class	50
14. Number of growing seasons	50
<u>II. VOLUME CLASSIFICATION</u>	<u>50</u>
A. Growing Stock Volume	50
B. Sawtimber Volume	50
<u>III. TREE CLASSIFICATION AND MEASUREMENT</u>	<u>51</u>
A. Species	51
B. Diameter Breast Height	52
C. Merchantable height	53
D. Tree Classes	55
E. Cut or leave	57
F. Soundness Classes and Visible Defect Indicators	58
G. Timber Quality	58
H. Stump Diameter	63
I. Total Height	63
J. Tree Age	63
K. Mortality Classification	64
<u>IV. MEASUREMENT OF ACCURACY AND COST</u>	
A. Variability Study	65
B. Cost Studies	65
C. Accuracy of Classification and Measurement	65
D. Formulae for Computing Accuracy	66
<u>V. TATUM GUIDES</u>	71--72

INSTRUCTIONS FOR THE THIRD MINNESOTA FOREST SURVEY

Lake States Forest Experiment Station

August - 1960

I. INTRODUCTION

A. Previous Forest Surveys in Minnesota

The initial inventory of Minnesota began in 1933 and was completed in 1936, showing for the first time accurate estimates of area, volume, and growth of the forest resource.

In 1946 a cooperative second survey started. The Lake States Forest Experiment Station took responsibility for planning and coordinating various segments of the job; the National Forest organization, the Bureau of Indian Affairs, and the Minnesota Department of Conservation assumed responsibility for surveying public lands under their jurisdiction. The Office of Iron Range Resources and Rehabilitation assumed responsibility for field work on other lands. As the work progressed, individual counties and several private industries participated. The entire job was completed in 1953. The IRR/RC published detailed reports covering most of the State, either by individual counties or groups of counties. The Lake States Forest Experiment Station, jointly with the IRR/RC, prepared and published a short report giving forest statistics for Minnesota. From all of these data a State analytical report was prepared by the Lake States Forest Experiment Station and published by the U. S. Department of Agriculture as Forest Resource Report No. 13, "Minnesota's Forest Resources."

B. Resurveys Planned at 10-Year Intervals

Since the second survey which began in 1946, several industrial forest owners and public agencies have included forest inventory in their programs, and have established permanent plots on their land. The two national forests in Minnesota are scheduled for reinventory within the next few years. Demands for recent forest resource information continue to increase.

The Forest Survey schedule calls for resurveys at 10-year intervals. For Minnesota the survey may be as of January, 1961, 1971, etc. As the national timber balance is studied from time to time, it may be necessary to arrive at certain figures some year between these inventories. Some public and private agencies are planning to remeasure their permanent plots at 5-year intervals. Their data may be used as part of a continuous inventory system which will indicate trends as the forest changes and facilitate bookkeeping revisions between periodic surveys. Systematic sampling and permanent plots will provide for accurate measurement of changes in the forests.

C. Cooperation for Expediting the Survey and Providing County Estimates.

The Forest Service recognizes the need for separate sets of forest statistics for areas small enough to facilitate planning by industries and local governments. However, the job of covering all the forests of the nation at this intensity within a reasonable period is too great for the funds provided. The policy is to seek cooperation with other federal agencies and with State, industrial, or other local groups. In Minnesota, the Lake States Station anticipates continued cooperation from the national forests, the Office of Indian Affairs, the Bureau of the Census, the Agricultural Stabilization and Conservation Administration, State and county forestry agencies, and large private ownerships.

D. General Plan for Third Minnesota Forest Survey

The plan outlined here is the outgrowth of talks with representatives of industry, county, State, and federal agencies in Minnesota. It is designed to utilize the efforts which each agency is able to put into forest survey. It is designed to give statistics on forest area by cover classes, stand condition, site, age, and ownership; timber volume by species and quality, growth, allowable cut, and annual timber cut by species and kind of material; and cut also by forest products. The needs of established industry and the major problems of improving the forest situation will be reviewed. Provision is made for conducting the survey within budget and time limitations and for bringing figures up-to-date between surveys.

A timber management resurvey of the Chippewa National Forest began during fall of 1959 and is scheduled to be completed (including computation) by June 1961. It involves complete mapping of National Forest land using new aerial photos, sampling of 1/3 of the compartments, and establishment of permanent plots. This survey was designed to provide most of the information needed by the Forest Survey. The Superior National Forest will not be reinventoried until 1962 which will be too late to contribute to this survey. However, new aerial photography may be available in time to be used by our crews.

The Indian Service is establishing a Continuous Forest Inventory and will have covered all Indian lands except those scattered lands south of the Chippewa National Forest by fall of 1961. This inventory also is collecting data to meet the needs of Forest Survey. It will provide an adequate measure of present areas, volume, and allowable cut. While permanent plot remeasurements will not be available, satisfactory growth will be projected using corrected growth rates from previous survey.

The State forests were completely reinventoried since July 1959. Most of the necessary data will be available in additive form. Some additional information was collected to meet our needs.

The Koochiching County forest and the Minnesota and Ontario Pulp and Paper Company lands are to be reinventoried during the summer and fall of 1961. These inventories already include almost all items needed by Forest Survey. It seems likely any remaining information that is necessary will be collected. Data will be available about the end of 1961.

The Kimberly-Clark lands will be recruited by Continuous Forest Inventory in time for use in survey reports.

The county forest lands of Wadena, Hubbard, and part of Beltrami will be completely mapped. These data will be used to improve area statistics.

The Forest Survey will utilize forest area, timber volume, growth, mortality, allowable cut, and actual cut information provided by each of the cooperators insofar as reliable figures meeting survey standards are available. The heavy sampling involved will increase the statistical accuracy of the survey. It appears more efficient for the Station and the IRR/RC to assist each cooperator in converting his survey data than to borrow certain plots and recompute forest statistics. In any event, a limited sample of CFI remeasurement data will be borrowed for determination of growth and mortality rates.

Proportional sampling will be used since it will simplify sampling in subsequent surveys.

Crews of the Office of Iron Range Resources and Rehabilitation began the third Minnesota Survey in September, 1959 by testing out new plans in Koochiching County. Six foresters are to be assigned to this work for about 2 years. They will survey most of the lands not covered by other cooperators in the Central Pine and Rainy River Districts, and in Carlton and western St. Louis Counties.

Crews of the Lake States Forest Experiment Station will cover the balance of the State. Dot counts were begun during the fall, 1959. Four to six men will be assigned to this job from February 1960 to fall, 1961. Computing of Forest Survey data will be largely done in the fall of 1961 and winter, 1962 by data processing machines.

Under national survey instructions the statistical accuracy of commercial forest area estimates to 1 standard deviation must be within ± 3 percent per million acres, and of total volume within ± 5 percent per billion cubic feet. In Minnesota the statistical accuracy of commercial forest area will be held to about 2 percent per million acres and the accuracy of total volume 2 percent per billion cubic feet, which is about the accuracy of the second forest survey. The sampling error of total volume for the larger well-forested counties will be below ± 4 percent per county. This accuracy will permit publication of forest area and timber volume figures by several breakdowns for each of the 18 counties in northeastern Minnesota.

In the second Minnesota Survey 19 reports were published by the IRR/RC covering the State by individual counties or group of counties. Results of the third Survey will be published in a State report by the Lake States Forest Experiment Station and a number of local reports by the Office of Iron Range Resources and Rehabilitation. County data will largely be presented in district reports to reduce the reporting job. These reports will include a brief text, several charts to portray the overall forest situation within the district, and statistics for the district and each county. The Office of Iron Range Resources and Rehabilitation plans to publish an individual county report for Koochiching, which was not reported on during the Second Forest Survey. The aim is to publish all reports by December, 1962.

II. FOREST INVENTORY

A. Sampling Blocks

The State has been divided into 9 volume sampling blocks in which the forests are relatively homogeneous and the percent of forest quite uniform. It is divided into 3 growth sampling blocks. Figure 1 shows these blocks and percent forest (of land area) in each county.

B. Status of Aerial Photography

The date of aerial photography to be used in the Minnesota Survey is indicated on the figure 2. In Kanabec and parts of 2 other counties, the photos will be 20 years old. Here, they will be used for the selection and location of sample points, but not for stereoclassifying. We will have to depend on intensive ground sampling. Fortunately, most of the State has been photographed since 1948. Arrangements have been made with the State Agricultural Stabilization and Conservation Office in St. Paul for use of their contact prints. Few, if any aerial photos will be purchased.

C. Determining the Area of Forest Land

A grid of sample acres on a transparent acetate sheet will be laid over every second aerial photo throughout most of the State except that in sampling block 1 (where counties are large) the sample will be reduced by placing the grid over every 4th photo. Since the grid is designed to cover two stereomodels, it provides a 100 percent coverage of the land and water area when every second photo is used. The arrangement of the dots is adjusted for scale and overlap specifications so that no ground will be covered twice or be unsampled.

Two grids* will be used (figure 3). The one for 1:20,000 scale photos contains 36 dots--each of which samples about 73 acres. The one for 1:15,840 scale contains 25 dots--each of which represents about 66 acres.

* Dimensions may vary somewhat with the photo job.
Grid shown is used on ASC photos in southern Minnesota.

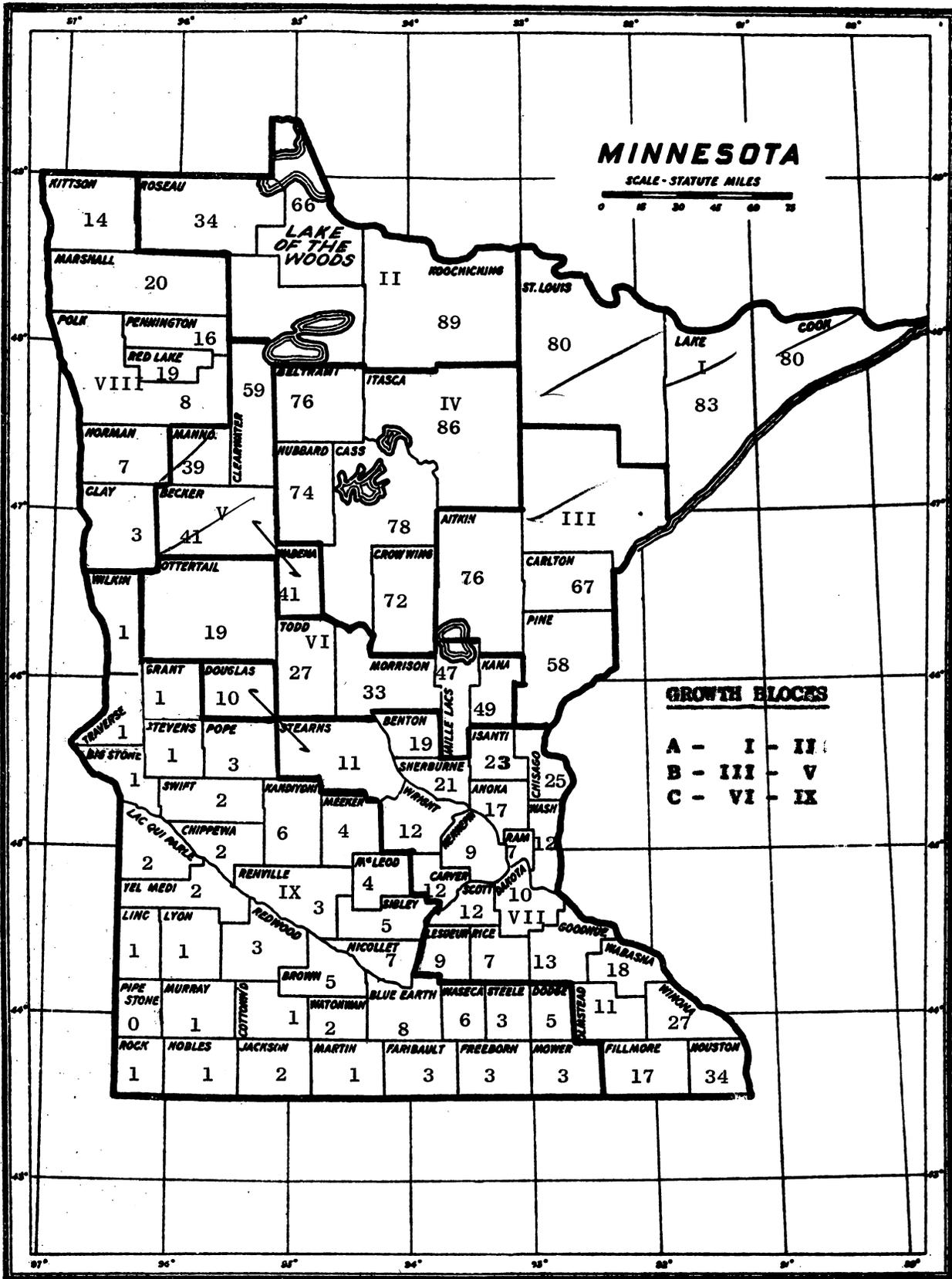


Figure 1.--Sampling blocks and percent of forest land.

U.S.D.A. - S.C.S., Milwaukee, Wis., 1954

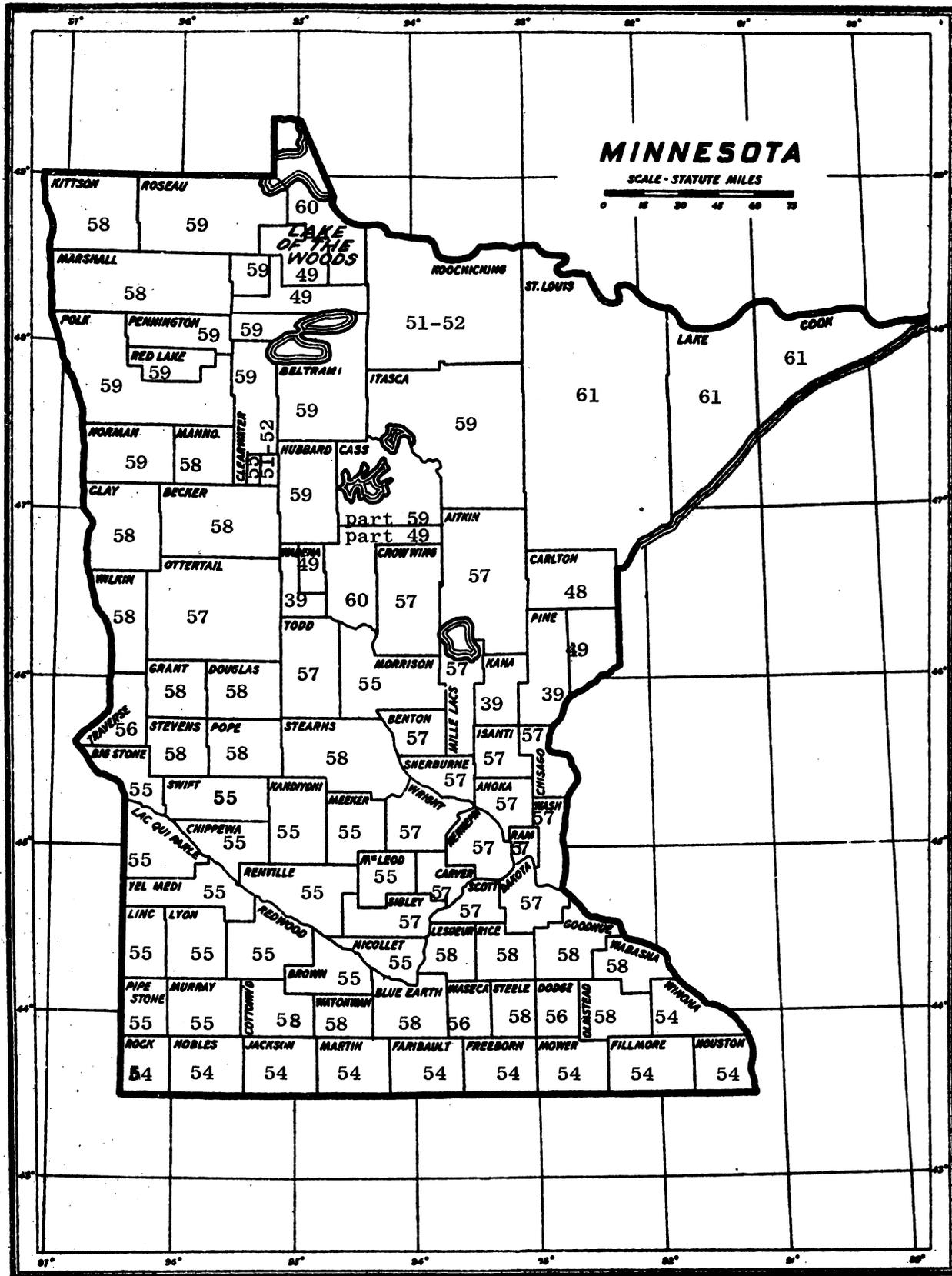


Figure 2.--Date of aerial photography (58 means 1958).

U.S.D.A. - S.C.S., Milwaukee, Wis., 1954

SCALE 1:20,000

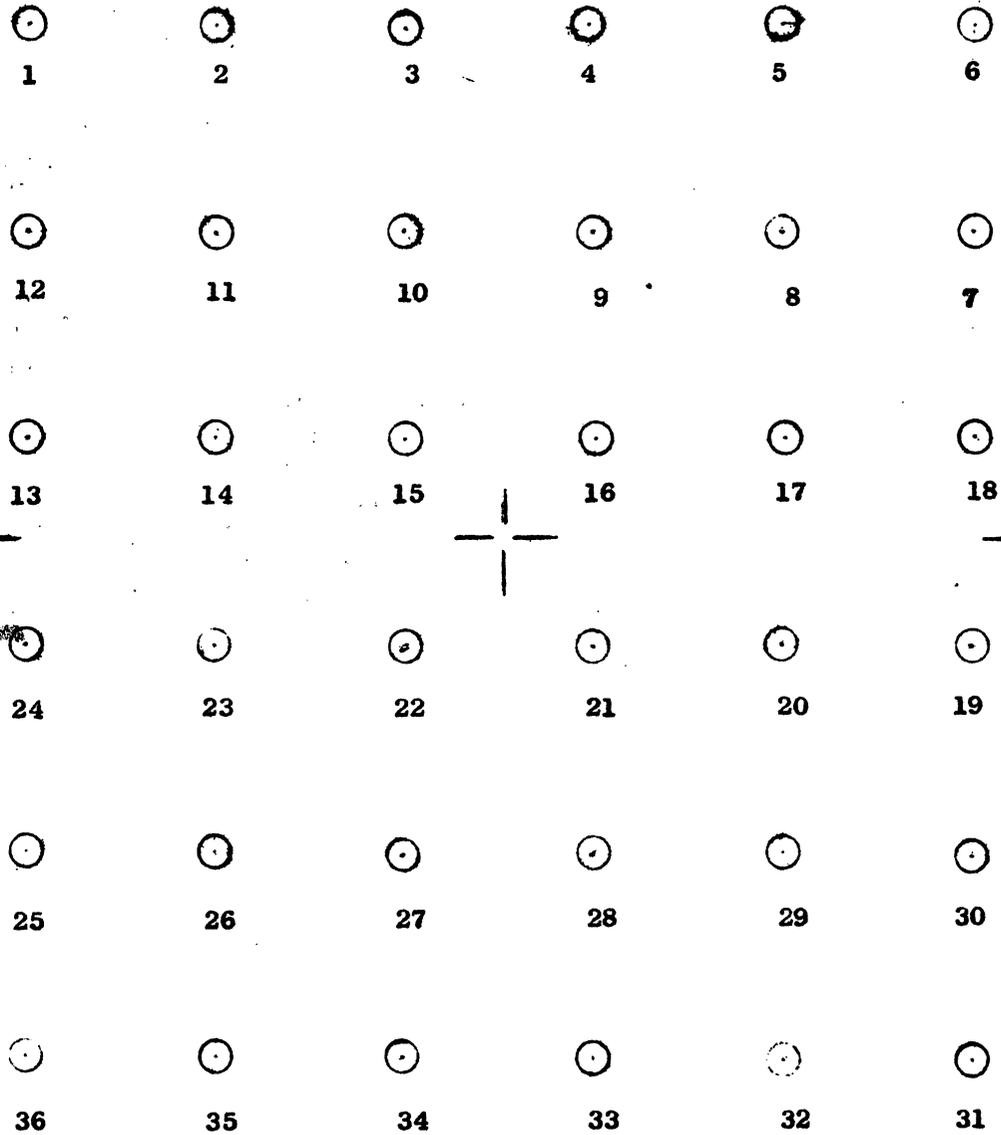


Figure 3.--Grid of sample acres.

The sampling plan provides 1 forest or nonforest point for each 66 or 73 acres in sampling units 2 to 9 and for 132 or 146 acres in sampling block 1.

The first step is to lay a grid (aligned by fiducial marks over a contact print and count the number of points (sample acres) falling on forest, water, or other nonforest. In sample blocks 1-6 and the northern part of 7 they will be counted separately by township to facilitate localization of volume estimates; in other blocks by counties. This sample will cover all ownerships. Large blocks of reserved land will be counted separately.

The classification of dots and the numbers involved will be recorded on a "Photo Point Record" (figure 4) by Lake States interpreters or on a "Dot Classification Record" (figure 5) by IRR/RC men. These forms facilitate systematic selection of points to be stereoclassified or ground checked and the computation of uncorrected forest area in each county (or township).

In areas inventoried by the IRR/RC, the ownership of every forest and nonforest dot will be determined.

D. Determining Area in Each Forest Cover Class

This step is designed to provide an appraisal of the area in each forest type, stand-size class, and stocking class in each county and of forest land ownership by groups of counties. It consists of stereoclassification followed by ground checking.

In sampling blocks 1 to 5 every 9th forest point (in block 6 to 9 every 10th one) will be selected on the photo point (or dot classification) record. These points are to be stereoclassified. The first of these dots will be chosen by random number from the first 9 (or 10) forest points on the first grid. Thereafter, every 9th (or 10th) will be taken in order numbered on each grid and in the order flight lines and counties are worked. They will be pin-pricked and marked by a short diagonal line on the aerial photo and checked by red pencil on the photo point record. When a photo includes dots in more than one county, the dot count data will be recorded on separate county photo point records (or dot class records used by IRR/RC).

Each of the selected forest points will be studied under the stereoscope to determine the photo classification for land area, forest type, stand-size, stocking, and site. These classes will be judged with little or no photo measurement, by men familiar with forest conditions on the ground. The classification will be for the sample acre. It will be recorded on the "Photo and Ground Classification Record", (figure 6), by flight number, photo number, and grid point number. Land classification, forest type, stand-size-density, and site will be indicated by appropriate codes (see appendix) in the "Photo Class" column. IRR/RC men will record this information on their dot class record form under "Photo Class" and "Photo Site".

If the acre includes a contrasting forest cover class boundary, the photo interpreter will move it perpendicularly into the class in which the dot falls. If the acre is split in two, equally, he will move it northerly or easterly one chain or enough to obtain a sample of but one cover class. The plot should be moved sufficiently so that the new plot center is 1 chain from the contrasting boundary. (Field men will take the plot at this point. They will not move it.)

Stereoclassification will be omitted if the photos are 9 years old or older. A larger proportion of points will be ground checked than when stereoclassification is used.

Every third stereoclassified forest point in sampling blocks 1-5 and every 5th in blocks 6 to 9 will be selected for ground checking (except when old photos are involved as noted above). At the beginning of the job the first point is selected from the first 3 (or 5) and thereafter, every 3rd (or 5th) is selected as work progresses down the flight line and from county to county.

Forest points to be ground checked will be indicated on the photo point record by a green circle. They will also be referenced on the back of the aerial photo by circling the pin-prick and noting plot number. They will be spotted on the county road map (generally 1/2" = 1 mile) to guide field travel. Stereoscopic pairs of photos will be set aside for use in the field. Nonforest points to be ground checked may be selected on the photo point record by a similar routine. In sampling blocks 1-5 every 27th nonforest dot, and in block 6 to 9 every 50th nonforest dot will be ground checked. They will be circled with red pencil on the photo point record.

If points are unquestionably nonforest (falling in water, urban and industrial areas, cultivated fields, etc.) they will be classified nonforest and not checked further. Otherwise, they must be located on a county road map and the aerial photo set aside for field use.

In addition to locating the points to be ground checked on aerial photos, county maps, and office records, it is advisable to set up field sheets. Two point and angle-gauge tally sheets are used in the field. The one numbered LS-4800-3 (figure 7) is used by Station crews. Form LS-4800-4 (figure 8) is used by the IRR/RC. A field sheet should be prepared for each prospective plot giving county, plot number, and description. Photo classification should not be entered until after field work is completed so that the field men may not be biased by previous classifications.

Ground checking consists of carefully locating, on the ground, the exact point indicated on the aerial photo and determining its classification as forest or nonforest and, if forest, the cover class involved. If nonforest, the Lake States Station cruiser will indicate the land type only under "ground class" on the Photo and Ground Classification Record. If the sample acre is forest, he will record the land type, forest type, stand-size, density and site classifications on the point and angle-gauge tally sheet. IRR/RC cruisers will indicate these ground class on their "Dot Class Record". The data will be recorded in code (see appendix).

A plot will be taken at each ground check forest point and much more information than indicated above will be shown on the tally sheets. This is covered in section E following.

The above procedure involving stereoclassification before ground checking is logical when photo-interpreters are familiar with the area. If they are new to an area, it is advisable to do ground checking before stereoclassification. In this case, the "ground class" must not be entered on the Photo and Ground Classification Record until after photo classification has been completed. Whatever the order of work, photo and ground classifications must be done independently to prevent bias.

E. Measuring Timber Volume and Timber Cut

At each ground check point which turns out to be forest, a plot will be taken. In the northern counties where numerous permanent plots have been established by IRR/RC and other cooperators, temporary plots will be used. In the balance of the State, permanent plots will be established.

Classification of type, stand-size, stocking, and area condition for the sample acre will be based upon a frequency index sample of at least 10 points well distributed over the acre. This provides more accurate classifications than obtained from a single plot tally. It facilitates a better comparison with the stereoscopic classification.

The upper section of each Point and Angle-gauge Tally Sheet is designed for tally of stand classification information. Some of this will be transferred from the photo interpretation records--the balance will be obtained on the plot or from ownership records. The underline marks indicate the number of digits in the code except for Recommended Cut which will be shown by a 3 digit number instead of a one digit number. The classifications and codes are presented in the appendix.

Calculation of volumes will depend on the tally of all live trees of five angle gauge (Bitterlick factor 10) subplots. This will reduce the coefficient of variation and improve accuracy at a small additional cost.

Fig. 7.- POINT AND ANGLE-GAUGE TALLY SHEET (IRR/RC)

County _____	Plot _____	Photo class _____	Photo site _____	Map type _____
Ground class _____	Stand age _____	Site index _____	Use trend _____	Ownership _____
Area condition _____	Recommended treatment _____	Basal area _____	Total height _____	Extra site _____
Town _____	Range _____	Section _____	Subdivision _____	
Photo No. _____	Photo date _____	Photo location _____		

POINT TALLY:

ITEM	1	2	3	4	5	6	7	8	9	10	11	12
Current stocking												
Species												
Tree-size												
Stocking w/o treatment												
Excess stocking												
Treatment needed												

STARTING POINT:

Course : (Azimuth _____
to plot: (Distance _____
Distance between: (I to III _____
witness trees : (II to IV _____
Cruisers _____ Date _____

Growing stock:	Desirable	_____ %	
	Acceptable	_____ %	
	Total	_____ %	
Cull & noncommercial		_____ %	Current
Inhibiting veg. & slash		_____ %	
Nonstocked		_____ %	
Nonstockable		_____ %	
			Prospective
			_____ %
			_____ %
			_____ %

ANGLE-GAUGE TALLY (Factor 10):

No.	D.B.H.	Species	Cut-leave stump	No. sticks	Soundness factor	No.	D.B.H.	Species	Cut-leave stump	No. sticks	Soundness factor
01						27					
02						28					
03						29					
04						30					
05						31					
06						32					
07						33					
08						34					
09						35					
10						36					
11						37					
12						38					
13						39					
14						40					
15						41					
16						42					
17						43					
18						44					
19						45					
20						46					
21						47					
22						48					
23						49					
24						50					
25						51					
26						52					

ESTIMATE OF GROSS VOLUME ON FACTOR 10 PLOT:

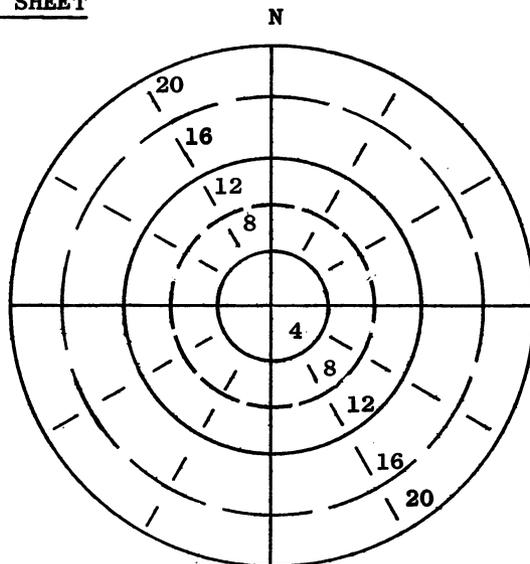
No. of sticks	1	2	3	4	5	6	7	8	Total
No. of trees									
Volume									
Cords per tree	(0.8)	(1.4)	(2.0)	(2.5)	(3.0)	(3.4)	(3.8)	(4.2)	
Divide volume by number of subplots to get volume per acre.									

LS-4800-3
(March 1960)

Figure 8.-- POINT AND ANGLE-GAUGE TALLY SHEET

County # _____ Ground cl. _____ Area condition _____
 Plot # _____ Stand age _____ Rec. treatment _____
 Photo cl. _____ Site index _____ Basal area _____
 Photo site _____ Use trend _____ Prev. Gr. cl. _____
 Map type _____ Ownership _____ Growing seasons _____
 _____ Total height _____

Owner and address _____
 Town _____ Range _____ Section _____ Subdivision _____



TALLY: NUMBER OF LIVE TREES OVER 5" DBH ON f-10 SUBPLOTS

* : * : * :		* :		No. of trees by subplot				
No.:	Species:	5C	Total	C	1	4	7	10
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:
XX	:	:	:	:	:	:	:	:

DBH, inches : 4 : 8 : 12 : 16 : 20 : 24 : 26
 Radius, feet : 11 : 22 : 33 : 44 : 55 : 66 : 77

CENTER SUBPLOT TALLY* (FACTOR 10) - 2.75' Radius Per 1" DBH

No.	Species	D.B.H.		Tree class		Merchantable height		Defect indicator	Sound factor	Cut or leave	Log Grade						Mort. class	
		Then	Now	Then	Now	4"	8"				T&T %	SF %	3	2	1	SF %		
301	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
302	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
303	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
304	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
305	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
306	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
307	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
308	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
309	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
410	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
411	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
412	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
413	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
414	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
415	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
416	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
417	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
418	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
419	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
520	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
521	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
522	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
523	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
524	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
525	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
526	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
527	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
528	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
529	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
630	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:

POINT SAMPLE TALLY AND SUMMARY

Item	C	1	2	3	4	5	6	7	8	9	10	11	12
Current stocking	:	:	:	:	:	:	:	:	:	:	:	:	:
Species	:	:	:	:	:	:	:	:	:	:	:	:	:
Tree size	:	:	:	:	:	:	:	:	:	:	:	:	:
Stock w/out treatment	:	:	:	:	:	:	:	:	:	:	:	:	:
Excess stocking	:	:	:	:	:	:	:	:	:	:	:	:	:
Treatment needed now	:	:	:	:	:	:	:	:	:	:	:	:	:
Percent by number of points:	:	(8)	(15)	(23)	(31)	(38)	(46)	(54)	(62)	(69)	(77)	(85)	(92)

Stocking Class	Current	Prospective w/o treatment	Stocking (GS)	Current	Prospective w/o treatment
Growing stock: Desirable	_____ %	_____ %	_____	_____	_____
Poor	_____ %	_____ %	Size class	_____	_____
Total	_____ %	_____ %	Type	_____	_____
Cull and noncommercial trees	_____ %	_____ %			
Inhibiting vegetation and slash	_____ %	_____ %			
Nonstocked	_____ %	_____ %			
Nonstockable	_____ %	_____ %			

LOCATIONAL DATA:

Flight # Photo # Point #

Starting point:

COURSE TO PLOT:

Direction _____

Distance (chains) _____

To _____

DIAGRAM:

Distance between _____ and _____ is _____ feet.

Witness trees _____ and _____ is _____ feet.

Tree Number _____ Direction _____ Distance _____ feet.

Tree Number _____ Direction _____ Distance _____ feet.

Tree Number _____ Direction _____ Distance _____ feet.

Cruisers _____ Date _____

Notes:

Stumps will be tallied to determine the cut by species, stand-size, and tree-size.

1. Establishing permanent plots

During or following the Second Forest Survey of Minnesota almost 600 permanent plots were established in sampling units 6 to 9. about half of these were established on a stratified sampling basis and thus cannot be used for repeated remeasurements without the sample being adjusted. Hence, it was decided to establish a new permanent plot at each ground check forest point in these units.

Form LS-4800-3, "Point and Angle-gauge Tally Sheet" (figure 7) will be used to record information at each ground check forest point by Station personnel. The classification of the acre will be based on 13 well-distributed points as described in the appendix. Only the factor-of-10 subplot at the center of the acre will be tallied as a permanent plot. Each tree on this subplot will be shown by number on the plat and measured in detail for the items under "center subplot tally" on the form. In addition, the numbers of live trees on four factor-of-10 subplots will be counted by species. The volume by species found on the center subplot will be adjusted by basal area to give volume per acre.

Average volume per acre (by species) =

$$\frac{\text{Average Basal Area of 5 subplots}}{\text{Basal Area of Center Subplot}} \times \text{Volume of Center Subplot}$$

The procedure for establishing a "permanent" plot follows:

The field crew (2-man) drives to a point near the plot location guided by county map and aerial photos. A good landmark visible on both photo and the ground is selected and marked by two-painted X's on tree, fencepost or pole. The crew walks to the plot location following a course scaled off the aerial photo. Hand compass and pacing is satisfactory. Trees are marked with one X at about 1-chain intervals along this line. Upon arrival at the plot, the stereoscope is used to check the position on aerial photos. The field men move, if necessary to the correct center of the plot as pin-pricked on the aerial photo. A metal stake is driven at plot center. It is referenced to three or four witness trees which are paint-marked with Roman numerals at stump height facing the stake.

A record of plot location is made on the back of the Point and Angle-gauge Tally Sheet. It consists of a note regarding the starting point, the course to the plot and the distance and direction from plot center to each witness tree. (If witness trees are conveniently located the intersection method of locating plot center may be used).

2. Temporary plot

In the north where sufficient permanent plots established on a proportional basis are already available, temporary plots will be taken at each ground check forest point. These are similar to permanent plots except that 12 points (instead of 13) will be used in the frequency index tally and fewer variables will be tallied on all trees on the five subplots in each sample acre. The "Point and Angle-gauge Tally Sheet", or LS-4800-4, August 1960 (figure 8) will be used. The point tally provides for classifying the acre normally but is not required when this can be accomplished from the plot tally as in the case of medium and well-stocked stands of pole or sawtimber-size. The distribution of points differs from that used by Station personnel. Ten points are located in a north-south line through plot center. Distances from plot center are 8, 24, 40, 56, 72 feet. In addition, one point is 72 feet east and another 72 feet west of the plot center.

The five subplots are located as follows: One at plot center and one 72 feet distant from plot center in each cardinal direction. At each of these five subplots starting with the center, then progressing north and clock-wise, each tree over 1.0 inches d.b.h. will be tallied. The tally-man will record d.b.h. to the closest inch species, whether tree should be cut or left under approved silvicultural practices, number of sticks of merchantable height, and the soundness factor. All stumps of sawtimber trees cut during the last 3 years from a 1/5-acre plot around the plot center (also all stumps of poletimber trees cut from a 1/50-acre plot) will be measured. The corresponding d.b.h. will be looked up in Lake States Technical Note No. 507 and tallied.

F. Measuring Growth and Mortality

Almost 1,500 permanent plots have been established by the IRR/RC and Lake States Station. Ninety-seven additional were established by the State Division of Forestry. Most of these will be remeasured. In addition, about 1,600 permanent plots will be remeasured by cooperating industries and Koochiching County.

latter

The / plots were all established in proportion to area but the numbers of acres per plot varied by owner. To provide a uniform sample of approximately 1 plot per 10,000 acres, a selection of plots will be made from those ownerships having a very intensive sample. Growth and mortality will be worked up by cover type, stand-size, density and site (3 classes) regardless of ownership--and then applied by the same criteria using the stock table method. Since the length of the period between remeasurements varies, the period must be indicated and used in computations to arrive at annual growth.

G. Generalized Forest Cover Mapping

The entire state has been covered by a generalized type map. Forest types will be transferred to State Highway maps. Field men will carry these maps and check them in the course of their travel making any necessary adjustments.

H. Accuracy Goals and The Job Load

The survey is designed to provide an area accuracy of about 2 percent per million acres of commercial forest land in each district. An accuracy of about 2 percent per billion cubic feet is sought in northeastern counties and about 3 percent in the remainder of the State. This will require the following dots and plots which are shown for areas worked by the Station (sample units 6-9 and part of 1), the IRR/RC (sample units 2 to 5 and part of 1), and other cooperators.

Table 1.---The Forest Inventory Job Division.

<u>ITEM</u>	<u>UNIT</u>	<u>TOTAL</u>	<u>STATION</u>	<u>IRR/RC</u>	<u>OTHER COOPERATORS</u>
Gross area	Million acres	53.80	34.54	12.00	7.26
Forest area	Million acres	19.34	6.21	8.03	5.10
Photo dots	Thousand dots	707.80	460.60	247.20	-
Forest dots	Thousand dots	173.70	68.40	105.30	-
Stereo dots	Thousand dots	18.82	7.11	11.71	-
New plots	Each	5,787	1,858	3,929	-
Nonforest checks	Each	10,879	7,830	3,049	-
Reoccupied plots	Each	1,600	700	900	-

The inventory job, plus an ownership study, a form factor study, a study of forest products utilization factors, and a timber production survey will require approximately 1,700 man-days of field crew time from the Lake States Forest Experiment Station and 3,600 man-days total time from IRR/RC personnel. The field job will require approximately 1-1/2 years for Lake States crews and about 2-1/3 years for IRR/RC men. Field work should be completed in December, 1961.

The job load by survey areas is shown in Table 2.

Table 2.--The Job Load for the Station and IRR&RC. 1/

Item	Unit	SURVEY AREAS									Total
		1	2	3	4	5	6	7	8	9	
Counties	Number	2-1/2	3-1/2	3-1/2	4-1/2	4	14	13	7	35	87
Gross area	Million acres	4.47	5.52	5.03	5.44	2.30	6.69	4.90	5.08	14.38	53.80
Forest area	Million acres	4.02	3.70	3.51	3.87	1.03	1.46	0.74	0.64	0.38	19.34
Photo dots	Thousand dots	32.00	75.60	68.90	74.50	31.50	91.60	67.10	69.60	197.00	707.80
Forest dots	Thousand dots	23.30	19.60	41.80	32.80	12.30	19.90	10.10	8.70	5.20	173.70
Stereo dots	Each	2,590	2,180	4,650	3,640	1,370	1,990	1,010	870	520	18,820
Forest ground checks	Each	865	733	1,563	1,229	470	405	213	186	123	5,787
Nonforest ground checks	Each	118	926	770	796	641	1,434	1,140	1,218	3,836	10,879
Remeasure permanent plots	Each	(350)	()	(650)	()	()	()	(600)	()	()	1,600

Accuracy Per million acres 1.9 1.6 1.7 1.7 1.7 2.7 (2.1)

1/ The photo classification of dots as forest and nonforest and the ground checking of this work will cover the entire State. Other work shown here covers all the State except the 5.1 million acres of forest land cruised by other cooperators.

III. TIMBER PRODUCTION SURVEYS AND UTILIZATION STUDIES

Periodic timber cut surveys are needed to show the current rate and change of cutting by species, product, and ownership throughout the State. These and other survey data are needed as a basis for making long range growth predictions, revisions, and adjustments in timber management plans, timber sale programs, and wood procurement policies.

This timber cut plan combines the most promising features of industry and landowner canvasses and the stump count approach for determining timber drain. Data will be collected for appraising the timber cut by species, tree-size, stand-size class, forest product, and ownership on a Statewide, district, and in some cases, on a county basis. Four sources of data are needed to estimate the volume of timber removed from each of the Forest Survey districts and ownership groups in the State.

A. Production Reports from Industry

The Station will make a comprehensive canvass of the large primary wood-using industries in the State. These surveys will be the same as those conducted during the second Forest Survey. Prior to the industry canvass the Station will check industry listings through associations, individual members of industry, and other sources.

All pulp, veneer, cooperage, excelsior, chemical, charcoal, and miscellaneous plants drawing logs and bolts from Minnesota will be contacted. A regionwide canvass of such plants is necessary because of the large quantities of logs and bolts that move across State lines. In addition, other producers and consumers of raw wood materials will be contacted--such as dealers, wholesalers of utility poles and piling, and mine operators.

1. Sawmills.--A survey of 1960 lumber production will be made by the Office of Iron Range Resources and Rehabilitation and the Minnesota Conservation Department. The Office of IRR/RC plans to make a 100 percent canvass of sawmills in the area commonly referred to as the 16 northern Minnesota counties. This area accounts for approximately three-fourths of the State's lumber output each year. In addition, a random selection of 8 counties will be made in the remainder of the State. Farm foresters employed by the Minnesota Conservation Department plan to make a complete field canvass of sawmills in the 8-county area.

In addition to lumber production estimates, these two State agencies plan to collect information on markets and milling equipment. Current data on these items are much desired by local foresters in order to carry on an active program with loggers, primary wood-using plants, and secondary users of wood.

The Station, following the same schedule of forest industry surveys as years past, will determine the cross-boundary movement of lumber logs in 1960. We plan to contact all the larger sawmills (5 million board feet or more of annual production) in Minnesota, Wisconsin, and Michigan which customarily obtain lumber logs and bolts from out-of-state. Procurement by these mills account for most of the movement of logs between Minnesota and neighboring states. Most of these large sawmills are members of the Northern Hardwood and Pine Association, and officials of the organization will follow-up on any nonreporting member mill. Any nontrade association mills that fail to report will be contacted by Station personnel. Information from individual sawmills will be obtained by mailing forms, "Logs, Bolts, and Cordwood Receipts, 1960", Bureau of the Budget No. 40-R2525.2 to each mill asking for a report showing the quantities of logs received by States and Canada. All reports are expected to be received by mail, thereby eliminating the need for any field follow-up.

These interstate log data together with lumber production figures collected by State forestry agencies will provide the information needed for estimating the 1960 output of lumber logs and bolts in Minnesota.

2. Pulp, Veneer, Cooperage Mills, etc.--Production and cross-boundary movement of logs and bolts from pulp, veneer, cooperage, excelsior, wood distillation, and charcoal plants will be obtained from a 100 percent canvass of plants in the Lake States region. Pulp mills will be asked to fill out a new form entitled, "Pulpwood Received, 1960" (see appendix).

The data obtained from pulp mills will show separately by species the quantity of rough and peeled wood received by county. Also, information will be obtained showing the quantity of pulpwood imported from other States and Canada. The pulpwood survey will furnish much of the information needed towards getting timber cut estimates for each of the 16 northern Minnesota counties.

Information from veneer, cooperage, excelsior, and charcoal plants will be obtained by mailing form, "Logs, Bolts, and Cordwood Received, 1960" No. 40-R2295.4 to each mill. A second mailing to nonrespondents will follow about a month after the initial contact. Field follow-up is not expected to exceed 5 mills. Station personnel will contact the non-reporting mills. With a 100 percent coverage of mills no sampling errors will be involved.

3. Poles and piling.--Production estimates for these items will be obtained through contacts with each individual dealer and wholesaler handling local poles and piling. A current listing of individuals or companies who handle these items has been compiled. It appears that 40 dealers and wholesalers handle most of the poles and piling produced in the Lake States. Information will be obtained by mailing forms, "Report on Utility Pole and Piling Receipts, 1960". Field follow-ups, where necessary, will complete the 100 percent canvass.
4. Round and split mine material.--Most of the mine timbers and other round or split wooden mine products produced in Minnesota are used by local mine operators. A small amount is transported to Michigan and Wisconsin mines. A current listing of mines has been compiled from information obtained from the Minnesota Mines Experiment Station, Michigan College of Mining and Technology, and the U. S. Bureau of Mines. It is planned to mail out questionnaires to the 35 active mine operators in the region. Information on the quantities of the different kinds of round and split wood mine materials purchased during the year will be obtained by mailing form, "Report on Mine Timber Receipts, 1960". With a 100 percent coverage of mine operators no sampling errors will be involved.
5. Fuelwood and fence posts.--A comprehensive fuelwood and fence post survey was made in Minnesota during the second survey. Fuelwood and fence post estimates were computed from data obtained from a stratified road sampling procedure. About 2 percent of the farmers and other forest residents were contacted in each county for fuelwood and fence post information. Because of this rather comprehensive 1953 survey, it is not considered necessary to conduct another survey of these two items again in 1961. It is proposed that the rate of change in the output of these items be measured through a production index. The fuelwood and fence post data contained in the U. S. Census of Agriculture Publication by States and Counties would provide such an index. The rate of change registered in the Minnesota farm cut from 1954 to 1959 will be applied to the Station's fuelwood and fence post estimate to come up with revised production figures for 1960 on a county, district, or Statewide basis.

6. Forecast of contacts required.

Type of contact	Number of contacts by states:			
	Minnesota	Wisconsin	Michigan	Total
A. Primary wood-using plants:				
1. Large sawmills ^{1/}	4	8	10	22
2. Medium and small sawmills	1,200	-	-	1,200
3. Pulp mills ^{2/}	12	29	13	54
4. Veneer plants	10	45	15	70
5. Cooperage plants	2	4	-	6
6. Excelsior mills	-	4	2	6
7. Chemical and charcoal plants	5	10	6	21
8. Misc. plants ^{3/}	20	-	-	20
Total	1,253	100	46	1,399
B. Other consumers of logs and bolts:				
1. Pole and piling dealers	20	15	8	43
2. Mine operators	20	2	13	35
Total	40	17	21	78
Grand Total	1,293	117	67	1,477

1/ Annual lumber output 5 million board feet or more.

2/ Includes two Canadian mills drawing wood from Minnesota

3/ Mostly lath and shingle mills.

7. Sampling accuracy.--The sampling accuracy goal for timber cut is 5 percent per billion cubic feet at one standard error. By assuming the timber cut from growing stock will be somewhere between 140 and 160 million cubic feet in 1960, the allowable error will be about 13 percent for Minnesota. Assuming that in 1960 the timber cut by product in Minnesota will be approximately the same as in 1954, the estimated distribution of cut is shown below. By conducting intensive production surveys for the major forest product as outlined in this plan, the error for total timber cut in the State should be less than 5 percent, which is well within the limits of the required accuracy.

Timber Cut by Forest Products and Sampling Accuracy, Minnesota

Timber product	:Estimated :volume of :timber cut : 1954	:Sampling :error of :production :estimates	: Error : of :converting : factors	:Estimated :error of : timber : cut
	<u>Thousand Cu. ft.</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Lumber logs and bolts	34,884	8	25	7.6
Veneer logs and bolts	2,321	0	25	1.7
Cooperage logs and bolts	3	0	-	-
Pulpwood	63,822	0	25	1.8
Poles and piling	1,614	0	25	1.7
Mine timbers, etc.	1,557	0	25	1.7
Other	39,923	15	40	14.2
Total	144,124	4.6	16.8	4.4

B. Stump Tallies on Forest Survey Plots

Cutting information on each permanent and temporary sample plot will be obtained at the same time tree measurements are made. Stumps of all trees cut during the 3-year period preceding inventory (except stumps of cull and dead trees) will be tallied. Stumps will be measured and recorded by size and species (see Item III H. in appendix). The stump data will be used as a basis for prorating industry drain by forest survey districts, tree-size classes, diameters, timber types, sites, etc. as needed. Field guides for determining age of stumps are available by species groups for upland and lowland areas (see mimeographed report, "Guides for Estimating Age of Stumps of Some Important Tree Species, Minnesota, March, 1960".)

Stump tally will be converted to standing timber volumes through use of special volume tables. The volume tables are based on sample felled trees collected at many widely scattered logging operations throughout the State.

C. Cutting Reports from Various Classes of Owners.

Wide differences in the allowable cut and actual cut of the various classes of owners were recognized early in the second Forest Survey. As part of the current Minnesota timber cut plan the Station will contact all large industrial timberland owners and public landowners for cutting reports. These reports will show separately the quantity of rough forest products harvested from such lands in 1960. Fourteen contacts are required to obtain the necessary information, including 5 federal agencies, 2 state agencies, and 7 large private owners. The information will be obtained by mailing form, "Report on Logging Operations, Minnesota" to the large private owners. Timber products data will be obtained from public landowners through cutting reports which are prepared by each of them at the end of each calendar or fiscal year. Such reports will make possible timber cut computations for the large industries and each class of public landowner.

D. Study of Forest Products Utilization Factors.

A regionwide study of logging residue was made during the 1952-53 logging season but factors from that study may not be applicable in 1961. For example, the wave of timber moving from poletimber to small sawtimber-size has resulted in a larger proportion of sawtimber being cut for timber products. This change in itself justifies the need for another study.

All timber products output data collected through production surveys must be converted into terms of growing stock (sawtimber and poletimber). To make such conversions, utilization factors are needed for each major product, taking into account logging residue, overutilization, etc. Basic data for computing such utilization factors will be obtained by measuring felled trees at going logging operations. Eight hundred sample felled trees will be measured to determine product volume and logging residue per standard unit of measure for each of the major products. Apportionment by product and district will be made on the basis of past timber products output records. Tree measurement data will be obtained at 5 widely scattered study areas in the State. All in all, about 50 logging operations will be visited. In addition to the woods studies, 10 companies handling poles, piling, round parts, hewn ties, and other piece products will be contacted. Data will be tallied on, "Field Form for Recording Felled Tree Measurement Data". For further information concerning logging residues study see, "Study of Forest Products Utilization Factors, Minnesota, March, 1960".

E. Mill Residues Resulting From Processing Logs and Bolts.

A survey will be made to estimate the quantity of coarse and fine mill residue resulting from the primary manufacturer of logs and bolts. Survey findings will also show the disposition of plant residue such as slabs, veneer cores, trimming, sawdust, etc.

Fig. 9.-- FIELD FORM FOR RECORDING FELLED TREE MEASUREMENT DATA

- | | | |
|-------------------------|--------------------------------|--------------------------------|
| 1. Field party _____ | 8. Stump height _____ | 14. Stump to 8" top _____ ft. |
| 2. Date _____ | 9. Stump diameter _____ | 15. Stump to 6" top _____ ft. |
| 3. Study area _____ | 10. DBH _____ | 16. Stump to 4" top _____ ft. |
| 4. Ownership _____ | 11. Major product _____ | 17. Stump to 3" top _____ ft. |
| 5. Tree Number _____ | 12. Other products _____ | 18. Total height _____ ft. |
| 6. Tree condition _____ | 13. Ground to 17.3' _____ | 19. 1/2 total height _____ ft. |
| 7. Species _____ | 20. Diameter I.B. _____ Inches | |

A. SECTION FOR RECORDING LOG AND BOLT SECTIONS USED AS PRODUCTS

Section number	Length (feet)	Cull Percent	Cause	Merchantable stem		Upper stem	Limewood	Cull logs	Log grade
				Bd. ft.	Cu. ft.	Net volume Cu. ft.	Net volume Cu. ft.	Net volume Cu. ft.	
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
Total									

B. SECTION FOR RECORDING LOGGING RESIDUE & DAMAGE:

(Net volumes)

Item	Waste section No.	Length (feet)	Merchantable stem		Upper stem	Unused cull
			Bd.ft.	Cu.ft.	Cu.ft.	sections of bole
Logging residue						
Logging damage						

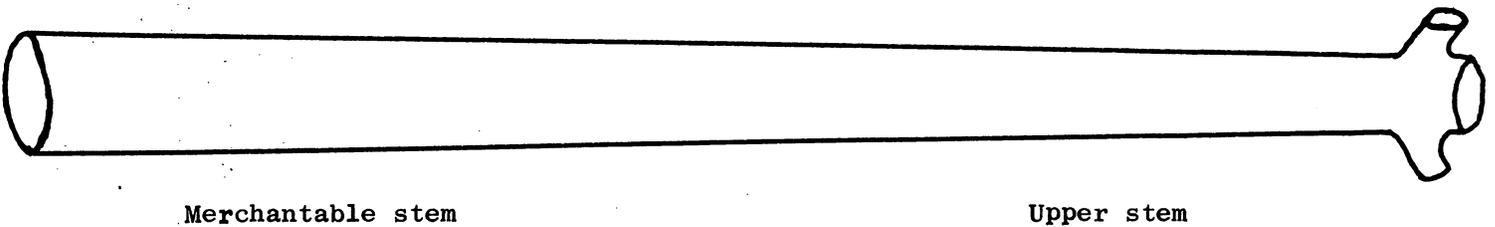
C. SECTION FOR RECORDING UPPER STEM AND LIMBWOOD:

Item	Volume to 4" DIB Minimum	
	Gross	Net
	Cubic feet	
Upper stem		
Limewood:		
Usable		
Other		
Total		
All Items		

D. SECTION FOR DIAGRAMMING TREE PORTIONS USED AND LEFT IN WOODS & RECORDING VISUAL DEFECT.

Classification of visual defects
By Code No.
(Code 1 through 9)

Severity of defect
By Code No.
(Code 0, 2, 3, 6, 8)



CLASSIFICATION OF VISIBLE DEFECTS AFFECTING SCALE

Use the following 2-digit code to indicate the type and seriousness of each visible defect affecting scale which will cut out separately. When several defects cut out together, code the principal ones indicating their proportion of loss in the section. If one visible defect affects more than 8 feet, indicate approximate length of defect by arrow. Sum of the severity codes for a tree multiplied by 2-1/2 should approximate total percent of defect in the tree.

CODE TYPE OF DEFECT

- 1 No visible defect.
- 2 Flange, flute, or bark pocket.
- 3 Fork, branch, knot, adventitious twig, or bud cluster.
- 4 Sweep or crook.
- 5 Stump swell, stem bulge, bump, swollen branch collar, burl, and overgrown wounds.
- 6 Bark canker or sun scald.
- 7 Seam, crack, or split.
- 8 Wounds (over 4-inches wide) or holes.
- 9 Conks or decaying wood.

CODE SEVERITY OF DEFECT

- 0 No visible defect of consequence.
- 2 Minor defect (roughly equivalent to loss of 1 foot section or 5% of tree volume).
 - Type 2 defect extending up to 2-inches into cylinder of log.
 - Type 3 and 5 defects 4-5.9 inches wide (flush with stem).
 - Sweep or crook 5-14 percent of top d.i.b. of 8-foot section.
 - Minor (10-19 percent of normal diameter) butt swell.
 - Wood not over 4 inches wide (horizontal), exposed.
 - Wound less than 2 years old except sound scars.
 - Short (under 2 feet long) tight seam.
 - Single, new ant entrance.
- 3 Moderate defect (roughly equivalent to loss of 3-foot section or 7% of tree volume).
 - Type 2 and 3 defects larger than in 2 (above).
 - Sweep or crook 15-27 percent of top d.i.b. of 8-foot section.
 - Wood (over 4-inches wide) exposed 2-5 years but no signs of decay except in sapwood.
 - Bumps and overgrown wounds over 2 feet long and 6-7.9 inches wide (flush with stem).
 - Tight seam over 2 feet or open crack or seam under 2 feet long.
 - Moderate (20-29% normal diameter) butt swell extending 2-4 feet above ground.
 - Single old ant entrance.
- 6 Severe defect (about 15 percent of tree volume).
 - Sweep or crook 28-37 percent of top d.i.b. of 8-foot section.
 - Overgrown wounds 8+ inches wide (flush with stem).
 - Wounds 5+ years old exposing heartwood; signs of incipient decay in heartwood.
 - Small perennial conks or decaying wood in upper stem.
 - Open seams or cracks aggregating under 4 feet.
 - Severe (30-39% normal diameter) butt swell.
 - Less than 2 feet of hollow stem.
 - One or two groups of ant entrances.
- 8 Very severe defect (about 20% of tree volume).
 - Sweep or crook 38+ percent of top d.i.b. of 8-foot section.
 - Swollen branch collars (aspen and conifers).
 - Conks, heart-rot cankers or exposed wood with advanced decay.
 - Open seams or cracks aggregating over 4 feet long.
 - Excessive (40% normal diameter) butt swell extending 4+ feet.
 - More than 2 feet of hollow stem.
 - Three or more scattered ant entrances.

The survey will be made in conjunction with the canvass of primary wood-using plants in Minnesota. The Station will collect the necessary mill residue information from all the pulp, veneer, cooperage, and miscellaneous, primary wood-using plants operating in the State. The State agencies plan to collect mill residue data from all sawmills operating in the 16 northern county areas and the 8 sample counties in the south-half of the State. All in all, it is estimated that information will be obtained from more than 1,200 local primary wood-using plants (see table, page 23). The data will be recorded on the form entitled, "Percentage Disposition of Plant Residue." The estimate of the total volume of plant residue will be made by applying conversion factors which were developed in special mill studies.

IV. A STUDY OF COST AND FEASIBILITY OF DETERMINING AREA CONDITION CLASSES BY SIZE OF OWNERSHIP.

As part of a nationwide study we will collect area condition classification and size of ownership at about 153 locations in Minnesota. Since this study must be completed promptly, the samples will be collected during the regular inventory in areas that will be covered by the end of August, 1960.

The following distribution by counties is proposed:

Itasca	75 samples (every fourth plot)
Stearns	27 samples (every plot)
Goodhue	19 samples (every plot)
Winona	<u>32 samples (every plot)</u>
Total	153 samples

At the selected locations, the following tasks will be done:

- A. Prepare an Ownership Record (figure 10). Indicate the location and field plot number. Record the current classification of stocking, size-class, type and area condition. For Minnesota; these may be obtained from the Point and Angle-gauge Tally Sheet (instead of the Point Sample Tally and Summary of the Ownership Record).
- B. The owner's name and address must be obtained for each sample. These can be obtained during the ownership tracing at each county court house. Check the ownership category.

Where convenient, the ownership questionnaire (figure 11), can be completed by personal contact when the plot is sampled; otherwise, the form must be mailed to the owner from St. Paul. Field men will be called on to follow-up on nonrespondents.

- C. The time needed to collect this information will be carefully estimated and recorded on the ownership tally form for every 4th sample. Record the proportionate cost of obtaining "area condition".

- D. The area of commercial forest land on each of the first 25 samples should be checked to determine if the owner's estimate is accurate by our definition of commercial forest land. The cruiser must determine which tracts are included in the ownership. Then make a calculation of commercial forest area using aerial photos and/or ground checking.

If sample location falls on public land do not complete questionnaire or area condition classification.

Send the first 5 ownership record forms to St. Paul for checking. After all ownerships have been sampled and all questionnaires are completed, they should be returned to St. Paul for summarizing. There, "area condition" will be reclassified from 8 to 5 classes. Point and Angle Gauge Tally Sheets must be attached to facilitate the recording.

V. FORM CLASS AND BARK THICKNESS STUDY

Experience has indicated the need for correction factors for use with the Lake States Composite Volume Tables to be based on diameter as well as species. Furthermore, form changes are somewhat different along the prairie margin than farther east. Hence, a form factor study of about the same size (800 trees) and following the same basic instructions as for the Second Missouri Forest Survey (page 51 of instructions) is planned. This will be supplemented by any data already available at the Station. The entire job will be done by Station personnel. About 60 man-days in the field are required.

VI. COMPUTING PLAN

Data collected by Station and Iron Range Resources and Rehabilitation personnel will be computed much the same as for the Second Missouri Forest Survey. This involves the use of the 650 IBM machine for computing volumes and growth, of simpler IBM machines for most other computations, and of hand methods where necessary. Growth rates and mortality will be determined from remeasurements of permanent plots rather than radial growth measurements and mortality estimates.

Data obtained from other cooperators will be added to our statistics after making any necessary adjustments. Much of this will have to be done by hand methods.

A computing plan for the Third Minnesota Forest Survey will be prepared during the fall of 1960.

Computing of special study data will be undertaken as soon as possible to provide correction or conversion factors for the survey. Survey data will be worked up by districts beginning about July, 1961. Considerable information within the districts will be computed by counties. A set of tables indicating information to be presented by district and by county is available. The entire computing job should be completed during the summer of 1962.

Figure 10.-- OWNERSHIP RECORD*
Lake States Forest Experiment Station
May, 1960

State _____ County _____ T. _____ R. _____ Section _____
 Field Plot No. _____

Subdivisions _____

Owner's Name and Address _____

Ownership Category: (Check one)
 Forest Industry (), Farmer (), Other Private (), Public ()

Size of Holding:
 Commercial Forest from Aerial Photo _____ Acres.
 Commercial Forest, Owner's Estimate _____ Acres.
 Classification of size, acres: (Check one)
 1-99 (), 100-499 (), 500-2,499 (),
 2,500-4,999 (), 5,000-49,999 (), 50,000+ ()

Point Sample Tally and Summary

Item	C	1	2	3	4	5	6	7	8	9	10	11	12
Current stocking	:	:	:	:	:	:	:	:	:	:	:	:	:
Species	:	:	:	:	:	:	:	:	:	:	:	:	:
Tree size	:	:	:	:	:	:	:	:	:	:	:	:	:
Stock w/o treatment	:	:	:	:	:	:	:	:	:	:	:	:	:
Excess stocking	:	:	:	:	:	:	:	:	:	:	:	:	:
Action needed	:	:	:	:	:	:	:	:	:	:	:	:	:
% by No. of points	:	:(8)	:(15)	:(23)	:(31)	:(38)	:(46)	:(54)	:(62)	:(69)	:(77)	:(85)	:(92)

Stocking Class	Prospective		Current Classifications
	Current	w/o treatment	
Growing stock: Desirable	_____ %	_____ %	Stocking (GS) _____ Size Class _____ Type _____
Poor	_____ %	_____ %	
Total	_____ %	_____ %	
Cull and noncommercial trees	_____ %	_____ %	Area Condition _____
Inhibiting vegetation and slash	_____ %	_____ %	
Nonstocked	_____ %	_____ %	
Nonstockable	_____ %	_____ %	

Time required, worker, and date:	Time to 0.1 Hour	Worker	Date
For area condition classification	_____	_____	_____
For forest area measurement on photos	_____	_____	_____
Name and address tracing	_____	_____	_____
Contacting and interviewing owners	_____	_____	_____
Tracing nonrespondents	_____	_____	_____
Total time for this sample	_____	_____	_____

* For a study of cost and feasibility of determining area condition classes by size of ownership.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
LAKE STATES FOREST EXPERIMENT STATION
ST. PAUL CAMPUS, UNIVERSITY OF MINNESOTA
ST. PAUL 1, MINNESOTA

IN REPLY REFER TO:

4800

As part of the nationwide Forest Survey, the Forest Experiment Stations of the U. S. Forest Service are compiling information on ownership of forest lands.

Records of _____ County, show that you own forest land in Section _____, T _____, R _____). This is one of several hundred tracts being covered by the present study. It would be most helpful if you would fill in the answers to the following questions, giving your best estimates where exact figures are not known.

1. How much land do you own?
In the above County? _____ acres.
In the above State? _____ acres.
Elsewhere in the United States? _____ acres.

2. How much of the above land is growing or capable of growing forest products, such as pulpwood and sawtimber, and not developed specifically for some other purposes? (This includes cut-over forest land which has not been improved for pasture or other uses).
In this County? _____ acres.
In the above State? _____ acres.
Elsewhere in the United States? _____ acres.

3. Do you operate a sawmill or other wood-using plant? _____

4. Do you operate a farm in the above-mentioned County? _____

All information on individual holdings will be held confidential.

A return envelope is enclosed for your convenience; no postage is required. An early reply would be most helpful, and your cooperation will be sincerely appreciated.

Very truly yours,

M. B. DICKERMAN, Director

By: James T. Morgan, Acting



5. (To be completed by Forest Expt. Station) Field Plot No. _____

APPENDIX

CLASSIFICATIONS, DEFINITIONS, AND CODES

Third Minnesota Forest Survey, May, 1960

I. AREA CLASSIFICATION

A. Land Area

Definition: The area of dry land and land temporarily or partially covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than one-eighth of a statute mile in width; and lakes, reservoirs, and ponds less than 40 acres in area.

On aerial photos the standard classification will include forest, water, and other nonforest areas. Questionable areas will be classified as forest.

On the ground the standard classification of land will indicate the primary character of the forest sites rather than the present cover. Thus, pine land is that land which is better qualified for growing pine than for growing other tree species. Other classifications of forest land include spruce-fir, swamp conifers, northern hardwoods, oak, lowland hardwoods, aspen noncommercial forest and wooded pasture. Areas in nonforest use are classified water or other nonforest. Wood pasture includes those areas of improved grazing land with over 10 percent tree cover but with less than 10 percent present or potential growing stock trees.

Land classification code:

Photo class

- 0 Forest
- 1 Questionable (if desired)
- 8 Water
- 9 Other nonforest

Ground class (land not cover type)

- 0 Pine
- 1 Spruce-fir
- 2 Swamp conifer
- 3 Northern hardwood
- 4 Oak
- 5 Lowland hardwood
- 6 Aspen
- 7 Wooded pasture
- 8 Water
- 9 Other nonforest
- X Noncommercial

1. Forest Land Area

Definition: Land at least 10 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest use.

Explanation: Includes all forested lands and lands suitable for forest trees which have not been developed for nonforest purposes. Does not include urban or thickly settled residential and resort areas, city parks, orchards, farm steads, improved roads, or lands developed and maintained for nonforest use by fencing, seeding, etc.

The minimum area for classification of forest land, or classes of forest land, is one acre. Roadside, streamside, and shelterbelt strips of timber must be at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams and clearings shall be classed as forest if less than 120 feet in width.

a. Commercial forest land

Definition: Forest land which is producing or capable of producing crops of industrial wood and not withdrawn from timber utilization.

Explanation: Industrial wood includes commercial products such as sawlogs and pulpwood but excludes fuelwood and fence posts.

b. Noncommercial forest land

Definition: Unproductive forest land incapable of yielding crops of industrial wood because of adverse site conditions and productive public forest land withdrawn from commercial timber use through statute or administrative regulation.

(1) Unproductive forest land

Definition: Forest land incapable of yielding crops of industrial wood because of adverse site conditions.

Explanation: Includes sterile and poorly-drained sites, and steep rocky areas. These lands ordinarily are valuable for watershed cover and many areas also are useful for grazing, recreation, or other purposes.

(2) Productive forest land reserved from commercial timber use.

Definition: Productive public forest land withdrawn from timber utilization through statute or administrative regulation.

Explanation: Includes lands physically suitable for the growing of timber crops but reserved for exclusive uses such as national parks, wilderness areas, municipal watersheds, etc.

2. Nonforest land (refer to definition of forest land area)

Code as follows in the forest cover columns.

<u>Code</u>	<u>Item</u>
91	Water-lakes, ponds, and flowage.
92	Other nonforest
93	Farmland (except farm woods), crop, orchard, or pasture land less than 10 percent stocked with forest trees.

3. Land use trend

This classification will be made at each ground check point to measure amount of changed land use since the previous forest survey.

<u>Code</u>	<u>Item</u>
0	Continuing forest use
1	Continuing nonforest use - grazing
2	Continuing other nonforest uses
3	Changed from forest to grazing
4	Changed from forest to cultivation
5	Changed from forest to urban
6	Changed from forest to mining
7	Changed from forest to water
8	Changed from forest to other nonforest
9	Changed from nonforest to forest

4. County Code (Minnesota)

01	Aitkin X	21	Douglas
02	Anoka	22	Faribault
03	Becker X	23	Fillmore
04	Beltrami X	24	Freeborn
05	Benton	25	Goodhue
06	Big Stone	26	Grant
07	Blue Earth	27	Hennepin
08	Brown	28	Houston
09	Carlton	29	Hubbard X
10	Carver	30	Isanti
11	Cass	31	Itasca X
12	Chippewa	32	Jackson
13	Chisago	33	Kanabec
14	Clay	34	Kandiyohi
15	Clearwater X	35	Kittson
16	Cook	36	Koochiching
17	Cottonwood	37	Lac qui Parle
18	Crow Wing X	38	Lake
19	Dakota	39	Lake of the Woods X
20	Dodge	40	Le Sueur

County Code (Minnesota) Con'td

41	Lincoln	65	Renville
42	Lyon	66	Rice
43	McLeod	67	Rock
44	Mahnomen	68	Roseau ✓
45	Marshall	69	St. Louis
46	Martin	70	Scott
47	Meeker	71	Sherburne
48	Mille Lacs	72	Sibley
49	Morrison	73	Stearns
50	Mower	74	Steele
51	Murray	75	Stevens
52	Nicollet	76	Swift
53	Nobles	77	Todd
54	Norman	78	Traverse
55	Olmsted	79	Wabasha
56	Otter Tail	80	Wadena
57	Pennington	81	Waseca
58	Pine	82	Washington
59	Pipestone	83	Watsonwan
60	Polk	84	Wilkin
61	Pope	85	Winona
62	Ramsey	86	Wright
63	Red Lake	87	Yellow Medicine
64	Redwood		

5. Land Ownership

The ownership of each stereoclassified point which is on commercial forest land (except for areas cruised by the IRR/RC) will be looked up in the county courthouse unless it can be ascertained in the field. IRR/RC men get ownership of each dot counted. The following classification will be used:

<u>Code</u>	<u>Item</u>
0	National forest lands. Federal lands which have been designated by Executive Order or Statute as national forests or purchase units and other lands under the administration of the Forest Service.
1	Bureau of Land Management
2	Indian. Indian tribal lands held in fee by the Federal Government, but administered for Indian tribal groups and Indian trust allotments.
3	Miscellaneous Federal
4	State. Lands owned by states or leased by the state for more than 50 years.
5	County
6	Municipal and school
7	Forest industry. Lands owned by companies or individuals operating wood-using plants. Indicate pulp and paper companies by P., lumber producers by L., and other wood products producers (both primary and secondary) by O. When an owner qualifies in more than one group, classify according to product using the largest cubic foot volume of timber.

Code Item

- 8 **Farmer-owned lands.** Lands owned by operators of farms. A farm operator is a person who operates a farm by performing the labor or directly supervising it. A farm is a place, operated as a unit, of 10 or more acres, from which the sale of agricultural products totaled \$50.00 or more, or a place operated as a unit of less than 10 acres from which the sale of agricultural products totaled \$250.00 or more. Lands leased from nonfarm owners are excluded. When an owner qualifies as both farmer and forest industry the ownership should be classed the latter if of significant commercial importance (intermittently operated farm sawmills would not meet this criterion unless they saw over 100 thousand board feet per year).
- 9 **Miscellaneous private lands.** Privately owned lands other than forest industry or farmer-owned lands. Include undivided interests.

B. Forest Stand Classifications

Commercial forest stands will be described by a number of classifications including type, size, stocking, site quality, area condition, age, basal area, and total height. In addition, any treatment needed will be recommended. All forest land will be described by the first 4 classifications. "Ground classification" indicates the present classification of land, type, forest cover, type, stand-size, and stocking.

The following instructions present the classifications and codes for determining and recording other stand information.

1. Frequency Index Sampling

The classification of forest type, stand-size, and density of stocking has always been quite subjective. As a result, type maps or point classifications for the same area varies considerably. The plot tally has not been a successful substitute because of its small size and its inadequacy for measuring distribution. These disadvantages were apparent regardless of whether the classification was based on numbers of trees, volume, or crown density. They were apparent in the 1947 Lake States standard classifications. The use of frequency index sampling^{1/}, long used by foresters in reproduction studies, provides an acceptable solution. The frequency index or "stocked quadrat" method involves sampling occurrence per unit area. "Quadrats" are classified as stocked if one (or more) growing stock trees are present. "Quadrat" size is determined by the number of well spaced trees needed to fully stock an acre. For seedlings and saplings, small ^{fixed} plots are used. Since the growing space needed increases with tree size, roughly in proportion to (d.b.h.),² it is possible to use the angle gauge to control "quadrat" size.

^{1/} Application of frequency index sampling to forest area classification has been advocated by A. A. Hasel and R. W. Larson of the U. S. Forest Service. "Proposed Area Condition Classes for Forest Survey-Review Draft, June 1959", and "Area Condition Classification, November 1959".

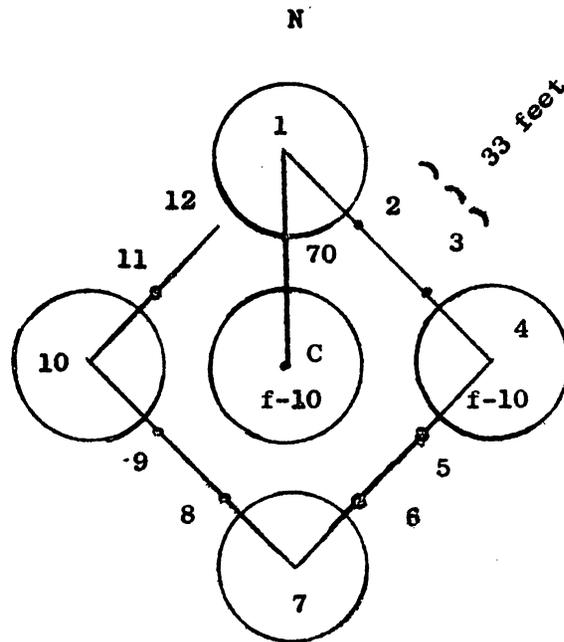
Point size recommended includes:

<u>ITEM</u>	<u>RADIUS</u> (feet)	<u>ANGLE-GAUGE</u> (factor)
All seedlings	3.7	
All 2-inch samplings	4.2	
All 4-inch samplings	4.7	
Brush, herbs, and sod	5.3	

For trees 5.0" and larger
 (With this scale distance in feet
 is equal to d.b.h. in inches.
 However, if the crown of a free
 growing tree, beyond the limiting
 distance, overtops and dominates
 the point, the tree is considered
 as stocking the point).

75

Hasel and Larson recommended the use of 20 points well distributed
 in a square pattern over the sample acre. To conserve time a
 sample of 13 points^{1/} will be used. Distribution of these points
 is shown for the sample acre:



Stocking of a point is determined by the presence of a tree stem
 of a free growing tree within the limiting distance, the crown
 (of a free growing tree) overtopping the point center though its
 stem is too far away, or sufficient brush foliage, grass sod, or
 slash to cover at least half the point.

^{1/} Thirteen points will be used except in northern Minnesota where the
 Iron Range Resources and Rehabilitation Office is using 12 points.

A free growing tree is one with at least one-half of its crown area open to the sky. Suppressed and intermediate trees will be ignored except for the better intermediates of tolerant species which should be considered free growing. A point will be classified for the most dominating tree (which may be desirable, acceptable, cull, or noncommercial). If no tree dominates the point, other classes are considered. Cover classes include:

- D - Desirable trees.--A healthy dominant or codominant tree with a crown more than 1/3 filled with foliage of good color and normal size; with no apparent physical weaknesses, pathogens, or insects present which are likely to kill or seriously deteriorate the tree within 10 years; having less than 10 percent loss of scale; capable of yielding now or prospectively at least one grade 1 or 2 sawlog or two 100-inch sticks of standard quality pulpwood. Any tree of commercial species meeting the above specifications may be classed desirable if 3" d.b.h. or larger. If smaller, it also must be of a species suitable for the type and site (Table 3.--Classification of Desirable Species by Forest Type and Site Group).
- A - Acceptable tree.--A free growing, growing stock tree which does not qualify as a desirable tree. Seedlings are D or C - never A.
- C - Cull trees and noncommercial species (nongrowing stock trees).
- I - Inhibiting vegetation (brush, herbs, or grass) and slash which inhibits growth.
- N - Nonstocked (temporarily not occupied by trees, inhibiting vegetation or slash).
- Z - Not stockable (water, rock, marsh, etc.)

The point classification will be recorded under, "Point Sample Tally and Summary" of the plot tally sheet. The species of the dominant tree occupying the point will be indicated using the regular species code. Tree-size will be indicated as r - reproduction (seedlings and saplings), p - poles or s - sawtimber. The stocking in 10 years without treatment will be indicated for those points lacking desirable trees now. This prospective stocking will be classified by the same symbols used for current stocking. If more than one tree over 1" d.b.h. occupies the point, record on the excessive stocking line as c (cull), or as r, p, or s (if growing stock) for each tree not tallied under current stocking. At each point not stocked with one desirable tree, the action needed to stock the point with a single desirable tree will be considered. Select the following action class which will provide the best silvicultural treatment for the particular point (without regard to the rest of the acre).

Table 3.--Classification of desirable species by forest type and site group.^{1/}

Type and Site	Code	01	02	03	11	12	13	21	22	23	31	32	33	34	35	37	38	41	42	44	50	51	53	54	61	62	71		
Red & white pine	01-02																												
SI below 65		D	D	D		D																							
SI 65+		D	D			D																							
Jack pine	03																												
SI below 50		D	D	D		D																							
SI 50+		D	D	D		D																							
Spruce-fir & cedar																													
Upland	10	D	D	D	D	D	D	D	D	D	D																		
Swamp	10-23	D	D		D	D	D	D	D	D																			
Black spruce & Tamarack	21-22								D ^{3/}	D																			
Northern Hardwoods	30																												
Upland		D	D		D	D	D				D	D	D	D	D	D	D												
Lowland		D			D	D	D	D			D	D	D	D	D	D	D												
Oak	40																												
SI below 60		D	D																										
SI 60+																													
Lowland Hardwoods	50																												
Aspen-paper birch	60																												
SI below 45		D	D	D		D																							
SI 45-59		D	D	D	D	D																							
SI 60+		D	D	D	D	D	D	D			D		D	D	D	D	D												

^{1/} Largely taken from Appendix, Table 91, Timber Resources for America's Future, Forest Resource Report No. 14.
^{2/} Not considered desirable in Minnesota.
^{3/} Considered desirable only in tamarack stands.

- C - Cut pole or sawtimber growing stock tree
- T - Other treatments than merchantable cut (TSI, deadening) to provide growing space
- S - Prepare site (seedbed) for natural regeneration
- R - Reforestation (planting or seedling) without site preparation
- SR - Site preparation (of any type) plus reforestation
- N - No action recommended
- NP - Nonproductive site. Not capable of growing a desirable tree

A No action should be recommended unless it is calculated to improve the stand. For example, cutting of intermediate or suppressed trees should not be recommended since their removal would have little effect on the growth rate of desirable trees. The goal is to record the work needed (in consideration of present silvicultural guides and tree characteristics) if the point is to become stocked with one desirable tree. No action is needed for point already stocked by a desirable tree or likely to be dominated by a nearby tree within 10 years; or for nonforest points. Grazed forest land will be handled as though grazing were to be discontinued.

The tally at each of 13 points on the sample acre facilitates a more accurate classification of the acre than could be accomplished by ocular estimation. Space is provided on the tally form for summarizing classification of the points.

The following procedure should be used:

1. Classify stocking (well, medium, poor, or nonstocked) based upon the proportion of points occupied by growing stock trees (omitting cull and noncommercial trees). Stocking classes are defined on page 40.
2. If over 10 percent stocked, rate stand-size class giving priority first to sawtimber then to poletimber; requiring 40 percent of the growing stock points as a minimum for predominance. If neither class qualifies but together they stock over half of the growing stock points, classify to the best represented of these classes (see chart, "Stand Classification in Minnesota by the Hasel-Larson Method"). Other stocked stands will be classed sapling and seedling. Stand-size classes are defined on page 41.
3. Classify forest cover type and age class for the stand-size class designated, limiting consideration to points stocked with trees of this size-class. Forest cover types are listed on pages 41, 43, stand ages on page 46.
4. Classify area condition on the basis of proportion of all points occupied by desirable trees and proportion occupied by inhibiting vegetation (including cull and noncommercial trees) and slash. Classes are given on pages 44 and 45. ?
5. Indicate the stand treatment needed to provide a stocking of at least 70 percent of the area with desirable trees, cutting or protection. Also show size of area. Classification are given on pages 45 and 46.

2. Stocking Classes

Stocking is the extent to which growing space is effectively utilized by growing stock trees (i. e. live sawtimber and pole-timber trees, saplings and established seedlings of commercial species). Cull trees are not considered in classifying stocking. Stocking percentages indicate actual stocking in relation to full stocking levels.

a. Well-stocked stands

Definition: Stands that are 70 percent or more stocked with growing stock trees.

b. Medium-stocked stands

Definition: Stands that are 40 to 69 percent stocked with growing stock trees.

c. Poorly stocked stands

Definition: Stands that are 10 to 39 percent stocked with growing stock trees.

d. Nonstocked

Definition: Areas of commercial forest land less than 10 percent stocked with growing stock trees.

All stands will be classed by a combination coding scheme.

<u>Code</u>	<u>Item</u>
0	Nonstocked
1	Restocking, Poorly stocked
2	Restocking, Medium stocked
3	Restocking, Well stocked
4	Poletimber, Poorly stocked
5	Poletimber, Medium stocked
6	Poletimber, Well stocked
7	Sawtimber, Poorly stocked
8	Sawtimber, Medium stocked
9	Sawtimber, Well stocked

3. Stand-size Classes

a. Sawtimber stands

Definition: Stands at least 10 percent stocked with growing stock trees and with a plurality of stocking by live sawtimber trees.

Explanation: Sawtimber trees are defined as trees of commercial species at least 9.0 inches in diameter breast height for eastern softwoods and 11.0 inches in diameter breast height for hardwoods containing at least one merchantable sawlog, and containing at least 50 percent sound volume in the sawlog portion of the tree.

A merchantable sawlog is defined as a log (a) with a minimum top diameter of 8 inches, (b) with a minimum length of 8 feet, (c) containing at least 50 percent sound volume; and (d) meeting the minimum log-grade specification. "Local-use" logs of poorer quality are not included even though locally used for low-grade lumber.

b. Poletimber stands

Definition: Stands at least 10 percent stocked with growing stock trees and with a plurality of stocking by poletimber trees.

Explanation: Poletimber trees are defined as trees 5.0 - 8.9 inches in diameter breast height for eastern softwoods, and 5.0 - 10.9 inches in diameter breast height for hardwoods,

c. Seedling and sapling stands

Definition: Stands at least 10 percent stocked and with a plurality of stocking by seedlings and/or saplings.

Seedlings and saplings are well established live trees of commercial species less than 5.0 inches in diameter and of good form and vigor.

d. Nonstocked

(See under 'stocking classification' above.)

4. Forest Cover Types

A forest type is a forest stand characterized by the predominance of area occupied by one or more key species. This differs from 1947 Lake States standards which were based on timber volumes for sawtimber and poletimber trees and numbers of seedlings and saplings.

Codes: Cover type codes are correlated with species codes for convenience and an aid to greater accuracy.

- (1) White pine type. ^{1/} A stand in which pine species predominate, with white pine the most common.
- (2) Red pine type. A stand in which pine species predominate, with red (Norway) pine the most common.
- (3) Jack pine type. A stand in which pine species predominate, with jack pine the most common.
- (10) Spruce-fir type. A mixed hardwood-coniferous stand, with white spruce and balsam fir the key species. May be subtyped balsam-fir if that species is most common or as white spruce if that species is most common.
- (21) Black spruce type. A stand in which swamp conifers predominate with black spruce the most common and with site index above 20 feet at 50 years.
- (22) Tamarack type. A stand in which swamp conifers predominate, with tamarack the most common and with a site index above 20 feet at 50 years.
- (23) White cedar type. A stand in which swamp conifers predominate, with white cedar the most common and with a site index above 15 feet at 50 years.
- (24) Redcedar type. A stand in which redcedar predominates.
- (30) Northern hardwoods type. A stand in which northern hardwood species (sugar maple, yellow birch, beech, and basswood) predominate. It may be subtyped hemlock if that species is the most common, or as red maple if that species is most common.
- (40) Oak type. A stand in which the oak and hickory species predominate. If the site is incapable of producing commercial products such as sawlogs and pulpwood, it should be classed as unproductive upland. If the site is incapable of producing commercial oak products but is capable of producing merchantable jack pine, red pine, or other species, it should be classed as "oak", i.e., commercial forest land.
- (50) Lowland hardwoods type. A stand on overflow or poorly-drained land in which lowland hardwood species such as ash, elm, and associated wetland hardwoods predominate. It may be subtyped ash if that species predominates.

1/ A forest type is a forest stand characterized by the predominance of area occupied by one or more key species.

- (53) Cottonwood type. A stand in which cottonwood predominates.
- (61) Aspen-birch type. A stand in which a mixture of trembling or large-toothed aspen, balsam poplar (Balm-of-Gilead), and paper birch predominate. It may be subtyped as paper birch if that species is most common, or as unproductive lowland or unproductive upland if the site is not capable of producing a commercial wood crop. A site occupied by aspen but incapable of producing commercial aspen products which is capable of producing merchantable crops of other species should be classed as "aspen", (commercial forest land).
- (72) Upland brush. Productive uplands supporting upland shrubs such as hazel, sumac, sweet fern, juniper, etc., from which forest trees have been removed to less than 10 percent stocking.
- (73) Upland grass. Productive uplands of upland grass and herbs from which forest tree stocking has been reduced to less than 10 percent. Includes permanently abandoned fields less than 10 percent stocked with forest trees but not prairie grass areas.
- (75) Lowland brush. Productive lowland supporting such lowland shrubs as alder, willow, dogwood, Labrador tea, etc., from which forest trees have been removed to less than 10 percent stocking. If trees are not present to establish commercial forest site quality, there must be stumps or snags of sufficient size, or local records to indicate the area can support forest trees.
- (76) Lowland grass. Productive lowlands of grass and sedges from which forest trees have been removed. If trees are not present to establish commercial forest site quality, there must be stumps or snags of sufficient size, or local records, to indicate the area can support forest trees.
- (81) Unproductive upland. Noncommercial forest on dry mineral soil or rock areas supporting, or capable of supporting, at least 10 percent stocking of forest trees but possessing such adverse site conditions that no species normally occupying such sites could meet commercial forest definitions.

Explanation: This category includes stunted stands of any upland species growing on extremely barren, rocky, or sandy lands or very adverse slopes. It replaces old classes such as "offsite aspen," "offsite oak," and similar types, but must not be used for lands with a poor forest cover due only to the wrong species for the site. For example, a very poor stand of aspen on outwash sands capable of growing merchantable jack pine would be classed as "aspen" - i.e., commercial forest land now in aspen type.

- (82) Unproductive lowland. Noncommercial forest on lowlands supporting, or capable of supporting, at least 10 percent stocking of forest trees but possessing such adverse site conditions that the characteristic tree species do not attain minimum site index for commercial forest.

Explanation: "Lowlands" means peatlands, bogs, swamps, and similar wet areas even though some actually occur on divides. This category replaces such old classes as offsite spruce (Sx), offsite tamarack (Tx), offsite cedar (Cx), and some borderline cases where aspen, jack pine, or other species may occupy very poor lowland and bogs. Minimum site index for commercial black spruce and tamarack stands is 20 feet at 50 years; for northern white-cedar 15 feet. Black spruce bogs of site index 10-20 feet should be classed as Christmas tree spruce land.

- (83) Christmas tree spruce land. Noncommercial black spruce forest capable of producing crops of Christmas trees.

Explanation: Includes spruce bog forest of less than site index 20 but more than site index 10 feet at 50 years. The stand need not be merchantable for Christmas trees but should be primarily black spruce and more than 10 percent stocked.

5. Area Condition Classes

Area condition class, as used herein, refers to condition of commercial forest land with respect to current productivity. The net wood growth produced on an area and its quality determines productivity. Stocking is basic to determining area condition.

The goal in stocking is to have at least 70 percent of the area occupied by desirable growing stock. The degree to which stocking of desirable trees is short of this goal and the presence or absence of adverse conditions will be used in rating the condition of the stand (or area if not stocked).

Condition class will be recorded in one of five classes.

<u>Code</u>	<u>Definition</u>
-------------	-------------------

1	Areas 70 percent or more stocked with desirable trees.
---	--

2	Areas 40 to 70 percent stocked with desirable trees and with less than 30 percent of the area controlled by inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.
---	---

3	Areas ⁴⁰ /to 70 percent stocked with desirable trees and with more than 30 percent of the area controlled by inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.
---	---

Code Definition

- 4 Areas less than 40 percent stocked with desirable trees and with adequate seed source and seedbed favorable to natural restocking.
- 5 Areas less than 40 percent stocked with desirable trees and with inadequate seed source and/or seedbed unfavorable to natural regeneration.

6. Recommended Stand Treatment

The primary stand treatment needed on each sample acre will be indicated by a three digit code. The first digit will indicate the need for cutting, stand improvement, or reforestation. The second will show need for protection to improve productivity, and the third will give size of the type-size-density class area represented by the acre as one measure of practicability of stand treatment action.

Treatment

Code Item

- 0 No treatment recommended
- 1 Emergency harvest cut (within 5 years)
- 2 Other harvest cut
- 3 Commercial stand improvement
- 4 Noncommercial stand improvement
- 5 Reforest only
- 6 Site preparation and reforest
- 7 Site preparation only

Protection

Code Item

- 0 No protection recommended
- 1 Disease
- 2 Insects
- 3 Domestic animals
- 4 Game animals
- 5 Porcupines
- 6 Other protection needed
- 7 Drainage needed to improve productivity

Size of type-size-density area for which treatment applies.
(approximated by cruiser).

<u>Code</u>	<u>Item</u>
1	1 acre
2	2 acres
3	3-9 acres
4	10+ acres

7. Stand-age

Age of the main stand will be indicated for both even and uneven age stands. It will normally be determined by boring one or a few free growing trees in the main stand. Refer to instructions for determining tree age in Section III J.

Stand-age in Minnesota will be indicated by the following one digit code:

<u>Code</u>	<u>Item</u>
0	0-9 years
1	10-19 years
2	20-29 years
3	30-39 years
4	40-49 years
5	50-59 years
6	60-79 years
7	80-99 years
8	100-119 years
9	120+ years

8. Site Classification

Forest Site classifications are used to measure quality of the land for raising timber products. To improve estimates of area by site classes this measure will be made in Minnesota on aerial photos as well as on the ground.

a. Photo site

Each forest point which is stereoscopically examined will be classified. Photo site classes must be based on information visible on aerial photos. This is largely physiographic, depending on land forms, topography, and drainage. Criteria are different in north and south.

(1) For southern Minnesota the following guides may be used:

<u>Code</u>	<u>Class</u>
1	Good site Lower 1/2 N & E moderate slopes Bottoms Sheltered coves
2	Medium site (2) Upper 1/2 N & E moderate slopes Lower 1/2 S & W moderate slopes Better ridges (broad flat low) Gentle S & W slopes
3	Poor site Upper 1/2 S & W moderate slopes Poorer ridges steep slopes
4	Unproductive The driest S & W upper slopes The wettest peat or muck bottoms (except marshes)

(2) For northern Minnesota
(to be used only by experienced interpreters).

<u>Code</u>	<u>Class</u>	<u>Site index by group - logs per tree</u>
1	Good	SI 70+ group A 3+ SI 60+ group B SI 50+ group C
2	Medium	SI 50-70 - group A 1 - 2-1/2 SI 40-60 - group B SI 30-50 - group C
3	Poor	SI 35-49 - group A 1/2 - 1 SI 25-39 - group B SI 20 ¹ / ₂ - 29 - group C
4	Unproductive - below poor	

When group A includes aspen, white birch, white pine, and oak (also include northern hardwoods and lowland hardwoods here for lack of better information).

Group B includes red pine, jack pine, white spruce, and balsam fir.

Group C includes cedar, black spruce, and tamarack.

1/ Fifteen for northern white cedar.

9. Site Index

Site index at age 50 will be used to indicate growth potential of the site from field measurements. This depends on age of a free growing tree selected from the main stand or overstory and total height of said tree. Using these measurements the corresponding height at age 50 will be determined from site index curves, (figure 12), for the species involved. Site index will be determined for the species best representing the type of forest cover (see page 38).

Site index cannot be measured in the regular way for trees below about 15 feet. If nearby trees suitable for measuring site are not present, the following guides may be used. For softwood stands estimate site index on the 5-year intercept method using the following table.

<u>Height growth</u> <u>during last 5 years</u>	<u>Estimated</u> <u>site index</u>
3 feet	33
4 feet	42
5 feet	50
6 feet	57
7 feet	62
8 feet	67
9 feet	71
10 feet	74
11 feet	75
12 feet	76

Jack pine, tamarack, and cedar tend to have site index slightly below the average in the table; white pine will be slightly above the table. For hardwood stands below 15 feet the site index must be estimated based on ocular appraisal of soil, drainage, vegetation, etc.

Site index will be recorded in 4 digits; the first two indicating species; the second two the height in feet at 50 years of age. When more than one species is well represented in the stand an "extra site" reading on the second species will be noted by IRR/RC men. This will indicate relationship of site indexes for various species.

10. Basal Area

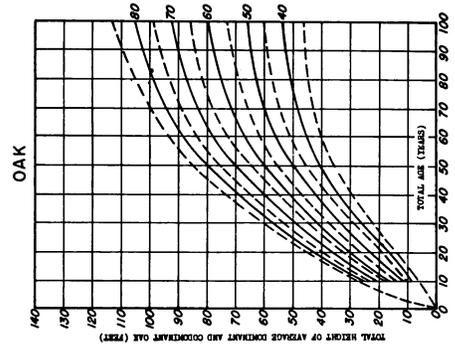
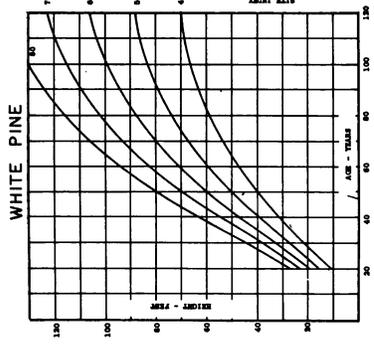
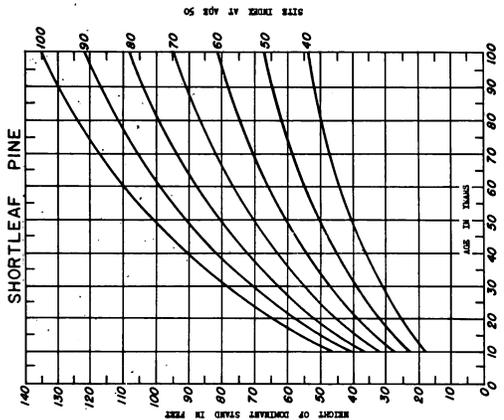
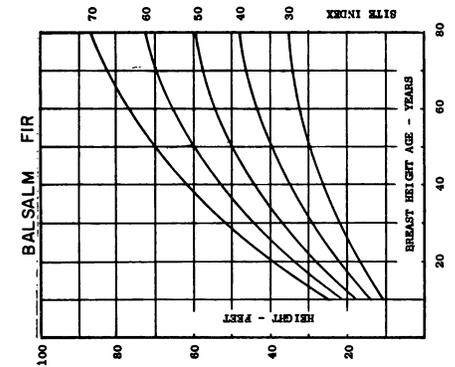
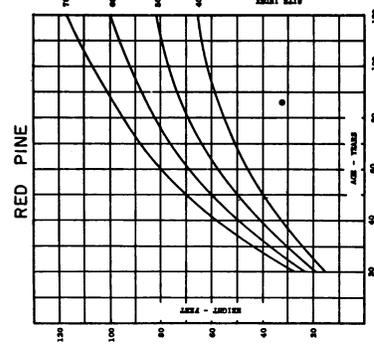
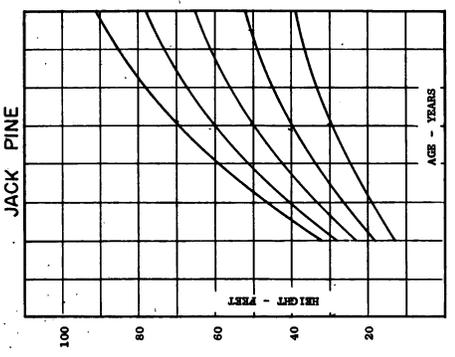
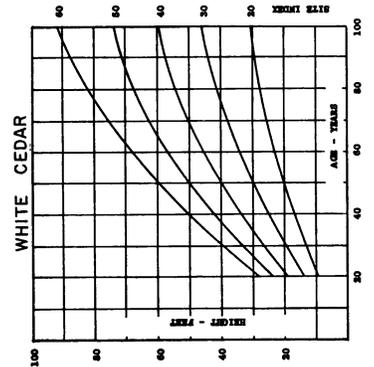
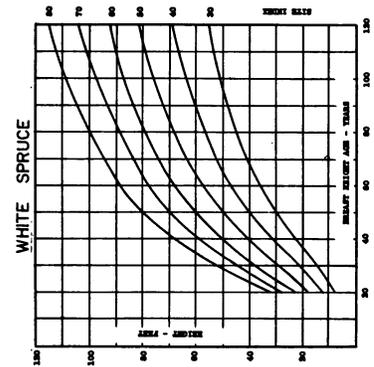
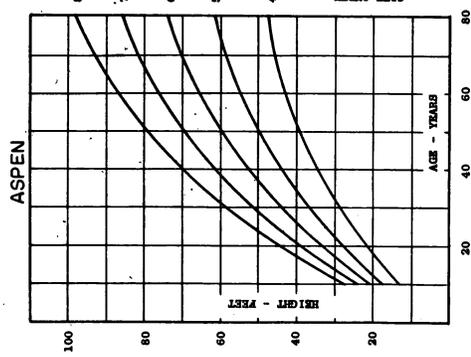
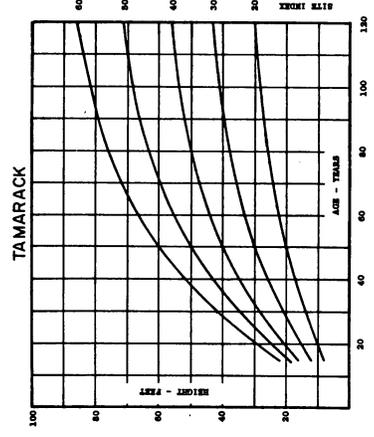
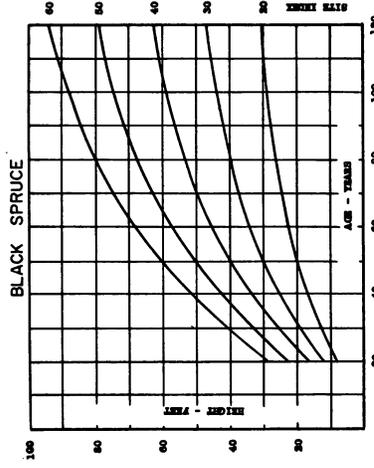
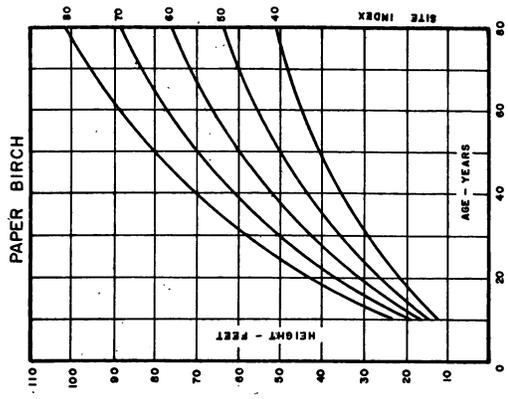
The basal area of growing stock trees over ¹/₂ inch d.b.h. in square feet per acre will be determined from trees tallied on 5 subplots.

11. Total Height

The total height above ground level of the average tree of the main stand will be measured and recorded to the closest even foot.

Figure 12.- SITE INDEX CURVES

REGION 9



USA-GS-MILWAUKEE, WI 1331

12. Map Type

Map type is the classification of an area 2-1/2 acres or larger in which the point falls. It will be made on every plot. It refers to the forest cover type, stand-size and stocking classification of the area now made according to instructions for the Second Minnesota Forest Survey. It will enable comparison of current area figures with those of the previous survey. Map type will be indicated by the codes now in use.

13. Previous ground class

This space is to be used for all old permanent plots and those new plots where cutting has occurred and stumps are tallied. Report the type, stand-size, and density using the Hasel-Larson Method before the timber was cut.

14. Number of growing seasons

To be used only on remeasurement of permanent plots. Indicate the number of growing seasons since the last previous remeasurement. Normally, growth years will be considered to be from July 15 to July 14 with most growth added from May to July 14.

II. VOLUME CLASSIFICATION

A. Growing Stock Volume on Commercial Forest Land

Definition: Volume of sound wood in the bole of live sawtimber and poletimber trees from stump to a minimum top diameter of 4.0 inches outside bark. May be expressed in cubic feet of solid wood or cords of unpeeled wood.

Explanation: Include central stem only to the point where it breaks into limbs or is 4.0 inches in diameter outside bark, whichever comes first.

B. Sawtimber Volume on Commercial Forest Land

Definition: Net volume in board-feet, International 1/4-inch Log Rule, of live sawtimber trees.

Explanation: Net volume is defined as gross board foot volume less deductions for rot, sweep, or other defects affecting use of a tree for lumber.

III. TREE CLASSIFICATION AND MEASUREMENT

A. Species

Each species should be tallied separately--they can be grouped later. The following codes are correlated with the cover type codes:

SPECIES

Softwoods

- 01 - White pine
- 02 - Red pine
- 03 - Jack pine
- 04 - Scotch pine
- 05 - Ponderosa pine
- 06 - Austrian pine
- 11 - Balsam fir
- 12 - White spruce
- 13 - Hemlock
- 14 - Norway spruce
- 15 - Colorado blue spruce
- 16 - Douglas fir
- 17 - European larch
- 21 - Black spruce
- 22 - Tamarack
- 23 - Northern white cedar
- 24 - Eastern redcedar

Hardwoods

(H)- Means hard (dense) hardwoods
(S)- Means soft hardwoods

- 30 - Black maple (H)
- 31 - Sugar maple (H)
- 32 - Red maple (S)
- 33 - Black cherry (S)
- 34 - Yellow birch (H)
- 35 - Basswood (S)
- 36 - Beech (H)
- 37 - Rock elm (H)
- 38 - White ash (H)
- 39 - Green ash (H)

- 41 - White oak (H)
- 42 - Bur oak (H)
- 43 - Swamp white oak (H)
- 44 - Northern red oak (H)
- 45 - Black oak (H)
- 46 - Northern pin oak (H)
- 47 - Hickory (H)

Hardwoods (cont'd)

- 50 - American elm (S)
- 51 - Slippery elm (S)
- 52 - Silver maple (S)
- 53 - Cottonwood (S)
- 54 - Black ash (S)
- 55 - River birch (H)
- 56 - Hackberry (S)
- 57 - Willow (S)
- 58 - Sycamore (S)
- 60 - Quaking aspen (S)
- 61 - Bigtooth aspen (S)
- 62 - Paper birch (S)
- 63 - Balsam poplar (S)

- 70 - Miscellaneous commercial
- 71 - Black walnut (H)
- 72 - Butternut (S)
- 73 - Ironwood (H)
- 74 - Boxelder (S)
- 75 - Mulberry (H)
- 76 - Black locust (H)
- 77 - Honey locust (H)

- 80 - Noncommercial
- 81 - Mountain maple
- 82 - Striped maple
- 83 - Chokecherry
- 84 - Pin cherry
- 85 - Service berry
- 86 - Blue beech
- 87 - Sassafras

B. Diameter Breast Height

Diameter breast height normally will be measured with a diameter tape carefully and tautly stretched in a horizontal plane around the tree trunk at 4-1/2 feet above average ground level. Previous to measurement all moss or bark likely to break off during measurement or check measurement should be removed by hand. On slopes, d.b.h. will be measured 4-1/2 feet above the ground on the uphill side of the tree. On leaning trees, d.b.h. will be taken at right angles to the lean 4-1/2 feet along the upper side. Fence-line trees containing, or suspected of containing, wire will be measured for diameter at the normal 4-1/2 foot height. Wire will be considered a culling defect. In case of irregularities at d.b.h. (swellings, bumps, depressions, branches, etc.) diameter will be measured immediately above the irregularity at the place where it ceases to affect the normal stem form. If the stem forks immediately above d.b.h., measure diameter below the swell at the place where the fork ceases to affect the normal stem form. When the stem forks below d.b.h. consider the tree as two trees and measure diameter at a point 3-1/2 feet above the likely cutting point above the fork. Indicate the point of measurement on side of the tree facing plot center with a (usually horizontal) paint line.

Code d.b.h. to nearest 0.1 inch; 15.8 inches will be coded 158.

If trees are cut, measure (or estimate) diameter outside bark at 6 inches above former ground level; look up corresponding DBH outside bark in the following table and record it in the DBH column.

(Inches)			
Stump	Diameter breast height		
diameter	Softwoods	Hardwoods	Aspen
<u>1/</u> 16	14	14	13
17	15	14	14
18	15	15	15
19	16	16	16
20	17	17	17
21	18	18	18
22	19	19	19
23	20	20	19
24	21	21	20
25	22	21	21
26	23	22	
27	23	23	
28	24	24	
29	25	25	
30	26	26	
31	27	27	
32	28	28	
33	29	28	
34	30	29	
35	31	30	
36	32	31	

1/ Below 16" DBH is same as stump diameter.

C. Merchantable Height

Timber volumes will be estimated using composite volume tables and measurements of d.b.h. and merchantable height from sample trees. The tables are made for use with merchantable height measurements to flexible tops with a minimum of 4" for total volume and 8" for sawtimber volume.

Net volume will be determined for the sawlog portion of the tree in board feet, International 1/4-inch Rule, and for all merchantable material in the main stem of the tree in cubic feet or cords. The net volume of hardwood limbs will be computed by use of conversion factors. Division of the sawtimber-size tree into component parts is illustrated for hardwoods by the following chart on page 54.

In the sawtimber-size tree, that section of the bole between stump or butt-off and the upper limit of sawlog merchantability is called the sawlog portion or lower stem. The upper stem is that portion of the main stem of a sawtimber tree from the merchantable top of the lower stem to a point where it is limited by branches, deformity, rot, or a minimum top diameter of 4 inches, d.o.b. The upper stem or any portion of it should not depart more than one-fourth of a 90 degree arc ($22\text{-}1/2^\circ$) from the general course of the lower stem (short abrupt crooks excepted). When branches appear it is always the largest, more or less vertical one following the general course of the lower stem. The upper stem stops when it is no longer the largest branch of the fork following the general course of the lower stem, is limited by rot, sweep or limbiness, or becomes less than 4 inches d.o.b.

Other portions of the tree include stump, rotten cull sections, limbs and twigs. Limbwood includes sound cull sections and branches to a minimum of 4 inches d.o.b. No restriction is made to quality or length of individual pieces of limbwood except that they be live and sound.

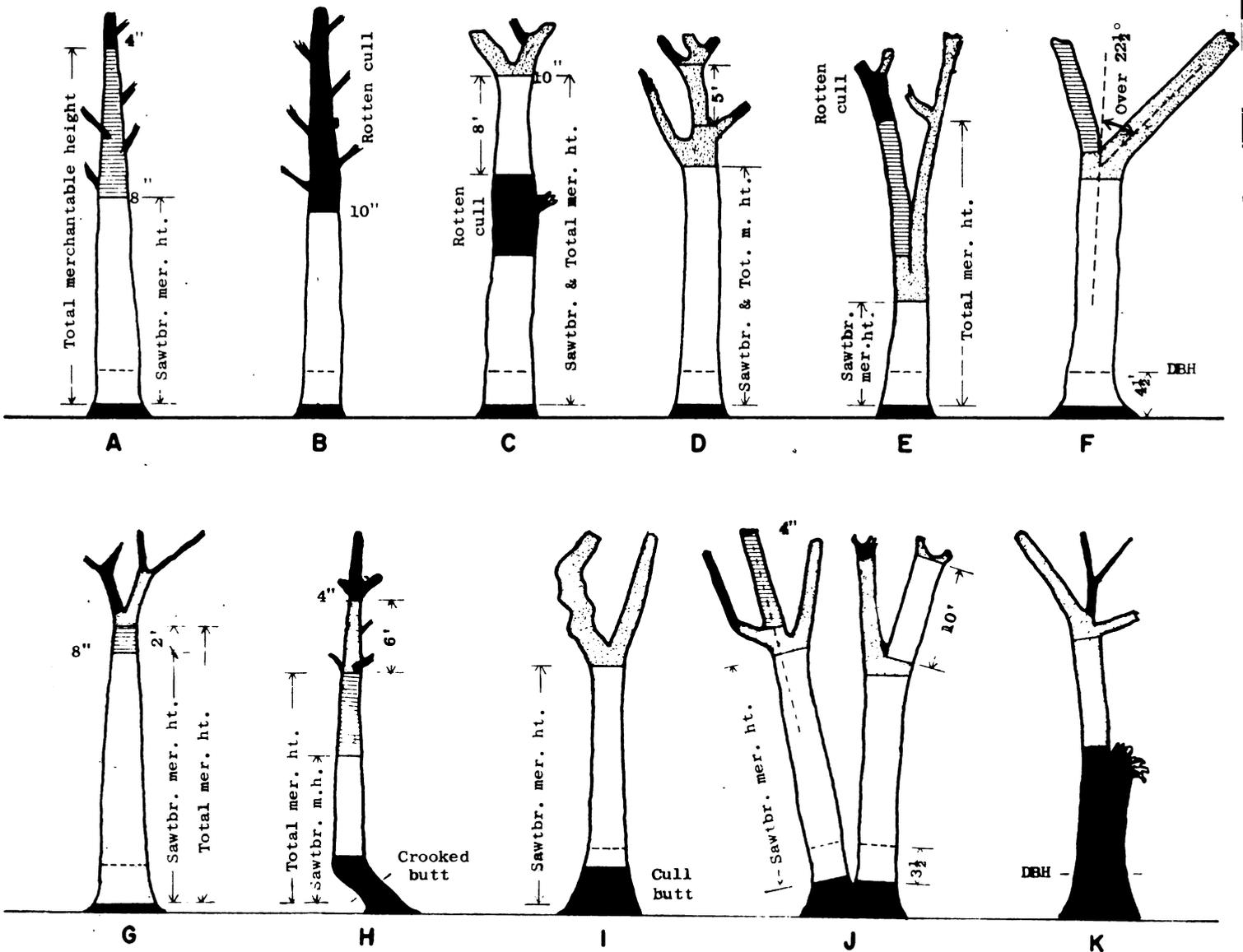
Merchantable height is the distance from stump (generally about 6 inches above average ground level) to that point where the stem or main fork reaches the minimum diameter inside bark, or becomes unmerchantable for other reasons.

The soundness factor will be adjusted to deduct for intervening cull sections as well as cull in merchantable sections. To be classed as merchantable a section must be at least 8 feet long. Merchantable sections longer than 8 feet will be increased by 2-foot intervals.

Measure both sawtimber and total merchantable height for each merchantable sawtimber tree and total merchantable height for each merchantable poletimber tree. Record to the nearest full even (two) foot interval.

MERCHANTABILITY IN HARDWOOD SAWTIMBER TREES

Sawlog section
 Upper stem
 Limbs
 Waste



Explanation:

- A. Illustrates relationship of total and sawtimber merchantable heights where diameter is the limiting factor.
- B. Total and sawtimber merchantable height may be the same when tree is alive but top is rotten cull section.
- C. Merchantable sections must be at least 8 feet long.
- D. A five foot section is too short to class upper stem. Sound cull sections are included in limbwood.
- E. Upper stem is the largest (in diameter) branch following general course of the lower stem. Utilization here is limited by rotten cull.
- F. A branch departing more than 1/4 of a 90° arc from general course of the lower stem is disqualified.
- G. Merchantable height will be measured from stump level to the upper limiting points (not for sawtimber and upper stem sections separately).
- H. Percent of defect will be increased to correct to net volume when a butt-off is necessary. One or more limbs whose diameter at the limb collar exceeds 1/3 of the diameter of the stem at that point will limit merchantability. DBH is measured at right angles to the stem.
- I. Merchantability here is limited by crook in the main stem. DBH is measured immediately above the butt swell.
- J. Trees forking below DBH are handled as two trees. Only merchantability in the main stem following the general course of the lower stem is considered. May have sawlog above fork. DBH is measured 3-1/2 feet above cut off point (usually above 4-1/2 feet above fork).
- K. No merchantable height will be measured for a cull tree.

LAKE STATES FOREST EXPERIMENT STATION, MAY 1959

Material must be sufficiently straight and sound to make standard pulpwood now or standard sawlogs now or prospectively; thus, sawlogs must be of grade 3 or tie and timber quality or potential; and pulpwood must be relatively straight, at least 50 percent sound and free of excessive knottiness. Substandard material is not included even though it may be used currently.

For want of better guides, the standards for pulpwood merchantability will be applied to cubic foot volume. "Relatively straight" indicates sticks whose scaling diameter in inches plus crook or sweep departure does not prevent it from going through a 16" diameter chipper (a 14" sum is recommended for field use). Larger sticks will be scaled like sawlogs. Excessive knottiness is limited by:

1. One limb or fork whose average knot collar measured flush with stem is larger than 1/2 of the diameter of the main stem at point of occurrence.
2. The sum of diameters of limb collars whose limbs exceed 2 inches in diameter, shall not exceed the diameter of the stem at point of occurrence (within a six inch vertical span). Refer to section F. below for guides to determining the percent of cull.

D. Tree Classes

The status and condition (vigor) of each tree tallied will be indicated.

CODE ITEM

- 0 Poor saplings and poles.--Trees likely to produce standard poletimber products but unlikely to produce standard quality sawtimber. The volume and growth of these trees should be included in cubic foot but not in board foot statistics. These trees should be removed in harvest or intermediate cuttings when possible.

CODE ITEM

- 1 Crop tree.--A growing stock tree which meets the following specifications: Risk and vigor--likely to survive 10 years, vigorous. Position and crown--dominant and codominant trees with crowns more than one-third filled with good foliage. (Lake States Tree Classes 1/ 1, 2, 3, with a or b crowns). This classification may include choice tolerant potential crop trees in the understory though overtopped.

Species--a desirable species for the site.

Form and soundness--good form and less than 10 percent defect. Capable of good growth in diameter and capable of reaching the average merchantable height for the site.

Log grade-- one/ log grade 1 or 2 now or potentially.

Location--not closer to a better crop tree than 1.0 times the d.b.h. (radius expressed in feet) of that tree (1.0 X 10" tree = 10 feet growing space required for a better 10" crop tree).

1/ For this purpose, the following classification of tree position and crown density will be used. For the entire classification refer to "A Tree Classification for Aspen, Jack pine, and Second-growth Red pine", Journal of Forestry, Vol. 41, No. 4, April 1943.

Tree Position

0. Open-grown. Isolated trees
1. Head dominants. Dominating surrounding trees with crowns definitely above the general level of the canopy.
2. Strong dominants. In competition with trees of the same crown class but of poorer development.
3. Conditional dominants and codominants. Competing with trees of the same crown class and development and not in immediate danger of being crowded out.
4. Weak dominants and codominants. Competing with trees of better development.
5. Intermediates. Competing with trees of higher crown class and development occupying small holes in the canopy.
6. Suppressed. Trees definitely below the general level of the canopy.

Crown Density

- a. Good crown. At least 2/3 filled, with foliage of healthy green color and normal size.
- b. Medium crowns.
- c. Poor crowns. Less than 1/3 filled and with foliage of poor color and of less than normal size.

CODE ITEM

- 2 Storage tree.--A growing stock tree which does not meet all the specifications for crop tree but does meet the following:
Risk--likely to survive 10 years.
- Form and soundness--no serious defects reducing scale over 30 percent. Tree may be capable of good growth only in diameter.
- Location--may be closer than 1.0 times the d.b.h. (radius expressed in feet) of a crop tree if it is not overtopping a potential crop tree. These are likely to be slow growing trees, of low quality or of an undesirable species for the site but free from serious insect or disease attack. They are suitable for "leave" trees, if desired.
- 3 Harvest tree.--A growing stock tree which does not meet the specifications for codes 0, 1, or 2. The trees in this class should normally be marked for harvest or intermediate cutting (unless needed for seed, shade, or as trainers).
- 4 Sound cull.--Nongrowing stock. Fifty percent or more of the gross volume is defective but less than 50 percent of the gross volume is ~~rendered~~ unusable by rot.
- 5 Rotten cull.--Nongrowing stock. Trees more than 50 percent defective because of rot.
- 6 Dead tree.--On tally sheet enter a letter "S" following the code number if the tree is salvable. Dead trees need be tallied only on permanent plots. Include trees cut by beaver since previous measurement.
- 7 Stump.--Tree cut by man.
- 8 Too small or missed in previous survey.
- In the "tree class--then" column record (using the above code) the most likely class at the time of the previous remeasurement. Trees which would have been check-marked in the previous survey will be coded 3; S = 4; R = 5; and D = 6. Code 8 will be used only for those trees which were too small or missed in the previous survey. It will be used only in the "then" column.
- 9 Noncommercial species.--Nongrowing stock.

E. Cut or Leave

Each tree will be tallied "cut or leave" in accordance with its condition and the silvicultural marking rules--if a cut of the stand is recommended. Code leave trees "O" and cut trees "1". Also code cut trees as 7 - stump in this column.

F. Soundness Classes and Visible Defect Indicators

The percent of defect for the entire merchantable stem and for the sawtimber portion will be determined for each tree and coded in classes. These will be estimated for all growing stock and cull trees over 5 inches d.b.h.

<u>CODE</u>	<u>ITEM</u>
00	Any tree with 0 percent defect
97	Any tree with 1 to 5 percent defect
93	Any tree with 6 to 10 percent defect
86	Any tree with 11 to 18 percent defect
78	Any tree with 19 to 27 percent defect
65	Any tree with 28 to 39 percent defect
54	Any tree with 40 to 49 percent defect
41	Any tree with 50 to 69 percent defect
19	Any tree with 70 to 100 percent defect

Tree soundness or cull loss is a subjective classification. The cruiser may estimate loss by tree sections and for the entire tree guided by the chart, "Determining proportion of cull" (figure 13) or he may use S. R. Gevorkiantz's "Guide for Estimating Percent Defect for Northern Hardwoods" where it applies.

In order to provide an index to the severity of cull in different surveys and to build toward better future estimates of loss of scale, a classification of visible defects will be made. To begin with this will be made by sections on trees diagrammed in the wood residue study. Later it will be extended to a small sample of standing trees--perhaps, one per plot. For this purpose a composite rating will be given for the tree.

Instructions for classifying and coding visible defects are are given on the back of the woods residue form (page 26).

G. Timber Quality

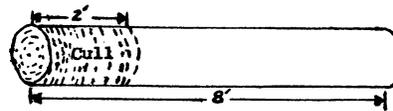
Merchantable hardwood sawtimber trees will be graded by log lengths using standard grades for factory and tie and timber logs. Aspen and red and white pine will also be log graded. The proportion of net volume in each log grade in the tree will be recorded. Each tree will be diagrammed showing location of log grades in the stem. Defect percent will be estimated for each log. Grading rules are attached.

DETERMINING PROPORTION OF CULL

This guide may be used for calculating percent of sawtimber or total volume lost in a section of a tree and the cull (or soundness) factor for the entire tree.

A. CULL SECTION

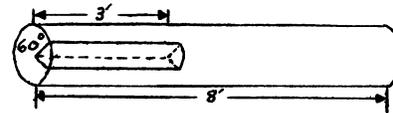
If section of bole is affected, deduct percent of log length affected.



Example: $\frac{2}{8} = 25$ percent cull in section

B. CULL SECTOR

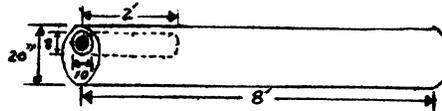
If sector is affected, multiply percent of circle times percent of length.



Example: $\frac{60^\circ}{360^\circ} \times \frac{3}{8} = 6$ percent cull in section

C. INTERIOR CULL

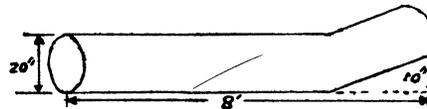
Square out interior cull as a percent of total volume of the section. For board foot cull add one inch to width and to thickness; for cubic foot cull use actual dimensions of rot. For board foot loss divide width and thickness by the scaling diameter (average d.i.b., small end) minus one; for cubic foot divide by scaling diameter. Multiply fractions by percent of log affected. Proportions may be looked up or interpolated in F. below.



Example: $\frac{8}{20-1} \times \frac{10}{20-1} \times \frac{2}{8} = 6$ percent cull in section

D. CROOK

Multiply proportion of diameter displaced times proportion of log length affected by crook.

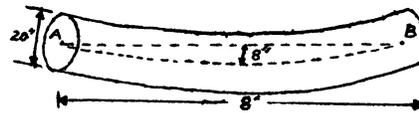


Example: $\frac{10}{20} \times \frac{2}{8} = 12$ percent cull in section

No reduction of cubic foot volume will be made unless the sum of displacement plus diameter exceeds 14 inches.

E. SWEEP

Determine sweep departure and subtract 1 inch for 8 foot logs or 2 inches for 16 foot logs. Divide by scaling diameter.



Example: $\frac{8-1}{20} = 35$ percent cull in section of 8 foot bolt.

If a straight line between A and B falls outside the bark, the affected section is over 50 percent cull. No reduction of cubic foot volume will be made unless the sum of sweep departure plus diameter exceeds 14 inches.

F. TABLE OF PROPORTIONS

Proportion of scaling diameter, log length or circle involved may be looked up directly or interpolated from this table.

Numerator	Denominator										
	6	8	10	12	14	16	18	20	22	24	36
	Percent										
2	33	25	20	17	14	12	11	10	9	8	6
4	67	50	40	33	29	25	22	20	18	16	11
6		75	60	50	43	38	33	30	27	25	17
8			80	67	57	50	44	40	36	33	22
10				83	71	62	56	50	45	42	28
12					86	75	67	60	54	50	33
14						88	78	70	64	58	39
16							89	80	73	67	44
18								90	82	75	50

DISTRIBUTION OF VOLUME IN THE TREE

To convert from percent cull in a section to cull percent for tree, multiply proportion of section lost times percent of tree volume in that section. If loss occurs in more than one section of the tree, find the percent of tree volume lost from each section and then add these percents to find total cull portion of the tree.

Tree size	Bolt Number	Percent of Tree Volume												
		1	2	3	4	5	6	7	8	9	10			
Bolts (8')	Logs (16')													
2	1	56	44											
3	1½	41	33	26										
4	2	33	28	22	17									
6	2½	27	23	19	17	14								
7	3	24	21	18	15	12	10							
-	3½	22	19	17	14	12	9	7						
-	4	20	18	15	13	11	9	8	6					
-	5	18	15	13	12	10	9	8	6	5	3			

Example: A 1-log tree has 56% of tree volume in the butt bolt, 44% in the second.

Hardwood Log Grades for Standard Lumber

Grade factors	Log grade 1		Log grade 2	Log grade 3
	Butts Only	Butts and uppers	Butts and uppers	Butts and uppers
Diameter (min.)	13-15"	16-19":20"+	11"	8"+
Length (min.)	10'+	10'+	8-11' : 12'+	8'+
Clear cuttings (on the 3 best faces)				
Length (min.)	7'	5' : 3'	3'	2'
Number on face (max.)	2	2	2 : 3	Unlimited
Yield in face length (min.)	5/6	5/6	4/6	3/6
Sweep and crook deduction (max.)	15%	15%	30%	50%
Cull deduction, including including sweep (max.)	40%	40%	50%	50%
Sound end defects, area (max.)	See instructions			

Exceptions.--In ash and basswood 12" d.i.b. for grade 1 butts.

Grade 2 10" d.i.b. must be grade 1 surface quality.

Grade 2 11" d.i.b. limited to two cuttings.

Grade 2 8' and 9' lengths limited to 12" d.i.b.;
3/4 yield in not more than 2 3'+ cuttings.

Sweep and crook allowance reduced 1/3 in logs
with more than 1/4 diameter in sound end defects.

Sixty percent cull deduction permitted in grade 2,
if otherwise of grade 1 quality.

Sixty percent cull deduction permitted in grade 3,
if otherwise of grade 2 quality.

From Hardwood Log Grades for Standard Lumber,
Forest Products Laboratory, 1953.

Specifications for Tie and Timber Logs

Position in tree	Butt and upper.
------------------	-----------------

D.I.B., small end, inches	8"+
---------------------------	-----

Length without trim, feet	8'+
---------------------------	-----

Clear cuttings	No requirements. Not graded on cutting basis.
----------------	--

Sweep allowance, maximum	1/4 d.i.b. of small end for half logs and 1/2 d.i.b. for log 16' long.
--------------------------	--

Sound surface defects permitted:	
Single knots	Any number, if none has an average collar diameter in excess of 1/3 of log diameter at point of occurrence ^{1/} .

Whorled knots	Any number provided the sum of the collar diameters does not exceed 1/3 the log diameter at point of occurrence.
---------------	--

Holes	Any number not exceeding knot specifications if they do not extend over 3 inches into the contained tie or timber.
-------	--

Unsound defects permitted:	
Surface	Any number and size if they do not extend into contained tie or timber. If they extend into contained tie and timber they shall not exceed size, number, and depth of limits of sound knots.

Interior	None permitted except one shake not more than 1/3 the width of contained tie or timber and one split not over 5 inches long.
----------	--

^{1/} Knot collar is the average of the vertical and horizontal diameters of the limb or knot swelling as measured flush with the surface of the log.

Local use logs that do not meet the minimum specifications of the above grades will not be considered merchantable for survey purposes.

Hardwood Log Grades for Standard Lumber

Grade factors	Log grade 1		Log grade 2	Log grade 3
	Butts Only	Butts and uppers	Butts and uppers	Butts and uppers
Diameter (min.)	13-15"	16-19":20"+	11"	8"+
Length (min.)	10'+	10'+	8-11' : 12'+	8'+
Clear cuttings (on the 3 best faces)				
Length (min.)	7'	5' : 3'	3'	2'
Number on face (max.)	2	2	2 : 3	Unlimited
Yield in face length (min.)	5/6	5/6	4/6	3/6
Sweep and crook deduction (max.)	15%	15%	30%	50%
Cull deduction, including including sweep (max.)	40%	40%	50%	50%
Sound end defects, area (max.)	See instructions			

Exceptions.--In ash and basswood 12" d.i.b. for grade 1 butts.

Grade 2 10" d.i.b. must be grade 1 surface quality.

Grade 2 11" d.i.b. limited to two cuttings.

Grade 2 8' and 9' lengths limited to 12" d.i.b.;
3/4 yield in not more than 2 3'+ cuttings.

Sweep and crook allowance reduced 1/3 in logs
with more than 1/4 diameter in sound end defects.

Sixty percent cull deduction permitted in grade 2,
if otherwise of grade 1 quality.

Sixty percent cull deduction permitted in grade 3,
if otherwise of grade 2 quality.

From Hardwood Log Grades for Standard Lumber,
Forest Products Laboratory, 1953.

Specifications for Tie and Timber Logs

Position in tree	Butt and upper.
------------------	-----------------

D.I.B., small end, inches	8"+
---------------------------	-----

Length without trim, feet	8'+
---------------------------	-----

Clear cuttings	No requirements. Not graded on cutting basis.
----------------	--

Sweep allowance, maximum	1/4 d.i.b. of small end for half logs and 1/2 d.i.b. for log 16' long.
--------------------------	--

Sound surface defects permitted:	
Single knots	Any number, if none has an average collar diameter in excess of 1/3 of log diameter at point of occurrence ^{1/} .
Whorled knots	Any number provided the sum of the collar diameters does not exceed 1/3 the log diameter at point of occurrence.
Holes	Any number not exceeding knot specifications if they do not extend over 3 inches into the contained tie or timber.

Unsound defects permitted:	
Surface	Any number and size if they do not extend into contained tie or timber. If they extend into contained tie and timber they shall not exceed size, number, and depth of limits of sound knots.
Interior	None permitted except one shake not more than 1/3 the width of contained tie or timber and one split not over 5 inches long.

^{1/} Knot collar is the average of the vertical and horizontal diameters of the limb or knot swelling as measured flush with the surface of the log.

Local use logs that do not meet the minimum specifications of the above grades will not be considered merchantable for survey purposes.

LOG GRADES FOR ASPEN

<u>Grade</u>	<u>Minimum length (Inches)</u>	<u>Minimum d.i.b. (Inches)</u>	
1	100	9	Logs must be 100 percent sound. No sweep permitted. Logs must have at least 5/6 of 3 faces clear in not more than one cutting. Cuttings to be 7 feet long and width of face.
2	100	9	Net scale of log to be more than <u>70</u> percent of gross scale including deduction for sweep. Three faces to be 3/4 clear in not less than 2 cuttings. Cuttings to be 3 feet long or longer and full width of face
3	100	6	All logs which do not fit into the above grades if <u>50</u> percent sound.

From Aspen Lumber Grades and Characteristics,
Lake States Aspen Report No. 6, 1948.

LOG GRADES FOR SOFTWOOD LOGS

Grade I.

1. Logs must be 16" or larger, 10' or longer, and with deduction for defect not over 30 percent of gross scale.
2. Logs must be at least 75 percent clear on each of the three faces.
3. All knots outside clear cutting must be sound and not over 2 $\frac{1}{2}$ " in size.

Grade II.

1. Logs must be 12" or larger, 10' or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.
2. Logs must be at least 50 percent clear on each of three faces or 75 percent clear on two faces.

Grade III.

1. Logs must be 8" or larger, 8' or longer, and a net scale after deduction for defect of at least 50 percent of the gross contents of the log.

From Specifications for Log Grades of Hardwoods and Softwoods,
Northern Hemlock and Hardwood Association, 1947.

H. Stump Diameter

Stump diameter outside bark will be measured to the nearest inch (or estimated) at a point 6 inches above the average ground level for pole and sawtimber trees which have been cut within 3 years (if first measurement) or since the last previous measurement. Pole-timber-size trees will be measured on a 1/10th acre plot (37.2 foot radius), and sawtimber-size trees on a 1/5 acre plot. Look up the corresponding DBH in the table on page 51 and record it in the DBH column. Record each stump as "7" under "tree class now" and as "7" in the "cut-leave stump" column.

I. Total Height

Total height of selected sample trees will be measured and recorded to the nearest full 2 feet.

J. Tree Age

Age will be taken for two reasons: To get stand-age and for calculation of site index. For both purposes and total age is desired. In the first case this should be for the main stand; in the second, for dominant or codominant trees (which have always been free growing) of the main stand.

The increment boring will be taken about 2 inches below d.b.h. and corrected for age from seed. While this correction would best be based on local studies, the following general figures may be used.

Average Number of Years to Reach Breast Height by Species and Site

<u>Species</u>	<u>Good Site</u>	<u>Poor Site or Suppressed trees</u>
Aspen	1	2
Ash	8	15
Balsam poplar	1	2
Balsam fir	10	15
Basswood	2	4
Birch (yellow)	8	15
Birch (paper)	2	4
Cedar (northern white)	10	20
Elm	4	8
Maple (hard)	8	15
Maple (soft)	2	4
Oak	3	6
Pine, jack	5	8
Pine, Norway	6	10
Pine, white	8	12
Spruce, black	10	20
Spruce, white	10	15
Tamarack	5	10

K. Mortality Classification

The major lethal agent will be indicated for all trees (on permanent plots) which have died or been cut since last previous measurement. Indicate an important contributing agent by a letter suffix to the number--thus, a tree weakened by disease then broken by the wind becomes "2e". Number "2" will be punched on the IBM cards; the "e" is material for a special study using plot records.

CODE ITEM

- 1 Fire (a)
- 2 Weather (b)
- 3 Flood (c)
- 4 Suppression (d)
- 5 Disease (e)
- 6 Insects (f)
- 7 Birds and animals (g)
- 8 Cut (by man) (h)
- 9 Logging damage (i)
- 0 Unknown (j)

IV. MEASUREMENT OF ACCURACY AND COST

A. Variability Study.

The range of variation in the sample data being collected will be measured and analyzed as soon as field work for a sampling block is completed. This will provide a check on anticipated survey accuracy and indicate whether sampling intensity is adequate. Coefficients of variation will be worked up for several districts. They will be used for future planning.

B. Cost Studies.

Cost studies will be made for two 2-week periods in Minnesota (one in 1960 and one in 1961). Time and dollar costs of each phase of the field inventory job will be carefully recorded. The present cost-reporting form will be revised. Data will be analyzed to provide unit cost information for use in survey planning.

C. Accuracy of Classification and Measurement

1. Training.--At the beginning of the Third Minnesota Survey each member of the Lake States and Office of Iron Range Resources and Rehabilitation survey crews were given at least 5 days' training despite the fact that every man was already experienced at survey work. New men (who reported later) were trained on the job. A check list is maintained to guide training of each man.
2. Inspection standards.--The inventory chief and the chief of party must provide sufficient inspection to insure that each crew member knows the job and is obtaining a high standard of accuracy. Check cruising of each crew shall be carried out on a schedule of one plot checked every two weeks for new crews. After crews are experienced one plot should be checked per crew every six weeks, unless presence of errors make more frequent checking necessary. Equipment and tools must be kept clean and in good working order. These will be checked during regular check cruising. Safe operations will be stressed. Recorded field data must be neat, numbers well-formed with all required items completely filled out.
3. Accuracy Studies and Evaluation.--As soon as sufficient dots, stereoclassification, and ground checks are available--and later when each district is done--the accuracy of photo-classifications will be studied. If sufficient accuracy is being obtained the sampling design need not be altered.
(NOTE: The initial checks showed a satisfactory level of accuracy in southern Minnesota and a very good level of accuracy in northern Minnesota).

The studies provide information needed for accuracy computations and for survey planning.

D. Proposed Formulae for Computing Accuracy

The following formulae will be used for determining accuracy of area and volume figures for Minnesota. Accuracy will be computed for each sampling block and shown in each report.

1. Forest area accuracy.--Forest area is determined by photo dot count with correction based on a ground-check of a proportion of these dots. In Minnesota the error of forest area depends upon the total dot count, forest dot ground-checks, and non-forest dot ground-checks. The formulae for variance of the proportion of area that is forested is:

$$S_{(P_f)}^2 = \frac{P_f Q_f (P_{ff} - P_{nff})^2}{N} + \frac{P_f^2 P_{ff} (1 - P_{ff})}{N_f} + \frac{Q_f^2 P_{nff} (1 - P_{nff})}{N_{nf}}$$

- Where N = Total number of photo dots
 N_f = Number of ground-checked forest dots
 N_{nf} = Number of ground-checked nonforest dots
 P_f = Proportion of N photo-classified as forest
 P_{ff} = Proportion of plots which were found to be forest
 Q_f = 1-P_f. Proportion of N photo-classified as nonforest
 P_{nff} = Proportion of Q_f which was found to be forest

To compute percent of error in forest area use $e_{Af} = 100 \frac{S (P_f)}{P_f}$

Where A = Gross area of block or county being sampled (including water area).

To compute error of commercial forest land use $e_{Acf} = e_{Af} \sqrt{\frac{P_f}{P_{fc}}}$

when P_{fc} = proportion of forest land which is commercial

In some cases this error must be weighted to that for a cooperating survey in the same block.

$$e_{A_{1s+c}} = \frac{\sqrt{(A_{1s} e_{1s})^2 + (A_c e_c)^2}}{A_{1s} + A_c}$$

- Where A_{1s} = Commercial forest area cruised by Lake States Station
 e_{1s} = Error for A_{1s}
 A_c = Commercial forest area cruised by a cooperator
 e_c = Error for A_c

If e_{1s} and e_c are in percent, the answer will be in percent error.

To compute error of commercial forest area per million acres:

$$e_{cf/MMa} = e_{Acf} \sqrt{\frac{TA_{cf}}{1,000,000}} \text{ or } \frac{e_{Acf} \sqrt{TA_{cf}}}{1,000}$$

To compute errors for county or other areas:

$$e_{oa} = e_{cf/MMa} \sqrt{\frac{TA_{cfo}}{1,000,000}} \text{ or } \frac{1,000 e_{cf/MMa}}{\sqrt{TA_{cfo}}}$$

The use of a table for organizing the figures is helpful. The following table shows the actual numbers of points stereo-classified and plots ground-checked. A similar table may be used to show proportions (P_i and $P_{j/i}$) and the products, $P_i P_{j/i}$ if desired.

Size-class	Stereo-		Ground plots				Total
	plots	Non-stocked:	S & S	Poles	Saw-timber		
	(N _{si})	stocked:					
Nonstocked							
S & S							
Poles							
Sawtimber							
<u>Total (N_s)</u>							

2. Accuracy of volume estimates.--Statistical accuracy of timber volume (cubic feet) estimates depend on the intensity and correctness of forest area measurement (discussed above), of stand-size class area measurement, and of volume-per-acre estimates. The variances for the first two items are added together and used with variance of the third for computing error of total volume.

a. The variance of area measurements for each stand-size class is dependent on numbers of stereoclassifications and ground-checks, and the accuracy of those classifications.

$$S^2_{(P_j)} = \sum_i \frac{P_i^2 P_{j/i} (1-P_{j/i})}{N_{si}} + \frac{1}{N_s} \left[\sum_i P_i \left(\frac{P_{j/i}^2}{P_i} - \left(\frac{P_i P_{j/i}}{N_s} \right)^2 \right) \right]$$

Where: P_j = Estimated proportion of forest area in j^{th} class.

P_i = Proportion of forest points in the i^{th} stereo (photo) size class.

$P_{j/i}$ = Proportion of forest points in the j^{th} ground size class for a given stereo size class

N_s = Total number of stereo points

N_{s_i} = Number of stereo points in the i class

The following table may be used to calculate the first portion of the above formula for each ground size-class;

Stereo size-class	P_i	$P_{j/i}$	$(P_i P_{j/i})^2$	$1 - P_{j/i}$	$P_{j/i} (1 - P_{j/i})$	N_{s_i}	$\frac{P_{j/i} (1 - P_{j/i})}{N_{s_i}}$	P_i^2	$\frac{P_i^2 (P_{j/i} (1 - P_{j/i}))}{N_{s_i}}$
-------------------	-------	-----------	-------------------	---------------	-------------------------	-----------	---	---------	---

Non-s.

S & S.

Poles

Sawtbr.

TOTAL	$\sum P_i P_{j/i}$	$\sum (P_i P_{j/i})^2$	(N_s)	$\frac{\sum P_i^2 P_{j/i} (1 - P_{j/i})}{N_{s_i}}$
-------	--------------------	------------------------	---------	--

Figures for the second part of the formula came from the totals of this table. Much of this computing may be done on the computing machine without using the table, if desired.

The error for each stand-size class is calculated by this formula:

$$e_{s_j} = 100 \frac{S (P_{s_j})}{P_{s_j}}$$

When P_{s_j} = proportion of forest which is in the j^{th} class.

From this, the coefficient of variation, which is useful in survey planning can be obtained if desired:

$$c_i = \frac{\sqrt{\frac{S_{i/a}^2}{\bar{X}_i}}}{\bar{X}_i} \quad \text{where } \bar{X}_i \text{ is the mean of } X_i$$

Determine the standard error of the mean for each size class:

$$S_{\bar{X}_{i/a}} = \sqrt{\frac{S_{i/a}^2}{N_i}}$$

Calculated weighted percent of error of total volume from error in each size class:

$$e_v^2 = \sum_i \left(\frac{S_{\bar{X}_{i/a}} V_i}{\bar{X}_{i/a}} \right)^2$$

$$e_v = 100 \frac{\sqrt{e_v^2}}{V}$$

Where: V_i = Volume in the i class

V = Total volume in all size classes

- d. The error for total volume within the block can now be computed. This involves combining percentage error in volume estimates with the percentage error in area estimates.

$$e_v = \sqrt{e_{TAcf}^2 + e_{Vcf}^2}$$

Where: e_{TAcf} = The error (in percent) of commercial forest for a block of land

$$TAcf \text{ in percent} = 100 e_{TAcf} \text{ from page 69}$$

e_{Vcf} = The percent of error of total volume in the same block

In some cases this error must be weighted with that for a cooperating survey in the same block.

$$e_{V_{ls+c}} = \frac{\sqrt{\left(\frac{e_{V_{ls}}}{V_{ls}}\right)^2 + \left(\frac{e_{V_c}}{V_c}\right)^2}}{\frac{V_{ls}}{V_{ls}} + \frac{V_c}{V_c}}$$

Where: ls = Lake States and c = cooperator.

- e. The computation of the volume error per billion cubic feet and the relative volume error for smaller volume units may be computed by the following formulae:

$$e_{\text{mm cu. ft.}} = e_{V_{ls+c}} \sqrt{\frac{V_{ls+c}}{1,000,000,000}}$$

$$e_{ov} = \frac{e_{\text{mm cu. ft.}}}{\sqrt{\frac{V_{ls+c}}{1,000,000,000}}}$$

MINNESOTA FOREST SURVEY TATUM GUIDE II
Lake States Forest Experiment Station
September 1960

VARIABLE PLOT RADII BY DBH AND PERCENT OF SLOPE (FACTOR 10)

DBH class	Percent Slope ^{1/}						
	0	10	20	30	40	50	60
	(in feet)						
1	2.8	2.8	2.8	2.9	3.0	3.1	3.2
2	5.5	5.5	5.6	5.7	5.9	6.1	6.4
3	8.2	8.3	8.4	8.6	8.9	9.2	9.6
4	11.0	11.1	11.2	11.5	11.8	12.3	12.8
5	13.8	13.8	14.0	14.4	14.8	15.4	16.0
6	16.5	16.6	16.8	17.2	17.8	18.4	19.2
7	19.2	19.3	19.6	20.1	20.7	21.5	22.4
8	22.0	22.1	22.4	23.0	23.7	24.6	25.7
9	24.8	24.9	25.2	25.8	26.7	27.7	28.9
10	27.5	27.6	28.0	28.7	29.6	30.7	32.1
11	30.2	30.4	30.8	31.6	32.6	33.8	35.3
12	33.0	33.2	33.7	34.4	35.5	36.9	38.5
13	35.8	35.9	36.5	37.3	38.5	40.0	41.7
14	38.5	38.7	39.3	40.2	41.5	43.0	44.9
15	41.2	41.5	42.1	43.1	44.4	46.1	48.1
16	44.0	44.2	44.9	45.9	47.4	49.2	51.3
17	46.8	47.0	47.7	48.8	50.3	52.3	54.5
18	49.5	49.7	50.5	51.7	53.3	55.3	57.7
19	52.2	52.5	53.3	54.6	56.3	58.4	60.9
20	55.0	55.3	56.1	57.4	59.2	61.5	64.1
21	57.8	58.0	58.9	60.3	62.2	64.6	67.3
22	60.5	60.8	61.7	63.2	65.2	67.6	70.6
23	63.2	63.6	64.5	66.0	68.1	70.7	73.8
24	66.0	66.3	67.3	68.9	71.1	73.8	77.0
25	68.8	69.1	70.1	71.8	74.0	76.9	80.2
26	71.5	71.8	72.9	74.6	77.0	79.9	83.4
27	74.2	74.6	75.7	77.5	80.0	83.0	86.6
28	77.0	77.4	78.5	80.4	82.9	86.1	89.8
29	79.8	80.1	81.3	83.3	85.9	89.2	93.0
30	82.5	82.9	84.1	86.1	88.8	92.2	96.2

^{1/} Rise in feet per 100 feet expressed as percent.

VOLUME CLASSIFICATION OF STANDS

Size class and: average DBH 1/ (inches)	Stocking Class		
	Poor	Medium	Good
	Volume ^{2/} or trees per plot ^{3/}		
0-5 ^{4/}	0-2.9 cords (4-15)	0-2.9 cords (16-27)	0-2.9 cords (28*)
Under 1.0	(5-10)	(11-20)	(20*)
2	(2-4)	(5-9)	(10*)
5-9 or 11 ^{5/}	3-6.9 cords (20-45)	7-12.9 cords (46-65)	13* cords (66*)
6	(9-19)	(20-31)	(32*)
8	(5-11)	(12-18)	(19*)
10	1.5-2.9 MBF (8-17)	3-5.9 MBF (18-34)	6* MBF (35*)
9 or 11-15 ^{6/}	(4-7)	(8-15)	(16*)
10	(3-5)	(6-9)	(10*)
12	1.5-4.9 MBF (2-7)	5-9.9 MBF (8-15)	10* MBF (16*)
14	(2-5)	(6-11)	(12*)

- ^{1/} Average stand DBH weighted by volume.
- ^{2/} Unpeeled cords or bd. ft. International 1/4-inch rule.
- ^{3/} Approximate number of trees (in parentheses); all trees on 1/50-acre in 0-5 stands - number over 5" DBH on 1/5-acre in pole stands - number over 9" or 11" DBH on 1/5-acre in sawtimber stands.
- ^{4/} Stands failing to meet specifications for larger size classes, at least 10 percent stocked with one-half the trees less than 5" DBH.
- ^{5/} Stands with less than 1,500 bd. ft. but at least 3-cord total net volume per acre with 1-1/2 cords per acre in pole-size trees.
- ^{6/} Stands of at least 1,500 bd. ft. net volume per acre with over one-half bd. ft. volume in trees 9"-15" (conifers) or 11"-15" (hardwoods).
- ^{7/} Stands of at least 1,500 bd. ft. net volume per acre with over one-half bd. ft. volume in trees over 15" DBH.

VARIABLE PLOT RADII CORRECTION FOR 1/10-INCH CHANGES
IN DBH AND PERCENT OF SLOPE (FACTOR 10)

Tenth-inch class	Correction in Plot Radius						
	Percent Slope ^{1/}						
	0	10	20	30	40	50	60
	(in feet)						
1	.3	.3	.3	.3	.3	.3	.3
2	.6	.6	.6	.6	.6	.6	.6
3	.8	.8	.8	.9	.9	1.0	1.0
4	1.1	1.1	1.1	1.1	1.2	1.2	1.3
5	1.4	1.4	1.4	1.4	1.5	1.5	1.6
6	1.6	1.7	1.7	1.7	1.8	1.8	1.9
7	1.9	1.9	2.0	2.0	2.1	2.2	2.2
8	2.2	2.2	2.2	2.3	2.4	2.5	2.6
9	2.5	2.5	2.5	2.6	2.7	2.8	2.9

These factors are used to correct the plot radii values to the nearest 1/10-inch. For example: for a tree 10.6 inches DBH on a 30 percent slope from table showing plot radius by DBH and percent of slope, a 10-inch tree has plot radius of 28.7 where the slope is 30 percent. An additional correction of 1.7 feet is read in this table for .6 inches in the 30 percent slope column. 28.7 + 1.7 = 30.4 feet; the plot radius for a 10.6 inch tree on a 30 percent slope.

^{1/} Number of feet rise per hundred feet of horizontal distance.

AVERAGE NUMBER OF YEARS TO REACH BREAST HEIGHT
BY SPECIES AND SITE

Species	Average number of years to reach breast height	
	Good site	Poor site or suppressed trees
Aspen	1	2
Ash	8	15
Balsam poplar	1	2
Balsam fir	10	15
Basswood	2	4
Birch (yellow)	8	15
Birch (paper)	2	4
Cedar (white)	10	20
Elm	4	8
Maple (hard)	8	15
Maple (soft)	2	4
Oak	3	6
Pine, jack	5	8
Pine, Norway	6	10
Pine, white	8	12
Spruce, black	10	20
Spruce, white	10	15
Tamarack	5	10

MULTIPLE VOLUME TABLE FOR FACTOR 10 ANGLE-GAUGE PLOT

Trees on plot	Number of 8-foot sticks in tree							
	1	2	3	4	5	6	7	8
	(cords per acre)							
1	.8	1.4	2.0	2.5	3.0	3.4	3.8	4.2
2	1.6	2.8	4.0	5.0	6.0	6.8	7.6	8.4
3	2.4	4.2	6.0	7.5	9.0	10.2	11.4	12.6
4	3.2	5.6	8.0	10.0	12.0	13.6	15.2	16.8
5	4.0	7.0	10.0	12.5	15.0	17.0	19.0	21.0
6	4.8	8.4	12.0	15.0	18.0	20.4	22.8	25.2
7	5.6	9.8	14.0	17.5	21.0	23.8	26.6	29.4
8	6.4	11.2	16.0	20.0	24.0	27.2	30.4	33.6
9	7.2	12.6	18.0	22.5	27.0	30.6	34.2	37.8

Example of use: 5 two-stick trees will indicate a volume of approximately 7.0 cords per acre.

POINT SIZE FOR AREA CONDITION CLASSIFICATION

Item	Radius in feet
All seedlings	3.7
All 2-inch saplings	4.2
All 4-inch saplings	4.7
Brush, herbs, and sod	5.3
5.0" and larger (75 factor)	1/
^{1/} Equals one foot per inch of DBH.	

LOG GRADING IN STANDING TREES FOR STANDARD LUMBER

	Grade I			Grade II			Grade III		
	Hardwoods (except aspen)	Red and white pines	Aspen	Hardwoods (except aspen)	Red and white pines	Aspen	All species		
LENGTH (minimum)	13"	16"	16"	11"	12"	9"	8"		
LENGTH (minimum)	10 ⁺	10 ⁺	8'	8'	10'	8'	8'		
LENGTH CUTTINGS (on best three faces)									
Length (minimum)	7'	5' ^{1/2}	---	3'	---	---	2'		
Number per face (maximum)	2	2	---	---	---	---	unlimited		
Yield in face length (minimum)	5/6	5/6	3/4	4/4	4/6	1/2	4/4	3/6	
DEEP AND CROOK DEDUCTION (maximum)	15%	15%	---	---	30%	---	---	50%	
ILL DEDUCTION, INCLUDES SWEEP (maximum)	40%	40%	25%	0%	50%	50%	30%	60%	

Exceptions: In ash and basswood 12" d.i.b. for grade 1 butts.
Grade 2 10" d.i.b. must be grade 1 surface quality.
Grade 2 11" d.i.b. limited to two cuttings.
Grade 2 8' and 9' lengths limited to 12" d.i.b. with three-quarters of yield in not more than two 3' cuttings.
Sweep and crook allowance reduced 1/3 in logs with more than 1/4 diameter in sound end defects.
Sixty percent cull deduction permitted in grade 2, if otherwise of grade 1 quality.
Sixty percent cull deduction permitted in grade 3, if otherwise of grade 2 quality.
Small end and timber logs must be 8" d.i.b. small end, at least 8' in length; maximum sweep allowance 1/4 d.i.b. of small end for 8' logs, 1/2 d.i.b. for 16' logs; sound knots are permitted if diameter of the knot collar (flush) is not more than 1/3 of log diameter at that point; whorles or cuped knots are allowed if their aggregate collar diameters occurring within a 6-inch vertical distance does not exceed 1/3 of the log diameter at that point; holes not to exceed knot specifications or not to extend over 3 inches into tie or timber are permitted. Sound defects are permitted if they can be slabbed off. No unsound internal defect is permitted except one shake not more than 1/3 the width of contained tie or member, and one split not over 5" long.
Three-foot cuttings are permissible in logs 20" + d.i.b.

RELATIONSHIP OF DBH TO STUMP DIAMETER

Stump diameter:	Diameter breast height		
	Softwoods	Hardwoods	Aspen
	(Inches)		
16 ^{1/2}	14	14	13
17	15	14	14
18	15	15	15
19	16	16	16
20	17	17	17
21	18	18	18
22	19	19	19
23	20	20	19
24	21	21	20
25	22	21	21
26	23	22	
27	23	23	
28	24	24	
29	25	25	
30	26	26	
31	27	27	
32	28	28	
33	29	28	
34	30	29	
35	31	30	
36	32	31	

^{1/} Below 16" DBH is same as stump diameter.

MINNESOTA FOREST SURVEY TATUM GUIDE
 Lake States Forest Experiment Station
 Revised August - 1960

LAND CLASSIFICATION

COVER TYPE

STAND-SIZE STOCKING

Photo Class
 0 Forest
 8 Water
 9 Other nonforest

01 White pine
 02 Red pine
 03 Jack pine
 04 Spruce-fir
 11 Balsam-fir
 12 White spruce
 20 Swamp conifers
 21 Black spruce
 22 Tamarack
 23 Cedar
 30 Northern hardwoods
 40 Oak
 50 Lowland hardwoods

53 Cottonwood
 61 Aspen
 62 Paper birch
 63 Balsam poplar
 72 Upland brush
 73 Upland grass
 75 Lowland brush
 76 Lowland grass
 81 Unproductive uplands
 82 Unproductive lowlands
 83 Christmas tree spruce
 91 Water
 92 Other nonforest
 93 Farm (except woodland)

0 Nonstocked
 1 Restocking, poorly stocked
 2 Restocking, medium stocked
 3 Restocking, well stocked
 4 Poletimber, poorly stocked
 5 Poletimber, medium stocked
 6 Poletimber, well stocked
 7 Sawtimber, poorly stocked
 8 Sawtimber, medium stocked
 9 Sawtimber, well stocked

Ground Class (land type)

1 Pine
 2 Swamp conifer
 3 Northern hardwoods
 4 Oak
 5 Lowland hardwoods
 6 Aspen
 7 Wooded pasture
 8 Water
 9 Other nonforest
 X Noncommercial

PHOTO SITE

1 Good
 2 Medium
 3 Poor
 4 Unproductive

AREA CONDITION

USE TREND

SITE INDEX

1 70 percent or more stocked with desirable trees.
 2 40 to 70 percent stocked with desirable trees, less than 30 percent of the area controlled by inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.
 3 40 to 70 percent stocked with desirable trees, more than 30 percent of the area controlled by inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.

0 Continuing forest use
 1 Continuing nonforest use - grazing
 2 Continuing other nonforest uses
 3 Changed from forest to grazing
 4 Changed from forest to cultivation
 5 Changed from forest to urban
 6 Changed from forest to mining
 7 Changed from forest to water
 8 Changed from forest to other nonforest
 9 Changed from nonforest to forest

Record species code (2 digits) and height at 50 years (2 digits).

5-year intercept site index guide

Height growth during last 5 years	Estimated site index
Feet	
3	33
4	42
5	50
6	57
7	62
8	67
9	71
10	74
11	75
12	76

4 Less than 40 percent stocked with desirable trees, adequate seed source and seedbed favorable to natural restocking.
 5 Areas less than 40 percent stocked with desirable trees inadequate seed source and/or seedbed unfavorable to natural regeneration.

OWNERSHIP

0 National Forest & related lands
 1 Bureau of Land Management
 2 Indian
 3 Other Federal
 4 State
 5 County
 6 Municipal and School
 7 Forest Industry (classify 7 further)
 P Pulp
 L Lumber
 O Other
 8 Farmer-owned
 9 Miscellaneous private

PROTECTION

0 No protection recommended
 1 Disease
 2 Insects
 3 Domestic animals
 4 Game animals
 5 Porcupines
 6 Other protection needed
 7 Drainage needed to improve productivity

STAND-AGE

0 0-9 years
 1 10-19 years
 2 20-29 years
 3 30-39 years
 4 40-49 years
 5 50-59 years
 6 60-79 years
 7 80-99 years
 8 100-119 years
 9 120+ years

STAND TREATMENT

0 No treatment recommended
 1 Emergency cut (within 5 years)
 2 Harvest cut
 3 Commercial stand improvement
 4 Noncommercial stand improvement
 5 Reforest only
 6 Site preparation and reforest
 7 Site preparation only

SIZE OF AREA

1 1 acre
 2 2 acres
 3 3 - 9 acres
 4 10+ acres

SPECIES

MORTALITY

TREE CLASSIFICATION

SOUNDNESS CLASS

01 White pine
 02 Red pine
 03 Jack pine
 11 Balsam fir
 12 White spruce
 21 Black spruce
 22 Tamarack
 23 White cedar
 24 Eastern redcedar
 30 Black maple
 31 Sugar maple
 32 Red maple
 33 Black cherry
 34 Yellow birch
 35 Basswood
 37 Rock elm
 38 White ash
 39 Green ash
 41 White oak
 42 Bur oak
 44 Northern red oak
 46 Northern pin oak

47 Hickory
 50 American elm
 51 Slippery elm
 52 Silver maple
 53 Cottonwood
 54 Black ash
 55 River birch
 56 Hackberry
 57 Willow
 60 Quaking aspen
 61 Bigtooth aspen
 62 Paper birch
 63 Balsam poplar
 70 Misc. commercial
 71 Black walnut
 72 Butternut
 73 Ironwood
 74 Boxelder
 76 Black locust
 77 Honey Locust
 80 Noncommercial

1 Fire (a)
 2 Weather (b)
 3 Flood (c)
 4 Suppression (d)
 5 Disease (e)
 6 Insects (f)
 7 Birds and animals (g)
 8 Cut (by man) (h)
 9 Logging damage (i)
 0 Unknown (j)

0 Poor saplings and poles
 1 Crop tree (D.T.)
 2 Storage tree (D.T.)
 3 Harvest tree (U.T.)
 4 Sound cull
 5 Rotten cull
 6 Dead tree
 7 Stump
 8 Too small or missed during previous survey
 9 Noncommercial

00 No defect
 97 1-5 percent defect
 93 6-10 percent defect
 86 11-18 percent defect
 78 19-27 percent defect
 65 28-39 percent defect
 54 40-49 percent defect
 41 50-69 percent defect
 19 70+ percent defect

DISTRIBUTION OF VOLUME IN THE TREE

Tree Size	Bolt Number											
	Bolts (8')	Logs (16')	1	2	3	4	5	6	7	8	9	10
2	1	56	44									
3	1½	41	33	26								
4	2	33	28	22	17							
5	2½	27	23	19	17	14						
6	3	24	21	18	15	12	10					
7	3½	22	19	17	14	12	9	7				
-	4	20	18	15	13	11	9	8	6			
-	5	18	15	13	12	10	9	8	6	5	3	

CUT-LEAVE-STUMP

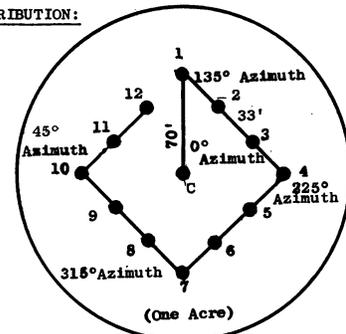
0 Leave
 1 Cut
 7 Stump

Example: A 1-log tree has 56 % of tree volume in the butt bolt, 44% in the second.

STAND CLASSIFICATION BY THE HASEL-LARSON METHOD IN MINNESOTA
 Lake States Forest Experiment Station
 January - 1961

Under the Hasel-Larson Method of classifying forest stands as adapted for Minnesota, thirteen small points, well distributed about a sample acre are considered. The current stocking situation on each point is appraised and the action needed to harvest volume or to obtain desirable growing stock is indicated. These data are then used to classify stand stocking and size classes, cover type, area (stand) condition, and the stand treatment needed.

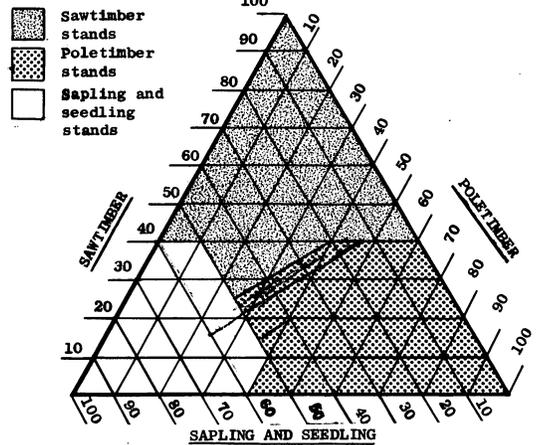
POINT DISTRIBUTION:



POINT RADIUS

Factor-75 plot for trees 5.0" + at DBH
 (1 foot radius for each inch DBH)
 4.7 feet for trees 3.0" - 4.9" at DBH
 4.2 feet for trees 1.0" - 2.9" at DBH
 3.7 feet for trees below 1.0" at DBH
 5.2 feet for brush, herbs, sod and slash
 If the crown of a free growing tree beyond the limiting distance overtops and dominates the point, the tree is considered as stocking the point.

STAND-SIZE CLASSIFICATION CHART BASED ON STOCKED POINTS.



PROPORTION OF GROWING STOCKED POINTS IN A SIZE-CLASS

No. of stocked points	Number of points in a size-class											
	1	2	3	4	5	6	7	8	9	10	11	12
2	50	100										
3	33	67	100									
4	25	50	75	100								
5	20	40	60	80	100							
6	17	33	50	67	83	100						
7	14	29	43	57	71	86	100					
8	12	25	38	50	62	75	88	100				
9	11	22	33	44	56	67	78	89	100			
10	10	20	30	40	50	60	70	80	90	100		
11	9	18	27	36	45	55	64	73	82	91	100	
12	8	17	25	33	42	50	58	67	75	83	92	100
13	8	15	23	31	38	46	54	62	69	77	85	92

STOCKING CLASS

Current stocking of a point is indicated by presence of one free growing tree within the limiting radius or sufficient brush, sod or slash to cover at least half the point. A free growing tree is one with at least half its crown area open to the sky. A point will be classified for the most dominating tree present. If no tree stocks the point consider other classes.

D - Desirable trees. A healthy dominant or codominant tree with a crown more than 1/3 filled with foliage of good color and normal size; with no apparent physical weaknesses, pathogens, or insects present which are likely to kill or seriously deteriorate the tree within 10 years; having less than 10 percent loss of scale; capable of yielding now or prospectively at least 1 or 2 sawlogs or on poor sites and in the case of nonsawlog species two 100-inch sticks of standard quality pulpwood or a 20-foot pole. Any tree of commercial species meeting the above specifications may be classed desirable if 3" d.b.h. or larger. If smaller, it also must be of a species suitable for the type and site as given below.

A - Acceptable tree.—A free growing, growing stock tree which does not qualify as a desirable tree.

C - Cull trees and noncommercial species (nongrowing stock trees).

I - Inhibiting vegetation (brush, herbs, or grass) and slash which inhibits growth.

N - Nonstocked (temporarily not occupied by trees, inhibiting vegetation or slash).

Z - Not stockable (water, rock, marsh, etc.)

TREE-SIZE CLASSES

Includes sawtimber (s), poletimber (p), reproduction (r - saplings and seedlings).

EXCESS STOCKING

Is indicated by presence of more than one tree on the point. Nonfree growing trees will be indicated only if they are merchantable.

ACTION NEEDED AT EACH POINT

Select the action class which will provide the best silvicultural treatment. Recommend only such action as may be needed to stock the point with a desirable tree, to harvest timber volume or remove undesirable material. No action is needed for a point likely to be dominated by a nearby tree within 10 years.

Grazed forest land will be handled as though grazing were to be discontinued.

- C - Cut pole or sawtimber growing stock tree
- T - Other treatments than merchantable cut (TSI, deadening) to provide growing space
- S - Prepare site (seedbed) for natural regeneration
- R - Reforestation (planting or seeding) without site preparation
- SR - Site preparation (of any type) plus reforestation
- N - No action recommended
- NP - Nonproductive site. Not capable of growing a desirable tree

STAND CLASSIFICATION PROCEDURE

(Classes are defined on pages 40-46 of Survey Instructions)

1. Classify forest stands as well, medium, poor, or nonstocked on the basis of points occupied by growing stock trees.
2. Classify stand-size (of stands at least 10 percent stocked) on the basis of proportion of points stocked with growing stock trees using table and chart. Look up proportion of points in each stand-size class in table before entering chart.
3. Classify forest type and stand-age for the stand-size class designated.
4. Classify area condition on the basis of proportion of points occupied by desirable trees and proportion occupied by inhibiting vegetation (including cull trees) and slash.

AREA CONDITION

- 1 70 percent or more stocked with desirable trees.
- 2 40 to 70 percent stocked with desirable trees, less than 30 percent of the area controlled by inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.
- 3 40 to 70 percent stocked with desirable trees, more than 30 percent of the area controlled by inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.
- 4 Less than 40 percent stocked with desirable trees, adequate seed (or aspen suckering) source and seedbed favorable to natural restocking.
- 5 Areas less than 40 percent stocked with desirable trees inadequate seed source and/or seedbed unfavorable to natural regeneration.

STAND TREATMENT

- 0 No treatment recommended
- 1 Emergency cut (within 5 years)
- 2 Harvest cut
- 3 Commercial stand improvement
- 4 Noncommercial stand improvement
- 5 Reforest only
- 6 Site preparation and reforest
- 7 Site preparation only

DESIRABLE SPECIES BY COVER TYPE AND SITE 1/

Cover Type	Site	White pine	Red Pine	Jack Pine	Balsam Pine	Spruce-fir	Hemlock 2/	B. Spruce	Tamarack	W. Cedar	S. Maple 2/	Red Maple	B. Cherry	Y. Birch	Basswood	Rock elm	W. Ash	W. Oak	Bur Oak	N. Red Oak	Am. Elm	Slip. Elm	Cottonwood	B. Ash	Aspen	Paper Birch	B. Walnut	
		Red & white pine	SI below 65	D	D	D	D																					
Jack-pine	SI 65 plus	D	D																									
Spruce-fir & cedar	SI below 50	D	D																									
Black spruce & tamarack	SI 50 plus	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Northern hardwoods	Upland	D			D	D					D	D	D	D	D	D	D	D	D	D								
Lowland hardwoods	Lowland	D			D		D				D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
Oak	SI below 60		D	D																								
Oak	SI 60 plus										D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
Aspen-paper birch	ALL										D										D	D	D	D	D	D	D	

1/ Largely taken from Appendix, Table 91, Timber Resources for America's Future, Forest Resources Report No. 14
 2/ Not considered desirable in Minnesota.
 3/ Considered desirable only in tamarack stands.

