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Introduction

This manual provides Forest Survey field instructions for the North Central Forest Experiment Station, National Forest Systems, and other cooperating organizations in establishing and measuring field sample plots for the Survey in the North Central Region.

Federal legislation mandates that periodic inventories and assessments be made of the Nation's forest resources. The US. Forest Service has the responsibility for meeting this mandate.

Anyone who establishes a permanent plot should recognize that he or she hereby assumes responsibility for furnishing workers with a complete picture of conditions on the plot at the time of its establishment. Not only must each plot be properly marked and all measures be in near perfect order, but all notes and records must be complete. Otherwise, the plots may fail to yield the desired results and those who in later years become responsible for their care and for the analysis of the data, may be led to serious mistakes.

(US. Department of Agriculture, Forest Service 1935)

Each forest experiment station has been assigned to provide statistics for a number of specific states (11 states for the North Central Station). Statistics from each station must be presented in a manner that permits aggregation with those from the other stations in order that uniform regional and national statistics may be produced. The experiment stations are further directed to cooperate with other agencies and individual states in order to provide additional resource information.

Field Equipment

The following equipment is necessary to measure required items at field locations. Field personnel should check to make sure they have this equipment, and that it is in good working order.

- Pocket Stereoscope
- Plot Tape (100 ft. woven type) & chaining pin
- Clinometer (Suunto)
- Clip Board (With Tatum Guides & Photo Scales)
- Telescopic Height Pole (30 ft.) - one per crew or vehicle
- Wheeler Pentaprism - one per crew or vehicle
- Cruiser's Vest
- Tree Marking Scribe
- One Yellow Stake
- Ten Metal Pins
- Data Recorder or field plot sheet
- 37.5 Factor Prism
- Hand Ax
- Compass (Suunto)
- Increment Borer
- Diameter Tape
- Photo Holder
- Tree Paint
- Flagging
- Safety Pin
- Hip chain (1 per crew)

Overview Of The Plot Design

This plot is designed to sample an area of land one acre in size and the trees on that acre. All conditions on the plot are sampled and trees are sampled within these conditions. The location of the plot and all sub-plots that makeup the plot is completely determined by plot center. Unlike the old 10-point plot design that sampled lands within a given land use, no movement of sub-plots is allowed. When remeasuring plots that were moved, all trees on the previously moved sub-plots will be remeasured as well as the new non-moved sub-plots.

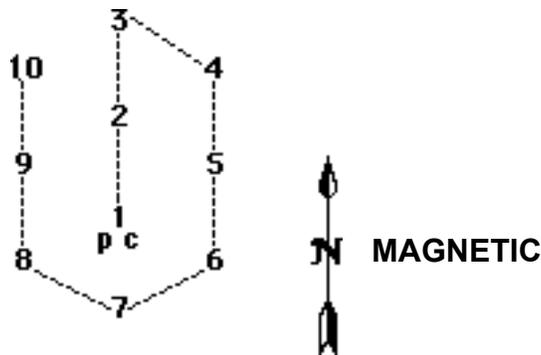
The basic plot consists of 10 sub-plots. The layout of these sub-plots is shown in figure 1. Plot center is the term applied to the point used to locate the plot. It is the ground location that corresponds to the pin prick on the photography. The centers of the sub-plots are referred to as sub-plot centers. Sub-plot center 1 is the same as plot center. Each sub-plot consists of a micro plot (6.8 ft. fixed radius) to sample trees less than 5.0 inches, a variable radius (37.5 BAF) plot to sample trees 5.0 to 16.9 inches, and a macro plot (24.0 ft. fixed radius) to sample trees 17.0 inches and larger. No trees are sampled at a distance greater than 24.0 feet from a sub-plot center (horizontal distance from sub-plot center to the center of the tree at 4.5 dbh).

Plot design

The pattern of sub-plot is designed to obtain a uniform distribution of sub-plot over approximately one acre. Distances between sequential sub-plot centers is 70 horizontal feet. (Figure 1).

Figure 1 Plot layout

<u>From</u> sub-plot center	<u>To</u> sub-plot center	<u>Azimuth</u>
1	2	0°
2	3	0°
3	4	120°
4	5	180°
5	6	180°
6	7	240°
7	8	300°
8	9	0°
910	0°	



After sub-plot center 1 has been established, locate and mark the other nine sub-plot centers with metal pins and flagging. Under no circumstances should sub-plot centers be moved away from this pattern.

This plot design requires the identification and location of condition boundaries that pass through the plot. A condition is defined as a land use classification or identifiable forest community that meets the following criteria:

- 1) It can be identified on the aerial photograph,
- 2) It is at least one acre in size, and
- 3) It is at least 120 feet in width (except in the case of rights of way, wooded strips, narrow windbreaks, shelter belts and urban and other)

Data is collected at various levels. Some data (plot record) is collected only once for the plot and applies to the plot center. All other data is collected within a condition. Some data describes the condition, and other data describes the trees and or shrubs within a condition or the location of condition boundaries. These various levels of data are described here and the data items in each level are listed. A complete description of each data item and how to measure them comes in later sections of this manual.

Plot record.

A number of data items are collected or assigned for plot center, that is they are only collected once for any plot. Two of these data items (current ground land use and ownership class) are also recorded again for each condition class on the condition class record. In general, items in the plot record identify the plot, help to locate the plot, or describe some attribute of plot center. These data items are:

State *	Nonforest/forest PI indicator ‡
Unit *	Forest/nonforest PI indicator ‡
County *	Township *
New plot number *	Range *
Old plot number *	Section *
Dot number ‡	Subdivision *
Sample kind *	Weather conditions
PI land use ‡	Office - Photo age
Cruiser code	Office - Photo flight line *
Tallier code	Office - Photo number *
County name *	Office - Photo scale *
Original ground land use *	Starting point description
Current ground land use	Direction to first sub-plot
Reason for ground land use change	Distance to first sub-plot
Type of closest water *	First sub-plot number
Area of closest water *	Data recorder
Distance from closest water *	Cruiser name
Type of closest road *	Tallier name
Distance from closest road *	Date
Ownership class	Owners name
National Forest *	Owners address
Ranger district *	Accuracy of owners name and address
Original date *	Accuracy of ownership class
Current date	

* These data items are collected or assigned in the office and only verified in the field.

‡ Entered in office, do not change.

Condition class data.

All other data items collected on a plot describe a condition class that occurs on one or more of the sub-plots. These data items either describe the condition itself, the location of a condition class or the border between two condition classes, or an individual tree or shrub within a condition class. Data items are grouped into records for data entry purposes. The group of data items that directly describe a condition class make up the Condition Class Record. The group of data items that describe the location of a condition class or the border between two condition classes make up the Sub-plot Record. The Tree Record is made up of data items collected on trees and the Shrub Record is made up of data items collected on shrubs. Trees and shrubs are measured within condition classes. Also, a special Site Tree Record is used to record the information needed to compute the site index of a condition class from the site tree measurements. The data items contained in each of these records are listed below with complete descriptions in later sections of this manual.

Condition class record

Each condition class that occurs anywhere on one of the sub-plots must be identified and described. Each condition is assigned a condition number starting at 1 for identification purposes. The first condition (condition number 1) should be the condition found at plot center. If additional conditions are found on the plot they are assigned condition numbers sequentially, starting with 2. As each new condition class is met, condition class information is recorded on the Condition Class Record. The following data items make up the Condition Class Record:

Condition number (CON#)	Stand history (SHIS)
Ground land use (GLUC)	Forest type-stand size class (FTS)
Aspect (ASP)	Stand age (AGE)
Position (POS)	Site index (SI)
Slope percent (SLP)	Site index species (SISP)
Slope shape (SHP)	Stand area (AREA)
Slope length (LEN)	Ownership class (OWNC) *
Physio graphic class (PHYS)	Basal area per acre (CBA)
Stand origin (SORI)	Riparian zone width (RIPW) "Plains States only"
	Bare ground (BRGD) "Plains States only"

Any of these data items may be different from one condition class to the next. A change in any one of these data items (except ownership class alone) can mark a condition class boundary, however it must be identifiable on the aerial photograph, at least once acre in size and at least 120 feet wide (except in the case of rights-of-way, wooded strips, narrow windbreaks, shelterbelts and urban and other).

Sub-plot record

The data items in the sub-plot record identify and map the conditions that occur on each of the 10 macro plots. There will be at least 10 sub-plot records for every completed plot. The first sub-plot record for a sub-plot corresponds to the condition present a sub-plot center. Whenever the boundary between any two condition clearly cuts through a sub-plot an additional sub-plot record must be recorded for that sub-plot. This additional sub-plot record identifies the additional condition and locates its boundary. If two adjacent sub-plots are in different conditions and the boundary between these two conditions does not clearly cut through either of the sub-plots it will be assumed that the boundary occurs between the two sub-plots. When only one sub-plot record is entered for a sub-plot it is assumed that the entire macro plot is within the condition identified at sub-plot center. The data items that make up the sub-plot record are:

- Sub-plot number (SUB#)
- Condition number (CON#)
- Percent of sub-plot area (%SAR)
- Cover class (COVC)
- Azimuth left (AZML)
- Azimuth right (AZMR)
- Azimuth corner (AZMC)
- Distance corner (DISTC)

Site tree record

The data items in the site tree record describe the trees measured to determine the site index of a condition or conditions. Two adjacent conditions may have the same site index and do not require the measurement of different site index trees, however if the same trees are being used for more than one condition they must be entered for each condition that they are being used for. The data items in the site tree record are:

- Tree number (TR#)
- Dbh (DBH)
- Species (SPP)
- Height (HGHT)
- Bored age (BAGE)
- Total age (TAGE)
- Years added (YADD)
- Site index (SI)
- Condition number (CON#)

Tree record

The data items in the tree records describe the trees that are measured. Trees less than 5.0 inches are measured on a micro plot (6.8 ft. fixed radius at base of tree-horizontal distance) trees 5.0 to 16.9 inches are measured on a variable radius (37.5 BAF) plot and trees 17.0 inches and over are measured on a macro plot (24.0 ft. fixed radius at dbh-horizontal distance). The data items in the tree record are:

Sub-plot number (SUB#)	Crown class original (CCO)
Tree number (TR#)	Crown class current (CCC)
Distance (DIST)	Azimuth (AZM)
Dbh original (DBHO)	Condition number (CON#)
Dbh current (DBHC)	Tree cavity (TCAV)
Species (SPP)	Tree grade/Number of seedlings (TGRD)
Damage/cause of death (DAM)	Bole length (BOLL)
Tree class original (TCO)	Bole top diameter outside bark (BDOB)
Tree class current (TCC)	Sawlog length (SAWL)
Tree history (THIS)	Sawlog top diameter outside bark (SDOB)
Crown ratio original (CRO)	Cull cubic feet (CULC)
Crown ratio current (CRC)	Cull board feet (CULB)
	Crown diameter (CDWI) "Plains States only"
	Crown diameter (CD90) "Plains States only"

Shrub record

The data items in the shrub records describe the shrubs that are measured. Shrubs are measured in the NE quadrant of the micro plots only for sub-plots 1, 2 and 3. The data items in the shrub record are:

Sub-plot number (SUB#)	Diameter class (DIAC)
Shrub number (SNUM)	Frequency of stems present (FREQ)
Species (SPP)	Percent cover (COV)
Shrub history (SHIS)	Browse (BROW)

Field Procedures

Permanent forest inventory plots measured during the previous survey are remeasured to obtain information on changes that have taken place between surveys. Some of these changes are reflected in land use, growth, and removals. Therefore, it is important that every plot and every tree tallied previously be accounted for at the time of remeasurement.

Uniform measuring and recording methods ensures efficiency in the collection of forest resource statistics and comparability of the resource data compiled by different units. Precise measurement and classification is essential to keep field-technique errors to a minimum. Errors in classification or tree measurement are expanded several hundred times in the processing phase of the Forest Survey. An accumulation of even small errors may lead to erroneous inventory results.

Plot numbers identify sample plot locations on aerial photographs. The 9 digit plot number is recorded by the photo interpreters. A new plot sheet is completed for all plots sent to the field offices.

For each plot, field crews receive a new plot sheet and aerial photographs, with the sample location marked. A remeasurement plot also includes the original plot sheet and aerial photographs if found. For remeasurement plots, check that the plot number on the original plot sheet matches the "Old plot number" on the new plot sheet.

Information obtained at each sample location is recorded on an electronic data recorder and/or a new plot sheet. See the sample field plot sheets in the appendix.

It may be helpful to consult the previous survey manual for procedure or definition changes between the time of the previous and current surveys. Copies are available in the field offices.

The following pages describe tally items. Headings show the tally item name and number and the prompt (in parentheses) that appears on the data recorder.

Most instructions that apply to a new measurement plot also hold true for a remeasurement plot. When necessary, specific instructions are given for a remeasurement plot.

Plot Record: Items 1-6, 67-73

Ownership: Item 1

Field personnel visit county court offices to collect ownership data for all plot locations. Owner's name and address, ownership class, and size (timberland only) are acquired from tax and ownership records.

Ownership information for National Forest land may be obtained from the land status atlas located at the Ranger District or Forest Supervisor's office. Ownership information on other public lands usually can be obtained from their local field offices.

Personal contact with the landowner (while gaining permission to measure the plot) is often the best way to get ownership information on very small tracts of land.

Ownership class (OWNC) 2 digits

Record the ownership class on the plot record using the following two-digit codes.

<u>Code</u>	<u>Owner</u>
11	National Forest
12	Bureau of Land Management
13	Indian
14	Miscellaneous Federal
15	State
16	County and Municipal
2*	Forest Industry (Must process own products.)
6*	Miscellaneous Private Corporate
7*	Farmer and miscellaneous Private Individual

*For Ownership Class codes 2 through 7, the second digit indicates ownership size (commercial forest land only) in the United States. Indicate size in acres by using one of the following codes.

<u>Code</u>	<u>Acres of Commercial forest land</u>
1	1-4
2	5-9
3	10-19
4	20-49
5	50-99
6	100-499
7	500-2499
8	2500-4999
9	5000+ (Include <u>actual</u> number of acres owned for all tracts 5000+ acres in the "Notes" section.)

How To Collect Ownership Information

- Go to the county courthouse and find the Assessor's office. Explain who you are and what you are doing.
- To find the owner's name for each plot, you will need to use a current plat book or the large set of plat sheets. You may need to find a "parcel number" first, and then refer to a card file or a computer terminal to find the owner. Each courthouse is unique, so your methods may vary from county to county.
- By cross-referencing the plat book with the current aerial photography, you can get a pretty good estimate of acres in forest land owned by each individual. The courthouse may have another method more accurate. Make sure to watch in the plat book for other parcels of land owned by the same person. Total all of the forested parcels together to obtain the second digit of the ownership class.

Ownership Class is recorded for the following plots:

- All plot locations where some portion of the plot is on Ground Land Use (GLU) 20, 21, 22, 40, 41, 45, 46, 57 or 59.
- All remeasurement plots previously having a Ground Land Use (GLU) 20, 21, 22, 40, 41, 45, 46, 57 or 59 even if the land use has changed.

Ownership accuracy is noted on the plot sheet for each of these items:

- Owner name and address
- Owner area class
- Indicate on plot sheet if personal contact with the landowner was made while gaining permission to measure the plot.

For each of the ownership items use one of the following codes.

<u>Code</u>	<u>Definition</u>
1	Unknown - best estimate.
2	Poor - courthouse records unclear or an unreliable source.
3	Good - verified in courthouse or by owner.

Note: Ownership accuracy is noted only on the plot sheet and is not entered into the data recorder.

How to handle plots that may straddle two ownerships.

It is possible for a plot to cover more than one ownership class. When this happens the second ownership class will not be recorded **unless both** of the following criteria are met.

- 1) The two owners fall into separate ownership classes. For this purpose consider OWNC 21-29 a single class and OWNC 61-79 a single class.
- 2) The ownership boundary also corresponds with a condition class boundary.

When multiple ownerships are recorded a note should be made on the plot sheet. For example, if the PC is in timberland (GLU = 20) owned by the State (OWNC = 15) but part of the plot extends into cropland (GLU = 61) privately owned (OWNC = 76) it should be noted in the notes section on page one of the plot sheet. A short note such as "cropland portion of this plot has ownership class 76" would be sufficient in this case. This ownership data for a second owner is collected with the other Condition Class items in the field.

Sample Kind (SK) 1 digit: Item 2

The plot sample kind indicates the information to be collected and identifies whether the plot was previously measured. The following is a list of sample kind codes and their descriptions.

<u>Code</u>	<u>Description</u>
0	Lost (non relocatable) or denied access plot
1	Full New Measurement Take all measurements including volume measurements (items 44 - 50). This is a new plot, with no old trees to locate.
2	Full Remeasurement Relocate and measure all old trees, also measure new trees. Take volume measurements as in Sample Kind #1.
6	Partial Remeasurement Relocate and measure all old trees, also measure new trees. Volume measurements (items 44 - 50) are not needed.
7	Partial New Measurement This is a new plot with no old trees to locate. Volume measurements (items 44 - 50) are not needed.
8	Remeasurement of a 5 point design plot (Western Unit - South Dakota). In addition, a new 10 sub-plot (SK 7 plot) will be established and will over lay this remeasurement plot with sub-plot center-1 being at the same location for both plots.

Plot Location: Item 3

Establishment of Baseline

The first step in locating the forest sample location is finding two features on the ground that are easily noticed on the photograph. The two features should be at least 10 chains apart for scale 1:20,000 and 20 chains apart for scale 1:40,000 to help minimize error. Select such features as straight road sections, drainage ditches, or two distinct trees. Avoid using railroads or power lines since they influence the compass reading.

Pinprick both features on the photograph and circle the pinpricks on the back of the photos. Draw the baseline on the back of the photograph with an arrow at one end of the line to indicate the azimuth direction. Measure the azimuth with a compass to the nearest half-degree and record it on the back of the photograph. Disregard magnetic declination.

Starting Point

A starting point (SP) is established for the purpose of locating a sample plot. It should be as near as possible to the sample location, yet not on the same acre as the sample plot.

When selecting the starting point, make sure it is readily identifiable on the ground and on the photograph. Select a prominent tree located at the edge of a field or clearing, at a bend in a stream, or any landmark easy to find on the next survey.

Pinprick the starting point on the aerial photograph on which the sample location is pinpricked. Label and circle the pinprick "SP" on the back of the photograph.

In the field, mark the starting point with paint facing the direction of normal approach. Paint "SP" (in letters four-inches tall) just above where the diameter breast height (DBH) measurement was taken. Paint a three-inches tall "SP" near ground level. Use discretion in painting trees on private lands and in well-travelled areas.

Describe the starting point on the plot sheet under "Starting Point Description." Include the landmarks you used to locate SP. Specify details such as:

- Species, DBH, and the face on which the tree is painted.
- Any nearby road, fence, pasture, etc. and the tree's location in relation to that feature.
- Any noticeable characteristic of the SP tree, such as a fork at 10 feet, multiple stems, deer stand, etc.

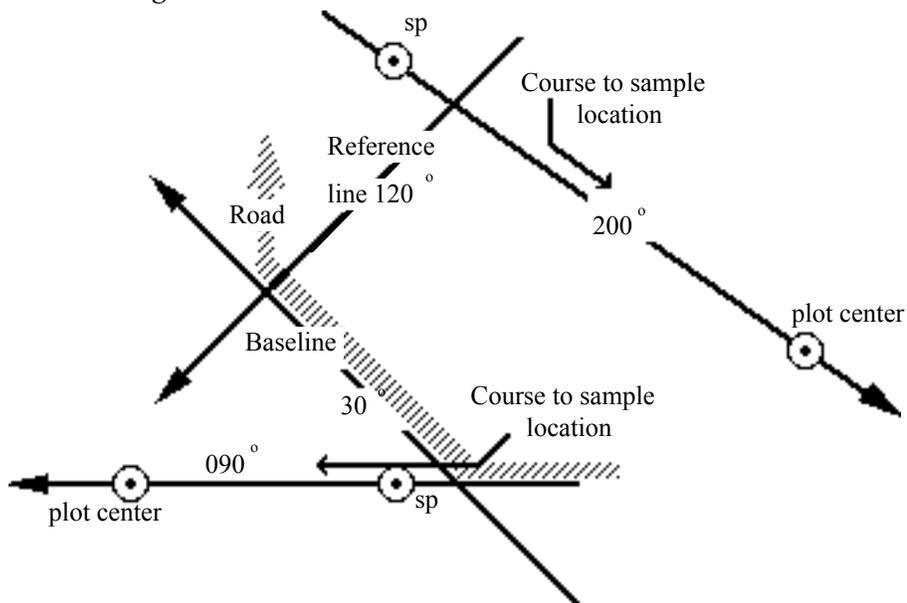
Azimuth and Distance Computation

On the back of the photograph, draw a straight line through the center of the starting point pinprick and the center of the sample location pinprick. Extend this line to intersect the baseline. Lines should extend well beyond the intersection to allow reading the backsight off the 360-degree protractor to check the accuracy of the angle being measured.

If the baseline and the line to the sample location do not intersect on the photograph, draw a straight line that will intersect the baseline and the course to sample location line. Indicate the directions of the sample location line and the baseline by putting an arrow at the end of each line. Measure the angle between these lines, starting from the baseline.

Be sure to use an inverted 360° protractor or flip a standard 360° protractor over. Align the 360-degree protractor over the azimuth of the baseline to get the azimuth of the sample location line. The azimuth is read directly off the protractor once the azimuth of the baseline is correctly aligned on the inverted protractor. This is because east-west azimuths are reversed 180 degrees when working on the back of the photographs. Repeat this procedure if an additional line (reference line) was needed to intersect the course to sample location. To minimize error, check the backsights of both base and course to sample location lines. This is a check to see if the protractor is precisely aligned.

Figure 2 - Azimuth settings



Important: East-west azimuths are reversed when working on back of photo with standard protractor. Inverted protectors are available.

Refer to Figure 2. Measure on the photograph the distance from the starting point (SP) to the plot center (PC) to the nearest quarter chain using a transparent photo scale. (Photo scales, corresponding to the aerial photography, are supplied.) Hold the photo up to the light and carefully measure, from the center of one pinprick to the center of the other. (Sometimes it helps to use your stereoscopes as a magnifier.) Record both distance and direction on the back of the photograph and on the plot sheet under "Course to Sample Location".

Chaining

Using compass and tape, run a course on the computed azimuth. Distance correction for slope is necessary when slope exceeds 10 percent. Using the Suunto clinometer, slope correction can be quickly determined and added by the tallier after the cruiser has run out the line. Making adjustments for differences in the height of crew partners, the tallier can sight on the cruiser and directly read the percent scale on the clinometer. The appropriate slope correction can then be found in Table 1. The correct adjustment should be added at the same percent slope. For example, to chain a horizontal distance of 66.0 feet on a 25 percent slope, chain 68.0 feet (66.0 + 2.0) on the slope.

Table 1--Slope Correction in feet
(Distance is measured on slope)

Percent	Feet		
	66'	70'	99'
10	.3	.3	.5
15	.7	.8	1.1
20	1.3	1.4	2.0
25	2.0	2.2	3.0
30	2.9	3.1	4.4
35	3.9	4.2	5.9
40	5.1	5.4	7.6
45	6.4	6.8	9.6
50	7.8	8.3	11.7
55	9.3	9.9	14.0
60	11.0	11.6	16.5
65	12.7	13.5	19.1
70	14.6	15.5	21.9
75	16.5	17.5	24.7
80	18.5	19.7	27.8
85	20.6	21.9	30.9
90	22.8	24.2	34.2
95	25.0	26.6	37.6
100	27.3	29.0	41.0

Once the computed course has been run, place a permanent stake at the end of the computed course. Important: Make sure that photograph location agrees with ground location.

Location Correction

If the ground location is clearly not the point pinpricked on the photograph, and the correct location can be determined on the site, place a second pin at the correct location. Note the azimuth and distance from the initial pin to the relocated pin and record these items under "Course to Sample Location" on the plot header sheet and remove the first pin. The initial pin is referred to as a turning point. The second pin becomes the location of the plot.

Chaining to sub-plots 2-10

In chaining to plot center, you may encounter some condition that makes it impossible or impractical to physically reach plot center and put in a pin. Plot center may be in water, the center of a barn, or on a busy highway. Other sub-plots on the plot may be in a forest condition and the plot must be installed. In this case you can chain to any one of the sub-plots and establish it first. This can be done by using the data recorder program to compute the direct distance and azimuth to take from the starting point to any sub-plot center and chaining directly to a given sub-plot. This method is best when you can see you will have trouble reaching plot center before you start chaining. **Note:** This program works only if you are farther than 140 ft. away from PC.

A turning point can also be used at any point when chaining to reach another sub-plot center. At any point while chaining, establish a turning point, chain the distance and azimuth from plot center to the sub-plot you wish to chain to, and then continue on your original course. For example, the course from the starting point to plot center is 200° , 700 ft. After chaining 600 ft you can see that plot center will be in a river and it would be best to chain to sub-plot 3. At 600 ft, establish a turning point and go 0° , 140 ft (the distance and azimuth from plot center to sub-plot 3). Establish another turning point and complete the original course (200° , for the remaining 100 ft) to reach sub-plot 3.

Plot Location Procedure For Remeasurement Plots

Using both the old and new photographs, locate the starting point, or SP. If the SP pinprick is missing from the old photo, refer to "Starting Point Description" on the old plot sheet and determine the SP location according to the azimuth and distance to plot center, PC. Pay close attention to any openings on the photo, such as clearings, roads, woods trails, lakes, and streams, where the SP might logically be located. Also check the sketch of the area on the back of the original plot sheet.

Once the SP tree is located, inspect to see that it is suitable. If the SP is suitable, the cruiser rescribes, repaints, and remeasures DBH. The tallier checks the "Course to Sample Location" on the plot sheet to see if it seems reasonable. The tallier then transfers the original course to sample location, SP description, and the remeasured DBH to item 3 on the new plot sheet. On the new photo, pinprick the SP and record the course to sample location on the back of the photo.

Plot Location *Continued*

Establish a new starting point if the original SP is not suitable, cannot be found, or the plot location was visualized. Record the course to sample location, SP description, and SP DBH on the new plot sheet. After re-establishing the SP, chain the computed azimuth and distance along the approach line and mark the location.

Search the area for evidence of the old plot. Items to look for are paint on the tree bases (vertical line) and at DBH (horizontal line). Look for 10-inch wire pins and bits of flagging at each sub-plot, blazed trees, and witness trees (painted with an "X").

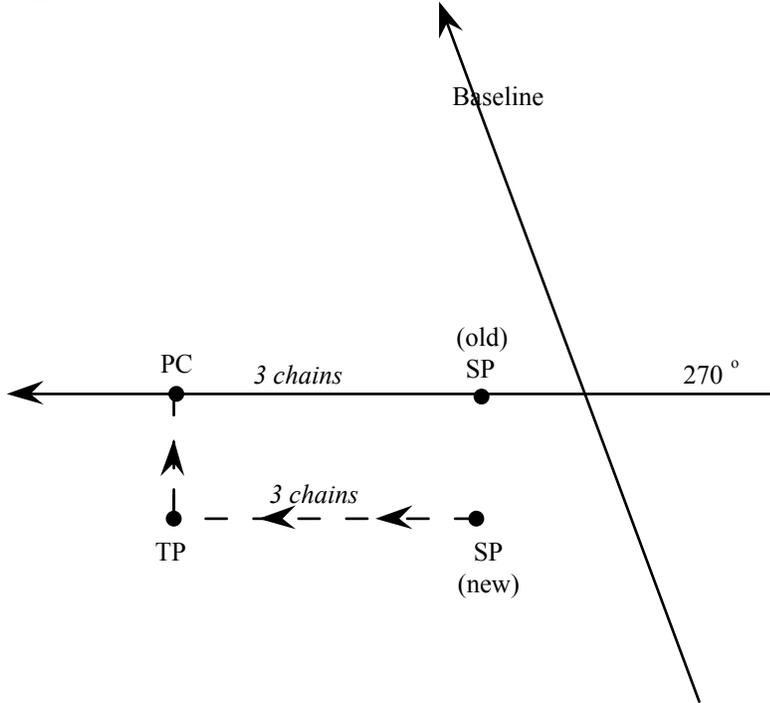
After finding plot center, establish a turning point if the distance between plot center and the end of the approach line exceeds 3% of the chaining distance.

In the event that, after chaining the prescribed distance, no evidence of the old plot can be found, the following alternatives for locating PC are available.

- Using the original SP, look for landmarks to discern if the plot is in the area. Look especially for mistaken openings, trails, etc.
- Search an area of five chains around the end of the approach line(s).
- Return to the SP, check the photo work, and try rechaining.
- Check the photo work to see if the original crew chained in the opposite direction.
- Pick a new SP, establish a new approach line, and chain in from there.

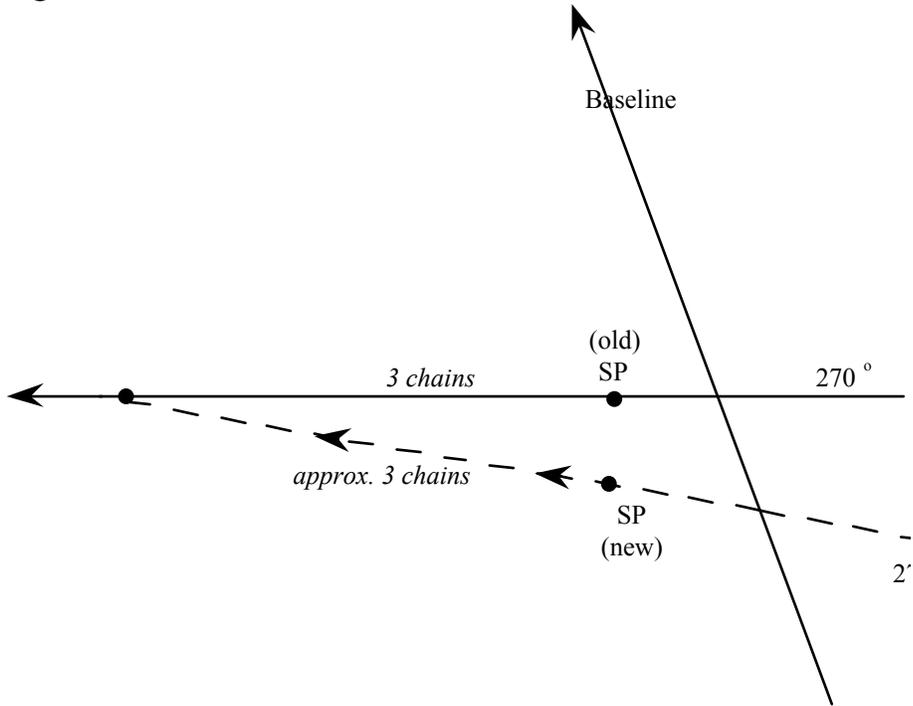
An easy way to establish a new SP, when needed, is to inspect the vicinity of the original SP for a suitable replacement. There are three options available once you've found a replacement.

Figure 3A



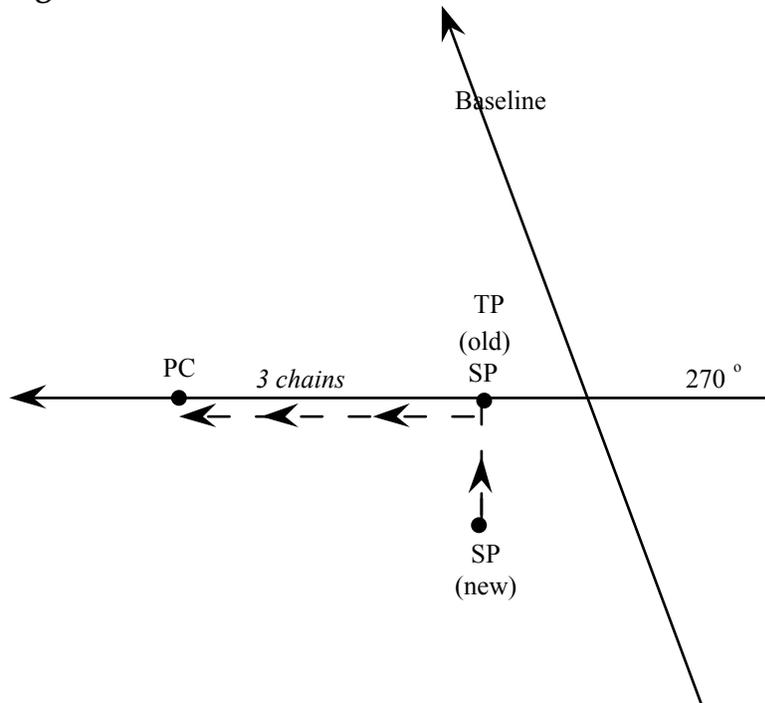
1. If the new SP is close by, pick the tree on the photo and use the original course to sample location. Leave a marker where you finally land in the woods and look for plot center. It should be approximately the same distance and azimuth that the old SP is from the new SP. Once PC is found, make a turning point from your marker to PC. (Figure 3A)

Figure 3B



2. Depending on how far the new SP is from the old SP, you may try adding or subtracting a degree or two (whichever is appropriate) and follow this azimuth into the plot. Adding a few feet onto the old distance may be helpful. Use a marker to show where you ended your chaining. Scan the area for the plot center and then make the necessary turning point to plot center. (Figure 3B)

Figure 3C



3. Measure the distance and azimuth from the new SP to the original SP. Record this information in "Course to Sample Location". Record the old course to sample location to the right of this new course. At this time, a new SP has been established and the original SP is used as a turning point in the course to sample location. (Figure 3C) Note: This is the least desirable choice, for it may result in having two turning points--one at the beginning and one at the end.

Occasionally, while chaining in you may pass near or over PC. Minimize the length of a turning point, or perhaps eliminate the need for a turning point, by reducing the chaining distance--backtrack along the line of approach.

Sub-plot Location

After finding some evidence of the old plot, look for trees marked at the base and at DBH with white paint. When several of these trees are found in close proximity, examine the original plot sheet and try to match these trees to trees on one of the original sub-plots.

Match by comparing current tree species, azimuths, distances, and DBH to the old figures for trees on the original plot sheet. Once it is determined to which sub-plot the trees belong, use triangulation to find the sub-plot center, marked with a piece of galvanized or aluminum wire--bent into a loop with a piece of blue flagging tied through it.

Triangulate by measuring back azimuths and distances of several known trees from the old plot sheet. The intersection of these back azimuths and distances provides a small area in which to search for the wire pin marking each respective sub-plot center.

After finding the old pin, place a new pin next to it. (leave about two inches of the wire projecting above the ground.) If the old pin cannot be found, triangulate to accurately re-establish the point in the original location.

It is very important to locate each individual sub-plot as accurately as possible. Finding each sub-plot is a challenge--most of the flagging disintegrates, the wires rust and appear just like twigs or roots. The best method is to run out 70 feet from the last sub-plot at the proper azimuth, mark the spot, and search by running your hands through the area.

Plot Location *Continued*

If several trees, identifiable from the paint, are available, use the triangulation method to relocate the sub-plot. If this is not possible, due to lack of trees or other circumstances, locate several adjacent sub-plots and use these to triangulate to the missing sub-plot. You can then determine the general location of the missing sub-plot and reduce the area to search.

If unable to locate a Remeasurement plot

If you and your partner can't find a remeasurement plot, bring it to the attention of the person in charge. After two crews have thoroughly searched for the plot without success, the second crew will establish the plot at the correct location.

When there has been a major disturbance (such as the area has been clearcut and bulldozed) and it is obvious that the plot can not be relocated because all or most of the old trees have removed, a remeasurement plot is established as near as possible to the old PC. All new trees receive a tree history reflecting ongrowth or ingrowth (31, 32, 61 or 62). Transfer original tree data to the data recorder and collect current data for them that indicates whether they have been cut or died. See Tree History, item 33, for details about tally items needed for these trees.

When there has been no major disturbance to the area, two plots will be created. The first plot retains the old plot number, is given SK = 0 and GLUC = 98 and only plot record information is recorded. The second plot is a new plot that is established to replace the old lost plot. Give the new plot a sample kind of new full measurement (SK #1) if the lost plot was a full remeasurement (SK #2). Give the new plot a sample kind of new partial measurement (SK #7) if the lost plot was a partial remeasurement (SK #6). Record the sample kind change in the "Notes" section of both plot sheets. Call St. Paul for a new plot number from the photo room.

Remeasurement plot in the wrong location

If a remeasurement plot was established in the wrong location (i.e. not in the same location as the photo pinprick), re-establish the plot in that wrong location. If the error is significant, re-pinprick the new photo where the plot is actually located.

In the "Notes" section of the plot sheet, indicate that the plot was put in a different location. Record the distance and azimuth (use photo scale) from the original pinprick on the new photo to where the plot is actually located.

Bring such plots to the attention of the person in charge. It is assumed that the plot is located in the correct location, unless evidence of the plot is found in the wrong place (i.e., pins, paint or flagging).

Denied access plot

When the land owner refuses to give you permission to access a plot, bring it to the attention of the person in charge. When all attempts to obtain permission to take the plot has failed, the plot is given SK = 0 and GLUC = 99. For what items to record see section in manual entitled: required data items by ground land use.

PI Land Use (PILU): Item 4

The photo interpretation land use of plot center is assigned by the office staff and should not be changed in the field. This information is based on careful stereoscopic examination of the aerial photography in the office. These codes are included on the plot center record of the new plot sheet for your information. The codes used by the office photo interpretation staff are:

PI land use Description

17	Urban natural forest land
18	Non-urban natural forest land
19	Reserved/deferred natural forest land
27	Urban plantation forest land
28	Non-urban plantation forest land
29	Reserved/deferred plantation forest land
30	Questionable
31	Questionable F/NF
32	Questionable NF/F
51	Nonforest with trees, cropland
52	Nonforest with trees, pasture
53	Nonforest with trees, wooded strip
54	Nonforest with trees, windbreak
55	Nonforest with trees, marsh
56	Nonforest with trees, farmstead/rural homestead
57	Field windbreak
58	Nonforest with trees, rural, non-agricultural
59	Nonforest with trees, reserved
61	Nonforest without trees, cropland
62	Nonforest without trees, pasture
65	Nonforest without trees, marsh
66	Nonforest without trees, farmstead/rural homestead
67	Nonforest without trees, urban
68	Nonforest without trees, rural, non-agricultural
69	Nonforest without trees, reserved
72	Nonforest with trees, urban
80	Noncensus water
89	Noncensus water, reserved
90	Census water

PI NF/F and PI F/NF 1 digit each: Item 5

PI NF/F and PI F/NF are items assigned by the photo interpreter to identify plots that have both forest and nonforest conditions on them. A value of 1 for PI NF/F is assigned to plots that appear to be nonforest at plot center but portions of the plot appear to extend into a forest condition. A value of 1, for PI F/NF, is assigned to plots that appear to be forest at plot center but portions of the plot appear to extend into a nonforest condition. Plots that are entirely within forest or entirely within nonforest will have a

zero in both of these items. All plots with a 1 in either of these items will be sent to the field.

Ground Land Use Original (GLUO) 2 digits: Item 6

Wisconsin - 1983 Ground land use original codes are identical to current ground land use codes.

Kansas - 1981 Ground land use original codes are identical to current ground land use codes except GLU 22 was not recorded.

Nebraska - 1983 Ground land use original codes are identical to current ground land use codes except GLU 22 was not recorded.

Ground Land Use Current (GLUC) 2 digits: Item 6

Ground land use is observed and recorded in two places on the plot sheet,

- 1) the plot record, and
- 2) the condition class record.

Determine the ground land use for the condition existing at point center and record this observed land use under plot record of plot sheet. In addition, ground land use is record for each condition found in the plot area under condition class record.

Note: The condition found at plot center is always condition number 1 on the condition class record. If a second land use is encountered on the plot it should be recorded as condition number 2.

An area must be at least one acre and 120 feet in width to receive a land use code. An acre is 43,560 square feet. To meet the minimum-size requirement, a strip of land 120 feet wide needs to be 363 feet long, a square area needs to be 209 feet on a side, and a circular area needs to be 235 feet in diameter.

When determining the ground land use of a point or the location of the boundary between two land uses keep the following rules in mind.

-Measure most forest/nonforest boundaries at the point where a vertical line is dropped from the edge of forest crowns (drip line). This point approximates the limit of influence of the forest canopy. Do not confuse this point with the line of shadows cast from the crowns. When uneven boundaries exist, the tallier must use an imaginary line to distinguish forest from non-forest. If you need to map a forest/nonforest edge, straighten this edge out over a stretch of about 50-75 ft. rather than going in and out with every branch.

-In some instances a well defined edge that clearly divides the forest land from a nonforest land use exists under the drip line and should be used as the forest/nonforest boundary (both for mapping and for measuring the 120 ft minimum width). Examples of a well defined edge would be a maintained fence, the edge of plowing in an agricultural field, the shore of a lake or the limit of right of maintenance (mowing, brush cutting, herbicide application).

-Most forest/forest and many forest/nonforest edges are transition zones and will not need to be mapped. Here are two examples:

1) There is a transition from an upland forest (an aspen stand) and to a marsh without trees (cat tails and tag alder). You may be tempted to define a narrow strip of marsh with trees between the forest and the nonforest, but it would be less than 120 ft wide. Do not even try to map the edge of the forest. The forest canopy probably does not have a clearly defined drip line. At each sub-plot center simply decide which side of the center of the transition zone you are on and put the whole sub-plot in that land use. Don't worry if you call a sub-plot 100% marsh without trees and there happens to be a couple of trees within the 24 ft macro-plot. These trees are simply part of the transition zone and because you say they are part of a nonforest condition you do not need to tally them. You may want to use them as reference trees.

2) There is a transition from wooded pasture or pastured timberland to pasture without trees. Cattle are grazing the entire area, but the slope has trees that give way to grass in the flat area. Sub-plots 3, 4 and 10 are clearly in an area with enough stocking to be wooded pasture or pastured timberland, and sub-plot 6, 7 and 8 are out in the grass (pasture and range without trees). Sub-plots 1, 2, 5, and 9 are in a transition zone of seedlings and saplings and even a few scattered trees over 5" dbh that is not wide enough to have its own land use. At each of these sub-plot centers simply decide which side of the center of the transition zone you are on and put the whole sub-plot in one land use. Don't worry if you call a sub-plot 100% pasture and range without trees and there happens to be a couple of trees within the 24 ft macro-plot. Again, these trees are simply part of the transition zone and because you say they are part of a nonforest condition you do not need to tally them. You may want to use them as reference trees.

-The boundary between two forest land uses (for example between GLU 20 and GLU 22) is the point on the ground where the crowns of the two stands come together. If there is a feature between the two stands such as a fence, forest road, stream, or fire break, the center of the feature is used to determine the boundary.

The following pages define the rules and codes to be used in assigning ground land use to a condition class.

Forest land

Forest land is land not currently developed for nonforest use and has (or formerly had) at least a stocking value of 10.0 of all live forest trees of any size. Roadside or streamside strips of trees must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams or other bodies of water, or clearings in forest areas are classed as forest if less than 120 feet wide. The minimum area for classification of forest land is one acre and 120 feet in width. (See definitions--especially nonstocked forest land.) Codes 20, 21 and 22 are referred to as "commercial forest land uses" and codes 40, 41, 45 and 46 are "noncommercial forest land uses".

Use one of the following two-digit codes:

Commercial forest land uses

- 20 **Timberland** Forest land that is capable of producing in excess of 20 cubic feet per acre per year of roundwood products, excluding fuelwood, and is not withdrawn from timber utilization by statute, administrative designation, or exclusive use for Christmas tree production. (If land is used for grazing, see codes 21 and 59.)
- 21 **Pastured Timberland** Forest land used for wood production and grazing. (If land has a stocking value of less than 10 in trees over 1.0" dbh or less than 25 in growing-stock trees of any size, see codes 52 and 59.)
- 22 **Plantations** An artificially reforested area, sufficiently productive to qualify as commercial forest land, established by planting or by direct seeding. Planted species is not necessarily predominant. The forest type, stand age, and stand size class should reflect the planted species. If the plantation has failed, give the plot a GLU code 20. (If land is used for Christmas tree production, see code 46.)

Noncommercial forest land uses

- 40 **Unproductive forest land** Forest land incapable of producing 20 cubic feet per acre per year of roundwood products, excluding fuelwood, because of adverse site conditions. Adverse conditions include sterile soils, dry climate, poor drainage, high elevation, steepness, and rockiness. Vegetation, if present, is widely spaced and scrubby, or tree growth cannot be established. Based on site index under 15 for northern white-cedar, under 20 for black spruce and tamarack, under 25 for eastern redcedar and rocky mountain juniper and under 35 for all other species. All commercial species must be unproductive. Ponderosa pine plots in South Dakota will be called unproductive if the site index is under 21.
- 41 **Reserved forest land - unproductive** Forest land that is withdrawn from timber utilization, by a public agency or by law, and is incapable of producing 20 cubic feet per acre per year of roundwood products .
- 45 **Reserved forest land - productive** Forest land withdrawn from timber utilization by a public agency or by law and is sufficiently productive to produce 20 cubic feet per acre per year of roundwood products.
- 46 **Christmas Tree Plantations** Forest land sufficiently productive to qualify as commercial forest land but withdrawn from timber utilization for exclusive use in Christmas tree production. There must be evidence of annual shearing, or other management practices that indicate the exclusive use.

Note: In a marginally productive forest condition, measure site index first. All commercial species found within the portion of the plot where the condition extends must be measured and determined unproductive (code 40) before classifying the condition as unproductive forest land. The tallier judges whether the unproductive area is over one acre in size; if it is, the condition is classified as unproductive. Refer to Site Index, items 51-59, for more information.

Nonforest land

Nonforest land is land currently developed for use other than growing trees; and/or land that never had a stocking value of 10.0 or larger in forest trees of 5.0" DBH or larger.

Some locations interpreted as nonforest on aerial photographs require a field check. Some locations, interpreted as forest on aerial photographs, turn out to be nonforest upon field examination.

Nonforest Land with Trees

These areas are nonforest conditions that have one or more trees, 5.0" DBH or larger, within the visual acre surrounding the sub-plot center. The visual acre must be in the same land use. When trees have been planted to create a nonforest with tree land use such as 56, 57 or 58, the 5.0" dbh rule does not apply. Planted windbreaks and shelterbelts with trees of any size are recorded as windbreaks and shelterbelts, not nonforest without trees. Windbreaks and shelterbelts (56-58) do not need to be planted, they can be of natural origin. If they are of natural origin they must have one or more 5.0" dbh tree within the visual acre, otherwise they are nonforest without trees.

Use one of the following two-digit codes for nonforest land with trees.

- 51 **Cropland with trees** Cropland with scattered inclusions of single trees or small groups of trees.
- 52 **Pasture and rangeland with trees** Land used for grazing with a stocking value of less than 10.0 in all live trees 1" dbh or larger. Examples of grazing evidence include:
- cattle trails
 - cow pies
 - water tanks
 - bush hogged periodically
 - evidence of being bush hogged (maximum height of seedlings three to four feet and basal scars present on trees)
 - area periodically treated with herbicides.
- 53 **Wooded strip** An acre or more of continuous forest land that meets the definition of commercial forest land (code 20, 21, 22) except that it is less than 120 feet wide.
- 54 **Idle farmland with trees** Farmland that has not been tended within the last two years and has a stocking value of less than 10.0 in all live trees. **Caution:** Do not confuse this with non-stocked forest land which is GLU 20 and should have a stand-size class code 4.
- 55 **Marsh with trees** Land that has a stocking value of less than 10.0 in all live trees; characteristically supports low, generally herbaceous or shrubby vegetation and is intermittently covered with water.

- 56 **Narrow windbreaks** A group of trees, less than 120 feet wide, used for the protection of buildings in use.
- 57 **Wide windbreaks** A group of trees, greater than 120 feet wide and one acre in size, protecting buildings in use. Area would qualify as commercial forest land except that the primary land use is protection of buildings.
- 58 **Shelterbelt** A group of trees, less than 120 feet wide, used for the protection of soil and cropfields.
- 59 **Wooded pasture** Grazed land with a stocking value of more than 10.0 in all live trees 1" dbh or larger, but less than 25.0 in growing stock (20 class) trees of any size. This is land that would qualify as pastured timberland except that the low stocking in growing stock trees indicates that the land is not being used for wood production. If evidence indicates that the primary use is wood production or the protection of buildings see code 21 and 57. The stocking value 25.0 rule applies when determining primary land use in fairly homogeneous areas. In clumps, openings, and other inclusions, use your best judgement.
- 71 **Urban forest land** Locationally reserved land that would meet the criteria for commercial forest land, but is in an urban-suburban area surrounded by commercial, industrial, or residential development. It is extremely unlikely that such land is used for timber products on a continuing basis. Example: wooded creek bottom surrounded by houses.
- 72 **Urban and other with trees** Area with trees that is developed for residential, industrial, recreational, or other urban use. For example city park, cemetery, golf course, maintained backyard, farmsteads with trees. The 120 feet/one acre rule does not apply in the case of a maintained yard.
- 79 In another country.

Nonforest Land without Trees

These areas are nonforest conditions that have no tree species present 5.0" DBH or larger, within the visual acre surrounding the sub-plot center.

Use the following two-digit codes for nonforest land without trees.

- 61 **Cropland without trees** Presently cropped or fallow up to two years.
- 62 **Pasture and rangeland without trees**
- 64 **Idle farmland without trees** Farmland that has not been tended within the last two years and has no trees.
- 65 **Marsh without trees**
- 66 **Other farmland** Including farmsteads and farm buildings.
- 67 **Urban and other areas without trees** Areas without trees that are developed for residential, industrial, recreational, or other use than those covered in other land use codes. The 120 feet/one acre rule does not apply in the case of a maintained yard.
- 68 **Rights-of-way** Transportation, utility, and communication rights-of-way. This includes railroads, powerlines, pipelines, and maintained roads. A right-of-way of any width qualifies as non-forest land--this is an exception to the one acre, 120 feet rule.
- 69 **Nonforest without trees** (reserved)
- 80 **Noncensus Water** A body of water more than 120 feet wide, and one acre in size, but less than 10 chains wide and 40 acres in size (normal water level).
- 89 **Noncensus Water** (reserved)
- 90 **Census Water** A body of water greater than 10 chains wide and greater than 40 acres (normal water level).
- 97 **Dropped plot** - Determined in office by field supervisor or crew leader.
- 98 **Lost (non relocated) plot**
- 99 **Denied access plot**

A right of way may create a strip of tree less than 120 feet that would otherwise be forest land if the right of way were not there. In this case the field crew should use its judgment to determine if the strip that has been created is being managed the same as the forest on the other side of the right of way or not. If it is being managed or is likely to be managed the same (just as likely to be harvested or receive other treatment) consider it part of the forest on the other side of the right of way. If there is reason to believe that the strip will not be managed the same it should receive a land use of wooded strip. For example, a strip of trees about 40 feet wide between a railroad line and a major highway should be given a land use of wooded strip because it would probably not be harvested with the forest on the other side of the railroad or the highway. However, a strip 100 feet wide between a gravel county or township road and very narrow utility right of way would probably receive the same management as the forest on the other side of the right of way and should be give a land use of forest.

How to calculate stocking for land use determination

Stocking values are required to determine the land use of a condition and decide what items must be recorded for that condition. When the land use is in question, assign stocking values to each tally tree based on each tree's diameter and the maximum diameter of all live trees in the condition. These stocking values are not recorded on the plot sheet or in the data recorder. They are only used to determine land use.

The basic stocking value is 3.0 for each live tree 5.0" dbh or larger. Trees less than 5.0" dbh are assigned stocking values based on Table 2. All trees in a condition must be tallied to calculate stocking.

Table 2. Stocking values for tally trees

DBH	Dbh of largest tree in the condition					
	5.0"+	4.0-4.9	3.0-3.9	2.0-2.9	1.0-1.9	seedling
seedlings	0.2	0.4	0.6	0.8	1.0	2.0
1.0-1.9	1.0	1.5	2.0	2.5	3.0	--
2.0-2.9	1.5	2.0	2.5	3.0	--	--
3.0-3.9	2.0	2.5	3.0	--	--	--
4.0-4.9	2.5	3.0	--	--	--	--
5.0+	3.0	--	--	--	--	--

Steps to compute stocking of a condition based on the tally trees in the condition.

1. Assign each live tally tree in the condition the appropriate stocking value base on its dbh and the dbh of the largest live tree in the condition.
2. Sum up the total live stocking for each sub-plot.
3. If the total live stocking for a sub-plot is greater than 8.0, reduce the stocking value of every tree on the sub-plot so that the total stocking is 8.0. This is done by multiplying each stocking value by the adjustment factor of $8.0/\text{total live stocking}$.
4. If the condition does not cover the entire plot, stocking must be expanded by an expansion factor. The expansion factor is equal to $1000/\text{sum of the percent of sub-plot area (\%SAR)}$ for the condition. The stocking value of every tree is multiplied by this expansion factor.
5. The stocking for each tree class is computed by summing the stocking values for each tree in that tree class.
6. If the condition occurs on only a small portion of the plot, (half the plot or less), use your best judgment in assigning a land use. You may place several additional temporary sub-plots in the condition in order to get a larger sample to base stocking on. When additional temporary sub-plots or judgment is used to assign land use, a note should be made on the plot sheet. Use the following procedure to establish these temporary sub-plots in a condition:

How to calculate stocking for land use determination *Continued*

- A. Consider locations 70 feet horizontal distance from the highest numbered sub-plot in the condition. First consider the location 0 azimuth from the sub-plot center. If this location is unsuitable, consider in turn locations at azimuth 60° , 120° , 180° , 240° , and 300° . When a suitable location has been found, establish the temporary sub-plot. Temporary sub-plots should be entirely within the condition (locations should not be within 24 ft. of a mapped boundary).
- B. If Step A fails to yield a suitable sub-plot location, repeat Step A at each of the next highest numbered regular sub-plot in the condition.
- C. If Steps A and B have been exhausted and a suitable temporary sub-plot still has not been found, repeat Step A at each temporary sub-plot in turn beginning with the first temporary sub-plot that was established.

If more than one temporary sub-plot is to be established, repeat Steps A and B to establish the second lowest numbered temporary sub-plot next, and continue in order until you have enough temporary sub-plots established in the condition to get a good, representative estimate of stocking. The general rule for establishing temporary sub-plots is:

Install the lowest temporary sub-plot off the highest established sub-plot, until all the established sub-plots have been exhausted.

Then establish the lowest temporary sub-plot yet to be established off the lowest one already established (lowest off highest, then lowest off lowest).

If there is a transition zone between two conditions use your best judgment to be sure that trees tallied in the transition zone do not have too much weight in the assignment of a land use.

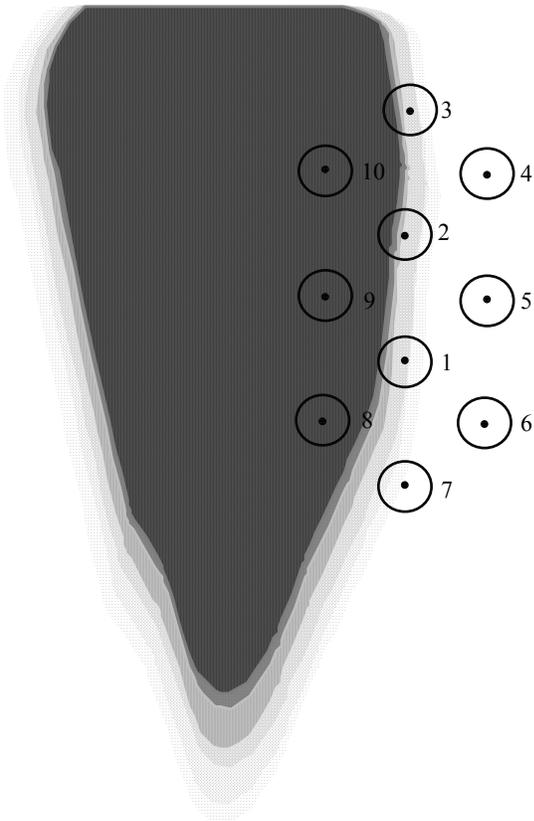


Figure 4. Here the dark shaded area is trees, surrounded by a treeless area or an area with only scattered trees. It could be a forest island surrounded by marsh/bog, a wooded draw in a grazed area, or a farm woodlot that is invading an abandoned field. Between the forest and the nonforest is a transition zone that is about 40 to 80 ft. wide. Because there is a transition zone, not an abrupt forest/nonforest edge, no mapping is done. Sub-plots 1, 3, 4, 5, 6, and 7 are recorded as 100% in condition 1 and sub-plots 2, 8, 9 and 10 are put in the condition 2. To determine the stocking in condition 2 you could exclude sub-plot 2 because it is in a transit zone. If needed, several temporary sub-plots could be installed off sub-plot 10 to have an adequate sample for determining the stocking of condition 2. Similarly, to get a stocking for condition 1 sub-plots 1, 3 and 7 could be excluded and if needed several temporary sub-plots could be installed off sub-plot 7.

How to calculate stocking for land use determination *Continued*

Simplest case: One condition on the plot, no sub-plot exceeds 8.0 total live stocking.

Live tally trees and computation of stocking for this simplest case are shown below.

SUB#	TR#	DBH	TCC	Stocking value from the table	Total sub-plot stocking
1	1	7.5	20	3.0	3.0
2	1	10.3	30	3.0	3.0
3	--	--	--	--	--
4	--	--	--	--	--
5	1	11.2	30	3.0	3.0
6	1	3.2	20	2.0	2.0
7	1	1.7	20	1.0	2.0
	2	1.3	20	1.0	
8	1	7.3	30	3.0	6.0
	2	8.2	30	3.0	
9	--	--	--	--	--
10	--	--	--	--	--
All live stocking					19.0
Growing-stock stocking					7.0
Cull stocking					12.0

The total all live stocking here is 19.0, which exceeds the minimum stocking value for forest land. If the condition meets the other standards for timberland (minimum site index and is not being grazed) it should be given a land use of 20 or 22. If there is evidence of grazing the land use should be 59 because the total stocking in growing stock trees (7.0) is less than 25.0.

How to calculate stocking for land use determination *Continued*

More difficult case: One condition on the plot, sub-plot 8 exceeds 8.0 total live stocking.

Live tally trees and computation of stocking for this more difficult case are shown below.

SUB#	TR#	DBH	TCC	Stocking value from the table	Total sub-plot stocking	Adj. factor	Adj. stocking value	Total sub-plot stocking
1	1	7.5	20	3.0	3.0	--	3.0	3.0
2	1	10.3	30	3.0	3.0	--	3.0	3.0
3	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--
5	1	11.2	30	3.0	3.0	--	3.0	3.0
6	1	3.2	20	2.0	2.0	--	2.0	2.0
7	1	1.7	20	1.0	2.0	--	1.0	2.0
	2	1.3	20	1.0			1.0	
8	1	7.3	30	3.0	10.0	8/10 = 0.8	2.4	8.0
	2	12.2	20	3.0			2.4	
	3	1.2	30	1.0			.8	
	4	3.3	30	2.0			1.6	
	5	1.2	30	1.0			.8	
9	--	--	--	--	--	--	--	--
10	--	--	--	--	--	--	--	--

All live stocking	21.0
Growing-stock stocking	9.4
Cull stocking	11.6

The total all live stocking here is 21.0, which exceeds the minimum stocking value for forest land. If the condition meets the other standards for timberland (minimum site index and is not being grazed) it should be given a land use of 20 or 22. If there is evidence of grazing the land use should be 59 because the total stocking in growing stock trees (9.4) is less than 25.0.

How to calculate stocking for land use determination *Continued*

Most difficult case: Two conditions on the plot, sub-plot 8 exceeds 8.0 total live stocking.

Live tally trees and computation of stocking for this most difficult case are shown below. A sketch of this plot is also shown in figure 5.

SUB #	TR#	DBH	TCC	Stock. value from table	Total sub-plot stock.	Adj. factor	Adj. stock. value	%SAR in cond. 1	Expan. factor	Expan. stock.	Total expan. stock.
1	1	7.5	20	3.0	3.0	--	3.0	100	2.0	6.0	6.0
2	1	10.3	20	3.0	3.0	--	3.0	40	2.0	6.0	6.0
3	--	--	--	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--	--	--	--
5	1	11.2	30	3.0	3.0	--	3.0	60	2.0	6.0	6.0
6	1	3.2	20	2.0	2.0	--	2.0	100	2.0	4.0	4.0
7	1	1.7	20	1.0	2.0	--	1.0	100	2.0	2.0	4.0
	2	1.3	20	1.0			1.0			2.0	
8	1	7.3	30	3.0	10.0	8/10 = 0.8	2.4	100	2.0	4.8	16.0
	2	12.2	20	3.0			2.4			4.8	
	3	1.2	20	1.0			.8			1.6	
	4	3.3	30	2.0			1.6			3.2	
	5	1.2	30	1.0			.8			1.6	
9	--	--	--	--	--	--	--	--	--	--	--
10	--	--	--	--	--	--	--	--	--	--	--

Sum = 500
 Expansion factor = 1000/500 = 2.0
 All live stocking 42.0
 Growing-stock stocking 26.4
 Cull stocking 15.6

The total all live stocking here is 42.0, which exceeds the minimum stocking value for forest land. If the condition meets the other standards for timberland (minimum site index and is not being grazed) it should be given a land use of 20 or 22. If there is evidence of grazing the land use could be 21 because the total stocking in growing stock trees (26.4) is at least 25.0. Because this condition occurs on only half the plot and had there been one less growing stock tally tree the land use would have been 59, judgement can be used and/or additional temporary sub-plots could be installed to increase the sample in condition 1. If the field crew goes beyond the information in the tallied trees to assign a land use it should be noted on the field sheet. For example, here the field crew may have observed that the corner of the pasture where the plot fell had more trees than the rest of the pasture and assigned a land use of 59 because of this.

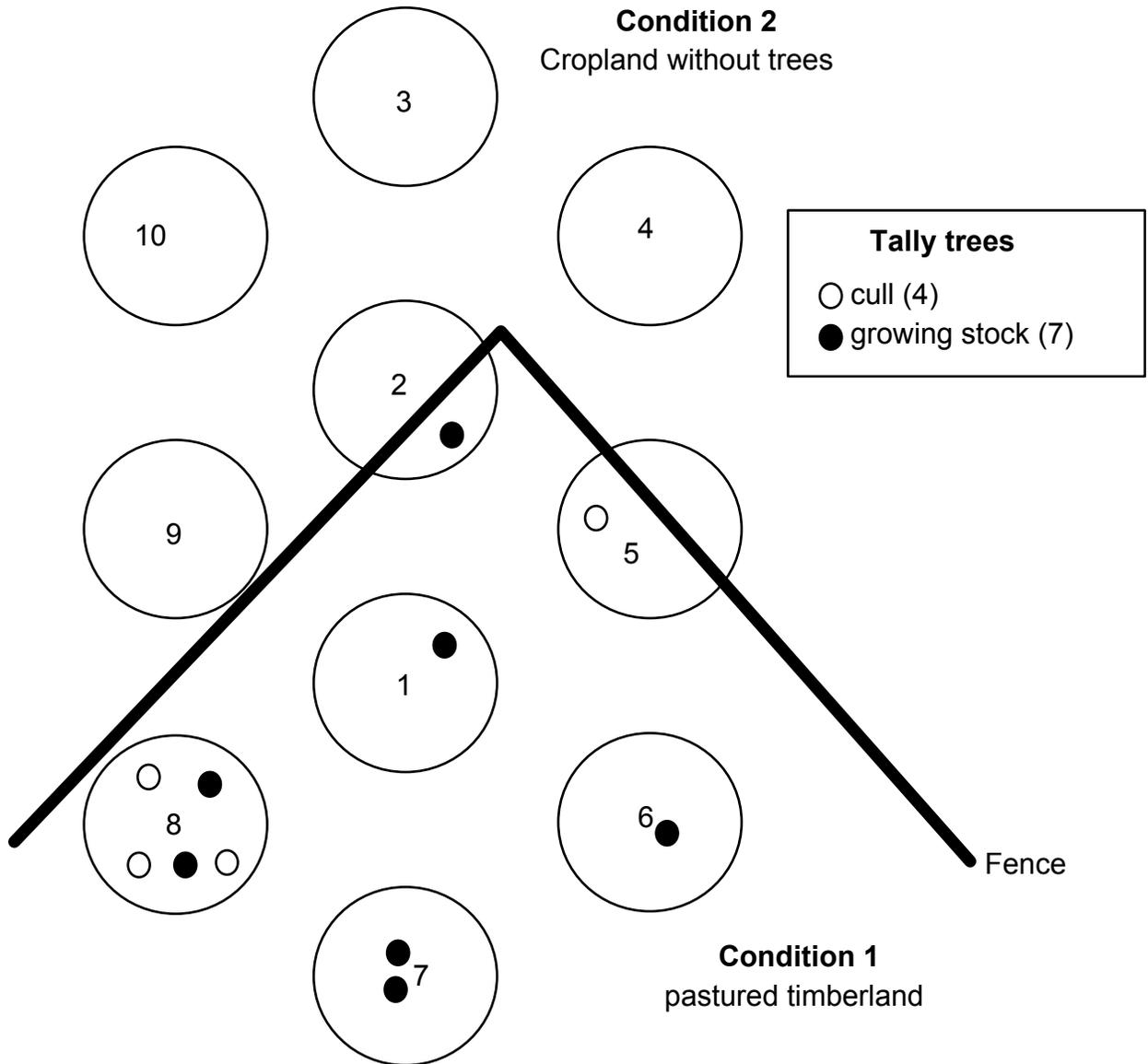
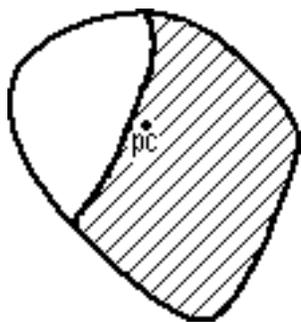


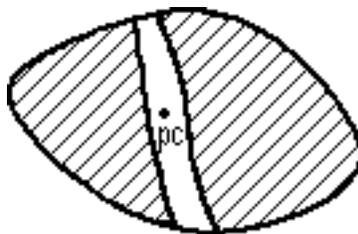
Figure 5. Example plot where stocking is calculated. Two conditions exist on the plot, sub-plot 8 exceeds 8.0 total live stocking.

Figure 6 - The following examples have been included to aid in assigning Ground Land Use to plot center. Shaded areas represent forest.



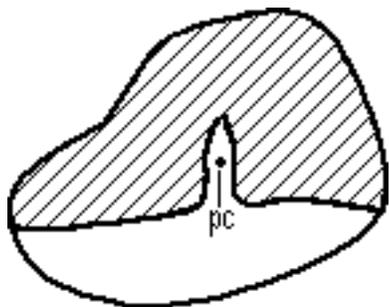
1.

Forest Dot falls on forest land larger than one acre in size.



2.

Forest Dot falls on strip of nonforest land (less than 120 feet in width) that is bounded by forest land on at least two sides.



3.

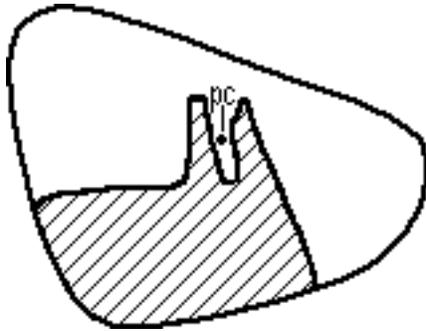
Forest Dot falls on strip of nonforest land (less than 120 feet in width) that is bounded by forest land on at least two sides.



4.

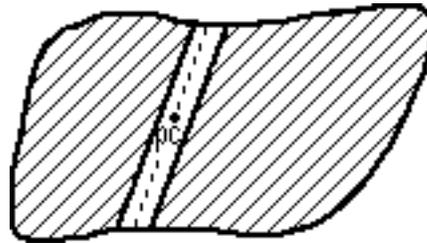
Forest Dot falls on nonforest land (less than one acre in size) that is surrounded by forest land.

Figure 6 CONTINUED



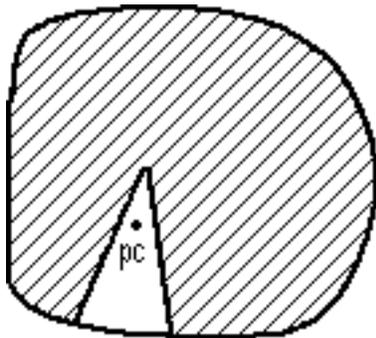
5.

Forest Dot falls in area of more than two adjacent strips of clearly defined forest and nonforest land (each strip less than 120 feet in width). As the band of strips in the acre is comprised of more forest than nonforest, the classification is forest.



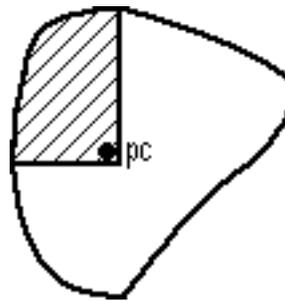
6.

Nonforest Dot falls in improved road less than 120 feet wide. Improved roads and powerline clearings of any width are nonforest.



7.

Forest Dot falls on nonforest land (less than 120 feet in width). If point had fallen in area 120+ feet wide, the classification would be nonforest.



8.

Forest Dot falls in a forest land area less than 120 feet in width, but it is classified as forest. This is a special case to handle corners (in the vicinity of 90°) of forest land that have man-created boundaries adjoining them to nonforest lands. An example would be a farm woodlot, over 120 feet in width and one acre in size, that was bordered by a field.

These rules apply equally, but in reverse manner, if the location of forest and nonforest land is reversed.

Reason For Change (CAUS) 1 digit: Item 6

Record in the plot record the original ground land use, current ground land use, and reason for change (if any) that has taken place at plot center. If both original and current ground land uses are the same, reason for change is recorded as "0". If a change in ground land use has occurred, indicate the process that caused the change with one of the codes below.

<u>Code</u>	<u>Reason that caused the land use change</u>
0	No change
1	Definition - Use only if current GLU code was unavailable on prior survey (See section in manual on: Ground Land Use Original, GLU codes used on the previous survey).
2	Legislation
3	Natural - Use also when you simply disagree with prior crew on GLU call. Explain in the "Notes" section of the plot sheet.
4	Herbicide
5	Clearing, not utilized - Land cleared by mechanical or hand means, but timber not utilized.
6	Clearing, utilized - Includes land clearing where timber is utilized, and commercial clearcuts.
7	Partial timber cut
8	Planting
9	Other, Man - Includes fencing to exclude livestock.

For new plots, no reason for change is recorded.

For a remeasurement plot with a ground land use change between surveys, one of the following applies.

If there has been a change from noncommercial or nonforest to commercial forest (or wide windbreak or wooded pasture), a remeasurement sub-plot is established and all trees receive a tree history reflecting ingrowth or ongrowth.

If a previously established sub-plot now falls on noncommercial or nonforest land, except for wide windbreak or wooded pasture, the sub-plot condition is recorded. The original trees need to be accounted for, and the appropriate Plot and Condition Class items completed.

See Tree History, item 33, for details about accounting for old trees in unusual situations.

Photo Age (PHAG) 1 digit: Item 67

Photo age represents the number of growing seasons between the photo date and the date the fieldwork is completed. July 1st is considered the last day of a growing season. Minimum photo age is one growing season. Record the appropriate one-digit code.

<u>Code</u>	<u>Photo Age</u>
1	One growing season or less
2	Two growing seasons
3	Three growing seasons
4	Four growing seasons
5	Five growing seasons
6	Six growing seasons
7	Seven growing seasons
8	Eight growing seasons
9	Nine or more growing seasons

If photo age is greater than nine years, write the actual age of the photos in the "Notes" section of the plot sheet.

An easy method to arrive at the correct figure is to count the number of "July 1st's" between the date of photography and the date of the field work. For example, suppose you are taking measurements on 6-23-92, and your photos are dated 6-01-86. The photo age is six years, or Code 6. The '86, '87, '88, '89, '90, and '91 growing seasons are included. The '92 growing season does count until July 1st, 1992.

Date Of Survey (ODAT, CDAT) 4 digits: Item 68

Record a four-digit code to show the month and year in which the plot is measured, using the following codes.

<u>First two digits</u>		<u>Second two digits</u>	
<u>Code</u>	<u>Month</u>	<u>Code</u>	<u>Year</u>
01	January	86	1986
02	February	87	1987
03	March	88	1988
04	April	89	1989
05	May	90	1990
06	June	91	1991
07	July	92	1992
08	August	93	1993
09	September	94	1994
10	October	95	1995
11	November	96	1996
12	December	97	1997

Example: A plot completed in June, 1992 is coded as 0692.

Nearest Water: Item 69

Determine the permanent water source nearest to the sample plot location. A permanent water source is present year-round, as opposed to an intermittent stream.

A lake, swamp, pond, or reservoir must meet the minimum area requirements of 120 feet in width and one acre in size. There is no minimum-size requirement for a stream or flowage.

Use the following codes to record Water Type, Water Area, and Water Distance.

Type Of Water (WTYP) 1 digits

<u>Code</u>	<u>Type of Water (WTYP)</u>
1	Streams and Flowages
2	Lakes
3	Swamps
4	Farm ponds
5	Reservoirs

Area Of Water (WARE) 3 digits

Record the width (in feet) of streams and flowages (000 to 999 feet) plus or minus 33 feet. For lakes, swamps and farm ponds, area is measured in acres (001 to 999 acres) plus or minus 5 acres.

Distance To Nearest Water (WDIS) 4 digits

Measure the distance from PC to the nearest permanent water source. Record the distance to the nearest half chain (0000 to 999.5 chains).

Nearest Road: Item 70

Type Of Road (RTYP) 1 digits

Field crews should check the straight line distance from PC to the nearest maintained road, using the following codes for type and distance.

<u>Code</u>	<u>Type of Road</u>
1	Paved - Four lanes
2	Paved - Two lanes
3	Improved - gravel

Distance To Nearest Road (RDIS) 4 digits

The distance to road is measured in chains to the nearest half chain (0000 to 999.5).

Sketch And Notes: Item 71

Provide information on the location of the field sample, the layout of the plot and description of any disturbances within the area. Make sure that this information is legible and understandable. Any physical features that could assist in accurately relocating the plot should be drawn onto the plot diagram. Include changes in timber type, old logging roads, forest and nonforest boundaries, streams, drainages, particular disturbances, etc. This information is used primarily in re-establishing the plot on future remeasurements. However, plots may be visited by personnel other than Forest Service for their own purposes. The sketch should contain information necessary to enable one to find the starting point of the course to the plot. Include a reference to a town, a numbered or named road, intersections, or easily identified landmarks. Describe any particular procedure or situation encountered on the plot. Explain in the "Notes" section so that remeasurement crews can take them into consideration.

Note: Aerial photos are usually not the property of the project. They may or may not be available for the next inventory.

State (ST) 2 digits: Item 72

Record the appropriate two-digit state code (listed with the county codes in the appendix).

Unit (UNIT) 1 digit: Item 72

Record the appropriate one-digit code for unit number (listed with the county codes in the appendix).

County (CTY) 2 digits: Item 72

Record the appropriate two-digit county code listed in the appendix.

National Forest-Ranger District (NFRD) 4 digits: Item 73

Record the appropriate National Forest (first 2 digits) and Ranger District (last 2 digits) codes listed in the appendix.

Required Data Items By Ground Land Use

If any portion of a sub-plot falls on timberland (code 20, 21 or 22), wide windbreak (code 57) or wooded pasture (code 59) then the plot must be established and the trees within these land uses must be tallied. In this case the field crew must collect values for all data items described in this manual (the collection of some data items depends further on sample kind).

If no portion of any sub-plot falls on one of these ground land uses (20, 21, 22, 57 or 59) then the plot does not need to be fully established. The plot center condition is the only condition that needs to be recorded. All required information for that land use must be recorded. For these plots, establish an SP and establish/witness one point (plot center is preferred) if it is practical and the information will be useful to the next field crew. The SP and witness point information are needed when the possibility exists that the condition may change to GLU 20, 21, 22, 57 or 59 before the next inventory, or the plot is very close to GLU 20, 21, 22 57 or 59 and the information will help re-establish the plot in exactly the same place.

Ground land use 20, 21, 22, 57, or 59:

Collect values for all data items listed on the plot sheet as described in this manual.

Ground land use 40 or 46:

Required plot data items:

All plot center data items are required when plot center falls in a condition that is unproductive forest land (GLU 40) or Christmas tree plantations (GLU 46). When no portion of the plot intersects a condition having land use 20, 21, 22, 57, or 59 only the condition at plot center needs to be recorded. Pins do not need to be placed at every sub-plot center in the plot. It may not be possible to find suitable witness trees at plot center or it may be necessary to establish another sub-plot center and witness it. When no suitable witness trees are available anywhere in the plot it should be noted on the field sheet. Do not use Christmas trees as witness trees. If the plot is entirely in a Christmas tree plantation simply establish a starting point and put a pin at plot center.

Required condition class data items:

Condition number	Slope shape	Site index species (GLU 40 only)
Ground land use	Slope length	Stand area
Aspect	Forest type/stand size class	Ownership class
Position	Stand age	Basal area per acre (GLU 40 only)
Slope percent	Site index (GLU 40 only)	

Note: On these plots stand age, site index and basal area per acre may be estimated.

Note: In Nebraska, plots were fully established on unproductive forest land (GLU 40).

Note: In South Dakota, Ponderosa pine plots that are determined to be unproductive will be fully established and trees tallied.

Required Data Items By Ground Land Use *Continued*

Ground land use 41 or 45:

Required plot center data items:

New plot number	Water Type/Area/Distance	Flight number
Old plot number	Road Type/Distance	Photo age
Dot number	Ownership class	Data recorder
State	National Forest	Photo scale
Unit	Ranger district	Tallier name
County	Original date	Cruiser name
Sample kind	Current date	Owners name
PI land use	Nonforest/forest PI indicator	Date
Cruiser code	Forest/nonforest PI indicator	Accuracy of owners name and address
Tallier code	Township	Owners address
County name	Range	Photo location
Original ground land use	Section	Accuracy of ownership class
Current ground land use	Subdivision	
Reason for ground land use change	Photo number	

Required condition class data items:

Condition number	Stand size class
Ground land use	Stand age
Aspect	Site index
Position	Site index species
Slope percent	Stand area
Slope shape	Ownership class
Slope length	Basal area per acre
Forest type	

Note: on these plots Stand age, Site index, and Basal area per acre may be estimated.

Note: In Wisconsin, plots that are determined to be reserved forest land--unproductive and productive (GLU 41 and 45)--will be fully established and trees tallied. See next page for monumentation of plots in reserved areas.

Monumentation of sample locations in reserved areas (Wisconsin only)

Locations must be sufficiently well marked that they can be relocated ten years hence, but still be visually unobtrusive to be consistent with the wilderness nature of the area. No paint or flagging should be used on reserved plots.

Marking the Starting Point

Follow directions found in this field manual, except do not paint "SP" above DBH or ground level. Instead, nail a tag to the base of the tree with the letters "SP."

Marking Sub-plot Centers

Use galvanized wire as we do now but do not attach flagging to it.

Witnessed Sub-plots

Follow current directions in this manual except for marking a witness tree with a scribe mark and a painted "X." Instead nail a tag to the base of the tree facing sub-plot center with the letter X on it.

Sub-plot Reference

Follow directions as usual except for the scribe mark and paint. Instead nail a tag to the base of the tree facing sub-plot center with the sub-plot number on the tag.

Marking Individual Sample Trees

Mark each sample tree 5.0 inches DBH and larger with a nail at ground level facing sub-plot center or on the uphill side of the tree. If only saplings are on the sub-plot mark just a couple of them with nails at ground level and note them. Leave the rest of the saplings unmarked.

Measure diameter at breast height at exactly 4.5 feet above the nail on the uphill side of the tree. If the measurement cannot be taken at 4.5 feet above the nail record on the plot sheet in the DBH High or Low note section the height to the nearest inch you made the measurement.

Ground land use 51-56, 58, 71, 72:

Required plot center data items:

New plot number	Current ground land use	Photo age
Old plot number	Reason for ground land use change	Flight number
Dot number	National Forest	Photo number
State	Ranger district	Photo scale
Unit	Original date	Data recorder
County	Current date	Cruiser name
Sample kind	Nonforest/forest PI indicator	Tallier name
PI land use	Forest /nonforest PI indicator	Date

Cruiser code
Tallier code
County name
Original ground land use

Township
Range
Section
Subdivision

Photo location

Required condition class data items:

Condition number	Stand size class
Ground land use	Stand area
Forest type	

Ground land use 61-69, 80-99:

Required plot center data items:

New plot number	Original ground land use	Section
Old plot number	Current ground land use	Subdivision
Dot number	GLU Reason for use change	Photo age
State	National Forest	Flight number
Unit	Ranger distract	Photo number
County	Original date	Photo scale
Sample kind	Current date	Data recorder
PI land use	Nonforest/ forest PI indicator	Cruiser name
Cruiser code	Forest/nonforest PI indicator	Tallier name
Tallier code	Township	Date
County name	Range	Photo location

Required condition class data items:

Condition number	Ground land use
------------------	-----------------

Sub-Plot Records: Items 7-14

The purpose of the sub-plot records is to identify and map the conditions that occur on the 10 macro plots. At least one sub-plot record must be recorded for each of the 10 macro-plots and also for any sub-plots that were previously moved. The information in the sub-plot records is used to compute the percent of the area that each condition covers within the sample.

An entry is recorded for each condition found on the macro-plot in the sub-plot records. The condition found at sub-plot center must be recorded first.

It is very important to remember to record a sub-plot record for all previously moved sub-plots, especially when there are no trees on one of these sub-plots. Without this record we have no way of identifying these sub-plots. There is no way for the data recorder or the edit program to check this either.

Sub-plot center

The first (and possibly only) sub-plot record entry for a sub-plot should have entries for only the following data items:

Sub-plot number	Condition number
Cover class (if no trees are present)	Percent of sub-plot area

Sub-Plot Number (SUB#) 2 digits: Item 7

Sub-plot number is a 2 digit number. For example 01 corresponds to sub-plot one, 10 corresponds to sub-plot ten, and 16 corresponds to moved sub-plot 6 on the old survey.

Condition Number (CON#) 1 digit: Item 8

Condition number identifies the condition that exists at sub-plot center and refers to the condition number in the condition class record.

Cover Class (COVC) 2 digits: Item 9

Cover class is only recorded at sub-plot center in conditions where the ground land use is 20, 21, 22, 57 or 59, and no live trees are found on the sub-plot. When this happens the micro-plot (6.8 ft. radius) should be examined and one of the following codes recorded:

<u>Code</u>	<u>Cover Class</u>
51-54	Inhibiting vegetation. Cover sufficiently dense to prevent establishment of tree seedlings. Use the following codes: 51 Grass 52 Shrubs 53 Vines 54 Other
60	Nonstocked not overtopped. Area sufficiently clear to permit establishment and development of one or more tree seedlings by natural or artificial methods.
70	Nonstocked overtopped. Area clear enough to permit establishment of seedlings, but sufficiently overtopped by tree crowns to prevent survival of tree seedlings.
81-83	Nonstockable. Not capable of supporting trees of commercial species because of the presence of rocks, water, etc. use the following codes: 81 Rocks 82 Water 83 Other

Sub-plots that are cover classed should be referenced to assist in their relocation (see sub-plot Reference under item 15, Plot Design).

For remeasurement plots

If a sub-plot was cover classed on the prior survey, and is cover classed this survey, determine and record the current cover class and reference.

If a point was cover classed on the prior survey and live trees or seedlings are now present on the point, record them as ingrowth or ongrowth. There is no need to record the original cover class in this situation.

If a point was not cover classed on the prior survey, and is currently cover classed, record a cover class code on the sub-plot. Account for trees tallied during the previous survey and record as cut or dead.

Percent Of Sub-Plot Area (%SAR) 3 digits: Item 10

Percent of sub-plot area (item 10), is the percentage of the total macro plot that the condition at sub-plot center covers. When the entire macro plot falls within a single condition, 100% is recorded. However, if two or more conditions are found on the macro plot, record the actual percent or area covered by the condition at sub-plot center.

Note: When using the Husky Data Recorder, the computer will figure actual percent of cover for you. If recording on a plot sheet, estimate area within plus or minus 5%.

Additional conditions on a sub-plot

When two or more conditions exist on a macro plot, one additional sub-plot record entry is made for each condition. Record the following data items in the sub-plot record.

Sub-plot number	Azimuth corner (if needed to describe an irregular boundary)
Condition number	Dist. corner (if needed to describe an irregular boundary)
Azimuth left	Percent of sub-plot area
Azimuth right	

Percent Of Sub-Plot Area (%SAR) 3 digits: ITEM 10

Percent of sub-plot area is the percentage of the total macro plot that the additional condition covers. If a data recorder is being used to enter the data this item will be computed by the data recorder. If the data is being collected on a plot sheet this item should be estimated to within plus or minus 5%.

Azimuth Left (AZML) 3 digits: Item 11

Azimuth Right (AZMR) 3 digits: Item 12

Azimuth Corner (AZMC) 3 digits: Item 13

Distance Corner (DISC) 2 digits: Item 14

Azimuth left, azimuth right, azimuth corner and distance corner are used to describe the location of the condition boundary within the sub-plot. A condition boundary within the sub-plot must be approximated as either a straight line, or a line with one corner. If the boundary is approximated as a straight line record azimuth left and azimuth right. Azimuth corner and distance corner should be left blank. When the boundary is approximated by a line with one corner record all of the sub-plot record items (except cover class) including azimuth corner and distance corner.

When a condition class boundary cuts through a sub-plot it may be useful to place pins or flagging at the sub-plot boundary every 60 degrees. Marking the plot this way will help you visualize where the condition boundary intersects the sub-plot boundary. Azimuth are recorded from sub-plot center to the point where the condition boundary intersects the sub-plot boundary. Left azimuth should be the intersection to your left as you face the condition boundary and right azimuth is the intersection to your right. If there is a corner in the boundary record the horizontal distance between the corner and sub-plot center to the nearest foot (enter 1 for all distances less than 1 foot) and the azimuth to the corner from sub-plot center. For azimuth left, right and center use 1 degree for due north.

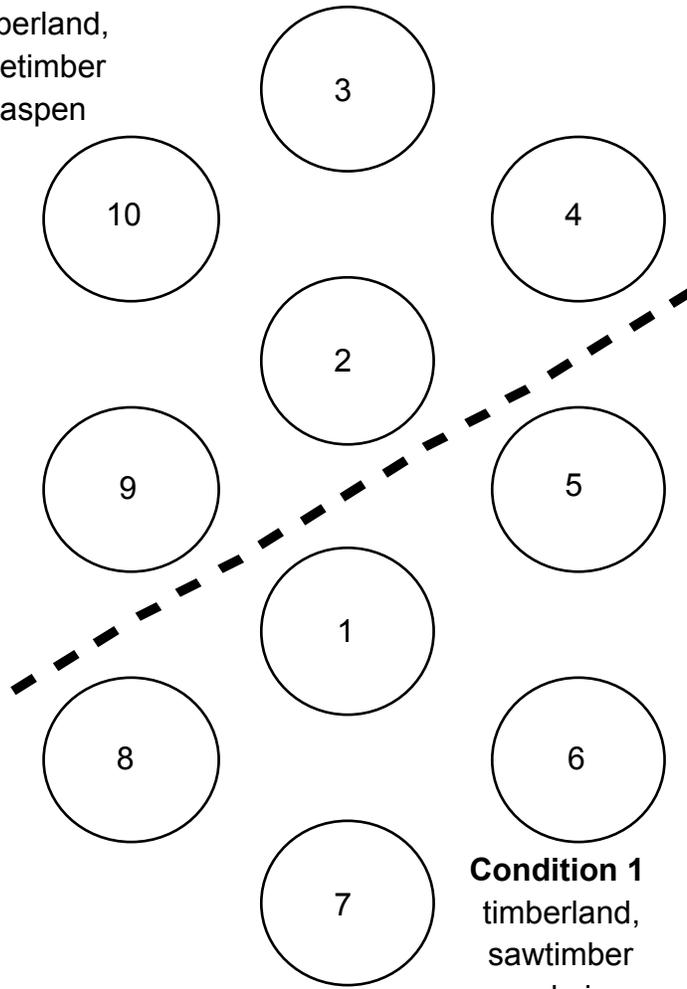
Note: Only when a well defined abrupt boundary between two conditions cuts through a sub-plot should an additional sub-plot record be recorded. This entry identifies the other condition and locates the boundary. When two adjacent sub-plots are in different conditions and the boundary between the two conditions is a transition zone, assume that the boundary occurs between the sub-plots.

Simple example of a plot that contains two conditions with only one condition on any sub-plot.

In figure 7 two conditions are shown on the plot but the condition boundary does not cut through a sub-plot. Both conditions are timberland and the condition boundary does not follow a change in ownership so therefore both conditions receive the same land use and ownership class. Since both conditions are timberland basal area does not need to be estimated for either condition, it will be computed from the tree observations. Condition 1 is a sawtimber red pine stand, condition 2 is a poletimber aspen stand. Sub-plots 1, 5, 6, 7, and 8 are in condition 1 and sub-plots 2, 3, 4, 9, and 10 are in condition 2. The boundary between the two conditions does not clearly cut through any of the macro plots. Since no condition boundary cuts through a plot, every sub-plot is 100% within the condition at sub-plot center. The condition class and sub-plot records for this example are shown in figure 8 on the next page.

Figure 7. Simple case with two conditions on a plot and no sub-plots with more than one condition on a sub-plot

Condition 2
timberland,
poletimber
aspen



Condition 1
timberland,
sawtimber
red pine

Figure 8. Condition class and sub-plot records for example shown in figure 7.

CONDITION CLASS RECORDS																		
C O N #	G L U C	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	C B A	B G R D	R I P W
(8)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(61)	(65)	(66)
XX	XX	XXX	X	XX	X	XXXX	X	X	XX	XX-X	XXX	XX	XXX	XXX	XX	XX	XX	XX
1	20	1	2	5	3	5	4	1	00	021	64	70	125	34	26			
2	20	35	3	2	3	15	5	1	00	912	24	80	746	15	26			
3																		

SUB-PLOT RECORDS							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
1	1	100					
2	2	100					
3	2	100					
4	2	100					
5	1	100					
6	1	100					
7	1	100					
8	1	100					
9	2	100					
10	2	100					

In figure 7 the boundary between the two conditions is shown as an abrupt line, however it may be a wide transition zone between the two stands. When these transition zones are wide, it may be somewhat difficult to determine the condition class a sub-plot is in. The following procedures should be used by the field crew in determining which condition a sub-plot center falls in:

- 1) Delineate the two conditions on the photo by drawing the boundary as best you can. Boundaries should go down the middle of a transition zone.
- 2) Walk into one condition until you are clearly in that condition.
- 3) Walk through the transition zone until you are clearly in the second condition. Note when you pass sub-plot center.
- 4) If sub-plot center is nearer to your final position, assign the second condition to sub-plot center otherwise assign the first condition.

Examples of sub-plots that contain two or more conditions.

Figures 9 and 10 illustrate how to record condition class record and sub-plot record information when two conditions are present on the plot and a distinct boundary is present that cuts through some of the sub-plots.

Here both conditions are timberland. Again, condition 1 is a sawtimber red pine stand, condition 2 is a poletimber aspen stand. Sub-plots 1, 6, 7, and 8 are completely in condition 1 and sub-plots 2, 3, and 10 are completely in condition 2. The condition boundary cuts through sub-plots 4, 5, and 9

Figure 9. Case with two conditions on a plot and a distinct condition boundary that cuts through sub-plots 4, 5 and 9.

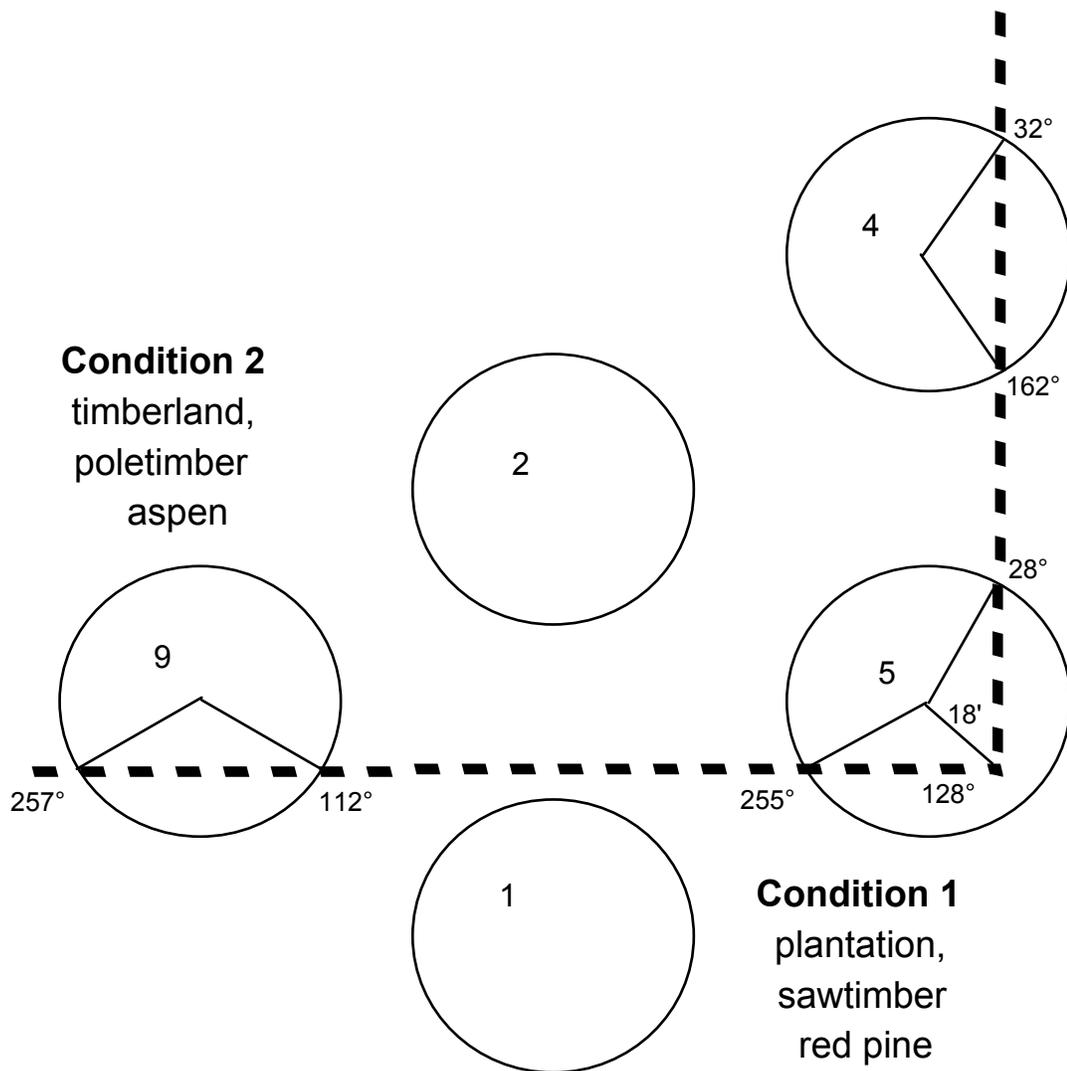


Figure 10. Condition class and sub-plot records for example shown in figure 9.

CONDITION CLASS RECORDS																		
C O N #	G L U C	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	C B A	B G R D	R I P W
(8)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(61)	(65)	(66)
XX	XX	XXX	X	XX	X	XXXX	X	X	XX	XX-X	XXX	XX	XXX	XXX	XX	XX	XX	XX
1	22	1	2	5	3	5	4	2	00	021	64	70	125	34	15			
2	20	35	3	2	3	15	5	1	00	912	24	80	746	15	26			
3																		

SUB-PLOT RECORDS							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
1	1	100					
2	2	100					
3	2	100					
4	2	80					
4	1	20		32	162		
5	2	70					
5	1	30		28	255	128	18
6	1	100					
7	1	100					
8	1	100					
9	2	80					
9	1	20		112	257		
10	2	100					

Note: At sub-plot 4, 5, and 9 the condition that is at sub-plot center (in these three cases it is always condition 2) is always recorded first and the second condition on the sub-plot (in the three cases condition 1) is always recorded second and contains the azimuth and distance information. It is very important that this is done correctly. Remember, the first sub-plot record is for the condition that occurs at sub-plot center and does not get any azimuth or distance entries. Additional sub-plot records are made for each additional condition that occurs on the sub-plot. Azimuth and distance entries must be made for these conditions to define where the condition boundary intersects the sub-plot boundary. Be sure to get the azimuth and distance information with the correct condition. Remember, when you are standing at sub-plot center to take the azimuth information that these azimuths go with the condition you are looking out at, not the one you are standing in.

Figures 11 and 12 illustrate what to do when three conditions are present on a plot. Here two of the conditions are timberland and one is nonforest. In this case the three conditions are:

- 1) Timberland, seed.-sap., aspen (recent clearcut), state owned
- 2) Timberland, poletimber, aspen, forest industry owned
- 3) Improved pasture and rangeland with trees, farmer owned.

The condition boundary is easy to locate. There are no broad transition zones. A fence separates the improved pasture and rangeland with trees from the timberland and the edge of the clearcut is very abrupt.

Figure 11. Case with three conditions on a plot and distinct condition boundaries that cut through sub-plots 4, 5, 6 and 8.

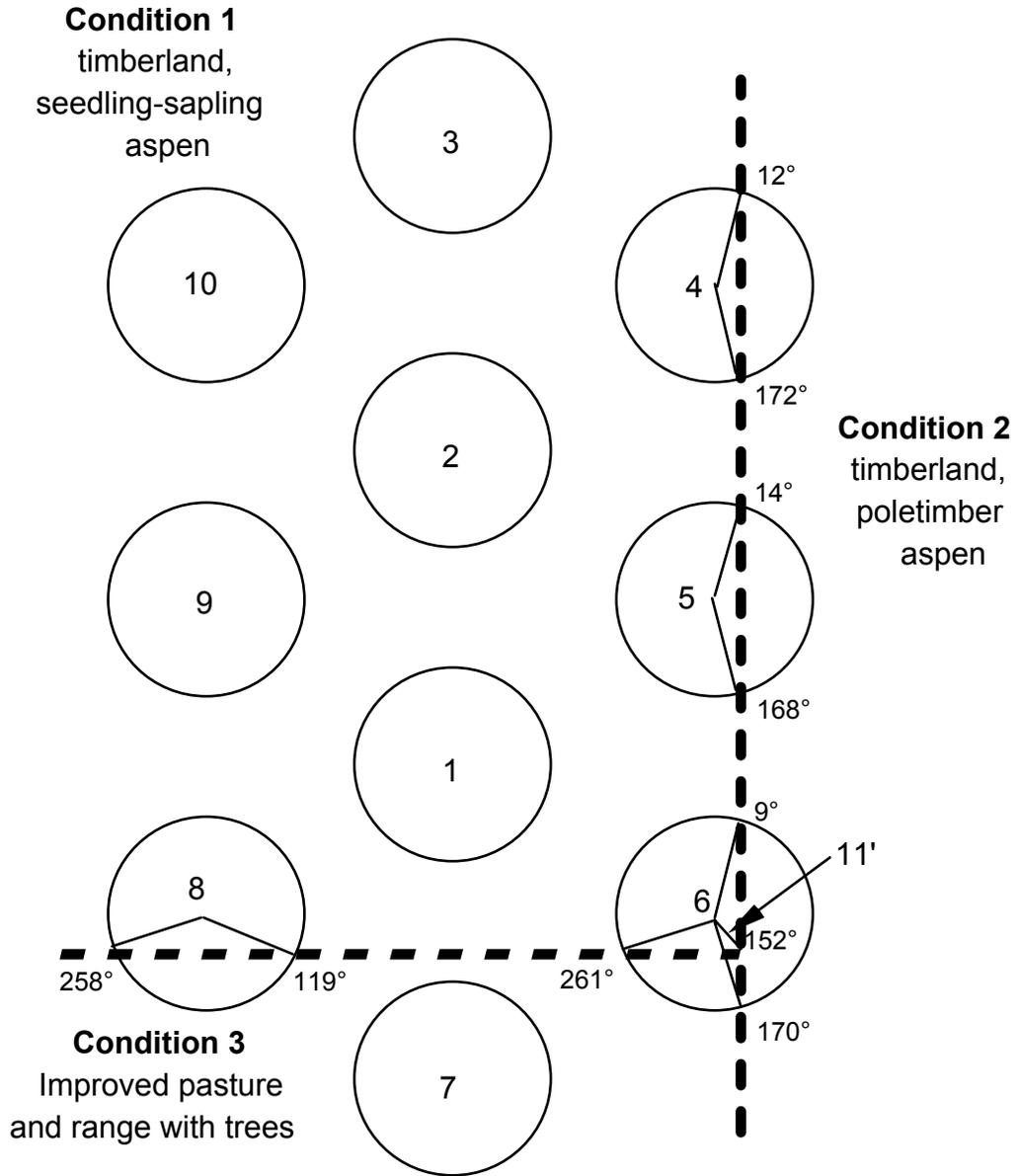


Figure 12. Condition class and sub-plot records for example shown in figure 11.

CONDITION CLASS RECORDS																		
C O N #	G L U C	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	C B A	B G R D	R I P W
(8)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(61)	(65)	(66)
XX	XX	XXX	X	XX	X	XXXX	X	X	XX	XX-X	XXX	XX	XXX	XXX	XX	XX	XX	XX
1	20	1	2	5	3	5	4	1	31	913	3	78	746	40	15			
2	20	35	3	2	3	12	4	1	00	912	27	78	746	15	28			
3	52									501				80				
4																		

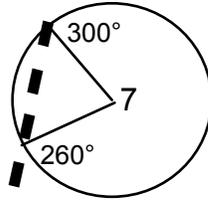
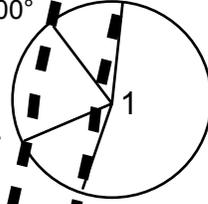
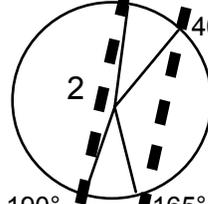
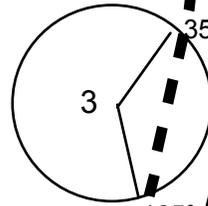
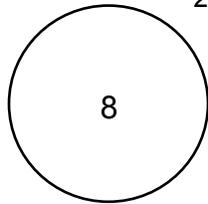
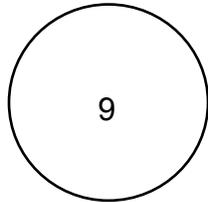
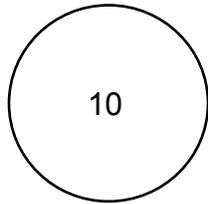
SUB-PLOT RECORDS							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
1	1	100					
2	1	100					
3	1	100					
4	1	60					
4	2	40		12	172		
5	1	60					
5	2	40		14	168		
6	1	45					
6	2	35		9	170		
6	3	20		170	261	152	11
7	3	100					
8	1	70					
8	3	30		119	258		
9	1	100					
10	1	100					

The corner azimuth recorded for condition 3, sub-plot 6, illustrates that the corner azimuth does not have to be between the left and right azimuths.

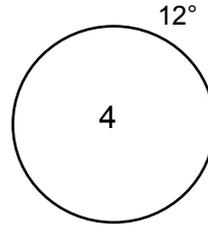
Figures 13 and 14 illustrate what to do when a narrow condition (such as a right of way, wooded strip, narrow windbreak or shelterbelt) cuts through the plot. These land uses can be less than 120 feet wide and could split a sub-plot. If the same condition exists on each side of the narrow strip and the strip cuts completely through a sub-plot you will have to make three sub-plot record entries even though only two conditions actually exist on the sub-plot. The situation shown at sub-plot 1 and 2 are the only situations where three entries should be made on a sub-plot where really only two conditions were found.

Figure 13. Case where a right-of-way cuts completely through a sub-plot, dividing a condition into two pieces.

Condition 1
poletimber
aspen



Condition 2
right-of-way



Condition 1
poletimber
aspen

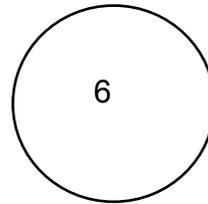
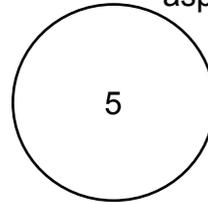


Figure 14. Condition class and sub-plot records for example shown in figure 13.

CONDITION CLASS RECORDS																		
C O N #	G L U C	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	C B A	B G R D	R I P W
(8)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(61)	(65)	(66)
XX	XX	XXX	X	XX	X	XXXX	X	X	XX	XX-X	XXX	XX	XXX	XXX	XX	XX	XX	XX
1	20	35	3	2	3	15	5	1	00	912	24	80	746	15	26			
2	68																	
3																		
4																		

SUB-PLOT RECORDS							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
1	1	60					
1	2	35		190	5		
1	1	5		260	300		
2	2	40					
2	1	15		40	165		
2	1	45		190	5		
3	1	85					
3	2	15		35	165		
4	1	100					
5	1	100					
6	1	100					
7	1	95					
7	2	5		260	300		
8	1	100					
9	1	100					
10	1	100					

Mapping nonforest conditions

Plots that do not contain any land use 20, 21, 22, 57 or 59 should not be mapped even if they contain more than one condition. Record only the condition at plot center. For these plots you just need to enter one condition class record, and no sub-plot records. For example, plot center falls on a wooded strip and the rest of the plot is partly in cropland and partly in pasture and range without trees. Record the wooded strip as condition 1, get a forest type, stand size class and stand area and go to your next plot. No need to record any other conditions, enter any sub-plot records or do any mapping.

When plots do contain land use 20, 21, 22, 57 and 59 only those land uses and any adjacent nonforest conditions need to be recorded. Consider everything beyond the adjacent nonforest condition to have the same land use. This can easily happen with a right of way. For example sub-plots 1, 6, 7 and 8 could be in timberland, and the rest of the plot in cropland without trees, except for sub-plot 3, which goes into a right of way.

Do not record the right of way as a condition, although you would want to draw it on the sketch map for future reference.

Remeasurement sub-plots that were previously moved

When remeasuring a plot that had moved sub-plots on it, both the old moved sub-plots and the new non-moved sub-plots will be measured. Sub-plots that were moved will be given a sub-plot number equal to their old point number plus 10 (for example a previously moved sub-plot 3 will be recorded as sub-plot 13) and new non-moved sub-plots will be given the correct sub-plot number corresponding to their actual position. Information on the old moved sub-plot will all be recorded as on any other sub-plot. A sub-plot record must be made for these sub-plots and all trees measured on these sub-plots will use this sub-plot number. Figure 15b on the next page shows a plot with a previously rotated sub-plot. Figure 15a below shows how to enter the condition class and sub-plot records for this plot

The only special treatment is that trees on these sub-plots should not be repainted and that these sub-plots may not be used as witness sub-plots. To save time in measuring these sub-plots it is OK to use original azimuth and distance to each old tree as current. Distance and azimuth will be recorded for new trees. Ingrowth, ongrowth and seedlings should be tallied.

Figure 15a. Condition class and sub-plot records for plot shown in figure 15 b.

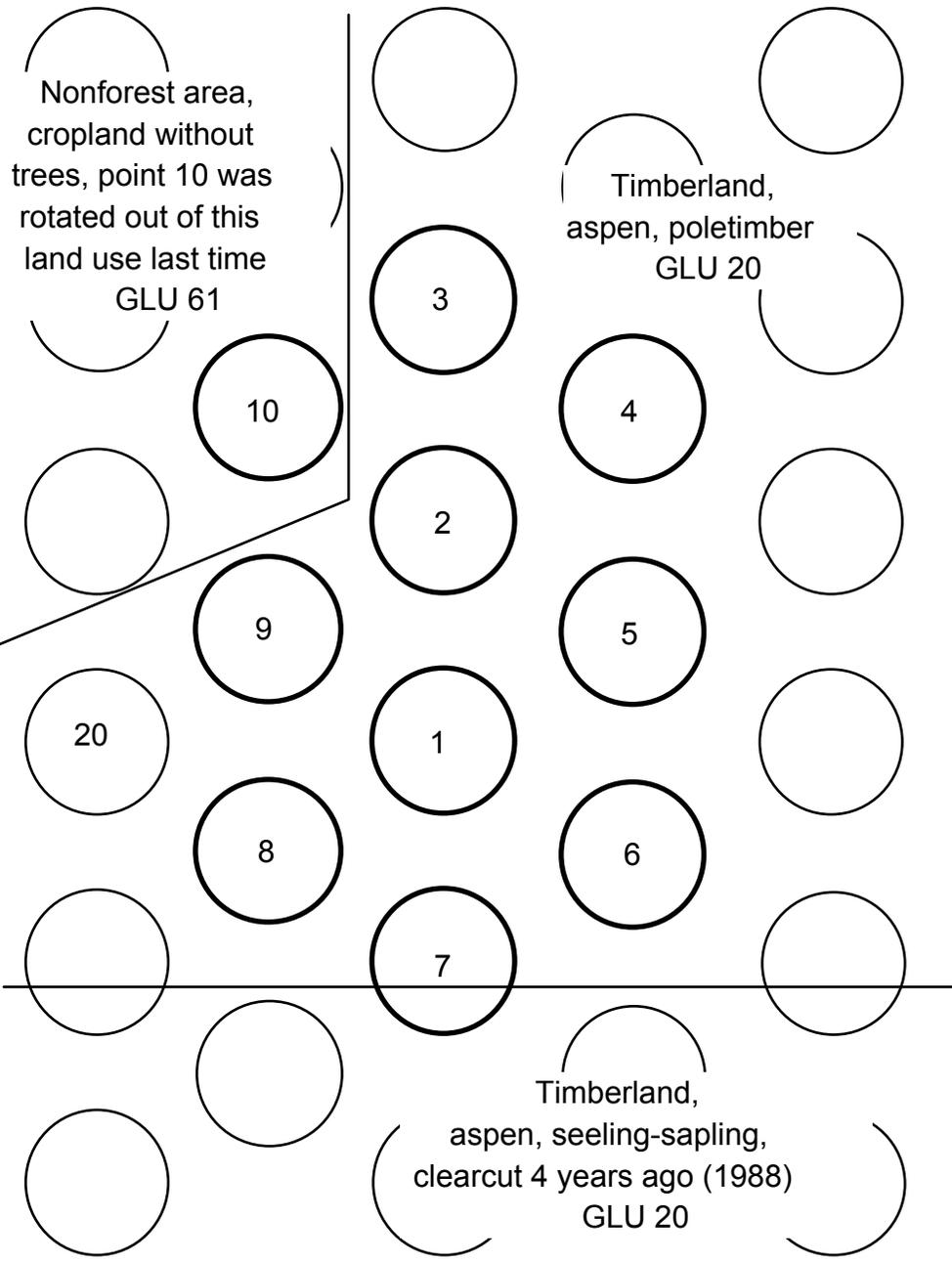
CONDITION CLASS RECORDS																		
C O N #	G L U C	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	C B A	B G R D	R I P W
(8)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(61)	(65)	(66)
XX	XX	XXX	X	XX	X	XXXX	X	X	XX	XX-X	XXX	XX	XXX	XXX	XX	XX	XX	XX
1	20	35	3	2	3	15	5	1	00	912	24	80	746	15	26			
2	20	35	3	2	3	15	5	1	31	913	4	80	746	20	26			
3	61																	
4																		

SUB-PLOT RECORDS							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
1	1	100					
2	1	100					
3	1	100					
4	1	100					
5	1	100					
6	1	100					
7	1	85					
7	2	15		120	240		
8	1	100					
9	1	100					
10	3	100					
20	1	100					

Plot sketch map

A sketch must be made on the plot sheet. This map must show the location of all condition boundaries that pass through the plot. Conditions should be labeled by GLU, CFTS and any other item that was used to distinguish them. Figure 15 is an example sketch map. Boundaries that pass through sub-plots should be drawn carefully with a straight edge to show the location of the intersections and corner points. These sketch maps will be helpful in resolving problems in the data edit and to show the locations of old moved plots.

Figure 15 b, Sample sketch map.



Shifted sub-plot centers

If sub-plot center falls within a tree trunk, shift the sub-plot center back, along the approach line, a distance of two feet from the edge of the tree trunk and mark with a pin or stake. Measure distance to the next sub-plot center from the pin or stake. Record such changes in the "Notes" section of the plot sheet.

Witnessed Sub-plots

Designate a witnessed sub-plot on all established plots. Use Plot Center (or any other sub-plot center within 70 feet) with three or more witness trees if possible. Witness trees should have the following characteristics:

- located within 100 feet of the witness sub-plot center
- not likely to die or be cut before the next survey
- species easily located in the stand
- at least 5.0" DBH (or at least 2.0" DBH if no 5.0"+ DBH is available).

Sub-plots 3, 4, or 10 can be used to witness when none of the other sub-plots have acceptable witness trees. Witness sub-plots should be within forest conditions if possible.

Record the sub-plot number of the witness sub-plot in the "Notes" and the following witness tree data on the plot sheet.

- Species
- DBH
- Azimuth
- Slope distance
(to nearest 1/10th foot from witnessed sub-plot center to the center of the tree at the base)

Some items require measurements to decimal fractions of inches or feet. For these items, the last digit represents a decimal fraction. For example, a tree DBH of 23.4 inches is coded 234. Decimal points are never placed in coded entries.

Mark each witness tree above DBH and at the base with a scribe and paint "X" on the side of the tree facing the witness sub-plot center.

When an acceptable witness tree is absent, a rock or other permanent feature may be used instead of a witness tree. Describe it and give distances, etc. in the "Notes" section of the plot sheet.

For remeasurement plots, find and inspect the witness trees established on the last survey. Remeasure and rescribe at DBH and the base if they are still suitable witness trees. If the witness trees are missing or in poor shape (not expected to live until the

next survey), select new witness trees. Remove the witness paint --scrape the old paint off-- if new witness trees are used.

Sub-plot Reference

On many plots, certain sub-plots within the plot lack information useful in determining their location on future surveys. Examples of this are cover classed sub-plots, sub-plots where only seedlings are tallied, and sub-plots that fall in a nonforest land use.

All established sub-plots without data that could be used to re-establish its location a point location (i.e. no azimuth or distances to any tree) must be referenced. Mark reference trees above DBH and at the base with a scribe mark and paint on the side of the tree facing the sub-plot center. Unlike witness trees, there is no set rule for painting a reference tree, but it is best to paint the tree with a number corresponding to the sub-plot being referenced. This method makes it easier for field crews on the next survey to identify which sub-plot they have located.

There is no need to reference sub-plots that fall entirely within a nonforest condition. In many cases this would be impossible. For example, there would be no reason to reference sub-plot 10 in figure 15 because it is entirely in cropland.

Reference trees should have the following characteristics:

- located within 70 feet of the sub-plot center
- not likely to die or be cut before the next survey
- species easily located in the stand
- at least 5.0" DBH (or at least 2.0" DBH if no 5.0" + DBH is available).

Record the sub-plot number, azimuth, slope distance to the center at the base (to the nearest tenth of a foot), and DBH (to the nearest tenth of an inch) for the reference tree in the "Reference Tree" grid of the plot sheet.

Condition Class Records: Items 16-21, 61-66

Position, Aspect, Slope, Slope Length, Slope Shape: Item 16

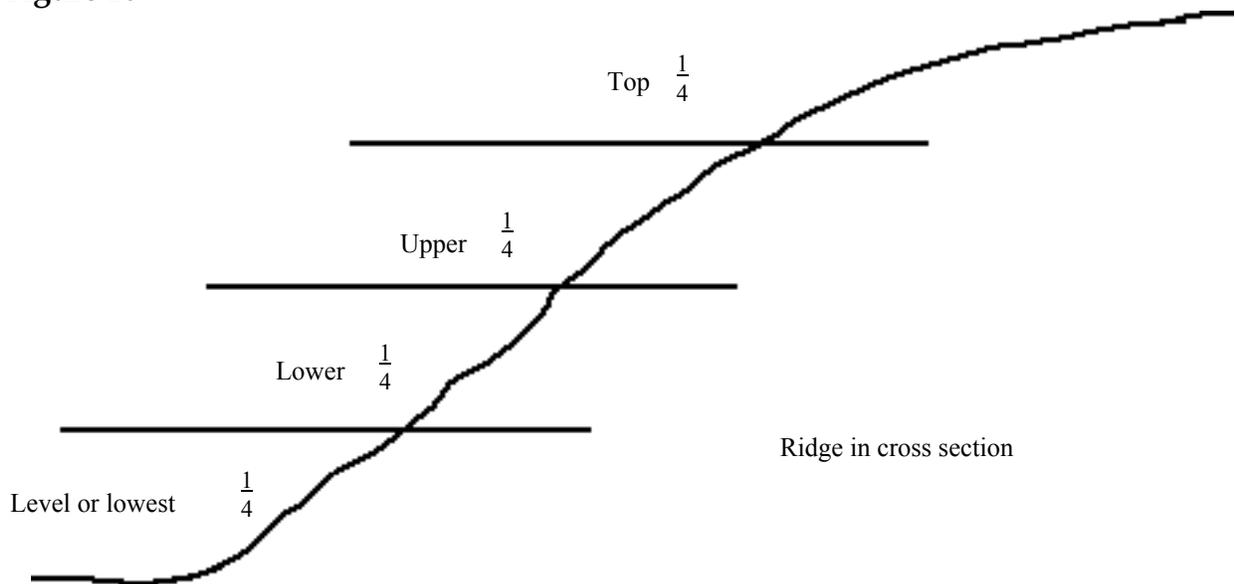
To determine how position, aspect, slope, slope length and slope shape affect a stand, these five items are measured. It is important to understand that all five items tie together or compliment each other. Thus, record the macro features only. Record the appropriate codes in the condition class record.

Position (POS) 1 digit

Position represents the location of the majority of the sub-plots within the condition in reference to topography of the immediate area (Figure 16).

<u>Code</u>	<u>Position</u>
1	Top 1/4
2	Upper 1/4
3	Lower 1/4
4	Level or lowest 1/4

Figure 16



Aspect (ASP) 3 digits

Aspect represents the direction of drainage for the majority of the sub-plots within the condition. It is recorded as the azimuth of this direction. For instance, if the direction of drainage is 36°, the code is 036. Direction due North is recorded as 360.

Slope (SLP) 2 digits

Slope is the average percent deviation from horizontal over all of the sub-plots within the condition. The recorded code is a measure of this percentage. For example, record 35 percent slope as 35. All slope percentages 100+ percent receive code 99.

Slope Length (LEN) 4 digits

On the slope where the majority of the sub-plots within the condition fall, estimate total slope length to the nearest half chain (from 0000 to 999.5 chains). Slope length is the distance from the point where water starts to flow down slope (upper slope - ridge top) to the point where runoff enters a well-defined channel, or at the bottom of the slope where deposition begins.

Slope length is easily determined by looking at the aerial photos in stereo and measuring along the direction of aspect. For flatland and bottomland with zero slope, record slope length as 0000. For all slope percents other than zero, record slope length.

Slope Shape (SHP) 1 digit

Slope shape, along with slope percent, indicates the relative erodibility of the majority of the sub-plots within the condition. A convex shape (code 4) is often found on the upper part of a slope and indicates an area with potential erodibility and rapid runoff. A concave shape (code 2) is found on the lower part of the slope profile and has good water holding capacity. (Figure 17)

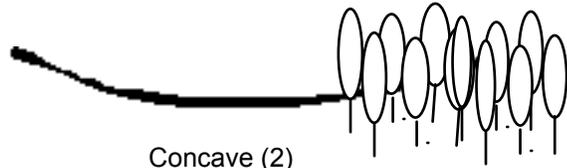
Record the appropriate code for slope shape.

<u>Code</u>	<u>Slope Shape</u>
1	Level
2	Concave
3	Uniform
4	Convex

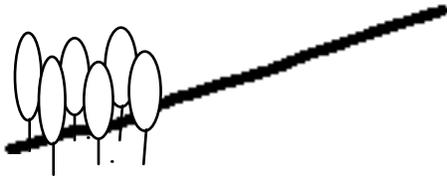
Figure 17 - *Slope shape*



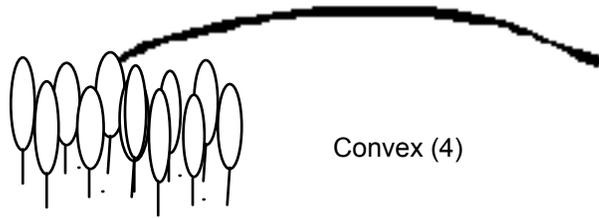
Level (1)



Concave (2)



Uniform (3)



Convex (4)

Physiographic Class (PHYS) 1 digit: Item 17

Physiographic class is a measure of soil and water conditions that affect tree growth on the majority of the sub-plots within the condition. Record the appropriate code.

Cod Physiographic Class

e

- 3 **Xeric sites** Very dry soils where excessive drainage and/or very limited precipitation seriously limit both growth and species occurrence.
Lake States examples: Sandy jack pine plains.
Plains States examples: Ponderosa pine and eastern redcedar on ridge tops and south or southwest aspects.
- 4 **Xeromesic sites** Moderately dry soils where excessive drainage limits growth and species occurrence to some extent.
Lake States examples: Dry oak ridges and the red pine-jack pine associations on sandy and gravelly soils.
Plains States examples: Eastern redcedar, upland elm-ash-locust, hackberry, bur oak, and Chinkapin oak, and north slopes with ponderosa pine in Nebraska and upland hardwoods in western Kansas and Nebraska.
- 5 **Mesic sites** Deep, well-drained soils. Soil and water relationship most favorable to management opportunities. Growth and species occurrence is limited only by climate.
Lake States examples: Well drained aspen, maple/birch/basswood and oak hickory stands.
Plains States examples: Well drained red oak/bur oak/hickory, black walnut, hackberry, and basswood.
- 6 **Hydromesic sites** Moderately wet soils where insufficient drainage limits growth and species occurrence to some extent.
Lake States examples: Poorly drained aspen.
Plains States examples: Silver maple, cottonwood, green ash, boxelder, lowland hardwoods, pin oak and pecan in Southern Kansas.
- 7 **Hydric sites** Very wet sites where excess water seriously limits both growth and species occurrence. These sites typically have soils with a very large organic content such as peat or muck.
Lake States examples: Tamarack, northern white cedar and black spruce bogs.
Plains States examples: Lowland willow, sometimes cottonwood with interior drainage and in fringes around potholes.

- 8 **Bottomland sites** Sites where flooding influences growth and/or species occurrence. Flooding may be frequent (annually) or periodic (every 5-10 years). Soils may range from sand to silt and typically have a large inorganic component. These sites are always associated with a river, perennial stream, or intermittent stream. Woody shrubs are usually not present in these stands because of flooding however a very thick herbaceous layer may be present and vines may be numerous.
- Lake States examples: Flood plain silver maple, ash, cottonwood stands.
- Plains States examples: Flood plain silver maple, ash, cottonwood, hackberry, boxelder, black willow, sycamore, hackberry and black walnut stands; first bench sites.

Stand Origin (SORI) 1 digit: Item 18

Record the stand origin of the condition using the following one-digit codes. Consider only trees in the predominant stand size class of the condition.

<u>Code</u>	<u>Stand Origin</u>
1	Natural stand with no evidence of artificial regeneration.
2	40 percent or more of the sample trees originating from artificial regeneration.
3	Less than 40 percent of the sample trees originating from artificial regeneration.

If stand origin is anything other than code 1, explain in the "Notes" section of the plot sheet.

Stand History (SHIS) 2 digits: Item 19

Stand history reflects the kind of disturbance on half or more of the sub-plots within the condition. For new sample plots, stand history reflects this disturbance over the last 20 years. For remeasurement plots, this code reflects the most recent disturbance since the last inventory. Stand history cannot exceed the remeasurement period.

First digit Use the appropriate code for the first digit to classify the disturbance.

- 0 **No Disturbance** No evidence to indicate any of the following.
- 1 **Grazing** Significant disturbance caused by livestock grazing. Evidence of livestock grazing includes: absence of an understory, exposed tree roots and mineral soil, dead standing timber, severe erosion, and cow patties.
- 2 **Timber Stand Improvement** There is evidence that some trees have been killed or removed (or vines cut) through some type of pre-commercial thinning, pruning, or selective firewood harvest.
- 3 **Commercial Clear Cut** All merchantable stems, or stems down to some minimum diameter, have been removed. Some large diameter cull-trees may have been left, but generally all merchantable material has been removed.
- 4 **Partial Harvest Cut** Less than 50 percent of merchantable stems have been removed. Usually only large diameter, old, or otherwise high value stems are removed in this type of cut.
- 5 **Natural** Significant disturbance from fire, wind, flooding, insect or disease.
- 6 **Man-caused** Significant disturbance has resulted directly or indirectly as a result of human activities, i.e. alteration of natural drainage, chemical spraying, salt damage from oil wells, or acid water run off, etc.
- 7 **Planting of Forest Land**
- 8 **Planting of Non-Forestland** Areas that were once old field sites, reclaimed strip mines, pasture, or crop land that were planted to commercial tree species (usually about 300 more than trees per acre).
- 9 **Natural Regeneration of Non-Forestland** Areas that are reverting to forest vegetation. Areas that were once old field sites, marshes, etc.

Explain the kind and extent of any disturbance in the "Notes".

Second digit Use the following codes for the second digit to indicate how long ago the disturbance took place.

- | | |
|---|----------------|
| 0 | No disturbance |
| 1 | 1-4 years |

- 2 5-10 years
- 3 11-15 years
- 4 16-20 years

Basal Area Per Acre (CBA) 3 digits: Item 61

Field crews must estimate BA/acre for noncommercial forest land conditions (GLU codes 40, 41, or 45). Use a three-digit code to record the basal area per acre for the condition.

Use the 37.5 BAF prism to estimate the basal are of conditions in these land uses and record this information in the condition class record. At each sub-plot center within the condition count the number of in trees, compute and record an average basal area. Table 3 is applicable if the entire plot is within the condition. To estimate BA only the prism sample should be applied to all live trees regardless of DBH. Trees less than 5.0" dbh should be counted only if they are picked up by the prism (do not use a 6.8 ft fixed radius plot) and trees over 17.0" dbh should be counted if they are picked up by the prism even if they are more than 24 ft. from sub-plot center. When the condition occurs on only a portion of the plot, the BA obtained from this table must be expanded using the same procedure used to expand stocking for land use determination (see page 28, step 4). When the condition occurs on a small portion of the plot, (half the plot or less) judgment and temporary sub-plots may be used as is done with stocking (see page 28, step 6).

Table 3--Basal Area per Acre*
(*Square feet per acre*)

# Trees	BA	# Trees	BA	# Trees	BA
01	004	21	079	41	154
02	008	22	082	42	158
03	011	23	086	43	161
04	015	24	090	44	165
05	019	25	094	45	169
06	022	26	098	46	172
07	026	27	101	47	176
08	030	28	105	48	180
09	034	29	109	49	184
10	038	30	112	50	188
11	041	31	116	51	191
12	045	32	120	52	195
13	049	33	124	53	199
14	052	34	128	54	202
15	056	35	131	55	206
16	060	36	135	56	210
17	064	37	139	57	214
18	068	38	142	58	218
19	071	39	146	59	221
20	075	40	150	60	225

* BA = # of trees x 3.75 (37.5 -factor prism)

Forest Type-Stand/ Size Class (FTS) 3 digits: Item 62

Forest type (first and second digit)

For all plots, record the appropriate two-digit code based on visual estimate while in the plot's area. If stocking is insufficient, use your best judgment. North Central analysts use your estimate as a check against the calculated forest type. Listing and brief descriptions of lake states and plains states forest types are found in the appendix.

Stand Size Class (third digit)

Normally, this item is calculated in the St. Paul office. On new sample plots it is not necessary for you to exactly calculate stand size class in the field. A visual estimate is sufficient. However, one primary use of stand size class is to correctly estimate the stand age of the sample location. If you don't know the stand size class, how can you accurately estimate stand age?

The best solution to this "Catch 22" is to record your best estimate for stand size class and stand age. If there is any doubt at all in your mind that the stand size class may be different, then record the stand age(s) for the other possible stand size class(es) in the "Notes" section of the plot sheet.

If 10 or fewer trees are recorded, enter the estimated size class. This is assumed to be correct by the St. Paul office. For remeasurement plots, the original stand size is recorded on the plot sheet in St. Paul and remains unchanged. A sample plot with a stocking value of less than 10.0 in growing-stock trees, but greater than 10.0 in all live trees is recorded as non-stocked. Record stand size class using the following codes:

<u>Code</u>	<u>Stand size class</u>
1	Sawtimber stands
2	Poletimber stands
3	Sapling and Seedling stands
4	Nonstocked stands

Note: A plot with a stocking value of less than 10.0 in growing-stock trees is recorded as nonstocked (code 4).

Stand Age (AGE) 3 digits: Item 63

Stand age is recorded for each condition found on the plot. Determine the age of the predominant stand-age class from three or more borings of trees in the condition (or other condition you feel are the same age). If there is an insufficient number of acceptable trees to determine stand age, record an estimate. Stand age must reflect stand size class.

Stand age is recorded with a three-digit code to the nearest year. A stand 49 years old is recorded as 049. Nonstocked stands (stand-size class code 4) receive an automatic stand age of 001.

Stand Area (AREA) 3 digits: Item 64

Stand area is recorded in acres for each condition class found on the plot with ground land uses of 20, 21, 22, 40-46, 51-56, 58, 71 and 72 and is used as an indicator of management feasibility. On the appropriate aerial photo measure the condition class area contiguous to the plot with the same overall forest type size density.

Bare Ground (BRGD) 2 digits Plains States only: Item 65

The percent bare ground on the first micro-plot in a condition, will be observed and recorded to the nearest 5 percent (100% is coded as 99). Bare ground is exposed soil or rock fragments less than 3/4 inches (longest dimension) that is not covered by litter or low understory vegetation such as grass, herbs, moss or ferns. Consider only exposed soil that will receive direct rainfall or drip fall from the overstory canopy. In the event that a condition does not contain a micro-plot, establish a temporary micro-plot 35 feet inside the condition boundary where the condition is first encountered on the plot.

This data is being gathered to use in conjunction with other items such as grazing, stand history, slope, aspect, species composition and percent cover to determine soil erosion potential and causes. This will be used to analyze productivity, off-site impacts, regeneration, and other factors important to the forest lands of the Plains States.

Riparian Zone Width (RIPW) 2 digits Kansas Only, Item 66

Riparian zones are areas of transition from aquatic to terrestrial ecosystems. During the growing season, they have excess soil moisture compared to the adjacent upland or bottomland terrestrial zones. They begin at the edge of a stream, river, or lake where there is a defined bank and channel and continue until an elevation in topography, or change in soils, impacts the species composition to a clearly terrestrial ecosystem. Riparian zones are characterized by abundant soil moisture. Tree species that may be associated with a riparian zone include willow, boxelder, cottonwood, and silver maple, however these same species may also occur outside the riparian zone. Because riparian zones are transitional, it can be difficult to make a finite distinction between the riparian and terrestrial zones. The occurrence of non-riparian tree species, such as eastern redcedar, would definitely indicate that you are out of a riparian zone. Riparian zones can be very narrow (just a few feet) in the case of a steep stream that is cutting into the bank.

If a riparian zone occurs within 100 feet of any sub-plot center in a plot that is being installed (contains a forest, wide windbreak or wooded pasture condition) the width of the riparian zone will be measured and recorded to the nearest foot. A riparian zone may straddle two conditions, in which case the total width should be measured and recorded

with each condition. Widths 99 feet or more are recorded as 99. A condition can contain more than one riparian zone if the condition crosses a stream. In this case record the width of the riparian zone closest to the first sub-plot center where the condition is encountered.

Tree Cover Width (RIPW) 2 digits NE, ND, SD only: Item 66

Replaces riparian zone width used in Kansas.

Procedure for determination of tree cover width in proximity to perennial streams.

1. Tree cover width should be determined after all sub-plots have been located and other measurements have been completed. In order to be considered tree cover the width of the wooded strip to be measured must meet the definition of forest land except that no minimum width or area restrictions apply.

2. If any sub-plot center falls within 100 feet of the mean high water mark of a perennial stream, follow the procedure outlined below. Consider only sub-plot centers 1 - 10, and not any previously rotated points.

3. From the nearest sub-plot center to the stream, go the shortest distance to the stream, turn and measure perpendicular to the stream the total width of the tree cover, only on the side of the stream on which the sub-plot center lies.

Measurement/estimation can be made from the aerial photograph and/or by pacing. Record width using the classification below:

<u>TCW</u>	<u>Code</u>
<50 feet wide	1
51' - 100'	2
101' - 500'	3
501' - 1000'	4
1001' - 2640'	5
2641' - 5280'	6
>5280'	7

4. Each tree cover width measurement will be coded using 2 digits. The first digit is the number of the sub-plot closest to the stream from which the measurement was made. The second digit should correspond to the width code as indicated above. Record 0 if sub-plot 10 is used.

Thus, a 1500 foot wide tree cover, measured because the center of sub-plot 3 was less than 100 feet from the mean high-water mark and was the closest of all sub-plots to the mean high-water mark, would be recorded as "35," and so on.

5. A sketch, on the sub-plot diagram on the field data sheet, should be made showing the approximate direction of the line along which the width measurement was made. Indicate in the sketch which sub-plot center was the one closest to the stream.

6. If two sub-plot centers are equally distant from the center of the stream, the field crew should select the lowest numbered sub-plot and proceed.

7. If the closest of all sub-plots centers is equally distant from two streams, select the stream to the north or east and proceed.

Shrub Records: Items 22-29

The following information is recorded for forest sub-plots 1, 2, and 3 in the NE quadrant, 0° to 90°, of the micro plot for all remeasurement plots (SK #2 and SK #6) from leaf flush to leaf fall. All information is recorded on the shrub record. It is assumed that all shrubs are in the condition present at sub-plot center, therefore condition is not recorded in the shrub record.

Sub-Plot Number (SUB#) 2 digits: Item 22

Record the sub-plot number for each entry in the shrub record.

Shrub Number (SNUM) 2 digits: Item 23

For each sub-plot, begin with shrub number 1 and increase. Each species-diameter class combination (tall woody perennials and tree seedlings) or species (other perennials) on a sub-plot is given a new shrub number. No special numbers have been reserved for shrubs. Begin to number shrubs at 1 on each sub-plot.

Species (SPP) 3 digits: Item 24

See shrub species list in the appendix.

Shrub History (SHIS) 2 digits: Item 25

Classify tall, woody perennials as shrub history 80. Other perennials, classify as shrub history 81. See listing under shrub species in the appendix.

Diameter Class (DIAC) 3 digits: Item 26

Classify shrub stem diameter, six inches from the ground. Use only for tall woody perennials (SHIS=80) and leave blank for other perennials (SHIS=81). See the table below for codes.

Shrub History 80	
<u>Code</u>	<u>Diameter (measured along stem six inches from the ground)</u>
001*	0.0 - .19" or less than 6" tall
002	.2 - .29"
003	.3 - .39"
004	.4 - .49"
005	.5 - .99"
010	1.0 - 1.49"

015	1.5 - 1.99"
020	2.0 - 2.49"
025,030, etc.	1/2" diameter classes continue

Frequency Of Stems Present (FREQ) 3 digits: Item 27

Enter the number of stems present in each species diameter class for tall woody perennials (SHIS=80) and leave blank for other perennials (SHIS=81).

Note: Only seedlings may be recorded twice, once on the shrub record and also on the tree record when tallied in the micro plot. Any tree 1.0" DBH or larger on the sub-plot is not recorded in the shrub record.

Percent Cover (COV) 3 digits: Item 28

Percent cover applies only to other perennials (SHIS=81) and is left blank for tall woody perennials (SHIS=80). Use codes listed in the table below

<u>Shrub History 81</u>	
<u>Code</u>	<u>Percent ground cover</u>
001	solitary plant, less than 1%
002	1 - 10%
003	11 - 20%
004	21 - 40%
005	41 - 70%
006	More than 70%

Evidence Of Browsing (BROW) 3 digits: Item 29

The percent of the number of stems by species and stem diameter class for tall woody perennials and the percent of the ground cover by species for other perennials that show evidence of the stems, twigs and foliage being browsed. This data helps determine the impact of deer and other browsing animals on regeneration, species composition, and the lower vegetation layer. Record general percent categories.

Tree Records: Items 30-50

Tally Rules For Trees > Or = 5.0" DBH,

The 37.5 BAF variable radius plot and the macro plot 24.0 feet fixed radius plot

A tree 5.0" DBH to 16.9" DBH is tallied if it is within the limiting distance of a 37.5 basal area factor prism. A tree 17.0" DBH or larger is tallied if it is within 24.0 feet of sub-plot center at dbh.

Figure 18 illustrates a tree within the variable radius plot, a tree outside the variable radius plot, and a questionable tree. Check a questionable tree for its limiting distance. **The limiting distance for all trees 5.0" DBH and larger (including those 17.0 " or larger) is measured as the horizontal distance from the pin to the center of the tree at DBH.** For trees 17.0" DBH or larger the limiting distance is 24.0 ft. and for trees 5.0" to 16.9" DBH the limiting distance is shown on the second page of the tatum guide in appendix.

For example, a tree with a DBH of 14.6 inches, must be closer than 20.7 feet (horizontal distance) at DBH to be considered "in" using a 37.5 basal area factor prism. A table on the second page of the tatum guide (see appendix) shows the limiting distances for the 37.5 basal area factor prism.

Use your prism carefully. Hold the prism directly above point center. Watch out for flat or triangular trees. On steep slopes, "in" trees may appear to be "out". Check all trees if close either way.

On new plots, all standing dead trees, 5.0" DBH or larger, within the variable-radius plot are tallied. See item 39, Tree Class, for more information on tallying dead trees.

Note: A leaning tree, <5.0" DBH, outside the micro-plot (6.8 fixed-radius plot) but within the limiting distance is not tallied.

Tally Rules For Trees < 5.0" Dbh,

Micro plot (6.8 foot fixed radius plot horizontal)

Saplings: Tally all live saplings (trees >1.0" DBH, but <5.0" DBH) within the micro plot. **The limiting distance for all trees less than 5.0" DBH is measured as the horizontal distance from the pin to the center of the tree at the base.**

Note: A leaning tree, 5.0" DBH or larger, within the micro plot, but outside the limiting distance of the prism, is not tallied. There is an exception to this rule. On

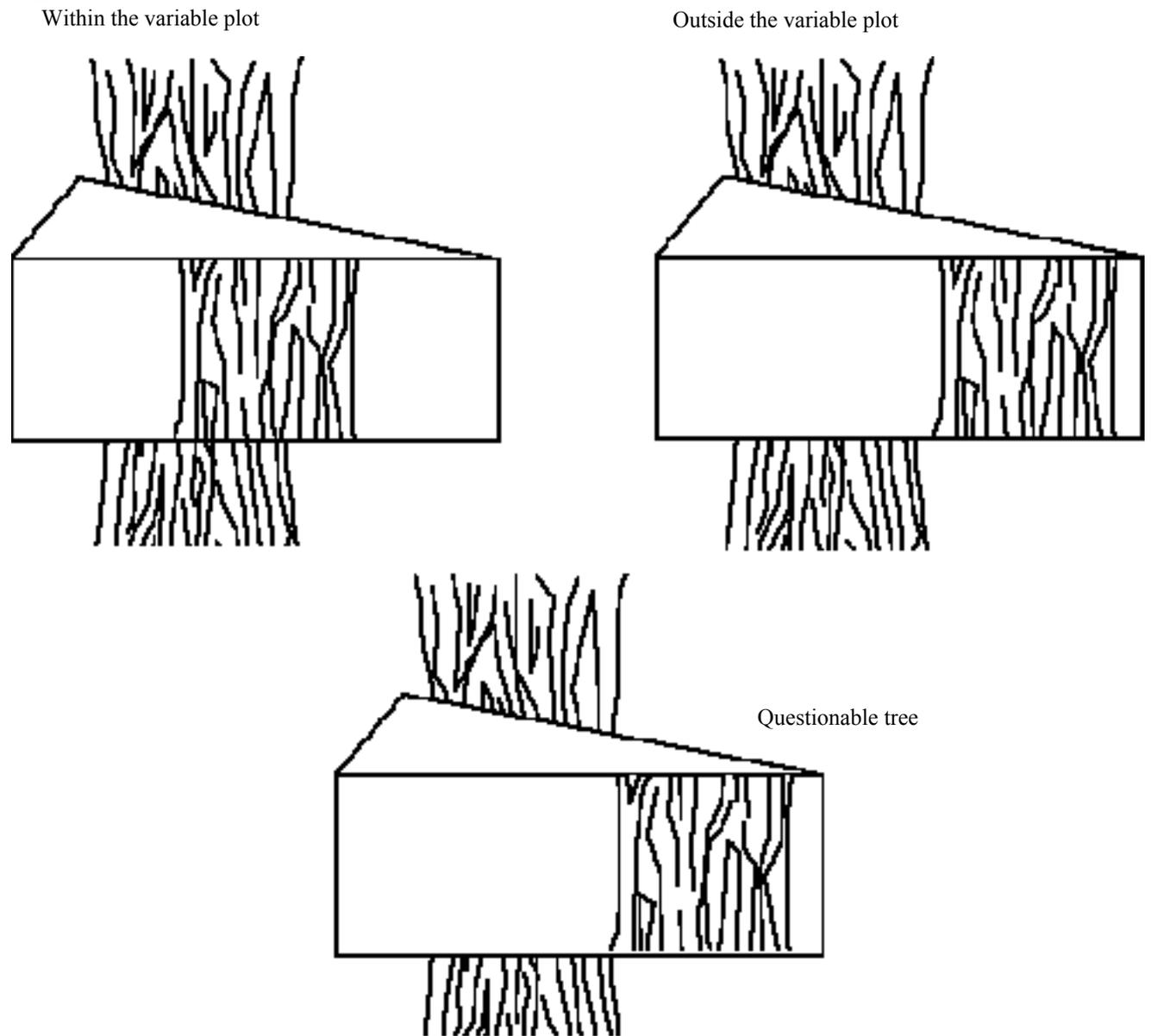
remeasurement plots every tree previously tallied on the micro plot (sub-plots 1-3) must be accounted for. It is possible for a tree that was tallied on the micro plot last time (less than 5.0" DBH) to now be >5.0" DBH but not on the variable radius plot because the tree is leaning or because it has moved. These trees should be given a tree history of 010 or 020.

Seedlings: Count or estimate the number of seedlings (trees less than 1.0") by species and damage class. Record totals in item 42, Tree Cavities/Number of Seedlings.

The Minimum height required to be considered a seedling is six inches for softwood and one foot for hardwood species. DBH for seedlings is recorded as 000.

Estimate the number of seedlings when there are too many to count. Use five or more seedlings per species as a guideline.

Figure 18 - Variable radius plot



Because the variable radius plot is only used to tally trees 5.0" or larger there is no reason to look at trees less than 5.0" DBH with the prism.

Checking trees when sub-plot center is inaccessible

It may be physically impossible for you to reach a sub-plot center and you may need to be to check and possibly tally trees on that sub-plot. This will most often occur when sub-plot center is in deep water within 24 ft. of land. To obtain a distance and azimuth for these trees establish a temporary pin (shifted sub-plot center) a known distance and azimuth from sub-plot center. Measure that same distance and azimuth from each check tree to get a shifted tree location. The distance and azimuth from the shifted sub-plot center to the shifted tree location is the appropriate distance and azimuth for each tree.

For example, in chaining from sub-plot 2 to sub-plot 3 a river bank is encountered, making it impossible to chain beyond 55 ft. A pin place 55 ft., 0° from sub-plot center 2 will be 15 ft, 180° from sub-plot center 3 and can be used as a shifted sub-plot center. To get a distance and azimuth for trees near the river bank simply measure 15 ft, 180° from each tree you wish to check and establish a shifted tree location. The distance and azimuth from the shifted sub-plot center to each shifted tree location is the appropriate distance and azimuth for each tree.

Sub-Plot Number (SUB#) 2 digits: Item 30

Record the sub-plot number for each entry in the tree record.

Tree Number (TR#) 2 digits: Item 31

Record a tree number (two digits if required) on the tree record for each entry including trees, stumps and seedlings. Use numbers 1 through 99.

For remeasurement plots

All old trees 5.0" DBH and larger (live or dead but not stumps) are retallied using the old tree number.

Last measurement before 1987:

On sub-plot 1-3 remeasure all trees >1" dbh using original tree numbers. On sub-plots 4-10 remeasure trees >5" dbh using original tree numbers. Old trees 1.0" - 4.9" dbh are measured as new trees. Stumps, seedlings, and saplings on sub-plot 4-10 are disregarded, and their old tree numbers are not used.

Last measurement after 1987:

Number previously measured trees using old tree numbers. Stumps, and seedling on the old tally sheets are disregarded, and their old tree numbers are not used.

Number new trees (ongrowth and ingrowth) consecutively, proceeding clockwise from 0° azimuth starting with the next available tree number. Tallier and cruiser work together locating original trees and adding new trees in the proper sequence. All seedlings are given new tree numbers.

Tree History *CONTINUED*

Tree Species (SPP) 3 digits: Item 32

Record a three-digit species code for all trees, live or dead. Codes from 010 to 299 are for softwoods, and from 300 to 998 are for hardwoods. Within these groups, species codes are listed in sequence by scientific name.

Verify the tree species codes for trees tallied in the previous survey and correct if necessary. If you change a tree species code, explain it in the "Notes" section on the plot sheet. Assign tree species codes as needed for new trees. For a tree identified as a noncommercial species on the prior survey (species code 999), assign the proper species code on the current survey. If the tree is missing, the tallier makes a best judgment in assigning a species. (See appendix for species list.)

Tree History (THIS) 3 digits: Item 33

Tree history is a three-digit code reflecting the previous and the current status of a tree.

New plots

The first and second digits are always 0 on a new measurement plot (SK #1 and SK #7). Use the following codes for the third digit of Tree History on a new measurement plot.

<u>Code</u>	<u>Tree History</u>
1	Growing stock live
2	Cull live
4	Salvable-dead
5	Standing-dead

Note: 001, 002, 004 and 005 are the valid tree history codes on a new plot.

Remeasurement plots

The first digit is used to identify previous measured trees that are outside the 24 ft. radius (**measured horizontally to the center at DBH**). The second digit describes the previous status of a tree. The third digit describes the current tree status.

<u>Code</u>	<u>Tree History, first digit</u>
0	24 ft. or less from sub-plot center at DBH.
1	Greater than 24 ft. from sub-plot center. No new paint is put on remeasured trees beyond the 24' limit. Ongrowth trees are not tallied beyond 24'.

<u>Code</u>	<u>Tree History, second digit, previous tree status</u>
0	No status
1	Growing stock live
2	Cull live
3	Ingrowth

- 4 Salvable-dead
- 5 Dead (standing or down)
- 6 Ongrowth

Tree History *CONTINUED*

<u>Code</u>	<u>Tree History, third digit, current tree status</u>
0	No status
1	Growing stock live
2	Cull live
4	Salvable-dead
5	Standing-dead
6	Down-dead (only on previously measured trees)
7	Stump of salvable-dead
8	Stump Utilized
9	Stump Not utilized

Tree History Descriptions for remeasurement plots

On remeasurement plots the second digit of tree history is used to identify the tree's status at the last inventory. It is used in processing to divide trees into four groups;

new sample trees that came onto the plot because the sub-plot was previously moved and there has been no land use change (second digit = 0),

new sample trees that came onto the micro plot due to growth, regeneration or land use change (second digit = 3),

new sample trees that came into the variable radius plot due to growth or land use change (second digit = 6), and

old sample trees (second digit = 1, 2, 4 or 5).

On remeasurement plots, all trees printed on the plot sheet summary from the data base for the past inventory must be accounted for; none can be dropped. The plot sheet will list all live, and dead trees 5.0" and greater plus live trees 1.0"-4.9" DBH on sub-plots 1-3 if the plots that were measured before 1987. No old stumps, dead trees less than 5.0" DBH, or seedlings on any sub-plot should be listed. In addition, any tree less than 5.0" DBH on sub-plots 4-10 should not be listed on a plot last measured prior to 1987. If these trees are listed, please contact St. Paul.

Prior to 1987, the micro-plot was installed only on sub-plots 1-3. On sub-plots 4-10 trees less than 5.0" were only measured if they were needed for stocking or they were picked up on the variable radius plot. Not every tree within the micro plot was inventoried. Because trees less than 5.0" on sub-plots 4-10 were not sampled equally in the last inventory the old information we have on them is not useful and should be ignored and these trees are considered new sample trees.

No status at previous measurement (Tree histories 001, 002 and 004 and 005)

These are new trees on a sub-plot that was previously moved that are in the area where there has been no land use change. These trees should be tallied as if they were on a new plot.

Tree History *CONTINUED*

No status at current measurement (Tree histories 010 and 020)

These are previously measured trees on lands that have changed land use. The land use change is from one where trees are measured (20, 21, 22, 57, or 59) to a land use where trees are not measured (anything else). Every old live tally tree must be accounted for when there is a land use change. If a tree was cut or died as a part of the land use change it would get a tree history that reflects the cutting or mortality of the tree. If the tree is still alive (or died/cut after the land use change and unrelated to the land use change) it should get a current tree history of no status. There is no need to determine if these trees are within 24 feet of sub-plot center because they are not being measured.

Ingrowth (Tree histories 031, 032 and 034 and 035)

Ingrowth trees are trees that were not tallied (or were seedlings) on the previous survey. They are now being tallied and occur on the micro plot. A new tally tree of any diameter that is within 6.8' of the pin (measured horizontally to the center of the base) should be given an ingrowth tree history.

All seedlings are tallied as ingrowth. Assign all live seedlings a tree history (031 or 032) according to their current tree class.

Ongrowth (Tree histories 061, 062, 064, 065)

Ongrowth trees are new tally trees that are outside of the micro plot (**measured horizontally to the center of the base**). They are now ≥ 5.0 " DBH and occur on the variable-radius plot or the macro plot.

Tally all ongrowth trees on sub-plots 1-10. Assign ongrowth tree history (061, 062 or 064) according to the current tree class.

Note: Trees tallied prior to 1987 on sub-plots 4-10 that were less than 5.0" DBH are not remeasured as old trees. If these trees are still alive they will be ingrowth, unless they have moved off of the micro plot and grown to 5.0" or larger, in which case they would be ongrowth. They are given new tree numbers and the old tree numbers are not used.

Dead trees (Tree histories 004, 005, 014, 015, 016, 025, 026, 114, 115, 116, 125, 126)

Salvable-dead A dead growing stock tree containing at least one 8-foot section that is at least 50 percent sound. Salvable dead trees must have been growing stock at the time of death.

Standing-dead A dead growing stock tree containing no merchantable volume (has no 8' or longer section that is at least 50 percent sound) or any dead cull tree. Standing dead trees must be 5.0" DBH and be free stand to a height of 4.5'.

Down-dead Any dead tree less than 5.0" DBH or 5.0" DBH or larger that is not free standing to a height of 4.5'. Dead trees that are leaning and supported by another tree are tallied as down dead.

Stumps (Tree histories 017, 047, 018, 028, 019, 029, 117, 147, 118, 128, 119, 129)

Stump-salvable-dead The stump of a tree that was salvable-dead at the time it was cut and which was utilized.

Stump-utilized The stump of a tree that was alive at the time it was cut and which was utilized.

Stump-not utilized The stump of a tree that was alive at the time it was cut and which was not utilized, that is it was not removed from the forest for forest products.

The following are instructions (numbered 1 through 11) for tallying trees on remeasurement plots and assigning tree history codes.

1. New Live Trees (Tree History Codes 031, 032, 061 and 062)

For ingrowth and ongrowth trees, tally all required items with the exception of original tree data (DBH, tree class, crown ratio, and crown class). These items are zeroed out. All seedlings receive an ingrowth tree history (031 or 032). If the land use where the tree is standing has changed from noncommercial or nonforest back to commercial forest, the sub-plot is established and the tree receives a tree history reflecting ingrowth or ongrowth (031, 032, 061, 062).

2. Original Tally Trees Still Alive (Tree History Codes 010, 011, 012, 020, 021, 022, 111, 112, 121 and 122)

Account for all live trees tallied as live during the previous survey. Transfer old tree number, DBH, crown ratio and crown class from the plot sheet to the data recorder, and complete all new items to survey standards. Use the proper tree history code to reflect both the original and current tree conditions. All entries, except no status trees, are filled in according to guidelines set for sawtimber, pole timber and sapling-sized trees.

For all trees with a tree history of 010 or 020, enter data for these items:

- Sub-plot number
- Species
- Tree Class (orig.)
- Tree number
- Tree History
- Crown Ratio (orig.)
- Condition number
- DBH (orig.)
- Crown Class (orig.)

3. Missing Trees (Tree History Codes 016, 017, 018, 019, 026, 028, 029, 116, 117, 118, 126, 128 and 129)

Account for live trees tallied on the last survey, that are now missing and classify as down-dead or cut. (See No. 4 and No. 5 for required tally items.)

Tree History *CONTINUED*

4. Trees Alive at the Last Survey, Now Dead (Tree History Codes 014, 015, 016, 025, 026, 114, 115, 116, and 125)

All trees tallied as live on the last survey that have since died, qualify as dead trees. Standards for salvable-dead trees remain the same as for a new plot. Trees qualifying as dead (salvable, standing and down) require the following entries on the data recorder.

Sawtimber-size and pole-sized trees, enter data for the items listed below:

- Sub-plot number
- Condition number
- Tree History
- Damage/Death
- Crown Ratio (original)
- Tree Cavity
- Tree number
- Species
- DBH (original and current)
- Tree Class (original and current)
- Crown Class (original)

Trees under 5.0" DBH on sub-plot 1-3, enter data for the items listed below:

- Sub-plot number
- Condition number
- Tree History
- Damage/Death
- Crown Ratio (original)
- Tree number
- Species
- DBH (original and current)
- Tree Class (original and current)
- Crown Class (original)

If the tree is down or standing and so badly decomposed that an accurate DBH measurement cannot be made, use the original information or estimate this figure to the best of your ability. By definition, trees that were cull at the previous survey that have since died cannot be salvable-dead trees. Assign a tree history of 025, 026, 125 or 126 and complete items for standing and down dead trees outlined above.

5. Trees Cut Since Last Survey (Tree History Codes 017, 018, 019, 028, 029, 117, 118, 119, 128 and 129)

For trees tallied as live on the last survey and have since been cut, enter data for the items listed below:

- Sub-plot number
- Condition number
- Tree History
- Damage/Death (017 and 117 only)
- Crown Ratio (original)
- Tree number
- Species
- DBH (original and current)
- Tree Class (original)
- Crown Class (original)

For salvable-dead stumps (017 and 117), record cause of death. If there is no way to determine cause of death, record unknown (code 900) but make an effort, especially with recently dead trees.

6. Original Stumps, Seedlings, and Trees < 5.0" DBH on sub-plot 4-10

Stumps, seedlings, and trees < 5.0" DBH from the previous inventory are disregarded and their entry not transferred to the remeasurement plot sheet.

7. Trees Tallied or Omitted from the Last Survey By Error

We assume that work completed on the last survey was done as accurately as possible and is correct. Record trees and tree history codes as they are, even if you are suspicious or positive that an error was made on the last survey. Two situations arise.

Tree History codes 061, 062, 031, 032 If a tree was not tallied last survey, but should have been, and should be tallied now, record the tree as ingrowth or ongrowth.

Tree History codes 011, 012, 021, 022, 017, 027, 018, 028, 019,029, 014, 015, 016, 025, 026, 111, 112, 121, 122, 117, 127, 127, 118, 128, 119, 129, 114, 115, 116, 125 and 126 If a tree was tallied last survey, but should not have been, and should be tallied now, transfer old information and regard as if the tree was tallied correctly.

8. Trees that should not have been tallied last survey (Tree history code 000)

If a tree was tallied last survey, but should not have been, and should not be tallied now, record tree history 000 and old information. Put reason in the note section of the plot sheet. Scrape the old paint off the tree.

9. Displaced Trees (Tree History Codes 010, 020, 031, 032, 061 and 062)

A tree may have been physically moved either onto or off of the plot by logging or wind. For trees displaced onto the plot and not tallied on the last survey, tally all current items and assign a tree history of ingrowth or ongrowth.

Trees tallied during the previous survey and displaced from the plot are considered no status trees. They receive a tree history of 010 or 020.

For all trees with a tree history of 010 or 020, enter data for these items:

- Sub-plot number
- Species
- Tree Class (orig.)
- Tree number
- Tree History
- Crown Ratio (orig.)
- Condition number
- DBH (orig.)
- Crown Class (orig.)

No current information needs to be recorded. Be sure to adequately explain the exact circumstances in the "Notes" section of the plot sheet. Trees tallied as live during the last survey, now dead and displaced off of the plot, are tallied as dead trees.

Tree History *CONTINUED*

10. Ingrowth and Ongrowth Salvable-dead and Sanding-dead Trees (Tree History Codes 034, 035, 064 and 065)

Trees ≥ 5 " DBH, that were too small the last survey, that have grown onto the plot and died, are recorded. Do not tally these trees if they are not standing, that is 036 and 066 are not valid tree histories.

11. Dead Trees (Tree History Codes 040, 044, 045, 046, 047, 050, 055, 056, 144, 145, 146, 147, 155, 156,)

Trees ≥ 5.0 " DBH and dead on the original survey must be accounted for. Salvability standards remain the same. Items required are listed below:

- Sub-plot number
- Condition number
- Tree History
- Tree Cavity
- Tree number
- Species
- DBH (original and current)
- Tree Class (original)

Special Instructions for installing new sub-plots in forest conditions on remeasurement plots

With the change to this non-moved sampling design, there may be some confusion as to how to tally trees on a remeasurement sub-plot that was not measured last time (either because it was a nonforest plot or because it was moved out of a nonforest condition) and now contains trees that should be tallied. The following instructions should serve as a guide in doing these plots. Always, the appropriate tree history depends on the land use where the tree is standing at the time of the previous inventory. This decision is made based on the judgment of the field crew using information from the old photography and knowledge of the old field procedures.

Two cases are possible. If the tree would have been tallied last time had we used the new procedures, then it should be given a tree history of 001, 002, 004 or 005. If the tree would not have been tallied previously using these new procedures it should be given a tree history of 031, 032, 061, 062 or 064. The decision to tally these trees as either new trees with no status at the previous inventory (001, 002 or 004) or as ingrowth/ongrowth (031, 032, 061, 062, or 064) depends entirely on the field crews judgment of what the land use of the tree was at the previous inventory.

When the land use where the tree is standing was 20, 21, 22, 57 or 59 at the time of the previous inventory then the tree should be given an original tree history of no status. If the

land use where the tree is standing was something other than 20, 21, 22, 57 or 59 at the time of the previous inventory then the tree should be given an original tree history of ingrowth (031, 032, 034 or 035) or ongrowth (061, 062, 064, 065) depending on if it is within the micro plot or not.

How to tally new trees on a plot that was nonforest at the previous inventory.

Under the old design, the decision to establish a plot or not was based on the land use at plot center. When plot center fell in a nonforest land use, the plot was not established, even if some of the sub-plots fell on timberland. In effect, the sub-plots that fell in timberland were moved to the nonforest land use. Under this new plot design all ten sub-plots will be established and measured in their correct location.

Two possibilities exist and it may be difficult to distinguished between them. New trees on remeasurement plots that were nonforest last time could be in a condition that was either forest or nonforest at the time of the last measurement. Field crews must use their judgment to determine which case. It is possible that both conditions may be present on a plot.

New trees in a condition that was forest at the previous measurement and PC was nonforest, thus the plot was not taken.

It may be clear that a condition on a sub-plot was forested last time by looking at the old photo and the age of the trees. PC was nonforest last time. In this case, the new tally trees in this condition should be given tree histories of 001, 002, or 004, and 005 because the land use of the condition has not changed since the last measurement.

For example: The previous land use was cropland, and the old photo shows that PC was in the cropland, near the edge of a forest area. This time you establish the plot and pick up tally trees on points 3, 4 and 10 that are in this forest condition. This condition was forest land at the time of the old inventory, therefore these trees should be given tree histories of 001, 002 or 004 and 005.

New trees in a condition that was nonforest last time, and PC was nonforest, thus the plot was not taken.

Here it is apparent that the condition on a sub-plot was nonforested last time by looking at the old photo and the age of the trees. New tally trees in this condition should be given tree histories reflecting ingrowth or ongrowth (codes 031, 032, 034, 035, 061, 062, 064 or 65), because the land use of the condition has changed since the last measurement.

For example: The previous land use is cropland, and the old photo shows that PC was in the cropland, near the edge of a forest area. This time you establish the plot and find that the cropland has been planted with trees. New seedlings and saplings in the old cropland would be given tree histories of 031 or 032. You also pick up some tally trees on points 3, 4 and 10 that are in forest north of PC that was forest last time. Any new trees tallied in the

forest condition at the north end of the plot that was forest land at the time of the previous inventory should be given tree histories of 001, 002, 004 or 005.

How to tally new trees on a plot that was forest with moved sub-plots from previous inventory.

Under the old design sub-plot centers (points) were moved out of nonforest conditions if PC fell in a forest condition. Under the new plot design, these sub-plots will be established and measured in their correct (un-moved) location. The old moved sub-plots will be remeasured, however they will be given new sub-plot numbers (10 plus their old number). Two possibilities exist but it is fairly easy to distinguished between these two possibilities. The new trees must be in a condition that was either forest or nonforest at the time of the last measurement, and field crews must use their judgment to determine which is true. Again, it is possible that both conditions may be present on a plot.

New trees on previously moved sub-plots in a condition that was nonforest last time. PC was forest, thus the plot was taken but sub-plots were moved out of the nonforest condition.

Here the previous field crew classified a condition as nonforested last time and moved the sub-plots into the forest condition. Now the land use of this condition has changed to forest (based on the judgment of the field crew). New tally trees in the area that was nonforest last time (where the land use has changed to forest) should be given tree histories reflecting ingrowth or ongrowth (codes 031, 032, 034, 035, 061, 062, 064 or 065) .

For example: The previous land use of the plot is timberland and the field crew moved several sub-plots out of a field. This time you establish the plot and install those sub-plots in the field. You also find that the field has been planted or has had sufficient natural regeneration so that it is now timberland. New seedlings and saplings in the old field would be given tree histories of 031 or 032.

New trees on previously moved sub-plots in a condition that was forest last time. PC was forest, thus the plot was taken but sub-plots were moved out of the nonforest condition.

Here the previous field crew classified a condition as nonforested last time and moved the sub-plots into the forest condition. Now, the sub-plots are not moved. New tally trees in the area that was forest last time (where the land use has not changed) should be given tree histories reflecting no status last time (codes 001, 002, 004 or 005) .

For example: The previous land use is timberland and the field crew moved several sub-plots out of a field. This time you establish the plot and install those sub-plots in the field. When measuring from one of these new sub-plots you pick up some trees along the edge of the field that were obviously in the timberland condition last time but were not

tallied because the sub-plot was moved. These trees would be given tree histories of 001, 002, 004 or 005 because they are were on timberland last inventory, they were just not tallied because the sub-plot was moved.

Tree History *CONTINUED*

Note: It is possible for an entire sub-plot to have been forest at the last measurement and still have been replaced by a moved sub-plot. Many of the remeasurement plots you are taking are being measured for the third time. A point may have been moved when the plot was established and then between the first and second measurement the point could have been planted with trees. At the second measurement we did not move these points back to their correct locations, we kept the moved locations. When you now establish these sub-plots at their correct locations there is no change in land use between the 2nd and 3rd measurements so all trees on these sub-plots get tree histories of 001, 002, 004 or 005.

Also, some sub-plots were mistakenly moved out of forest conditions last time because of forest type, ownership and plantation differences. If a sub-plot was moved out of a plantation last time and is now being established in that stand all trees on that sub-plot would get tree histories of 001, 002, 004 or 005. Tree histories of ingrowth or ongrowth should be used on new sub-plots only if you are sure there has been a land use change on the sub-plot.

Special Instructions for trees in nonforest conditions that were forest at the last measurement

When a previously measured condition no longer needs to be measured because of a land use change, the original trees are accounted for according to the following guidelines.

- **Reserved areas with trees still standing (CGLU 41 or 45) and Unproductive forest (CGLU 40)**

Trees are assigned a tree history code 010, 020, 040 or 050. Required tally items are listed in No. 8 previously in this section. For points previously cover classed, record sub-plot number and cover class. There is no need to determine if these trees are inside or outside the macro plot.

- **Nonforest areas that are a result of clearing (CGLU 61 - 69, 80, or 90)**

Trees are assigned a tree history of 018, 019, 028, 029, 048, 049, or 059 depending on whether the cleared trees were utilized or not. Use your best estimate from owner contact, field examination, etc. if utilization isn't clear. Example: Owner says all the larger oaks were utilized and the other trees were pushed to the side of the field. All larger oaks receive a tree history of cut and utilized and other trees receive a not utilized tree history. The required tally items for stumps are listed in No. 5.

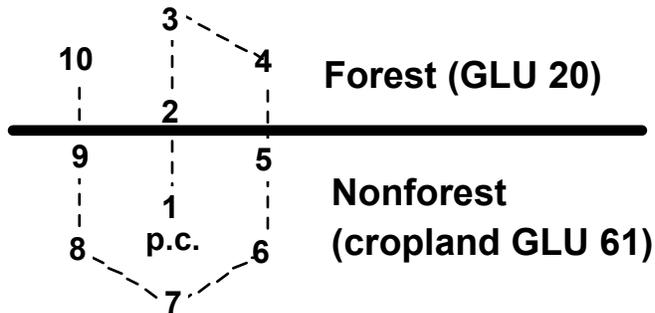
- **Nonforest areas that have been partially cleared (CGLU 46, 51-56, 58, 61-69, 80, or 90)**

Determine the cause of the land use change. North Central data processing personnel are mainly concerned with getting an estimate of the cut and utilized portion of the sample. Make an effort to determine the cut and utilized trees and assign a cut and

utilized tree history. Trees still standing receive a no status history. Required tally items for stumps and for no status trees are listed in No. 5 and No. 9 on the previous pages. See the examples on the next page.

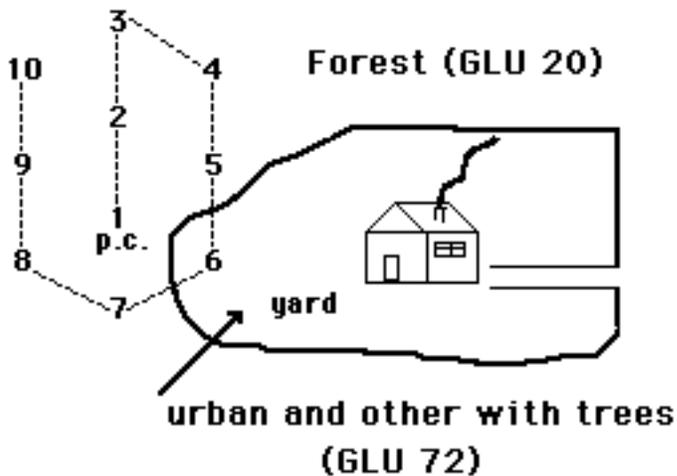
Tree History *CONTINUED*

These three examples are all remeasurement plots that were timberland at the time of the last measurement and had no moved sub-plots.



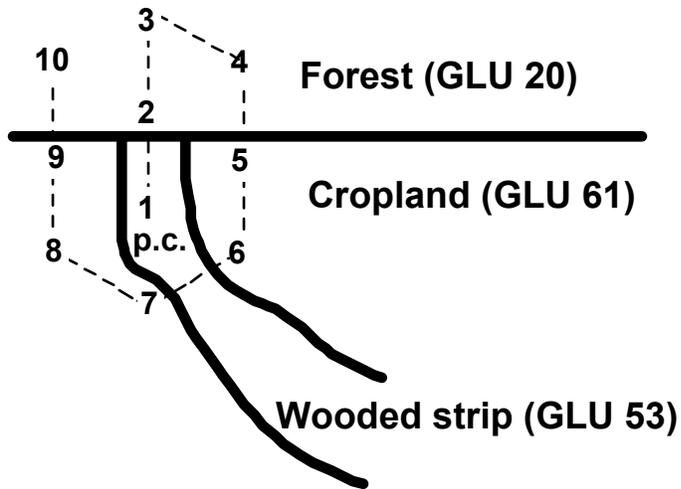
Example 1

Assign trees in the nonforest condition (sub-plots 1, 5, 6, 7, 8, and 9) a tree history of stump-utilized or stump-not utilized. Remeasure trees that are still in the timberland condition (sub-plots 2, 3, 4, and 10) and give them their normal three digit tree histories and other measurements.



Example 2

The land use of the yard area has changed and we now have two conditions. In the yard assign trees that were not cut a tree history of 010 or 020 and any tree that has been removed a tree history of cut and utilized or cut and not utilized. Remeasure trees that are still in the timberland condition (outside of the yard) and give them their normal three digit tree histories and other measurements.



Example 3

Here we have gone from one condition to 3 conditions. Assign trees still alive and standing in the wooded strip a tree history of no status tree (010 or 020). Remeasure trees that are still in the timberland condition (sub-plots 2, 3, 4, and 10) and give them their normal three digit tree histories. Assign any tree that has been removed a tree history of cut and utilized or cut and not utilized.

Tree Distance (DIST) 2 digits: Item 34

Record distances on all live trees tallied (except seedlings) on sub-plots 1 - 10. The distance recorded is the slope distance to the nearest foot from sub-plot center to the near face of each tree at its base. Record a two-digit code.

Record a three-digit code for all distances given in the witness tree grid and the reference tree grid of the plot sheet. The distance recorded is slope distance to the nearest tenth of a foot from sub-plot center to the center at the base of each tree. The last digit represents a decimal fraction.

Diameter Breast Height (DBHO, DBHC) 3 digits: Item 35

Diameter at breast height (DBH) is taken 4.5 feet above the ground, measured on the uphill side of the tree. Record a three-digit code for each all trees to the last tenth-inch. The 6.1" diameter class (coded as 061), for example, should include trees 6.10" in diameter up to, but not including, trees 6.20" in diameter. Record code 000 for trees < 1.0" DBH.

On the side of the tree facing sub-plot center, scribe and paint a two-inch horizontal mark just above the upper tape at the point where DBH is measured. Within the one-foot stump facing sub-plot center, scribe and paint a vertical mark to facilitate remeasurement in the event the tree is cut. Paint but do not scribe small, thin-barked trees and trees < 3.0" DBH. Scribe marks should not penetrate the cambium.

It is essential that the measurements are accurate since trees are determined as "in" or "out" of the tally, depending in part on their DBH. For remeasured plots, it is important that DBH measurements are taken at the same point.

Irregularities at DBH (swelling, bumps, depressions, or branches). Measure the diameter immediately above the irregularity at the place where it ceases to affect the normal stem form. If a measurement cannot be taken above the irregularity, record the diameter at the least abnormal spot. Measure butt-swelled trees at a point 1.5' above the end of the swell if the swell is more than 3' high.

If the stem forks at or above DBH, measure diameter below the swell at the place where the fork ceases to affect the stem form. When the stem forks below DBH, consider the tree as two trees and measure the diameter 3.5' above the fork (apply this rule only once per tree).

Important: Use care in determining where the tree forks--extend the centerlines of the two stems to their junction. Don't equate the point where daylight can be seen with the point where the tree forks. Figures 19 and 20 illustrate the proper methods for obtaining DBH.

DBH for remeasurement plots

Original Transfer any original DBH as it appears on the original plot sheet. If paint or scribe mark is found, do not move the measurement location. If there is an obvious error in the original measurement use what means you have to determine what the entry should have been and change it.

Current Check to see that the original DBH was taken in the correct place. If DBH was correct, remeasure, rescribe, and repaint this original measurement. It is extremely important to measure the same place if the measurement was initially correct; look carefully for evidence of paint at DBH.

Remeasure DBH at the original location, make a note on the plot sheet if DBH was previously measured high or low. Measure DBH at the correct place on the bole if the previous measurement was taken on a deformity or can not be relocated.

If the tree is now dead at DBH, it is considered a dead tree. If a new leader has taken over below dbh and is ≥ 1.0 " DBH, give it a tree history of ingrowth or ongrowth. If the tree is not at least 1.0" DBH, it is taken as a seedling and can be recorded twice--once as a dead tree and once as a seedling.

Figure 19 - Diameter breast high measurement in a variety of situations

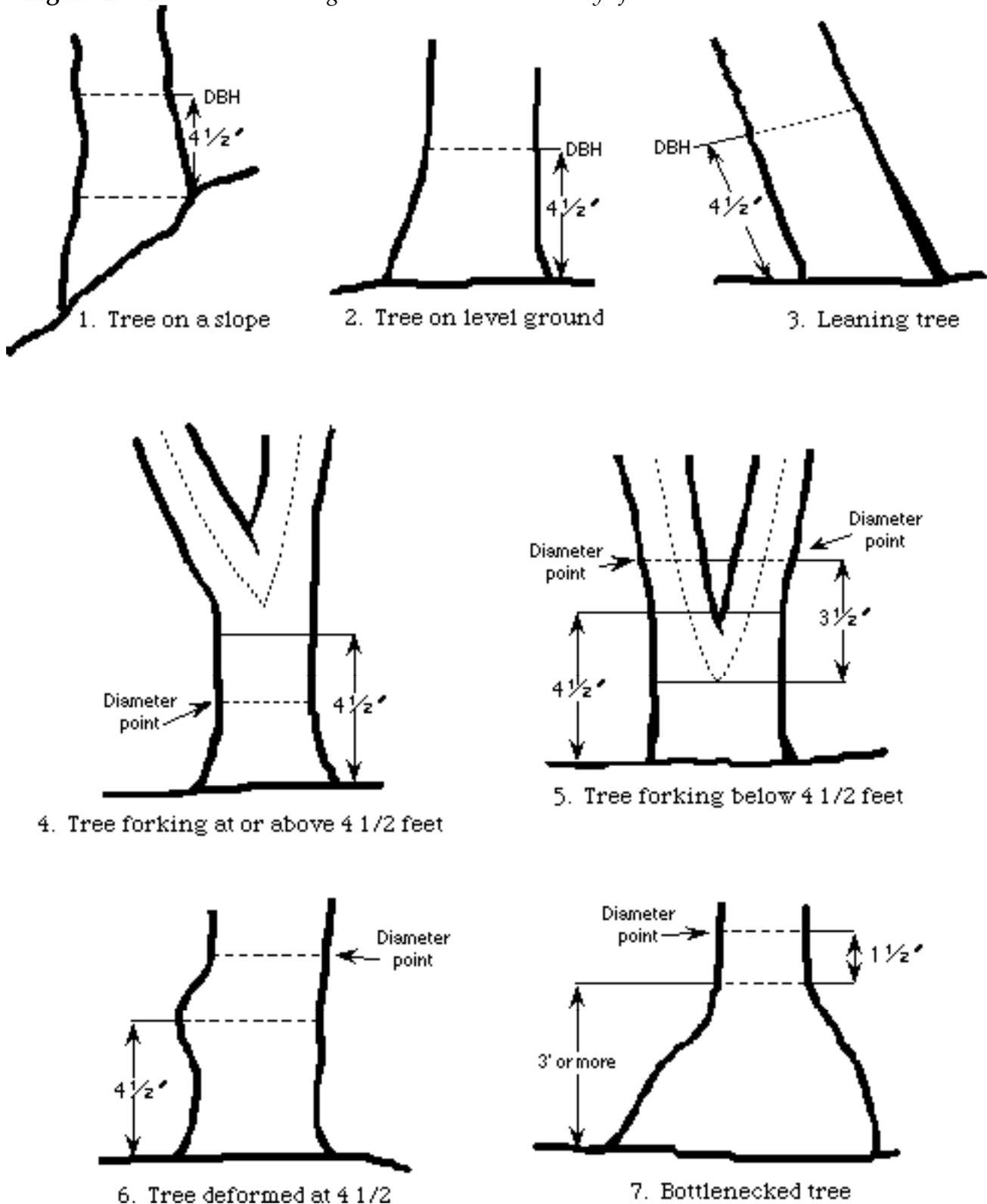


Figure 20 - Using the diameter tape

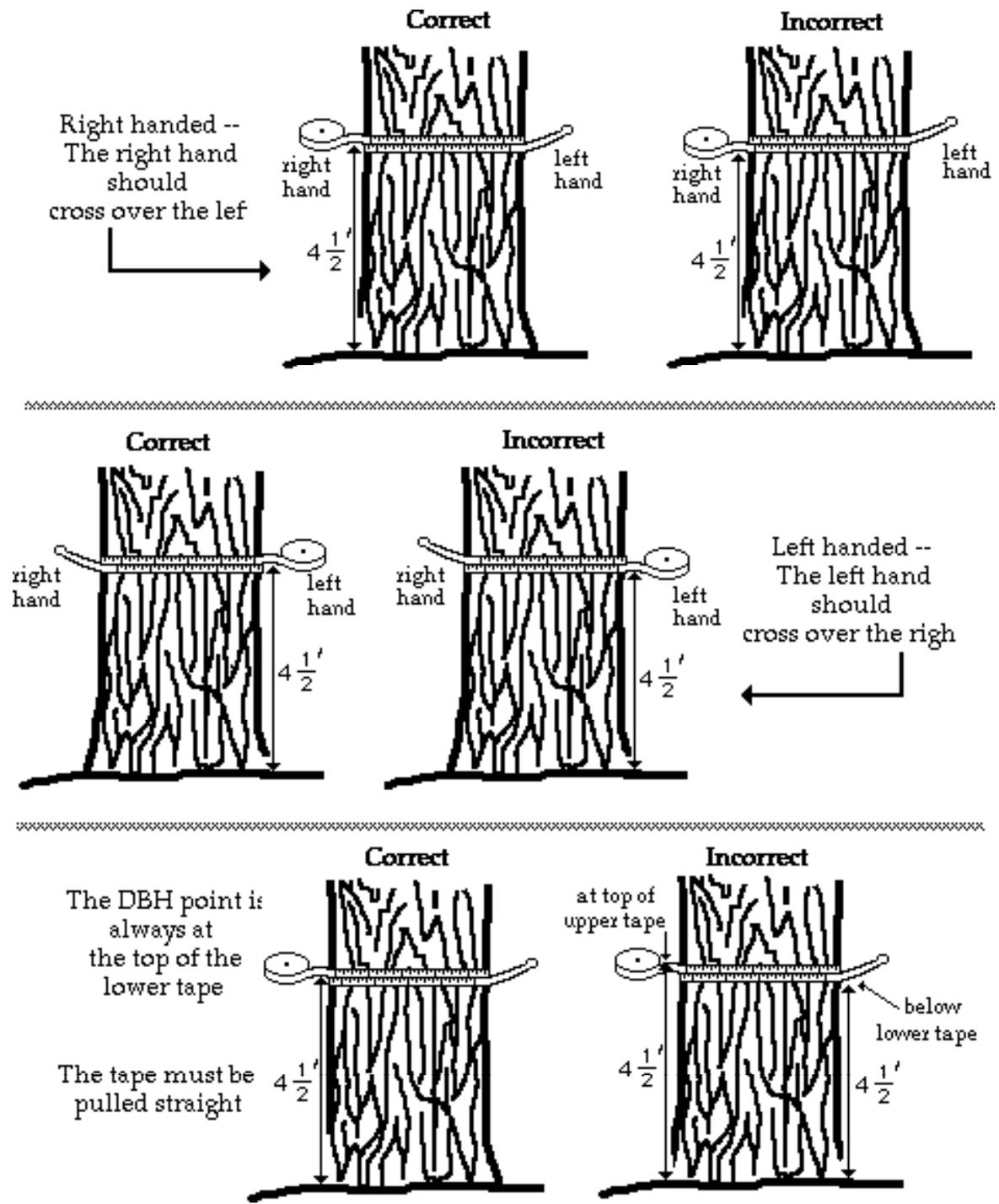
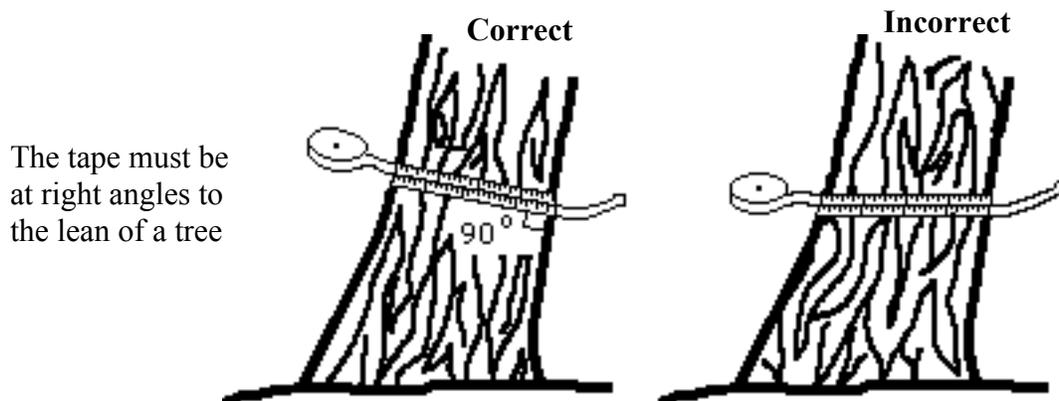
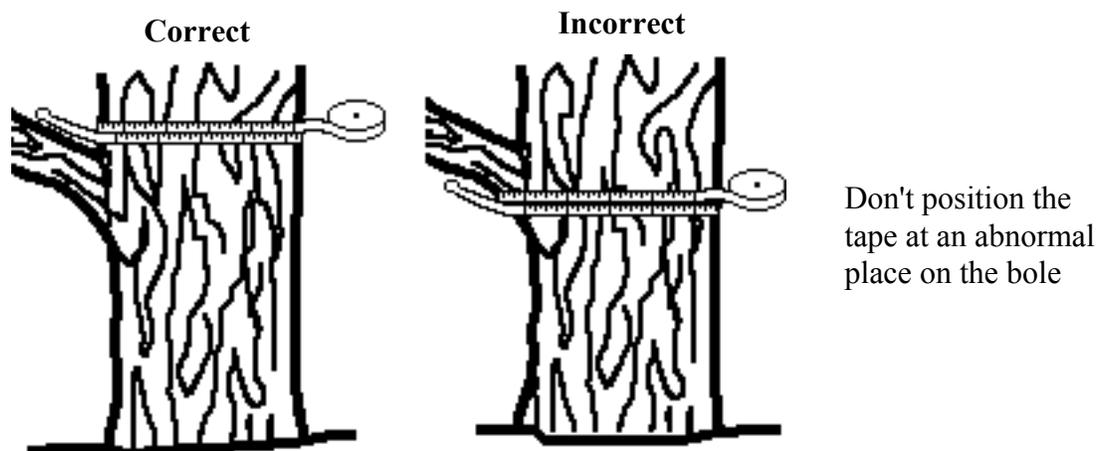


Figure 20 CONTINUED



Tree Azimuth (AZM): Item 36

Record azimuth on all live trees tallied (except seedlings) on sub-plot 1 through 10. The azimuth recorded is a three-digit code representing the magnetic azimuth from the point center to the center of the tree at its base. Examples: Nine is recorded as 009; 89 is recorded as 089; 347 is recorded as 347.

Zero-degree azimuth is not used. Any tree at 0° azimuth is tallied as 360.

Two trees on the same point cannot be recorded with the same azimuth. Record one before the other, for example, record one as 059 and the other as 060.

For remeasurement plots

Record current azimuth readings at the time of remeasurement. For example, a tree with an original azimuth of 358°, has a current azimuth of 1°, record the current azimuth as 001. This could lead one to presume changing the tree number. Do not do this. Never change a tree number.

Condition Number (COND) 1 digit: Item 37

Record the condition number of the condition the tree occurs in. This item is required for all trees, including seedlings, stumps, dead trees and no status trees.

Damage Or Cause Of Death (DAM) 3 digits: Item 38

For live trees, record presence of damage or pathogen activity if it is serious enough to reduce the quality or vigor of the tree. Record the cause of death for dead trees.

The pest or damage is identified using the coding criteria (minimum severity requirements). A complete list of damage codes and coding criteria appears in the appendix of this manual. Follow these guides for assigning damage/death codes:

- Use the most specific code. Avoid general injury codes if possible. For example, Eutypella canker code has preference over bole canker code, which has preference over unknown/uncoded canker.
- The damage must meet the severity rating for its particular damage code. Examples: an insect defoliator is coded only when it is causing > 20 percent defoliation; a Hypoxylon canker on a branch is not coded because its severity rating is "any occurrence on the bole."
- If the pest/damage does not satisfy the coding criteria, it is coded to a more general code, such as one of the 900 codes, unknown, uncoded damage.

When two or more pests occur on a tree, record the most significant and important pest. The following applies.

1. Record the agent causing the most severe damage. An agent which will cause death takes precedence over one causing volume loss, which takes precedence over one causing growth or quality loss. For example, a canker low on the main bole takes precedence over decay higher on the stem, but decay low on the main bole takes precedence over a canker high in the crown.
2. Record permanent damage before temporary or seasonal damage. For example, decay or canker takes precedence over insect defoliation, even if defoliation was 100 percent on a hardwood tree.
3. Record bole damage over branch damage.

Death codes are the same as damage codes, when coding the cause of death, choose a code from the list of damage codes. If the tree is dead and the cause can be determined, code the cause of death. If the cause is unknown, and the tree is salvageable, code the damage rather than unknown death, if there is damage.

	<u>Prioritization</u>		
<u>Highest priority</u>			<u>Lowest priority</u>
Specific pest	>	General Pest	>
Death or potential death	>	Volume reduction	>
			Damage or injury
			Growth slowed quality reduction

Cull trees (except noncommercial species) must have a damage code other than 000.

Seedlings and saplings are considered growing stock, unless a specific damage is observed. Excessive sweep and crook is not considered a specific damage code for seedlings and small saplings (< 3.0" DBH).

A damage code is not recorded to indicate a reason for not qualifying as a better tree grade. Damage codes are given in the appendix section of this manual.

Tree Class (TCO, TCC) 2 digits: Item 39

Tree class reflects tree suitability for timber products. Tree class is basically a check for the straightness and soundness of the sawlog portion on a sawtimber tree or the potential sawlog portion on a poletimber tree or sapling. Not considered in determining tree class are: tree vigor, predicted death, and plot site index.

Use one of the following codes for tree class.

20--Growing Stock

Any live tree of commercial species that is sawtimber size and has at least one merchantable 12-foot sawlog or two merchantable 8-foot sawlogs meeting minimum log-grade requirements. At least one-third of the gross board-foot volume of the sawlog portion must be merchantable material. (Sawlog portion is the length between the one-foot stump and the 9.0" top diameter of outside bark, DOB, for hardwoods, or the 7.0" top DOB for softwoods.) A merchantable sawlog must be at least 50 percent sound at any point.

Any poletimber-size tree that has the potential to meet the above specifications. Assume that pole-size trees will eventually attain sawlog size at DBH. In evaluating potential sawlog portion of pole-size trees, only rot, large limbs, forks, and excessive sweep and crook may be used to disqualify the tree as a growing-stock tree.

When estimating potential sawlog height for poletimber trees, apply the two-inch rule as a guide. The two-inch rule assumes that a tree's diameter increases uniformly along its bole. For example, a hardwood poletimber tree with an 8.0" DBH needs 3" of diameter growth to become sawtimber size. If diameter growth is uniform, then the DBH minus two inches (eight minus two), or six inches, identifies the potential sawlog top. This method works for both hardwoods and softwoods.

Consider a seedling or sapling as growing stock unless a specific damage is observed. A seedling or small sapling (< 3.0" DBH) may not be culled on the basis of excessive sweep or crook. Assume that seedlings and saplings will eventually attain sawlog size at DBH.

Tally items for 20-class trees For growing-stock trees on full remeasurement plots, record bole length to the highest possible 4.0" top DOB, or to that point where the central stem or branch breaks into limbs and above which there is no 4.0" DOB. On forked sawtimber trees, record bole length using the fork with the highest sawlog. Record cubic-foot cull for the rotten or missing wood to the 4.0" top. Sawlog length is recorded to the top of the highest sawlog section meeting minimum sawlog requirements. Board-foot cull includes the unusable board-foot volume in merchantable sawlog sections, and the total volume of sections that do not meet sawlog requirements below the sawlog top. Accurately record all remaining required information.

30--Rough Cull

Any tree of noncommercial species.

Any tree of commercial species that is sawtimber size and has no merchantable sawlog. Over one-half of the volume in the sawlog portion does not meet minimum log-grade specifications because of roughness, excessive sweep or crook, splits, cracks, limb stoppers, or forks. The sawlog portion is the length between the one-foot stump and the 9.0" top DOB for hardwoods, or the 7.0" top DOB for softwoods.

Any pole-size tree that does not have the potential to meet the specifications for growing stock because of forks, limb stoppers, or excessive sweep or crook. Assume that all live trees not currently sawlog size will eventually attain sawlog size at DBH. Predicted death, tree vigor, and plot site index are not considered in determining tree class.

Tally items for 30-class trees Record bole length to a 4.0" top DOB. Cubic-foot cull includes actual rot or missing wood only. For sawtimber trees, zero-out sawlog length, sawlog top DOB, board-foot cull and tree grade. Accurately record crown ratio and crown class. The damage code must not be "000," except for noncommercial species. Code any tree cavity.

31--Short-log Cull

Any live sawtimber-size tree of commercial species that has at least one 8-foot sawlog, but less than a 12-foot sawlog, meeting minimum log-grade specifications.

Any live sawtimber-size tree of commercial species that has less than one-third of the volume of the sawlog portion in merchantable logs, but has at least one 8-foot or longer sawlog meeting minimum log-grade specifications. Short sawlog must be 50 percent sound at any point. (The sawlog portion is the length between the one-foot stump and the 9.0" top DOB for hardwoods and the 7.0" top DOB for softwoods.)

Note: Pole-size trees never receive a tree class code 31.

Tally items for 31-class trees Record bole length to a 4.0" top DOB. On forked trees, bole length is recorded using the fork that contains the highest sawlog. Cubic-foot cull includes actual rot or missing wood only. Record sawlog length and sawlog top DOB to the height where the highest merchantable log terminates. Board-foot cull includes all unmerchantable sections in the sawlog portion, and the unusable board-foot volume within the merchantable sawlog. Tree grade is usually code 5, due to length and/or position in the tree. Accurately record crown ratio and crown class. Damage code cannot be "000". Code any tree cavity.

40--Rotten Cull

Any live tree of commercial species that is sawtimber size and has no merchantable sawlog. Over one-half of the volume in the sawlog portion does not meet minimum log-grade specifications primarily because of rot or missing sections. (The sawlog portion is the length between the one-foot stump and the 9.0" top DOB for hardwoods, or the 7.0" top DOB for softwoods.)

Any pole-size tree that does not have the potential to meet the specifications for growing stock because of rot. Assume that all live trees will eventually attain sawlog size at DBH. Predicted death, tree vigor, and plot site index are not considered in determining tree class.

Tally items for 40-class trees Record bole length to a 4.0" top DOB. Cubic-foot cull includes actual rot or missing wood only. Zero-out sawlog length, sawlog top DOB, board-foot cull and tree grade. Accurately record crown ratio and crown class. Damage code must reflect rot or disease and must not be "000". Cubic-foot cull seldom exceeds 90 percent of total cubic volume.

Summary: If any of the requirements for growing stock (tree class 20) are not met, the tree is considered cull. If a short sawlog is present, the tree class is 31 and sawlog information is recorded. If no sawlog is present, tree class is either 30 or 40. If a pole-size tree does not have the potential to meet sawlog standards, it is either tree class 30 or 40.

Dead Trees

Determine whether a dead tree is a salvable, standing or down dead tree. A standing or down dead tree containing at least one 8-foot section that is at least 50 percent sound is a salvable dead tree. A standing or down dead tree containing no merchantable volume (has no 8-foot or longer section that is at least 50 percent sound) is can not be a salvable dead tree.

The following tally items are required for dead trees:

- Tree number
- DBH
- Cause of Death
- Tree Cavities (not required on down-dead trees)
- Species
- Tree History
- Tree Class

Volume measurements or tree grade are never needed for a dead tree. Unless specified, all tally items are recorded using rules from the appropriate sections on live trees in this manual.

DBH Estimate the diameter of the tree at time of death, be sure to consider any distortion, lost bark, cracks, splits, shrinkage, etc. Do this for all dead trees (salvable, standing and down).

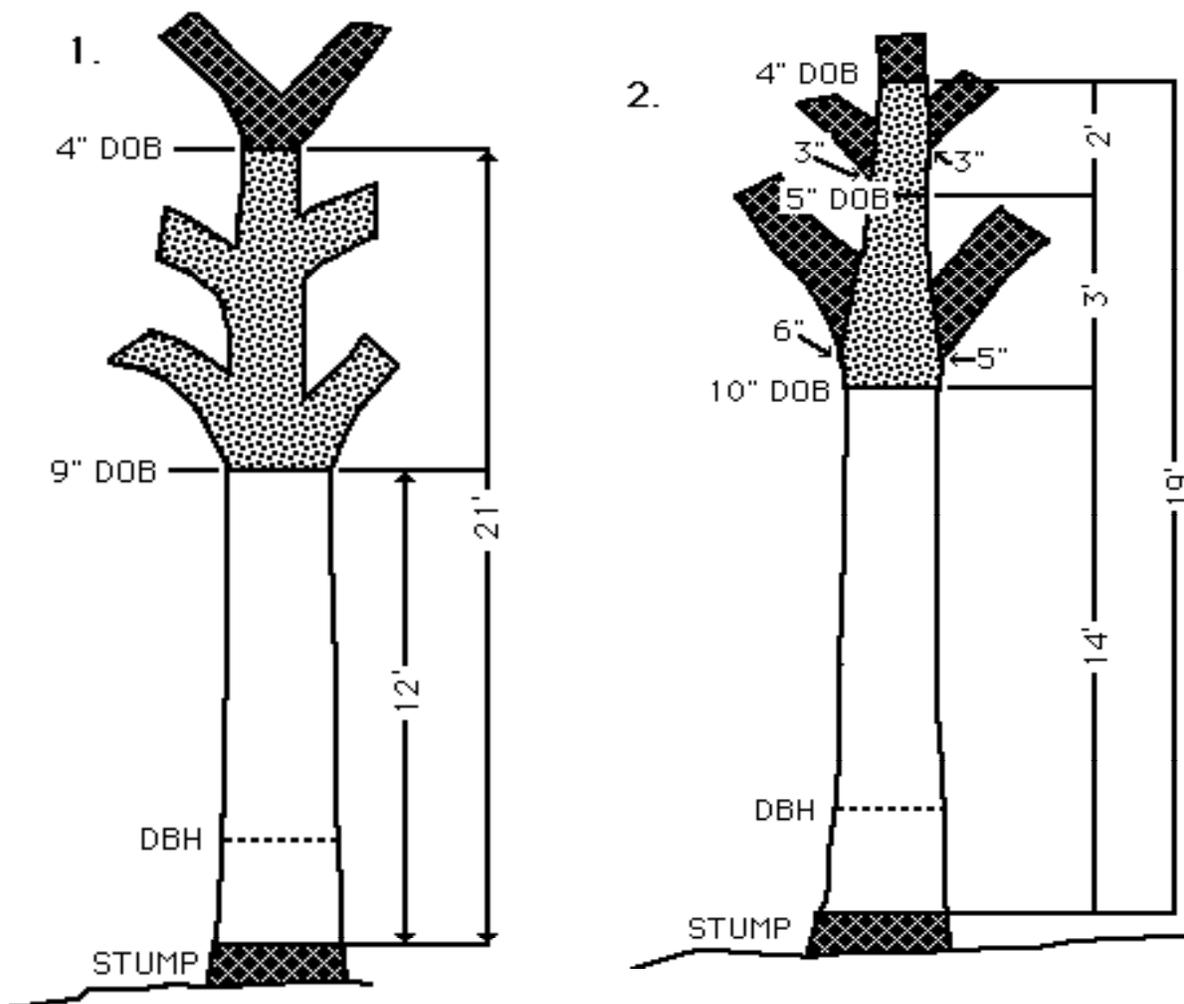
Standing-dead and down-dead trees All required information is projected back to the time of death except tree cavities, which is recorded as they exist now (do not record tree cavities on down-dead trees). A standing-dead tree may not look very good, but assign a tree class of 20 if that's what it was at the time of death. Down-dead trees are recorded only on remeasurement plots.

Salvable-dead trees All required information reflects the present condition of the tree. Record your information as though the tree was alive today.

Summary: First, determine whether the tree is a salvable-dead, standing-dead, or down-dead tree. Next, project the tree to the correct place in time (the present for salvable dead trees and time of death for standing and down dead trees). Finally, record required information according to this manual.

On the following pages are nine selected examples (Figure 21) explaining tree classification. Hardwood trees are represented in the illustrations, however softwoods may be implied using a minimum 7.0" sawlog top DOB.

Figure 21- How to handle tree measurements for all tree classes



1. A GROWING-STOCK HARDWOOD SAWTIMBER TREE

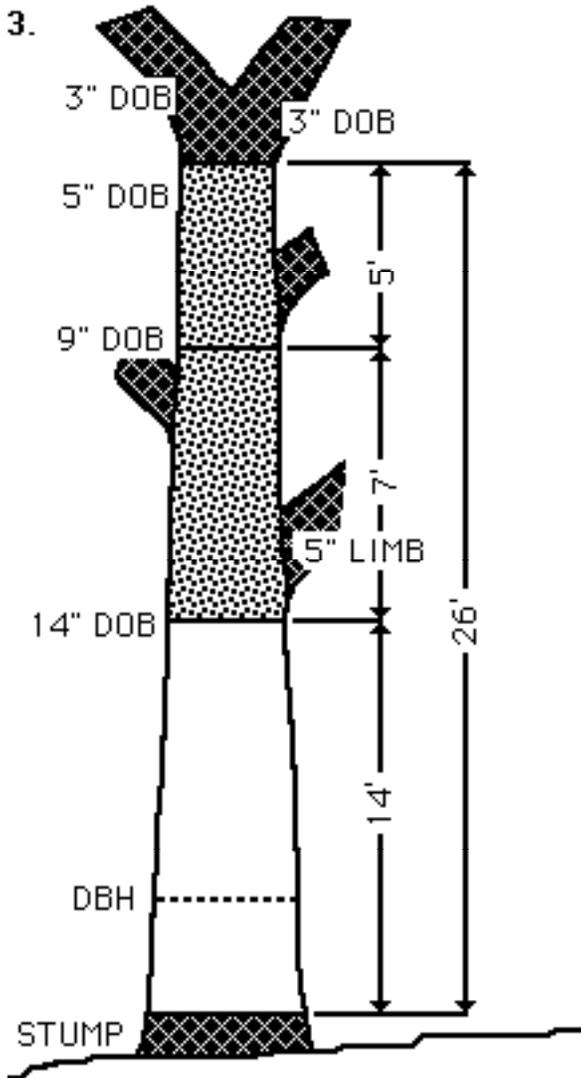
Sawlog length terminates at 9" top DOB. The sawlog meets both minimum log-grade specifications and the minimum 12-foot qualification for a growing-stock tree. The upper-stem portion contains no cull and terminates at 4" DOB. Sawlog length is recorded as 12 feet; bole length as 21 feet.

-  Sawlog
-  Upper stem (Pulpwood)
-  1-foot stump, top, and limbs

2. A HARDWOOD GRADED 1, 2, OR 3 OR A SOFTWOOD SAWTIMBER TREE

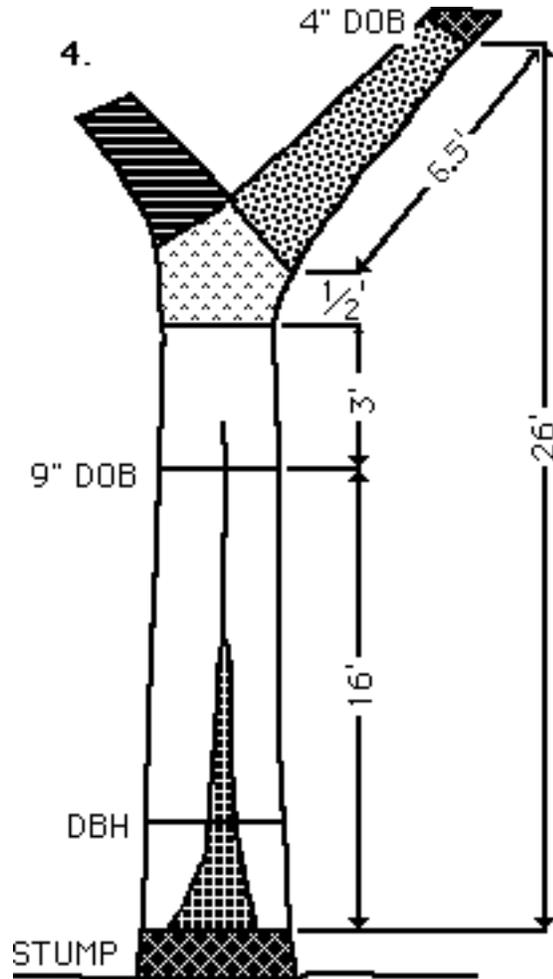
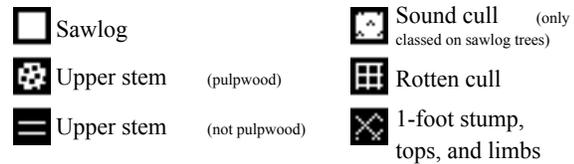
Sawlog portion is terminated by limbs creating a full diameter stopper. Each limb is over 2" in diameter, and their sum exceeds the diameter at the stopping point (10" DBH). The sawlog contains no cull and meets minimum grade specifications. Sawlog length is 14 feet. The upper-stem portion contains no cull and terminates at 4" DOB, 5 feet above the sawlog portion. Bole length is 19 feet. Cubic-foot cull is 0 for the tree.

Figure 21 continued



3. A GROWING-STOCK HARDWOOD, GRADE 4, SAWTIMBER TREE

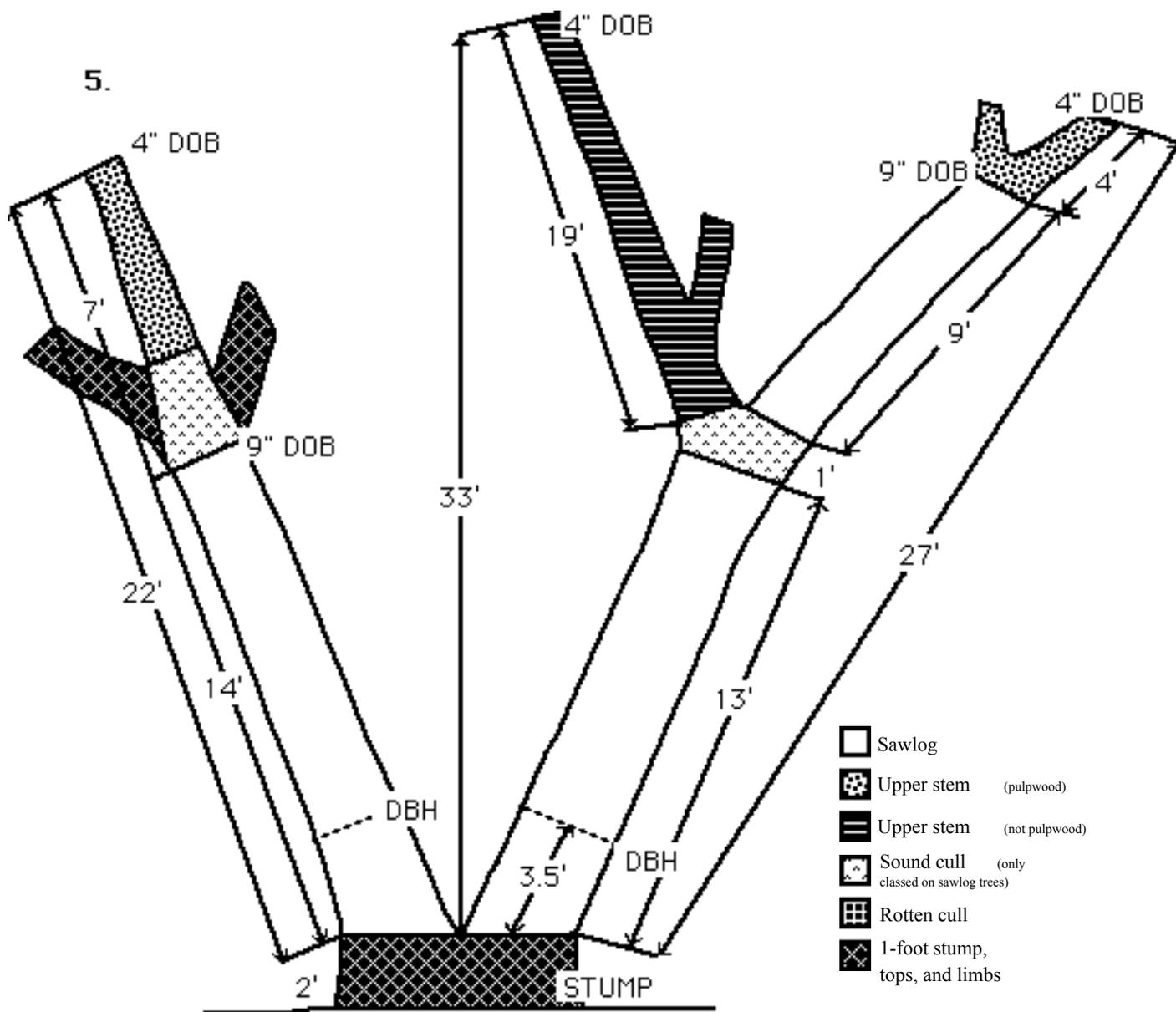
There are no sawlogs in the 21-foot sawlog portion that have minimum clear-panel length to meet hardwood factory log-grade 3 specifications, but the bottom 14 feet contain no rot or sweep and meets hardwood construction-grade 4 specifications. The sawlog terminates at 14 feet, because the 5-inch diameter limb creates a one-third diameter stopper for hardwood construction-grade 4, and only a 6-foot section is left above the 1-foot sawlog stopper. Log grade specifications require a minimum sawlog length of 8 feet. Bole length is terminated at 26 feet with a 5-inch top DOB because of a fork with two 3-inch diameter limbs. Cull board feet and cull cubic feet are zero.



4. A HARDWOOD SAWTIMBER TREE

The sawlog length is 16 feet to the 9" DOB. The bottom 2 feet are over 50 percent rotten and does not meet log-grade specifications. The next 14-foot section meets minimum factory log-grade specifications, but contains some cull due to a frost crack and a narrow cone of rot extending up from the bottom. A 6 1/2-foot section above a 1/2-foot fork at 19 1/2 feet terminates the bole at 26 feet. Board-foot cull includes the entire board-foot volume in the bottom 2 feet, and the unusable board-foot volume in the next 14 feet. Cubic-foot cull includes the cubic-foot volume loss due to rot in the first 16 feet.

Figure 21 continued

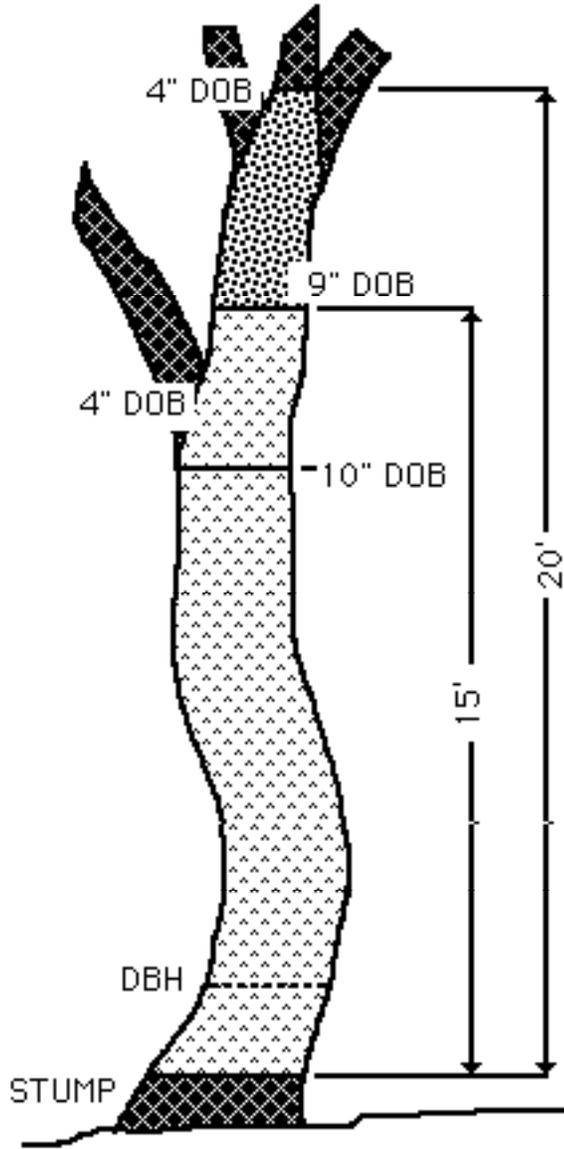


5. TWO HARDWOOD SAWTIMBER TREES

Since the lowest fork is below DBH, each fork is appraised and recorded as a separate tree. The lower 14 feet of the left-hand fork (or tree) meets log-grade specifications. The bole length is 22 feet and the sawlog length is 14 feet. Cull board feet is zero and cubic-foot cull is zero.

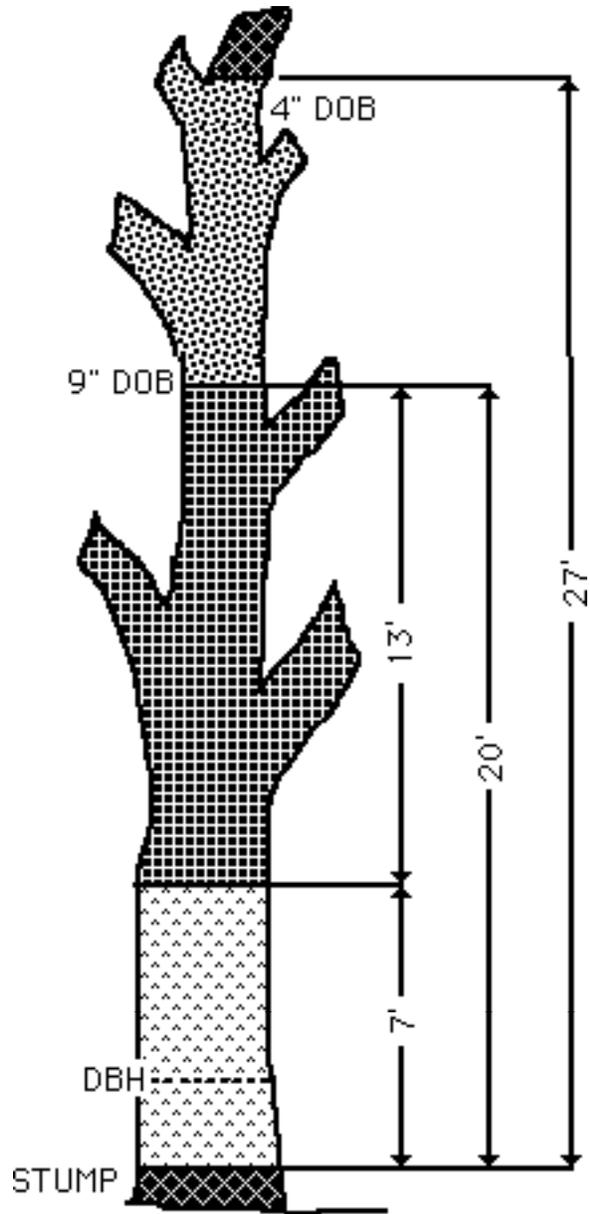
In the right-hand tree, a 13-foot merchantable sawlog, plus a 9-foot merchantable sawlog in the right-hand fork (with an intervening one-foot section of sound cull) is recorded as 23 feet of sawlog length. A 4-foot section of the right-hand fork meets pulpwood specifications, making the bole length 27 feet. Cull board feet includes the total volume of the one-foot fork. When a tree forks above DBH, measurements are recorded on one fork only. Merchantable bole length is recorded continuing up the same fork that has the highest merchantable sawlog length. In this illustration, the left-hand fork on the right-hand tree had a higher merchantable bole length at 33 feet, but the right-hand fork on the same tree had a higher merchantable sawlog length, so the bole length is recorded as 27 feet using the right-hand fork.

Figure 21 continued



6. A ROUGH HARDWOOD SAWTIMBER TREE

Sawlog portion is 15 feet long. There is no sawlog present that will meet minimum hardwood log grades 1-4. Minimum clear-panel length is not present for grade 3 and sweep plus a 1/3 diameter limb stopper prevents grade 4. Since more than half the board-foot volume is lost as sound cull, it is a rough tree (tree class 30). Dash out sawlog information. Bole length is taken 20 feet to the 4-inch DOB. Cull cubic foot is zero.

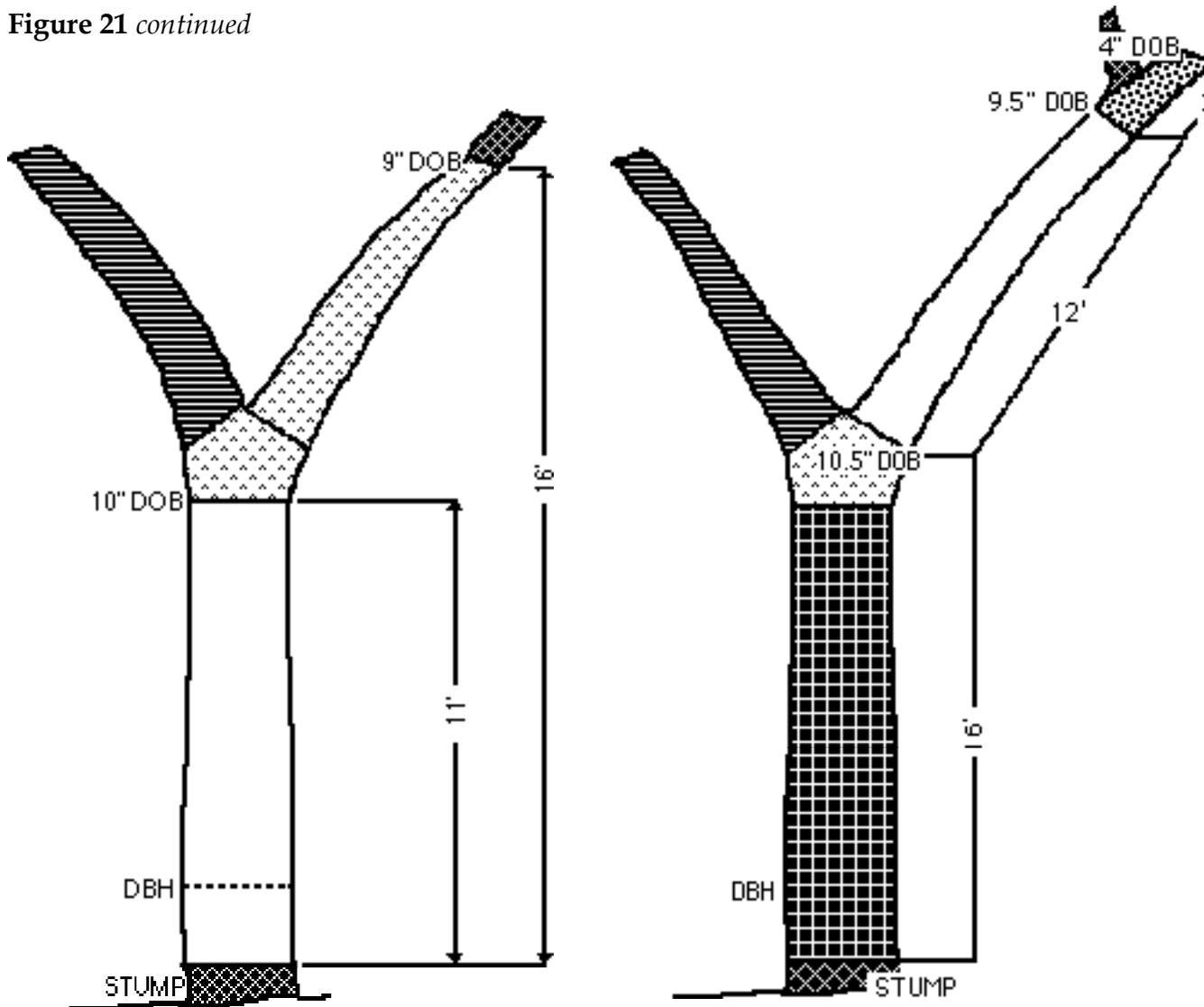


7. A ROTTEN HARDWOOD SAWTIMBER TREE

The sawlog portion is 20 feet long. The entire volume of a 13-foot section is cull, because it will not meet log-grade specifications because of excessive rot. This creates a 7-foot sound cull section beneath, since there is not a minimum sawlog length of 8 feet. Since there is no sawlog that will meet minimum log-grade specifications, the tree is cull. Because more than half the board-foot volume loss is due to rot, the tree is a rotten cull tree (tree class 40). Dash out sawlog information and log grade. Bole length is 27 feet and cubic-foot cull represents only the rotten cubic-foot volume within the 13-foot rotten section.

- | | |
|---|---|
|  Sawlog |  Sound cull (only classed on sawlog trees) |
|  Upper stem (pulpwood) |  Rotten cull |
|  Upper stem (not pulpwood) |  1-foot stump, tops, and limbs |

Figure 21 continued



8. A TREE CLASS 31

The sawlog portion is 16 feet to the 9.0" DOB. The tree does not contain a 12-foot merchantable sawlog, or two 8-foot merchantable sawlogs, because of a fork at 11 feet. This classifies the tree as a cull and since it contains a merchantable sawlog at least 8 feet long, it is a tree class 31. Sawlog length is recorded as 011, sawlog to DOB 100, and board-foot cull 0000. Bole length and cubic-foot cull are handled in the same way as for other trees, culling out for rot and missing wood only.

9. A TREE CLASS 31

The sawlog portion is 28 feet and stops at a point just below where the tree forks for a second time at a 9.5" DOB. The first 16 feet do not meet minimum log-grade specifications, but there is a 12-foot merchantable sawlog above the first fork. Since over 2/3 of the total board-foot volume between the 1-foot stump and the top of the merchantable sawlog is cull, this is a cull tree, but since the tree contains a merchantable sawlog, it is a tree class 31. Use Tatum Guides to compute the board foot volumes of the sections listed. For this example the sawlog information is recorded as sawlog length 028, sawlog top DOB 095, and board-foot cull is the total board-foot volume in the 16-foot cull section. Bole length and cubic-foot cull are handled in the same way as for other trees, culling out for rot and missing wood only.

- | | |
|---|---|
|  Sawlog |  Sound cull (only classed on sawlog trees) |
|  Upper stem (pulpwood) |  Rotten cull |
|  Upper stem (not pulpwood) |  1-foot stump, tops, and limbs |

Crown Ratio (CRO, CRC) 1 digit: Item 40

Crown ratio is the percentage of total tree height that supports full, live, green, healthy foliage effectively contributing to tree growth. Crown ratio is expressed as a percent of total tree height and is recorded as a one-digit code for all live trees ≥ 1.0 " DBH. For trees with uneven length crowns, ocularly transfer branches to fill holes in the upper portions, until an even crown is visualized. For example: A tree might have scattered green branches extending over 60 percent of its total height, by ocularly transferring branches to produce a full crown, the crown ratio might be 40 percent.

Transfer the original crown ratio from the plot sheet to the data recorder. If the original crown ratio is missing, record an estimate. Use the following codes:

Code	Crown ratio	Code	Crown ratio
1	1 through 10 percent	6	51 through 60 percent
2	11 through 20 percent	7	61 through 70 percent
3	21 through 30 percent	8	71 through 80 percent
4	31 through 40 percent	9	81 through 100 percent
5	41 through 50 percent		

Crown Class (CCO, CCC): Item 41

Record a one-digit code to show crown class of all live trees ≥ 1.0 " DBH. Crown class is determined by an individual tree's dominance in relation to adjacent trees in the stand, as indicated by crown development and amount of light received from above and the sides. Transfer the original crown class from the plot sheet to the data recorder. If the original crown class is missing, record an estimate.

- 1--Open grown** Tree receiving full light from above and from all sides throughout all or most of the life of the tree, particularly during early development.
- 2--Dominant** Tree crown extending above the general level of the crown cover and receiving full light from above and partly from the sides. Tree is larger than the average tree in the stand, crown is well developed, but possibly somewhat crowded on the sides.
- 3--Codominant** Tree crown forming part of the general level of the crown cover and receiving full light from above, but comparatively little from the sides. Typically a medium-sized crown, more or less crowded on the sides. (In stagnated stands, includes a small-sized tree crown, crowded on the sides.)
- 4--Intermediate** Tree shorter than those in the two preceding classes, crown is either below or extending into the crown cover formed by codominant and dominant trees, receiving little direct light from above, and none from the sides. Typically a small crown, considerably crowded on the sides.
- 5--Overtopped** Tree crown entirely below the general level of the crown cover, receiving no direct light either from above or from the sides.
- 6--Supra canopy** Usually a mature or over-mature tree, crown at least 25% taller than the majority of dominant and codominant trees in the stand.

In multiple-age stands with understory trees of younger age classes, crown classification is often difficult. As a general rule, the crown class for each tree should be judged in the context of its immediate environment; that is, those trees affecting it or being affected by it in terms of

crown competition. For example, the intermediate and overtopped crown classes are intended to include only trees seriously affected by direct competition from adjacent trees.

Tree Cavities/Number Of Seedlings (TCAV) 2 digits: Item 42

Tree Cavities

At each sample point, examine all live, salvable-dead and standing-dead trees, ≥ 5.0 " DBH, for cavities that could be used for nesting, resting or storage by birds or mammals. To qualify as a cavity, an entrance hole must be 1.0" or larger in the main stem, fork, or large limb. (A limb must be greater than 8.0" DOB.)

For the largest cavity record a two-digit code. The first digit indicates the size of the cavity. Cavity size is the diameter of the largest ball that could fit through the entrance hole. The second digit indicates the location of the cavity on the tree.

<u>First Digit</u>		<u>Second Digit</u>	
<u>Code</u>	<u>Size of opening (inches)</u>	<u>Code</u>	<u>Location of cavity (feet above ground)</u>
1	1	1	0 - 1
2	2	2	2 - 5
3	3	3	6 - 9
4	4	4	10 - 19
5	5	5	20 - 29
6	6	6	30 - 39
7	7	7	40 - 49
8	8	8	50 - 59
9	9+	9	60+

Number Of Seedlings

Seedlings are tallied on the micro plot by condition number, species and damage class. This item is used to record the number of seedlings of a given species-damage class tallied on the plot. When more than 5 seedlings are on the fixed radius plot, the number of seedlings can be estimated. The accuracy of these estimates should be plus or minus 25%. For example, if you tally 40 seedlings, you should be confident that the true number of seedlings is between 30 and 50. For seedlings record condition number, species, damage, tree history, tree class, and total count. If more than 99 seedlings-record 99.

Tree Grade (TGRD) 3 digits: Item 43

Grade sawlog trees (20 and 31 class) that qualify on all plots in North Dakota, South Dakota, Nebraska, and western Kansas. In eastern Kansas, Wisconsin and Minnesota only grade trees on sample kinds 1, 2 and 7.

First digit For a hardwood sawtimber tree (tree class 20), grade the sawlog portion of the tree using "Hardwood Tree Grades for Factory Lumber" (USDA Forest Service Research Paper NE-333). The table on the next page contains the specifications for hardwood tree grades. Use the table and the following steps to determine tree grade.

- Measure DBH.
- Establish the location of all defect indicators on the surface of the butt 16-foot log, and then locate the best 12-foot section.
- Estimate inside bark diameter (DIB) at the top of the 12-foot section to the nearest inch.
- Estimate scalable defect in the 12-foot section selected previously.
- The grade of the 12-foot section becomes the tree's grade, unless the grade can be improved by using a 14- or 16-foot section

For a hardwood sawtimber tree that does not qualify as tree grade 3, but meets specifications for hardwood construction lumber logs (tie and timber) assign a grade 4. For a hardwood sawtimber tree that does not meet minimum tree-grade specifications, but has a 12-foot section above the butt log or two 8-foot sections that meets log-grade requirements, assign a log grade of 5.

See USDA Forest Service General Technical Report NE-1, "A Guide to Hardwood Log Grading," for the specifications for construction class (grade 4) logs, and for upper logs.

For a softwood sawtimber (20 class) tree, grade first merchantable 16-foot log or shorter length down to 12 feet if a 16-foot log is not present. Use the grading rules in the Tatum Guides for determining log grade.

For a softwood 31-class tree, grade the log that is present. For a hardwood 31-class tree, assign a grade 5.

TABLE OF HARDWOOD TREE GRADES FOR FACTORY LUMBER

Grade factor	Grade 1			Grade 2		Grade 3
Length of grading zone (feet)	Butt 16			Butt 16		Butt 16
Length of grading section ^a (feet)	Best 12			Best 12		Best 12
DBH, minimum (inches)	16 ^b			13		11
Diameter, minimum inside bark at top of grading section (inches)	13 ^b	16	20	11 ^c	12	8
Clear cuttings (on the 3 best faces) ^d						
Length, minimum (feet)	7	5	3	3	3	2
Number on face (maximum)	2			2	3	e
Yield in face length (minimum)	5/6			4/6		3/6
Cull deduction (including crook and sweep, but excluding shake) maximum within grading section (percent)	9			9 ^f		50

^a Whenever a 14- or 16-foot section of the butt 16-foot log is better than the best 12-foot section, the grade of the longer section will become the grade of the tree. This longer section, when used, is the basis for determining the grading factors such as diameter and cull deduction.

^b In basswood and ash, DIB at top of grading section must be 12 inches and DBH must be 15 inches. In all other hardwoods if you have a 10-foot clear-cutting a minimum DBH of 15.6" can be used.

^c Grade 2 trees can be 10 inches DIB at top of grading section if otherwise meeting surface requirements for small grade 1s. A minimum DBH of 12.6" can be used if minimum length of clear-cutting are 3 feet.

^d A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth of the surface of the grading section as divided lengthwise.

^e Unlimited.

^f Fifteen percent crook and sweep or 40 percent total cull deduction are permitted in grade 2, if size and surface of grading section qualify as grade 1. If rot shortens the required clear cuttings to the extent of dropping the butt log to grade 2, do not drop the tree grade to 3 unless the cull deduction for rot is greater than 40 %.

Second and third digit For hardwoods given a grade 2, 3, 4, or 5, record the limiting quality factor that is keeping the log from moving into a better quality grade. For softwoods, the second and third digits are always "00".

<u>Code</u>	<u>Limiting Factor</u>
00	Not applicable, already a grade 1
10	Diameter
20	Length
30	Clear cuttings
40	Sweep and crook
50	Cull
60	Position in tree
70	Multiple factors
80	Diameter and clear cutting

Sawlog Length (SAWL) 3 digits: Item 44

Sawlog length on a live sawtimber-size tree is the distance from the top of the one-foot stump to a minimum top of 9.0" DOB for hardwoods or 7.0" DOB for softwoods or to the point on the bole above which no merchantable sawlog exists. Record sawlog length on live 20 and 31 class sawtimber-size trees. Record sawlog length to the last whole foot. Example: Sawlog length of 14.8' is recorded as 14.

Sawlog length should not extend above a large fork, excessive limbs or other defects or a section of the tree bole that does not meet minimum log-grade specifications, unless the tree has at least 8 feet of saw-log length above the limitation. Limitations or "stoppers" for all softwoods and for grade 1, 2, and 3 hardwoods include: any limb (live or dead) having a diameter exceeding the stem DOB at that point; or any group of 2.0" diameter or larger limbs (live or dead), within a one-foot span, having a combined sum of diameters greater than the stem DOB of that section. Limitations for grade 4 hardwoods only include any limb or group of limbs, within a one-foot span, with a diameter or sum of diameters greater than one-third the stem DOB of that section.

Minimize limb limitations by logical log making, aim at obtaining the longest sawlog length. For example, for a tree with two staggered limbs combining to form a stopper, bucking between the limbs may give a longer sawlog length.

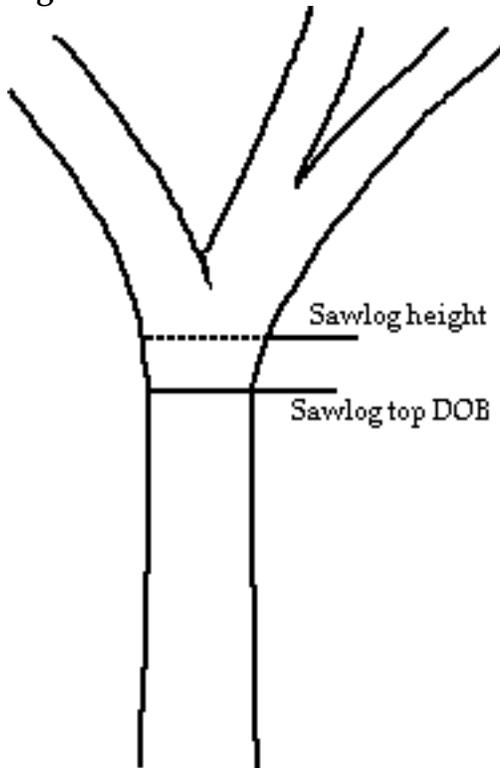
In situations where limbs are a limiting factor in determining merchantable length, length is taken to the point where the limbs divide the diameter of the merchantable section (Figure 22).

As long as a merchantable log, 8 feet or longer, is present above an unmerchantable section, no sawlog length reduction is made because of an unmerchantable piece.

In the case of a tree forking above DBH, sawlog length is taken on the trunk yielding the greatest length.

Use a height pole for heights to 40 feet, over 40 feet use a clinometer.

Figure 22



Sawlog Top Diameter Outside Bark (SDOB) 3 digits: Item 45

For each sawtimber-sized tree, record sawlog top DOB to the last tenth-inch, using a three-digit code. For example, record 7.0" as 070. The minimum top DOB recorded for hardwoods is 9.0" and 7.0" for softwoods. If a tree's sawlog length terminates before reaching minimum top DOB, or if the sawlog length is affected by a fork or the flare from a limb, record the smallest diameter immediately below the swell. Sawlog top DOB is easily measured with the Wheeler Pentaprism ("Dobber").

Board-Foot Cull (CULB) 4 digits: Item 46

Board-foot cull is the volume within the sawlog portion of a tree that cannot be recovered for use as lumber because of rot, sweep, crook, fork or other defects.

The following are included in cull volumes.

- The entire volume of tree sections that do not meet minimum log-grade requirements.
- The entire volume in any one-foot or longer section of a tree less than 50 percent sound.
- The cull volume only in any one-foot or longer section of a tree greater than 50 percent sound.
- Computed volume for sweep and crook.
- Forks or stoppers.

Board-foot measure is computed from a squared-off section within the circular form of a log. This is the only portion which contains lumber. Therefore, shallow defects that are expected to be cut in slabbing for lumber and rounding for veneer are ignored.

Determine the board-foot cull volume in logs and/or cull sections by estimating the length and DOB at midpoint and looking up the board-foot volume in the "Board-foot Volume of Short Logs" table of the Tatum Guides. In determining cull due to sweep and crook, minimize the defect by logical log making aimed at obtaining maximum high-grade material. Sweep and crook tables and guides for determining the proportion of cull are found in the Tatum Guides in the appendix.

Use a four-digit code to record cull volume, to the last board foot. When no sawlog is present, record a zero " 0 " in board-foot cull on sawtimber-sized trees.

Bole Length (BOLL) 3 digits: Item 47

Bole length of all live trees ≥ 5.0 " DBH is determined between the top of a one-foot stump and 4.0" DOB, or to the point where the central stem breaks into limbs and above which there is no 4.0" DOB. On a 20-class sawlog-size tree, forking above DBH, bole length is taken on the same trunk as sawlog length.

Record length to the last whole foot using a three-digit code. For example, a bole length of 23 feet includes lengths of 23.0 feet up to, but not including, 24.0 feet and is coded as 023.

Note: Use a clinometer on heights over 40 feet.

Bole Length Top Dob (BDOB) 3 digits: Item 48

Top DOB is measured to the highest possible 4.0" DOB or where the central stem or branch breaks into limbs and above which there is no 4.0" DOB. Use a three-digit code to record bole top DOB to the last tenth-inch. Bole length top DOB is measured at the smallest point before the bole length terminates. If the bole length is taken to the bottom of a fork or the flare from a limb, record the smallest diameter immediately below the swell.

Cubic-Foot Cull (CULC) 4 digits: Item 49

For all live trees, cubic-foot cull is the cubic-foot volume of decayed or missing wood up to the bole length top.

Cubic-foot cull may be computed by determining the length of the section affected, and the midpoint DOB. The volume of the section can then be looked up in the table, "Cubic Foot Volumes of Short Logs," of the Tatum Guides. Using a four-digit code, estimate and record cull to the last one-tenth cubic foot (0.1 cubic foot is recorded as 0001).

Diameter (CDWL, CD90) 2 digits: Item 50

Eastern redcedar and Rocky mountain juniper, Plains States only

For all live eastern redcedar trees 5.0" dbh or larger on full measurement plots, measure the crown diameter at the widest point and the crown diameter perpendicular (90 degrees) to the widest point. Measure and record both items to the nearest foot. Crown diameter is measured drip line to drip line. Only the live crown should be considered. See figure 22.

This data will be utilized to develop eastern redcedar tree crown cover equations based on basal area, stand composition, dbh, and crown ratios. The Plains States have experienced a dramatic increase in the number of eastern redcedar trees in the last 20 years. This increase has primarily occurred in pastures and abandoned croplands. As the eastern redcedar become established, they reduce forage production which is of economic concern to the landowners. This data is needed to develop methods of determining forage reduction of eastern redcedar.

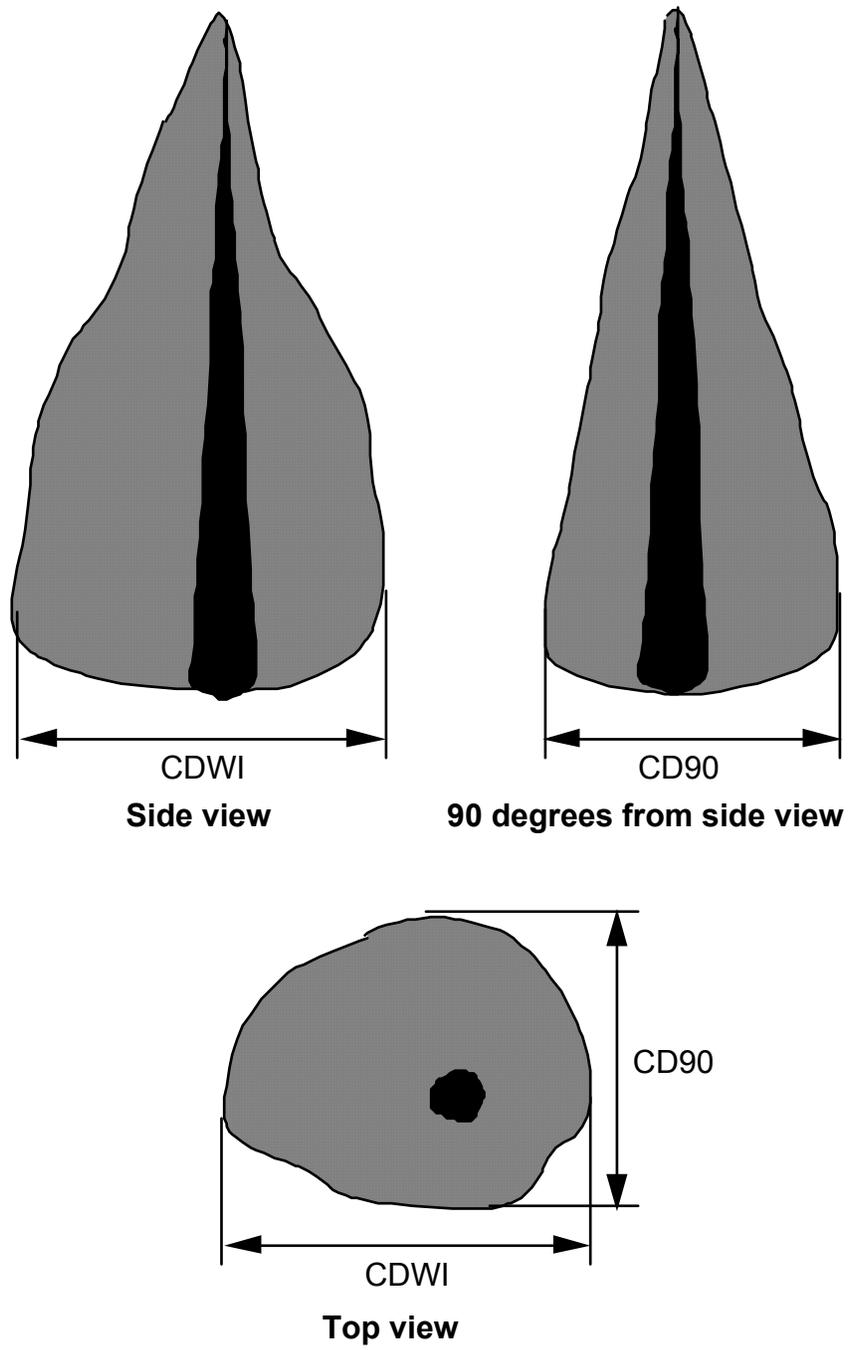


Figure 23. Eastern redcedar crown diameter measurements.

Site Tree Records: Items 51-59

Site index is the height attainable by the average dominant and codominant trees of a species in a stand at an index age (usually 50 years in the eastern states). It reflects the combined effects of different environmental factors, and is used as an indicator of stand productivity. Site index is determined in the field using available site index curves appropriate for the area. A site index is needed for each condition, however the same trees may be used for more than one condition if the field crew determines that it is appropriate to do so. This can be done when the two conditions do not have different site indexes. If the same trees are being used for more than one condition they must be entered for each condition that they are being used for.

Site Tree Data

For all trees measured for site index information record the following items on the site tree record.

- Item 51 Condition number that the site tree is in (CON#)
- Item 52 Tree number (TR#) start numbering at 1
- Item 53 Diameter at breast height (DBH)
- Item 54 Species (SPP)
- Item 55 Total height (HGHT)
- Item 56 Bored age (BAGE)
- Item 57 Total age (TAGE)
- Item 58 Years added to bored age to get total age (YADD)
- Item 59 Site index (from site curves), also recorded on the condition class record (SI)

For remeasurement plots, a new site index is recorded.

Site Tree Selection

For each condition (or conditions that you decide have the same site index) measure a minimum of three site index trees. Use tree species that are of the forest type from the condition you are sampling. For example, if the condition is a forest type of aspen, try to use aspen for site index trees. If none are available, use any suitable tree, as long as a site index curve is available for it.

Generally, site trees should be vigorous in growth and currently putting on height. Avoid trees declining in vigor or stagnated. All site trees should have been dominant or codominant throughout their lives. Do not use trees that have been suppressed during early years and then released. These can be identified by increment cores that show growth rings close together in early years followed by a sudden and marked widening of growth rings. Avoid trees with major injuries.

Finding vigorous, free growing trees is more important than finding the largest trees in the stand. Site trees should be as near the index age of the site index curves for that species. Look for trees that are 20 to 80 years old for curves based on an index age of 50 years.

Reliable site index curves are available for most tree species that are major components of forest types in the survey area. Be aware of what species have site index curves available. Do not collect site index data on a species unless curves are available. Refer to Site Index book.

Site trees should be well distributed over the plot area. If there are no suitable site trees on the plot, select nearby trees from the same general aspect, elevation, and soil type. Collect and record data on more than one species if it is needed to get a good site index estimate. Do not select permanent tally trees. Do not select high value trees.

Note the locations of the site trees on the sub-plot diagram.

Growth Intercept Method

If suitable trees are not available to use with site index curves, the growth intercept method of measuring site index is an alternative. This method has been proposed and tables developed for some tree species that have limbs showing distinct annual whorls (i.e. red pine and southern pines). This method is applied in situations where only young trees (less than 25 years old) of these species are available for site index indicators. You should know what species have these tables available and how to use them. If this method is used, mention it in the "Notes" section and record height, age and diameter as usual on the plot sheet.

For red pine:

<u>Height growth during the last 5 years</u>	<u>Site Index (Estimated)</u>
4 feet	46
5 feet	50
6 feet	53
7 feet	57
8 feet	60
9 feet	63
10 feet	67
11 feet	70
12 feet	74

Minimum Stand Productivity

In order for a stand to be classified as productive commercial land, there must be at least one tree in the condition that has a site index that meets the following minimum site indices.

<u>Species</u>	<u>Minimum Site Index</u>
N. white cedar	15
Black spruce	20
Tamarack	20
E. red cedar	25
R. mountain juniper	25
All other species	35

(Remember, if you can not find a tree of a species in the forest type, use a different species.)

Techniques of Site Data Collection

Carefully measure tree height and age to get a good estimate of site index.

Tree Height (HGHT) 3 digits: Item 55

This measurement is taken to the nearest whole foot. For trees up to 30 feet in height, use the 30-foot height pole. Use a clinometer and tape for trees greater than 30 feet. Make a visual estimate of tree height before choosing the scale on the clinometer. Choose a place to stand that gives you a clear view of both the top and base of the tree. The distance from where you stand to the base of the tree should be approximately equal to the total tree height. Try to keep the sun at your back.

Bored Age (BAGE) 3 digits: Item 56

Total Age (TAGE) 3 digits: Item 57

Years Added To Bored Age (YADD) 2 digits: Item 57

This measurement is taken at DBH using an increment borer. Keep your increment borer clean and sharp to get clean, smooth cores. WD-40, sharpening stones and instructions are available in the office. During the winter, it is best to remove your borer from the tree before taking time to count the core.

Ring porous hardwoods are generally easier to count. Growth rings of many softwoods and diffuse porous hardwoods can be difficult to see. To get an accurate count on these species, it may help to moisten the core and hold it up to the light. If growth rings are very difficult to see, put the core in a plastic straw, label it, and take it with you. Later, try soaking the core, shaving one side of it clean and holding it up to or under a strong light. Count growth rings more than once and have your partner count them to reach agreement on the tree age.

After counting growth rings to age d.b.h. age, convert to total age by adding years needed from information found on the same page as the site index curve is located for that species.

Site Index (SI) 3 digits: Item 59

On the site tree record the site index of each tree as found on the site index curve. Record the highest value obtained for site index on site tree record and on the condition class records for every condition that the site index applies to.

Site Tree Species (SPP) 3 digits: Item 54

Record a three-digit code for the species of tree bored in determining site index on the site tree record. Also record this information with site index on the condition class records for every condition that the site index applies to.

Tree Distance (DIST) 2 digits: Item 34

Record distances on all live trees tallied (except seedlings) on sub-plots 1 - 10. The distance recorded is the slope distance to the nearest foot from sub-plot center to the near face of each tree at its base. Record a two-digit code.

Record a three-digit code for all distances given in the witness tree grid and the reference tree grid of the plot sheet. The distance recorded is slope distance to the nearest tenth of a foot from sub-plot center to the center at the base of each tree. The last digit represents a decimal fraction.

Diameter Breast Height (DBHO, DBHC) 3 digits: Item 35

Diameter at breast height (DBH) is taken 4.5 feet above the ground, measured on the uphill side of the tree. Record a three-digit code for each all trees to the last tenth-inch. The 6.1" diameter class (coded as 061), for example, should include trees 6.10" in diameter up to, but not including, trees 6.20" in diameter. Record code 000 for trees < 1.0" DBH.

On the side of the tree facing sub-plot center, scribe and paint a two-inch horizontal mark just above the upper tape at the point where DBH is measured. Within the one-foot stump facing sub-plot center, scribe and paint a vertical mark to facilitate remeasurement in the event the tree is cut. Paint but do not scribe small, thin-barked trees and trees < 3.0" DBH. Scribe marks should not penetrate the cambium.

It is essential that the measurements are accurate since trees are determined as "in" or "out" of the tally, depending in part on their DBH. For remeasured plots, it is important that DBH measurements are taken at the same point.

Irregularities at DBH (swelling, bumps, depressions, or branches). Measure the diameter immediately above the irregularity at the place where it ceases to affect the normal stem form. If a measurement cannot be taken above the irregularity, record the diameter at the least abnormal spot. Measure butt-swelled trees at a point 1.5' above the end of the swell if the swell is more than 3' high.

If the stem forks at or above DBH, measure diameter below the swell at the place where the fork ceases to affect the stem form. When the stem forks below DBH, consider the tree as two trees and measure the diameter 3.5' above the fork (apply this rule only once per tree).

Important: Use care in determining where the tree forks--extend the centerlines of the two stems to their junction. Don't equate the point where daylight can be seen with the point where the tree forks. Figures 19 and 20 illustrate the proper methods for obtaining DBH.

DBH for remeasurement plots

Original Transfer any original DBH as it appears on the original plot sheet. If paint or scribe mark is found, do not move the measurement location. If there is an obvious error in the original measurement use what means you have to determine what the entry should have been and change it.

Current Check to see that the original DBH was taken in the correct place. If DBH was correct, remeasure, rescribe, and repaint this original measurement. It is extremely important to measure the same place if the measurement was initially correct; look carefully for evidence of paint at DBH.

Remeasure DBH at the original location, make a note on the plot sheet if DBH was previously measured high or low. Measure DBH at the correct place on the bole if the previous measurement was taken on a deformity or can not be relocated.

If the tree is now dead at DBH, it is considered a dead tree. If a new leader has taken over below dbh and is ≥ 1.0 " DBH, give it a tree history of ingrowth or ongrowth. If the tree is not at least 1.0" DBH, it is taken as a seedling and can be recorded twice--once as a dead tree and once as a seedling.

Figure 19 - Diameter breast high measurement in a variety of situations

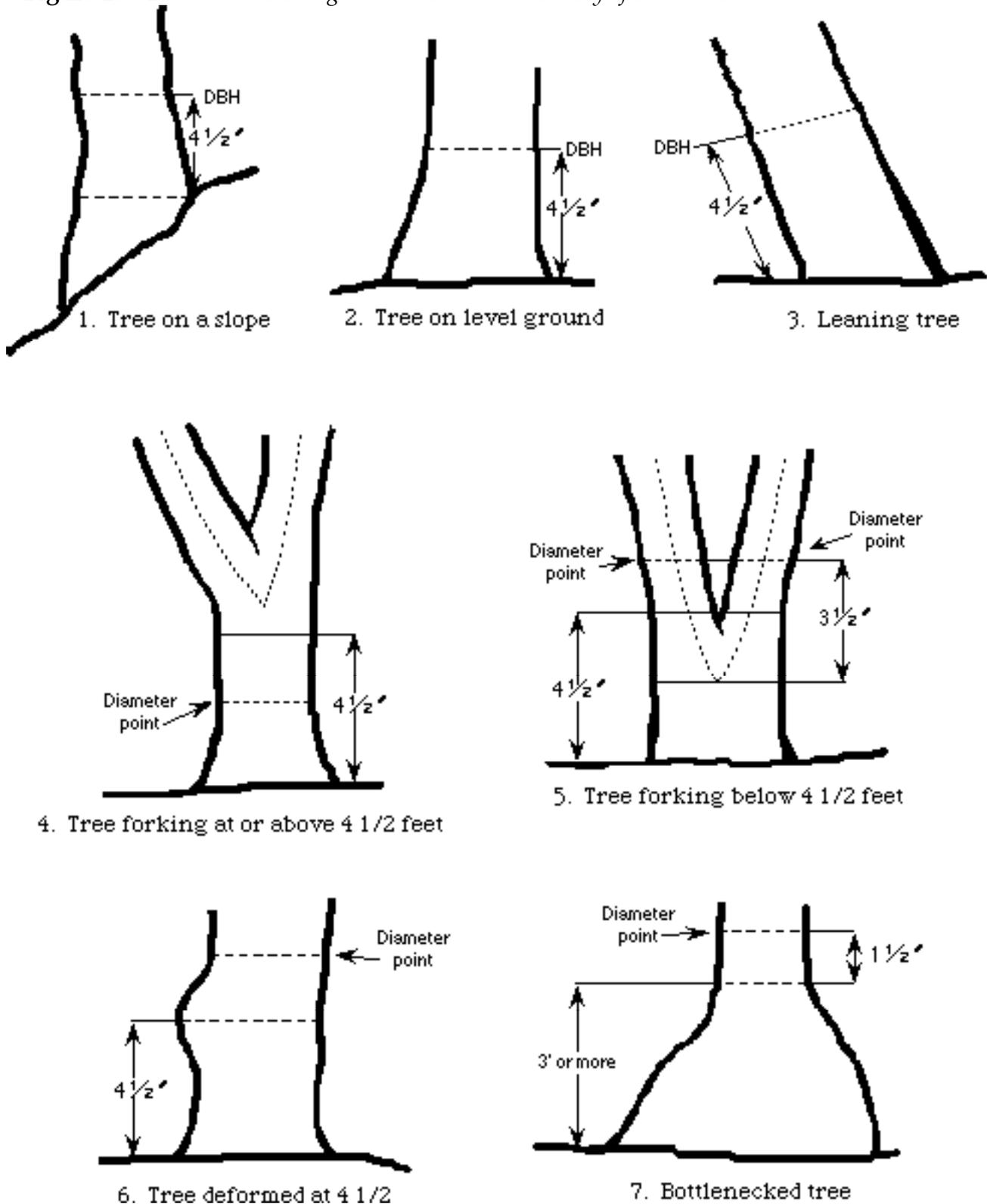


Figure 20 - Using the diameter tape

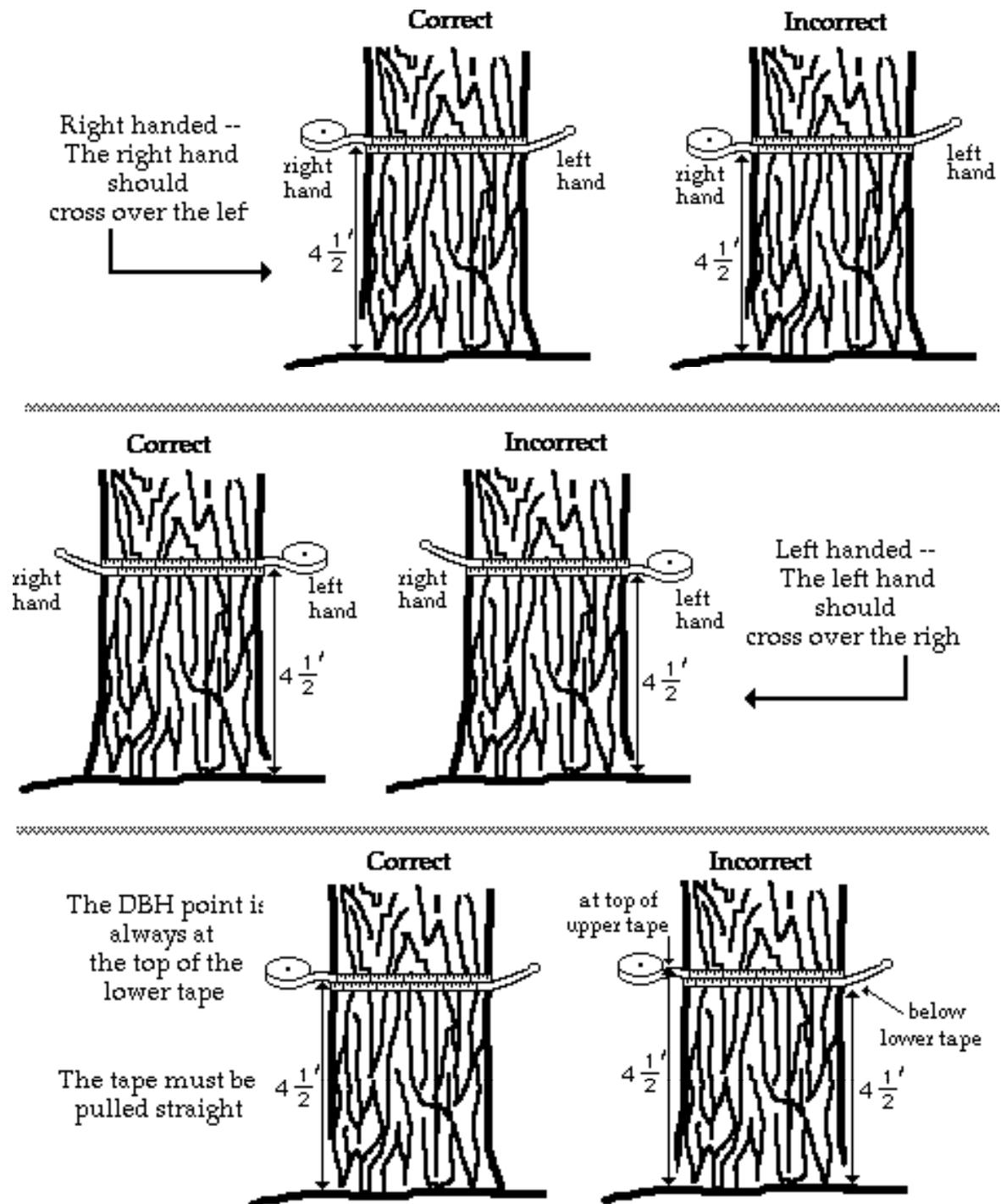
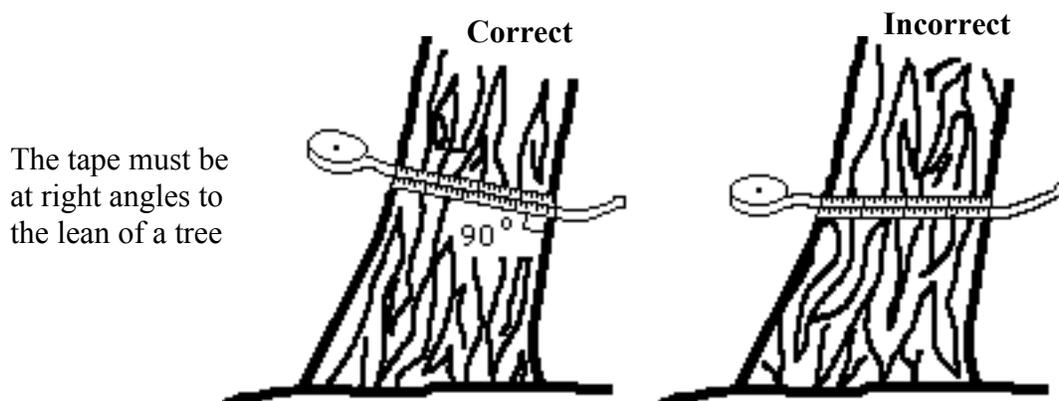
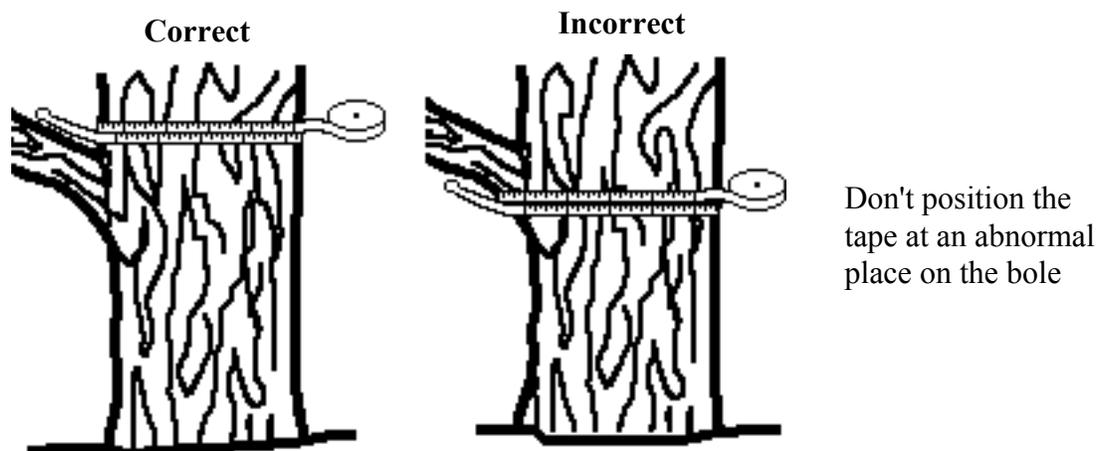


Figure 20 CONTINUED



Tree Azimuth (AZM): Item 36

Record azimuth on all live trees tallied (except seedlings) on sub-plot 1 through 10. The azimuth recorded is a three-digit code representing the magnetic azimuth from the point center to the center of the tree at its base. Examples: Nine is recorded as 009; 89 is recorded as 089; 347 is recorded as 347.

Zero-degree azimuth is not used. Any tree at 0° azimuth is tallied as 360.

Two trees on the same point cannot be recorded with the same azimuth. Record one before the other, for example, record one as 059 and the other as 060.

For remeasurement plots

Record current azimuth readings at the time of remeasurement. For example, a tree with an original azimuth of 358°, has a current azimuth of 1°, record the current azimuth as 001. This could lead one to presume changing the tree number. Do not do this. Never change a tree number.

Condition Number (COND) 1 digit: Item 37

Record the condition number of the condition the tree occurs in. This item is required for all trees, including seedlings, stumps, dead trees and no status trees.

Damage Or Cause Of Death (DAM) 3 digits: Item 38

For live trees, record presence of damage or pathogen activity if it is serious enough to reduce the quality or vigor of the tree. Record the cause of death for dead trees.

The pest or damage is identified using the coding criteria (minimum severity requirements). A complete list of damage codes and coding criteria appears in the appendix of this manual. Follow these guides for assigning damage/death codes:

- Use the most specific code. Avoid general injury codes if possible. For example, Eutypella canker code has preference over bole canker code, which has preference over unknown/uncoded canker.
- The damage must meet the severity rating for its particular damage code. Examples: an insect defoliator is coded only when it is causing > 20 percent defoliation; a Hypoxylon canker on a branch is not coded because its severity rating is "any occurrence on the bole."
- If the pest/damage does not satisfy the coding criteria, it is coded to a more general code, such as one of the 900 codes, unknown, uncoded damage.

When two or more pests occur on a tree, record the most significant and important pest. The following applies.

1. Record the agent causing the most severe damage. An agent which will cause death takes precedence over one causing volume loss, which takes precedence over one causing growth or quality loss. For example, a canker low on the main bole takes precedence over decay higher on the stem, but decay low on the main bole takes precedence over a canker high in the crown.
2. Record permanent damage before temporary or seasonal damage. For example, decay or canker takes precedence over insect defoliation, even if defoliation was 100 percent on a hardwood tree.
3. Record bole damage over branch damage.

Death codes are the same as damage codes, when coding the cause of death, choose a code from the list of damage codes. If the tree is dead and the cause can be determined, code the cause of death. If the cause is unknown, and the tree is salvageable, code the damage rather than unknown death, if there is damage.

	<u>Prioritization</u>		
<u>Highest priority</u>			<u>Lowest priority</u>
Specific pest	>	General Pest	>
Death or potential death	>	Volume reduction	>
			Damage or injury
			Growth slowed quality reduction

Cull trees (except noncommercial species) must have a damage code other than 000.

Seedlings and saplings are considered growing stock, unless a specific damage is observed. Excessive sweep and crook is not considered a specific damage code for seedlings and small saplings (< 3.0" DBH).

A damage code is not recorded to indicate a reason for not qualifying as a better tree grade. Damage codes are given in the appendix section of this manual.

Tree Class (TCO, TCC) 2 digits: Item 39

Tree class reflects tree suitability for timber products. Tree class is basically a check for the straightness and soundness of the sawlog portion on a sawtimber tree or the potential sawlog portion on a poletimber tree or sapling. Not considered in determining tree class are: tree vigor, predicted death, and plot site index.

Use one of the following codes for tree class.

20--Growing Stock

Any live tree of commercial species that is sawtimber size and has at least one merchantable 12-foot sawlog or two merchantable 8-foot sawlogs meeting minimum log-grade requirements. At least one-third of the gross board-foot volume of the sawlog portion must be merchantable material. (Sawlog portion is the length between the one-foot stump and the 9.0" top diameter of outside bark, DOB, for hardwoods, or the 7.0" top DOB for softwoods.) A merchantable sawlog must be at least 50 percent sound at any point.

Any poletimber-size tree that has the potential to meet the above specifications. Assume that pole-size trees will eventually attain sawlog size at DBH. In evaluating potential sawlog portion of pole-size trees, only rot, large limbs, forks, and excessive sweep and crook may be used to disqualify the tree as a growing-stock tree.

When estimating potential sawlog height for poletimber trees, apply the two-inch rule as a guide. The two-inch rule assumes that a tree's diameter increases uniformly along its bole. For example, a hardwood poletimber tree with an 8.0" DBH needs 3" of diameter growth to become sawtimber size. If diameter growth is uniform, then the DBH minus two inches (eight minus two), or six inches, identifies the potential sawlog top. This method works for both hardwoods and softwoods.

Consider a seedling or sapling as growing stock unless a specific damage is observed. A seedling or small sapling (< 3.0" DBH) may not be culled on the basis of excessive sweep or crook. Assume that seedlings and saplings will eventually attain sawlog size at DBH.

Tally items for 20-class trees For growing-stock trees on full remeasurement plots, record bole length to the highest possible 4.0" top DOB, or to that point where the central stem or branch breaks into limbs and above which there is no 4.0" DOB. On forked sawtimber trees, record bole length using the fork with the highest sawlog. Record cubic-foot cull for the rotten or missing wood to the 4.0" top. Sawlog length is recorded to the top of the highest sawlog section meeting minimum sawlog requirements. Board-foot cull includes the unusable board-foot volume in merchantable sawlog sections, and the total volume of sections that do not meet sawlog requirements below the sawlog top. Accurately record all remaining required information.

30--Rough Cull

Any tree of noncommercial species.

Any tree of commercial species that is sawtimber size and has no merchantable sawlog. Over one-half of the volume in the sawlog portion does not meet minimum log-grade specifications because of roughness, excessive sweep or crook, splits, cracks, limb stoppers, or forks. The sawlog portion is the length between the one-foot stump and the 9.0" top DOB for hardwoods, or the 7.0" top DOB for softwoods.

Any pole-size tree that does not have the potential to meet the specifications for growing stock because of forks, limb stoppers, or excessive sweep or crook. Assume that all live trees not currently sawlog size will eventually attain sawlog size at DBH. Predicted death, tree vigor, and plot site index are not considered in determining tree class.

Tally items for 30-class trees Record bole length to a 4.0" top DOB. Cubic-foot cull includes actual rot or missing wood only. For sawtimber trees, zero-out sawlog length, sawlog top DOB, board-foot cull and tree grade. Accurately record crown ratio and crown class. The damage code must not be "000," except for noncommercial species. Code any tree cavity.

31--Short-log Cull

Any live sawtimber-size tree of commercial species that has at least one 8-foot sawlog, but less than a 12-foot sawlog, meeting minimum log-grade specifications.

Any live sawtimber-size tree of commercial species that has less than one-third of the volume of the sawlog portion in merchantable logs, but has at least one 8-foot or longer sawlog meeting minimum log-grade specifications. Short sawlog must be 50 percent sound at any point. (The sawlog portion is the length between the one-foot stump and the 9.0" top DOB for hardwoods and the 7.0" top DOB for softwoods.)

Note: Pole-size trees never receive a tree class code 31.

Tally items for 31-class trees Record bole length to a 4.0" top DOB. On forked trees, bole length is recorded using the fork that contains the highest sawlog. Cubic-foot cull includes actual rot or missing wood only. Record sawlog length and sawlog top DOB to the height where the highest merchantable log terminates. Board-foot cull includes all unmerchantable sections in the sawlog portion, and the unusable board-foot volume within the merchantable sawlog. Tree grade is usually code 5, due to length and/or position in the tree. Accurately record crown ratio and crown class. Damage code cannot be "000". Code any tree cavity.

40--Rotten Cull

Any live tree of commercial species that is sawtimber size and has no merchantable sawlog. Over one-half of the volume in the sawlog portion does not meet minimum log-grade specifications primarily because of rot or missing sections. (The sawlog portion is the length between the one-foot stump and the 9.0" top DOB for hardwoods, or the 7.0" top DOB for softwoods.)

Any pole-size tree that does not have the potential to meet the specifications for growing stock because of rot. Assume that all live trees will eventually attain sawlog size at DBH. Predicted death, tree vigor, and plot site index are not considered in determining tree class.

Tally items for 40-class trees Record bole length to a 4.0" top DOB. Cubic-foot cull includes actual rot or missing wood only. Zero-out sawlog length, sawlog top DOB, board-foot cull and tree grade. Accurately record crown ratio and crown class. Damage code must reflect rot or disease and must not be "000". Cubic-foot cull seldom exceeds 90 percent of total cubic volume.

Summary: If any of the requirements for growing stock (tree class 20) are not met, the tree is considered cull. If a short sawlog is present, the tree class is 31 and sawlog information is recorded. If no sawlog is present, tree class is either 30 or 40. If a pole-size tree does not have the potential to meet sawlog standards, it is either tree class 30 or 40.

Dead Trees

Determine whether a dead tree is a salvable, standing or down dead tree. A standing or down dead tree containing at least one 8-foot section that is at least 50 percent sound is a salvable dead tree. A standing or down dead tree containing no merchantable volume (has no 8-foot or longer section that is at least 50 percent sound) is can not be a salvable dead tree.

The following tally items are required for dead trees:

- Tree number
- DBH
- Cause of Death
- Tree Cavities (not required on down-dead trees)
- Species
- Tree History
- Tree Class

Volume measurements or tree grade are never needed for a dead tree. Unless specified, all tally items are recorded using rules from the appropriate sections on live trees in this manual.

DBH Estimate the diameter of the tree at time of death, be sure to consider any distortion, lost bark, cracks, splits, shrinkage, etc. Do this for all dead trees (salvable, standing and down).

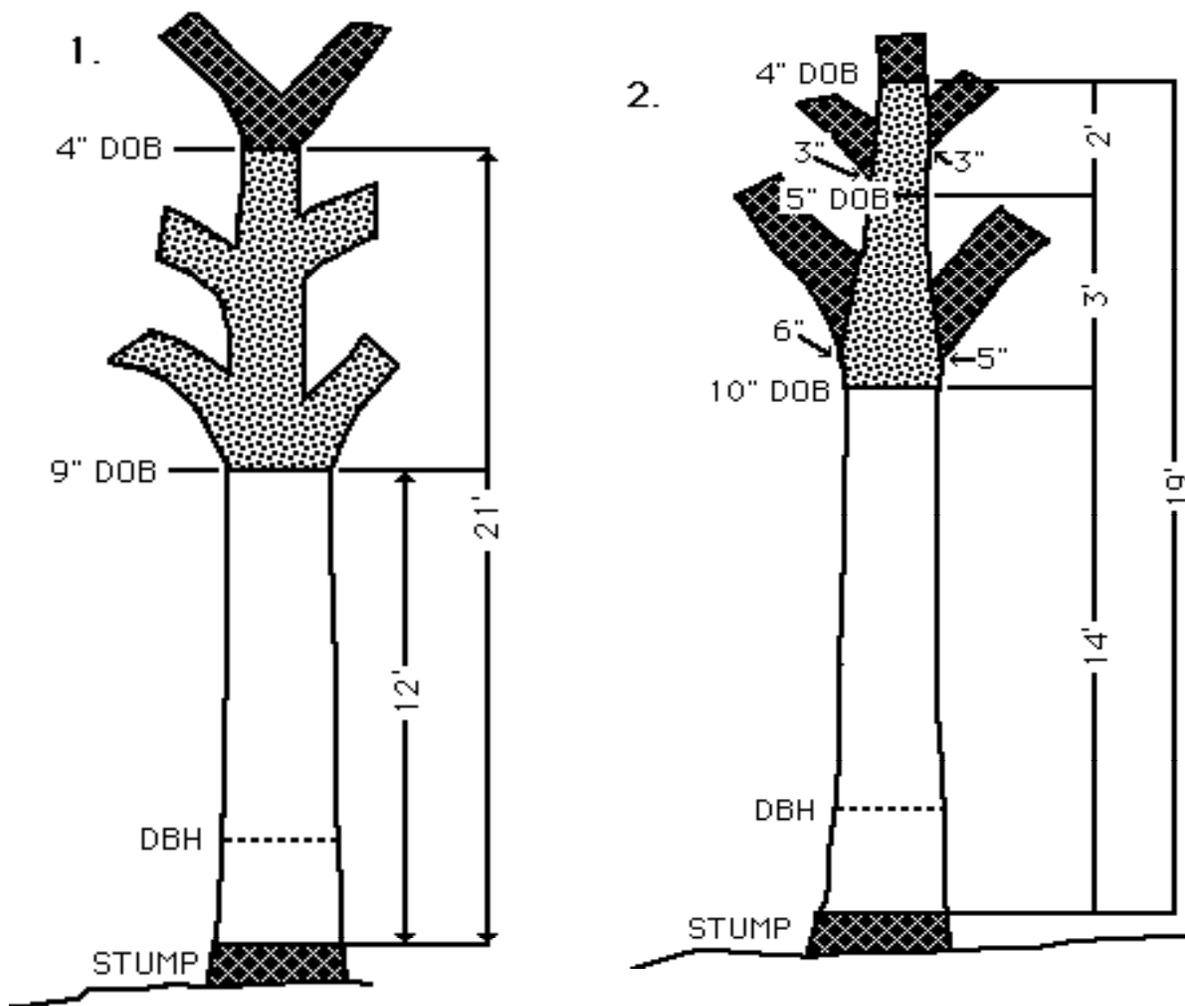
Standing-dead and down-dead trees All required information is projected back to the time of death except tree cavities, which is recorded as they exist now (do not record tree cavities on down-dead trees). A standing-dead tree may not look very good, but assign a tree class of 20 if that's what it was at the time of death. Down-dead trees are recorded only on remeasurement plots.

Salvable-dead trees All required information reflects the present condition of the tree. Record your information as though the tree was alive today.

Summary: First, determine whether the tree is a salvable-dead, standing-dead, or down-dead tree. Next, project the tree to the correct place in time (the present for salvable dead trees and time of death for standing and down dead trees). Finally, record required information according to this manual.

On the following pages are nine selected examples (Figure 21) explaining tree classification. Hardwood trees are represented in the illustrations, however softwoods may be implied using a minimum 7.0" sawlog top DOB.

Figure 21- How to handle tree measurements for all tree classes



1. A GROWING-STOCK HARDWOOD SAWTIMBER TREE

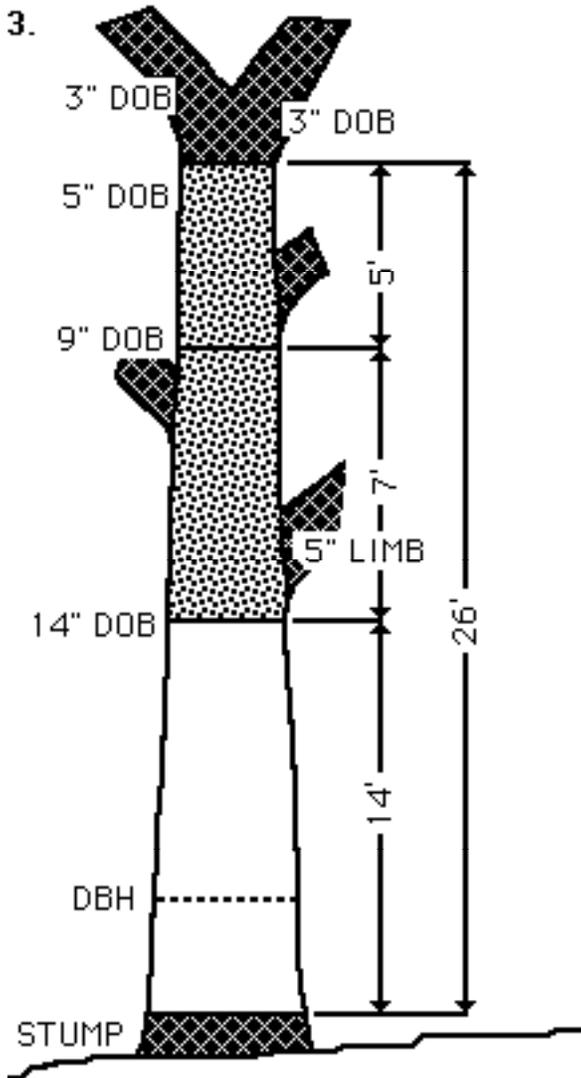
Sawlog length terminates at 9" top DOB. The sawlog meets both minimum log-grade specifications and the minimum 12-foot qualification for a growing-stock tree. The upper-stem portion contains no cull and terminates at 4" DOB. Sawlog length is recorded as 12 feet; bole length as 21 feet.

-  Sawlog
-  Upper stem (Pulpwood)
-  1-foot stump, top, and limbs

2. A HARDWOOD GRADED 1, 2, OR 3 OR A SOFTWOOD SAWTIMBER TREE

Sawlog portion is terminated by limbs creating a full diameter stopper. Each limb is over 2" in diameter, and their sum exceeds the diameter at the stopping point (10" DBH). The sawlog contains no cull and meets minimum grade specifications. Sawlog length is 14 feet. The upper-stem portion contains no cull and terminates at 4" DOB, 5 feet above the sawlog portion. Bole length is 19 feet. Cubic-foot cull is 0 for the tree.

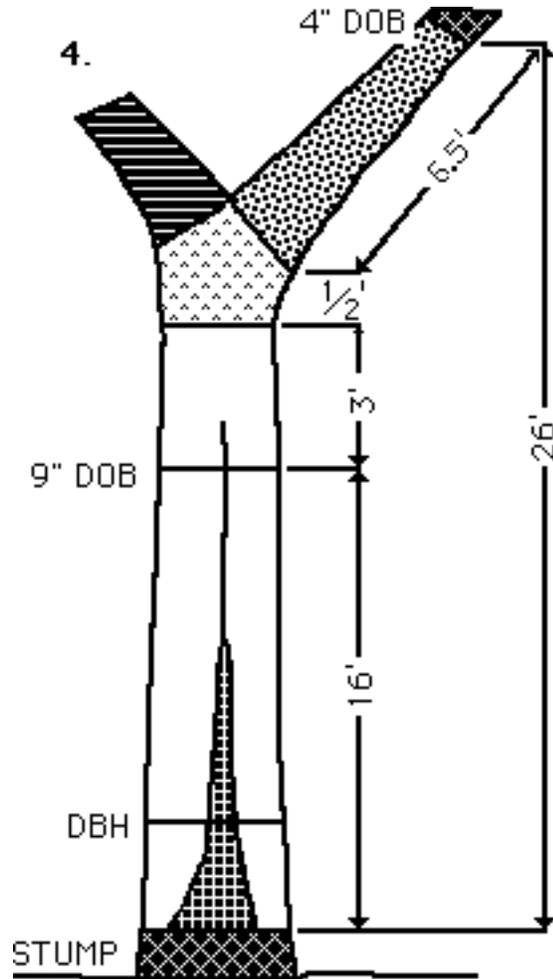
Figure 21 continued



3. A GROWING-STOCK HARDWOOD, GRADE 4, SAWTIMBER TREE

There are no sawlogs in the 21-foot sawlog portion that have minimum clear-panel length to meet hardwood factory log-grade 3 specifications, but the bottom 14 feet contain no rot or sweep and meets hardwood construction-grade 4 specifications. The sawlog terminates at 14 feet, because the 5-inch diameter limb creates a one-third diameter stopper for hardwood construction-grade 4, and only a 6-foot section is left above the 1-foot sawlog stopper. Log grade specifications require a minimum sawlog length of 8 feet. Bole length is terminated at 26 feet with a 5-inch top DOB because of a fork with two 3-inch diameter limbs. Cull board feet and cull cubic feet are zero.

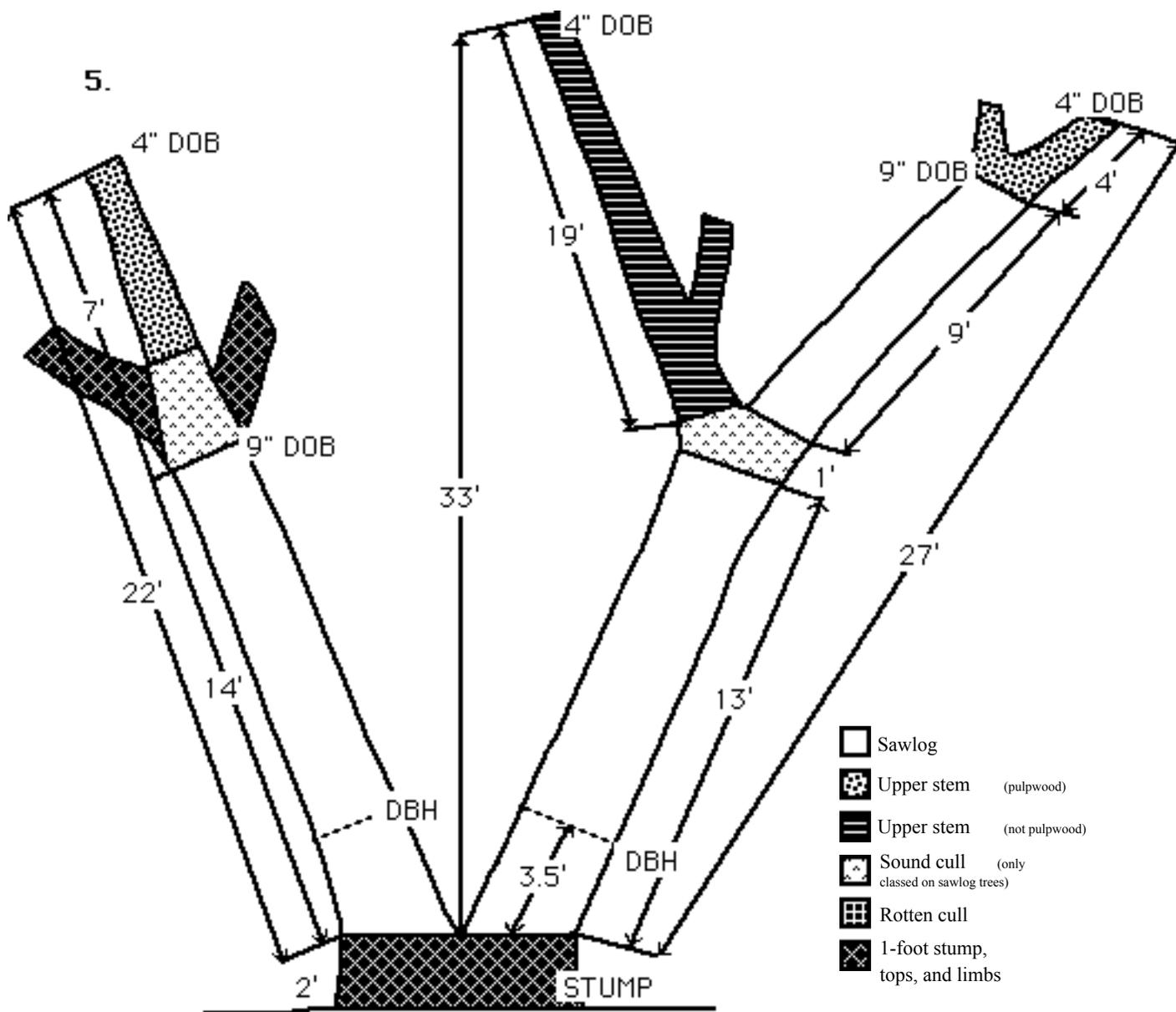
	Sawlog		Sound cull (only classed on sawlog trees)
	Upper stem (pulpwood)		Rotten cull
	Upper stem (not pulpwood)		1-foot stump, tops, and limbs



4. A HARDWOOD SAWTIMBER TREE

The sawlog length is 16 feet to the 9" DOB. The bottom 2 feet are over 50 percent rotten and does not meet log-grade specifications. The next 14-foot section meets minimum factory log-grade specifications, but contains some cull due to a frost crack and a narrow cone of rot extending up from the bottom. A 6 1/2-foot section above a 1/2-foot fork at 19 1/2 feet terminates the bole at 26 feet. Board-foot cull includes the entire board-foot volume in the bottom 2 feet, and the unusable board-foot volume in the next 14 feet. Cubic-foot cull includes the cubic-foot volume loss due to rot in the first 16 feet.

Figure 21 continued

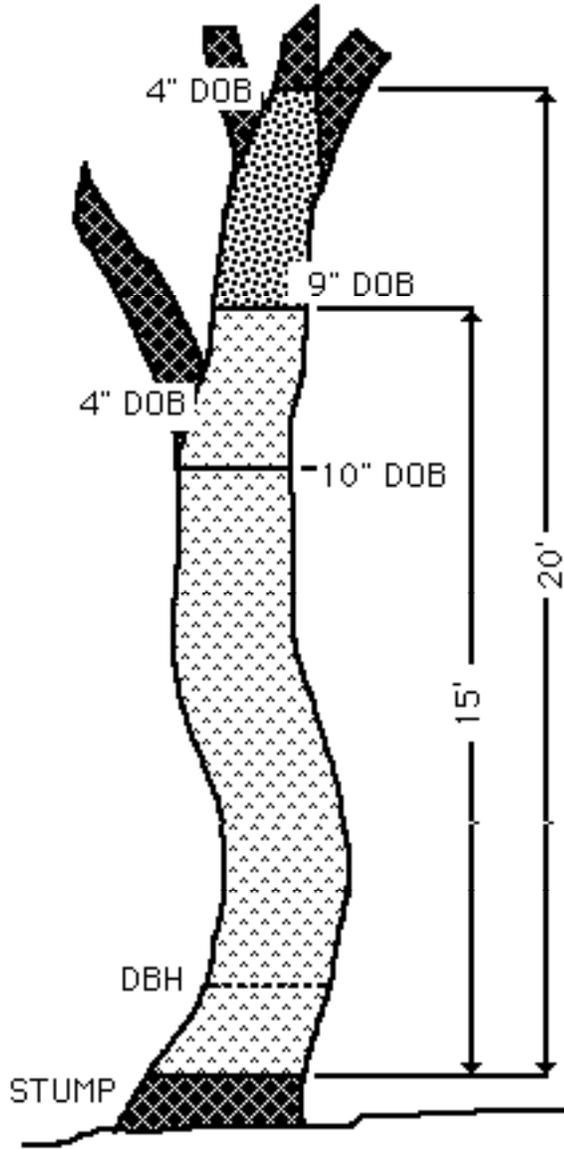


5. TWO HARDWOOD SAWTIMBER TREES

Since the lowest fork is below DBH, each fork is appraised and recorded as a separate tree. The lower 14 feet of the left-hand fork (or tree) meets log-grade specifications. The bole length is 22 feet and the sawlog length is 14 feet. Cull board feet is zero and cubic-foot cull is zero.

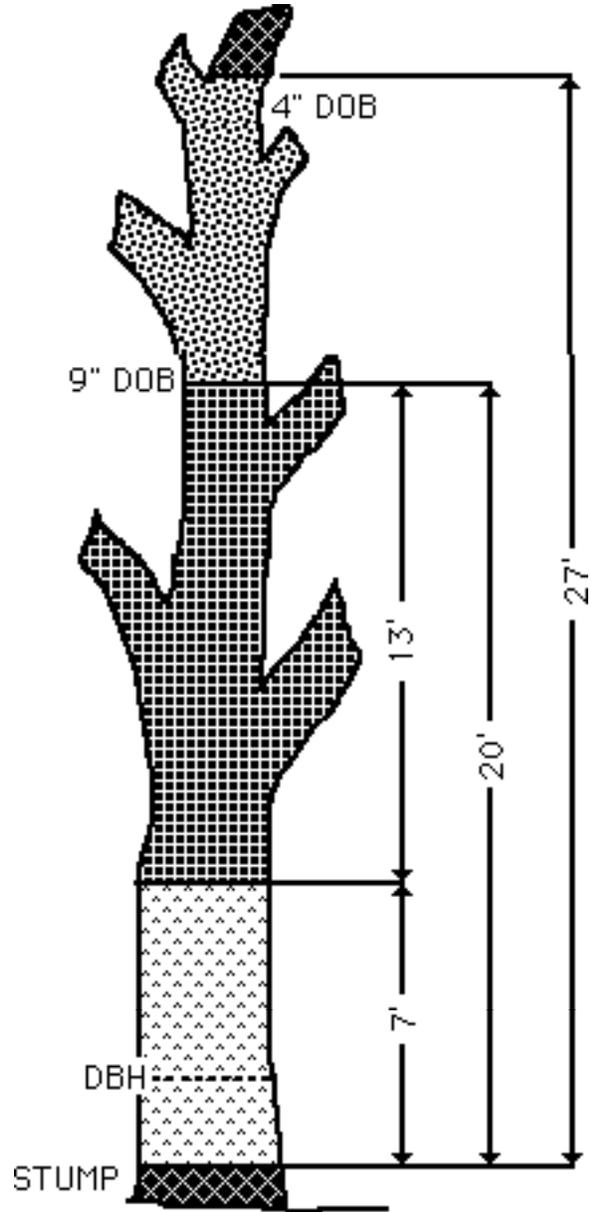
In the right-hand tree, a 13-foot merchantable sawlog, plus a 9-foot merchantable sawlog in the right-hand fork (with an intervening one-foot section of sound cull) is recorded as 23 feet of sawlog length. A 4-foot section of the right-hand fork meets pulpwood specifications, making the bole length 27 feet. Cull board feet includes the total volume of the one-foot fork. When a tree forks above DBH, measurements are recorded on one fork only. Merchantable bole length is recorded continuing up the same fork that has the highest merchantable sawlog length. In this illustration, the left-hand fork on the right-hand tree had a higher merchantable bole length at 33 feet, but the right-hand fork on the same tree had a higher merchantable sawlog length, so the bole length is recorded as 27 feet using the right-hand fork.

Figure 21 continued



6. A ROUGH HARDWOOD SAWTIMBER TREE

Sawlog portion is 15 feet long. There is no sawlog present that will meet minimum hardwood log grades 1-4. Minimum clear-panel length is not present for grade 3 and sweep plus a 1/3 diameter limb stopper prevents grade 4. Since more than half the board-foot volume is lost as sound cull, it is a rough tree (tree class 30). Dash out sawlog information. Bole length is taken 20 feet to the 4-inch DOB. Cull cubic foot is zero.

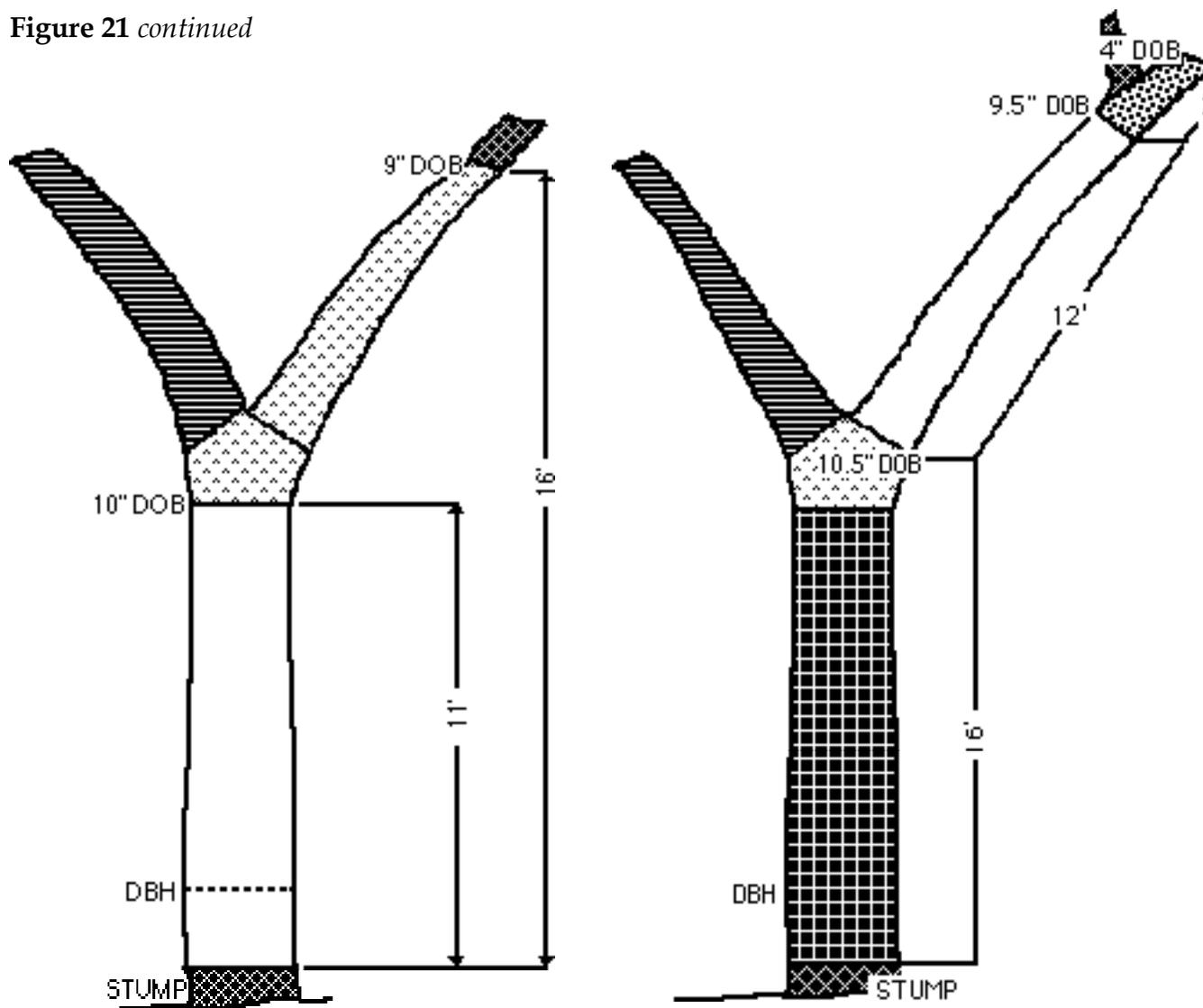


7. A ROTTEN HARDWOOD SAWTIMBER TREE

The sawlog portion is 20 feet long. The entire volume of a 13-foot section is cull, because it will not meet log-grade specifications because of excessive rot. This creates a 7-foot sound cull section beneath, since there is not a minimum sawlog length of 8 feet. Since there is no sawlog that will meet minimum log-grade specifications, the tree is cull. Because more than half the board-foot volume loss is due to rot, the tree is a rotten cull tree (tree class 40). Dash out sawlog information and log grade. Bole length is 27 feet and cubic-foot cull represents only the rotten cubic-foot volume within the 13-foot rotten section.

- | | |
|---|---|
|  Sawlog |  Sound cull (only classed on sawlog trees) |
|  Upper stem (pulpwood) |  Rotten cull |
|  Upper stem (not pulpwood) |  1-foot stump, tops, and limbs |

Figure 21 continued



8. A TREE CLASS 31

The sawlog portion is 16 feet to the 9.0" DOB. The tree does not contain a 12-foot merchantable sawlog, or two 8-foot merchantable sawlogs, because of a fork at 11 feet. This classifies the tree as a cull and since it contains a merchantable sawlog at least 8 feet long, it is a tree class 31. Sawlog length is recorded as 011, sawlog to DOB 100, and board-foot cull 0000. Bole length and cubic-foot cull are handled in the same way as for other trees, culling out for rot and missing wood only.

9. A TREE CLASS 31

The sawlog portion is 28 feet and stops at a point just below where the tree forks for a second time at a 9.5" DOB. The first 16 feet do not meet minimum log-grade specifications, but there is a 12-foot merchantable sawlog above the first fork. Since over 2/3 of the total board-foot volume between the 1-foot stump and the top of the merchantable sawlog is cull, this is a cull tree, but since the tree contains a merchantable sawlog, it is a tree class 31. Use Tatum Guides to compute the board foot volumes of the sections listed. For this example the sawlog information is recorded as sawlog length 028, sawlog top DOB 095, and board-foot cull is the total board-foot volume in the 16-foot cull section. Bole length and cubic-foot cull are handled in the same way as for other trees, culling out for rot and missing wood only.

- | | |
|---|---|
|  Sawlog |  Sound cull (only classed on sawlog trees) |
|  Upper stem (pulpwood) |  Rotten cull |
|  Upper stem (not pulpwood) |  1-foot stump, tops, and limbs |

Crown Ratio (CRO, CRC) 1 digit: Item 40

Crown ratio is the percentage of total tree height that supports full, live, green, healthy foliage effectively contributing to tree growth. Crown ratio is expressed as a percent of total tree height and is recorded as a one-digit code for all live trees ≥ 1.0 " DBH. For trees with uneven length crowns, ocularly transfer branches to fill holes in the upper portions, until an even crown is visualized. For example: A tree might have scattered green branches extending over 60 percent of its total height, by ocularly transferring branches to produce a full crown, the crown ratio might be 40 percent.

Transfer the original crown ratio from the plot sheet to the data recorder. If the original crown ratio is missing, record an estimate. Use the following codes:

Code	Crown ratio	Code	Crown ratio
1	1 through 10 percent	6	51 through 60 percent
2	11 through 20 percent	7	61 through 70 percent
3	21 through 30 percent	8	71 through 80 percent
4	31 through 40 percent	9	81 through 100 percent
5	41 through 50 percent		

Crown Class (CCO, CCC): Item 41

Record a one-digit code to show crown class of all live trees ≥ 1.0 " DBH. Crown class is determined by an individual tree's dominance in relation to adjacent trees in the stand, as indicated by crown development and amount of light received from above and the sides. Transfer the original crown class from the plot sheet to the data recorder. If the original crown class is missing, record an estimate.

- 1--Open grown** Tree receiving full light from above and from all sides throughout all or most of the life of the tree, particularly during early development.
- 2--Dominant** Tree crown extending above the general level of the crown cover and receiving full light from above and partly from the sides. Tree is larger than the average tree in the stand, crown is well developed, but possibly somewhat crowded on the sides.
- 3--Codominant** Tree crown forming part of the general level of the crown cover and receiving full light from above, but comparatively little from the sides. Typically a medium-sized crown, more or less crowded on the sides. (In stagnated stands, includes a small-sized tree crown, crowded on the sides.)
- 4--Intermediate** Tree shorter than those in the two preceding classes, crown is either below or extending into the crown cover formed by codominant and dominant trees, receiving little direct light from above, and none from the sides. Typically a small crown, considerably crowded on the sides.
- 5--Overtopped** Tree crown entirely below the general level of the crown cover, receiving no direct light either from above or from the sides.
- 6--Supra canopy** Usually a mature or over-mature tree, crown at least 25% taller than the majority of dominant and codominant trees in the stand.

In multiple-age stands with understory trees of younger age classes, crown classification is often difficult. As a general rule, the crown class for each tree should be judged in the context of its immediate environment; that is, those trees affecting it or being affected by it in terms of

crown competition. For example, the intermediate and overtopped crown classes are intended to include only trees seriously affected by direct competition from adjacent trees.

Tree Cavities/Number Of Seedlings (TCAV) 2 digits: Item 42

Tree Cavities

At each sample point, examine all live, salvable-dead and standing-dead trees, ≥ 5.0 " DBH, for cavities that could be used for nesting, resting or storage by birds or mammals. To qualify as a cavity, an entrance hole must be 1.0" or larger in the main stem, fork, or large limb. (A limb must be greater than 8.0" DOB.)

For the largest cavity record a two-digit code. The first digit indicates the size of the cavity. Cavity size is the diameter of the largest ball that could fit through the entrance hole. The second digit indicates the location of the cavity on the tree.

<u>First Digit</u>		<u>Second Digit</u>	
<u>Code</u>	<u>Size of opening (inches)</u>	<u>Code</u>	<u>Location of cavity (feet above ground)</u>
1	1	1	0 - 1
2	2	2	2 - 5
3	3	3	6 - 9
4	4	4	10 - 19
5	5	5	20 - 29
6	6	6	30 - 39
7	7	7	40 - 49
8	8	8	50 - 59
9	9+	9	60+

Number Of Seedlings

Seedlings are tallied on the micro plot by condition number, species and damage class. This item is used to record the number of seedlings of a given species-damage class tallied on the plot. When more than 5 seedlings are on the fixed radius plot, the number of seedlings can be estimated. The accuracy of these estimates should be plus or minus 25%. For example, if you tally 40 seedlings, you should be confident that the true number of seedlings is between 30 and 50. For seedlings record condition number, species, damage, tree history, tree class, and total count. If more than 99 seedlings-record 99.

Tree Grade (TGRD) 3 digits: Item 43

Grade sawlog trees (20 and 31 class) that qualify on all plots in North Dakota, South Dakota, Nebraska, and western Kansas. In eastern Kansas, Wisconsin and Minnesota only grade trees on sample kinds 1, 2 and 7.

First digit For a hardwood sawtimber tree (tree class 20), grade the sawlog portion of the tree using "Hardwood Tree Grades for Factory Lumber" (USDA Forest Service Research Paper NE-333). The table on the next page contains the specifications for hardwood tree grades. Use the table and the following steps to determine tree grade.

- Measure DBH.
- Establish the location of all defect indicators on the surface of the butt 16-foot log, and then locate the best 12-foot section.
- Estimate inside bark diameter (DIB) at the top of the 12-foot section to the nearest inch.
- Estimate scalable defect in the 12-foot section selected previously.
- The grade of the 12-foot section becomes the tree's grade, unless the grade can be improved by using a 14- or 16-foot section

For a hardwood sawtimber tree that does not qualify as tree grade 3, but meets specifications for hardwood construction lumber logs (tie and timber) assign a grade 4. For a hardwood sawtimber tree that does not meet minimum tree-grade specifications, but has a 12-foot section above the butt log or two 8-foot sections that meets log-grade requirements, assign a log grade of 5.

See USDA Forest Service General Technical Report NE-1, "A Guide to Hardwood Log Grading," for the specifications for construction class (grade 4) logs, and for upper logs.

For a softwood sawtimber (20 class) tree, grade first merchantable 16-foot log or shorter length down to 12 feet if a 16-foot log is not present. Use the grading rules in the Tatum Guides for determining log grade.

For a softwood 31-class tree, grade the log that is present. For a hardwood 31-class tree, assign a grade 5.

TABLE OF HARDWOOD TREE GRADES FOR FACTORY LUMBER

Grade factor	Grade 1			Grade 2		Grade 3
Length of grading zone (feet)	Butt 16			Butt 16		Butt 16
Length of grading section ^a (feet)	Best 12			Best 12		Best 12
DBH, minimum (inches)	16 ^b			13		11
Diameter, minimum inside bark at top of grading section (inches)	13 ^b	16	20	11 ^c	12	8
Clear cuttings (on the 3 best faces) ^d						
Length, minimum (feet)	7	5	3	3	3	2
Number on face (maximum)	2			2	3	e
Yield in face length (minimum)	5/6			4/6		3/6
Cull deduction (including crook and sweep, but excluding shake) maximum within grading section (percent)	9			9 ^f		50

^a Whenever a 14- or 16-foot section of the butt 16-foot log is better than the best 12-foot section, the grade of the longer section will become the grade of the tree. This longer section, when used, is the basis for determining the grading factors such as diameter and cull deduction.

^b In basswood and ash, DIB at top of grading section must be 12 inches and DBH must be 15 inches. In all other hardwoods if you have a 10-foot clear-cutting a minimum DBH of 15.6" can be used.

^c Grade 2 trees can be 10 inches DIB at top of grading section if otherwise meeting surface requirements for small grade 1s. A minimum DBH of 12.6" can be used if minimum length of clear-cutting are 3 feet.

^d A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth of the surface of the grading section as divided lengthwise.

^e Unlimited.

^f Fifteen percent crook and sweep or 40 percent total cull deduction are permitted in grade 2, if size and surface of grading section qualify as grade 1. If rot shortens the required clear cuttings to the extent of dropping the butt log to grade 2, do not drop the tree grade to 3 unless the cull deduction for rot is greater than 40 %.

Second and third digit For hardwoods given a grade 2, 3, 4, or 5, record the limiting quality factor that is keeping the log from moving into a better quality grade. For softwoods, the second and third digits are always "00".

<u>Code</u>	<u>Limiting Factor</u>
00	Not applicable, already a grade 1
10	Diameter
20	Length
30	Clear cuttings
40	Sweep and crook
50	Cull
60	Position in tree
70	Multiple factors
80	Diameter and clear cutting

Sawlog Length (SAWL) 3 digits: Item 44

Sawlog length on a live sawtimber-size tree is the distance from the top of the one-foot stump to a minimum top of 9.0" DOB for hardwoods or 7.0" DOB for softwoods or to the point on the bole above which no merchantable sawlog exists. Record sawlog length on live 20 and 31 class sawtimber-size trees. Record sawlog length to the last whole foot. Example: Sawlog length of 14.8' is recorded as 14.

Sawlog length should not extend above a large fork, excessive limbs or other defects or a section of the tree bole that does not meet minimum log-grade specifications, unless the tree has at least 8 feet of saw-log length above the limitation. Limitations or "stoppers" for all softwoods and for grade 1, 2, and 3 hardwoods include: any limb (live or dead) having a diameter exceeding the stem DOB at that point; or any group of 2.0" diameter or larger limbs (live or dead), within a one-foot span, having a combined sum of diameters greater than the stem DOB of that section. Limitations for grade 4 hardwoods only include any limb or group of limbs, within a one-foot span, with a diameter or sum of diameters greater than one-third the stem DOB of that section.

Minimize limb limitations by logical log making, aim at obtaining the longest sawlog length. For example, for a tree with two staggered limbs combining to form a stopper, bucking between the limbs may give a longer sawlog length.

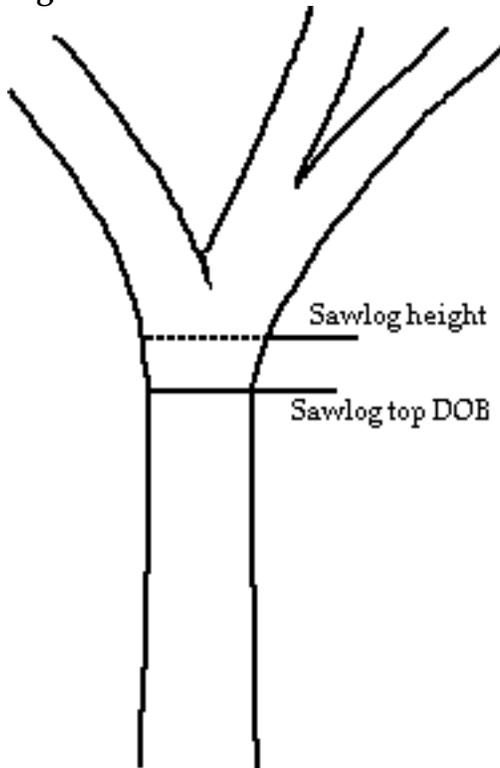
In situations where limbs are a limiting factor in determining merchantable length, length is taken to the point where the limbs divide the diameter of the merchantable section (Figure 22).

As long as a merchantable log, 8 feet or longer, is present above an unmerchantable section, no sawlog length reduction is made because of an unmerchantable piece.

In the case of a tree forking above DBH, sawlog length is taken on the trunk yielding the greatest length.

Use a height pole for heights to 40 feet, over 40 feet use a clinometer.

Figure 22



Sawlog Top Diameter Outside Bark (SDOB) 3 digits: Item 45

For each sawtimber-sized tree, record sawlog top DOB to the last tenth-inch, using a three-digit code. For example, record 7.0" as 070. The minimum top DOB recorded for hardwoods is 9.0" and 7.0" for softwoods. If a tree's sawlog length terminates before reaching minimum top DOB, or if the sawlog length is affected by a fork or the flare from a limb, record the smallest diameter immediately below the swell. Sawlog top DOB is easily measured with the Wheeler Pentaprism ("Dobber").

Board-Foot Cull (CULB) 4 digits: Item 46

Board-foot cull is the volume within the sawlog portion of a tree that cannot be recovered for use as lumber because of rot, sweep, crook, fork or other defects.

The following are included in cull volumes.

- The entire volume of tree sections that do not meet minimum log-grade requirements.
- The entire volume in any one-foot or longer section of a tree less than 50 percent sound.
- The cull volume only in any one-foot or longer section of a tree greater than 50 percent sound.
- Computed volume for sweep and crook.
- Forks or stoppers.

Board-foot measure is computed from a squared-off section within the circular form of a log. This is the only portion which contains lumber. Therefore, shallow defects that are expected to be cut in slabbing for lumber and rounding for veneer are ignored.

Determine the board-foot cull volume in logs and/or cull sections by estimating the length and DOB at midpoint and looking up the board-foot volume in the "Board-foot Volume of Short Logs" table of the Tatum Guides. In determining cull due to sweep and crook, minimize the defect by logical log making aimed at obtaining maximum high-grade material. Sweep and crook tables and guides for determining the proportion of cull are found in the Tatum Guides in the appendix.

Use a four-digit code to record cull volume, to the last board foot. When no sawlog is present, record a zero " 0 " in board-foot cull on sawtimber-sized trees.

Bole Length (BOLL) 3 digits: Item 47

Bole length of all live trees ≥ 5.0 " DBH is determined between the top of a one-foot stump and 4.0" DOB, or to the point where the central stem breaks into limbs and above which there is no 4.0" DOB. On a 20-class sawlog-size tree, forking above DBH, bole length is taken on the same trunk as sawlog length.

Record length to the last whole foot using a three-digit code. For example, a bole length of 23 feet includes lengths of 23.0 feet up to, but not including, 24.0 feet and is coded as 023.

Note: Use a clinometer on heights over 40 feet.

Bole Length Top Dob (BDOB) 3 digits: Item 48

Top DOB is measured to the highest possible 4.0" DOB or where the central stem or branch breaks into limbs and above which there is no 4.0" DOB. Use a three-digit code to record bole top DOB to the last tenth-inch. Bole length top DOB is measured at the smallest point before the bole length terminates. If the bole length is taken to the bottom of a fork or the flare from a limb, record the smallest diameter immediately below the swell.

Cubic-Foot Cull (CULC) 4 digits: Item 49

For all live trees, cubic-foot cull is the cubic-foot volume of decayed or missing wood up to the bole length top.

Cubic-foot cull may be computed by determining the length of the section affected, and the midpoint DOB. The volume of the section can then be looked up in the table, "Cubic Foot Volumes of Short Logs," of the Tatum Guides. Using a four-digit code, estimate and record cull to the last one-tenth cubic foot (0.1 cubic foot is recorded as 0001).

Diameter (CDWL, CD90) 2 digits: Item 50

Eastern redcedar and Rocky mountain juniper, Plains States only

For all live eastern redcedar trees 5.0" dbh or larger on full measurement plots, measure the crown diameter at the widest point and the crown diameter perpendicular (90 degrees) to the widest point. Measure and record both items to the nearest foot. Crown diameter is measured drip line to drip line. Only the live crown should be considered. See figure 22.

This data will be utilized to develop eastern redcedar tree crown cover equations based on basal area, stand composition, dbh, and crown ratios. The Plains States have experienced a dramatic increase in the number of eastern redcedar trees in the last 20 years. This increase has primarily occurred in pastures and abandoned croplands. As the eastern redcedar become established, they reduce forage production which is of economic concern to the landowners. This data is needed to develop methods of determining forage reduction of eastern redcedar.

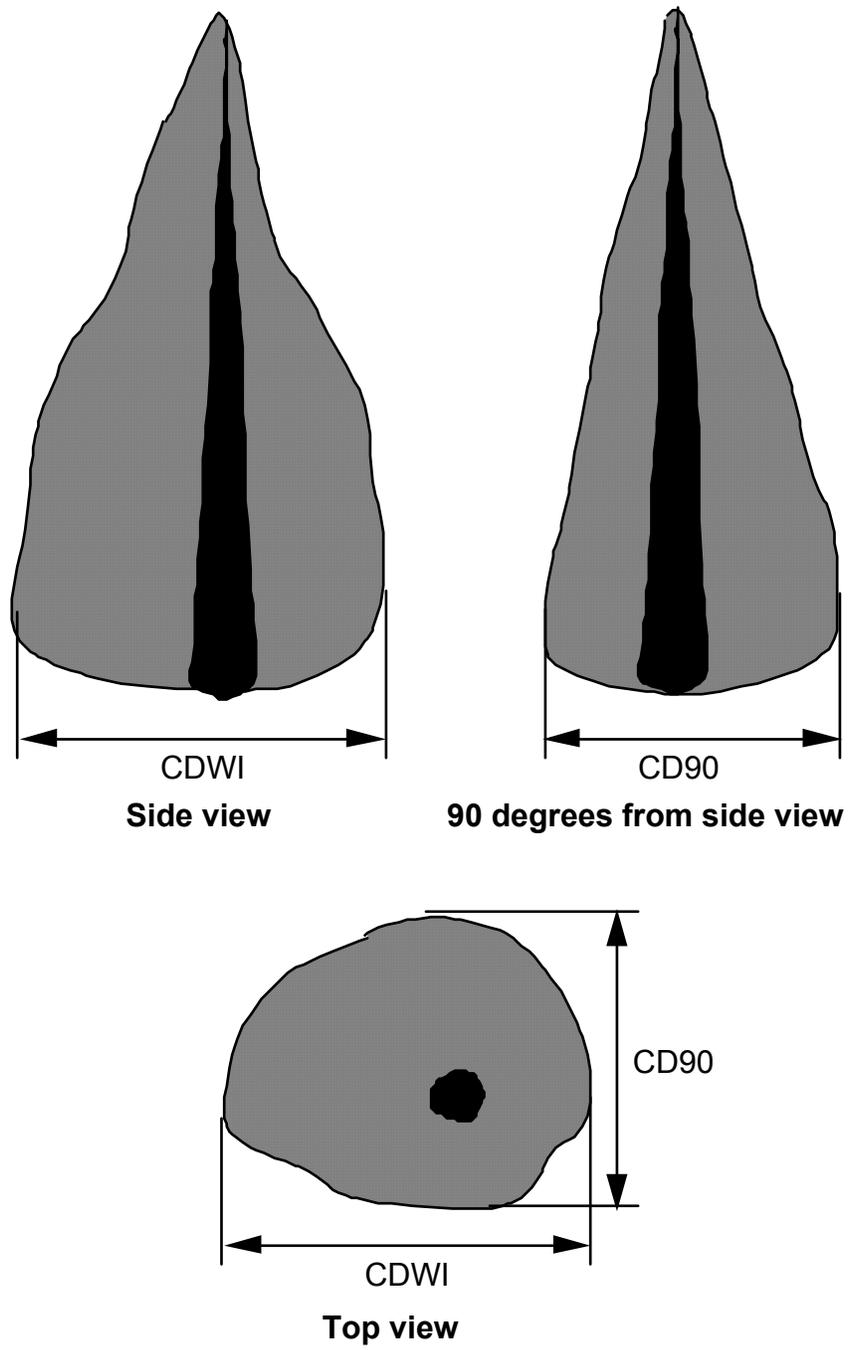


Figure 23. Eastern redcedar crown diameter measurements.

Site Tree Records: Items 51-59

Site index is the height attainable by the average dominant and codominant trees of a species in a stand at an index age (usually 50 years in the eastern states). It reflects the combined effects of different environmental factors, and is used as an indicator of stand productivity. Site index is determined in the field using available site index curves appropriate for the area. A site index is needed for each condition, however the same trees may be used for more than one condition if the field crew determines that it is appropriate to do so. This can be done when the two conditions do not have different site indexes. If the same trees are being used for more than one condition they must be entered for each condition that they are being used for.

Site Tree Data

For all trees measured for site index information record the following items on the site tree record.

- Item 51 Condition number that the site tree is in (CON#)
- Item 52 Tree number (TR#) start numbering at 1
- Item 53 Diameter at breast height (DBH)
- Item 54 Species (SPP)
- Item 55 Total height (HGHT)
- Item 56 Bored age (BAGE)
- Item 57 Total age (TAGE)
- Item 58 Years added to bored age to get total age (YADD)
- Item 59 Site index (from site curves), also recorded on the condition class record (SI)

For remeasurement plots, a new site index is recorded.

Site Tree Selection

For each condition (or conditions that you decide have the same site index) measure a minimum of three site index trees. Use tree species that are of the forest type from the condition you are sampling. For example, if the condition is a forest type of aspen, try to use aspen for site index trees. If none are available, use any suitable tree, as long as a site index curve is available for it.

Generally, site trees should be vigorous in growth and currently putting on height. Avoid trees declining in vigor or stagnated. All site trees should have been dominant or codominant throughout their lives. Do not use trees that have been suppressed during early years and then released. These can be identified by increment cores that show growth rings close together in early years followed by a sudden and marked widening of growth rings. Avoid trees with major injuries.

Finding vigorous, free growing trees is more important than finding the largest trees in the stand. Site trees should be as near the index age of the site index curves for that species. Look for trees that are 20 to 80 years old for curves based on an index age of 50 years.

Reliable site index curves are available for most tree species that are major components of forest types in the survey area. Be aware of what species have site index curves available. Do not collect site index data on a species unless curves are available. Refer to Site Index book.

Site trees should be well distributed over the plot area. If there are no suitable site trees on the plot, select nearby trees from the same general aspect, elevation, and soil type. Collect and record data on more than one species if it is needed to get a good site index estimate. Do not select permanent tally trees. Do not select high value trees.

Note the locations of the site trees on the sub-plot diagram.

Growth Intercept Method

If suitable trees are not available to use with site index curves, the growth intercept method of measuring site index is an alternative. This method has been proposed and tables developed for some tree species that have limbs showing distinct annual whorls (i.e. red pine and southern pines). This method is applied in situations where only young trees (less than 25 years old) of these species are available for site index indicators. You should know what species have these tables available and how to use them. If this method is used, mention it in the "Notes" section and record height, age and diameter as usual on the plot sheet.

For red pine:

<u>Height growth during the last 5 years</u>	<u>Site Index (Estimated)</u>
4 feet	46
5 feet	50
6 feet	53
7 feet	57
8 feet	60
9 feet	63
10 feet	67
11 feet	70
12 feet	74

Minimum Stand Productivity

In order for a stand to be classified as productive commercial land, there must be at least one tree in the condition that has a site index that meets the following minimum site indices.

<u>Species</u>	<u>Minimum Site Index</u>
N. white cedar	15
Black spruce	20
Tamarack	20
E. red cedar	25
R. mountain juniper	25
All other species	35

(Remember, if you can not find a tree of a species in the forest type, use a different species.)

Techniques of Site Data Collection

Carefully measure tree height and age to get a good estimate of site index.

Tree Height (HGHT) 3 digits: Item 55

This measurement is taken to the nearest whole foot. For trees up to 30 feet in height, use the 30-foot height pole. Use a clinometer and tape for trees greater than 30 feet. Make a visual estimate of tree height before choosing the scale on the clinometer. Choose a place to stand that gives you a clear view of both the top and base of the tree. The distance from where you stand to the base of the tree should be approximately equal to the total tree height. Try to keep the sun at your back.

Bored Age (BAGE) 3 digits: Item 56

Total Age (TAGE) 3 digits: Item 57

Years Added To Bored Age (YADD) 2 digits: Item 57

This measurement is taken at DBH using an increment borer. Keep your increment borer clean and sharp to get clean, smooth cores. WD-40, sharpening stones and instructions are available in the office. During the winter, it is best to remove your borer from the tree before taking time to count the core.

Ring porous hardwoods are generally easier to count. Growth rings of many softwoods and diffuse porous hardwoods can be difficult to see. To get an accurate count on these species, it may help to moisten the core and hold it up to the light. If growth rings are very difficult to see, put the core in a plastic straw, label it, and take it with you. Later, try soaking the core, shaving one side of it clean and holding it up to or under a strong light. Count growth rings more than once and have your partner count them to reach agreement on the tree age.

After counting growth rings to age d.b.h. age, convert to total age by adding years needed from information found on the same page as the site index curve is located for that species.

Site Index (SI) 3 digits: Item 59

On the site tree record the site index of each tree as found on the site index curve. Record the highest value obtained for site index on site tree record and on the condition class records for every condition that the site index applies to.

Site Tree Species (SPP) 3 digits: Item 54

Record a three-digit code for the species of tree bored in determining site index on the site tree record. Also record this information with site index on the condition class records for every condition that the site index applies to.

Appendix

Biomass Study "Shrubs" (SPP): Item 24

Minnesota and Michigan States Shrub Species

Code	Tree History	Common Name	Scientific Name
230	81	Yew	<i>Taxus canadensis</i>
353	80	Speckled alder	<i>Alnus rugosa</i>
356	80	Alder species	<i>Alnus spp.</i>
380	80	Bog birch	<i>Betula pumila</i>
490	80	Dogwood (gray, alternate-leafed)	<i>Cornaceae</i>
492	80	Red osier dogwood	<i>Cornus stolonifera</i>
493	80	Alternate-leafed dogwood	<i>Cornus alternifolia</i>
494	81	Bunchberry	<i>Cornus canadensis</i>
500	80	Hawthorn	<i>Crataegus spp.</i>
592	80	Black alder, mountain holly, winterberry	<i>Ilex verticillata</i>
712	81	Virginia creeper	<i>Parthenocissus spp.</i>
749	81	Labrador tea	<i>Ledum groenlandicum</i>
750	81	Leatherleaf	<i>Chamaedaphne calyculata</i>
751	81	Bog laurel	<i>Kalmia polifolia</i>
764	80	Sandcherry	<i>Prunus pumila</i>
849	81	Sweetfern	<i>Comptonia peregrina</i>
853	80	Witch hazel	<i>Hamamelis virginiana</i>
854	80	Common ninebark	<i>Physocarpus opulifolius</i>
855	80	Juneberry	<i>Amelanchier spp.</i>
856	80	Beaked hazel	<i>Corylus cornuta</i>
857	80	Prickly ash	<i>Zanthoxylum americanum</i>
858	80	American hazel	<i>Corylus americana</i>
859	80	Buckthorn species	<i>Rhamnus spp.</i>
861	80	Leatherwood	<i>Dirca palustris</i>
862	80	Viburnum, Nannyberry	<i>Viburnum spp.</i>
863	80	Elderberry	<i>Sambucus spp.</i>
864	80	Sumac	<i>Rhus spp.</i>
865	81	Gooseberry-currant	<i>Ribes spp.</i>
867	81	Raspberry-Blackberry	<i>Rubus spp.</i>
868	81	Rose	<i>Rosa spp.</i>
870	80	American bladdernut	<i>Staphylea trifolia</i>
873	81	Black huckleberry	<i>Gaylussacia bassata</i>
874	81	Blueberry, Bilberry	<i>Vaccinium spp.</i>
875	81	Bush honeysuckle	<i>Dierovilla lonicera</i>
876	81	Honeysuckle	<i>Lonicera spp.</i>
880	80	Buffaloberry	<i>Shepherdia spp.</i>

Minnesota and Michigan Shrub Species, *continued*

Code	Tree History	Common Name	Scientific Name
902	81	Poison ivy	<i>Rhus radicans</i>
907	80	New Jersey tea	<i>Ceanothus americanus</i>
909	81	Bearberry	<i>Arctostta paylos</i>
912	80	Buttonbush	<i>Cephalanthus occidentalis</i>
913	80	Russian or Autumn olive	<i>Eleagnus spp.</i>
920	80	Willow species (clumped)	<i>Salix spp.</i>
920	80	Willow sp.(single stemmed)	<i>Salix spp.</i>
932	81	Greenbrier	<i>Smilax spp.</i>
978	81	Bog rosemary	<i>Andromeda glaucophylla</i>
982	81	Grape	<i>Vitis spp.</i>
984	81	Strawberry	<i>Fragaria spp.</i>
997	80	Other species	<i>(Tall, woody perennials)</i>
998	81	Other species	<i>(Other perennials)</i>

Wisconsin Shrub Species

Code	Tree History	Common Name	Scientific Name
230	81	Yew	<i>Taxus canadensis</i>
356	80	Alder	<i>Alnus spp.</i>
490	80	Dogwood	<i>Cornus spp.</i>
500	80	Hawthorn	<i>Crataegus spp.</i>
592	80	Black Alder	<i>Ilex verticillata</i>
712	81	Virginia Creeper	<i>Parthenocissus quinquefolia</i>
749	81	Labrador Tea	<i>Ledum groenlandicum</i>
750	81	Leatherleaf	<i>Chamaedaphne calyculata</i>
751	81	Bog laurel	<i>Kalmia polifolia</i>
849	81	Sweet fern	<i>Comptonia peregrina</i>
853	80	Witch-hazel	<i>Hamamelis virginiana</i>
854	80	Common ninebark	<i>Physocarpus opulifolius</i>
855	80	Juneberry	<i>Amelanchier spp.</i>
856	80	Hazelnut	<i>Corylus spp.</i>
857	80	Pricky Ash	<i>Zanthoxylum americanum</i>
859	80	Buckthorn	<i>Rhamnus spp.</i>
861	80	Leatherwood	<i>Dirca palustris</i>
862	80	Viburnum	<i>Viburnum spp.</i>
863	80	Elderberry	<i>Sambucus spp.</i>
864	80	Sumac	<i>Rhus spp.</i>
865	81	Gooseberry-Current	<i>Ribes spp.</i>
867	81	Raspberry-Blackberry	<i>Rubus spp.</i>
868	81	Rose	<i>Rosa spp.</i>
870	81	American bladdernut	<i>Staphylea trifolia</i>
874	81	Blueberry	<i>Vaccinium spp.</i>
875	81	Bush honeysuckle	<i>Dierovilla lonicera</i>
876	81	Honeysuckle	<i>Lonicera spp.</i>
880	80	Buffaloberry	<i>Shepherdia spp.</i>
902	81	Poison ivy	<i>Rhus radicans</i>
907	80	New Jersey Tea	<i>Ceanothus americanus</i>
913	80	Russian or Antunm olive	<i>Elaeagnus angustifolia</i>
920	80	Willow species	<i>Salix spp.</i>
932	81	Green briar	<i>Smilax spp.</i>
978	81	Bog rosemary	<i>Andromeda glaucophylla</i>
982	81	Grape	<i>Vitis spp.</i>
984	81	Strawberry	<i>Fragaria spp.</i>
997	80	Other species	<i>Tall woody perennials</i>
998	81	Other species	<i>Other perennials</i>

Kansas Shrub Species

Code	Tree History	Common Name	Scientific Name
463	80	Dwarf hackberry	<i>Celtis tenuifolia</i>
490	80	Dogwood	<i>Cornaceae drummondii</i>
712	81	Virginia Creeper	<i>Parthenocissus spp.</i>
764	80	Sandcherry	<i>Prunus pumila</i>
854	80	Common ninebark	<i>Physocarpus opulifolius</i>
855	80	Serviceberry	<i>Amelanchier sp.</i>
857	80	Prickly ash	<i>Zanthoxylum americanum</i>
858	80	American hazel	<i>Corylus americana</i>
859	80	Buckthorn	<i>Rhamnus lanceolata</i>
862	80	Viburnum	<i>Viburnum spp.</i>
863	80	Elderberry	<i>Sambucus canadensis</i>
864	80	Sumac	<i>Rhus spp.</i>
865	81	Gooseberry	<i>Ribes spp.</i>
867	81	Raspberry-blackberry	<i>Rubus spp.</i>
868	81	Rose	<i>Rosa spp.</i>
869	80	Shrubby Trefoil	<i>Ptelea trifoliata</i>
870	81	American Bladdernut	<i>Staphylea trifolia</i>
874	81	Bilberry-Blueberry	<i>Vaccinium spp.</i>
876	81	Honeysuckle	<i>Lonicera spp.</i>
877	81	Snowberry/Coralberry	<i>Symphoricarpos occidentalis/orbiculatus</i>
881	81	Multiflora rose	<i>Rosa multiflora</i>
902	81	Poison ivy	<i>Rhus radicans</i>
907	80	New Jersey tea/red root	<i>Ceanothus americanus/herbaceous</i>
913	80	Russian Olive	<i>Elaeagnus angustifolia</i>
915	80	Wild crabapple	<i>Pyrus ioensis</i>
916	80	Lead plant /false indigo	<i>Amorpha canescens/fruiticosa</i>
917	80	Wahoo	<i>Euonymus atropurpurea</i>
918	81	Bittersweet	<i>Celastrus scandens</i>
920	80	Willow species (clumped)	<i>Salix spp.</i>
920	80	Willow sp.(single stemmed)	<i>Salix spp.</i>
924	81	Raccoon grape	<i>Ampelopsis cordata</i>
925	80	Tamarisk	<i>Tamarix ramosissima</i>
928	80	Rabbitbrush	<i>Chrysothamus pulchellus</i>
929	81	Sandhill sage	<i>Artemisia filifolia</i>
982	81	Grape	<i>Vitis spp.</i>
997	80	Other species	<i>Tall, woody perennials</i>
998	81	Other species	<i>Other perennials</i>

Nebraska Shrub Species

Code	Tree History	Common Name	Scientific Name
059	81	Creeping juniper	<i>Juniperus horizontalis</i>
069	81	Common juniper	<i>Juniperus communis</i>
490	80	Dogwood	<i>Cornaceae drummondii</i>
492	80	Redosier dogwood	<i>Cornus sericea</i>
496	80	Gray-stemmed dogwood	<i>Cornus racemosa</i>
712	81	Virginia creeper	<i>Parthenocissus sp.</i>
764	80	Sandcherry	<i>Prunus pumila</i>
854	80	Common ninebark	<i>Physocarpus opulifolius</i>
855	80	Serviceberry	<i>Amelanchier sp.</i>
857	80	Prickly ash	<i>Zanthoxylum americanum</i>
858	80	American hazelnut	<i>Corylus americana</i>
859	80	Buckthorn	<i>Rhamnus lanceolata</i>
862	80	Viburnum	<i>Viburnum sp.</i>
863	80	Elderberry	<i>Sambucus canadensis</i>
864	80	Sumac	<i>Rhus sp.</i>
865	81	Gooseberry	<i>Ribes sp.</i>
867	81	Raspberry/Blackberry	<i>Rubus sp.</i>
868	81	Rose	<i>Rosa sp.</i>
876	81	Honeysuckle	<i>Lonicera sp.</i>
877	81	Snowberry/coralberry	<i>Symphoricarpos occidentalis/orbiculatus</i>
880	80	Buffaloberry	<i>Shepherdia canadensis</i>
902	81	Poison ivy	<i>Rhus radicana</i>
907	80	New Jersey Tea/redroot	<i>Ceanothus americanus/herbaceous</i>
912	80	Buttonbush	<i>Cephalanthus occidentalis</i>
913	80	Russian olive	<i>Elaeagnus angusti</i>
916	80	Lead plant/false indigo	<i>Amorpha canescens, fruticosa</i>
917	80	Wahoo	<i>Euonymus atropurpurea</i>
918	81	Bittersweet	<i>Celastrus scandens</i>
920	80	Willow species (single stem)	<i>Salix spp.</i>
924	81	Raccoon grape	<i>Ampelopsis cordata</i>
928	80	Rabbitbrush	<i>Chrysothamnus pulchellus</i>
929	81	Sandhill sage	<i>Artemisia filifolia</i>
932	81	Greenbriar	<i>Smilax spp.</i>
982	81	Grape	<i>Vitis spp.</i>
997	80	Other species	<i>Tall, woody perennials</i>
998	81	Other species	<i>Other perennials</i>

North Dakota Shrub Species

Code	Tree History	Common Name	Scientific Name
059	81	Creeping juniper	<i>Juniperus horizontalis</i>
492	80	Red-osier dogwood	<i>Cornus stolonifera</i>
712	81	Virginia creeper	<i>Parthenocissus spp.</i>
764	80	Sand cherry	<i>Prunus pumila</i>
855	80	Service-berry	<i>Amelanchier spp.</i>
856	80	Beaked hazelnut	<i>Corylus cornuta</i>
858	80	American hazelnut	<i>Corylus americana</i>
859	80	Buckthorn	<i>Rhamnus spp.</i>
862	80	Viburnum	<i>Viburnum spp.</i>
864	80	Sumac	<i>Rhus spp.</i>
865	81	Gooseberry	<i>Ribes spp.</i>
867	81	Raspberry-Blackberry	<i>Rubus spp.</i>
868	81	Rose	<i>Rosa spp.</i>
876	81	Honeysuckle	<i>Lonicera spp.</i>
877	81	Snowberry/Coral berry	<i>Symphoricarpos spp.</i>
880	80	Buffaloberry	<i>Shepherdia canadensiss</i>
902	81	Poison ivy	<i>Rhus radicans</i>
913	80	Russian olive	<i>Elaeagnus spp.</i>
916	80	Lead-plant, false indigo	<i>Amorpha spp.</i>
920	80	Willow species (single stem)	<i>Salix spp.</i>
928	80	Rabbit brush	<i>Chrysothamnus pulchellus</i>
982	81	Grape	<i>Vitis spp.</i>
985	80	Highbrush cranberry	<i>Viburnum trilobum</i>
997	80	Other species (Tall woody, perennials)	
998	81	Other species (other perennials)	

South Dakota Shrub Species

Code	Tree History	Common Name	Scientific Name
059	81	Creeping juniper	<i>Juniperus horizontalis</i>
069	81	Common juniper	<i>Juniperus communis</i>
490	80	Dogwood	<i>Cornaceae spp.</i>
712	81	Virginia creeper	<i>Parthenocissus spp.</i>
764	80	Sand cherry, Western S.	<i>Prunus pumila</i>
854	80	Common ninebark	<i>Physocarpus opulifolius</i>
855	80	Service-berry	<i>Amelanchier spp.</i>
856	80	Beaked hazelnut	<i>Corylus cornuta</i>
859	80	Buckthorn	<i>Rhamnus spp.</i>
862	80	Viburnum, Newberry	<i>Viburnum spp.</i>
863	80	Elderberry	<i>Sambucus spp.</i>
864	80	Sumac	<i>Rhus spp.</i>
865	81	Gooseberry-Current	<i>Ribes spp.</i>
867	81	Raspberry-Blackberry	<i>Rubus spp.</i>
868	81	Rose	<i>Rosa spp.</i>
876	81	Honeysuckle	<i>Lonicera spp.</i>
877	81	Snowberry/Coral berry	<i>Symphoricarpos spp.</i>
880	80	Buffaloberry	<i>Shepherdia canadensis</i>
902	81	Poison ivy	<i>Rhus radicans</i>
909	81	Bearberry	<i>Arctostaphylos uva-ursi</i>
913	80	Russian olive-Silverberry	<i>Elaeagnus spp.</i>
916	80	Lead-plant, false indigo	<i>Amorpha spp.</i>
918	81	Bittersweet	<i>Celastrus scandens</i>
920	80	Willow (single stem)	<i>Salix spp.</i>
929	81	Sandhill sage	<i>Artemisia filifolia</i>
982	81	Grape	<i>Vitis spp.</i>
985	80	Highbrush cranberry	<i>Viburnum trilobum</i>
997	80	Other species	<i>(Tall woody, perennials)</i>
998	81	Other species	<i>(Other perennials)</i>

Tree History (shrub history) 80 = Tall, woody, perennials

Tree History (shrub history) 81 = Other perennials

Tree Species (SPP): Item 32

Minnesota and Michigan tree species

Code	Common Name	Scientific Name
012	Balsam fir	<i>Abies balsamea</i>
068	Eastern redcedar	<i>Juniperus virginiana</i>
071	Tamarack	<i>Larix laricina</i>
091	Norway spruce	<i>Picea abies</i>
093	Engelmann spruce	<i>Picea engelmanni</i>
094	White spruce	<i>Picea glauca</i>
095	Black spruce	<i>Picea mariana</i>
105	Jack pine	<i>Pinus banksiana</i>
125	Red pine	<i>Pinus resinosa</i>
129	White pine	<i>Pinus strobus</i>
130	Scotch pine	<i>Pinus sylvestris</i>
136	Austrian pine	<i>Pinus nigra</i>
241	Northern white-cedar	<i>Thuja occidentalis</i>
261	Eastern hemlock	<i>Tsuga canadensis</i>
313	Boxelder	<i>Acer negundo</i>
314	Black maple	<i>Acer nigrum</i>
315*	Striped maple	<i>Acer pensylvanicum</i>
316	Red maple	<i>Acer rubrum</i>
317	Silver maple	<i>Acer saccharinum</i>
318	Sugar maple	<i>Acer saccharum</i>
319*	Mountain maple	<i>Acer spicatum</i>
331	Ohio buckeye	<i>Aesculus glabra</i>
341*	Ailanthus, tree-of-heaven	<i>Ailanthus altissima</i>
371	Yellow birch	<i>Betula alleghaniensis</i>
372	Sweet birch	<i>Betula lenta</i>
373	River birch	<i>Betula nigra</i>
375	Paper birch	<i>Betula papyrifera</i>
391*	American hornbeam(musclewood)	<i>Carpinus caroliniana</i>
402	Bitternut hickory	<i>Carya cordiformis</i>
403	Pignut hickory	<i>Carya glabra</i>
405	Shellbark hickory	<i>Carya laciniosa</i>
407	Shagbark hickory	<i>Carya ovata</i>
409	Mockernut hickory	<i>Carya tomentosa</i>
421	American chestnut	<i>Castanea dentata</i>
462	Hackberry	<i>Celtis occidentalis</i>
471*	Eastern redbud	<i>Cercis canadensis</i>
491	Flowering dogwood	<i>Cornus florida</i>
500*	Hawthorn	<i>Crataegus spp.</i>
531	American beech	<i>Fagus grandifolia</i>
541	White ash	<i>Fraxinus americana</i>

* Noncommercial tree species.

Minnesota and Michigan tree species, *continued*

Code	Common Name	Scientific Name
543	Black ash	<i>Fraxinus nigra</i>
544	Green ash	<i>Fraxinus pennsylvanica</i>
552	Honeylocust	<i>Gleditsia triacanthos</i>
571	Kentucky coffeetree	<i>Gymnocladus dioicus</i>
601	Butternut	<i>Juglans cinerea</i>
602	Black walnut	<i>Juglans nigra</i>
621	Yellow poplar	<i>Liriodendron tulipifera</i>
641*	Osage-orange	<i>Maclura pomifera</i>
660*	Apple	<i>Malus spp.</i>
682	Red mulberry	<i>Morus rubra</i>
693	Black tupelo	<i>Nyssa sylvatica</i>
701*	Eastern hophornbeam (ironwood)	<i>Ostrya virginiana</i>
731	Sycamore	<i>Platanus occidentalis</i>
741	Balsam poplar	<i>Populus balsamifera</i>
742	Eastern cottonwood	<i>Populus deltoides</i>
743	Bigtooth aspen	<i>Populus grandidentata</i>
746	Quaking aspen	<i>Populus tremuloides</i>
761*	Pincherry	<i>Prunus pensylvanica</i>
762	Black cherry	<i>Prunus serotina</i>
763*	Chokecherry	<i>Prunus virginiana</i>
802	White oak	<i>Quercus alba</i>
804	Swamp white oak	<i>Quercus bicolor</i>
806	Scarlet oak	<i>Quercus coccinea</i>
809	Northern pin oak	<i>Quercus ellipsoidalis</i>
823	Bur oak	<i>Quercus macrocarpa</i>
826	Chinkapin oak	<i>Quercus muehlenbergii</i>
830	Pin oak	<i>Quercus palustris</i>
832	Chestnut oak	<i>Quercus prinus</i>
833	Northern red oak	<i>Quercus rubra</i>
837	Black oak	<i>Quercus velutina</i>
851*	Mountain ash	<i>Sorbus</i>
901	Black locust	<i>Robinia pseudoacacia</i>
921*	Peachleaf willow	<i>Salix amygdaloides</i>
922	Black willow	<i>Salix nigra</i>
923*	Diamond willow	<i>Salix eriocephala</i>
931	Sassafras	<i>Sassafras albidum</i>
951	American basswood	<i>Tilia americana</i>
972	American elm	<i>Ulmus americana</i>
975	Slippery elm	<i>Ulmus rubra</i>
977	Rock elm	<i>Ulmus thomasii</i>

* Noncommercial tree species.

Wisconsin tree species

Code	Common Name	Scientific Name
012	Balsam fir	<i>Abies balsamea</i>
068	Eastern redcedar	<i>Juniperus virginiana</i>
071	Tamarack	<i>Larix laricina</i>
091	Norway spruce	<i>Picea abies</i>
094	White spruce	<i>Picea glauca</i>
095	Black spruce	<i>Picea mariana</i>
105	Jack pine	<i>Pinus banksiana</i>
125	Red pine	<i>Pinus resinosa</i>
129	Eastern white pine	<i>Pinus strobus</i>
130	Scotch pine	<i>Pinus sylvestris</i>
241	Northern white-cedar	<i>Thuja occidentalis</i>
261	Eastern hemlock	<i>Tsuga canadensis</i>
313	Boxelder	<i>Acer negundo</i>
314	Black maple	<i>Acer nigrum</i>
315*	Striped maple	<i>Acer pensylvanicum</i>
316	Red maple	<i>Acer rubrum</i>
317	Silver maple	<i>Acer saccharinum</i>
318	Sugar maple	<i>Acer saccharum</i>
319*	Mountain maple	<i>Acer spicatum</i>
341*	Ailanthus, Tree of heaven	<i>Ailanthus altissima</i>
371	Yellow birch	<i>Betula alleghaniensis</i>
373	River birch	<i>Betula nigra</i>
375	Paper birch	<i>Betula papyrifera</i>
391*	American hornbeam	<i>Carpinus caroliniana</i>
402	Bitternut hickory	<i>Carya cordiformis</i>
403	Pignut hickory	<i>Carya glabra</i>
407	Shagbark hickory	<i>Carya ovata</i>
452	Northern Catalpa	<i>Catalpa speciosa</i>
462	Hackberry	<i>Celtis occidentalis</i>
500*	Hawthorn	<i>Crataegus sp.</i>
531	Beech	<i>Fagus grandifolia</i>

* Noncommercial tree species.

Wisconsin tree species, *continued*

Code	Common Name	Scientific Name
541	White ash	<i>Fraxinus americana</i>
543	Black ash	<i>Fraxinus nigra</i>
544	Green ash	<i>Fraxinus pennsylvanica</i>
552	Honeylocust	<i>Gleditsia triacanthos</i>
601	Butternut	<i>Juglans cinerea</i>
602	Black walnut	<i>Juglans nigra</i>
660*	Apple	<i>Malus sp.</i>
682	Red mulberry	<i>Morus rubra</i>
701*	Eastern hophornbeam	<i>Ostrya virginiana</i>
741	Blasam poplar	<i>Populus balsamifera</i>
742	Eastern cottonwood	<i>Populus deltoides</i>
743	Bigtooth aspen	<i>Populus grandidentata</i>
746	Quaking aspen	<i>Populus tremuloides</i>
761*	Pincherry	<i>Prunus pensylvanica</i>
762	Black cherry	<i>Prunus serotina</i>
763*	Chokecherry	<i>Prunus virginiana</i>
765*	Canada plum	<i>Prunus nigra</i>
766*	Wild plum	<i>Prunus americana</i>
802	White oak	<i>Quercus alba</i>
804	Swamp white oak	<i>Quercus bicolor</i>
809	Northern pin oak	<i>Quercus ellipsoidalis</i>
823	Bur oak	<i>Quercus macrocarpa</i>
833	Northern red oak	<i>Quercus rubra</i>
837	Black oak	<i>Quercus velutina</i>
851*	Mountain ash	<i>Sorbus spp.</i>
901	Black locust	<i>Robinia pseudoacacia</i>
921*	Peachleaf willow	<i>Salix amygdaloides</i>
922	Black willow	<i>Salix nigra</i>
951	American basswood	<i>Tilia americana</i>
972	American elm	<i>Ulmus americana</i>
975	Slippery elm	<i>Ulmus rubra</i>
977	Rock elm	<i>Ulmus thomasii</i>

* Noncommercial tree species.

Kansas tree species

Code	Common Name	Scientific Name
068	Eastern redcedar	<i>Juniperus virginiana</i>
313	Boxelder	<i>Acer negundo</i>
314	Black maple	<i>Acer nigrum</i>
317	Silver maple	<i>Acer saccharinum</i>
318	Sugar maple	<i>Acer saccharum</i>
333*	Texas buckeye	<i>Aesculus glabra var. arguta</i>
341*	Ailanthus, Tree of heaven	<i>Ailanthus altissima</i>
373	River birch	<i>Betula nigra</i>
926*	Chittamwood, gum bumelia	<i>Bumelia lanuginosa</i>
402	Bitternut hickory	<i>Carya cordiformis</i>
404	Pecan	<i>Carya illinoensis</i>
405	Shellbark hickory	<i>Carya laciniosa</i>
407	Shagbark hickory	<i>Carya ovata</i>
408	Black hickory	<i>Carya texana</i>
409	Mockernut hickory	<i>Carya tomentosa</i>
452	Northern catalpa	<i>Catalpa speciosa</i>
461	Sugarberry	<i>Celtis laevigata</i>
462	Hackberry	<i>Celtis occidentalis</i>
464	Netleaf hackberry	<i>Celtis reticulata</i>
471*	Eastern redbud	<i>Cercis canadensis</i>
491	Flowering dogwood	<i>Cornus florida</i>
500*	Hawthorn	<i>Crataegus sp.</i>
521	Common persimmon	<i>Diospyros virginiana</i>
541	White ash	<i>Fraxinus americana</i>
544	Green ash	<i>Fraxinus pennsylvanica</i>
546	Blue ash	<i>Fraxinus quadrangulata</i>
552	Honey locust	<i>Gleditsia triacanthos</i>
571	Kentucky coffeetree	<i>Gymnocladus dioicus</i>
602	Black walnut	<i>Juglans nigra</i>
603	Texas walnut	<i>Juglans microcarpa</i>
641*	Osage-orange	<i>Maclura pomifera</i>

* Noncommercial tree species.

Kansas tree species, *continued*

Code	Common Name	Scientific Name
660*	Apple sp.	<i>Malus sp.</i>
681	White mulberry	<i>Morus alba</i>
682	Red mulberry	<i>Morus rubra</i>
701*	Eastern hophornbeam	<i>Ostrya virginiana</i>
731	Sycamore	<i>Platanus occidentalis</i>
742	Eastern cottonwood	<i>Populus deltoides</i>
752	Silver poplar	<i>Populus alba</i>
762	Black cherry	<i>Prunus serotina</i>
763*	Chokecherry	<i>Prunus virginiana</i>
766*	Wild plum	<i>Prunus americana</i>
767*	Paw paw	<i>Asimina triloba</i>
802	White oak	<i>Quercus alba</i>
817	Shingle oak	<i>Quercus imbricaria</i>
823	Bur oak	<i>Quercus macrocarpa</i>
824	Blackjack oak	<i>Quercus marilandica</i>
826	Chinkapin oak	<i>Quercus muehlenbergii</i>
830	Pin oak	<i>Quercus palustris</i>
833	Northern red oak	<i>Quercus rubra</i>
834	Shumard oak	<i>Quercus shumardii</i>
835	Post oak	<i>Quercus stellata</i>
837	Black oak	<i>Quercus velutina</i>
839*	Dwarf chinkapin oak	<i>Quercus prinoides</i>
901	Black locust	<i>Robinia pseudocacia</i>
919*	Soapberry	<i>Sapindus drummondii</i>
921*	Peachleaf willow	<i>Salix amygdaloides</i>
922	Black willow	<i>Salix nigra</i>
931	Sassafras	<i>Sassafras albidum</i>
951	American basswood	<i>Tilia americana</i>
971	Winged elm	<i>Ulmus alata</i>
972	American elm	<i>Ulmus americana</i>
974	Siberian elm	<i>Ulmus pumila</i>
975	Slippery elm	<i>Ulmus rubra</i>
977	Rock elm	<i>Ulmus thomasii</i>

* Noncommercial tree species.

Nebraska tree species

Code	Common Name	Scientific Name
066	Rocky mountain juniper	<i>Juniperus scopulorum</i>
068	Eastern red cedar	<i>Juniperus virginiana</i>
096	Blue spruce	<i>Picea pungens</i>
105	Jack pine	<i>Pinus banksiana</i>
113	Limber pine	<i>Pinus flexilis</i>
122	Ponderosa pine	<i>Pinus ponderosa</i>
130	Scotch pine	<i>Pinus sylvestris</i>
136	Austrian pine	<i>Pinus nigra</i>
313	Boxelder	<i>Acer negundo</i>
317	Silver maple	<i>Acer saccharinum</i>
321*	Rocky mountain maple	<i>Acer glabrum</i>
331	Ohio buckeye	<i>Aesculus glabra</i>
341*	Ailanthus, Tree of heaven	<i>Ailanthus altissima</i>
375	Paper birch	<i>Betula papyrifera</i>
402	Bitternut hickory	<i>Carya cordiformis</i>
407	Shagbark hickory	<i>Carya ovata</i>
452	Northern catalpa	<i>Catalpa speciosa</i>
461	Sugarberry	<i>Celtis laevigata</i>
462	Hackberry	<i>Celtis occidentalis</i>
471*	Eastern redbud	<i>Cercis canadensis</i>
500*	Hawthorn	<i>Crataegus sp.</i>
541	White ash	<i>Fraxinus americana</i>
544	Green ash	<i>Fraxinus pennsylvanica</i>
552	Honeylocust	<i>Gleditsia triacanthos</i>
571	Kentucky coffeetree	<i>Gymnocladus dioicus</i>
602	Black walnut	<i>Juglans nigra</i>
641*	Osage-orange	<i>Maclura pomifera</i>
660*	Apple sp.	<i>Malus sp.</i>
681	White mulberry	<i>Morus alba</i>

* Noncommercial tree species.

Nebraska tree species, *continued*

Code	Common Name	Scientific Name
701*	Eastern hophornbeam	<i>Ostrya virginiana</i>
731	Sycamore	<i>Platanus occidentalis</i>
742	Eastern cottonwood	<i>Populus deltoides</i>
746	Quaking aspen	<i>Populus tremuloides</i>
752	Silver poplar	<i>Populus alba</i>
753	Narrowleaf cottonwood	<i>Populus angustifolia</i>
762	Black cherry	<i>Prunus serotina</i>
763*	Chokecherry	<i>Prunus virginiana</i>
766*	Wild plum	<i>Prunus americana</i>
767*	Paw paw	<i>Asimina triloba</i>
804	Swamp white oak	<i>Quercus bicolor</i>
823	Bur oak	<i>Quercus macrocarpa</i>
824	Blackjack oak	<i>Quercus marilandica</i>
826	Chinkapin oak	<i>Quercus muehlenbergii</i>
833	Northern red oak	<i>Quercus rubra</i>
835	Post oak	<i>Quercus stellata</i>
837	Black oak	<i>Quercus velutina</i>
839*	Dwarf chinkapin oak	<i>Quercus prinoides</i>
901	Black locust	<i>Robinia psuedocacia</i>
921*	Peachleaf willow	<i>Salix amygdaloides</i>
922	Black willow	<i>Salix nigra</i>
951	American basswood	<i>Tilia americana</i>
972	American elm	<i>Ulmus americana</i>
974	Siberian elm	<i>Ulmus pumila</i>
975	Slippery elm	<i>Ulmus rubra</i>

* Noncommercial tree species.

North Dakota tree species

Code	Common Name	Scientific Name
066	Rocky mountain juniper	<i>Juniperus scopulorum</i>
068	Eastern red cedar	<i>Juniperus virginiana</i>
070	larch (introduced)	<i>Larix spp.</i>
094	White spruce	<i>Picea glauca</i>
096	Blue spruce	<i>Picea pungens</i>
113	Limber pine	<i>Pinus flexilis</i>
122	Ponderosa pine	<i>Pinus ponderosa</i>
125	Red pine	<i>Pinus resinosa</i>
130	Scotch pine	<i>Pinus sylvestris</i>
313	Boxelder	<i>Acer negundo</i>
317	Silver maple	<i>Acer saccharinum</i>
331	Ohio buckeye	<i>Aesculus glabra</i>
373	River birch	<i>Betula nigra</i>
375	Paper birch	<i>Betula papyrifera</i>
462	Hackberry	<i>Celtis occidentalis</i>
491	Flowering dogwood	<i>Cornus florida</i>
500*	Hawthorn	<i>Crataegus sp.</i>
543	Black ash	<i>Fraxinus nigra</i>
544	Green ash	<i>Fraxinus pennsylvanica</i>
602	Black walnut	<i>Juglans nigra</i>
701*	Eastern hophornbeam	<i>Ostrya virginiana</i>
741	Balsam poplar	<i>Populus balsamifera</i>
742	Eastern cottonwood	<i>Populus deltoides</i>
745	Plains cottonwood	<i>Populus sargentii</i>
746	Quaking aspen	<i>Populus tremuloides</i>
752	Silver poplar	<i>Populus alba</i>
753	Narrow leaf cottonwood	<i>Populus anquistifolia</i>
754	Poplars (Introduced)	<i>Populus spp.</i>
761*	Pin cherry	<i>Prunus pensylvanica</i>
763*	Chokecherry	<i>Prunus virginiana</i>
766*	Wild plum	<i>Prunus amaricana</i>
823	Bur oak	<i>Quercus macrocarpa</i>
921*	Peachleaf willow	<i>Salix amygdaloides</i>
923*	Diamond willow	<i>Salix eriocephala</i>
927	White willow	<i>Salix alba</i>
951	American basswood	<i>Tilia americana</i>
972	American elm	<i>Ulmus americana</i>
974	Siberian elm	<i>Ulmus pumila</i>
975	Slippery elm	<i>Ulmus rubra</i>

* Noncommercial tree species.

South Dakota tree species

Code	Common Name	Scientific Name
015	White fir	<i>Abies concolor</i>
066	Rocky mountain juniper	<i>Juniperus scopulorum</i>
068	Eastern red cedar	<i>Juniperus virginiana</i>
070	larch (introduced)	<i>Larix spp.</i>
091	Norway spruce	<i>Picea abies</i>
094	White spruce	<i>Picea glauca</i>
096	Blue spruce	<i>Picea pungens</i>
105	Jack pine	<i>Pinus banksiana</i>
108	Lodgepole pine	<i>Pinus contorta</i>
122	Ponderosa pine	<i>Pinus ponderosa</i>
129	White pine	<i>Pinus strobus</i>
130	Scotch pine	<i>Pinus sylvestris</i>
136	Austrian pine	<i>Pinus nigra</i>
202	Douglas fir	<i>Pseudotsuga Menziesii</i>
241	Northern white-cedar	<i>Thuja occidentalis</i>
313	Boxelder	<i>Acer negundo</i>
314	Black maple	<i>Acer nigrum</i>
317	Silver maple	<i>Acer saccharinum</i>
318	Sugar maple	<i>Acer saccharum</i>
331	Ohio buckeye	<i>Aesculus glabra</i>
373	River birch	<i>Betula nigra</i>
374	Water birch	<i>Betula occidentalis</i>
375	Paper birch	<i>Betula papyrifera</i>
452	Northern catalpa	<i>Catalpa speciosa</i>
462	Hackberry	<i>Celtis occidentalis</i>
500*	Hawthorn	<i>Crataegus sp.</i>
544	Green ash	<i>Fraxinus pennsylvanica</i>
552	Honeylocust	<i>Gleditsia triacanthos</i>
571	Kentucky coffeetree	<i>Gymnocladus dioicus</i>
601	Butternut	<i>Juglans cinerea</i>
602	Black walnut	<i>Juglans nigra</i>
660*	Apple sp.	<i>Malus sp.</i>
681	White mulberry	<i>Morus alba</i>
682	Red mulberry	<i>Morus rubra</i>
701*	Eastern hophornbeam	<i>Ostrya virginiana</i>
731	Sycamore	<i>Platanus occidentalis</i>
741	Balsam poplar	<i>Populus balsamifera</i>
742	Eastern cottonwood	<i>Populus deltoides</i>
743	Bigtooth aspen	<i>Populus grandidentata</i>
745	Plains cottonwood	<i>Populus sargentii</i>

* Noncommercial tree species.

South Dakota tree species, *continued*

Code	Common Name	Scientific Name
746	Quaking aspen	<i>Populus tremuloides</i>
752	Silver poplar	<i>Populus alba</i>
754	Poplars (Introduced)	<i>Populus spp.</i>
762	Black cherry	<i>Prunus serotina</i>
763*	Chokecherry	<i>Prunus virginiana</i>
766*	Wild plum	<i>Prunus americana</i>
823	Bur oak	<i>Quercus macrocarpa</i>
851*	Mountain ash	<i>Sorbus spp.</i>
901	Black locust	<i>Robinia psuedocacia</i>
920*	Willow	<i>Salix spp.</i>
921*	Peachleaf willow	<i>Salix amygdaloides</i>
927*	White willow	<i>Salix alba</i>
951	American basswood	<i>Tilia americana</i>
972	American elm	<i>Ulnus americana</i>
974	Siberian elm	<i>Ulnus pumila</i>
975	Slippery elm	<i>Ulnus rubra</i>
977	Rock elm	<i>Ulmus thomasii</i>

* Noncommercial tree species.

Damage Or Cause Of Death (DAM): Item 38

Michigan damage codes and coding criteria

Code	Damage or Death	Hosts	Severity
000	Healthy	All species	<20% crown affected, no volume/degrade loss
100	Insect Defoliators	All species	>20% foliage affected
101	Budworms	Conifers	
104	Sawflies	Pines	
110	Forest tent caterpillar	Oaks, aspens N. hardwoods	
112	Large aspen tortrix	Aspens	
113	Gypsy moth	Hardwoods	Any occurrence
130	Shoot and Branch Insects	All species	Any occurrence on leader, >20% shoots/branches affctd
131	White pine weevil	White pine	
133	Saratoga spittlebug	Pines	
134	Scales	Hardwoods	
140	Branch Gall Insects	All species	>20% branches affected
143	Saperda shoot borer	poplars	
150	Bole Borers	All species	Any occurrence on bole
151	Two-lined chestnut borer	Oaks	
154	Sugar maple borer	Sugar maple	
155	Dioryctria borer	Red pine	
159	Pine bark adelgid	White pine	
170	Bark Beetles	Conifers	>20% crown dead/dying
171	Ips spp	Pines	
190	Root/Root Collar Insects	Conifers	Entire crown off color; dead tree
191	Root collar weevil	Hard pines	
200	Foliage Diseases	All species	>20% foliage affected
201	Needlecasts	Pines	
202	Anthracnose	Hardwoods	
210	Shoot Blights	All species	Any occurrence on leader, >20% shoots/branches affctd
212	Scleroderris	Red, jack, scots pines	
214	Diplodia tip blight	Pines	

Michigan damage codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
220	Mistletoes	Black and white spruces, jack pine, tamarack,	Any occurrence
231	Black knot	Black cherry	Any occurrence
233	Gall rusts	Jack, scots pine	Any occurrence
240	Bole Rusts	Pines	Any occurrence on bole
241	White pine blister rust	White pine	
242	Stem rusts of hardpines	Pines	
250	Bole Cankers	Hardwoods	Any occurrence on bole
251	Eutypella canker	Maple	
252	Hypoxylon canker	Aspens	
253	Cytospora canker	Spruces	
254	Nectria canker	Hardwoods	
257	Butternut canker	Butternut	
260	Stem Decay	All species	Any occurrence on bole
261	Phellinus pini	Conifers	
262	Phellinus tremulae	Aspens	
263	Inonotus obliquus	Birches	
271	Ash yellows	Ashes	Any occurrence
273	Beech bark disease	Beech	Any occurrence
281	Dutch elm disease	Elms	Any occurrence
282	Oak wilt	Oaks	Any occurrence
291	Annosus root rot	Conifers	Any occurrence
292	Armillaria root rot	All species	>20% crown dieback
300	Weather	All species	>20% crown affected; Any damage to leader or bole cambium
301	Hail		
302	Wind		
303	Lightening		
304	Frost cracks		
305	Frost kill (foliage and shoots)		
306	Winter drying		
307	Flooding		
308	Drought		
309	Ice/snow		

311	Sunscald		
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Michigan damage codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
400	Animal Damage	All species	Any damage to leader or bole cambium
401	Browse		
402	Moose/Elk/Deer		
403	Rabbit		
404	Beaver		
405	Squirrel		
406	Porcupine		
408	Sapsucker		
409	Cattle/domestic animals		
500	Fire	All species	>20% crown affected; Any damage to leader or bole cambium
600	Suppression	All species	Any damage to leader
760	Vine damage	All species	>20% crown affected; Any damage to leader or bole cambium
800	Logging/TSI	All species	
810	Mechanical Damage	All species	
820	Soil Compaction	All species	
811	Barbed wire, nails, etc.	All species	
830	Vehicle Damage	All species	Any occurrence
860	Chemical	All species	>20% crown affected
861	Pesticides	All species	
900	Unknown/Uncoded - Dead	All species	Use on dead trees only
901	Unknown/Uncoded - Defoliation	All species	>20% foliage affected
902	Unknown/Uncoded - Discoloration	All species	>20% foliage affected
903	Unknown/Uncoded - Decline/Dieback	All species	>20% crown affected
904	Unknown/Uncoded - Breakage	All species	>20% crown affected; any occurrence on bole
905	Unknown/Uncoded - Abnormal Growth Form in the Crown	- or All species	>20% crown affected
906	Unknown/Uncoded - Canker	- All species	Any occurrence on bole

907	Unknown/Uncoded Crack	-	All species	Any occurrence on bole
908	Unknown/Uncoded Abnormal Growth Form on the Bole	- or	All species	any occurrence causing a volume loss

Minnesota damage codes and coding criteria

Code	Damage or Death	Hosts	Severity
000	Healthy	All species	<20% crown affected No volume/degrade loss
100	Insect Defoliators	All species	>20% foliage affected
101	Budworms	Balsam fir White spruce Black Spruce Jack Pine	>20% defoliation
110	For. Tent Caterpillar	Hardwoods	>20% defoliation
113	Gypsy Moth	Hardwoods	Any occurrence
130	Shoot/Branch Insects	All species	Any occurrence on leader; >20% shoots/branches affected
131	White Pine Weevil	White pine Jack pine All spruces	Any occurrence
140	Branch Gall Insects	All species	>20% branches affected
150	Bole Borers	All species	Any occurrence on bole
170	Bark Beetles	Conifers	>20% crown dead/dying
190	Root/Root Collar Insects	Conifers	Entire crown off color; Dead tree
200	Foliage Diseases	All species	>20% foliage affected
210	Shoot Blights	All species	Any occurrence on leader; >20% shoots affected
212	Scleroderris	Pines	Any occurrence
220	Mistletoe	Black spruce White spruce Black Hills spruce Tamarack Jack pine Lodgepole pine	Any occurrence
240	Bole Rusts	Pines	Any occurrence on bole
241	White pine blister rust	White pine	Any occurrence on bole; Branch occurrence within 18" of bole
250	Bole Cankers	Hardwoods	Any occurrence on bole
251	Eutypella Canker	Maple	Any occurrence on bole
252	Hypoxylon Canker	Aspens	Any occurrence on bole
254	Nectria Canker	Hardwoods	Any occurrence on bole
257	Butternut Canker	Butternut	Any occurrence on tree

260	Stem Decay (Heartrot)	All Species	Any occurrence on bole
261	Phellinus pini	Conifers	Any occurrence on bole

Minnesota damage codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
262	Phellinus tremulae	Aspens	Any occurrence on bole
271	Ash Yellow	Ashes	Any occurrence
281	Dutch Elm Disease	Elms	Any occurrence
282	Oak Wilt	Oaks	Any occurrence
290	Root/Butt Rot	All species	Any occurrence
291	Annosus Root Rot	Conifers	Any occurrence
292	Armillaria Root Rot	All species	>20% crown dieback
300	Weather	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
302	Wind	All species	>20% crown damage; Any damage to bole
307	Flooding	All species	>20% crown affected
309	Ice/snow	All species	>20% crown damage; Any damage to bole
400	Animal Damage	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
402	Moose/elk/deer	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
404	Beaver	All species	Any occurrence
409	Cattle/Domestic Livestock	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
500	Fire	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
800	Logging/TSI	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
850	Land Use Conversion	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
860	Chemical	All species	>20% crown affected
900	Unknown/Uncoded Dead	All species	Use on dead trees only
901	Unknown/Uncoded Defoliation	All species	>20% foliage affected

902	Unknown/Uncoded Discoloration	All species	>20% foliage affected
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Minnesota damage codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
903	Unknown/Uncoded Decline/Dieback	All species	>20% foliage affected
904	Unknown/Uncoded Breakage	All species	>20% crown affected; Any occurrence on bole
905	Unknown/Uncoded Abnormal Growth or Form in the Crown	All species	>20% crown affected
906	Unknown/Uncoded Canker	All species	Any occurrence on bole
907	Unknown/Uncoded Crack	All species	Any occurrence on bole
908	Unknown/Uncoded Abnormal growth or Form on the Bole	All species	Any occurrence causing a volume loss

Wisconsin damage codes and coding criteria

Code	Damage or Death	Hosts	Severity
000	Healthy	All species	<20% crown affected, no volume/degrade loss
100	Insect Defoliators	All species	>20% foliage affected
101	Budworms	Conifers	
102	Cankerworms	Oaks	
104	Sawflies	Pines	
110	Forest Tent Caterpillar	Oaks, aspens, N. Hardwoods	
112	Large Aspen Tortrix	Aspens	
113	Gypsy Moth	Hardwoods	Any occurrence
116	Basswood Thrips	Basswood	>20% of foliage affected
130	Shoot & Branch Insects	All species	Any occurrence on leader; and/or >20% shoots/branches affected
131	White Pine Weevil	White pine	
133	Saratoga Spittlebug	Pines	
140	Branch Gall Insects	All species	>20% of branches affected
150	Bole Borers	All species	Any occurrence on bole
151	Two-Lined Chestnut Border	Oaks	
170	Bark Beetles	Conifers	>20% crown dead /dying
171	Ips spp.	Pines	
190	Root/Root Collar	Conifers	Entire crown off color; dead tree
200	Foliage Diseases	All species	>20% foliage affected
201	Needlecasts	Pines	
202	Anthraxnose	Hardwoods	
210	Shoot Blights	All species	Any occurrence on leader; and/or >20% shoots/branches affected
220	Mistletoes	Black, white spruces, jack pine, tamarack	Any occurrence
233	Gall Rusts	Jack, Scotch pine	Any occurrence

Wisconsin damage codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
240	Bole Rusts	Pines	Any occurrence on bole
241	White Pine Blister Rust	White pine	
250	Bole Cankers	Hardwoods	Any occurrence on bole
251	Eutypella Canker	Maple	
252	Hypoxylon Canker	Aspens	
254	Nectria Canker	Hardwoods	
257	Butternut Canker	Butternut	
259	Walnut Canker	Walnut	
260	Stem Decay	All species	Any occurrence
261	Phellinus Pini	Conifers	
262	Phellinus Tremulae	Aspens	
263	Inonotus Obliquus	Birches	
271	Ash Yellowings	Ashes	Any occurrence
273	Beech Bark Disease	Beech	Any occurrence
281	Dutch Elm Disease	Elms	Any occurrence
282	Oak Wilt	Oaks	Any occurrence
291	Annosus Root Rot	Conifers	Any occurrence
292	Armillaria Root Rot	All species	>20% crown dieback
300	Weather		>20% crown affected; any damage to leader or bole cambium
301	Hail		
302	Wind		
303	Lightening		
305	Frost Kill (foliage and shoots)	All species	
306	Weather Drying		
307	Flooding		
308	Drought		
309	Ice/Storm		

Wisconsin damage codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
400	Animal Damage		Any damage to the leader or bole cambium
401	Browse		
404	Beaver	All species	
406	Porcupine		
409	Cattle/Domestic Animals		
500	Fire	All species	>20% crown affected; any damage to leader to bole cambium
760	Vine damage	All species	>20% crown affected; any damage to leader to bole cambium
800	Logging/TSI	All species	
810	Mechanical Damage	All species	
811	Imbedded objects - wire, nails	All species	Any occurrence on bole
860	Chemical	All species	>20% crown affected
900	Unknown/Uncoded Dead	All species	Use on dead trees only
901	Unknown/Uncoded Defoliation	All species	>20% foliage affected
902	Unknown/Uncoded Discoloration	All species	>20% foliage affected
903	Unknown/Uncoded Dieback/Decline	All species	>20% crown affected
904	Unknown/Uncoded Breakage	All species	>20% crown affected; and occurrence on bole
905	Unknown/Uncoded Abnormal Growth or form in the Crown	All species	>20% crown affected
906	Unknown/Uncoded Canker	All species	Any occurrence on bole
907	Unknown/Uncoded Crack	All species	Any occurrence on bole

908	Unknown/Uncoded Abnormal Growth or Form on the Bole	All species	Any occurrence causing a volume loss
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Kansas and Nebraska codes and coding criteria

Code	Damage or Death	Hosts	Severity
000	Healthy	All species	<20% crown affected no volume/degrade loss
100	Insect Defoliators	All species	>20% foliage affected
113	Gypsy moth	Hardwoods	Any occurrence
130	Shoot and Branch Insects	All species	Any occurrence on leader; >20% shoots/branches affected
140	Branch Gall Insects	All species	>20% branches affected
150	Bole Borers	All species	Any occurrence on bole
170	Bark Beetles	Conifers	>20% crown dead/dying
190	Root/Root Collar Insects	Conifers	Entire crown off color; dead tree
200	Foliage Diseases	All species	>20% foliage affected
210	Shoot Blights	All species	Any occurrence on leader; >20% shoots affected
220	Mistletoe	All species Jack pine	Any occurrence
240	Bole Rusts	Pines	Any occurrence on bole
250	Bole Cankers	Hardwoods	Any occurrence on bole
251	Eutypella Canker	Aspens	Any occurrence on bole
252	Hypoxylon Canker	Aspens	Any occurrence on bole
254	Nectria Canker	Hardwoods	Any occurrence on bole
260	Stem Decay	All species	Any occurrence on bole
271	Ash Yellowings	Ashes	Any occurrence
281	Dutch Elm Disease	Elms	Any occurrence
282	Oak Wilt	Oaks	Any occurrence
291	Annosus Root Rot	Conifers	Any occurrence
292	Armillaria Root Rot	All species	>20% crown dieback
300	Weather	All species	>20% crown affected; any damage to leader; any damage to bole cambium

Kansas and Nebraska codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
307	Flooding	All species	>20% crown affected; any damage to leader; any damage to bole cambium
400	Animal Damage	All species	>20% crown affected, any damage to leader; any damage to bole cambium
409	Cattle/domestic animals	All species	Any damage to leader or bole cambium
500	Fire	All species	>20% crown affected, any damage to leader or bole cambium
600	Suppression	All species	Any damage to leader
760	Vine damage	All species	>20% crown affected;
800	Logging/TSI	All species	any damage to leader or bole
810	Mechanical Damage	All species	cambium
811	Imbedded objects - wires, nails	All species	Any occurrence
860	Chemical	All species	>20% crown affected
900	Unknown/Uncoded Dead	All species	Use on dead trees only
901	Unknown/Uncoded Defoliation	All species	>20% foliage affected
902	Unknown/Uncoded Discoloration	All species	>20% foliage affected
903	Unknown/Uncoded Decline/Dieback	All species	>20% crown affected
904	Unknown/Uncoded Breakage	All species	>20% crown affected; any occurrence on bole
905	Unknown/Uncoded Abnormal Growth or Form in the crown	All species	>20% crown affected
906	Unknown/Uncoded Canker	All species	Any occurrence on bole
907	Unknown/Uncoded Crack	All species	Any occurrence on bole
908	Unknown/Uncoded Abnormal Growth or Form on the Bole	All species	Any occurrence causing a volume loss

North Dakota codes and coding criteria

Code	Damage or Death	Hosts	Severity
000	Healthy	All species	<20% crown affected no volume/degrade loss
100	Insect Defoliators	All species	>20% foliage affected
102	Cankerworms	Hardwoods	>20% foliage affected
104	Sawflies	Pines	>20% foliage affected
113	Gypsy Moth	Hardwoods	Any occurrence
130	Shoots and Branch Insects	All species	Any occurrence on leader; >20% shoots/branches affected
132	Tip Moths	Pine	Any occurrence on leader >20% shoots/branches affected
140	Branch Gall Insects	All species	>20% branches affected
150	Bole Borers	All species	Any occurrence on bole
170	Bark Beetles	Conifers	>20% crown dead/dying
190	Root/Root Collar Insects	Conifers	Entire crown off color; dead tree
200	Foliage Diseases	All species	>20% foliage affected
201	Needle Casts	Pine	>20% foliage affected
210	Shoot Blights	All species	Any occurrence on leader; >20% shoots/branches affected
220	Mistletoes	Black, White spruce, Jack pine and Tamarack	Any evidence of infection
231	Black Knot	Choke cherry	Any occurrence
233	Gall Rusts	Jack & Scotch pine	Any occurrence
240	Bole Rusts	Pine	Any occurrence
250	Bole cankers	Hardwoods	Any occurrence on bole
251	Eutypella canker	Maple	Any occurrence on bole
252	Hypoxylon canker	Aspens	Any occurrence on bole
253	Cytospora canker	Spruces	Any occurrence
254	Nectria canker	Hardwoods	Any occurrence on bole
260	Stem Decay	All species	Any occurrence on bole
262	Phellinus Tremulae	Aspens	Any occurrence on bole
271	Ash Yellows	Ashes	Any occurrence
272	Western X Disease	Choke cherry	Any occurrence

281	Dutch Elm Disease	Elms	Any occurrence
282	Oak Wilt	Oaks	Any occurrence
291	Annosus Root Rot	Conifers	Any occurrence
292	Armillaria Root Rot	All species	>20% crown dieback
300	Weather	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium

North Dakota codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
307	Flooding	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
309	Ice/snow	All species	>20% crown affected; Any damage to leader or bole cambium
400	Animal Damage	All species	>20% crown affected, Any damage to leader; Any damage to bole cambium
401	Browse	All species	Any damage to leader or bole cambium
403	Rabbit	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
409	Cattle/domestic animals	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
500	Fire	All species	>20% crown affected, Any damage to leader or bole cambium
760	Vine damage	All species	>20% crown affected; Any damage to leader or bole cambium
800	Logging/TSI	All species	
810 830	Mechanical Damage Vehicle Damage	All species	>20% crown affected; Any damage to leader or bole cambium
811	Imbedded Objects	All species	Any occurrence
860	Chemical	All species	>20% crown affected
900	Unknown/Uncoded Dead	All species	Use on dead trees only
901	Unknown/Uncoded Defoliation	All species	>20% foliage affected
902	Unknown/Uncoded Discoloration	All species	>20% foliage affected
903	Unknown/Uncoded Decline/Dieback	All species	>20% crown affected
904	Unknown/Uncoded Breakage	All species	>20% crown affected; Any occurrence on bole

905	Unknown/Uncoded Abnormal Growth or Form in the crown	All species	>20% crown affected
906	Unknown/Uncoded Canker	All species	Any occurrence on bole
907	Unknown/Uncoded Crack	All species	Any occurrence on bole
908	Unknown/Uncoded Abnormal Growth or Form on the Bole	All species	Any occurrence causing a volume loss

South Dakota codes and coding criteria

Code	Damage or Death	Hosts	Severity
000	Healthy	All species	<20% crown affected, no volume/degrade loss
100	Insect defoliators	All species	>20% foliage loss
130	Shoot and Branch Insects	All species	>20% shoots/branches affected
132	Pine Tip Moths	Pines	Any occurrence on leader
135	Pine Needle Scale	Pines/Spruces	>50% needles affected
140	Branch Gall Insects	All Species	>20% branches affected
141	Ash Flower Gall Mite	Green Ash	
150	Bole Borers	All Species	Any occurrence on bole
155	Dioryctria Borers	Pines	
170	Bark Beetles	All Species	>20% of crown dead/dying
171	Ips species	Pine/Spruce	
172	Mountain Pine Beetle	Pine	Any occurrence on bole
173	Red Turpentine Beetle	Pine	
190	Root /Root Collar Insects	All Species	>50% crown dieback or entire crown off color
200	Foliage Diseases	All Species	>20% foliage affected
203	Spruce Broom Rust	Spruce	Any occurrence in crown
204	Elytroderma Brooming	Ponderosa Pine	Any occurrence in crown
210	Shoot Blights	All Species	>20% shoots/branches affected
214	Diplodia Tip Blight	Ponderosa/Austrian Pine	Any occurrence on leader
215	Juniper Blights	Rocky Mountain Juniper, E Red Cedar	>20% shoots/branches affected
240	Bole Rust	Pine	Any occurrence on bole
243	Western Gall Rust	Pine	>20% of shoots/ branches affected; Any occurrence on bole
250	Bole Cankers	All species	Any occurrence on bole
251	Eutypella Canker	Maple	Any occurrence on bole
252	Hypoxylon Canker	Aspens	Any occurrence on bole
253	Cytospora Canker	Hardwoods	>20% branches affected
258	Ceratocystis Canker	Aspen	Any occurrence on bole
260	Stem Decay	All Species	Any occurrence on bole
264	Pereniporia fraxinophila	Green Ash	

281	Dutch Elm Disease	American Elm	Any occurrence
292	Armillaria Root Disease	All Species, primarily Ponderosa Pine/Spruce	>20% crown dieback

South Dakota codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
300 301 303 307	Weather Hail Lightning Flooding	All Species	>20% crown affected; any damage to leader; any damage to bole cambium
400 402 404 405 406 409 410	Animal Damage Moose/Elk/Deer Beaver Squirrel Porcupine Cattle/Domestic/Buffalo Mice	All Species	>20% crown affected; any damage to leader; any damage to bole cambium
500	Fire Note: Fire on 1-species	All Species Ponderosa Pine only	>20% crown affected; any damage to leader or bole cambium >75% crown damage or cambium
760	Vine damage	All Species	>20% crown affected; any damage to leader or bole cambium
800	Logging/TS	All Species	>20% crown affected; any damage to leader or bole cambium
810	Mechanical damage	All Species	>20% crown affected; any damage to leader or bole cambium
811	Imbedded objects	All Species	Any occurrence
860 861	Chemical Pesticides (Herbicides)	All Species	>20% crown affected
900	Unknown/Uncoded Dead	All Species	Use on dead trees only
901 902 903	Unknown/Uncoded Defoliation Unknown/Uncoded Discoloration Unknown/Uncoded Decline/Dieback	All Species	>20% foliage affected
904	Unknown/Uncoded Breakage	All Species	>20% crown affected; Any occurrence on bole

905	Unknown/Uncoded Abnormal Growth or Form in the crown	All Species	>20% crown affected
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South Dakota codes and coding criteria, *continued*

Code	Damage or Death	Hosts	Severity
906	Unknown/Uncoded Canker	All Species	Any occurrence on bole
907	Unknown/Uncoded Crack		
908	Unknown/Uncoded Abnormal Growth or Form on the bole	All Species	Any occurrence causing a volume loss

FOREST TYPE (FTS): Item 62

Lake States Forest Types

Code Forest type

- 01 **Jack pine** Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)
- 02 **Red pine** Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch, and maple.)
- 03 **White pine** Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch, and maple.)
- 06 **Exotic** Forests in which species not native to Michigan comprise a plurality of the stocking. (Mostly Scotch pine in plantations.)
- 11 **Balsam fir** Forests in which balsam fir and white spruce comprise a plurality of the stocking with balsam fir the most common. (Common associates include white spruce, aspen, maple, birch, northern white-cedar, and tamarack.)
- 12 **Black spruce** Forests in which swamp conifers comprise a plurality of the stocking with black spruce the most common. (Common associates include tamarack and northern white-cedar.)

- 14 **Northern white-cedar** Forests in which swamp conifers comprise a plurality of the stocking with northern white-cedar the most common. (Common associates include tamarack and black spruce.)
- 15 **Tamarack** Forests in which swamp conifers comprise a plurality of the stocking with tamarack the most common. (Common associates include black spruce and northern white-cedar.)

Lake States Forest Types *continued*

Code Forest type

- 16 **White spruce** Forests in which white spruce and balsam fir comprise a plurality of the stocking with white spruce the most common. (Common associates include balsam fir, aspen, maple, birch, northern white-cedar, and tamarack.)
- 50 **Oak-hickory** Forests in which northern red oak, white oak, bur oak, or hickories, singly or in combination, comprise a plurality of the stocking. (Common associates include jack pine, beech yellow-poplar, elm, and maple.)
- 70 **Elm-ash-cottonwood** Forests in which low-land elm, ash, cottonwood, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include birch, spruce, and balsam fir.)
- 80 **Maple-beech-birch** Forests in which sugar maple, beech, basswood, yellow birch, upland American elm, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include white pine, elm, hemlock, and basswood.)
- 91 **Aspen** Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir, and paper birch.)
- 92 **Paper birch** Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen, and balsam fir.)
- 94 **Balsam poplar** Forests in which balsam poplar comprises a plurality of the stocking. (Common associates aspen, elm and ash.)

Plains States Forest Types

Code Forest type

- 01 **Jack pine** Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)
- 02 **Red pine** Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch, and maple.)

- 06 **Exotic** Forests in which species not native to the Plains States comprise a plurality of the stocking. (Mostly Scotch pine and other exotic softwood plantations.)
- 07 **Ponderosa pine** Forests in which ponderosa pine comprises a plurality of the stocking.
- 19 **Rocky Mountain juniper** Forests in which rocky mountain juniper comprises a plurality of the stocking.

Plains States Forest Types *continued*

- 35 **Eastern redcedar** Forests in which eastern redcedar comprises a plurality of the stocking. Found on dry uplands, usually abandoned pastures or fields.
- 42 **Eastern redcedar-hardwood** Forests in which hardwoods comprise 50 percent of the stocking and eastern redcedar comprises at least 25 percent of the stocking. Found on dry uplands usually abandoned pastures or fields.
- 51 **Post-blackjack oak** Forests in which oaks or hickories, singly or in combination, comprise a plurality of the stocking and post oak or blackjack oak singly or in combination contain more stocking than all other oaks and hickories combined . (Common associates include mockernut hickory, black or scarlet oak.)
- 53 **Red oak-white oak-hickory** Forests in which oaks or hickories, singly or in combination, comprise a plurality of the stocking. (Common associates include elm, ash, hackberry and black walnut.)
- 59 **Bur oak** Forests in which bur oak comprises at least 50 percent of the stocking. (Common associates include post or blackjack oak and other oaks on uplands.)
- 71 **Elm-ash-soft maple (lowland)** Forests in which low-land elm, ash, cottonwood, red silver maple, singly or in combination, comprise a plurality of the stocking. (Common associates include basswood, black walnut, mulberry, hackberry or boxelder.)
- 73 **Cottonwood** Forests in which cottonwood comprises at least 50 percent of the stocking. Along river or stream bottoms.
- 74 **Willow** Forests in which willow comprises at least 50 percent of the stocking. Found along river or stream bottoms and is associated with other bottomland hardwoods.
- 82 **Maple-basswood** Forests in which sugar maple, basswood, walnut and hackberry, singly or in combination, comprise a plurality of the stocking.
- 87 **Elm-ash-locust (upland)** Forests in which upland American elm, boxelder, ash, and red maple, singly or in combination, comprise a plurality of the stocking.

90 **Aspen-birch** Forests in which quaking aspen, bigtooth aspen, balsam poplar or paper birch singly or in combination, comprise a plurality of the stocking.

County (CTY): Item 72

Michigan (State code 26) County Codes by Unit

UNIT 1 - EASTERN UPPER PENINSULA

01 Alger
02 Chippewa
03 Delta
04 Luce
05 Mackinac
06 Menominee
07 Schoolcraft

UNIT 2 - WESTERN UPPER PENINSULA

01 Baraga
02 Dickinson
03 Gogebic
04 Houghton
05 Iron
06 Keweenaw
07 Marquette
08 Ontonagon

UNIT 3 - NORTHERN LOWER PENINSULA

01 Alcona
02 Alpena
03 Antrim
04 Arenac
05 Bay
06 Benzie
07 Charlevoix
08 Cheboygan
09 Clare
10 Crawford
11 Emmet
12 Gladwin
13 Grand Traverse
14 Iosco
15 Isabella
16 Kalkaska
17 Lake
18 Leelanau
19 Manistee
20 Mason
21 Mecosta
22 Midland
23 Missaukee

UNIT 3- N. LOWER, continued

26 Oceana
27 Ogemaw
28 Osceola
29 Oscoda
30 Otsego
31 Presque Isle
32 Roscommon
33 Wexford

UNIT 4 - SOUTHERN LOWER PENINSULA

01 Allegan
02 Barry
03 Berrien
04 Branch
05 Calhoun
06 Cass
07 Clinton
08 Eaton
09 Genesee
10 Gratiot
11 Hillsdale
12 Huron
13 Ingham
14 Ionia
15 Jackson
16 Kalamazoo
17 Kent
18 Lapeer
19 Lenawee
20 Livingston
21 Macomb
22 Monroe
23 Montcalm
24 Muskegon
25 Oakland
26 Ottawa
27 Saginaw
28 St. Clair
29 St. Joseph
30 Sanilac
31 Shiawassee
32 Tuscola
33 Van Buren

24 Montmorency
25 Newaygo

34 Washtenaw
35 Wayne

Minnesota (State code 27) County Codes by Unit

UNIT 1 - ASPEN-BIRCH

01 Carlton
 02 Cook
 03 Koochiching
 04 Lake
 05 St. Louis

UNIT 2 - NORTHERN PINE

01 Aitkin
 02 Becker
 03 Beltrami
 04 Cass
 05 Clearwater
 06 Crow Wing
 07 Hubbard
 08 Itasca
 09 Lake of the Woods
 10 Mahnommen
 11 Roseau
 12 Wadena

UNIT 3 - CENTRAL HARDWOOD

01 Anoka
 02 Benton
 03 Carver
 04 Chisago
 05 Dakota
 06 Douglas
 07 Fillmore
 08 Goodhue
 09 Hennepin
 10 Houston
 11 Isanti
 12 Kanabec
 13 Le Sueur
 14 Mille Lacs
 15 Morrison
 16 Olmsted
 17 Otter Tail
 18 Pine
 19 Ramsey
 20 Rice
 21 Scott
 22 Sherburne
 23 Stearns
 24 Todd

UNIT 4 - PRAIRIE

01 Big Stone
 02 Blue Earth
 03 Brown
 04 Chippewa
 05 Clay
 06 Cottonwood
 07 Dodge
 08 Faribault
 09 Freeborn
 10 Grant
 11 Jackson
 12 Kandiyohi
 13 Kittson
 14 Lac qui Parle
 15 Lincoln
 16 Lyon
 17 McLeod
 18 Marshall
 19 Martin
 20 Meeker
 21 Mower
 22 Murray
 23 Nicollet
 24 Nobles
 25 Norman
 26 Pennington
 27 Pipestone
 28 Polk
 29 Pope
 30 Red Lake
 31 Redwood
 32 Renville
 33 Rock
 34 Sibley
 35 Steele
 36 Stevens
 37 Swift
 38 Traverse
 39 Waseca
 40 Watonwan
 41 Wilkin
 42 Yellow Medicine

25 Wabasha
26 Washington
27 Winona
28 Wright

Wisconsin (State code 55) County Codes by Unit

UNIT 1-NORTHEASTERN

- 1 Florence
- 2 Forest
- 3 Langlade
- 4 Lincoln
- 5 Menominee
- 6 Marinette
- 7 Oconto
- 8 Oneida
- 9 Shawano
- 10 Vilas

UNIT 2-NORTHWESTERN

- 1 Ashland
- 2 Barron
- 3 Bayfield
- 4 Burnett
- 5 Douglas
- 6 Iron
- 7 Polk
- 8 Price
- 9 Rusk
- 10 Sawyer
- 11 Taylor
- 12 Washburn

UNIT 3-CENTRAL

- 1 Adams
- 2 Chippewa
- 3 Clark
- 4 Eau Clair
- 5 Jackson
- 6 Juneau
- 7 Marathon
- 8 Marquette
- 9 Monroe
- 10 Portage
- 11 Waupaca
- 12 Waushara
- 13 Wood

UNIT 4-SOUTHWESTERN

- 1 Buffalo
- 2 Crawford
- 3 Dunn
- 4 Grant
- 5 Iowa
- 6 La Crosse
- 7 Lafayette
- 8 Pepin
- 9 Pierce
- 10 Richland
- 11 St. Croix
- 12 Sauk
- 13 Trempealeau
- 14 Vernon

UNIT 5-SOUTHEASTERN

- | | | | |
|---|-------------|----|-----------|
| 1 | Brown | 13 | Manitowoc |
| 2 | Calumet | 14 | Milwaukee |
| 3 | Columbia | 15 | Outagamie |
| 4 | Dane | 16 | Ozaukee |
| 5 | Dodge | 17 | Racine |
| 6 | Door | 18 | Rock |
| 7 | Fond du lac | 19 | Sheboygan |
| 8 | Green | 20 | Walworth |

9 Green Lake
10 Jefferson
11 Kenosha
12 Kewaunee

21 Washington
22 Waukesha
23 Winnebago

Kansas (State code 20) County Codes by Unit

UNIT I-NORTHEASTERN

1. Atchison	8. Geary	15. Nemaha
2. Brown	9. Jackson	16. Osage
3. Clay	10. Jefferson	17. Pottawatomie
4. Dickinson	11. Johnson	18. Riley
5. Doniphan	12. Leavenworth	19. Shawnee
6. Douglas	13. Marshall	20. Wabaunsee
7. Franklin	14. Miami	21. Washington
		22. Wyandotte

UNIT II-SOUTHEASTERN

1. Allen	8. Coffey	15. Lyon
2. Anderson	9. Cowley	16. Marion
3. Bourbon	10. Crawford	17. Montgomery
4. Butler	11. Elk	18. Morris
5. Chase	12. Greenwood	19. Neosho
6. Chautauqua	13. Labette	20. Wilson
7. Cherokee	14. Linn	21. Woodson

UNIT III-WESTERN

1. Barber	22. Hodgeman	43. Republic
2. Barton	23. Jewell	44. Rice
3. Cheyenne	24. Kearny	45. Rooks
4. Clark	25. Kingman	46. Rush
5. Cloud	26. Kiowa	47. Russell
6. Comanche	27. Lane	48. Saline
7. Decatur	28. Lincoln	49. Scott
8. Edwards	29. Logan	50. Sedgewick
9. Ellis	30. McPherson	51. Seward
10. Ellsworth	31. Meade	52. Sheridan
11. Finney	32. Mitchell	53. Sherman
12. Ford	33. Morton	54. Smith
13. Gove	34. Ness	55. Stafford
14. Graham	35. Norton	56. Stanton
15. Grant	36. Osborne	57. Stevens
16. Gray	37. Ottawa	58. Sumner
17. Greeley	38. Pawnee	59. Thomas

18. Hamilton
19. Harper
20. Harvey
21. Haskell

39. Phillips
40. 10 Pratt
41. Rawlins
42. Reno

60. Trego
61. Wallace
62. Wichita

Nebraska (State code 31) County Codes by Unit

UNIT I-EASTERN

1. Adams	21. Gage	41. Pierce
2. Boone	22. Gosper	42. Platte
3. Buffalo	23. Greeley	43. Polk
4. Burt	24. Hall	44. Red Willow
5. Butler	25. Hamilton	45. Richardson
6. Cass	26. Harlan	46. Saline
7. Cedar	27. Hitchcock	47. Sarpy
8. Clay	28. Howard	48. Saunders
9. Colfax	29. Jefferson	49. Seward
10. Cuming	30. Johnson	50. Sherman
11. Custer	31. Kearney	51. Stanton
12. Dakota	32. Lancaster	52. Thayer
13. Dawson	33. Madison	53. Thurston
14. Dixon	34. Merrick	54. Valley
15. Dodge	35. Nance	55. Washington
16. Douglas	36. Nemaha	56. Wayne
17. Fillmore	37. Nuckolls	57. Webster
18. Franklin	38. Otoe	58. York
19. Frontier	39. Pawnee	
20. Furnas	40. Phelps	

UNIT II-WESTERN

1. Antelope	13. Dundy	25. Logan
2. Arthur	14. Garden	26. Loup
3. Banner	15. Garfield	27. McPherson
4. Blaine	16. Grant	28. Morrill
5. Box Butte	17. Hayes	29. Perkins
6. Boyd	18. Holt	30. Rock
7. Brown	19. Hooker	31. Scotts Bluff
8. Chase	20. Keith	32. Sheridan
9. Cherry	21. Keya Paha	33. Sioux
10. Cheyenne	22. Kimball	34. Thomas
11. Dawes	23. Knox	35. Wheeler
12. Deuel	24. Lincoln	

North Dakota (State code 38) County Codes

- | | |
|-------------------|---------------|
| 1. Adams | 28. McLean |
| 2. Barnes | 29. Mercer |
| 3. Benson | 30. Morton |
| 4. Billings | 31. Mountrail |
| 5. Bottineau | 32. Nelson |
| 6. Bowman | 33. Oliver |
| 7. Burke | 34. Pembina |
| 8. Burleigh | 35. Pierce |
| 9. Cass | 36. Ramsey |
| 10. Cavalier | 37. Ransom |
| 11. Dickey | 38. Renville |
| 12. Divide | 39. Richland |
| 13. Dunn | 40. Rolette |
| 14. Eddy | 41. Sargent |
| 15. Emmons | 42. Slope |
| 16. Foster | 43. Sheridan |
| 17. Golden Valley | 44. Sioux |
| 18. Grand Forks | 45. Stark |
| 19. Grant | 46. Steele |
| 20. Griggs | 47. Stutsman |
| 21. Hettinger | 48. Towner |
| 22. Kidder | 49. Traill |
| 23. La Moure | 50. Walsh |
| 24. Logan | 51. Ward |
| 25. McHenry | 52. Wells |
| 26. McIntosh | 53. Williams |
| 27. McKenzie | |

South Dakota (State code 46) County Codes by Unit

UNIT 1 - EASTERN

- | | |
|----------------|---------------|
| 1. Aurora | 30. Hyde |
| 2. Beadle | 31. Jackson |
| 3. Bennet | 32. Jerauld |
| 4. Bon Homme | 33. Jones |
| 5. Brookings | 34. Kingsbury |
| 6. Brown | 35. Lake |
| 7. Brule | 36. Lincoln |
| 8. Buffalo | 37. Lyman |
| 9. Campbell | 38. Marshall |
| 10. Charles | 39. McCook |
| 11. Clark | 40. McPherson |
| 12. Clay | 41. Mellette |
| 13. Codington | 42. Miner |
| 14. Corson | 43. Minnehaha |
| 15. Davison | 44. Moody |
| 16. Day | 45. Perkins |
| 17. Deuel | 46. Potter |
| 18. Dewey | 47. Roberts |
| 19. Douglas | 48. Sanborn |
| 20. Edmunds | 49. Spink |
| 21. Faulk | 50. Stanley |
| 22. Grant | 51. Sully |
| 23. Gregory | 52. Todd |
| 24. Haakon | 53. Tripp |
| 25. Hamlin | 54. Turner |
| 26. Hand | 55. Union |
| 27. Hanson | 56. Walworth |
| 28. Hughes | 57. Yankton |
| 29. Hutchinson | 58. Ziebach |

UNIT 2 - WESTERN

- | | |
|---------------|---------------|
| 1. Butte | 5. Lawrence |
| 2. Custer | 6. Meade |
| 3. Fall River | 7. Pennington |
| 4. Harding | 8. Shannon |

National Forest-Ranger District (NFRD): Item 73

Michigan National Forest-Ranger District Codes

- 10 Hiawatha National Forest**
- 04 Huron-Manistee National Forest**
- 07 Ottawa National Forest**

<u>Hiawatha Ranger Districts</u>		<u>Huron-Maistee Ranger Districts</u>		<u>Ottawa Ranger Districts</u>	
02	Manistique	01	Baldwin	01	Bergland
03	Munising	02	Cadillac	02	Bessemer
01	Rapid River	07	Harrisville	03	Iron River
05	St. Ignace	03	Manistee	04	Kenton
04	Sault Ste. Marie	05	Mio	05	Ontonagon
		06	Tawas	06	Watersmeet
		04	White Cloud		

Minnesota National Forest-Ranger District Codes

- 09 Superior National Forest**
- 03 Chippewa National Forest**

<u>Superior Ranger Districts</u>		<u>Chippewa Ranger Districts</u>	
01	Aurora	01	Blackduck
02	Gun Flint	02	Cass Lake
05	Kawishiwi	03	Deer River
06	La Croix	04	Marcell
07	Tofte	05	Walker
08	Two Harbors		
09	Virginia		

Wisconsin National Forest-Ranger District Codes

- 02 Chequamegon National Forest**
- 06 Nicolet National Forest**

Chequamegon Ranger Districts

- 01 Park Falls
- 02 Glidden
- 03 Medford
- 04 Hayward
- 05 Washburn

Nicolet Ranger Districts

- 01 Three Lakes
- 02 Eagle River
- 03 Florence
- 04 Lakewood
- 05 Laona

KS, NE, ND, SD, National Forest-Ranger District Codes

National Forests-National Grasslands

Kansas:	Pike and San Isabel National Forest 01	
	Cimarron National Grassland	01
Nebraska:	Nebraska National Forest 07	
	Ogalala National Grassland	01
	Bessey Ranger District	04
	Pine Ridge Ranger District	05
North Dakota:	Custer National Forest 08	
	Cedar River National Grassland	01
	Little Missouri National Grassland	02
	Sheyenne National Grassland	03
South Dakota:	Black Hill National Forest 03	
	Custer Ranger District	03
	Harney Ranger District	06
	Nemo Ranger District	08
	Custer National Forest 08	
	Sioux Ranger District	03
	Grand River National Grassland	04
	Pactola Ranger District	09
	Spearfish River National Grassland	11
	Nebraska National Forest 07	
	Buffalo Gap National Grassland	02

Fort Pierre National Grassland	03
Fall River Ranger District	06
Wall Ranger District	07

Tatum Guides

Wisconsin Tatum Guide #1

Wisconsin Tatum Guide #2

Tatum Guide #3

Tatum Guide #4

Tatum Guide #5

Tatum Guide #6

WI DNR District Foresters

WI DNR Area Foresters

National Forest Supervisor and Ranger District Offices for Wisc.

Field plot sheet

Field plot sheet - page 1

Field plot sheet - page 2

Field plot sheet - page 3

Field plot sheet - page 4

