FOREST INVENTORY AND ANALYSIS
NATIONAL CORE FIELD GUIDE
NORTH CENTRAL

VOLUME I: FIELD DATA COLLECTION PROCEDURES FOR PHASE 2 PLOTS

Version 1.5

FOREST INVENTORY AND ANALYSIS
NATIONAL CORE FIELD GUIDE

VOLUME I: FIELD DATA COLLECTION PROCEDURES FOR PHASE 2 PLOTS

Version 1.5

Version History:
1.1: March 1999 (first version implemented, Maine, 1999)
1.2: August 1999
1.3: September 1999 (revised from Bangor, ME Data Acquisition Band meeting, Aug 1999)
1.4: February 2000 (revised from Charleston, SC Data Acquisition Band meeting, Dec 1999)
1.5: January 2001 (revised from Portland, OR Data Acquisition Band meeting, Sept 2000)

Mention of trade names or commercial products does not constitute endorsement or recommendation for use.
NC Note: Items that are in very light gray text do not apply in the North Central FIA region but are National Core Field Guide items that are core optional (left in for consistency).

INTRODUCTION

This document describes the standards, codes, methods, and definitions for Forest Inventory and Analysis (FIA) field data items. The objective is to describe CORE FIA field procedures that will be consistent and uniform across all FIA units. **This CORE serves as the framework for regional FIA programs; individual programs may add variables, but may not change the CORE requirements.** Unless otherwise noted, the items in this manual are considered CORE, that is, the information will be collected by all FIA Units as specified. Items or codes specified as CORE OPTIONAL are not required by individual units; however, if the item is collected or coded, it will be done so as specified in this manual. It is expected that all items in Volume I can be measured by a two-person field crew in less than a single day, on average, including time spent traveling to and from the plot.

The FIA program is in transition, changing in response to legislation and new customer demands. One of these demands is for increased consistency, which this manual begins to address. Another change is the merger of the FIA program with the field plot component of the Forest Health Monitoring (FHM) program. This will be accomplished by a joint sampling approach where FHM plots become a subset of the larger sample of FIA plots. In this model, plots formerly known as FIA plots will now be called Phase 2 plots; plots formerly known as FHM plots will be called Phase 3 plots.

The focus of Volume I is on data that are collected in the field on all Phase 2 plots in the FIA sample and on mensuration add-ons collected on Phase 3 plots. Volume II of the series will describe an additional expanded suite of data collected on the Phase 3 subsample. Volume II will consist of the FHM field manual, minus data elements already collected on the FIA sample. Volume III of the series (in preparation) will document the office procedures including data elements measured in the office, data from other sources that are merged into the FIA database, and CORE compilation and analysis algorithms. When complete, the three-volume set will describe all field data measured consistently across the country, comprising the CORE FIA program.

FIELD GUIDE LAYOUT

Each section of the field guide corresponds to one of the following sections:

0 General Description
1 Plot
2 Condition
3 Boundary
4 Subplot
5 Tree Measurements
6 Seedling
7 Site Tree
8 Nonforest/Denied Access/Hazardous Plots

Each section begins with some general overview of the data elements collected at that level, along with whatever technical background is necessary to prepare the field crews for data collection. Descriptions of data elements follow, in the following format:

DATA ELEMENT NAME -- <brief variable description>

When collected: <when data element is recorded>
Field width: <X digits>
Tolerance: <range of measurement that is acceptable>
MQO: <measurement quality objective>
Values: <legal values for coded variables>

Data elements and descriptions of when to collect, field width, tolerances, MQOs, and values, apply to both Phase 2 plots (formerly called FIA plots) and Phase 3 plots (formerly called FHM plots) unless specifically noted. Field width designates the number of columns (or spaces) needed to properly record the data element.

Tolerances may be stated in +/- terms or a number of classes for ordered categorical data elements (e.g., +/- 2 classes); in absolute terms for some continuous variables (e.g., +/- 0.2 inches); or in terms of percent of the value of the data element (e.g., +/- 10% of the value). For some data elements, no errors are tolerated (e.g., PLOT NUMBER).

MQOs state the percentage of time when the collected data are required to be within tolerance. Percentage of time within tolerance is generally expressed as "at least X percent of the time," meaning that crews are expected to be within tolerance at least X percent of the time.

UNITS OF MEASURE

The field guide will use ENGLISH units as the measurement system.

Plot Dimensions:

Annular plot - for sample intensification or sampling relatively rare events.

Radius = 58.9 ft
Area = 10,890 sq. ft or 0.25 ac or 1/4 ac

Subplot - for selecting trees with diameter $\geq$ 5.0 in

Radius = 24.0 ft
Area = 1,809.56 sq. ft or approximately 0.04 ac or approximately 1/24 ac

Microplot - for counting seedlings and selecting saplings

Radius = 6.8 ft
Area = 145.27 sq. ft or approximately 0.003 ac or approximately 1/300 ac

The distance between subplot centers is 120.0 ft horizontal.
The minimum area needed to qualify as accessible forest land is 1.0 ac.
The minimum width to qualify as accessible forest land is 120.0 ft

Tree Limiting Dimensions:

breast height	4.5 ft
stump height	1.0 ft
merchantable top	4.0 in
merchantable top for woodland	1.5 in
minimum conifer seedling length	0.5 ft
minimum hardwood seedling length	1.0 ft
seedling/sapling DBH/DRC break	1.0 in
sapling/tree DBH/DRC break	5.0 in

0.0 GENERAL DESCRIPTION

The CORE field plot consists of four subplots approximately 1/24 ac in size with a radius of 24.0 ft. The center subplot is subplot 1. Subplots 2, 3, and 4 are located 120.0 ft horizontal at azimuths of 360, 120, and 240 degrees, respectively from the center of subplot 1. See Figure 1. Subplots are used to collect data on trees with a diameter (at breast height "DBH", or at root collar "DRC") of 5.0 in or greater. Throughout this manual, use of the word 'plot' refers to the entire set of four subplots. “Plot center” is defined as the center of subplot 1.

Each subplot contains a microplot of approximately 1/300 ac in size with a radius of 6.8 ft. The center of the microplot is offset 90 degrees and 12.0 ft horizontal from each subplot center. Microplots are numbered in the same way as subplots. Microplots are used to select and collect data on saplings (DBH/DRC of 1.0 in to 4.9 in) and seedlings (DBH/DRC less than 1.0 inch in diameter and greater than 0.5 ft in length (conifers) or greater than 1.0 ft in length (hardwoods)).

As a **CORE OPTION**, the field plot may also include annular plots of 1/4 ac in size with radius of 58.9 ft with the annular plot center coinciding with each subplot center. Annular plots are numbered in the same way as subplots. Annular plots may be used to select and collect additional data for regional enhancements. For example, annular plots may be used to provide a better sample of rare population elements such as very large trees.

Data are collected on field plots at the following levels:

Plot	Data that describe the entire cluster of four subplots.
Subplot	Data that describe a single subplot of a cluster.
Condition Class	A discrete combination of landscape attributes that describe the environment on all or part of the plot. These attributes include CONDITION STATUS, RESERVED STATUS, OWNER GROUP, FOREST TYPE, STAND SIZE CLASS, REGENERATION STATUS, and TREE DENSITY.

Boundary	An approximate description of the demarcation line between two condition classes that occur on a single subplot, microplot, or annular plot. There is no boundary recorded when the demarcation occurs beyond the fixed radius plots.
Tree	Data describing saplings with a diameter 1.0 in to 4.9 in, and trees with diameter ≥ 5.0 in
Seedling	Data describing trees with a diameter < 1.0 inch and ≥ 0.5 ft in length (conifers) or ≥ 1.0 ft in length (hardwoods).
Site Tree	Data describing site index trees.

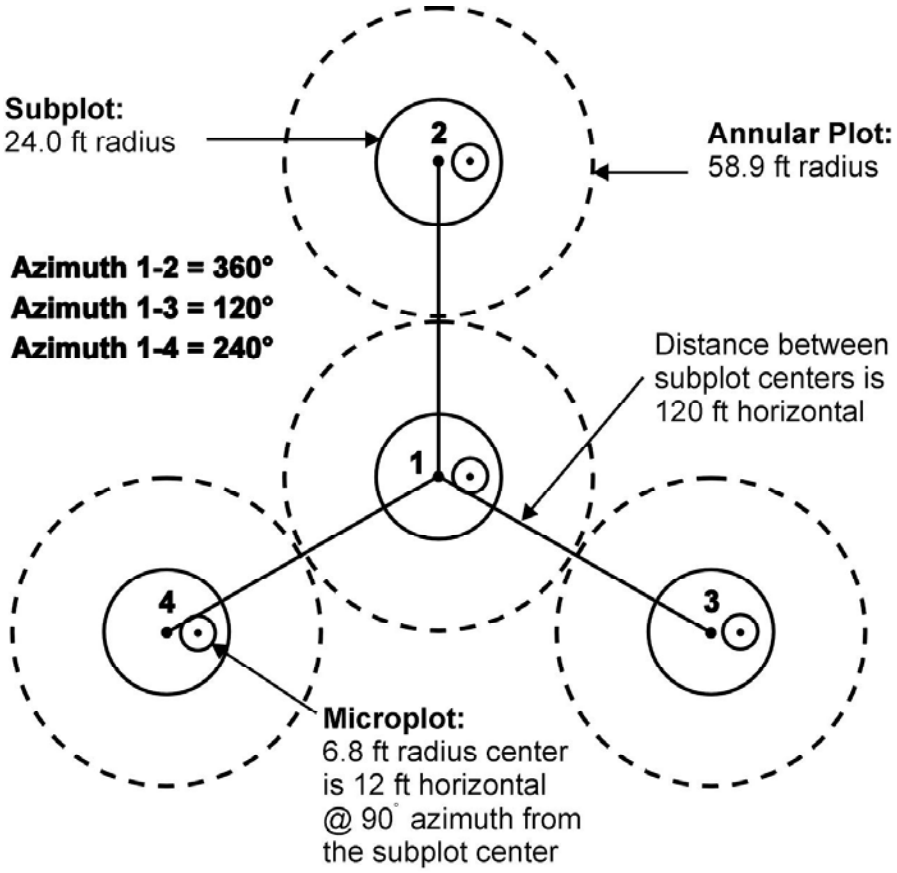


Figure 1. FIA plot diagram.

0.1 PLOT SETUP

Plots will be established according to the regional guidelines of each FIA program. In cases where the plot center cannot be occupied due to safety hazards, lack of access, or when the plot center is out of the sample, but some of the subplots can be occupied and are in the sample, those subplots which can be established should be established and sampled according to normal procedures. In cases where a subplot or microplot center cannot be occupied, no data will be collected from that subplot or microplot; instead, the entire subplot or microplot should be classified according to the condition preventing occupancy.

The table provided below can assist in locating subplot 2-4 from a subplot other than subplot 1.

Subplot Numbers		Azimuth	Backsight	Distance
From	To	*degrees*		*feet*
2	3	150	330	207.8
2	4	210	030	207.8
3	4	270	090	207.8

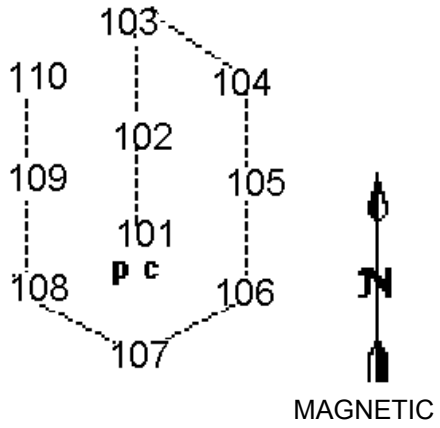
0.1.1NC NC OLD VARIABLE RADIUS PLOT

The old variable radius plot consists of 10 subplots. The layout of these subplots is shown in figure NC1. Plot center (PC) 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. To distinguish subplots on the new standard plots from subplots on the old 10-point plot, the new standard subplots will be given subplot numbers 1-4 and the old 10-point subplots will be numbered 101-110. Subplot center 101 is the same as plot center. All old subplots consisted of a variable radius (37.5 BAF) plot to sample trees 5.0 inches and larger and a fixed radius micro plot (6.8 ft. radius) to sample trees less than 5.0 inches.

In MO, MI, IA and prior to Cycle 6 in MN, when a subplot center was in a different land use than plot center, subplots were rotated so that all ten subplots fell in the same land use as PC. If PC was non-forest, subplots were not established. If PC was forest, all subplots were rotated to be located in forest. Figure NC1 does not apply for these plots. Instead, refer to the plot sheets for subplot location.

Figure NC1. Old variable radius plot layout.

From subplot center	70' to subplot center	Azimuth
101	102	0°
102	103	0°
103	104	120°
104	105	180°
105	106	180°
106	107	240°
107	108	300°
108	109	0°
109	110	0°



0.1NC NC LOCATING THE PLOT

There is a mix of new and re-measurement plots sent to the field for measurement. First determine which type of plot you have, using the information sent to you (old photos, NC sample kind on the plot sheet). There are also different types of re-measurement plots, some were done as 10 points, some in the slightly modified 4 point design of today, and some will only be used to locate the new plot and will not involve any old information being re-measured.

There are several steps in the process of locating the plot center:

- Establish true direction on the photo using a Baseline
- Locate or relocate Starting Point
- Compute and traverse course to plot

ESTABLISH A BASELINE

A baseline is established on a photo image so that it is oriented with the ground as to compass direction.

The first step in locating the baseline is finding two features on the ground that are easily recognized on the new photograph or image. 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 a line between these pinpricks 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.

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.

Using both the new and/or old photograph(s) and/or provided image, locate the starting point (SP). For the remainder of this manual photo will refer to any image format. A starting point is a point that can be seen on the photo and on the ground. It will help re-locate the plot center at the time the plot is re-measured.

0.1.1NC NC STARTING POINT TREE MONUMENTATION

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 at 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-traveled areas. Make a note when painting deviates from normal procedures on the plot sheet. In reserved areas do not use paint, unless the manager of the reserved area* indicates otherwise. Instead, nail a tag marked with "SP" to the base of the tree.

Please make a note on the plot sheet if reserved areas are marked differently than with a nail and tag at the base.

** If the reserved area is a National Park, we have a National agreement to use the nails. Do not paint, in a National Park.*

Describe the starting point on the plot sheet under "Starting Point Description." Include the landmarks you used to locate SP. Specify details of the starting point 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.
- Take a GPS reading at SP tree and record on the plot sheet. Follow the same directions as getting a GPS reading at plot center. (See Appendix 11.)

0.1.2NC NC LOCATING NEW PLOT

When establishing a plot for the first time you may use the provided GPS coordinates and the GPS unit to assist you. These coordinates are listed on the printed plot sheet provided to the crew. The true location of the plot is the x on the image. When you use the GPS to get you to the location on the ground if it is markedly different than the x on the image you will need to adjust to put yourself on the x if possible.

- Enter coordinated of plot from plot sheet into GPS unit
- Establishing a Starting Point.
- Read and record the GPS coordinates of the Starting Point
- Navigate to within 100 – 120 feet of the Plot center coordinates entered
- Measure out the remaining Distance and Azimuth to PC and establish the plot

See Appendix 11 for directions on using the Rockwell Plugger or the Garmin GPS units. Currently these are the only GPS units used in the North Central FIA region.

0.1.3NC NC LOCATING A RE-MEASUREMENT PLOT

When establishing a plot from previous visit maps and information may be done many ways. A Starting Point must be established or re-established for re-measurement plots. Navigation to the plot center can be done using a GPS unit, the old course to plot work or with new course to plot work.

0.1.3.1NC NC WHERE THERE IS AN OLD STARTING POINT

LOCATE AND RE-ESTABLISH 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 verify that it is suitable. If the SP is suitable, the cruiser re-scribes (not in reserved areas), repaints (not in reserved areas), and re-measures 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 re-measured DBH to the new plot sheet. On the new photo, pinprick the SP and record the course to sample location on the back of the photo.

Establish a new starting point if the original SP is not suitable or cannot be found. Record the course to sample location, SP description, and SP DBH on the new plot sheet.

COURSE TO PLOT

After re-establishing the SP, chain the computed azimuth and distance along the approach line and mark the location. If the original PC is found here continue to relocate other subplots and establish all new subplots.

If the original PC is not found at the end of the chaining, search the area for evidence of the old plot. Items to look for are paint on the tree bases (vertical line) and at breast height (horizontal line). Look for 10-inch wire pins and bits of flagging at each subplot, and witness trees (painted with an "X").

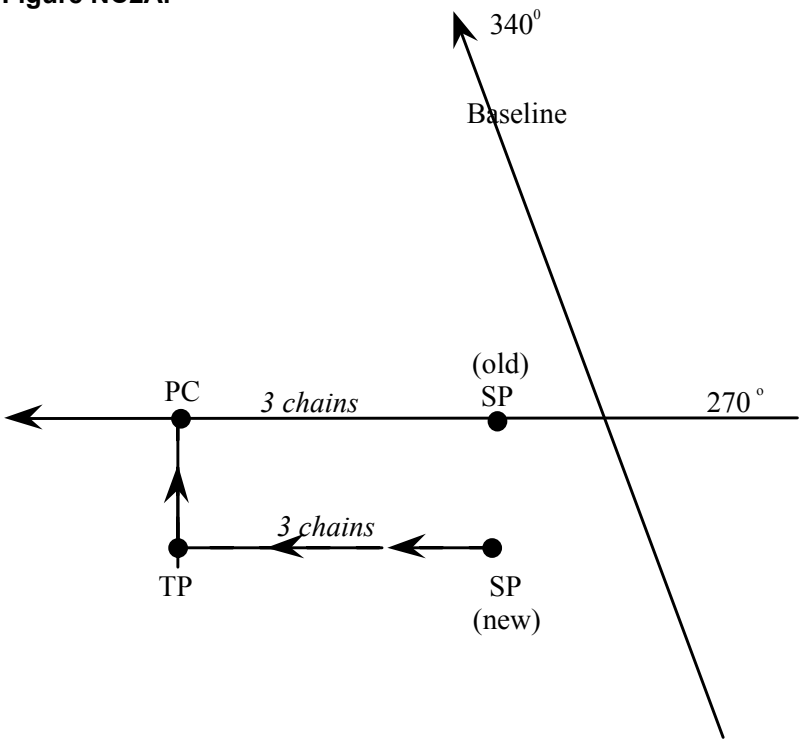
After finding plot center, establish a Turning Point (TP) if the distance between plot center and the end of the approach line exceeds 3% of the chaining distance.

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 re-chaining.
- 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.

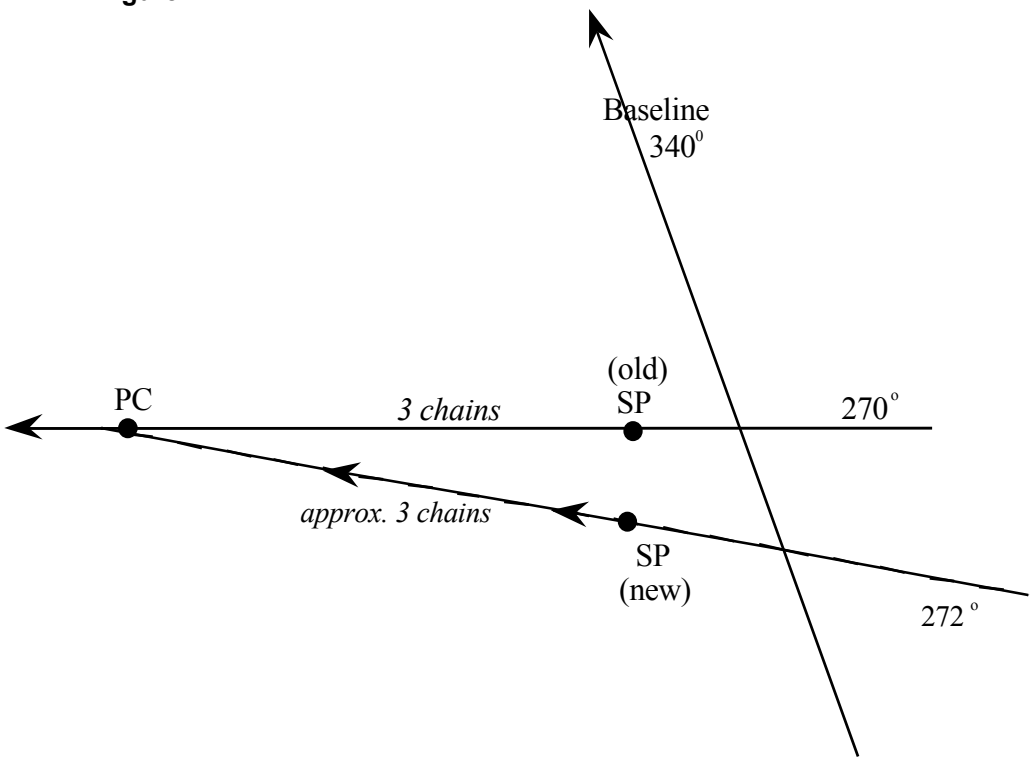
An easy way to establish a new SP, when needed, is to inspect the vicinity of the original SP for a suitable replacement. The following three options are available once you've found a replacement (fig. NC2A, NC2B, NC2C). Note that fig. NC3 shows the plot sketch—east-west azimuths would need to be reversed if drawn on the back of the photo.

Figure NC2A.



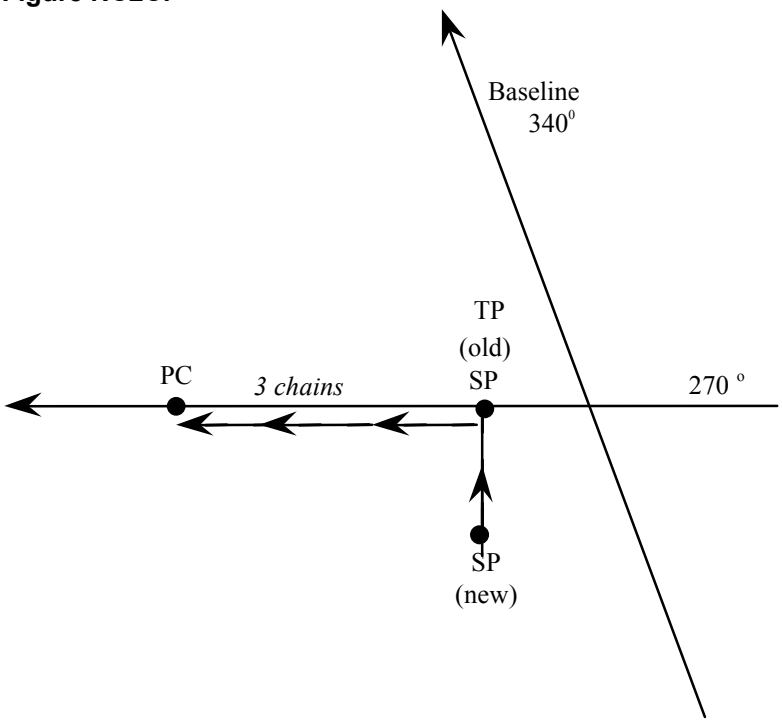
If the new SP is close by, pick the tree on the photo and use the original course to sample location. Leave a marker at your destination and look for plot center. It should be approximately the same distance and azimuth that the old SP is from the new SP. Once PC is found, make a Turning Point (TP) from your marker to PC.

Figure NC2B.



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 NC2C.



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. 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.

LOCATING ORIGINAL PLOT CENTER AND OTHER SUBPLOTS

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

Match by comparing current tree species, azimuths, distances, and DBH to the data for trees on the tree record sheet. Once it is determined which subplot the trees are on, use triangulation to find the subplot center and mark it with a piece of galvanized or aluminum wire bent into a loop with a piece of blue flagging tied through it. If this is not the plot center, move to the plot center by knowing which subplot you are on and chaining the distance and azimuth to the correct location to plot center.

After finding the old pin at Plot Center, place a new pin next to it. 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 subplot that you are required to re-measure as accurately as possible. Finding each subplot is a challenge—most of the flagging disintegrates and the wires rust and look just like twigs or roots. The best method is to run out 120 feet (70 feet if re-measuring a 10-point plot) from the last subplot at the proper azimuth, mark the spot, and search by running your hands through the area.

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

0.1.3.2NC NC WHERE THERE IS NOT AN OLD STARTING POINT

ESTABLISH A 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 that has the sample location pinpricked. Label and circle the pinprick "SP" on the back of the photograph. Record the latitude and longitude of the “SP” tree on the plot sheet using the same method as “Collecting the Plot Center Coordinate” in Appendix 11.

If there is a former Forest Health Monitoring (FHM) plot installed on the location already and the location of the FHM subplot one does not mesh with subplot one of a FIA 10 point plot use the FHM 4 point location as the plot. If there were FIA trees sent to the field on subplots 101-105 delete them and just measure the trees downloaded on subplots 1 – 4. Make a note on the plot sheet about where the FHM plot is located in relation to the FIA plot, for future crews.

If there was a 4 point FIA plot installed at a different location than the FHM plot re-measure the FIA plot where it was installed and delete any of the FHM trees in the download file. Use the provided FHM Tree Sheets to help determine which trees are FHM. (Indiana, Illinois)

COURSE TO PLOT

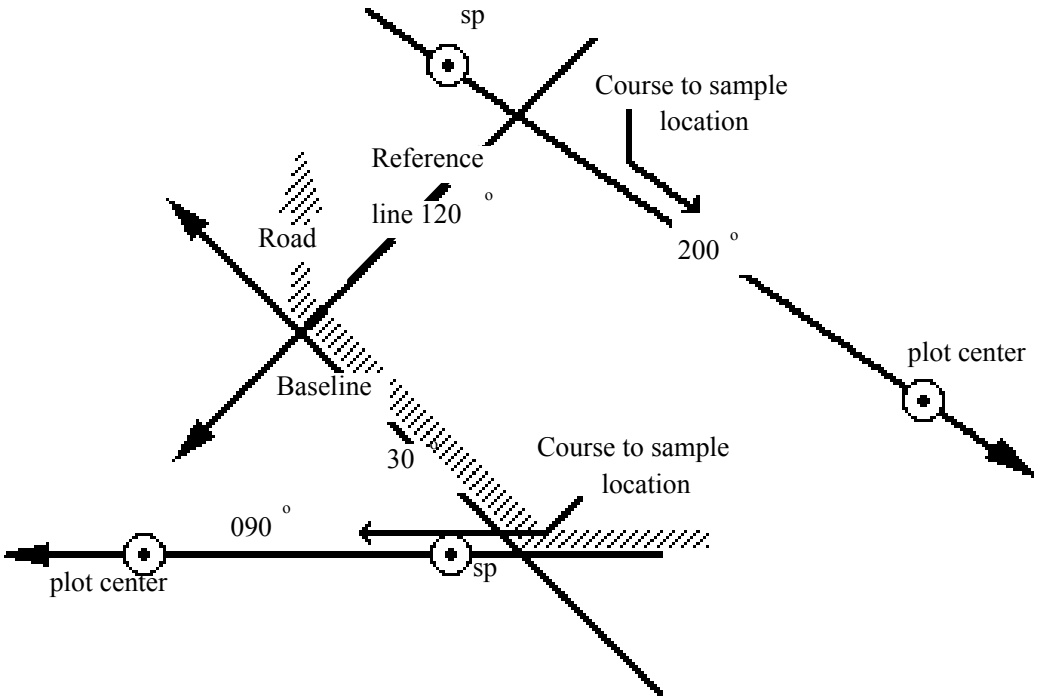
AZIMUTH AND DISTANCE COMPUTATION

On the back of the photograph, connect the pinpricks for the starting point and plot center with a straight line. 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 360^0 protractor or flip a standard 360^0 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) is 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.

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

Refer to Figure NC3. 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 stereoscope as a magnifier.) Record both distance and direction on the back of the photograph and on the plot sheet under "Course to Sample Location".

Figure NC3. Azimuth settings (back of photo)



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 after the the line is run out. The appropriate slope correction can then be found in NC 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.

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

	Feet		
Percent	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 (more than 2 chains error), and the correct location can be determined on the ground, 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.

This is only done when on a new plot it is obvious that the location arrived at with the chaining azimuth and distance does not agree with the location on the photo or image provided.

0.1.3.3NC NC CHAINING TO OTHER THAN PC

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 subplots 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 subplots 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 subplot center and chaining directly to a given subplot. 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 subplot center. At any point while chaining, establish a turning point, chain the distance and azimuth from plot center to the subplot you wish to chain to, and then continue on your original course. For example, the course from the starting point to plot center is 200^0, 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 subplot 103. At 600 ft, establish a turning point and go 360^0, 140 ft (the distance and azimuth from plot center to subplot 103). Establish another turning point and complete the original course (200^0, for the remaining 100 ft) to reach subplot 103.

0.1.3.4NC NC IF UNABLE TO LOCATE A RE-MEASUREMENT PLOT

If the crew can't find a re-measurement plot, bring it to the attention of the crew leader. After the crew has thoroughly searched for the plot without success, establish the plot using one of the following guidelines.

1. When there has been a major disturbance (such as the area has been clearcut and bulldozed) and it is obvious that the plot can't be relocated, establish the plot as near as possible to the old PC.

   On subplots 101-105 all original trees should be accounted for using status of removed or dead. Any other current data that is possible should be collected (i.e. lean, utilization, DBH). Then establish subplots 1-4.

   OR

2. When there has been no major disturbance to the area, two plots will be created. The first plot retains the old plot number and is assigned SK=0 and NCSK=0 in the data file and on the old plot sheet. This is considered a LOST PLOT. Code the Condition for the LOST PLOT as 7- Not in Sample. The second plot is a new plot that is established to replace the old lost plot. Contact headquarters for a new plot number and retrieve a Husky download file. Give the new plot a SK=1 and NCSK=33 and complete the entire plot.

LOST PLOT

A lost plot must meet the following criteria:

1. There has been no major disturbance to the plot area.
2. It may be any downloaded sample kind that refers to re-measurement. This excludes plots where SK=1 **and** NCSK=0.

IF YOU ARE IN THE FIELD AND ARE READY TO START THE PLOT HERE IS HOW TO HANDLE THE DOWNLOAD DATA FROM THE LOST PLOT AND THE NEW PLOT.

A. The lost plot is closed out as a condition status 7 "Not in sample" with:
   1. Plot header filled out, change sample kind to zero (0) and the NC sample kind to zero (0)
   2. Condition data needed = CON#, STAT, NCLU

B. Start a new plot on the Husky using the Husky option from Data entry below:

   >0000000.00 NEW PLOTEnter/Edit

   1. Change the default values for State, Unit, County to the correct ones for the plot location. Leave the plot number as 9999 until you get to the office to get a new number from St. Paul. Collect all the data under this plot number of 9999 and return to the office. Once you get the new number from St. Paul, change the plot number to the number you are given before trying to upload the data. Sample kind for this new plot would follow manual directions in Section 0.1.1.3NC of the manual that you are working in.

   2. When you save the new plot with the correct new plot number, you will still have the plot you called 9999 in the plot list and on the Husky. Now you must delete the plot number 9999 from the Husky, using the "Delete a Plot" option.

C. Transfer/send both the lost plot file and the new plot file to St. Paul.

IF YOU ARE IN THE OFFICE BEFORE YOU NEED TO START THIS PLOT:

A. The lost plot is closed out as a condition status 7 "Not in sample" with:

   1. Plot header filled out, change sample kind to zero (0) and the NC sample kind to zero (0)
   2. Condition data needed = CON#, STAT

B. Call St. Paul for a new plot number. St. Paul will create a new plot file for you to download.

C. Get the new download file one of two ways.
   1. When St. Paul gives you the new plot number filename use the JAVA program to retrieve the new download file.
   2. Have St. Paul send you the new download file with the new plot number.

D. Go to the field and collect all the data for the plot on the new download file.

E. Transfer/send both the lost plot file and the new plot file to St. Paul.

0.1.3.5NC NC RE-MEASUREMENT PLOT IN THE WRONG LOCATION

If a re-measurement plot (NCSK=6 or 8) 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 more than 2 chains or if it needs clarification for next crew, re-pinprick the new photo where the plot is actually located.

NOTE: An example that needs clarification for the next crew is when the current pinprick is on the north side of the road within one chain away but the plot is on the south side of the road. In this case please re-pinprick the new photo.

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 crew leader or state coordinator. 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).

Occasionally, while chaining in, you may pass near or over PC. To minimize the length of a turning point, or perhaps eliminate the need for a turning point, reduce the chaining distance by backtracking along the line of approach.

0.2 PLOT INTEGRITY

Each FIA program is responsible for minimizing damage to current or prospective sample trees and for specifying how these trees are monumented for remeasurement. The following field procedures are permitted:

- Scribing and nailing tags on witness trees so that subplot centers can be relocated.
- Boring of trees for age on subplots and annular plots to determine tree age, site index, stand age, or for other reasons.
- Nailing and tagging of trees on microplots, subplots, and annular plots so that these trees can be identified and relocated efficiently and positively at times of remeasurement.
- Nailing, scribing, or painting microplot, subplot, and annular plot trees so that the point of diameter measurement can be accurately relocated and remeasured.

All other potentially damaging procedures that may erode plot integrity are prohibited.
The following practices are specifically prohibited:

- Boring and scribing of some specific tree species, such as quaking aspen, that are known to be negatively affected (i.e., the initiation of infection or callusing).
- Chopping vines from tally trees. When possible, vines should be pried off trunks to enable accurate measure. If this is not possible, alternative tools (calipers, biltmore sticks) should be used.

1.0 PLOT LEVEL DATA

In general, plot level data apply to the entire plot. They are recorded from the center of subplot 1. If subplot 1 is not established, record from the lowest numbered subplot which is established.

1.0.1NC NC SUBPLOT CENTER MONUMENTATION

Subplot centers are marked with wire, bent into a loop and wrapped with flagging (usually blue). Leave about two inches of the wire projecting above the ground. In reserved areas do not attach flagging to the wire. All subplot centers 1-4 are marked.

1.0.2NC NC SUBPLOT REFERENCE TREES

On many plots, certain subplots within the plot lack information useful in determining their location on future surveys. Examples of this are subplots with a forested condition but without any trees within the subplot area.

All subplots 1-4 on the plot without live trees on the subplot or microplot that could be used to re-established subplot center location (i.e. no azimuth or distances to any tree) must be referenced. Monument reference trees above DBH and at the base with a scribe mark and paint on the side of the tree facing the subplot center. There is no set rule for painting a reference tree, but it is best to paint the tree with a number corresponding to the subplot being referenced. This method makes it easier for field crews on the next survey to identify which subplot they have located. In reserved areas, follow the same rules as on a subplot tree for monumentation.

Reference trees should have the following characteristics:

- Located within 119 feet of the subplot 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)

In the "Reference Tree" grid of the plot sheet record the subplot number, azimuth, slope distance to the center at the base (nearest tenth of a foot), and DBH.

1.1 STATE (ST)

Record the unique FIPS (Federal Information Processing Standard) code identifying the State where the plot center is located.

When collected: All plots
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: See Appendix 1

1.1NC NC UNIT (UNIT)

Record the unique one digit North Central code identifying the unit where the plot center is located.

When collected: All plots
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: See Appendix 1

1.2 COUNTY (CNTY)
Record the unique FIPS (Federal Information Processing Standard) code identifying the county (or unit in AK) where the plot center is located.

When collected: All plots
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: See Appendix 1

1.2NC NC CYCLE (CYCL)
This is the number assigned by state for each group of 5 panels which will complete one full state inventory. This number is in all downloaded plot files and on all plotsheets and should never be changed in the field.

When collected: All plots (assigned and set with download data)
Field width: 2 digits
Tolerance: No Errors
MQO: None
Values:

State	Cycle	State	Cycle	State	Cycle
Illinois	5	Michigan	6	North Dakota	4
Indiana	5	Minnesota	12	South Dakota	5
Iowa	4	Missouri	5	Wisconsin	6
Kansas	5	Nebraska	4		

1.2NC NC SUBCYCLE (SUBC)
Each cycle is broken down to 5 sub-cycles and these are the sub-cycles assigned to each state for this year of data collection. . This number is in all downloaded plot files and on all plotsheets and should never be changed in the field.

When collected: All plots (assigned and set with download data)
Field width: 2 digits
Tolerance: No Errors
MQO: None
Values:

State	SubCycle	State	SubCycle	State	SubCycle
Illinois	2	Michigan	2	North Dakota	2
Indiana	4	Minnesota	4	South Dakota	2
Iowa	4	Missouri	4	Wisconsin	3
Kansas	2	Nebraska	2		

1.3 PLOT NUMBER (PLT#)
Record the identification number for each plot, unique within a county (survey unit in AK).

When collected: All plots
Field width: 4 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 0001 to 9999

1.4 SAMPLE KIND (SK)
Record the code that describes the kind of plot being installed.

When collected: All plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 **Initial plot establishment** - field-visited or remotely classified.

2 **Remeasurement** of a previously established National design plot - field visited or remotely classified.

3 **Replacement plot** - a previously established National design plot that was replaced with a new plot because the original plot could not be relocated or because plot data were lost.

0 **NC only code –** Used only on a lost plot. Do not install a new 4 point National design plot here.

1.4NC NC SAMPLE KIND (NCSK)
The NC sample kind indicates the information to be collected on plot types that are unique to North Central Research Station FIA.

When collected: All plots
Field width: 1 digit
MQO: No errors, 100% of the time
Values:

0 **New plot/Lost plot** – This is a first time visit to the location to install a plot. If ground evidence of an old plot could not be found and there has been no major disturbance to the area, change the NCSK on the plot to zero.

6 **Partial Re-measurement Relocate**. Measure all old trees on subplots 101-105.

8 **No Re-measurement Relocate**. Do not measure old plot just use old plot information to locate subplot center to begin installation of new plot design.

33 **Replacement plot**. No old subplots are measured here.

1.5 MANUAL VERSION
Record the version number of the National Core Field Guide that was used to collect the data on this plot. This will be used to match collected data to the proper version of the field manual.

NC Note: The manual version will be applied by St. Paul after the field data is returned.

When collected: All plots
Field width: 2 digits (x.y)
Tolerance: No errors
MQO: At least 99% of the time
Values: 1.1 (Maine 1999) and higher

1.6 CURRENT DATE
Record the year, month, and day that the current plot visit was completed as follows:

1.6.1 YEAR (YEAR)
Record the year that the plot was completed.

When collected: All plots
Field width: 4 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: Beginning with 1998, constant for a given year

1.6.2 MONTH (MONT)
Record the month that the plot was completed.

When collected: All plots
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

January	01	May	05	September	09
February	02	June	06	October	10
March	03	July	07	November	11
April	04	August	08	December	12

1.6.3 DAY (DAY)
Record the day of the month that the plot was completed.

When collected: All plots
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 01 to 31

1.7 DECLINATION (CORE OPTIONAL) (**NC Note:** Not collected in North Central FIA region)

1.8 TRAILS OR ROADS (RTYP)
Record the nearest trail or road to the plot. Use the plot photo, maps, or reasonable observations made while traveling to the plot to determine nearest trail or road (within 1 mile straight-line distance of the plot center). If two or more trails or roads are estimated to be equally distant, code the higher quality trail or road (lower code number). Base the coding decision on the condition of the road at the time of the visit.

When collected: All plots with at least one accessible forest land condition class
Field width: 1 digit
Tolerance: No errors
MQO: At least 90% of the time
Values:

0 None within 1 mile
1 Paved road or highway
2 Improved gravel road (has gravel, ditching, and/or other improvements)
3 Improved dirt road (has ditching, culverts, signs, reflectors, or other improvements)
4 Unimproved dirt road/four-wheel drive road (has no signs of any improvements)
5 Human access trail- clearly noticeable and primarily for recreational use

1.9 HORIZONTAL DISTANCE TO IMPROVED ROAD (RDIS)

Record the straight-line distance from plot center (subplot 1) to the nearest improved road. An improved road (TRAILS OR ROADS = 1, 2, or 3) is a road of any width that is maintained as evidenced by pavement, gravel, grading, ditching, and/or other improvements.

NC Note: A private drive is considered a road if it meets the qualifications above.

When collected: All plots with at least one accessible forest land condition class
Field width: 1 digit
Tolerance: No errors
MQO: At least 90% of the time
Values:

1	100 ft or less
2	101 to 300 ft
3	301 to 500 ft
4	501 to 1000 ft
5	1001 ft to 1/2 mile
6	1/2 to 1 mile
7	1 to 3 miles
8	3 to 5 miles
9	Greater than 5 miles

1.10 ROAD ACCESS (RACC)

Record the first road access restrictions encountered while traveling to the plot. These restrictions limit car and truck access to the starting point for the walk to the plot, and may occur on ownerships encountered before reaching the plot area.

When collected: All plots with at least one accessible forest land condition class
Field width: 1 digit
Tolerance: No errors
MQO: At least 90% of the time
Values:

0	None – no road access restrictions
1	Road blocked by locked gate or cable across road
2	Road blocked by a human-made obstruction across road (ditch, mound, etc.)
3	Road blocked by natural occurrences (trees blown over onto road, road or bridge washed out)
4	Posted no motorized vehicle signs; road present, but restricted area such as Wilderness or National Park where vehicles are not allowed
9	Other – specify in plot-level notes

NC Note: Place the note on the husky in plot notes.

1.11 PUBLIC USE RESTRICTIONS (REST)

Record, if any, the restriction posted near or on the plot area that limits public use of the plot area; if more than one restriction occurs for the plot area, record the lowest number restriction present (1-3, 9).

When collected: All plots with at least one accessible forest land condition class
Field width: 1 digit
Tolerance: No errors

MQO: At least 90% of the time
Values:

0 None – no public use restrictions
1 Keep out / no trespassing
2 No hunting or fishing
3 No dumping

9 Other - specify in plot-level notes

NC Note: Place the note on the husky in plot notes.

1.12 RECREATION USE 1 (RECU)

Record up to 3 signs of recreation use encountered within the accessible forest land portion of any of the four subplots, based on evidence such as campfire rings, compacted areas (from tents), hiking trails, bullet or shotgun casings, tree stands, etc. Record the recreation use that has had the most significant impact on the plot area first, then the second and third use. For example, in general numerous four-wheel drive or ATV trails would be coded before camping, and camping before hiking, and hiking before fishing. Use the coding system provided as a hierarchy. Do not repeat codes, except codes 0 and 9. Physical recreation evidence must be present to code 1-9. Also, disregard dumping where no evidence of recreation is present. Examine the plot area for clues before spending an exorbitant amount of time trying to find evidence that normally would not be found in the area; look for the obvious signs first.

When collected: All plots with at least one accessible forest land condition class
Field width: 1 digit

NC Note: Field width is 3 for North Central as we collect Recreation use 1,2 & 3 all on the same data field with no separator between the numbers.

Tolerance: No errors
MQO: At least 90% of the time
Values:

0 No evidence of recreation use
1 Motor vehicle (four wheel drive, ATV, motorcycle, snowmobile)
2 Horse riding, dog team trails, ski trails
3 Camping
4 Hiking
5 Hunting/shooting
6 Fishing
7 Boating – physical evidence such as launch sites or docks

9 Other – recreation use where evidence is present, such as human litter, but purpose is not clear or does not fit into above categories.

1.13 RECREATION USE 2

Record the second most significant recreation use impact. See RECREATION USE 1 for coding instructions.

NC Note: this is the second digit of RECREATION USE 1 (RECU)

1.14 RECREATION USE 3

Record the third most significant recreation use impact. See RECREATION USE 1 for coding instructions.

NC Note: this is the third digit of RECREATION USE 1 (RECU)

1.15 WATER ON PLOT (WTYP)

Record the water source that has the greatest impact on the area within the accessible forest land portion of any of the four subplots. The coding hierarchy is listed in order from large permanent water to temporary water. This variable may be used for recreation, wildlife, hydrology, and timber availability studies.

When collected: All plots with at least one accessible forest land condition class
Field width: 1 digit
Tolerance: No errors
MQO: At least 90% of the time
Values:

0 None – no water sources within the accessible forest land CONDITON CLASS
1 Permanent streams or ponds too small to qualify as noncensus water
2 Permanent water in the form of deep swamps, bogs, marshes without standing trees present and less than 1.0 ac in size, or with standing trees
3 Ditch/canal – human-made channels used as a means of moving water, such as irrigation or drainage which are too small to qualify as noncensus water
4 Temporary streams
5 Flood zones – evidence of flooding when bodies of water exceed their natural banks

9 Other temporary water – specify in plot notes

1.16 QA STATUS (QAST)

Record the code to indicate the type of plot data collected, using the following codes:

When collected: P2 - All plots
P3 - All plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Standard production plot
2 Cold check
3 Reference plot (off grid)
4 Training/practice plot (off grid)
5 Botched plot file (disregard during data processing)
6 Blind check
7 Production plot (hot check)

1.17 CREW TYPE (CRTY)

Record the code to specify what type of crew is measuring the plot.

When collected: P2 - All plots
P3 - All plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Standard field crew
2 QA crew (any QA crew member present collecting data)

1.18 GPS COORDINATES

Use a global positioning system (GPS) unit to determine the plot coordinates and elevation of all field visited plot locations.

1.18.1 GPS UNIT SETTINGS, DATUM, and COORDINATE SYSTEM

Consult the GPS unit operating manual or other regional instructions to ensure that the GPS unit internal settings, including Datum and Coordinate system, are correctly configured.

Each FIA unit will determine the Datum to be used in that region. Most will use the NAD 27 Datum (also known as NAS-C or NA 27 CONUS/CLK66), but coordinates collected using any appropriate datum can be converted back to a national standard for reporting purposes.

Each FIA unit will also determine which coordinate system to use. Regions using a Geographic system will collect coordinates in Degrees, Minutes, and Seconds of Latitude and Longitude; those using the UTM coordinate system will collect UTM Easting, Northing, and Zone.

NC Note: North Central FIA collects all GPS coordinates in the field using NAD 83.

1.18.2 COLLECTING READINGS

Collect at least 180 GPS readings at the plot center. These may be collected in a file for post-processing or may be averaged by the GPS unit. Each individual position should have an error of less than 70 ft if possible (the error of all the averaged readings is far less).

Soon after arriving at plot center, use the GPS unit to attempt to collect coordinates. If suitable positions (180 readings at error $\leq$ 70 ft) cannot be obtained, try again before leaving the plot center.

If it is still not possible to get suitable coordinates from plot center, attempt to obtain them from a location within 200 ft of plot center. Obtain the azimuth and horizontal distance from the "offset" location to plot center. If a PLGR unit is used, use the Rng-Calc function in the PLGR to compute the coordinates of the plot center. If another type of GPS unit is used, record the azimuth and horizontal distance in Sections 1.18.12 and 1.18.13.

Coordinates may be collected further than 200 ft away from the plot center if a laser measuring device is used to determine the horizontal distance from the "offset" location to plot center. Again, if a PLGR unit is used, use the Rng-Calc function in the PLGR to compute the coordinates of the plot center. If another type of GPS unit is used, record the azimuth and horizontal distance in Sections 1.18.12 and 1.18.13.

In all cases try to obtain at least 180 positions before recording the coordinates.

1.18.3 GPS UNIT (UNIT)

Record the kind of GPS unit used to collect coordinates. If suitable coordinates cannot be obtained, record 0.

When collected: All field visited plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0 GPS coordinates not collected
1 Rockwell Precision Lightweight GPS Receiver (PLGR)
2 Other brand capable of field averaging
3 Trimble GeoExplorer or Pathfinder Pro
4 Recreational GPS (Garmin, Magellan, etc.)

1.18.4 GPS SERIAL NUMBER (GPS#)
Record the last six digits of the serial number on the GPS unit used.

When collected: When GPS UNIT > 0
Field width: 6 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 000001 to 999999

1.18.5 COORDINATE SYSTEM
Record a code indicating the type of coordinate system used to obtain readings.

NC Note: North Central FIA region always collects using code 1 : Geographic coordinate system (Latitude and Longitude).

When collected: When GPS UNIT > 0
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Geographic coordinate system
2 UTM coordinate system

1.18.6 LATITUDE (N:)
Record the latitude of the plot center to the nearest hundredth second, as determined by GPS.

NC Note: Collected in degrees and decimal minutes. Record decimal minutes to the 3rd decimal place and do not round.

When collected: When COORDINATE SYSTEM = 1
Field width: 8 digits (DDMMSSSS) **NC Note:** 7 digits collected as Degrees and decimal minutes.
Tolerance: +/- 140 ft
MQO: At least 99% of the time
Values: **NC Note:** Vary by State.

1.18.7 LONGITUDE (W:)
Record the longitude of the plot center, to the nearest hundredth second, as determined by GPS.

NC Note: Collected in degrees and decimal minutes. Record decimal minutes to the 3rd decimal place and do not round.

When collected: When COORDINATE SYSTEM = 1
Field width: 9 digits: (DDDMMSSSS) **NC Note:** 8 digits collected as Degrees and decimal minutes.
Tolerance: +/- 140 ft
MQO: At least 99% of the time
Values: **NC Note:** Vary by State.

1.18.8 UTM ZONE

Record a 2-digit and 1 character field UTM ZONE as determined by GPS.

When collected: When COORDINATE SYSTEM = 2
Field width: 3 digits: (##C)
Tolerance: No errors
MQO: At least 99% of the time
Values: 03-19Q and 03-19W

NC NOTE: Not collected in North Central FIA region.

1.18.9 EASTING (X) UTM

Record the Easting coordinate of the plot center as determined by GPS.

When collected: When COORDINATE SYSTEM = 2
Field width: 7 digits
Tolerance: +/- 140 ft
MQO: At least 99% of the time
Values:

NC NOTE: Not collected in North Central FIA region.

1.18.10 NORTHING (Y) UTM

Record the Northing coordinate of the plot center as determined by GPS.

When collected: When COORDINATE SYSTEM = 2
Field width: 7 digits
Tolerance: +/- 140 ft
MQO: At least 99% of the time
Values:
NC NOTE: Not collected in North Central FIA region.

1.18.11 CORRECTION FOR "OFFSET" LOCATION

As described in Section 1.18.2, coordinates may be collected at a location other than the plot center (an “offset” location). If a PLGR unit is used all offset coordinates will be "corrected" back using the Rng/Calc function. If a GPS unit other than a PLGR is used, then record items 1.18.12 and 1.18.13.

1.18.12 AZIMUTH TO PLOT CENTER (AZM)

Record the azimuth from the location where coordinates were collected to actual plot center. If coordinates are collected at plot center, record 000.

When collected: When GPS UNIT = 2, 3 or 4
Field width: 3 digits
Tolerance +/- 3 degrees
MQO: At least 99% of the time
Values: 000 when coordinates **are** collected at plot center
001 to 360 when coordinates **are not** collected at plot center

1.18.13 DISTANCE TO PLOT CENTER (DIST)

Record the horizontal distance in feet from the location where coordinates were collected to the actual plot center. If coordinates are collected at plot center, record 000. As described in Section 1.18.2, if a Laser range finder is used to determine DISTANCE TO PLOT CENTER, offset

locations may be up to 999 ft from the plot center. If a range finder is not used, the offset location must be within 200 ft.

When collected: When GPS UNIT = 2, 3 or 4
Field width: 3 digits
Tolerance: +/- 6 ft
MQO: At least 99% of the time
Values: 000 when coordinates **are** collected at plot center
001 to 200 when a Laser range finder **is not** used to determine distance
001 to 999 when a Laser range finder **is** used to determine distance

1.18.14 GPS ELEVATION (ELEV)

Record the elevation above mean sea level of the plot center, in feet, as determined by GPS.

When collected: When GPS UNIT = 1, 2 or 4
Field width: 6 digits
Tolerance:
MQO: At least 99% of the time
Values: -00100 to 20000

1.18.15 GPS ERROR (ERRS)

Record the error as shown on the GPS unit to the nearest foot. As described in Section 1.18.2, make every effort to collect readings only when the error $\leq$ 70 ft. However, if after trying several different times during the day, at several different locations, this is not possible, record reading with an error of up to 999 ft.

When collected: When GPS UNIT =1 or 2
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 0 to 70 if possible
71 to 999 if an error of less than 70 cannot be obtained

1.18.16 NUMBER OF READINGS (READ)

Record a 3-digit code indicating how many readings were averaged by the GPS unit to calculate the plot coordinates. Collect at least 180 readings if possible.

When collected: When GPS UNIT = 1 or 2
Field width: 3 digits
Tolerance: No errors MQO: At least 99% of the time
Values: 1 to 999

1.18.17 GPS FILENAME (CORE OPTIONAL)

Record the filename containing the GPS positions collected on the plot.

NC Note: Not collected in the North Central FIA region.

When collected: When GPS UNIT = 3
Field width: 8 characters.3 characters e.g. R0171519.ssf
Tolerance: No errors
MQO: At least 99% of the time
Values: Letters and numbers

1.19 PLOT-LEVEL NOTES

Use these fields to record notes pertaining to the entire plot. If the notes apply only to a specific subplot or other specific aspect of the plot, then make that clear in the notes.

When collected: All plots
Field width: Unlimited alphanumeric character field **NC Note:** Limited to one line between quotes.
Tolerance: N/A
MQO: N/A
Values: English language words, phrases and numbers

1.20 P3 HEXAGON NUMBER

Record the unique code assigned to each Phase 3 (former FHM) hexagon.

NC Note: This data item will be attached to the data by St. Paul after the data is collected. The information is printed on the North Central Re-measurement tree list portion of the Plot sheet.

When collected: All Phase 3 plots
Field width: 7 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

1.21 P3 PLOT NUMBER

Record the P3 PLOT NUMBERS that are used to identify individual plots within the same Phase 3 (former FHM) hexagon.

NC Note: This data item will be attached to the data by St. Paul after the data is collected. The information is printed on the North Central Re-measurement tree list portion of the Plot sheet.

When collected: All Phase 3 plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 to 9

1.22NC NC ADDRESS

The name, address and phone number for the owner of the plot will be collected in the courthouse or with other available records. Collect this information only once per plot and record the owner of the first forested condition that you assign. This data is collected in the data recorder (Husky) from the main plot menu option F2.

1.23NC NC OWNER FIRST NAME (FIRST NAME)

Enter the First name of the owner of the first forested condition defined on a plot.

When collected: All forested plots on first forested condition
Field width: 40 characters
Tolerance: None
MQO: 99% of the time
Values:

1.24NC NC OWNER LAST NAME (LAST NAME)

Enter the last name of the owner of the first forested condition defined on a plot. When ownership is Public enter the agency name in the Last Name location.

When collected: All forested plots on first forested condition
Field width: 40 characters
Tolerance: None
MQO: 99% of the time
Values:

1.25NC NC OWNER STREET (STREET)

Record the street address for the owner of the plot. If the land-owner is a government agency or private industry, owner groups less than 40, this item is not needed.

When Collected: First forested condition where owner group = 40.
Field width: 40 characters
Tolerance: None
MQO: 99% of the time
Values:

1.26NC NC OWNER CITY (CITY)

Record city name for the street address for the owner of the plot. If the land-owner is a government agency or private industry, owner groups less than 40, this item is not needed.

When Collected: First forested condition where owner group = 40.
Field width: 40 characters
Tolerance: None
MQO: 99% of the time
Values:

1.27NC NC OWNER STATE (STATE)

Record two digit State name for the street address for the owner of the plot. If the land-owner is a government agency or private industry, owner groups less than 40, this item is not needed.

When Collected: First forested condition where owner group = 40.
Field width: 2 digits
Tolerance: None
MQO: 99% of the time
Values: all two character state codes

1.28NC NC OWNER ZIP (ZIP)

Record city zip code for the street address for the owner of the plot. If the land-owner is a government agency or private industry, owner groups less than 40, this item is not needed.

When Collected: First forested condition where owner group = 40.
Field width: 15 characters
Tolerance: None
MQO: 99% of the time
Values:

1.29NC NC PHONE (PHONE)

Record phone number of the land-owner of the plot. Record using dashes between area code and the next 3 digits (exchange) and between the exchange and the number (i.e.: nnn-nnn-nnnn). If the owner group is a government agency or private industry, owner groups less than 40, this item is not needed.

When Collected: First forested condition where owner group = 40 when possible.
Field width: 10 digits
Tolerance: None
MQO: When available
Values: nnn-nnn-nnnn

2.0 CONDITION CLASS

The Forest Inventory and Analysis (FIA) plot is a cluster of four subplots in a fixed pattern. Subplots are never reconfigured or moved in order to confine them to a single condition class; a plot may straddle more than one condition class. Every plot samples at least one condition class: the condition class present at plot center (the center of subplot 1). Delineation and mapping of condition classes is a major departure from past inventory practices, and is intended to allow flexible post stratification of data for a variety of purposes.

NC Note: Any previously defined condition class for the plots done during a periodic inventory in the NC region will be re-defined as if they were never defined. In Illinois and Indiana where we installed the 4 point plot and mapped, see appendix 10 for special instructions.

2.1 DETERMINATION OF CONDITION CLASS

2.1.1 Step 1: Delineate the plot area by CONDITION STATUS

The first attribute considered when defining a condition class is CONDITION STATUS. The area sampled by a plot is assigned into condition classes based upon the following differences in CONDITION STATUS:

1. Accessible forest land
2. Nonforest land
3. Noncensus water
4. Census water
5. Denied access area
6. Area too hazardous to visit
7. Area that is not in the sample, e.g., in Canada or Mexico.

Accessible forest land defines the population of interest for FIA purposes. This is the area where most of the data collection is conducted.

2.1.2 Step 2: Further subdivide Accessible Forest Land by 6 delineation variables

Any condition class sampled as accessible forest land may be further subdivided, in order of listed priority, into smaller condition classes if distinct, contrasting condition classes are present because of variation within the sampled area in any of the following attributes:

1. Reserved Status
2. Owner Group
3. Forest Type
4. Stand Size Class
5. Regeneration Status
6. Tree Density

At time of re-inventory, two additional attributes, PAST NONFOREST/INACCESSIBLE LAND USE and PRESENT NONFOREST LAND USE are mapped to delineate new condition classes if the sampled area on a plot has changed to or from accessible forest land (See Sections 2.4.24 and 2.4.25). This allows tracking of land use changes without requiring mapping of all nonforest condition classes on all plots.

No other attribute shall be the basis for recognizing contrasting accessible forest land condition classes. For each condition class recognized, several “ancillary attributes” that help describe the condition will be collected, but will not be used for delineation purposes (see Sections 2.4.7 to 2.4.23).

2.1.3 Step 3 Further subdivide Accessible Forest Land by non-delineation variables

A CONDITION CLASS NUMBER and a classification for CONDITION STATUS is required for every condition class sampled on a plot. For each condition class classified as accessible forest land, a classification is required for each of the following attributes:

2.4.1	Reserved Status	=	
2.4.2	Owner Group	=	
2.4.3	Forest Type	=	Attributes where a change causes
2.4.4	Stand Size	=	a separate condition class
2.4.5	Regeneration Status	=	
2.4.6	Tree Density	=	

2.4.7	Owner Class	=	
2.4.7NC	NC Private Acres	=	
2.4.8	Private Owner Industrial Status	=	
2.4.9	Artificial Regeneration Species	=	
2.4.10	Stand age	=	
2.4.11	Disturbance (up to 3 coded)	=	Ancillary - changes do not
2.4.12	Disturbance Year (1 per disturbance)	=	delineate a new condition class
2.4.17	Treatment (up to 3 coded)	=	
2.4.18	Treatment Year (1 per treatment)	=	
2.4.23	Physiographic Class	=	
2.4.23NC	NC Land Use	=	
2.4.24	Past Nonforest / inaccessible Land Use	=	
2.4.25	Present Nonforest Land Use	=	
2.4.26	Nonforest Year	=	

Three additional attributes require classification in specific situations:

2.4.24 Past Nonforest/ Inaccessible Land Use (for area afforested since last inventory).

2.4.25 Present Nonforest Land Use (for area converted from accessible forest land condition class to nonforest land since last inventory).

2.4.26 Nonforest Year (estimate year that accessible forest land condition class was converted to nonforest).

When classifying condition status, owner group, reserved status, and previous and present nonforest use, base the classification on what is present within the area defined by the fixed radius plot (annular, subplot, or microplot). When classifying all other condition class variables, base the classification on the annular plot.

Specific instructions for the classification of each attribute follow.

2.2 CONDITION CLASS ATTRIBUTES

A CONDITION CLASS NUMBER and a classification for CONDITION STATUS is required for every condition class sampled on a plot.

2.2.1 CONDITION CLASS NUMBER (CON#)

On a plot, assign and record a unique identifying number for each condition class. At the time of the plot establishment, the condition class at plot center (the center of subplot 1) is designated condition class 1. Other condition classes are assigned numbers sequentially at the time each

condition class is delineated. On a plot, each sampled condition class must have a unique number that can change at remeasurement to reflect new conditions on the plot.

When collected: All condition classes
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 to 9

CONDITION CLASS DEFINING (DELINEATION) VARIABLES:

2.2.2 CONDITION CLASS STATUS (STAT)
Record the code that describes the status of the condition. Record for all condition classes sampled on a plot. The instructions in Section 2.2 and 2.3 apply when delineating condition classes that differ by CONDITION CLASS STATUS.

NC Note: On any North Central plot sent to the field with re-measurement trees that has changed condition class status to anything other than Accessible Forest Land, the trees must be accounted for in the returned data file. See Tree section (Section 5) in the manual for how to deal with these.

When collected: All condition classes
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1. Accessible forest land
2. Nonforest land
3. Noncensus water
4. Census water
5. Denied access area
6. Area too hazardous to visit
7. Area that is not in the sample, e.g., in Canada or Mexico.

The condition class status codes are defined below except for forested which is defined under section 2.3.1.

2.3.2 NONFOREST LAND
Nonforest land is any land within the sample that does not meet the definition of accessible forest land or any of the CONDITION STATUS values defined in Sections 2.3.3 through 2.3.7. To qualify, the area must be at least 1.0 ac in size and 120.0 ft wide, with 5 exceptions discussed previously at the beginning of section 2.3. Do not consider evidence of "possible" or future development or conversion. A nonforest land condition will remain in the sample and will be examined at the next occasion to see if it has become forest land.

2.3.3 NONCENSUS WATER
Lakes, reservoirs, ponds, and similar bodies of water 1.0 ac to 4.5 ac in size. Rivers, streams, canals, etc., 30.0 ft to 200 ft wide.

2.3.4 CENSUS WATER
Lakes, reservoirs, ponds, and similar bodies of water 4.5 ac in size and larger; and rivers, streams, canals, etc., more than 200 ft wide (1990 U.S. Census definition).

2.3.5 DENIED ACCESS

Any area within the sampled area on a plot on which access is denied by the legal owner of the land the plot falls on, or by an owner of the only reasonable route to the plot. There are no minimum area or width requirements for a condition class delineated by denied access. Because a denied-access condition can become accessible in the future, it remains in the sample and is re-examined at the next occasion to determine if access is available.

2.3.6 HAZARDOUS

Any area within the sampled area on plot that cannot be accessed because of a hazard or danger, for example cliffs, quarries, strip mines, illegal plantations, temporary high water, etc. Although the hazard is not likely to change over time, a hazardous condition remains in the sample and is re-examined at the next occasion to determine if the hazard is still present. There are no minimum size or width requirements for a condition class delineated by a hazardous condition.

2.3.7 NOT IN THE SAMPLE

Any area within the sampled area on a plot that is not within the boundaries of the sample population of interest. Examples of areas out of the sample would be plots or portions of plots falling in Mexico or Canada. A condition outside the sample area remains in the potential population of interest and is re-examined at the next occasion to determine if it becomes part of the population of interest. There are no minimum size or width requirements for a condition class delineated as out of the sample.

2.3 DELINEATING CONDITION CLASSES DIFFERING IN CONDITION STATUS:

The first step in delineating condition classes is to recognize differences in CONDITION STATUS. The most common difference is adjacent accessible forest land and nonforest land. Adjacent accessible forest land and nonforest land condition classes are recognized only if each of the two prospective condition classes is at least 1.0 ac in size, and each is at least 120.0 ft in width. These size and width minimums apply to both accessible forest land and nonforest land.

Within an accessible forest land condition class, unimproved roads, rock outcrops, and natural nonforest openings less than 1.0 ac in size and less than 120.0 ft in width are considered forest land and are not delineated and classified as a separate nonforest condition class.

Within a nonforest land condition class, forested areas or linear strips of trees less than 1.0 ac in size and less than 120.0 ft in width are considered part of the nonforest condition class.

Five exceptions to these size and width requirements apply:

1. Developed nonforest condition: human-caused nonforest land condition classes such as homes or cabins that are less than 1.0 ac in size and 120.0 ft in width and are surrounded by forest land. All extensions from developed nonforest inclusions are nonforest condition classes regardless of length or width. There are three kinds of developed nonforest conditions that do not have to meet area or width requirements.

    a) Improved roads: paved roads, gravel roads, or improved dirt roads regularly maintained for long-term continuing use (Figure NC 5). Unimproved traces and roads created for skidding logs are not considered improved roads.

b) Maintained rights-of-way: corridors created for railroads, power lines, gas lines, and canals that are periodically treated to limit the establishment and growth of trees and shrubs.

c) Developments: structures and the maintained area next to a structure, all less than 1.0 ac in size and surrounded by forest land. Examples of developments are houses or trailers on very small lots, communication installations in a small cleared area within forest land, and barns and sheds.

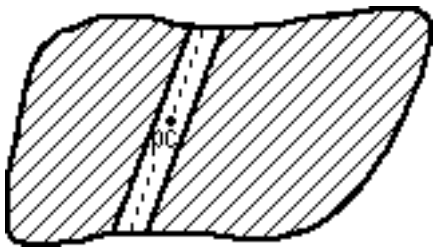


Figure NC 5 Nonforest (STAT=2)

Subplot Center falls in improved road less than 120 feet wide. Improved roads and power line clearings of any width are nonforest.

2. Distinct, alternating strips of forest and nonforest land: this situation occurs when a plot or subplot samples a condition class that is less than 1.0 ac in size and less than 120.0 ft in width. The condition class is one of a series of parallel strips of forest and nonforest land in which none of the strips meet the minimum width requirement.

   For many small intermingled strips, determine the total area that the alternating strips occupy, and classify according to the CONDITION STATUS (forest land or nonforest land) that occupies the greater area (figure NC 6). If the area of alternating strips is so large or indistinct as to make a total area determination impractical, then classify the sample as forest land.

   For two alternating strips of forest and nonforest between two qualifying areas of nonforest land and forest land, see Figure 2. Any subplot that falls in the alternating strips uses the rule. Any subplot that falls in assigned nonforest / forest is assigned that type.

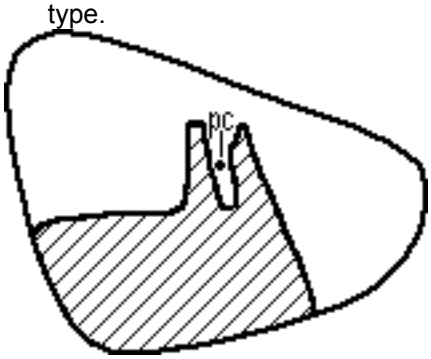


Figure NC 6 Forest (STAT=1) Subplot Center falls in area of more than two adjacent strips of clearly defined forest and nonforest land (each strip less than 120 feet in width). As the band of strips in the acre is comprised of more forest than nonforest, the classification is forest.

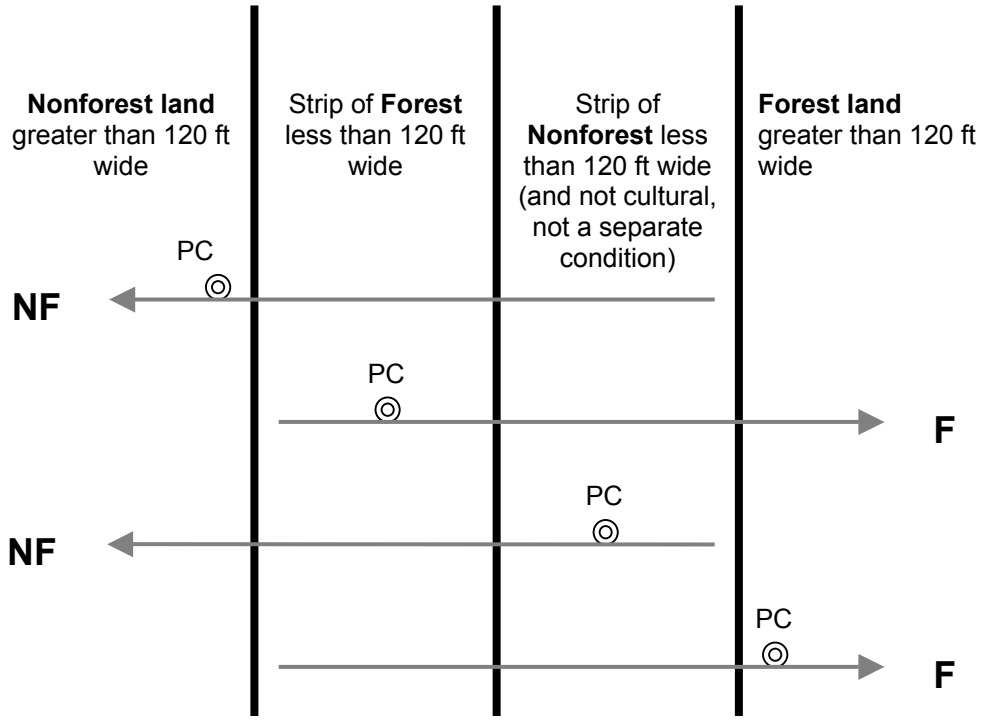


Figure 2. Example of alternating strips of forested and nonforested conditions.

3. The 120 foot minimum width for delineation does not apply when a corner angle is 90 degrees or greater (Figure 3 and NC 7).

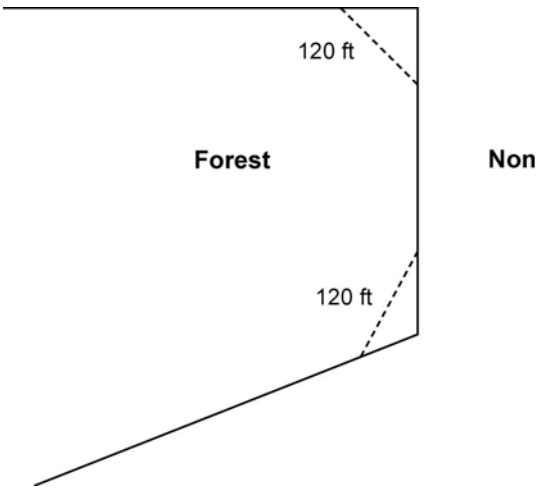


Figure 3. Illustration of the 90 degree corner rule. The dotted lines do not create nonforest conditions.

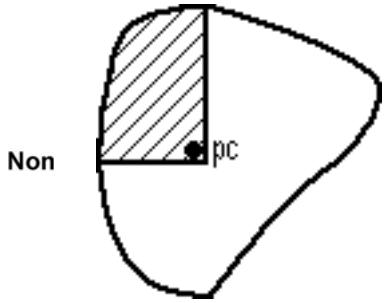


Figure NC 7 Forest (STAT=1)
Subplot Center falls in a forest land area less than 120 feet in width, but it is classified as forest. This is a special case to handle corners (in the vicinity of 90°) of forest land that have man-created boundaries adjoining them to nonforest lands. An example would be a farm woodlot, over 120 feet in width and one acre in size, that was bordered by a field.

4. Linear water features: natural water features that are linear in shape such as streams and rivers. A linear water feature must meet the definition for Census or noncensus water to be nonforest area. Therefore, a linear water feature must be at least 30.0 ft wide and cover at least 1.0 ac. The width of a linear water feature is measured across its channel between points on either side up to which water prevents the establishment and survival of trees. To determine whether a linear water feature qualifies as nonforest, rely on all available information on hand such as aerial photos, topographic maps, past survey land calls, and ocular estimates at the current survey visit. Linear water features which do not meet the definition for Census or noncensus water should be classified as forest land only if bounded by forest land on both shores. Crews are NOT expected to measure the length of a linear water feature to determine if it meets the 1.0 ac requirement; use professional judgment and common sense on any linear water feature.

5. Hazardous or denied access conditions within accessible forest land are delineated, regardless of size, as a separate condition.

CONDITION STATUS DEFINITIONS:

2.3.1 ACCESSIBLE FOREST LAND

Land that is within the population of interest, is accessible, is on a subplot that can be occupied at subplot center, can safely be visited, and meets at least one of the two following criteria:

(a) the condition is at least 10-percent stocked by trees of any size (Appendix 4) or has been at least 10-percent stocked in the past. Additionally, the condition is not subject to nonforest use(s) that prevent normal tree regeneration and succession such as regular mowing, intensive grazing, or recreation activities;

or

(b) in several western woodland types (see Appendix 4) where stocking cannot be determined, and the condition has at least 5 percent crown cover by trees of any size, or has had at least 5 percent cover in the past. Additionally, the condition is not subject to nonforest use that prevents normal regeneration and succession such as regular mowing, chaining, or recreation activities.

NC Note: If the stocking is 10-percent by trees, and there is mowing or intensive grazing the plot is given a Condition Status of 1- Forest Land and the plot is installed as a forested plot.

To qualify as forest land, the prospective condition must be at least 1.0 ac in size and 120.0 ft wide measured stem-to-stem (Figure NC 8, NC 9, NC 10). Forested strips must be 120.0 ft wide for a continuous length of at least 363.0 ft in order to meet the acre threshold. Forested strips that do not meet these requirements are classified as part of the adjacent nonforest land.

Transition zones and forest/nonforest encroachment. When an accessible forest land condition encroaches into a nonforest condition, the border between forest and nonforest is often a gradual change in tree cover or stocking with no clear and abrupt boundary. In addition, it may be difficult to determine exactly where the forested area meets the minimum stocking criteria and where it does not. For these cases, determine where the land clearly meets the 10% minimum forest land stocking, and where it clearly is less than required stocking; divide the zone between these points in half, and determine the side of the zone on which the subplot center is located. Classify the condition class of the subplot based on this line (Figure 4).

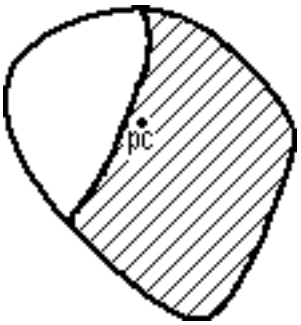


Figure NC 8 Forest (STAT=1)
Subplot Center falls on forest land larger than one acre in size.

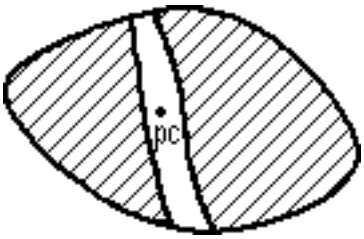


Figure NC 9 Forest (STAT=1)
Subplot Center falls on strip of nonforest land (less than 120 feet in width) that is bounded by forest land on at least two sides. Note exceptions.

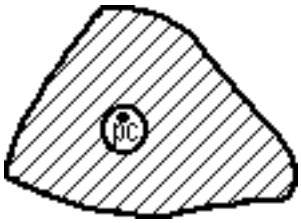


Figure NC 10 Forest (STAT=1)
Subplot Center falls on nonforest land (less than one acre in size) that is surrounded by forest land. Note exceptions.

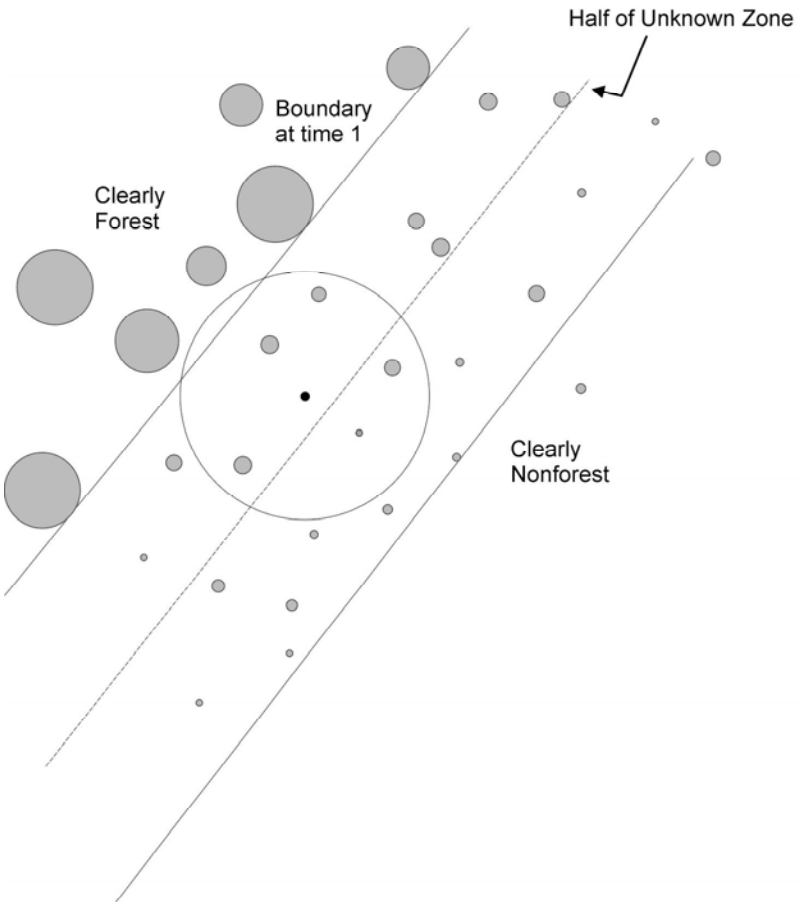


Figure 4. Example of classifying the condition class of the subplot in a transition zone with forest/nonforest encroachment.

For example, at measurement time 1, a clear and distinct boundary existed between the forest and nonforest condition classes. At time 2, however, there now exists a zone of regeneration or small diameter trees between the previous forest condition and where the nonforest clearly remains. If the zone of encroachment is clearly stocked where it meets the nonforest, classify the entire zone as forest. If the zone is clearly nonforest up to the original stand, call it all nonforest. If the encroachment or transition zone is not clearly stocked where it meets the nonforest, determine where it is clearly stocked (forest) and where it is clearly not stocked (nonforest); divide this zone in half, and classify the entire subplot based on which side of the line the subplot center falls.

Treated strips – Occasionally, crews will come across plantations of trees, in which rows of trees alternate with strips of vegetation that have been bulldozed, mowed, tilled, treated with herbicide, or crushed. Because these strip treatments are conducted to optimize growth or to release the stand, the areas are considered forest land, and the treatment is considered a timber stand improvement operation. Do not confuse these practices with similar treatments on nonforest lands such as yards or rights-of-way. Contact with the land owner may help determine the intent of a treatment.

Indistinct boundary due to the condition minimum-width definition: Do not subdivide subplots where a condition class may change due only to the forest vs. nonforest minimum width (120.0 ft) definition. Although the point where the definition changes from forest to nonforest creates an invisible "line" between conditions, **this definitional boundary is not distinct and obvious**. See Figures 5 and 6. Where the point of the definition change occurs on the subplot, determine only if the subplot center is on the forest or nonforest side of that approximate boundary, and classify the entire subplot based on the condition of the subplot center. If the boundary crosses through the center of the subplot, classify the subplot as the condition it most resembles. If the boundary occurs between subplots, classify each subplot based on its relation to the definitional boundary.

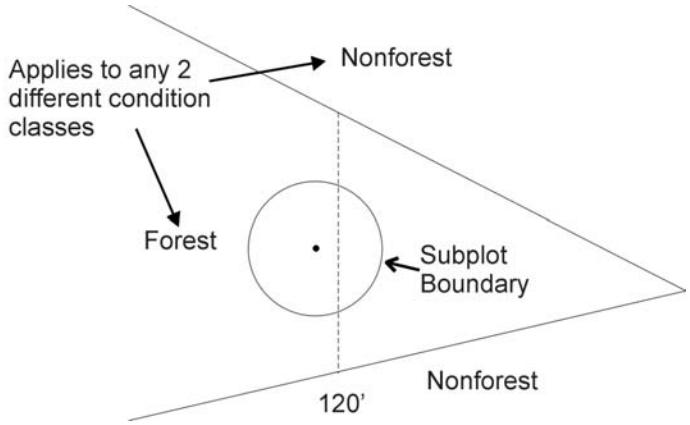


Figure 5. Forest condition narrows within a nonforest condition. Examine the location of the subplot center in reference to the approximate line where the forest narrows to 120 ft wide. In this example, the entire subplot is classified as forest.

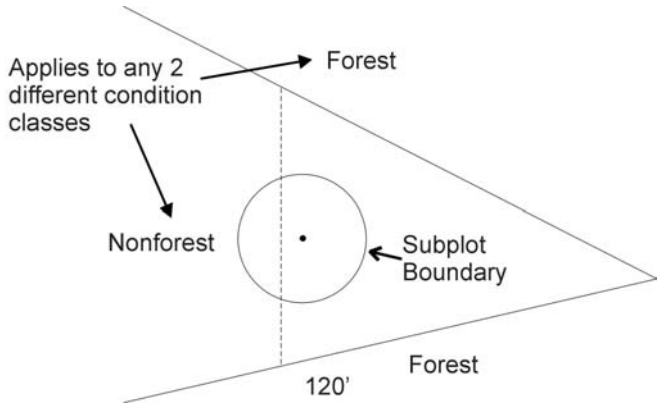


Figure 6. Nonforest condition narrows within a forest condition. Examine the location of the subplot center in reference to the approximate line where the nonforest narrows to 120 ft wide. In this example, the entire subplot is classified as forest.

2.4 DELINEATING CONDITION CLASSES WITHIN ACCESSIBLE FOREST LAND:

Accessible forest land is subdivided into condition classes that are based on differences in RESERVED STATUS, OWNER GROUP, FOREST TYPE, STAND SIZE CLASS, REGENERATION STATUS, and TREE DENSITY. Section 2.1 applies when delineating contrasting forest condition classes. Specific criteria apply for each of the six attributes and are documented by attribute in subsections within 2.4.1 to 2.4.6. "Stands" are defined by plurality of stocking for all live trees that are not overtopped.

Additionally, each separate forest condition class recognized within accessible forest land must be at least 1.0 ac in size and at least 120.0 ft in width. If prospective contrasting forest land condition classes do not each meet these minimum size and width requirements, the most similar prospective conditions should be combined until these minimums are attained.

No other attribute shall be the basis for recognizing contrasting condition classes. For each condition class recognized, there are many "ancillary attributes" that help describe the condition will be collected, but will not be used for delineation purposes (see Sections 2.4.7 to 2.4.23).

General instructions for delineating condition classes within accessible forest lands:

1. Distinct boundary within an annular plot (if applicable), subplot, or microplot: Separate condition classes ARE recognized if, within a subplot, two (or more) distinctly different condition classes are present and delineated by a distinct, abrupt boundary. The boundary is referenced; see Section 3.0.

2. Indistinct boundary within a subplot: Separate condition classes are NOT recognized if the prospective condition classes abut along an indistinct transition zone, rather than on an abrupt, obvious boundary. Only one condition is recognized, and the subplot is classified entirely as the condition it most resembles.

   Example: The 4 subplots all sample only accessible forest land. Subplots 1, 3, and 4 sample what is clearly a stand of large diameter trees. Subplot 2 falls in the middle of a stand size transition zone. In the zone, the large diameter stand phases into a sapling stand.

   Subplot 2 must not be divided into two condition classes on the basis of stand size. Instead, it is treated entirely as part of the large diameter condition class or is assigned entirely to a new condition class that is classified as a seedling-sapling stand. The latter occurs only if the crew thinks the entire subplot is more like a stand of seedling-saplings than a stand of large diameter trees; then the boundary between the large and small diameter stands is assumed to occur between and not on the subplots.

3. A boundary or transition zone between fixed radii plots that sample distinctly different condition classes: Separate condition classes are recognized and recorded when a valid attribute obviously differs between two fixed radius plots, but a distinct boundary or indistinct transition zone exists outside the sampled (fixed-radius) area of the subplots. In such cases, a boundary, if present, is not referenced.

   Example: The northernmost subplot (2) samples entirely accessible forest land. The other three subplots, 1, 3, and 4, fall clearly in a nonforest meadow. Between subplot 1 and 2 is a transition zone; the number of trees present goes from none to what clearly represents at least 10-percent tree stocking. Two condition classes are sampled: accessible forest land sampled on subplot 2, and nonforest land sampled on the other subplots.

4. Riparian forest area: A riparian forest area is defined as a forest area between 30.0 and 120.0 ft wide, and 1.0 ac or more in size, cumulative, but not necessarily present on both sides of and adjacent to a naturally occurring or artificially created body of water or watercourse with continuous or intermittent flow. Riparian forest areas may be associated with but not limited to streams, rivers, lakes, sloughs, seeps, springs, marsh, beaver ponds, sink holes, cypress domes and ponds, man-made ditches and canals. A riparian forest area must be associated “within forest” and contain at least one distinct and obvious change in a condition class delineation attribute from its adjacent accessible forest land condition class.

   Note: When the width of forest adjacent to a stream is between 120.0 ft and 150.0 ft and the width of the riparian forest is at least 30.0 ft wide, the rules for identifying the non-riparian forest (at least 30.0 ft but less than 120.0 ft) need to be modified. The non-riparian forest can be between 30.0 ft and 120.0 ft and mapped as a separate condition as long as it meets the criteria for delineating a separate condition class, otherwise it will be an inclusion in the riparian forest condition class.

2.4.1 RESERVED STATUS (RESV)

Record the code that identifies the reserved designation for the condition. Reserved land is withdrawn by law(s) prohibiting the management of land for the production of wood products (not merely controlling or prohibiting wood harvesting methods). Such authority is vested in a public agency or department, and supersedes rights of ownership. The prohibition against management for wood products cannot be changed through decision of the land manager (management agency) or through a change in land management personnel, but rather is permanent in nature. The phrase "withdrawn by law" includes as reserved land, parcels of private land with deeds that specifically prohibit the management of the tract for the production of wood products.

When collected: All accessible forestland condition classes (CONDITION STATUS = 1)
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0	Not reserved
1	Reserved

2.4.2 OWNER GROUP (OWNG)

Record the OWNER GROUP code identifying the ownership (or the managing Agency for public lands) of the land in the condition class. Conditions will be delineated based on changes in OWNER GROUP only; separate conditions due to changes in OWNER GROUP are recognized only where differences can be clearly identified on the ground when visiting the plot.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 2 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

10	Forest Service
20	Other Federal
30	State and Local Government
40	Private

2.4.3 FOREST TYPE (FTYP)

Record the code corresponding to the FOREST TYPE (from Appendix 2) that best describes the species with the plurality of stocking for all live trees in the condition class that are not overtopped.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 3 digits
Tolerance: No errors in group or type
MQO: At least 99% of the time in group; at least 95% of the time in type
Values: See Appendix 2

The instructions in section 2.1 and 2.3 apply when delineating, within accessible forest land, contrasting conditions based on differences in FOREST TYPE.

2.4.4 STAND SIZE CLASS (STSZ)

Record the code that best describes the predominant size class of all live trees in the condition class that are not overtopped.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0 Nonstocked:
Meeting the definition of accessible forest land, and one of the following applies:

(a) less than 10 percent stocked by trees of any size, and not classified as cover trees, or

(b) for forest types where stocking standards are not available, less than 5 percent **crown cover** of trees of any size.

1 < 4.9 in (seedlings / saplings)
At least 10 percent stocking (or 5 percent crown cover if stocking tables are not available) in trees of any size; and at least 2/3 of the crown cover is in trees less than 5.0 in DBH/DRC.

2 5.0 – 8.9 in (softwoods) / 5.0 – 10.9 in (hardwoods)
At least 10 percent stocking (or 5 percent crown cover if stocking tables are not available) in trees of any size; and at least 1/3 of the crown cover is in trees greater than 5.0 in DBH/DRC **and** the plurality of the crown cover is in softwoods between 5.0 – 8.9 in diameter and/or hardwoods between 5.0 – 10.9 in DBH, and/or western woodland trees 5.0 – 8.9 in DRC.

3 9.0 – 19.9 in (softwoods) / 11.0 – 19.9 in (hardwoods)
At least 10 percent stocking (or 5 percent crown cover if stocking tables are not available) in trees of any size; and at least 1/3 of the crown cover is in trees greater than 5.0 in DBH/DRC **and** the plurality of the crown cover is in softwoods between 9.0 – 19.9 in diameter and/or hardwoods between 11.0 – 19.9 in DBH, and for western woodland trees 9.0 – 19.9 in DRC.

4 20.0 – 39.9 in
At least 10 percent stocking (or 5 percent crown cover if stocking tables are not available) in trees of any size; and at least 1/3 of the crown cover is in trees greater than 5.0 in DBH/DRC **and** the plurality of the crown cover is in trees between 20.0 – 39.9 in DBH.

5 40.0 + in
At least 10 percent stocking (or 5 percent crown cover if stocking tables are not available) in trees of any size; and at least 1/3 of the crown cover is in trees greater than 5.0 in DBH/DRC **and** the plurality of the crown cover is in trees ≥ 40.0 in DBH.

6 Cover trees (non-tallied):
Less than 10 percent stocking by trees of any size, and greater than 5 percent **crown cover** of species that comprise cover trees.

The instructions in Sections 2.1 and 2.3 apply when delineating, on accessible forest land, contrasting conditions based on differences in STAND SIZE CLASS.

Within the sampled area on microplot, subplot, or annular plot, recognize only very obvious contrasting stands of different mean diameter with an abrupt boundary. Example: an obvious abrupt boundary exists within the sampled (fixed-radius) area of a subplot and demarcates a large diameter stand from a small diameter stand. Use tree stocking of all live trees that are not overtopped to differentiate between stand-size classes; for most western woodland forest types (e.g., pinyon, juniper, gambel oak) where stocking values are not readily available, use percent tree cover to represent stocking.

Use crown cover as the surrogate for stocking to determine STAND SIZE CLASS. View the plot from the top down and examine crown cover. The stand must have at least 5% of the crown cover in STAND SIZE CLASSES of 1,2,3,4, and 5 or any combination of these STAND SIZE CLASSES; otherwise the STAND SIZE CLASS is either 0 or 6 depending on the characteristics of the stand. If at least 1/3 of crown cover is made up of STAND SIZE CLASSES = 2, 3, 4, and 5 (combined), the accessible forested condition will be classified in one of these STAND SIZE CLASSES based on which of these STAND SIZE CLASSES has the most crown cover. If less than 1/3 of the crown cover is made up of STAND SIZE CLASSES = 2, 3, 4, and 5 (combined), classify the accessible forested condition as a STAND SIZE CLASS = 1, if adequate cover is present.

If no other condition class defining variables are different between accessible forest conditions, delineate on differences in STAND SIZE CLASS only for the following combinations:

Between Nonstocked (STAND SIZE CLASS = 0) or cover trees (STAND SIZE CLASS = 6) and any stocked forest land (STAND SIZE CLASS = 1, 2, 3, 4, or 5);
Between STAND SIZE CLASS = 1 and STAND SIZE CLASS = 3, 4, and 5;
Between STAND SIZE CLASS = 2 and STAND SIZE CLASS = 4 and 5; or
Between STAND SIZE CLASS = 3 and STAND SIZE CLASS = 5.

Note: Differing stand size classes can be used to describe separate condition classes, while at the same time not be used to delineate separate condition classes. Example: Two adjacent forested stands of the same forest type, one with a STAND SIZE CLASS = 1 and the other with a STAND SIZE CLASS = 2 could be delineated as separated CONDITION CLASS if one of the other condition class delineation variables differs (based on the rules), i.e. OWNER GROUP differs between the two condition classes. In addition, the STAND SIZE CLASS variables for the two condition classes would be recorded and treated as an ANCILLARY variable.

2.4.5 REGENERATION STATUS (SORI)

Record the code that best describes the degree of evidence of artificial regeneration which occurred in the condition.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0	Natural	Present stand shows no clear evidence of artificial regeneration. Includes unplanted, recently cut lands.
1	Artificial	Present stand shows clear evidence of artificial regeneration.

The instructions in section 2.1 and 2.3 apply when delineating, within accessible forest land, contrasting conditions based on differences in REGENERATION STATUS.

For a forest land condition to be delineated and/or classified as artificially regenerated, the condition must show distinct evidence of planting or seeding. If it is difficult to determine whether or not a stand has been planted or seeded, then use code 0. If no distinct boundary exists within the sampled (fixed-radius) area on any subplot, then do not recognize separate conditions. In many regions of the West, trees are not planted in rows, and planted stands do not differ in physical appearance from natural conditions. In these cases, there is no need to differentiate conditions based on stand origin.

Note: Plot records or verbal evidence from landowner is acceptable for determining regeneration status.

2.4.6 TREE DENSITY (DENS)

Record a code to indicate the relative tree density classification. Base the classification on the number of stems/unit area, basal area, tree cover, or stocking of all live trees in the condition which are not overtopped, compared to any previously defined condition class TREE DENSITY.

The instructions in section 2.1 and 2.3 apply when delineating, within accessible forest land, contrasting conditions based on differences in TREE DENSITY.

Codes 2 and higher are used ONLY when all other attributes used to delineate separate condition classes are homogenous, i.e. when a change in density is the ONLY difference within what would otherwise be treated only as one forest condition. Otherwise, code 1 for all condition classes. Codes 2 and higher are usually, but not always, used to demarcate areas that differ from an adjacent area due to forest disturbance, e.g., a partial harvest or heavy but not total tree mortality due to a ground fire. Delineation by density should only be done when the less-dense condition is 50% or less as dense as the denser condition.

Do not distinguish between low stocked stands or stands of sparse and patchy forest.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Initial density class
2 Density class 2 - density different than 1
3 Density class 3 - density different than 1 and 2

In order to qualify as a separate condition based on density, there MUST be a distinct, easily observed change in the density of an area's tree cover or basal area.

Examples of valid contrasting conditions defined by differences in tree density are forest land conditions with the same type, origin, stand size, ownership, and reserved status, but:

- the eastern half of an otherwise homogeneous, 20 ac stand has many trees killed by a bark beetle outbreak,

or

- one portion of a stand is partially cut over (with 40 sq. ft basal area per ac) while the other portion is undisturbed (with 100 sq. ft basal area per ac).

ANCILLARY (NON-DELINEATING) VARIABLES

2.4.7 OWNER CLASS (OWNC)

Record the OWNER CLASS code that best corresponds to the ownership (or the managing Agency for public lands) of the land in the condition class. Conditions will **NOT** be delineated based on changes in owner class. If multiple owner classes within a group occur on a single condition class, record the owner class closest to the plot center.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

Owner Classes within Forest Service Lands (Owner Group 10):

11 National Forest
12 National Grassland
13 Other Forest Service

Owner Classes within Other Federal Lands (Owner Group 20)

21 National Park Service
22 Bureau of Land Management
23 Fish and Wildlife Service
24 Departments of Defense/Energy
25 Other Federal

Owner Classes within State and Local Government lands (Owner Group 30)

31 State
32 Local (County, Municipality, etc.)
33 Other Non Federal Public

Owner Classes within Private lands (Owner Group 40)

41 Corporate
42 Non Governmental Conservation / Natural Resources Organization - examples: Nature Conservancy, National Trust for Private Lands, Pacific Forest Trust, Boy Scouts of America, etc.
43 Unincorporated Partnerships / Associations / Clubs – examples: Hunting Clubs that **own, not lease** property, recreation associations, 4H, etc.
44 Native American (Indian) – within reservation boundaries
45 Individual

2.4.7NC NC PRIVATE ACRES (NCPA)

For Ownership Group code 40, record the acres owned using the code that indicates ownership size (Condition Status=1) in the United States.

When collected: Only when owner group=40
Field width: 1 digit
MQO: +/- 1 code
Values:

Code	Acres forest land
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+

2.4.8 PRIVATE OWNER INDUSTRIAL STATUS (INDU)

Record the code identifying the status of the owner with regard to being considered industrial as determined by whether or not they own and operate a primary wood processing plant. A primary wood processing plant is any commercial operation which originates the primary processing of wood on a regular and continuing basis. Examples include: pulp or paper mill, sawmill, panel board mill, post or pole mill, etc. Cabinet shops, "mom & pop" home-operated businesses, etc., should not be considered as industrial plants. If any doubt exists with the determination by the field crew about the owner's industrial status due to name, commercial plant size, type plant, etc., choose code 0 below.

NOTE: Unit or State headquarters may have to maintain a list of recognized industrial owners within a State for crews to use when making these determinations.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1) when the owner group is private (OWNER GROUP 40)
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0	Land **is not** owned by industrial owner with a wood processing plant
1	Land **is** owned by industrial owner with wood processing plant

2.4.9 ARTIFICIAL REGENERATION SPECIES (SOSP)

Record the species code of the predominant tree species for which evidence exists of artificial regeneration in the stand. This attribute is ancillary; that is, contrasting condition classes are never delineated based on variation in this attribute.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1) with evidence of artificial regeneration (REGENERATION STATUS = 1)
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: See Appendix 4

2.4.10 STAND AGE (SAGE)

Record the average total age, to the nearest year, of the trees (plurality of all live trees not overtopped) in the predominant STAND SIZE CLASS of the condition, determined using local procedures. Record 000 for non-stocked stands.

An estimate of STAND AGE is required for every forest land condition class defined on a plot. Stand age is usually highly correlated with stand size and should reflect the average age of all trees that are not overtopped. Unlike the procedure for Site tree age, estimates of stand age should estimate the time of tree establishment (e.g., not age at the point of diameter measurement). Note: For planted stands, estimate age based on the year the stand was planted (e.g., do not add in the age of the planting stock).

To estimate STAND AGE, select two or three dominant or codominant trees from the overstory. If the overstory covers a wide range of tree sizes and species, try to select the trees accordingly, but it is not necessary to core additional trees in such stands. The variance associated with mean stand age increases with stand heterogeneity, and additional cores are not likely to improve the estimate. Core each tree at the point of diameter measurement and count the rings between the outside edge and the core to the pith. Add in the number of years that passed from germination until the tree reached the point of core extraction to determine the total age of the tree. Unless more specific information is provided at training or by the unit, add 5 years to all eastern species, 5 years to western hardwoods, and 10 years to western softwoods. Assign a weight to each core by visually estimating the percentage of total overstory trees it represents. Make sure the weights from all cores add up to 1.0, compute the weighted average age, and record. For example, if three trees aged 34, 62, and 59 years represent 25 percent, 60 percent, and 15 percent of the overstory, respectively, the weighted stand age should be:

(34 x 0.25) + (62 x 0.60) + (59 x 0.15) = 55 years.

In some cases, it may be possible to avoid coring trees to determine age. If a stand has not been seriously disturbed since the previous survey, simply add the number of years since the previous inventory to the previous STAND AGE. In other situations, cores collected from site trees can be used to estimate STAND AGE.

If a condition class is nonstocked, assign a STAND AGE of 000.

If all of the trees in a condition class are of a species which, by regional standards, can not be bored for age (e.g., mountain mahogany, tupelo) record 998. This code should be used in these cases only.

If tree cores are not counted in the field, but are collected and sent to the office for the counting of rings, record 999. Note on the core the % of stand that type of core represents so that STAND AGE can be calculated later.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 3 digits
Tolerance: +/- 10%
MQO: At least 95% of the time
Values: 000 to 997, 998, 999

2.4.11 DISTURBANCE 1 (DIS1)

Record the code corresponding to the presence of the following disturbances. Disturbance can connote positive or negative effects. The area affected by any natural or human-caused disturbance must be at least 1.0 ac in size. Record up to three different disturbances per

condition class from most important to least important as best as can be determined. This attribute is ancillary; that is, contrasting conditions are never delineated based on variation in this attribute.

For initial forest plot establishment (initial grid activation or newly forested plots), the disturbance must be within the last 5 years. For remeasured plots recognize only those disturbances that have occurred since the previous inventory. **NC Note:** Last 5 years all NC region.

The disturbance codes below require "significant threshold" damage, which implies mortality and/or damage to 25 percent of individual trees in the condition class.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

Code	Definition
00	None - no observable disturbance
10	Insects
20	Disease
30	Fire (from crown and ground fire, either prescribed or natural)
31	ground fire
32	crown fire
40	Animal damage
41	beaver (includes flooding caused by beaver)
42	porcupine
43	deer/ungulate
~~44~~	~~bear~~ (CORE OPTIONAL) **NC Note:** Not used
~~45~~	~~rabbit~~ (CORE OPTIONAL) **NC Note:** Not used
46	domestic animal/livestock (includes grazing):
50	Weather damage
51	ice
52	wind (includes hurricane, tornado)
53	flooding (weather induced)
54	drought
60	Vegetation (suppression, competition, vines):
70	Unknown / not sure / other (include in NOTES)
80	Human-caused damage – any significant threshold of human-caused damage not described in the DISTURBANCE codes listed above or in the TREATMENT codes listed below.

2.4.12 DISTURBANCE YEAR 1 (SYR1)

Record the year in which DISTURBANCE 1 occurred. If the disturbance occurs continuously over a period of time, record 9999.

When collected: When DISTURBANCE 1 > 00
Field width: 4 digits
Tolerance: +/- 1 year for measurement cycles of 5 years
+/- 2 years for measurement cycles of > 5 years
MQO: At least 99% of the time
Values: Since the previous plot visit, or the past 5 years for plots visited for the first time

2.4.13 DISTURBANCE 2 (DIS2)

If a stand has experienced more than one disturbance, record the second disturbance here. See DISTURBANCE 1 for coding instructions.

2.4.14 DISTURBANCE YEAR 2 (DYR2)

Record the year in which DISTURBANCE 2 occurred. See DISTURBANCE YEAR 1 for coding instructions.

2.4.15 DISTURBANCE 3 (DIS3)

If a stand has experienced more than two disturbances, record the third disturbance here. See DISTURBANCE 1 for coding instructions.

2.4.16 DISTURBANCE YEAR 3 (DYR3)

Record the year in which DISTURBANCE 3 occurred. See DISTURBANCE YEAR 1 for coding instructions.

2.4.17 TREATMENT 1 (TRE1)

Record the code corresponding to the presence of one of the following treatments since the last inventory cycle or within the past 5 years. The area affected by any treatment must be at least 1.0 ac in size. Record up to three different treatments per condition class from most important to least important as best as can be determined. This attribute is ancillary; that is, contrasting conditions are never delineated based on variation in this attribute.

For initial forest plot establishment (initial grid activation or newly forested plots), the treatment must be within the last 5 years. For remeasured plots recognize only those treatments that have occurred since the previous inventory. **NC Note:** Last 5 years all NC region.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

Code	Definition
00	None - No observable treatment.
10	Cutting - The removal of one or more trees from a stand.
20	Site preparation - Clearing, slash burning, chopping, disking, bedding, or other practices clearly intended to prepare a site for either natural or artificial regeneration.
30	Artificial regeneration - Planting or direct seeding has resulted in a stand at least 50% stocked with live trees of any size.
40	Natural regeneration - Growth of existing trees and/or natural seeding has resulted in a stand at least 50% stocked with live trees of any size.
50	Other silvicultural treatment - The use of fertilizers, herbicides, girdling, pruning or other activities (not already listed above) designed to improve the commercial value of the residual stand.

2.4.18 TREATMENT YEAR 1 (TYR1)
Record the year in which TREATMENT 1 occurred.

When collected: When TREATMENT 1 > 00
Field width: 4 digits
Tolerance: +/- 1 year for measurement cycles of 5 years
+/- 2 years for measurement cycles of > 5 years
MQO: At least 99% of the time
Values: Since the previous plot visit, or the past 5 years for plots visited for the first time

2.4.19 TREATMENT 2 (TRE2)
If a stand has experienced more than one treatment, record the second treatment here. See TREATMENT 1 for coding instructions, code 00 if none.

2.4.20 TREATMENT YEAR 2 (TYR2)
Record the year in which TREATMENT 2 occurred. See TREATMENT YEAR 1 for coding instructions.

2.4.21 TREATMENT 3 (TRE3)
If a stand has experienced more than two treatments, record the third treatment here. See TREATMENT 1 for coding instructions, code 00 if none.

2.4.22 TREATMENT YEAR 3 (TYR3)
Record the year in which TREATMENT 3 occurred. See TREATMENT YEAR 1 for coding instructions.

2.4.23 PHYSIOGRAPHIC CLASS (PHYS)
Record the code that best describes the PHYSIOGRAPHIC CLASS of the condition; land form, topographic position, and soil generally determine physiographic class. As a rule of thumb, look over the annular plot area to determine physiographic class, but always use your best judgment when assessing any condition level variables.

When collected: All accessible forest land condition classes (CONDITION STATUS = 1)
Field width: 2 digits
Tolerance: No errors
MQO: At least 80% of the time
Values:

Xeric Sites that are normally low or deficient in moisture available to support vigorous tree growth. These areas may receive adequate precipitation, but experience a rapid loss of available moisture due to runoff, percolation, evaporation, etc.

11 Dry Tops - Ridge tops with thin rock outcrops and considerable exposure to sun and wind.

12 Dry Slopes - Slopes with thin rock outcrops and considerable exposure to sun and wind. Includes most steep slopes with a southern or western exposure.

13 Deep Sands - Sites with a deep, sandy surface subject to rapid loss of moisture following precipitation. Typical examples include sand hills, sites along the beach and shores of lakes and streams, and many deserts.

19 Other Xeric - All dry physiographic sites not described above.

Mesic Sites that have moderate but adequate moisture available to support vigorous tree growth except for periods of extended drought. These sites may be subjected to occasional flooding during periods of heavy or extended precipitation.

21 Flatwoods - Flat or fairly level sites outside flood plains. Excludes deep sands and wet, swampy sites.

22 Rolling Uplands - Hills and gently rolling, undulating terrain and associated small streams. Excludes deep sands, all hydric sites, and streams with associated flood plains.

23 Moist Slopes and Coves - Moist slopes and coves with relatively deep, fertile soils. Often these sites have a northern or eastern exposure and are partially shielded from wind and sun. Includes moist mountain tops and saddles.

24 Narrow Flood plains/Bottomlands - Flood plains and bottomlands less than 1/4-mile in width along rivers and streams. These sites are normally well drained but are subjected to occasional flooding during periods of heavy or extended precipitation. Includes associated levees, benches, and terraces within a 1/4 mile limit. Excludes swamps, sloughs, and bogs.

25 Broad Flood plains/Bottomlands - Flood plains and bottomlands 1/4 mile or wider in width along rivers and streams. These sites are normally well drained but are subjected to occasional flooding during periods of heavy or extended precipitation. Includes associated levees, benches, and terraces. Excludes swamps, sloughs, and bogs with year-round water problems.

29 Other Mesic - All moderately moist physiographic sites not described above.

Hydric Sites that generally have a year-round abundance or over-abundance of moisture. Hydric sites are very wet sites where excess water seriously limits both growth and species occurrence.

31 Swamps / Bogs - Low, wet, flat forested areas usually quite extensive that are flooded for long periods of time except during periods of extreme drought. Excludes cypress ponds and small drains.

32 Small Drains - Narrow, stream-like, wet strands of forest land often without a well-defined stream channel. These areas are poorly drained or flooded throughout most of the year and drain the adjacent higher ground.

33 Bays and wet pocosins - Low, wet, boggy sites characterized by peaty or organic soils. May be somewhat dry during periods of extended drought. Examples include sites in the Lake States with lowland swamp conifers or the Carolina bays in the southeast US.

34 Beaver ponds

35 Cypress ponds

39 Other hydric - All other hydric physiographic sites.

2.4.23NC NC LAND USE (NCLU)

All conditions defined will also receive an NC Land Use. This item is not a condition class defining variable and will only be added to the ancillary data collected on a condition.

When collected: All condition classes
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

Code	Description
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.) Unless the land is used primarily for grazing, code 22 is preferred over codes 21 and 59. **Note**: All species found within the portion of the plot where the condition extends should be considered and determined unproductive (code 40) before classifying the condition as unproductive forest land. Do not include species that are only growing in small inclusions in the condition such as a small high or low spot in the topography. 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.
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 Tamarack & Black Spruce, under 25 for Eastern Redcedar & Rocky Mt. Juniper, under 21 for Ponderosa Pine and under 35 for all other species. All commercial species must be unproductive. In cases where compaction or other negative impact by grazing is the cause for the low productivity use code 52 or 59.
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 at least 20 cubic feet per acre per year of roundwood products.
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 timberland except that the primary land

use is protection of buildings. As a guideline, consider using code 22 if there are more than 12 rows of trees or the area is larger than 5 acres.

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. Two situations are possible. The first is that the land could qualify as pastured timberland except that the low stocking in growing stock trees indicates that the land is not being used for wood production. The second is that the land is unproductive for timber, due to livestock or intrinsic site factors, and is being used for forage. 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 judgment.

71 **Urban forest land** Locationally reserved land that normally would meet the criteria for timberland, 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. The following NC land use codes are `Nonforest/Denied Access/Hazardous` condition status.

46 **Christmas Tree Plantations** Forest land sufficiently productive to qualify as timberland 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 for Christmas trees.

The following NC landuse codes of 50-58 must have one or more trees, 5.0 inches DBH or larger, within the visual acre surrounding the subplot center.

50 **Reserved, nonforest with trees** Nonforest land with trees that is withdrawn from timber utilization, by a public agency or by law.

51 **Cropland with trees** Cropland with scattered inclusions of single trees or small groups of trees. Orchards are also included in this class.

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 forest land (code 20, 21, 22, 40, 41, 45) 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.

58 **Shelterbelt** A group of trees, less than 120 feet wide, used for the protection of soil and crop fields. Do not confuse this land use with an old fence line between two fields that contains a few trees.

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.**

The following NC Land Uses must have no tree species present 5.0 inch DBH or larger, within the visual acre surrounding the subplot center.

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. Do not confuse with non-stocked forest land.

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, power lines, 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 30 feet wide but less than 200 feet, and one acre in size but less than 4.5 acres in size (normal water level)

89 **Noncensus Water** (reserved)

90 **Census Water** A body of water greater than 200 feet wide and greater than 4.5 acres (normal water level).

96 **Inaccessible plot** When any portion of a forest plot cannot be reached or measured because permanent physical conditions prohibit **safe** access (e.g. steep slopes) no field measurements are required. Explain in notes why the plot is inaccessible. Includes forested areas on military bases, depots, or proving grounds where access and use are restricted because of certain activities.

97 **Dropped plot** Determined in office by field supervisor or crew leader.

98 **Lost (not relocated) plot**
99 **Denied access plot**

NC Table 2

Chart of valid NC Land Use Codes with Condition Status Codes

	Condition Status						
NC Land Use	**1**	**2**	**3**	**4**	**5**	**6**	**7**
20	X						
21	X						
22	X						
40	X						
41	X						
45	X						
57	X						
59	X						
71	X						
46		X					
50		X					
51		X					
52		X					
53		X					
54		X					
55		X					
56		X					
58		X					
72		X					
79							X
61		X					
62		X					
64		X					
65		X					
66		X					
67		X					
68		X					
69		X					
80			X				
90				X			
96						X	
97							X
98	**This plot will not have a new 4-point plot.**						X
99					X		

NC Note: The last 3 data items will not be collected until we return to re-measure the National Core design and manual.

2.4.24 PAST NONFOREST / INACCESSIBLE LAND USE

2.4.25 PRESENT NONFOREST LAND USE

2.4.26 NONFOREST YEAR

3.0 BOUNDARY REFERENCES

Boundary reference data are used to remeasure plots and to compute the area for the condition classes sampled on a plot. Record all boundaries between condition classes that occur within the sampled (fixed-radius) area on subplots and microplots (and optionally annular plots). Boundaries outside sampled (fixed-radius) areas are not referenced.

In addition to the recording procedures described herein, sketch maps of condition class boundaries onto the pre-printed plot diagrams on field tally sheets.

NC Note: No mapping of condition boundaries will be done on the old NC variable radius plot (subplots 101-105).

NC Note: In Indiana and Illinois the 4 –point plot will be re-measured so there are some specific examples on how to handle these in Appendix 10.

3.1 REFERENCE PROCEDURE

Reference, within the sampled area on each microplot, subplot, and annular plot, the approximate boundary of each condition class that differs from the condition class at a subplot center. Trees selected on these fixed-radius plots are assigned to the actual condition in which they lie regardless of the recorded approximate boundary.

Boundary referencing is done by recording azimuths and distances from subplot center to the reference points (Figures 7 and 8). Each boundary is marked by a maximum of three points - two where the boundary intersects the subplot circumference, and one "corner" point between the two end points, if necessary. Only the corner point requires a distance, since the distance from the center to the circumference is always equal to the fixed plot radius.

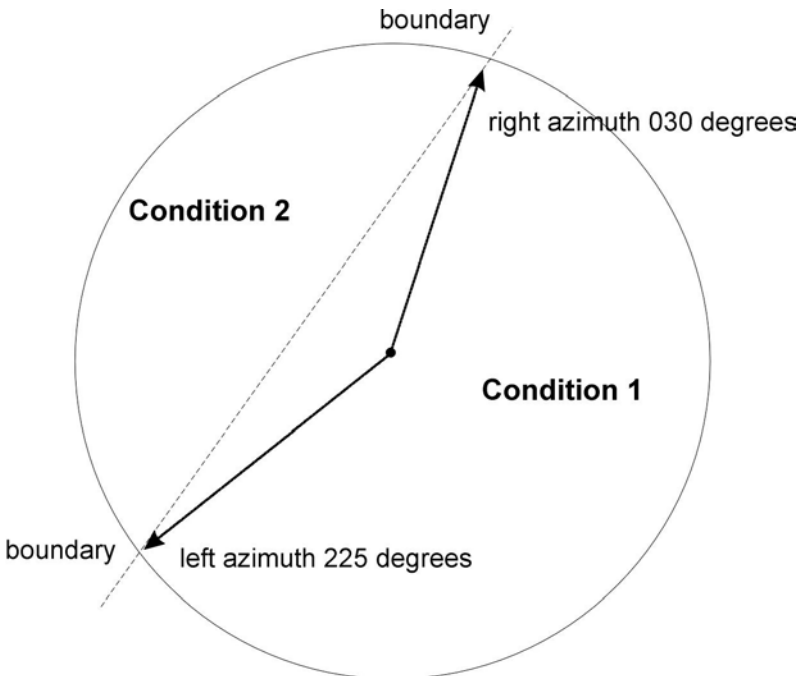


Figure 7. How to measure a straight boundary on a microplot, subplot, or annular plot.

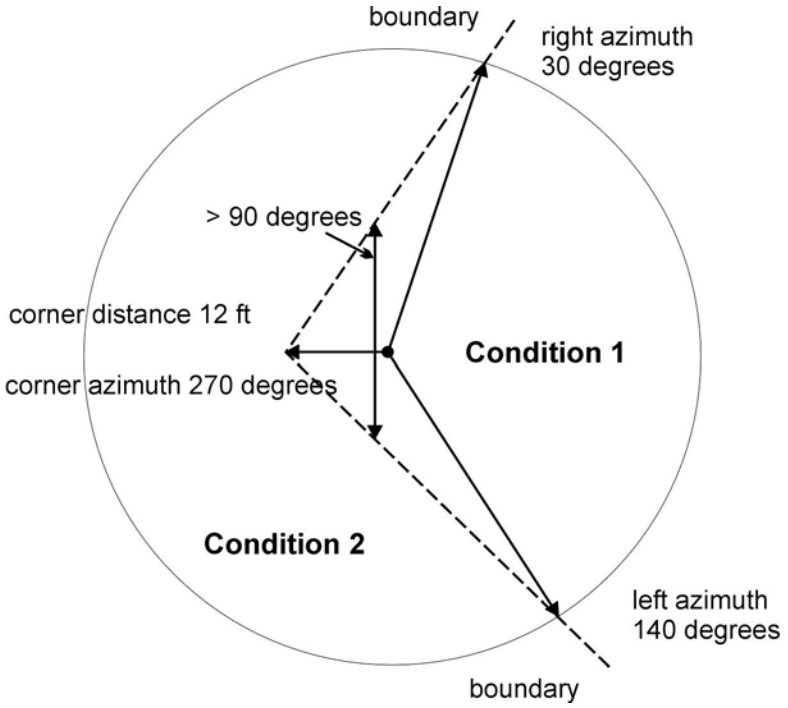


Figure 8. How to measure a boundary with a corner on a subplot or annular plot.

Microplot boundaries are referenced to the microplot center, and annular plot boundaries are referenced to the subplot center in the same manner described for subplots. Note that the larger the plot, the greater likelihood of a need for a boundary corner to record boundaries that are not straight lines.

Refer to Sections 2.1 and 2.3 for general condition class delineation guidelines. The following additional rules apply when referencing a boundary within a subplot, microplot, or annular plot:

1. When a boundary between accessible forest land and nonforest land or between two contrasting accessible forest land condition classes is clearly marked, use that feature to define the boundary. Examples of clear demarcation are a fence line, plowed field edge, sharp ridge line, and water's edge along a stream course, ditch, or canal.

2. When a boundary between forest land and nonforest land is not clearly marked by an obvious feature, the boundary should follow the nonforest side of the stems of the trees at the forest edge.

3. When a boundary between two contrasting forest land condition classes is not clearly marked, map along the stems of the contrasting condition. When the boundary between two contrasting forest land condition classes is separated by a narrow linear inclusion (creek, fire line, narrow meadow, unimproved road), establish the boundary at the far edge, relative to subplot center, of the inclusion.

4. When a plot is remeasured, the crew will examine the boundaries referenced at last inventory. If no change has occurred, the current crew will retain the boundary data that were recorded at last inventory. If a boundary has changed, or a new boundary is present, or the previous crew made an obvious error, record new or updated boundary data. Delete boundaries that are no longer distinct.

5. Although individual MQOs are specified for the azimuths and distances, in practice a crew will be considered 'correct' when the difference in areas as mapped by the original crew and by the QA crew is less than 10% of the subplot or microplot area. This allows for slight variations in azimuths or distances due to the approximate nature of our mapping procedures.

3.2 BOUNDARY DATA

Record the appropriate values for each boundary mapped on the subplot, microplot, or annular plot as follows:

NC Note: No data is recorded for this menu if there is only one condition on the subplot. No mapping will be done on the old NC plot design.

3.2.1 SUBPLOT NUMBER

Record the code corresponding to the number of the subplot.

NC Note: This item is given to you on the data recorder screen, just be sure you are recording the boundary data on the correct subplot number.

When collected: All boundaries
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Center subplot
2 North subplot
3 Southeast subplot
4 Southwest subplot

3.2.2 PLOT TYPE (TYPE)

Record the code to specify whether the boundary data are for a subplot, microplot, or annular plot.

When collected: All boundaries
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Subplot boundary
2 Microplot boundary
3 Annular plot boundary (coded only when annular plots are taken)
NC Note: No annular plots are measured.

3.2.2NC NC PERCENT AREA (%ARE)

Record the percent area of the subplot is in the condition listed as the Contrasting Condition(CCON).

When collected: All boundaries
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 - 100

3.2.3 BOUNDARY CHANGE

Remeasurement (SAMPLE KIND = 2) locations only. Record the appropriate code to indicate the relationship between previously recorded and current boundary information.

When collected: SAMPLE KIND = 2, All boundaries **NC Note:** Not collected in North Central Region.
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0	No change - boundary is the same as indicated on plot map by a previous crew.
1	New boundary, or boundary data has been changed to reflect an actual on-the-ground physical change resulting in a difference from the boundaries recorded.
2	Boundary has been changed to correct an error from previous crew.
3	Boundary has been changed to reflect a change in variable definition.

3.2.4 CONTRASTING CONDITION

Record the CONDITION CLASS NUMBER of the condition class that contrasts with the condition class located at the subplot center (for boundaries on the subplot or annular plot) or at the microplot center (for boundaries on the microplot), e.g., the condition class present on the other side of the boundary line.

When collected: All boundaries
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 to 9

3.2.5 LEFT AZIMUTH (LAZM)

Record the azimuth from the subplot, microplot, or annular plot center to the farthest left point (facing the contrasting condition class) where the boundary intersects the subplot, microplot, or annular plot circumference.

When collected: All boundaries
Field width: 3 digits
Tolerance: +/- 10 degrees
MQO: At least 90% of the time
Values: 001 to 360

3.2.6 CORNER AZIMUTH(CAZM)

Record the azimuth from the subplot, microplot, or annular plot center to a corner or curve in a boundary. If a boundary is best described by a straight line between the two circumference points, then record 000 for CORNER AZIMUTH (000=none).

When collected: All boundaries
Field width: 3 digits
Tolerance: +/- 10 degrees
MQO: At least 90% of the time
Values: 000 to 360

3.2.7 CORNER DISTANCE (CDIS)

Record the horizontal distance, to the nearest 1 ft, from the subplot, microplot, or annular plot center to a boundary corner point.

When collected: All boundaries when CORNER AZIMUTH > 000
Field width: 2 digits
Tolerance: +/- 1 ft
MQO: At least 90% of the time
Values:

microplot	1 to 7 ft
subplot	1 to 24 ft
annular plot	1 to 59 ft

3.2.8 RIGHT AZIMUTH (RAZM)

Record the azimuth from subplot, microplot, or annular plot center to the farthest right point (facing the contrasting condition) where the boundary intersects the subplot, microplot, or annular plot circumference.

When collected: All boundaries
Field width: 3 digits
Tolerance: +/- 10 degrees
MQO: At least 90% of the time
Values: 001 to 360

4.0 SUBPLOT INFORMATION

Each subplot is described by a series of area parameters relating to topographic features and existing cover type. These data also relate to the microplot, since the microplot is contained within the subplot perimeter. If the subplot center cannot be accessed, do not collect and record data on the subplot except for SUBPLOT NUMBER and SUBPLOT CENTER CONDITION.

NC Note: Subplot data will not be collected on the old plot design (subplots ≥ 101).

4.1 SUBPLOT NUMBER
Record the code corresponding to the number of the subplot.

NC Note: This item is given to you on the data recorder screen, just be sure you are recording the boundary data on the correct subplot number.

When Collected: All subplots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1	Center subplot
2	North subplot
3	Southeast subplot
4	Southwest subplot

4.2 SUBPLOT CENTER CONDITION (SCEN)
Record the CONDITION CLASS NUMBER of the condition class at the subplot center.

When collected: All subplots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 to 9

4.3 MICROPLOT CENTER CONDITION (MCEN)
Record the CONDITION CLASS NUMBER of the condition class at the microplot center.

When collected: All microplots where subplot center is CONDITION STATUS = 1, 2, 3, 7
NC Note: Also collected on CONDITION STATUS 4
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 to 9

4.4 SUBPLOT SLOPE (SLOP)
Record the angle of slope across the subplot to the nearest 1 percent. SUBPLOT SLOPE is determined by sighting the clinometer along a line parallel to the average incline (or decline) of each subplot. This angle is measured along the shortest pathway down slope before the drainage direction changes. To measure SUBPLOT SLOPE, Observer 1 should stand at the uphill edge of the subplot and sight Observer 2, who stands at the downhill edge of the subplot. Sight Observer 2 at the same height as the eye-level of Observer 1. Read the slope directly from the percent scale of the clinometer.

If slope changes gradually across the subplot, record an average slope. If slope changes across the subplot but the slope is predominately of one direction, code the predominate slope percentage rather than the average. If the subplot falls directly on or straddles a canyon bottom or narrow ridge top, code the slope as follows:

- If the subplot falls directly between two side hills, code the average slope of the side hill(s).
- If the subplot falls on a canyon bottom or on a narrow ridge top, but most of the area lies on one side hill, code the slope of the side hill.

When collected: All subplots with an accessible forest land condition class (CONDITION STATUS = 1)
Field width: 3 digits
Tolerance: +/- 10%
MQO: At least 90% of the time
Values: 000 to 155

4.5 SUBPLOT ASPECT (ASP)

Record the aspect across the subplot, to the nearest 1 degree. SUBPLOT ASPECT is determined along the direction of slope for land surfaces with at least 5 percent slope in a generally uniform direction. SUBPLOT ASPECT is measured with a hand compass along the same direction used to determine slope. If aspect changes gradually across the subplot, record an average aspect. If aspect changes across the subplot but the aspect is predominately of one direction, code the predominate direction rather than the average.

If the subplot falls on or straddles a canyon bottom or narrow ridge top, code aspect as follows:

- Code the aspect of the ridge line or canyon bottom.
- If the subplot falls on a canyon bottom or on a narrow ridge top, but most of the area lies on one side hill, code the aspect of the side hill.

When collected: All subplots with an accessible forest land condition class (CONDITION STATUS = 1)
Field width: 3 digits
Tolerance: +/- 10 degrees
MQO: At least 90% of the time
Values:

000	no aspect, slope < 5 percent
001	1 degree
002	2 degrees
.	.
.	.
360	360 degrees, due north

4.6 SNOW/WATER DEPTH (SWD)

Record to the nearest 0.1 ft the average approximate depth of water or snow covering the subplot at the time of data collection. This variable is used to indicate subplots where some variables (e.g., seedling count, total heights) may be measured with less certainty due to conditions at the time of measurement.

When collected: All subplots with an accessible forest land condition class (CONDITION STATUS = 1)
Field width: 2 digits (x.y)
Tolerance: +/- 0.5 ft
MQO: At the time of measurement (no MQO after initial date of visit)
Values: 0.0 to 9.9

4.7 SUBPLOT/ANNULAR PLOT STATUS

Indicate whether or not this subplot currently has at least one accessible forested condition class. In regions measuring the CORE OPTIONAL annular plot, indicate whether or not this annular plot currently has at least one forested condition class.

NC Note: This data item is added to the plot data after field data is collected.

When collected: All forested Phase 3 plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0 No accessible forest land condition class
1 At least one accessible forest land condition class

4.8 SUBPLOT/ANNULAR PLOT CONDITION LIST (CORE OPTIONAL)

This is a listing of all condition classes located within the 24.0-ft radius around the subplot center. In regions measuring the CORE OPTIONAL annular plot, this is a listing of all condition classes located within the 58.9-ft radius around the annular plot center. A maximum of four conditions is permitted at any individual subplot / annular plot. If a condition class has already been defined at a previously completed subplot / annular plot, use the same condition class number whenever that condition is encountered. Define new condition classes as they are encountered. If more than one condition class is listed here, boundary data are required. If only one condition class is listed, this condition is automatically assigned to the subplot center and microplot center. If less than four condition classes occur on this subplot, complete the remainder of this field with zeros. For example, if condition 1 is the only condition class on a subplot, record 1000.

NC Note: Not collected in North Central Region.

When collected: All forested Phase 3 plots
Field width: 4 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 1000 to 9876

5.0 TREE AND SAPLING DATA

Trees at least 5.0 inches in diameter are sampled within the subplot. 'Tally trees' are defined as all live and standing dead trees in accessible forest land condition classes encountered on the subplot the first time a subplot is established, and all trees that grow into a subplot thereafter. These data yield information on tree growth, mortality, removals; coarse woody debris; wildlife habitats; forest structure and composition; biomass; and carbon sequestration.

Trees with a diameter at least 1.0 in but less than 5.0 in, termed saplings, are sampled within the microplot. 'Tally saplings' are defined as all live saplings in accessible forest land condition classes encountered the first time a microplot is established, and all saplings that grow into each microplot thereafter are included until they grow to 5.0 in or larger, at which time they are tallied on the 24.0 ft subplot and referenced (new azimuth and distance taken) to the subplot center. For multi-stemmed western woodland species, a cumulative DRC is used to compute diameter as described in Sections 5.9 and 5.9.2.

Trees are alive if they have any living parts (leaves, buds, cambium) at or above the point of diameter measurement, either diameter at breast height (DBH) or diameter at root collar (DRC). Trees that have been temporarily defoliated are still alive.

Once tallied, dead trees over 5.0 in diameter are tracked until they fall down. **Working around dead trees is a safety hazard - crews should exercise extreme caution! Trees that are deemed unsafe to measure should be estimated.**

To qualify as a standing dead tally tree, dead trees must be standing (LEAN ANGLE = 0) at least 4.5 ft tall and be at least 5.0 inches in diameter. Broken portions of trees that are completely separated from their base are not treated as separate trees. **NC Note: (***If the tree is separated from it's base it is not a tree, regardless of if it is held up by other trees or it's limbs.***)** For western woodland species (Appendix 4) with multiple stems, a tree is considered down if more than 2/3 of the volume is no longer attached or upright; do not consider cut and removed volume.

Whether live or dead, standing trees do not have to be self-supported. They may be supported by other trees.

High stumps (trees that have been cut) do not qualify as standing dead trees.

Begin tallying trees at an azimuth of 001 degrees from subplot center and continue clockwise around the subplot. Repeat this sequence for trees on the microplot and again on the annular plot.

5.0.1NC NC TREE MONUMENTATION

Monumentation of subplots and microplots 101-105 are handled differently than subplots and microplots 1-4. For all trees and saplings on 1-4, scribe and paint a two-inch horizontal mark just below the lower tape at the point where DBH is measured. Do this on the side of the tree facing subplot center. Within the one-foot stump facing subplot center, scribe and paint a vertical mark to facilitate re-measurement 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.

For subplots 101-105, re-mark only if necessary with scribe only at the point where DBH is measured. Scribe marks should not penetrate the cambium. If the old paint on the tree is still visible leave it on the tree and do not re-scribe.

In reserved areas monument each sample tree 5.0" DBH and larger with a nail at ground level either facing subplot center or on the uphill side of the tree if there is a slope. If only saplings are on the subplot, mark a couple of them with nails at ground level and note which are so marked.

Measure DBH at exactly 4.5 feet above the nail. If DBH needs to be taken at a different location, record the location above the nail in feet and tenths of a foot in Height To Diameter (DIAH).

5.0.2NC NC RE-MEASUREMENT TREES

Re-measure all trees listed on the plot tree sheet that are listed "for re-measurement." All old trees measured on the plot will be located on the tree sheet of the plot sheet packet for use to determine subplot center location.

SK=1 and NCSK=6:
Tally all old trees on the download data (sheets or data recorder file). Trees 5.0" and greater on subplots 101-105 and trees less than 5.0" on microplots 101-103.
Install and measure new subplots (1-4)

SK=1 and NCS=8
The old ten point PC(subplot 101) will be the location of subplot 1. Follow the old SP map and directions to the plot center. If plot center is not found, place a pin where the starting point directions took you and start installing the new subplots (1-4). **OLD TREES WILL NOT BE MEASURED.** Old tree information may be provided only for your use to locate plot center.
Install and measure new subplots (1-4)

SK=1 and NCSK=0:
No old trees will be remeasured.
Install and measure new subplots (1-4)

5.0.3NC NC RE-MEASUREMENT TREES ON LAND USE CONVERSIONS

Trees on lands that have changed condition status (land use). The condition status change is from one where trees were measured (1) to a condition status where trees are not mesured (2,3,4,5,7). Every old live or standing dead tree on the list for re-measure must be accounted for when there is a land use change. If the tree was cut as a part of the land use change it would get a tree status that reflects the cutting of the tree (3). 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 tree status of NO STATUS (0). If the tree is still standing dead it should get a tree status also of NO STATUS (0).

5.0.4NC NC RE-MEASUREMENT TREES THAT SHOULD NOT HAVE BEEN

A tree was tallied on the old NC plot design, but should not have been and should not be tallied now is given a tree status of NO STATUS (0). Put a reason on data recorder in the tree note.

5.0.5NC NC RE-MEASUREMENT TREES OF DISPLACED TREES

Trees tallied on the old NC plot design that are now displaced off the plot due to natural reasons, are given a tree status of MISSING (4).

5.0.6NC NC TREES ON SUBPLOTS 1-4 OF A P3 PLOT

Some of the Phase 3(P3) plots are old Forest Health Management (FHM) plot installations with previously measured trees by the FHM program. The FIA National Managers agreed to keep the tree numbers that the FHM program had assigned to these trees. They did not agree to re-measure the trees for change though. This means that any tree that no longer meets the qualifications for a measurement tree on a new plot needs to be deleted from the data on the downloaded data file in the data recorder.

If the plot was measured by an North Central FIA crew as a 4-point plot design (IN & IL) the trees are not deleted as mentioned in the above paragraph.

5.0.7NC NC RE-MEASUREMENT TREES ON NOW DENIED ACCESS CONDITIONS

Trees on an old plot what is now denied access need to have their tree status changed to zero (0). See Manual Section 8 for further information on denied access conditions.

NC Table 3

Data needed by Subplot number, DBH and Tree status on P2 plots

Subplot numbers	1-4	1-4		OLD SUBPLOTS 1-4* dbh < 5.0" OLD SUPLOTS 1-4* dbh ≥ 5.0"	101-103				101-105				
	DBH < 5.0"	DBH ≥ 5.0"			DBH < 5.0"				DBH≥ 5.0"				
Tree Status Codes	1	1	2		1	2	3		1	2	3	4	0
Sub#	X	X	X		X	X	X	X	X	X	X	X	X
TR#	X	X	X		X	X	X	X	X	X	X	X	X
TYPE	X	X	X		X	X	X	X	X	X	X	X	
DIST	X	X	X		X	X	Z	Z	Z*	Z*	Z	Z	Z
DBH	X	X	X		X	X	X[1]	X[1]	X	X	X[1]	X[1]	Z
DIAH	X	X	X	Indiana & Illinois only See Appendix 10	X	X			X	X			
DCHE	X	X	X		X	X			X	X			
SPP	X	X	X		X	X	X	X	X	X	X	X	Z
LEAN		X	X		X	X			X	X			
TCC/DEC	X	X	X		X	X			X	X			
STAT	X	X	X		X	X	X	X	X	X	X	X	X
UTIL							X				X		
DECA			X										
CCR	X	X							X				
CCC	X	X							X				
AZM	X	X	X		X	X	Z	Z	Z*	Z*	Z	Z	Z
CON#	X	X	X										
THGT	X(P3 only)	X											
ACTU	X(P3 only)	X	X										
METH	X(P3 only)	X											
TRGD		X											
ROTT		X											
CAUS						X				X			
LOC12		X											
DAM12		X											
SEV12		X											
NCD12		X											

*If changed for subplot 101 it will not need to be reentered to the tenth of a foot on subplot 1.

X = record this data for tree status and subplot listed
Z = leave old data in this field.
X[1]= Record DBHO unless able to measure current DBH

The following elements are recorded for all tally trees and tally saplings:

5.1 SUBPLOT NUMBER
Record the subplot number where the tree occurs.

NC Note: This item is given to you on the data recorder screen, just be sure you are recording the boundary data on the correct subplot number.

When Collected: All live and dead tally trees ≥ 1.0 in DBH/DRC
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1	Center subplot
2	North subplot
3	Southeast subplot
4	Southwest subplot

5.2 TREE RECORD NUMBER (TR#)
Record a code to uniquely and permanently identify each tree on a given subplot. The TREE RECORD NUMBERS must be unique within a subplot – being unique is more important than being sequential. In general, work clockwise from azimuth 001 to 360, and work outwards from subplot center to subplot edge. On remeasured plots, use the tree number assigned at the previous visit. Saplings tallied on microplots will retain their initially assigned tree number if they grow to tree size. Missed trees will be assigned the next available tree number. DO NOT renumber all plot trees in order to assign a more "correct" tree number to a missed tree. Numbers assigned to trees that are subsequently found to be extra will be dropped and not reused.

If TREE RECORD NUMBERs are not assigned in the field, record 000.
NOTE: If this is a Phase 3 plot, match the trees on this point to the hard copy list provided. Record the three-digit FHM tree number assigned to each standing tree.

NC Note: On all subplots 1 – 4 use next available tree number to assign new tree numbers to any trees not in the download data file. The next available tree number is on the printed plot sheets and an option on the data recorder. On P3 plots first re-measure any old trees on subplot 101and then use the "copy tree" option on the data recorder to move the trees to subplot 1. This will assure we keep the P3 tree numbers. The P3 plot the tree numbers in the download data file and on the printed plot sheet reflect their old FHM tree number. To assign tree numbers to new trees on the subplot use the "next available tree number" option on the data recorder.

When Collected: All live and standing dead tally trees ≥ 1.0 in DBH/DRC
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 000, 001 to 999

5.2NC NCPLOT TYPE (TYPE)
Record whether the tree is on the subplot (≥ 5.0"dbh) or microplot (< 5.0" dbh).

When Collected: All live and dead tally trees ≥ 1.0 in DBH/DRC
Field width: 1 digit
MQO: No errors 100% of time
Values:

CODE	PLOT TYPE
1	subplot tree
2	microplot tree

5.3 CONDITION CLASS NUMBER (CON#)

Record the CONDITION CLASS NUMBER in which each tree is located. Often, a referenced boundary is approximate, and trees selected for tally are assigned to the actual condition in which they lie regardless of the recorded approximate boundary (Figure 9).

When Collected: All live and standing dead tally trees ≥ 1.0 in DBH/DRC
NC Note: Not collected on subplots 101 and higher
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 to 9

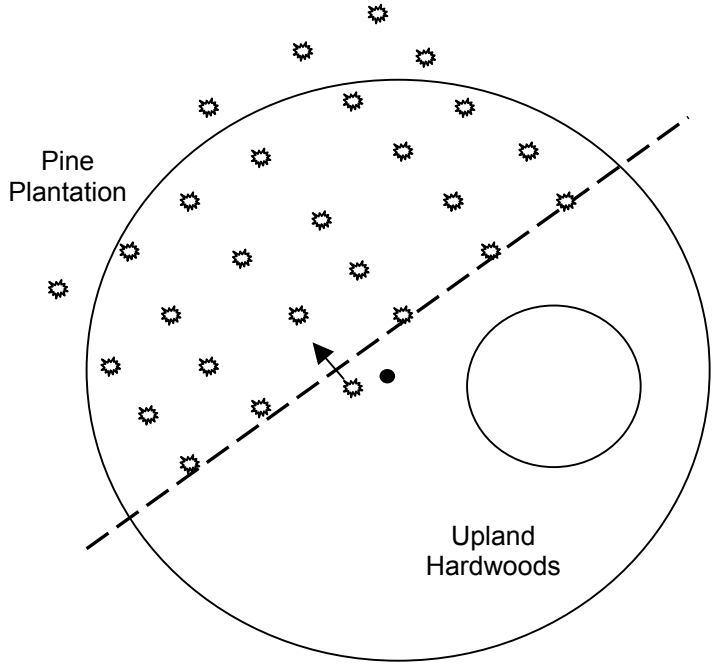


Figure 9. Ragged CONDITION CLASS boundary and tree condition class designation.

5.4 AZIMUTH (AZM)

Record the AZIMUTH from the subplot center (for trees ≥ 5.0 in DBH/DRC) or the microplot center (for trees ≥ 1.0 in and < 5.0 in DBH/DRC), sight the center of the base of each tree with a compass. Sight to the geographic center for multi-stemmed western woodland species. The geographic center is a point of equal distance between all tallied stems for a given woodland tree. Record AZIMUTH to the nearest degree. Use 360 for north.

NC Note: Do not repeat azimuths on a subplot, if needed separate by one degree.

When Collected: All live and standing dead tally trees ≥ 1.0 in DBH/DRC
Field width: 3 digits
Tolerance: +/- 10 degrees
MQO: At least 90% of the time
Values: 001 to 360

5.5 HORIZONTAL DISTANCE (DIST)

Record the measured HORIZONTAL DISTANCE, to the nearest 0.1 ft, from the subplot center (for trees ≥ 5.0 in DBH/DRC) or microplot center (for trees ≥ 1.0 in and < 5.0 in DBH/DRC) to the pith of the tree at the base. For all multi-stemmed western woodland trees (woodland species indicated in Appendix 4), the HORIZONTAL DISTANCE is measured from subplot or microplot center to the "geographic center" of the tree. The geographic center is a point of equal distance between all tallied stems for a given woodland tree.

When Collected: All live and standing dead tally trees ≥ 1.0 in DBH/DRC
Field width: 3 digits (xx.y)
Tolerance: Microplot: +/- 0.2 ft
Subplot: +/- 1.0 ft
Annular plot: +/- 3.0 ft
MQO: At least 90% of the time
Values: Microplot: 00.1 to 6.8
Subplot: 00.1 to 24.0
Annular plot: 00.1 to 58.9

5.6 TREE STATUS (STAT)

Record a current TREE STATUS for each tallied tree; this code is used to track the status of sample trees over time: as they first appear, as ingrowth, as they survive, and when they die or are removed. This information is needed to correctly assign volume information to the proper component of volume change.

When Collected: All new live tally trees ≥ 1.0 in DBH/DRC
All new dead tally trees ≥ 5.0 in
On remeasurement plots, all previously tallied trees
Field width: 1 digit
Tolerance: No errors
MQO: At least 95% of the time
Values:

0 No status — tree is not presently in the sample (remeasurement plots only). Tree was incorrectly tallied at the previous survey or currently is not tallied due to definition or procedural change.

1 Live tree – any live tree (new, remeasured or ingrowth)

2 Dead tree -- any dead tree (new, remeasured, or ingrowth), regardless of cause of death, which does not qualify as a removal.

3 Removal - a tree that has been cut or killed by direct human activity related to harvesting, silviculture or land clearing (remeasurement plots only). The tree may, or may not, have been utilized. Only code trees killed by fire as removals if it was a prescribed burn.

4 Missing – tree was tallied in previous inventory but now is missing due to natural causes such as landslide, fire, etc. (remeasurement plots only).

Note: For microplot trees (saplings) which become trees, crews must collect new azimuth and distance information from the subplot center.

NC Note: Only trees on a Plot where NCSK=6 may be recorded as a Tree Status of 3 or 4.

5.6.1 NEW TREE RECONCILE

For remeasurement locations only, record a NEW TREE RECONCILE for any new tally tree that was not tallied in the previous inventory; this code is used to identify the reason a new tree appeared in the inventory. This information is needed to correctly assign volume information to the proper component of volume change.

NC Note: Not collected in NC region because there are no true re-measurement (sample kind2) plots.

When Collected: On SAMPLE KIND 2; all new live tally trees ≥ 1.0 inch DBH/DRC (TREE STATUS=1), all new dead tally trees ≥ 5.0 in (TREE STATUS=2)
Field width: 1 digit
Tolerance: No errors
MQO: At least 95% of the time
Values:

1 Ingrowth – new tally tree not qualifying as through growth (includes reversions).
2 Through growth – new tally tree 5 inches DBH/DRC and larger, within the microplot.
3 Missed live – a live tree missed at previous inventory and that is live, dead or removed now.
4 Missed dead – a dead tree missed at previous inventory and that is dead or removed now.

5.6.2 MORTALITY (new location) (CORE OPTIONAL)
NC Note: Not collected in NC region.

When Collected: All dead trees (TREE STATUS 2) 5.0 in DBH/DRC and larger that were live at the previous inventory (TREE STATUS 1), or within the past 5 years if no previous inventory
Field width: 1 digit
Tolerance: No errors
MQO: At least 85% of the time
Values:

0 No - tree does not qualify as mortality.
1 Yes – tree does qualify as mortality

5.7 LEAN ANGLE (LEAN)

Record the code that describes the angle of lean from vertical of the tree, from base to top of ACTUAL LENGTH. Trees supported by other trees or by their own branches are considered standing.
NC Note: Trees supported by other trees must still be attached to their roots not cut or separated.

When Collected: CORE: All live and standing dead tally trees ≥ 5.0 in DBH/DRC
NC Note: Collected for all live and dead trees on NC Sample Kind = 6 plots.
CORE OPTIONAL: All live and standing dead tally trees ≥ 1.0 in DBH/DRC
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0 Standing (less than 45 degrees of lean from vertical)
1 Down (more than 45 degrees of lean)

5.8 SPECIES (SPP)

Record the appropriate SPECIES code from the list in Appendix 4. If you encounter a species not listed in Appendix 4 and are not sure if it should be tallied as a tree, consult your Field Supervisor. If the species cannot be determined in the field, tally the tree, but bring branch samples, foliage, cones, flowers, bark, etc. to your supervisor for identification. If possible, collect samples outside the subplots from similar specimens and make a note to correct the SPECIES code later. Use code 299 for unknown dead conifer and 999 for unknown dead hardwood when the genus or species codes cannot be used. The generic code should only be used when you are sure the species is on the species list, but you cannot differentiate among acceptable species. In this case use the sample collections procedures described earlier in this paragraph.

When Collected: All live and standing dead tally trees $\geq$ 1.0 in DBH/DRC
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time for genus, at least 95% of the time for species
Values: See Appendix 4

5.9 DIAMETER

Diameters are measured at either breast height (DBH) or at the root collar (DRC). Species requiring DRC, referred to as woodland species, are denoted with a "w" in Appendix 4. Trees with diameters between 1.0- and 4.9-inches are measured on the 6.8-ft radius microplot, those with diameters of 5.0-inches and larger are measured on the 24-ft radius subplots.

In order to accurately remeasure diameter (DBH or DRC) at the same point on the tree bole at successive visits, regions have the option of measuring and recording the distance from the ground to the point of diameter, or marking the point of measurement with a scribe, crayon, paint, or aluminum nail. When marking trees for the first time, measure the diameter after the mark is in place. Use caution to avoid damaging trees with scribes and nails. Do not scribe or nail trees less than 3.0-inches in diameter, or species vulnerable to introduction of pathogens (e.g., aspen). Do not penetrate the cambium when using a bark scribe.

Remeasurement trees:

When remeasuring the diameter of a tree tallied at a previous survey, always take the measurement at the location monumented by the previous crew unless it is not physically possible (e.g., tree buried by mudslide), or the previous location is more than 12 inches beyond where the diameter should be measured according to current protocols (either because protocols have changed or the previous crew made a mistake). Assign a DIAMETER CHECK code of 2 whenever the point of measurement is moved.

NC Note: On subplot 101 and higher or subplot 1-4 of a P3 plot with old trees: treat the DBH location as mentioned above in Remeasurement trees. So if the previous location is more than 12 inches beyond where the diameter should be measured according to current protocols move the old mark. Do not assign Diamenter Check code of 2. Do assign a Diameter Check code of 0.

When Collected: All live tally trees $\geq$ 1.0 in DBH/DRC and standing dead tally trees $\geq$ 5.0 in DBH/DRC
Field width: 4 digits (xxx.y)
Tolerance: +/- 0.1 in per 20.0 in of diameter on trees with a measured diameter
MQO: At least 95% of the time. For example: a tree with a diameter of 41.0 in would have a tolerance of plus or minus 0.3 in. (Note: the MQO for point of measurement is +/- 0.2 in when the tree is first measured and within 1 ft of the location established by the previous crew when the tree is remeasured.)
Values: 0001 to 9999

5.9.1 PREVIOUS DIAMETER AT BREAST HEIGHT (DBHO)

This is the DBH assigned at the previous survey. It has been downloaded from the previous inventory. Any change made to this field signifies an error at the time of the previous inventory. "DIAMETER CHECK" should be set to 2 and an explanation is required in the notes if previous DBH is changed.

NC Note: In the North Central region do not enter a 2 in "DIAMETER CHECK" tp signifies an error at the time of pervious inventory.

5.9.2 DIAMETER AT BREAST HEIGHT (DBH)

Unless one of the special situations described below is encountered, measure DBH at 4.5 ft above the ground line on the uphill side of the tree. Round each measurement down to the last 0.1 inch. For example, a reading of 3.68 inches is recorded as 3.6 inches.

Special DBH situations:

1. Forked tree: In order to qualify as a fork, the stem in question must be at least 1/3 the diameter of the main stem and must branch out from the main stem at an angle of 45 degrees or less. Forks originate at the point on the bole where the piths intersect. Forked trees are handled differently depending on whether the fork originates below 1.0 ft, between 1.0 and 4.5 ft, or above 4.5 ft.

   - Trees forked below 1.0 ft. Trees forked in this region are treated as distinctly separate trees (Figure 10). Distances and azimuths are measured individually to the center of each stem where it splits from the stump (Figure 13 A-C). DBH is measured for each stem at 4.5 ft above the ground. When stems originate from pith intersections below 1 ft, it is possible for some stems to be within the limiting distance of the microplot or subplot, and others to be beyond the limiting distance. If stems originating from forks that occur below 1.0 ft fork again between 1.0 and 4.5 ft (Figure 13-E), the rules in the next paragraph apply.

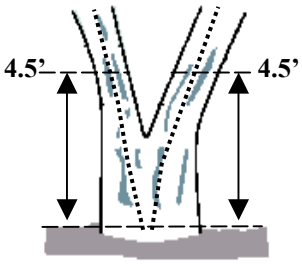


Figure 10. Forked below 1.0 ft.

   - Trees forked between 1.0 ft and 4.5 ft. Trees forked in this region are also counted as separate trees (Figure 11), but only one distance and azimuth (to the central stump) is used for all (Figure 13 D-F). Although a single azimuth and distance applies to all, multiple stems should be recorded as they occur in clockwise order (from front to back when one stem is directly in front of another). The DBH of each fork is measured at a point 3.5 ft above the pith intersection. When forks originate from pith intersections between 1.0 and 4.5 ft, the limiting distance is the same for all forks--they are either all on, or all off the plot.

     Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure DBH on all stems at 3.5 ft above the common pith intersection (Figure 13 F).

     Once a stem is tallied as a fork that originated from a pith intersection between 1.0 and 4.5 ft, do not recognize any additional forks that may occur on that stem. Measure the diameter of such stems at the base of the second fork as shown in Figure 13-E (i.e., do not move the point of diameter the entire 3.5 ft above the first fork).

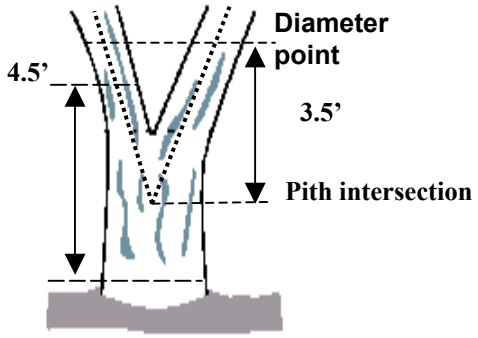


Figure 11. Forked between 1.0-4.5 ft.

- Trees forked at or above 4.5 ft. Trees forked in this region count as one single tree (Figure 12). If a fork occurs at or immediately above 4.5 ft, measure diameter below the fork just beneath any swelling that would inflate DBH.

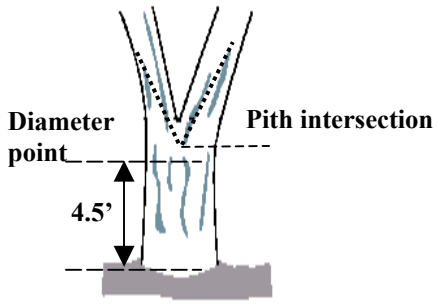


Figure 12. One tree

2. Stump Sprouts. Stump sprouts originate between ground level and 4.5 ft on the boles of trees that have died or been cut. Stump sprouts are handled the same as forked trees, with the exception that stump sprouts are not required to be 1/3 the diameter of the dead bole. Stump sprouts originating below 1.0 ft are measured at 4.5 ft from ground line. Stump sprouts originating between 1.0 ft and 4.5 ft are measured at 3.5 ft above their point of occurrence. As with forks, rules for measuring distance and azimuth depend on whether the sprouts originate above or below 1.0 ft. For multi-stemmed woodland species, treat all new sprouts as part of the same new tree.

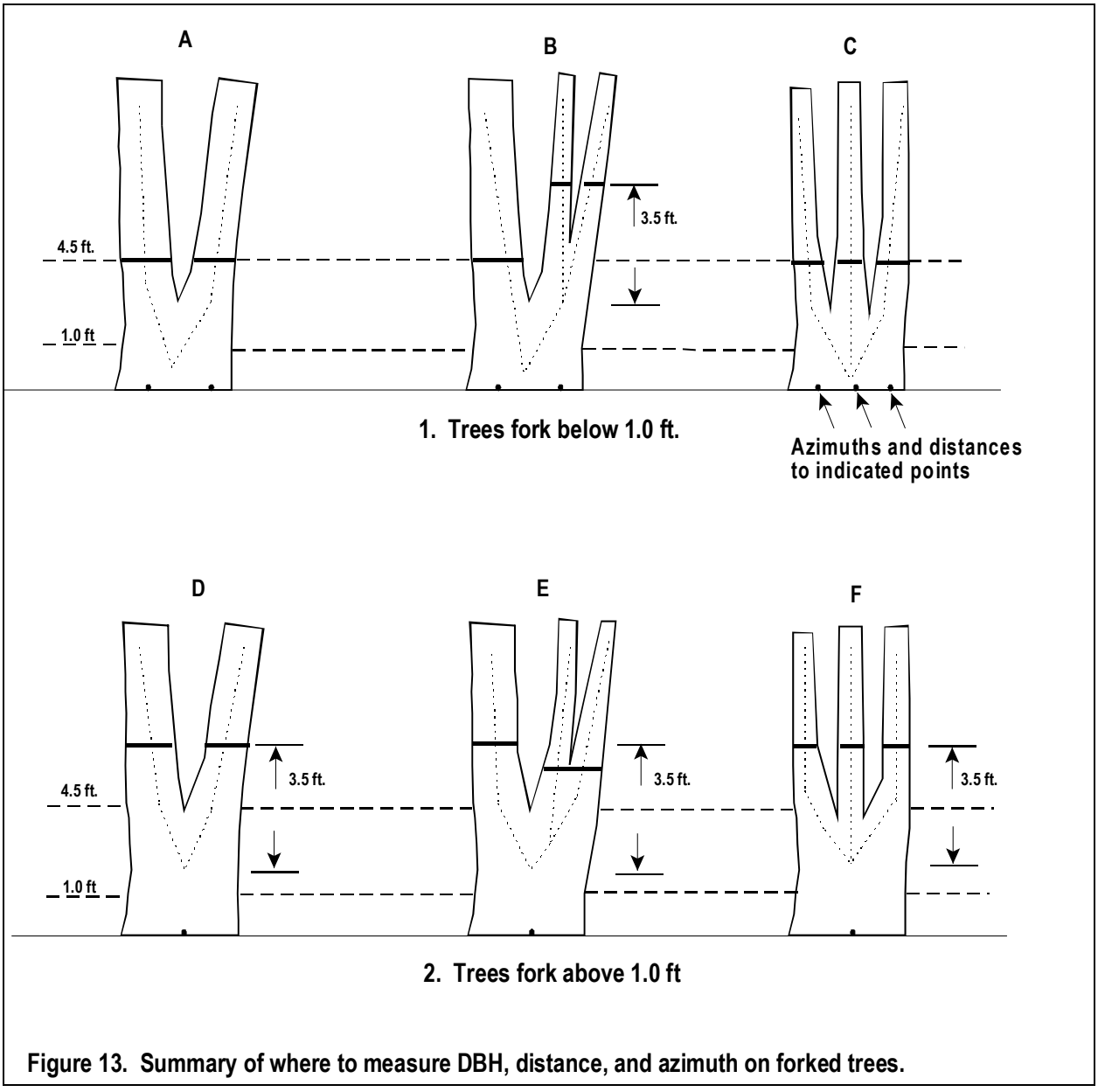


Figure 13. Summary of where to measure DBH, distance, and azimuth on forked trees.

NC Note: Figure 13 is only used for examples of forked trees and how to divide up forks. In the North Central region we do not repeat azimuths on a subplot or microplot, so always record a difference in azimuth by one degree at least.

3. Tree with butt-swell or bottleneck: Measure these trees 1.5 ft above the end of the swell or bottleneck if the swell or bottleneck extends 3.0 ft or more above the ground (Figure 14).

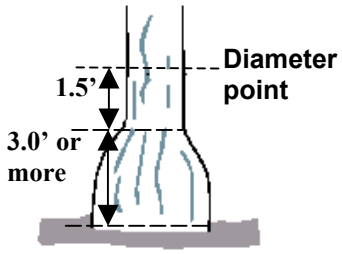


Figure 14. Bottleneck tree.

4. Tree with irregularities at DBH: On trees with swellings (Figure 15), bumps, depressions, and branches (Figure 16) at DBH, diameter will be measured immediately above the irregularity at the place it ceases to affect normal stem form.

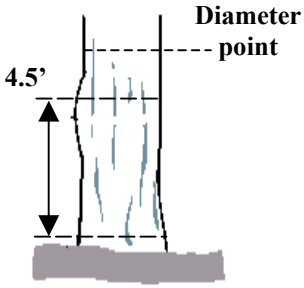


Figure 15. Tree with swelling

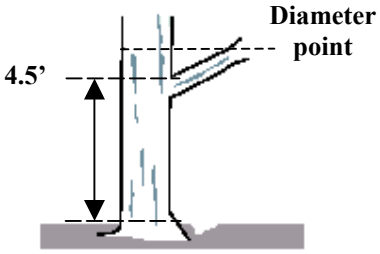


Figure 16. Tree with branch

5. Tree on slope: Measure diameter at 4.5 ft from the ground along the bole on the uphill side of the tree (Figure 17).

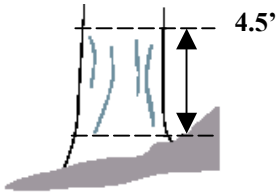


Figure 17. Tree on a slope

6. Leaning tree: Measure diameter at 4.5 ft from the ground along the bole. The 4.5 ft distance is measured along the underside face of the bole (Figure 18).

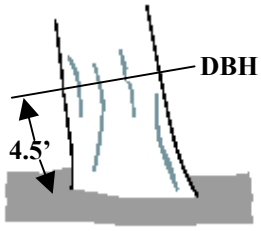


Figure 18. Leaning tree

7. Turpentine tree: On trees with turpentine face extending above 4.5 ft, estimate the diameter at 10.0 ft above the ground and multiply by 1.1 to estimate DBH outside bark.

8. Independent trees that grow together: If two or more independent stems have grown together at or above the point of DBH, continue to treat them as separate trees. Estimate the diameter of each, set the "DIAMETER CHECK" code to 1, and explain the situation in the notes.

9. Missing wood or bark. Do not reconstruct the DBH of a tree that is missing wood or bark or at the point of measurement. Record the diameter, to the nearest 0.1, of the wood and bark that is still attached to the tree (Figure 19). If a tree has a localized abnormality (gouge, depression, etc.) at the point of point of DBH, apply the procedure described for trees with irregularities at DBH (Figure 14).

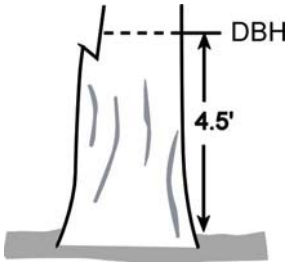


Figure 19. Tree with broken stem

10. Live windthrown tree: Measure from the top of the root collar along the length to 4.5 ft (Figure 20).

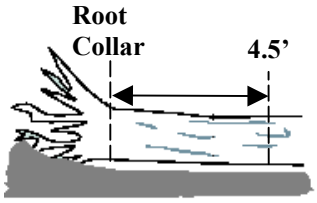


Figure 20. Tree on the ground

11. Down live tree with tree-form branches growing vertical from main bole. When a down live tree, touching the ground, has vertical (<45° from vertical) tree-like branches coming off the main bole, first determine whether or not the pith of the main bole (averaged along the first log of the tree) is above or below the duff layer.

- If the pith of the main bole is above the duff layer, use the same forking rules specified for a forked tree, and take all measurements accordingly (Figure 21).

  A. If the pith intersection of the main down bole and vertical tree-like branch occurs below 4.5' from the stump along the main bole, treat that branch as a separate tree, and measure DBH 3.5 ' above the pith intersection for both the main bole and the tree-like branch.

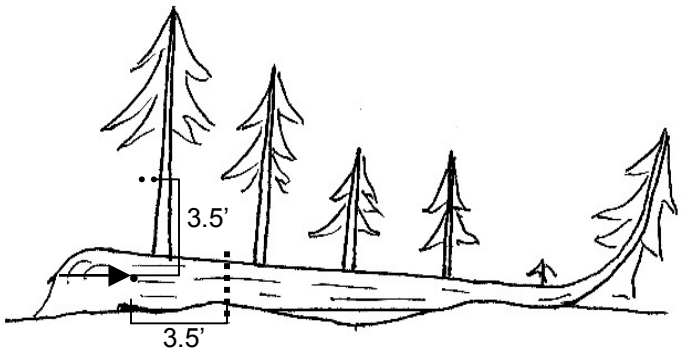


Figure 21. Down tree above duff

  B. If the intersection between the main down bole and the tree-like branch occurs beyond the 4.5' point from the stump along the main bole, treat that branch as part of the main down bole.

- If the pith of main tree bole is below the duff layer, ignore the main bole, and treat each tree-like branch as a separate tree; take DBH and length measurements from the ground, not necessarily from the top of the down bole (Figure 22). However, if the top of the main tree bole curves out of the ground towards a vertical angle, treat that portion of that top as an individual tree originating where the pith leaves the duff layer.

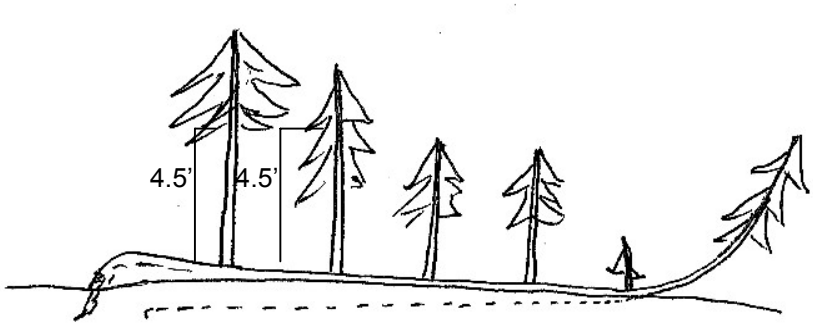


Figure 22. Down tree below duff

5.9.3 PREVIOUS DIAMETER AT ROOT COLLAR

This is the DRC assigned at the previous survey. It has been downloaded from the previous inventory. Any change made to this field signifies a misclassification at the time of the previous inventory. "DIAMETER CHECK" should be set to 2 and an explanation is required in the notes if previous DRC is changed.

5.9.4 DIAMETER AT ROOT COLLAR (DRC)

For species requiring diameter at the root collar (refer to Appendix 4), measure the diameter at the ground line or at the stem root collar, whichever is higher. For these trees, treat clumps of stems having a unified crown and common root stock as a single tree; examples include mesquite, juniper, and mountain mahogany. Treat stems of woodland species such as Gambel oak and Rocky Mountain maple as individual trees if they originate below the ground. For multi-stemmed trees, compute and record a cumulative DRC (see below); record individual stem diameters and a stem status (live or dead) on a separate form or menu as required.

1 Measuring DRC: Before measuring DRC, remove the loose material on the ground (e.g., litter) but not mineral soil. Measure just above any swells present, and in a location so that the diameter measurements are reflective of the volume above the stems (especially when trees are extremely deformed at the base).

Stems must be at least 1.0 ft in length and 1.0 inch in diameter to qualify for measurement; stems that are missing due to cutting or damage must have previously been at least 1.0 ft in length.

Whenever DRC is impossible or extremely difficult to measure with a diameter tape (e.g., due to thorns, extreme number of limbs), stems may be estimated and recorded to the nearest 1.0-in class.

Additional instructions for DRC measurements are illustrated in Figure 23.

2 Computing and Recording DRC: For all tally trees requiring DRC, with at least one stem 1.0 inch in diameter or larger at the root collar, DRC is computed as the square root of the sum of the squared stem diameters. For a single-stemmed DRC tree, the computed DRC is equal to the single diameter measured.

Use the following formula to compute DRC:

$$DRC = SQRT [SUM (stem\ diameter^2)]$$

Round the result to the nearest 0.1 in. For example, a multi-stemmed woodland tree with stems of 12.2, 13.2, 3.8, and 22.1 would be calculated as:

$$DRC = SQRT (12.2^2 + 13.2^2 + 3.8^2 + 22.1^2)$$
$$= SQRT (825.93)$$
$$= 28.74$$
$$= 28.7$$

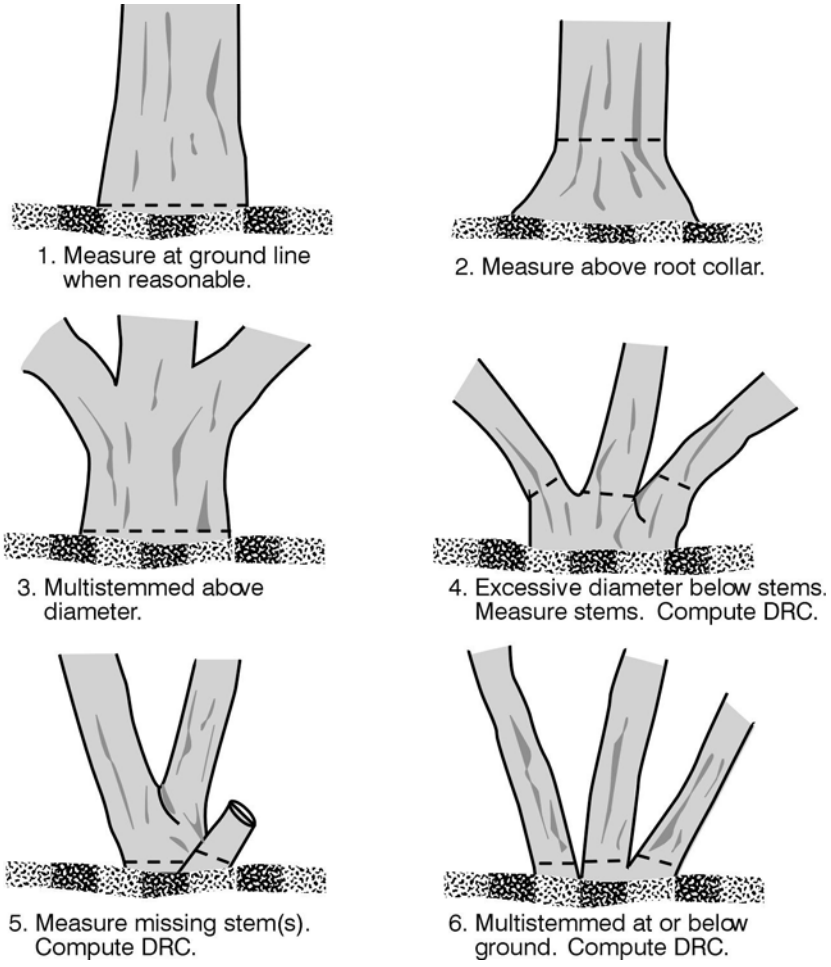


Figure 23. How to measure DRC in a variety of situations.

5.10 DIAMETER CHECK (DCHE)

Record this code to identify any irregularities in diameter measurement positions (e.g., abnormal swellings, diseases, damage, new measurement positions, etc.) that may affect use of this tree in diameter growth/change analyses.

When Collected: All live and standing dead tally trees ≥ 1.0 in DBH/DRC
NC Note: Collected on re-measurement trees (subplots 101 and higher).

Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0	Diameter measured accurately
1	Diameter estimated
2	Diameter measured at different location than previous measurement (remeasurement trees only)

Note: If both codes 1 and 2 apply, use code 2.

5.10NC NC TREE CLASS/DECAY CLASS CURRENT (TCC)

Tree class/decay class reflects tree suitability for timber products or the extent of decay in the butt section of down-dead trees. 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. The extent of decay in the **butt section** of down-dead trees determines the decay class. A metal pin is useful in assessing the amount of decay, but be sure to minimize damage to the tree. If the pin penetrates to the center of the log the tree is in decay class 44 or 45. Record decay class in the tree class field.
Use one of the following codes for tree/decay class of live standing, standing-dead, and down-dead trees.

When collected: All live and dead trees ≥ 1.0 in DBH on all subplots will be given a NC Tree Class/Decay Class.
Field width: 2 digits
MQO: None
Values: All subplots: 20,30,31,40. Subplots 101 and greater: 20,30,31,40,41,42,43,44,45.

Code	Description
20	Growing Stock
30	Rough Cull, Salvable, and Salvable-down
31	Short-log Cull
40	Rotten Cull

Remeasurement trees only where NCSK=6 for the plot

41	Solid
42	Solid-punky
43	Punky
44	Disintegrating
45	Gone

20--Growing Stock

Any live tree of commercial species that is saw-timber size and has at least one merchantable 12-foot saw-log or two merchantable 8-foot saw-logs meeting minimum log-grade requirements. At least one-third of the gross board-foot volume of the saw-log portion must be merchantable material. (Saw-log 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 saw-log must be at least 50 percent sound at any point.

Any pole timber size tree that has the potential to meet the above specifications. Assume that pole-size trees will eventually attain saw-log size at DBH. In evaluating potential saw-log portion of pole-size trees, only rot/missing/dead wood, forks, excessive sweep/crook, & potential grade may disqualify the tree as a growing stock. Predict what grade the future log will have, this will determine the appropriate size limb stopper needed to stop the log length. When estimating potential saw-log height for pole-timber 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 pole-timber tree with an 8.0" DBH needs 3" of diameter growth to become saw-timber size. If diameter growth is uniform, then the DBH minus two inches (eight minus two), or six inches, identifies the potential saw-log 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 saw-log size at DBH.

30--Rough Cull, Salvable, and Salvable-down

Any tree of noncommercial species is a rough cull

Any tree that is saw-timber size and has no merchantable saw-log. Over one-half of the volume in the saw-log portion does not meet minimum log-grade specifications because of roughness, excessive sweep or crook, splits, cracks, limb stoppers, or forks the tree is considered rough cull. The saw-log 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.

Rough cull pole-size trees do 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 saw-log size will eventually attain saw-log size at DBH. Predicted death, tree vigor, and plot site index are not considered in determining tree class.

A standing-dead tree that contains at least one 8-foot section that is at least 50 percent sound has a tree/decay class of 30. A down-dead tree $\geq$ 5.0" DBH that meets these standards is given a tree/decay code of 30.

31--Short-log Cull

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

Any live saw-timber-size tree of commercial species that has less than one-third of the volume of the saw-log portion in merchantable logs, but has at least one 8-foot or longer saw-log meeting minimum log-grade specifications. A short saw-log must be 50 percent sound at any point. (The saw-log 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.

40--Rotten Cull

Any live tree of commercial species that is saw-timber size and has no merchantable saw-log. Over one-half of the volume in the saw-log portion does not meet minimum log-grade specifications primarily because of rot, missing sections, or deadwood. (The saw-log 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.)

Classify any pole-size tree that does not have the potential to meet the specifications for growing stock because of rot as rotten cull. Assume that all live trees will eventually attain saw-

log size at DBH. Predicted death, tree vigor, and plot site index are not considered in determining tree class.

A standing-dead tree without an 8-foot or longer section that is at least 50 percent sound has a tree class of 40. Any standing-dead sapling is also given a tree class of 40.

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

Note: Tree class codes 41 and higher are only valid on trees that are dead and down.

41--Solid
The butt section of a down-dead tree with this decay class has intact bark and is structurally sound enough that it cannot be penetrated with a pin. Any rotten portions are also intact. Use this class for trees ≥ 5" DBH that are not salvable due to breakage or form.

42--Solid-punky
Bark may or may not still be attached and the structural integrity of the butt section is sound to somewhat rotten. Branch stubs are still firmly attached. Any rotten portions are partly soft.

43—Punky
Decay has progressed substantially in the butt section. Although bark may still be attached, most is sloughing or detached and a pin easily penetrates the wood. Branch stubs pull out and rotten portions are soft and perhaps even squishy if moist.

44--Disintegrating
Little structural integrity remains. Bark is detached or absent (for some species it may still be intact). A pin penetrates to the center of the log and branch stubs have rotted. Rotten portions are "doughy" when wet and fluffy when dry.

45--Gone
Little to no evidence of the butt section remains.
The following table summarizes valid tree/decay class for the various tree histories.

The following table summarizes valid tree/decay class for the various tree histories.

	Tree Status (STAT)	**Tree lean (LEAN)**	**Tree/Decay Class (TCC)**								
			Subplots 1 - 4				**NC Sample Kind (NCSK) = 6 (Shaded)**				
			20	30	31	40	41	42	43	44	45
	1	0,1	Yes	Yes	Yes	Yes	No	No	No	No	No
	2	0	No	Yes	No	Yes*	No	No	No	No	No
	2	1	No	Yes**	No	No	Yes	Yes	Yes	Yes	Yes

* Use this class for standing-dead trees <5.0" DBH

** Trees ≥ 5.0" DBH only

See Appendix 10 for diagrams of trees to assist in assigning tree class.

5.11 ROTTEN/MISSING CULL (ROTT)

Record the percent rotten or missing cubic-foot cull for all live tally trees ≥ 5.0 in DBH/DRC (CORE) and all standing dead tally trees ≥ 5.0 in DBH/DRC (CORE OPTIONAL).

Record the percentage of rotten and missing cubic-foot volume, to the nearest 1 percent. When estimating volume loss (tree cull), only consider the cull on the merchantable bole/portion of the tree, from a 1-ft stump to a 4-inch top. Do not include any cull estimate above actual length. For western woodland species, the merchantable portion is between the point of DRC measurement to a 1.5-inch DOB top.

Rotten and missing volume loss is often difficult to estimate. Refer to supplemental disease and insect pests field guides and local defect guidelines as an aid in identifying damaging agents and their impact on volume loss. Use your best judgment and be alert to such defect indicators as the following:

- Cankers or fruiting bodies.
- Swollen or punky knots.
- Dull, hollow sound of bole (use regional standards).
- Large dead limbs, especially those with frayed ends.
- Sawdust around the base of the tree.

When Collected: CORE: All live tally trees ≥ 5.0 in DBH/DRC
CORE OPTIONAL: All live and standing dead tally trees ≥ 5.0 in DBH/DRC
NC Note: Only collected on live (CORE). Not collected on re-measurement trees (subplots 101 and higher).
Field width: 2 digits
Tolerance: +/- 10 %
MQO: At least 90% of the time
Values: 0 to 99

5.12 TOTAL LENGTH (THGT)

Record the TOTAL LENGTH of the tree, to the nearest 1.0 ft from ground level to the tip of the apical meristem. For trees growing on a slope, measure on the uphill side of the tree. If the tree has a broken or missing top, estimate what the total length would be if there were no missing or broken top. Forked trees should be treated the same as unforked trees.

When Collected: P2 CORE - All live tally trees ≥ 5.0 in DBH/DRC
P2 CORE OPTIONAL - All live tally trees ≥ 1.0 in DBH/DRC and all standing dead tally trees ≥ 5.0 in DBH/DRC
P3 - All live tally trees ≥ 1.0 in DBH/DRC
NC Note: Not collected on re-measurement trees (subplots 101 and higher).
Field width: 3 digits
Tolerance: +/- 10 % of true length
MQO: At least 90% of the time
Values: 005 to 400

5.13 ACTUAL LENGTH (ACTU)

For trees with broken or missing tops. Record the ACTUAL LENGTH of the tree to the nearest 1.0 ft from ground level to the highest remaining portion of the tree still present and attached to the bole. Use the length to the break for ACTUAL LENGTH until a new leader qualifies as the new top for TOTAL LENGTH; until that occurs, continue to record ACTUAL LENGTH to the break. If the top is intact, this item may be omitted. Forked trees should be treated the same as unforked trees. Trees with previously broken tops are considered recovered (i.e., ACTUAL LENGTH = TOTAL LENGTH) when a new leader is 1/3 the diameter of the broken top at the point where the top was broken (not where the new leader originates from the trunk).

When Collected: P2 CORE - All live and standing dead tally trees (with broken or missing tops) ≥ 5.0 in DBH/DRC
P2 CORE OPTIONAL - All live tally trees (with broken or missing tops) 1.0 – 4.9 in DBH/DRC
P3 - All live tally trees (with broken or missing tops) ≥1.0 in DBH/DRC
NC Note: Not collected on re-measurement trees (subplots 101 and higher).
Field width: 3 digits
Tolerance: +/- 10 % of true length
MQO: At least 90% of the time
Values: 005 to 400

5.14 LENGTH METHOD
Record the code that indicates the method used to determine tree lengths.

When Collected: P2 CORE - All live tally trees ≥ 5.0 in DBH/DRC
P2 CORE OPTIONAL - All live tally trees ≥ 1.0 in DBH/DRC and all standing dead tally trees ≥ 5.0 in DBH/DRC
P3 - All live tally trees ≥ 1.0 in DBH/DRC

Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Total and actual lengths are field measured with a measurement instrument (e.g., clinometer, relascope, tape)

2 Total length is visually estimated, actual length is measured with an instrument

3 Total and actual lengths are visually estimated

5.14NC NC TREE GRADE (TRGD)
Grade all live trees that are saw-log size and have a tree class of 20 or 31 on subplots 1-4. See Appendix 10 for help using tree grade flow charts.

When collected: All live trees with a tree class of 20 or 31
Hardwoods ≥ 11” DBH
Softwoods ≥ 9” DBH
Field width: 3 digits
MQO: None
Values:

000	hardwoods/ softwoods	370	hardwoods
100	hardwoods/ softwoods	380	hardwoods
200	softwoods	400	softwoods - White Pine only
210	hardwoods	430	hardwoods
230	hardwoods	520	hardwoods
240	hardwoods	560	hardwoods
250	hardwoods	570	hardwoods
270	hardwoods		
280	hardwoods		
300	softwoods		
310	hardwoods		
330	hardwoods		
340	hardwoods		
350	hardwoods		

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

- Measure DBH to the nearest inch.
- Establish the location of all defect indicators on the surface of the butt 16-foot log, and then locate the best 12-foot section.
- Within the best 12-foot section, select the third best face of the log. Use this face to determine length of clear cuttings.
- 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 saw-timber tree that does not qualify as tree grade 3, but has a 12-foot log within the butt 16-foot log and meets specifications for hardwood construction lumber logs (tie and timber) assign a grade 4. For a hardwood saw-timber tree that does not qualify as a tree grade 3 or log grade 4, but has a 12-foot log above the butt log or two 8-foot logs that meets log-grade requirements (therefore a 20 class tree), assign a log grade of 5.

A hardwood construction log grade table (grade 4) and a hardwood lumber log grade table (upper logs or grade 5) are included on the following pages.

For a **softwood** saw-timber (tree class 20) tree, grade the portion of the log that gives the best grade. Use the grading rules in the Tatum Guides for determining log grade.
For a softwood 31-class tree, grade the log that is present.

Minimum saw-log length for tree grades is 12 feet and for log grades is 8 feet. Saw-log lengths should not extend above large forks, have excessive limbs or other defects, or have a section of the tree bole that does not meet minimum log grade specification. Limitations or "stoppers" for all softwoods and for hardwood grades 1, 2 and 3 include: any limb (live or dead) having a collar diameter exceeding the stem DOB at that point; or any group of 2.0" collar diameter or larger limbs (live or dead), within a 1 foot span, having a combined sum of diameters greater than the stem DOB of that section. Limitations for grade 4 hardwoods include: any limb or group of limbs, within a 1 foot span, with a collar diameter or sum of collar diameters greater than 1/3 of the stem DOB of that section.

Code 1st Digit	Valid Species
1	hardwoods & softwoods
2	hardwoods & softwoods
3	hardwoods & softwoods
4	hardwoods only
5	hardwoods only

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. When a grade 5 is given to a hardwood log, the second digit is a 2 or 7 when an 8' log is present. If a 12' upper log is present, assign a second digit of 6.

For **softwoods**, the second and third digits are always "00".

Code 2nd & 3rd	Limiting Factor
00	Not applicable, already a grade 1, all softwoods
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

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) Number on face (maximum) Yield in face length (minimum)	7 5 3 2 5/6	3 3 2 3 4/6	2 [e] 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.

c Grade 2 trees can be 10 inches DIB at top of grading section if otherwise meeting surface requirements for small grade 1s.

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 %.

NOTE: The tree grading in this table is based on measuring DBH to the nearest inch, since FIA measures to the higher 10th of a inch use diameter classes, i.e. for grade 1, DBH can be 15.5" and for grade 2, DBH can be 12.5" for this table. Also FIA uses 11 inch as the minimum DBH to record tree grades so there only grade 1 and 2 are affected by diameter classes.

FOREST SERVICE STANDARD SPECIFICATIONS FOR HARDWOOD CONSTRUCTION (GRADE 4) LOGS

Position in tree		Butt & Upper.
Min. diameter, small end		8 inches +.
Min. length, without trim		8 feet +.
Clear cuttings		No requirements.
Sweep allowance, absolute		1/4 d.i.b. of small end for half logs, 1/2 d.i.b. for logs 16 feet long.
Sound surface defects permitted	Single knots	Any number, if no one knot has an average collar diameter over 1/3 of log diameter at point of occurrence.
	Whorled knots	Any number, if sum of collar diameters does not exceed 1/3 of the log diameter at point of occurrence.
	Holes	Any number provided none has a diameter over 1/3 of log diameter at point of occurrence and none extends over 3 inches into included timber.
Unsound defects permitted	Surface	Any number and size if they do not extend into included timber. If they do, they can't exceed size, number, and depth, or limits of sound knots.
	Interior	None allowed; log must be sound internally, but will permit 1 shake not to exceed 1/3 the scaling diameter and a longitudinal split not extending over 5 inches into the contained timber. No center rot.

FOREST SERVICE STANDARD GRADES FOR HARDWOOD FACTORY LUMBER LOGS [a]

Grading Factors*		Log grades							
		F1			F2				F3
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Scaling diameter, inches		13-15[b]	16-19	20+	11+[c]	12+			8+
Length without trim, feet		10+			10+	8-9	10-11	12+	8+
Required clear[d] cuttings of each of 3 best faces[e]	Min. length, feet	7	5	3	3	3	3	3	2
	Max. number	2	2	2	2	2	2	3	No limit
	Min. proportion of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Maximum sweep & crook allowance	For logs with less than 1/4 of end in sound defects	15%			30%				50%
	For logs with more than 1/4 of end in sound defects	10%			20%				35%
Maximum scaling deduction		40%[f]			50%[g]				50%

[a] From USDA Forest Service Research FPL. 63
[b] Ash and Basswood butts can be 12 inches if otherwise meeting the requirements for small No. 1's
[c] Ten-inch logs of all species can be #2 if they if otherwise meeting the requirements for small No. 1's
[d] A Clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth the surface of the log as divided lengthwise.
[e] A face is ¼ of the surface of the log as divided lengthwise
[f] Otherwise No. 1 logs with 41-60 percent cull can be No. 2.
[g] Otherwise No. 2 logs with 51-60 percent cull can be No. 3.

EASTERN WHITE PINE SAW-LOG GRADE SPECIFICATIONS

GRADING FACTOR	LOG GRADE 1	LOG GRADE 2	LOG GRADE 3	LOG GRADE 4
1 MINIMUM SCALING	14[1]	6	6	6
2 MINIMUM LOG LENGTH (feet)	10[2]	8	8	8
3 MAXIMUM WEEVIL INJURY (number)	NONE	NONE	2 INJURIES[3]	NO LIMIT
	Two full length or four 50% length good faces.*4* (In addition, log knots	NO GOOD FACES REQUIRED. Maximum diameter of log knots on three best faces:	Includes all logs not qualifying for No. 3 or better and judged to	
4 MINIMUM FACE REQUIREMENTS	on balance of faces shall not exceed size limitations of grade 2 logs.)	SOUND RED KNOTS not to exceed 1/6 scaling diameter and 3 inch maximum. DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/12 scaling diameter and 1 1/2 inch maximum.	SOUND RED KNOTS not to exceed 1/3 scaling diameter and 5 inch maximum. DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/6 scaling diameter and 2 1/2 inch maximum	have at least one third of their gross volume in sound wood suitable for manufacture into standard lumber.
5 MAXIMUM SWEEP OR CROOK ALLOW-ANCE (percent)	20	30	40	66 2/3
6 MAXIMUM TOTAL SCALING DEDUC-TION (percent)	50	50	50	66 2/3

After the tentative log grade is established from face examination, the log will be reduced in grade whenever the following defects are evident:

7 CONKS, PUNK KNOTS, AND PINE BORER DAMAGE ON BARK SURFACE[5]

Degrade one grade if present on one face
Degrade two grades if present on two faces
Degrade three grades if present on three or more faces

8 LOG END DEFECTS: RED ROT, RING SHAKE, HEAVY STAIN AND PINE BORER DAMAGE OUTSIDE THE HEART CENTER OF THE LOG [5]

Consider log as having a total of 8 quarters (4 on each end) and degrade as indicated below:
Degrade one grade if present in 2 quarters of log ends.
Degrade two grades if present in 3 or 4 quarters of log ends.
Degrade three grades if present in 5 or more quarters of log ends.

1 12 and 13 inch logs with four full length good faces are acceptable.
2 8 foot logs with four full length good faces are acceptable.
3 8 foot Number 3 logs limited to one weevil injury.
4 Minimum 50% length good face must be at least 6 feet.
5 Factors 7 and 8 are not cumulative (total degrade based on more serious of the two). No log to be degraded below grade 4 if net scale is at least one third of gross scale.

LOG GRADES FOR SOFTWOOD LOGS

Grade 1

1. Logs must be 16" d.i.b. or larger, 10' or longer, and with deduction for defect, not over 30 %of gross scale.
2. Logs must be at least 75 % clear on each of three faces.
3. All knots outside clear cutting must be sound and not over 2 1/2" large.

Grade 2

1. Logs must be 12" d.i.b. or larger, 10' or longer, and with a net scale after deduction for defect of at least 50 % of the gross contents of the log.

2. Logs must be at least 50 % clear on each of three faces or 75 % clear on 2 faces.

Grade 3

1. Logs must be 6" d.i.b. or larger, 8' or longer, and with a net scale after deduction for defect of at least 50 % of the gross contents of the log.

Notes: Diameters are d.i.b. at small end of log
% clear refers to % clear in one continuous section

JACK PINE AND RED PINE LOG GRADES

GRADE 1 Logs with 3 or 4 clear faces *
GRADE 2 Logs with 1 or 2 clear faces.
GRADE 3 Logs with no clear faces.

After the tentative log grade is established from above, the log will be degraded one grade for each of the following defects, except that no log can be degraded below grade 3. Net scale after deduction for defect must be at least 50 percent of the gross contents of the log.

1. **SWEEP** Degrade any tentative 1 or 2 log one grade if sweep amounts to 3 or more inches and equals or exceeds one third the diameter inside bark at the small end.

2. **HEART ROT** Degrade any tentative 1 or 2 log one grade if conk, massed hyphae, or other evidence of advanced heart rot is found anywhere in the log.

---

* A face is one fourth of the circumference in width extending the full length of the log. Clear faces are those free of: knots measuring more than 1/2 inch in diameter, overgrown knots of any size, and holes more than 1/4 inch in diameter. Faces may be rotated to obtain the maximum number of clear ones.

SOUTHERN PINE TREE GRADES

Always grade the bottom 16-foot log, or the first merchantable log 12 feet or longer in the tree.

Clear face - free of knots measuring more than 1/2 inch in diameter, overgrown knots of any size, holes more than 1/4 inch in diameter. The faces may be rotated if necessary to obtain the maximum number of clear ones.

Overgrown knot - a knot overgrown and buried beneath the log surface, but indicated by a surface bump or distribution of bark pattern.

Tentative Grades

Grade 1 - trees with 3 or 4 clear faces
Grade 2 - trees with 1 or 2 clear faces
Grade 3 - trees with no clear faces

Degrade for Sweep or Heart Rot

(1) Degrade any tentative grade 1 or 2 tree one grade if sweep in the lower 12 feet of the grading sections amount to 3 or more inches and equals or exceeds one-fourth the DBH.

(2) Degrade any tentative 1 or 2 tree one grade if conks, punk knots, or otherwise evidence of advanced heart rot is found anywhere on the tree stem.

1995, FIA-SE

5.15 CROWN CLASS (CCC)

Rate tree crowns in relation to the sunlight received and proximity to neighboring trees (Figure 24). Base the assessment on the position of the crown at the time of observation. Example: a formerly suppressed tree which is now dominant due to tree removal is classified as dominant.

When Collected: All live tally trees ≥ 1.0 in DBH/DRC
Field width: 1 digit
Tolerance: No errors
MQO: At least 85% of the time
Values:

1 Open Grown: Trees with crowns that received full light from above and from all sides throughout most of its life, particularly during its early developmental period.

2 Dominant: Trees with crown extending above the general level of the crown cover and receiving full light from above and partly from the sides. These trees are taller than the average trees in the stand and their crowns are well developed, but they could be somewhat crowded on the sides.

Also, trees whose crowns have received full light from above and from all sides during early development and most of their life. Their crown form or shape appears to be free of influence from neighboring trees.

3 Co-dominant: Trees with crowns at the general level of the crown canopy. Crowns receive full light from above but little direct sunlight penetrates their sides. Usually they have medium-sized crowns and are somewhat crowded from the sides. In stagnated stands, co-dominant trees have small-sized crowns and are crowded on the sides.

4 Intermediate: Trees that are shorter than dominants and co-dominant, but their crowns extend into the canopy of co-dominant and dominant trees. They receive little direct light from above and none from the sides. As a result, intermediates usually have small crowns and are very crowded from the sides.

5 Overtopped: Trees with crowns entirely below the general level of the crown canopy that receive no direct sunlight either from above or the sides.

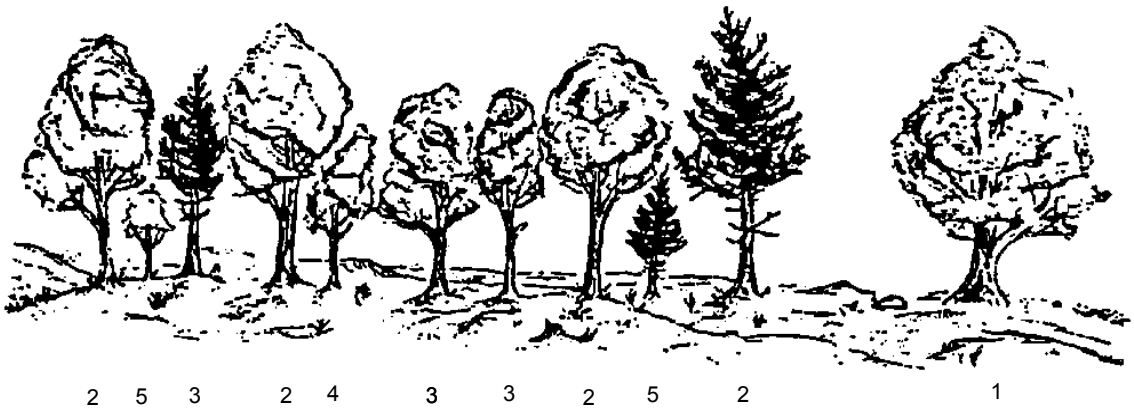


Figure 24. Examples of CROWN CLASS definitions.

5.16 UNCOMPACTED LIVE CROWN RATIO (P2 – CORE OPTIONAL, P3 – CORE)
Record the UNCOMPACTED CROWN RATIOs to the nearest 1%. UNCOMPACTED LIVE CROWN RATIO is the percentage of total tree height supporting live foliage that is effectively contributing to tree growth. UNCOMPACTED LIVE CROWN RATIO is determined by the ratio of live crown length to top of live crown (Figure 25). Live crown length is determined from the last live foliage at the crown top (dieback in the upper portion of the crown is not part of the live crown) to the "base of live crown". Many times there are additional live branches below the "base of live crown". These branches are only included if they have a basal diameter greater than 1 in and are within 5 ft of the base of the obvious live crown. The live crown base becomes that point on the main bole perpendicular to the lowest live foliage on the last branch that is included in the live crown. The live crown base is determined by the live foliage and not by the point where a branch intersects with the main bole.

When collected: P2 (CORE OPTIONAL) – All live tally trees ≥ 5.0 in DBH/DRC
P3 (CORE) – All live tally trees ≥ 1.0 in DBH/DRC
Field width: 2 digits
Tolerance: +/- 10%
MQO: At least 90% of the time
Values: 00 to 99 percent

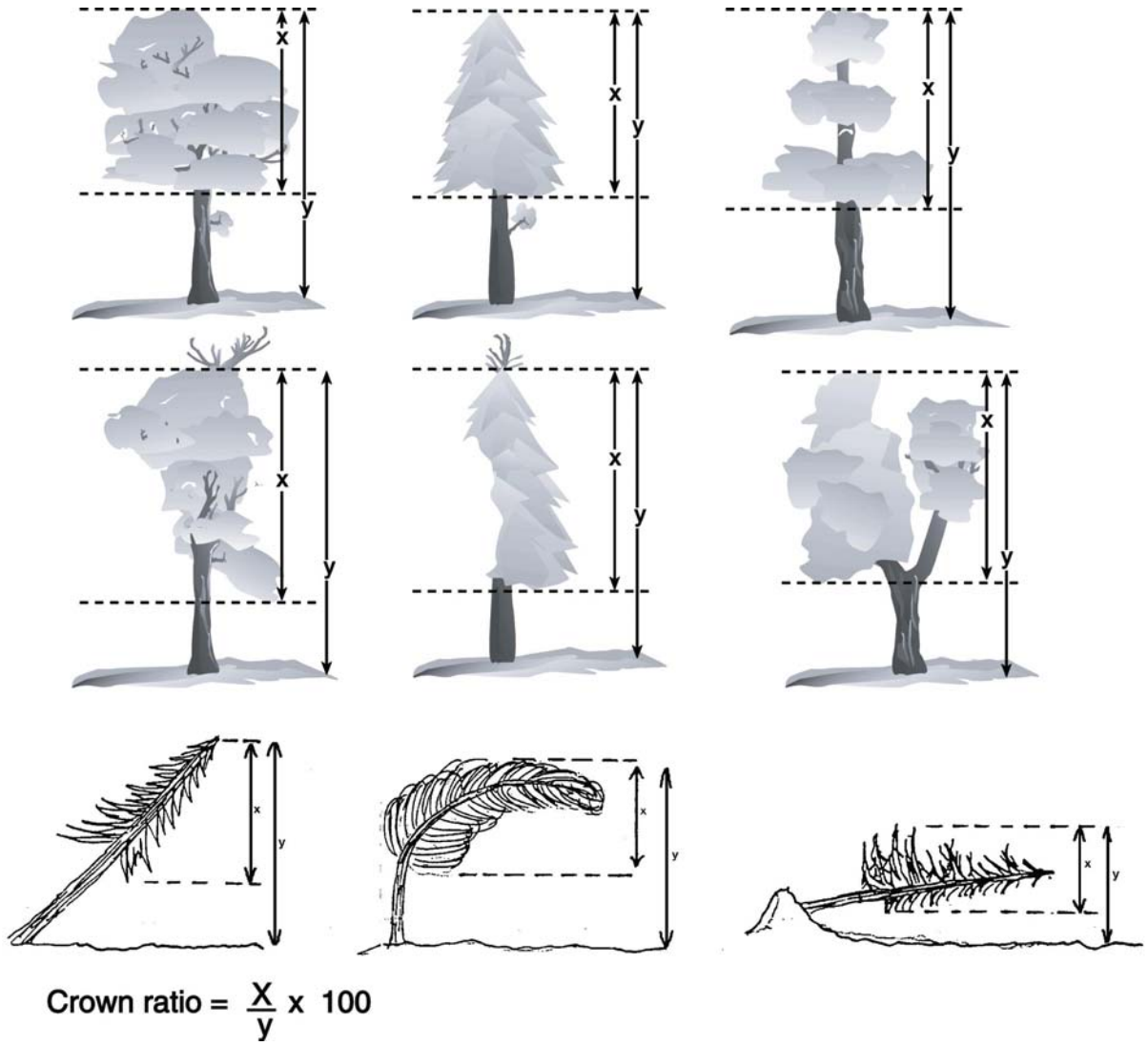


Figure 25. UNCOMPACTED LIVE CROWN RATIO examples.

Determine sapling LIVE CROWN RATIO by dividing the live crown length by total tree height to the live 1crown top. Live crown length is the distance between the top live foliage (dieback and dead branches are not included) and the lowest live twig for saplings. The live crown base for saplings is different from trees 5.0 in DBH/DRC and larger; the 1 in/5 ft rule does not apply in this case. Do not include sprigs or leaves on the main stem below the lowest live twig (Figure 26).

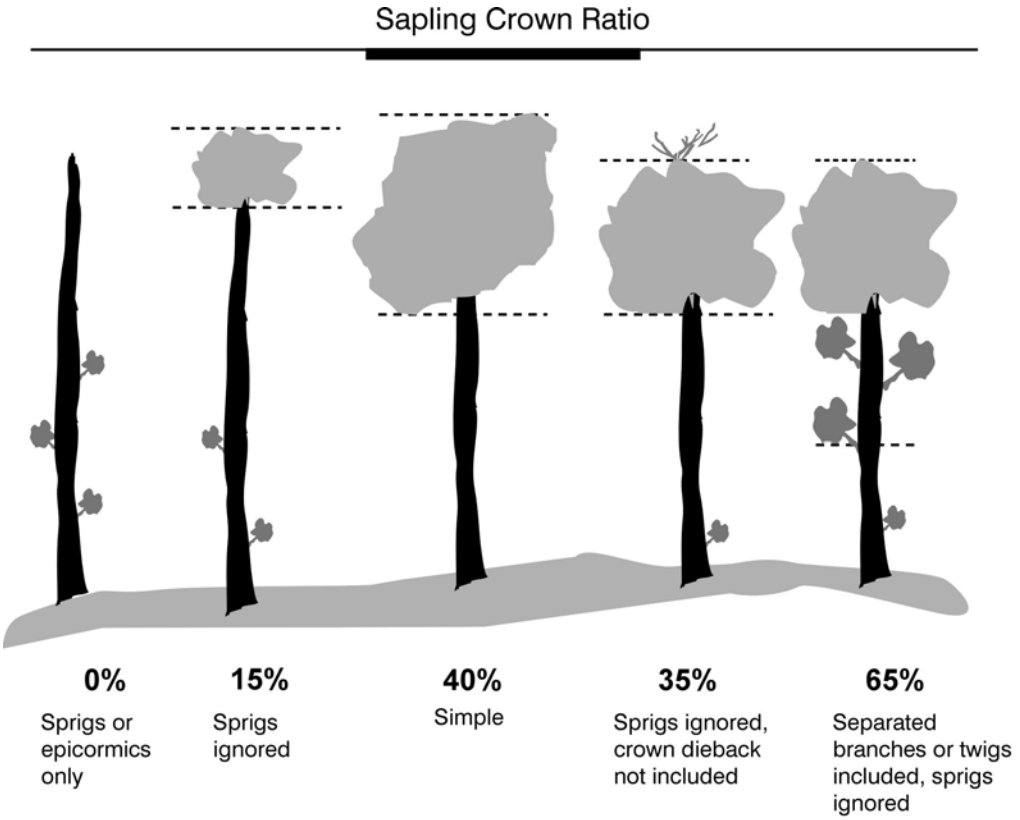


Figure 26. Sapling ratio determination examples.

5.17 COMPACTED CROWN RATIO (CRC)

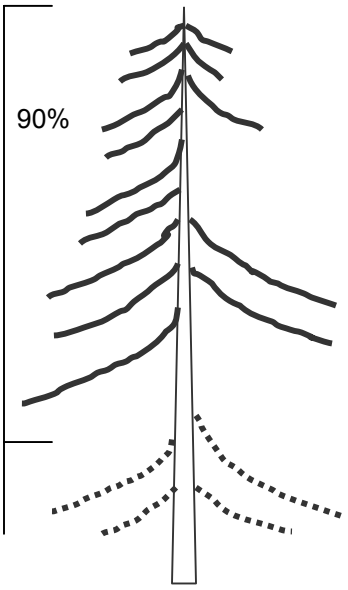
Record the COMPACTED CROWN RATIO for each live tally tree, 1.0 in and larger to the nearest 1%. COMPACTED CROWN RATIO is that portion of the tree supporting live foliage and is expressed as a percentage of the actual tree length. To determine COMPACTED CROWN RATIO, ocularly transfer lower live branches to fill in large holes in the upper portion of the tree until a full, even crown is visualized.

Do not over-compact trees beyond their typical full crown situation. For example, if tree branches tend to average 2-feet between whorls, do not compact crowns any tighter than the 2-foot spacing (Figure 27).

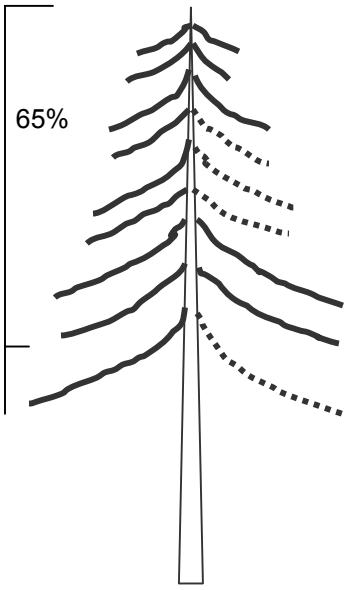
When Collected: All live tally trees ≥ 1.0 in DBH/DRC
Field width: 2 digits
Tolerance: +/- 10 %
MQO: At least 80% of the time
Values: 00 to 99

Open-crown conifer (e.g., ponderosa pine) –

Uncompacted:

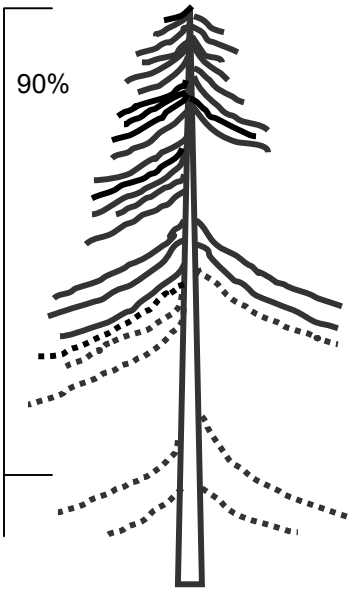


Compacted:



Dense-crown conifer (e.g., subalpine fir) –

Uncompacted:



Compacted:

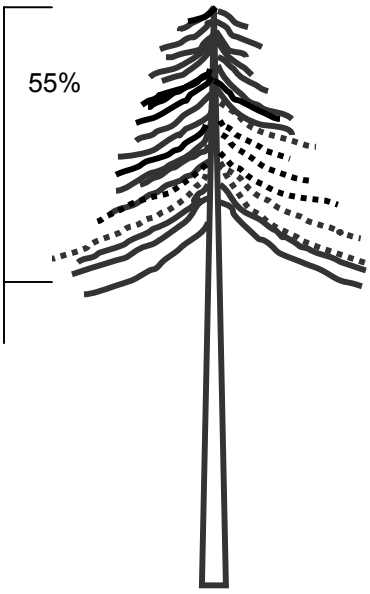


Figure 27. Examples of COMPACTED CROWN RATIO of conifers.

For multi-stemmed western woodland species, ocularly transfer lower live foliage to fill large holes on all stems and form an even crown across the tree (Figure 28).

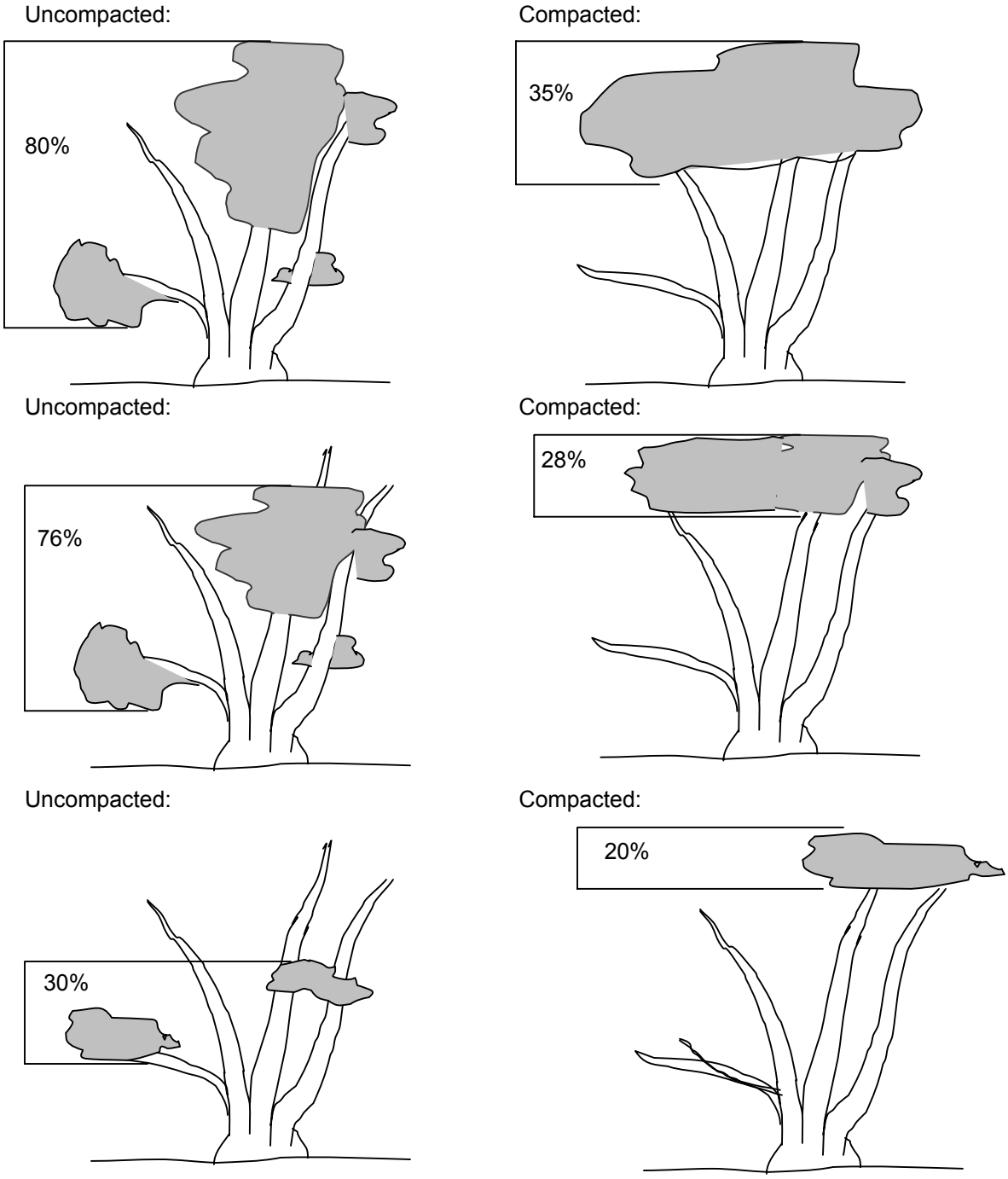


Figure 28. Examples of COMPACTED CROWN RATIO of western woodland species.

5.18 TREE DAMAGE

Record up to two different damages per tree. Damage is characterized according to three attributes: location of damage, type of damage, and severity of damage. Damages must meet severity thresholds (defined in section 5.18.3, DAMAGE SEVERITY) in order to be recorded.

The tree is observed from all sides starting at the roots. Damage signs and symptoms are prioritized and recorded based on location in the following order: roots, roots and lower bole, lower bole, lower and upper bole, upper bole, crownstem, and branches recorded as location code 0 (for no damage), or DAMAGE LOCATION 1-9.

Within any given location, the hierarchy of damage follows the numeric order of DAMAGE TYPE possible for that location. The numeric order denotes decreasing significance as the code number goes up, i.e., DAMAGE TYPE 01 is more significant than DAMAGE TYPE 25. A maximum of two damages are recorded for each tree. If a tree has more than two damages that meet the threshold levels, the first two that are observed starting at the roots are recorded.

When multiple damages occur in the same place, the most damaging is recorded. For example, if a canker, DAMAGE TYPE 01, meets the threshold and has a conk growing in it, record only the canker. Another example: if an open wound meets threshold and also has resinosis, record only the open wound.

5.18.1 DAMAGE LOCATION 1 (LOC1)

Record the location on the tree where DAMAGE TYPE 1 is found (Figure 29). If the same damage continues into two or more locations, record the appropriate code listed below, or if the combination of locations does not exist (damage extends from crownstem to roots), record the lowest location that best describes the damage (see Figure 30). Multiple damages may occur in the same location, but record the higher priority damage (lower code number) first. If the damages are coincident (a conk within a canker), record only the higher priority damage.

The “base of the live crown” is defined as the horizontal line which would touch the lowest part of the foliage, excluding branches towards the base of the tree which are less than 1.0 inch or more than 5 ft from the rest of the crown. See Section 5.16 (UNCOMPACTED LIVE CROWN RATIO) for more details.

When Collected: CORE: All live tally trees $\geq$ 5.0 in DBH/DRC
Field width: 1 digit
Tolerance: +/- 1 location class
MQO: At least 80% of the time
Values:

0 No damage
1 Roots (exposed) and stump (12 inches in height from ground level)
2 Roots, stump, and lower bole
3 Lower bole (lower half of the trunk between the stump and base of the live crown)
4 Lower and upper bole
5 Upper bole (upper half of the trunk between stump and base of the live crown)
6 Crownstem (main stem within the live crown area, above the base of the live crown)
7 Branches (>1 in at the point of attachment to the main crown stem within the live crown area)
8 Buds and shoots (the most recent year’s growth)
9 Foliage

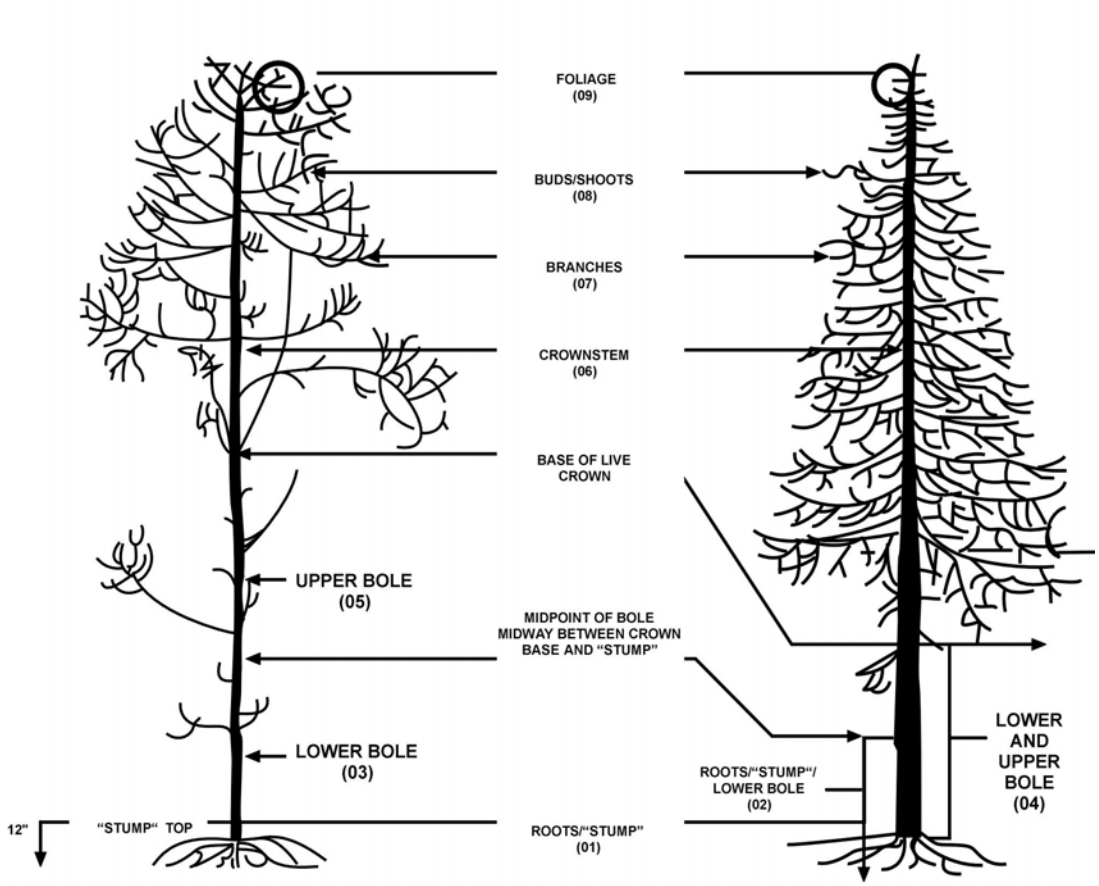


Figure 29. Location codes for damage.

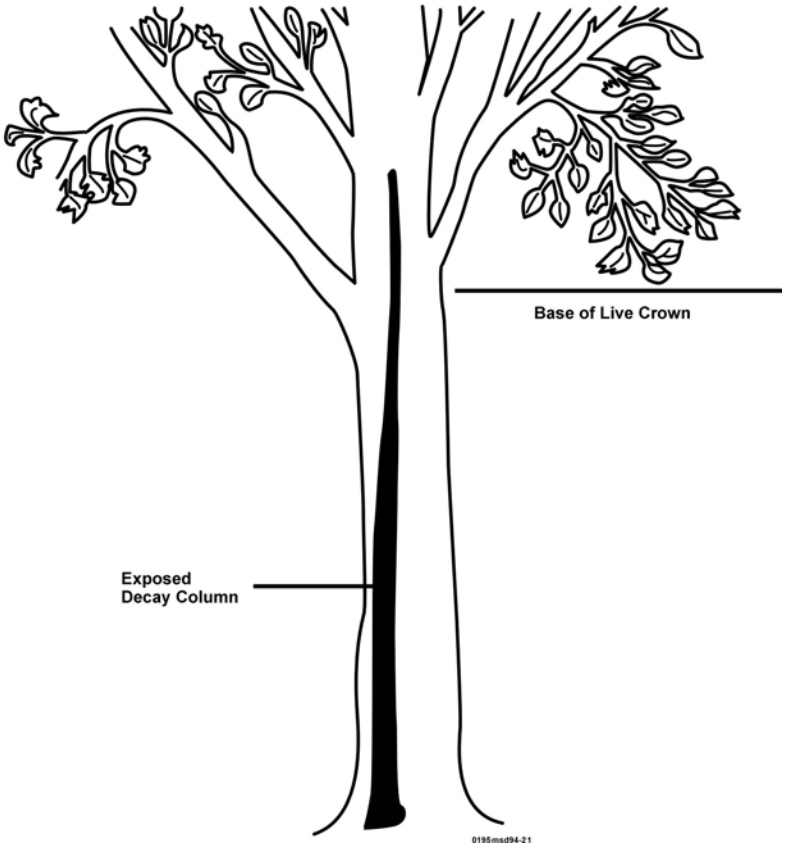


Figure 30. The damage runs from stump to crownstem. Code here should be 02 (roots and "stump" and lower bole) which represents the lowest locations of this multi-location damage.

5.18.2 DAMAGE TYPE 1 (DAM1)

Record the first damage type observed that meets the damage threshold definition in the lowest location. Damage categories are recorded based on the numeric order that denotes decreasing significance from damage 01 - 31.

When Collected: All tally trees where DAMAGE LOCATION 1 > 0
Field width: 2 digits
Tolerance: No errors
MQO: At least 80% of the time
Values:

1 Canker, gall: Cankers may be caused by various agents but are most often caused by fungi. The bark and cambium are killed, and this is followed by death of the underlying wood, although the causal agent may or may not penetrate the wood. This results in areas of dead tissue that become deeper and wider, or galling (including galls caused by rusts), on roots, bole, or branches. Due to the difficulty in distinguishing some abnormal swellings (e.g., burls) from classic galls and cankers, all are recorded as damage 01. A canker may be:

Annual (enlarges only once and does so within an interval briefer than the growth cycle of the tree, usually less than one year),

Diffuse (enlarges without characteristic shape or noticeable callus formation at margins), or

Perennial (enlarges during more than one year - often has a target appearance).

2 Conks, fruiting bodies, and signs of advanced decay: Fruiting bodies on the main bole, crownstem, and at the point of the branch attachment are signs of decay. "Punky wood" is a sign of decay and is evidenced by soft, often moist, and degraded tissue.

Cavities into the main bole that are oriented in such a way that they act as catchment basins for water are signs of decay. Bird cavities are signs of decay.

Rotten branches or branches with conks **are not indicators of decay unless** the threshold is met (>20% of branches are affected).

Rotting stumps associated with coppice regeneration (e.g., northern pin oak, maple) are excluded from coding.

3 Open wounds: An opening or series of openings where bark has been removed or the inner wood has been exposed and no signs of advanced decay are present. Improper pruning wounds that cut into the wood of the main stem are coded as open wounds, if they meet the threshold; those which leave the main stemwood intact are excluded.

4 Resinosis or gummosis: The origin of areas of resin or gum (sap) exudation on branches and trunks.

5 Cracks and seams: Cracks in trees are separations along the radial plane greater than or equal to 5 ft. When they break out to the surface they often are called frost cracks. These cracks are not caused by frost or freezing temperature, though frost can be a major factor in their continued development. Cracks are most often caused by basal wounds or sprout stubs, and expand when temperatures drop rapidly. Seams develop as the tree attempts to seal the crack, although trees have no mechanism to compartmentalize this injury.

Lightning strikes are recorded as cracks when they do not meet the threshold for open wounds.

11 Broken bole or roots (less than 3 ft from bole): Broken roots within 3 ft from bole either from excavation or rootsprung for any reason. For example, those which have been excavated in a road cut or by animals.

Stem broken in the bole area (below the base of the live crown) and tree is still alive.

12 Brooms on roots or bole: Clustering of foliage about a common point on the trunk. Examples include ash yellows witches' brooms on white and green ash and eastern and western conifers infected with dwarf mistletoes.

13 Broken or dead roots (beyond 3 ft): Roots beyond 3 ft from bole that are broken or dead.

20 Vines in the crown: Kudzu, grapevine, ivy, dodder, etc. smothers tree crowns. Vines are rated as a percentage of tree crown affected.

21 Loss of apical dominance, dead terminal: Mortality of the terminal of the crownstem caused by frost, insect, pathogen, or other causes.

22 Broken or dead: Branches that are broken or dead. Branches with no twigs are ignored and not coded as dead. Dead or broken branches attached to the bole or crownstem outside the live crown area are not coded. 20% of the main, first order portion of a branch must be broken for a branch to be coded as such.

23 Excessive branching or brooms within the live crown area: Brooms are a dense clustering of twigs or branches arising from a common point that occur within the live crown area. Includes abnormal clustering of vegetative structures and organs. This includes witches' brooms caused by ash yellows on green and white ash and those caused by dwarf mistletoes.

24 Damaged buds, foliage or shoots: Insect feeding, shredded or distorted foliage, buds or shoots >50% affected, on at least 30% of foliage, buds or shoots. Also includes herbicide or frost-damaged foliage, buds or shoots.

25 Discoloration of foliage: At least 30% of the foliage is more than 50% affected. Affected foliage must be more of some color other than green. If the observer is unsure if the color is green, it is considered green and not discolored.

31 Other: Use when no other explanation is appropriate. Specify in the tree notes section. Code 31 is used to maintain consistency with the Phase 3 crown damage protocols.

Legal Combinations of DAMAGE TYPE by DAMAGE LOCATION:

For each of the following location codes, possible damage codes and damage definitions are presented. Minimum damage thresholds are described in Section 5.17.3, DAMAGE SEVERITY.

NC Table 4 - Valid severity codes by damage type and location in the tree. Cells that have a diagonal line though them indicate that they are not a valid location and type combination.

	Damage Type (DAM1 & DAM2)														
LOC	**1**	**2**	**3**	**4**	**5**	**11**	**12**	**13**	**20**	**21**	**22**	**23**	**24**	**25**	**31**
1	2-9	0,2-9	2-9	2-9	2-9	0	0	2-9							0
2	2-9	0	2-9	2-9	0	0	0								0
3	2-9	0	2-9	2-9	0	0	0								0
4	2-9	0	2-9	2-9	0	0	0								0
5	2-9	0	2-9	2-9	0	0	0								0
6	2-9	0	2-9	2-9	0					0-9					0
7	2-9	2-9	2-9	2-9	2-9				2-9		2-9	2-9			0
8													3-9		0
9													3-9	3-9	0

Location 1: Roots and stump

- 01 Canker, gall -- exceeds 20% of circumference of stump
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds -- exceeds 20% of circumference of stump
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference of stump
- 05 Cracks and seams -- any occurrence
- 11 Broken bole or roots less than 3 ft from bole -- any occurrence
- 12 Brooms on roots or bole -- any occurrence.
- 13 Broken or dead roots -- exceeds 20% of roots, beyond 3 ft from bole, broken or dead
- 31 Other

Location 2: Roots, stump, and lower bole

- 01 Canker, gall -- exceeds 20% of circumference of stump
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds – exceeds 20% at the point of occurrence, or for the portion in root zone, 20% of the circumference of stump
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% at the point of occurrence, or for the portion in root zone, 20% of circumference of stump.
- 05 Cracks and seams - any occurrence
- 11 Broken bole or roots less than 3 ft from bole -- any occurrence
- 12 Brooms on roots or bole - -any occurrence.
- 13 Broken or dead roots -- exceeds 20% of roots, beyond 3 ft from bole, broken or dead
- 31 Other

Location 3: Lower bole

- 01 Canker, gall -- exceeds 20% of circumference at the point of occurrence
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds -- exceeds 20% of circumference at the point of occurrence
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference at the point of occurrence
- 05 Cracks and seams -- any occurrence
- 11 Broken bole or roots less than 3 ft from bole -- any occurrence
- 12 Brooms on roots or bole -- any occurrence
- 31 Other

Location 4: Lower and upper bole -- same as lower bole.

Location 5: Upper bole - same as lower bole.

Location 6: Crownstem

- 01 Canker, gall -- exceeds 20% of circumference of crownstem at the point of occurrence
- 02 Conks, fruiting bodies, and signs of advanced decay -- any occurrence
- 03 Open wounds - exceeds 20% of circumference at the point of occurrence -- any occurrence
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference at the point of occurrence
- 05 Cracks and seams -- all woody locations -- any occurrence.
- 21 Loss of apical dominance, dead terminal -- any occurence
- 31 Other

Location 7: Branches >1 in at the point of attachment to the main or crown stem

- 01 Canker, gall -- exceeds 20% of circumference on at least 20% of branches
- 02 Conks, fruiting bodies and signs of advanced decay -- more than 20% of branches affected
- 03 Open wounds -- exceeds 20% of circumference at the point of occurrence on at least 20% of branches
- 04 Resinosis or gummosis -- origin of flow width exceeds 20% of circumference at the point of occurrence on at least 20% of branches
- 05 Cracks and seams -- all occurrences, and on at least 20% of branches
- 20 Vines in the crown -- more than 20% of live crown affected
- 22 Broken or dead -- more than 20% of branches affected within the live crown area
- 23 Excessive branching or brooms -- more than 20% of branches affected
- 31 Other

Location 8: Buds and shoots

- 24 Damaged buds, shoots or foliage - more than 30% of buds and shoots damaged more than 50%.
- 31 Other.

Location 9: Foliage

- 24 Damaged buds, shoots or foliage - more than 30% of foliage damaged more than 50%.
- 25 Discoloration of foliage - more than 30% of foliage discolored more than 50%.
- 31 Other.

5.18.3 DAMAGE SEVERITY 1 (SEV1)

Record a code to indicate the amount of affected area (above threshold) in DAMAGE LOCATION 1 recorded for TREE DAMAGE 1. Severity codes vary depending on the type of damage recorded.

When Collected: All tally trees where DAMAGE LOCATION 1 > 0
Field width: 2 digits
Tolerance: No errors
MQO: At least 80% of the time
Values: The codes and procedures for SEVERITY 1 values are defined for each DAMAGE TYPE 1.

DAMAGE TYPE Code 01 -- Canker, gall

Measure the affected area from the margins (outer edges) of the canker or gall within any 3-ft vertical section in which at least 20% of circumference is affected at the point of occurrence. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes. See Figure 31.

Severity classes for code 01 (percent of circumference affected):

Classes	Code
20-29	2
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

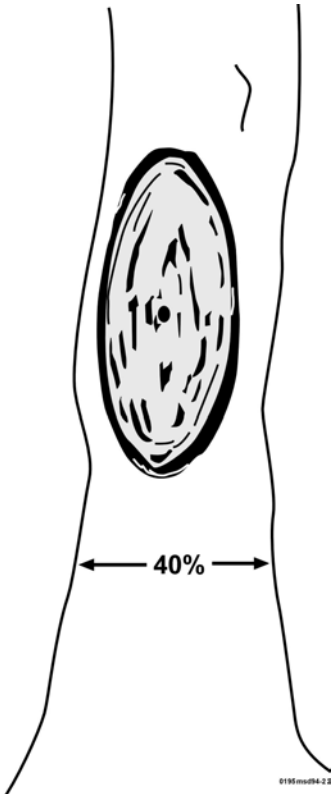


Figure 31. A canker which exceeds threshold. Since 40% of circumference is visible from any side, and since over half the visible side is taken up by the canker, it obviously exceeds the 20% minimum circumference threshold.

DAMAGE TYPE Code 02 -- Conks, fruiting bodies, and signs of advanced decay

Severity classes for code 02: **None**. Enter code 0 regardless of severity, except for roots > 3 ft from the bole, or number of branches affected - 20%

DAMAGE TYPE Code 03 -- Open wounds

The damaged area is measured at the widest point between the margins of the exposed wood within any 3-ft vertical section in which at least 20% of the circumference is affected at the point of occurrence. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes. See Figure 32.

Severity Classes for code 03 (percent of circumference affected):

Classes	Code
20-29	2
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

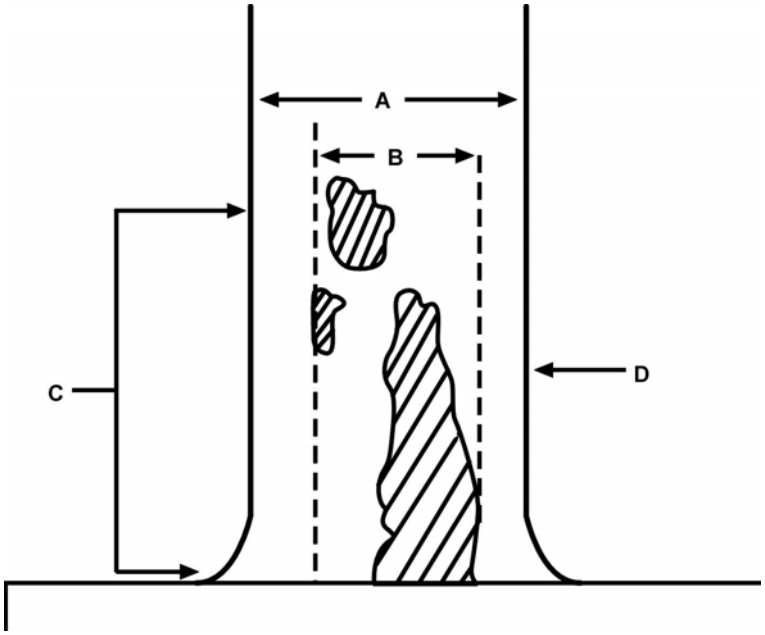


Figure 32. Multiple damage in "stump" and lower bole. A=approximately 40% of tree circumference; B=portion of tree circumference affected by damage; C=vertical distance within one meter; D=midpoint of occurence at which circumference is measured.

DAMAGE TYPE Code 04 -- Resinosis or gummosis

Resinosis or gummosis is measured at the widest point of the origin of the flow width in which at least 20% of the circumference is affected at the point of occurrence. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes.

Severity classes for code 04 (percent of circumference affected):

Classes	Code
20-29	2
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

DAMAGE TYPE Code 05 -- Cracks and seams greater than or equal to 5 ft

Severity class for code 05 -- Record "0" for the lowest location in which the crack occurs. For location 7, and location 1, 20% of branches and roots beyond 3 ft, respectively, must be affected, then record in 10% classes.

DAMAGE TYPE Code 11 -- Broken bole or roots less than 3 ft from bole

Severity classes for code 11: None. Enter code 0 regardless of severity.

DAMAGE TYPE Code 12 -- Brooms on roots or bole

Severity classes for code 12: None. Enter code 0 regardless of severity.

DAMAGE TYPE Code 13 -- Broken or dead roots

At least 20% of roots beyond 3 ft from bole that are broken or dead.

Severity classes for code 13 (percent of roots affected):

Classes	Code
20-29	2
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

DAMAGE TYPE Code 20 -- Vines in crown

Severity classes for code 20 (percent of live crown affected):

Classes	Code
20-29	2
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

DAMAGE TYPE Code 21 -- Loss of apical dominance, dead terminal

Any occurrence (> 1%) is recorded in 10% classes as a percent of the crownstem affected. Use trees of the same species and general DBH/DRC class in the area or look for the detached portion of the crownstem on the ground to aid in estimating percent affected. If a lateral branch has assumed the leader and is above where the previous terminal was, then no damage is recorded.

Severity classes for code 21:

Classes	Code
01-09	0
10-19	1
20-29	2
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

DAMAGE TYPE Code 22 -- Broken or dead branches (> 1in above the swelling at the point of attachment to the main or crown stem within the live crown area)

At least 20% of branches are broken or dead.

Severity classes for code 22 (percent of branches affected):

Classes	Code
20-29	2
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

DAMAGE TYPE Code 23 -- Excessive branching or brooms

At least 20% of crownstem or branches affected with excessive branching or brooms.

Severity classes for code 23 (percent of area affected):

Classes	Code
20-29	2
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

DAMAGE TYPE Code 24 - Damaged buds, shoots or foliage

At least 30% of the buds, shoots or foliage (i.e., chewed or distorted) are more than 50% affected.

Severity classes for code 24:

Classes	Code
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

DAMAGE TYPE Code 25 - Discoloration of Foliage

At least 30% of the foliage is more than 50% affected.

Severity classes for code 25 (percent affected):

Classes	Code
30-39	3
40-49	4
50-59	5
60-69	6
70-79	7
80-89	8
90-99	9

DAMAGE TYPE Code 31 -- Other

Severity classes for code 31:

None. Enter code 0 regardless of severity. Describe condition in tree notes.

Examples are shown in Figures 33-39.

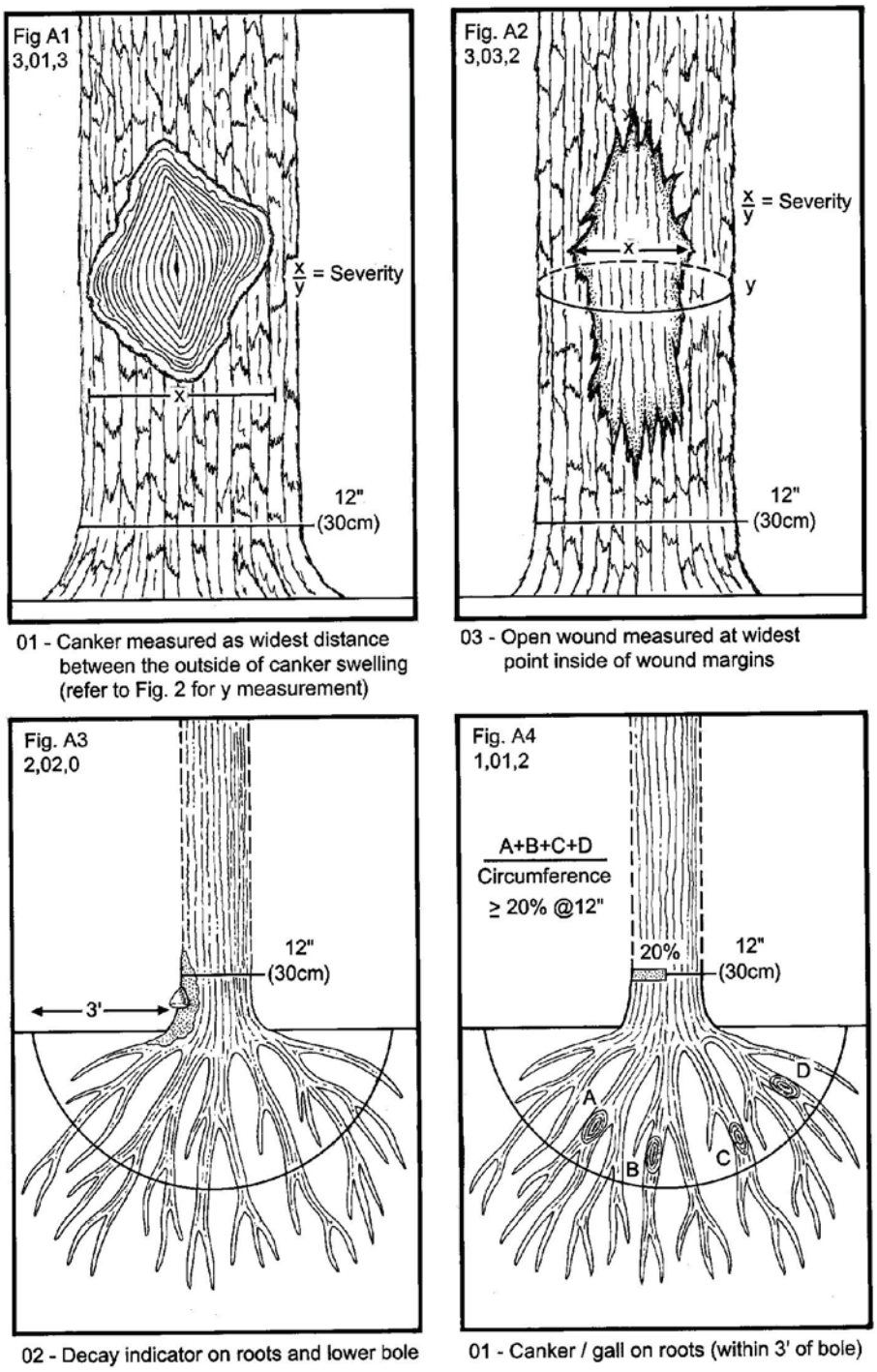


Figure 33. Examples of damage coding.

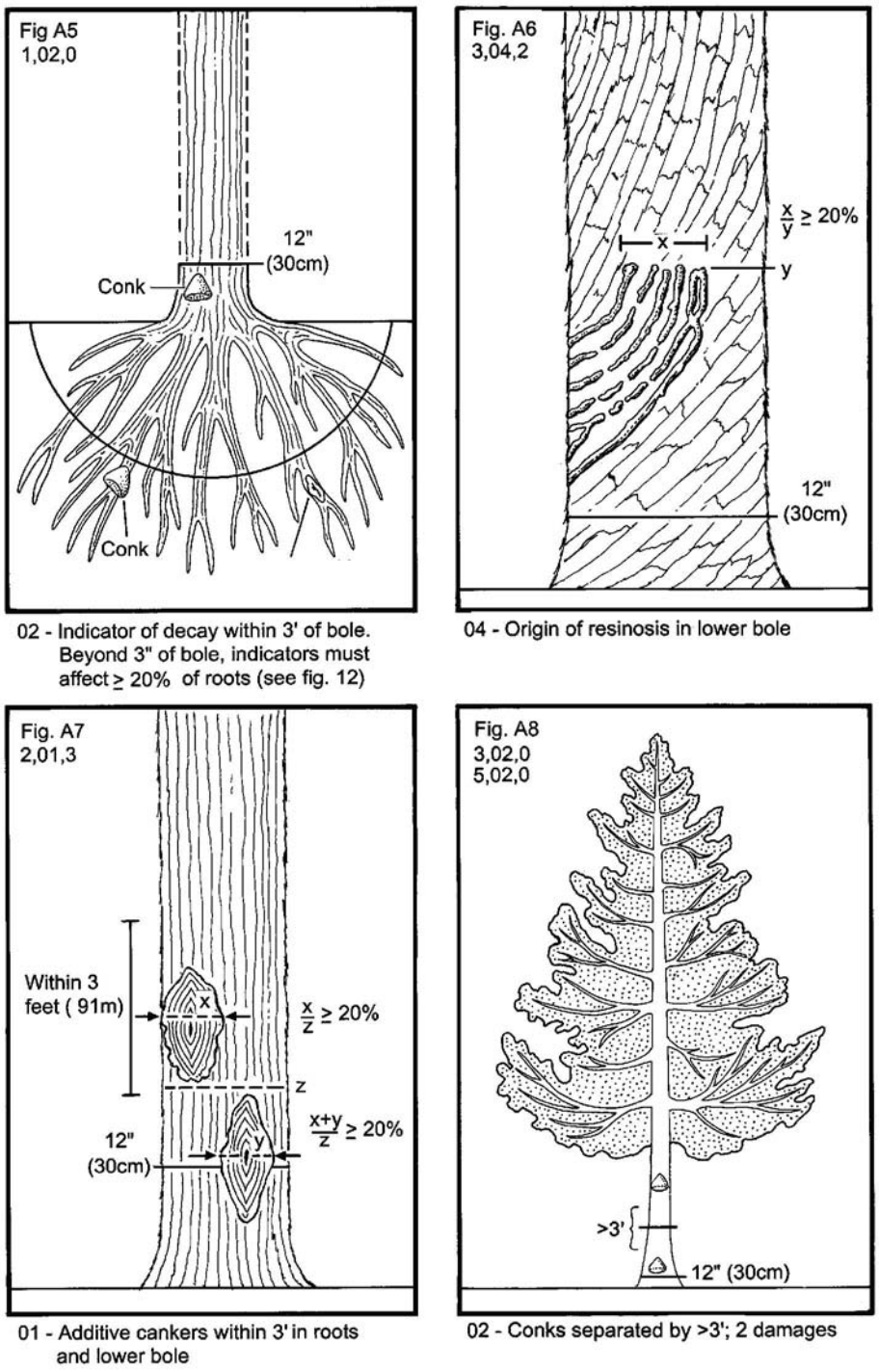
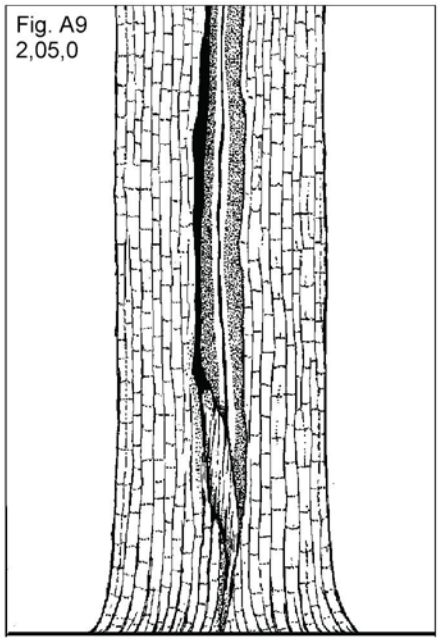
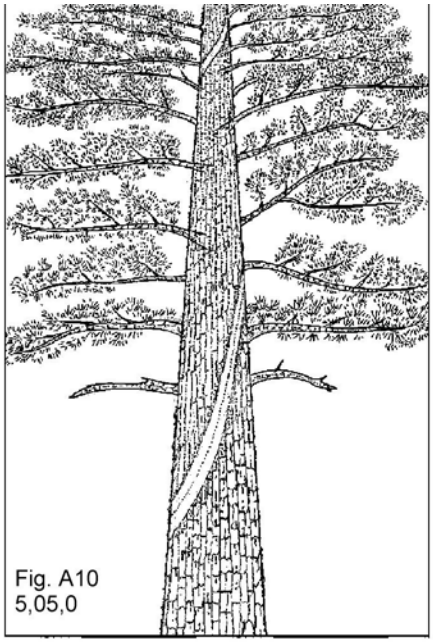


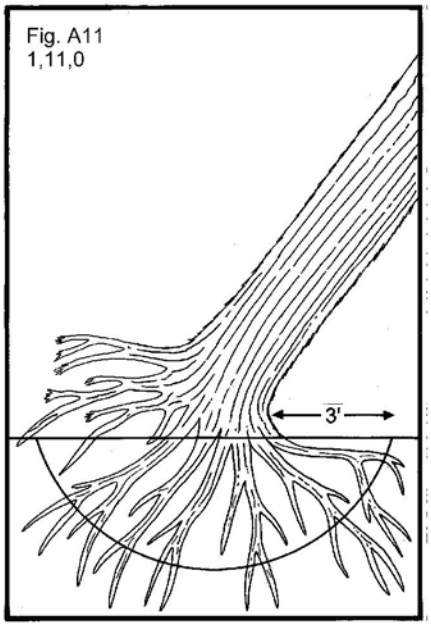
Figure 34. Examples of damage coding.



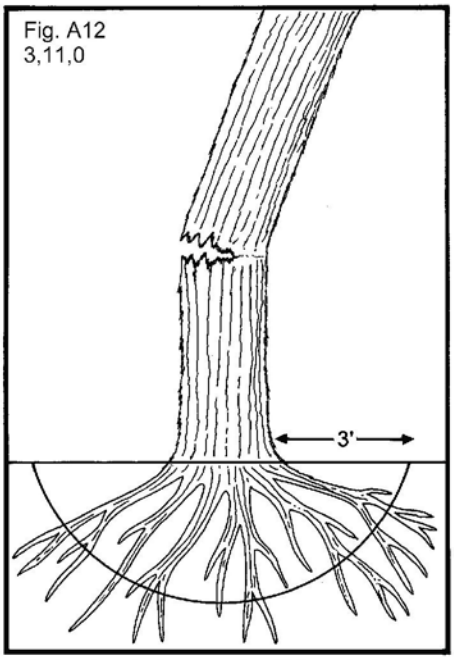
05- Cracks and seams



05 - Lightning strike



11 - Broken bole or roots <3' from bole, broken roots must be visible



11 - Broken bole or roots <3' from bole

Figure 35. Examples of damage coding.

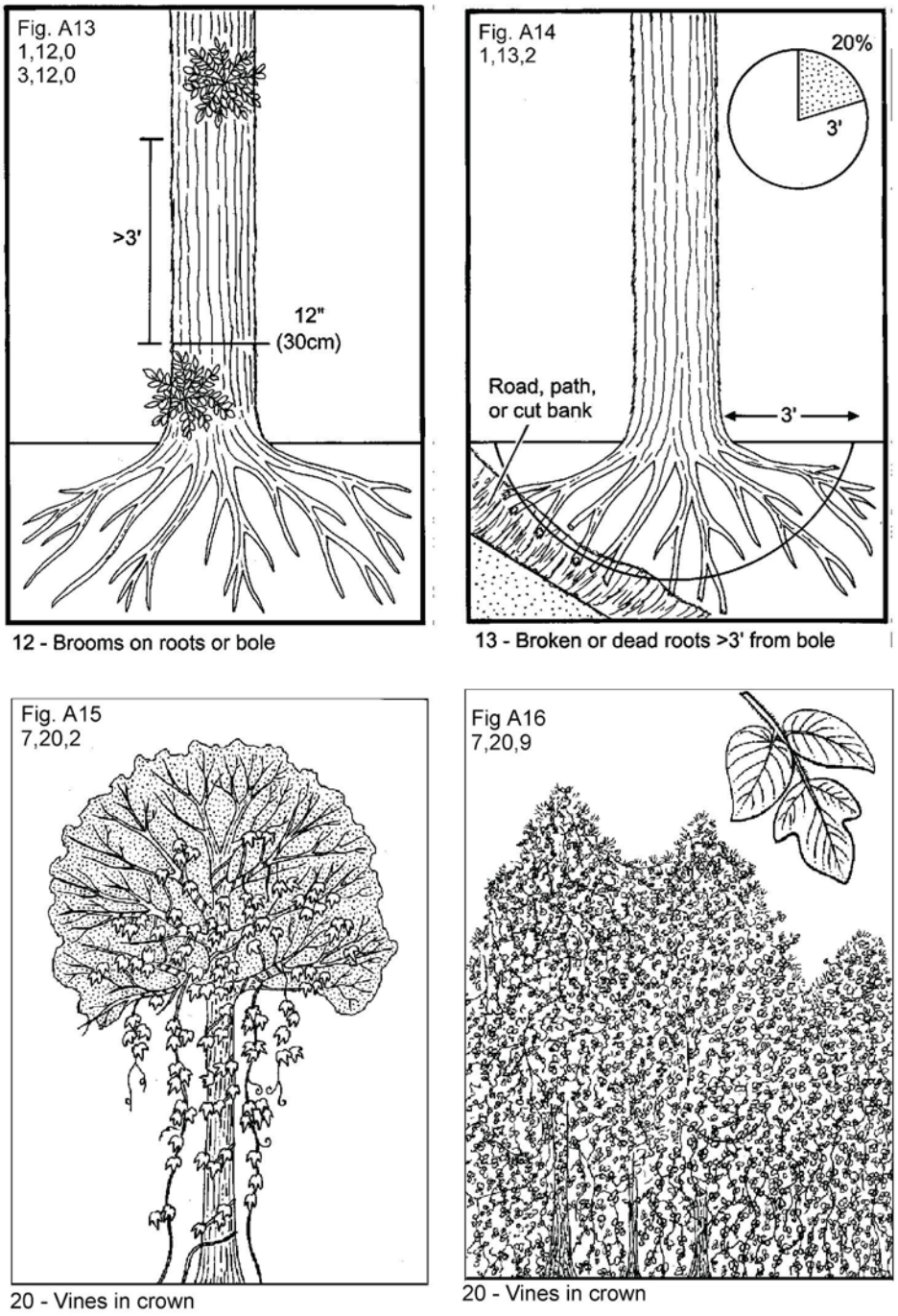
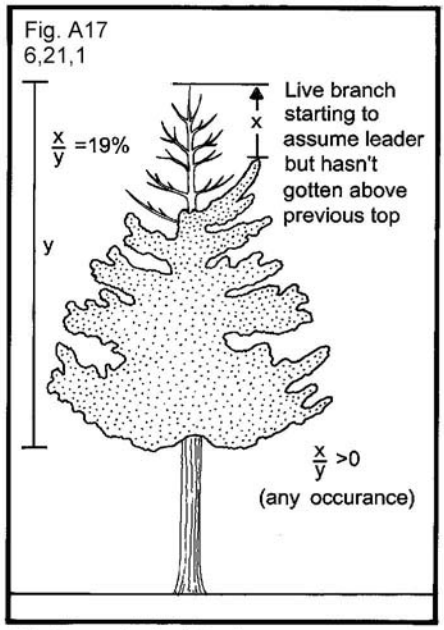
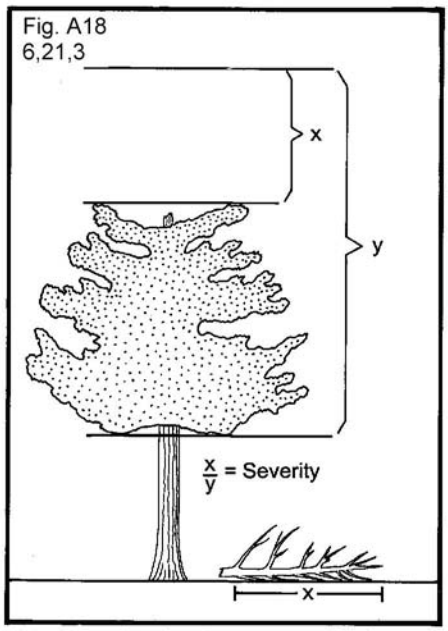


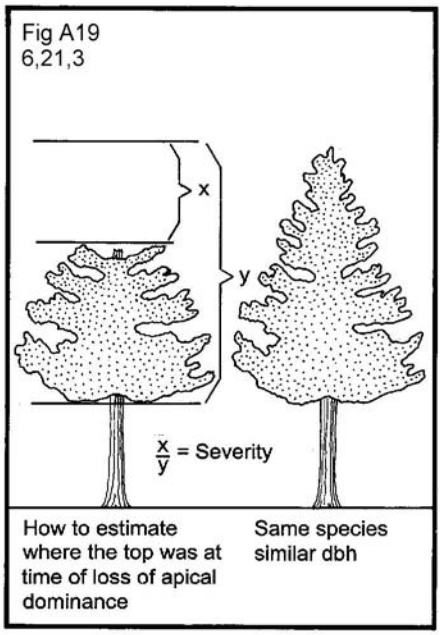
Figure 36. Examples of damage coding.



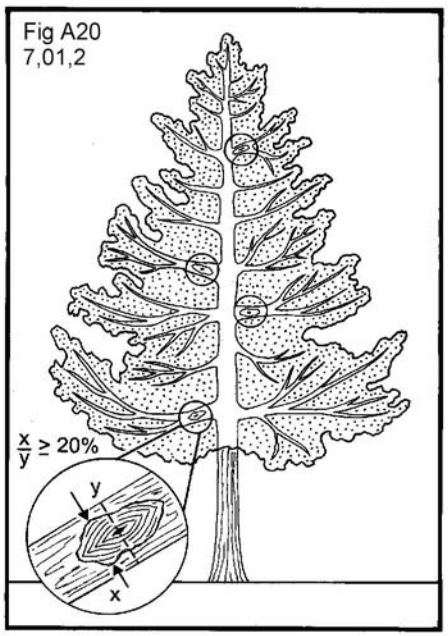
21 - Loss of apical dominance



21 - Loss of apical dominance, look for old top to estimate the top of x and y

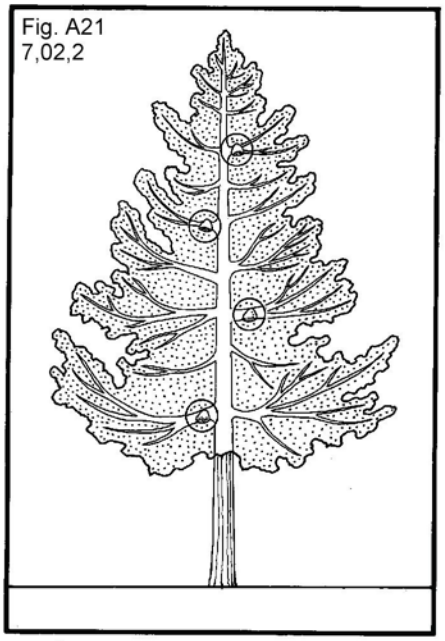


21 - Loss of apical dominance, look for same species of similar dbh

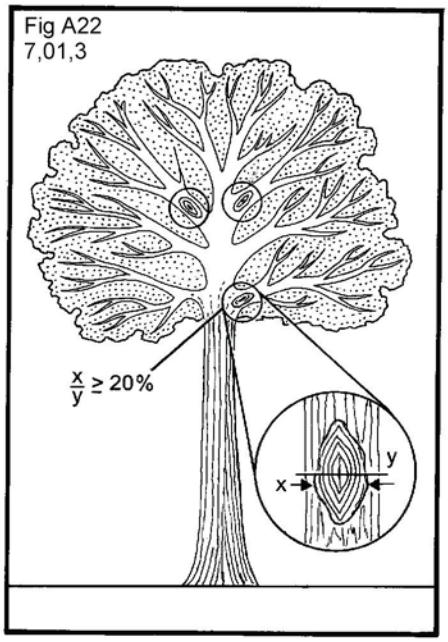


01 - Cankers above the threshold on ≥ 20% of branches

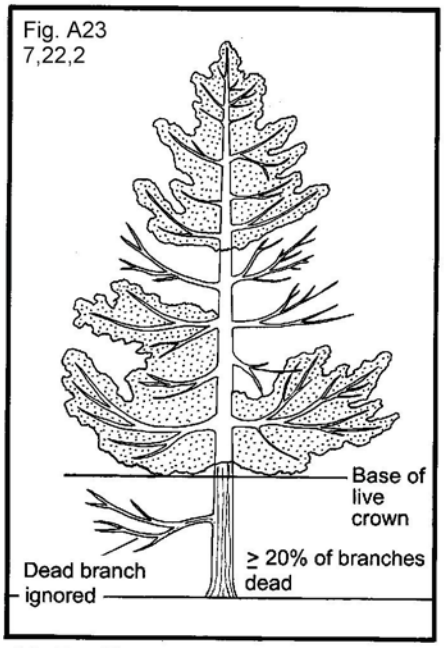
Figure 37. Examples of damage coding.



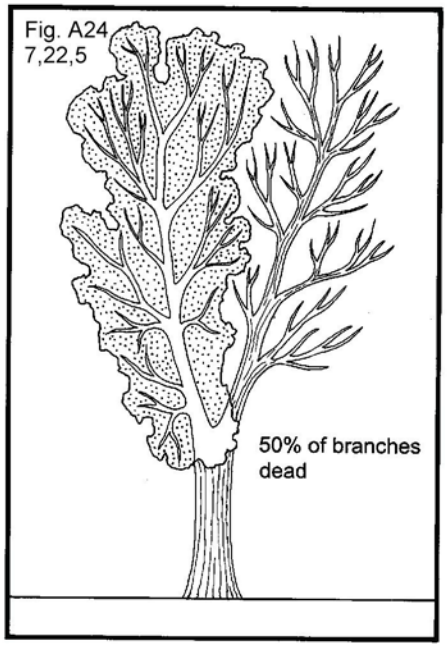
02 - Conks on ≥ 20% of branches



01 - Cankers above threshold on ≥ 20% of branches

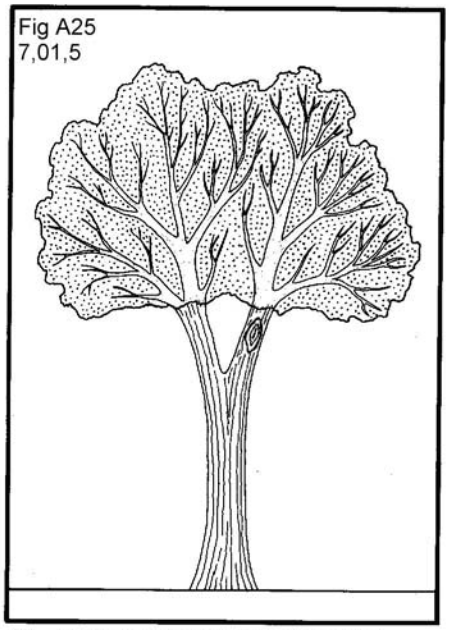


22 - Dead branches within the live crown area. If branches cannot easily be counted, estimate % area of live crown affected

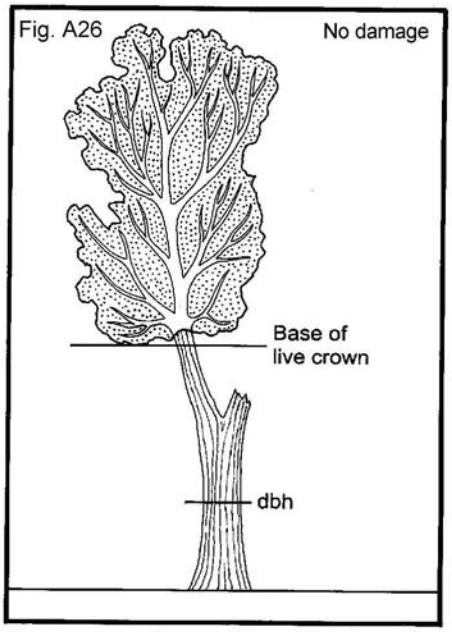


22 - Dead branches; only 2 branches present within live crown area, fines present and ≥20% of branch dead

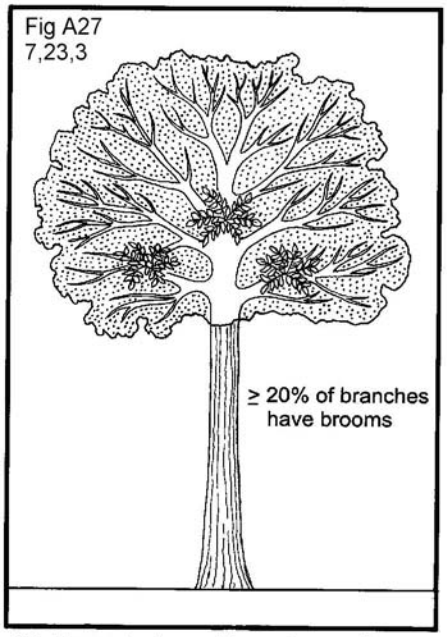
Figure 38. Examples of damage coding.



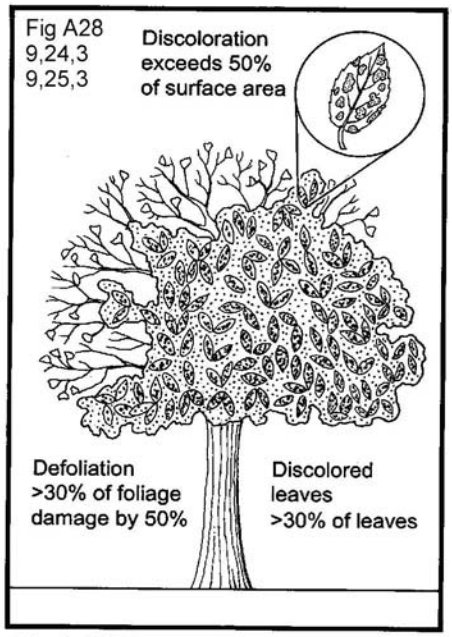
01 - Canker; no crown stem and only 2 branches present



No damage - base of live crown is above old fork, stub is a snag branch



23 - Excessive branching or brooms in crown



24 - Defoliation, 25 - Discoloration

Figure 39. Examples of damage coding.

Procedures to Record Multiple Occurrences of the Same Damage

Damage codes 01 (canker), 03 (open wounds), and 04 (resinosis/gummosis) must meet a threshold of 20 percent of the circumference at the point of occurrence, within any 3-ft section. Multiple cankers or open wounds which are directly above one another pose no more threat to long term tree survival than would a single damage incidence of the same width. However, should multiple damages be located horizontally within any 3-ft section, the translocation of water and nutrients would be significantly affected. The widths of each individual damage are added and compared as a percent, to the total circumference at the midpoint of the 3-ft section (Figure 32).

Procedures to Measure Circumference Affected

A practical approach is to observe every face of the "stump", bole, or crownstem. About 40% of the circumference of a face can be observed at any one time. The damage is measured horizontally between the margins. If the cumulative area affected within a 3-ft section exceeds 1/2 of any face, then the 20% minimum threshold has been met. The percent of the circumference affected by damage is then estimated in 10% classes. If in doubt, measure the damage and circumference at the widest point of occurrence on the bole with a linear tape, and determine the percent affected.

5.18.4 DAMAGE LOCATION 2 (LOC2)
Record the location on the tree where TREE DAMAGE 2 is found. Follow the same procedures as for DAMAGE LOCATION 1.

5.18.5 DAMAGE TYPE 2 (DAM2)
RECORD the second damage type observed that meets the damage threshold definition in the lowest location. Follow the same procedures as for DAMAGE TYPE 1.

5.18.6 DAMAGE SEVERITY 2 (SEV2)
Record the amount of affected area (above threshold) in DAMAGE LOCATION 2 recorded for DAMAGE TYPE 2. Follow the same procedures as for DAMAGE SEVERITY 1.

5.18NC NC DAMAGE AGENTS

5.18.1NC NC DAMAGE AGENTS STANDARD (NCD1,NCD2)

For each DAMAGE TYPE(DAM1,2) recorded, identify <u>if available</u> a causal agent from the Standard NC Damage Agent list. **Minnesota crews see codes under item number 5.18.2NC**.

When Collected: All live trees for each DAMAGE TYPE (DAM1, 2) recorded
Field width: 3 digit
MQO: None
Values: 000-909

Standard NC Damage Agent codes (all states except Minnesota)

CODE	DAMAGE OR DEATH	HOSTS
000	**Healthy**	**All species**
100	**Insect defoliators**	**All species**
113	Gypsy Moth	Hardwoods
130	**Shoot and Branch Insects**	**All species**
140	**Branch Gall Insects**	**All species**
150	**Bole Borers**	**All species**
170	**Bark Beetles**	**Conifers**
190	**Root/Root Collar Insects**	**Conifers**
200	**Foliage Diseases**	**All species**
210	**Shoot Blights**	**All Species**
220	**Mistletoe**	**Black spruce, White spruce, Tamarack, Jack pine**
240	**Bole Rusts**	**Pines**
250	**Bole Cankers**	**Hardwoods**
251	*Eutypella* Canker	Maple
252	*Hypoxylon* Canker	Aspens
254	*Nectria* Canker	Hardwoods
257	Butternut Canker	Butternut
260	**Stem Decay (heartrot)**	**All species**
271	Ash Yellows	Ashes
281	Dutch Elm Disease	Elms
282	Oak Wilt	Oaks
290	**Root/Butt Rot**	**All species**
291	*Annosus* Root Rot	Conifers
292	*Armillaria* Root Rot	All species
300	**Weather**	**All species**
400	**Animal Damage**	**All species**
500	**Fire**	**All species**
800	**Logging/TSI/Other human**	**All species**
860	**Chemical**	**All species**

5.18.2NC NC DAMAGE AGENTS MINNESOTA(NCD1,NCD2)

When collecting data in Minnesota use the list below for NCD1 and NCD2.

Minnesota Damage Agent List

NC Damage agent codes for Minnesota only		
CODE	DAMAGE OR DEATH	HOSTS
000	**Healthy**	**All species**
100	**Insect defoliators**	**All species**
101	Budworms	Balsam fir, White spruce, Black spruce, Jack pine
110	**Forest Tent Caterpillar**	**Hardwoods**
113	Gypsy Moth	Hardwoods
130	**Shoot and Branch Insects**	**All species**
131	White Pine Weevil	White pine, Jack pine, all spruces
140	**Branch Gall Insects**	**All species**
150	**Bole Borers**	**All species**
170	**Bark Beetles**	**Conifers**
190	**Root/Root Collar Insects**	**Conifers**

Minnesota damage agent list continued		
CODE	DAMAGE OR DEATH	HOSTS
200	**Foliage Diseases**	**All species**
210	**Shoot Blights**	**All Species**
212	*Scleroderris*	Pines
220	**Mistletoe**	**Black spruce, White spruce, Tamarack, Jack pine**
240	**Bole Rusts**	**Pines**
241	White Pine Blister Rust	White Pine
250	**Bole Cankers**	**Hardwoods**
251	*Eutypella* Canker	Maple
252	*Hypoxylon* Canker	Aspens
254	*Nectria* Canker	Hardwoods
257	Butternut Canker	Butternut
260	**Stem Decay (heartrot)**	**All species**
261	*Phellinus pini*	Conifers
262	*Phellinus tremulae*	Aspens
263	*Inonotus obliquus*	Birches
271	Ash Yellows	Ashes
281	Dutch Elm Disease	Elms
282	Oak Wilt	Oaks
290	**Root/Butt Rot**	**All species**
291	*Annosus* Root Rot	Conifers
292	*Armillaria* Root Rot	All species
300	**Weather**	**All species**
302	Wind	All species
307	Flooding	All species
309	Ice/Snow	All species
400	**Animal Damage**	All species
402	Moose/Elk/Deer	All species
404	Beaver	All species
409	Cattle/Domestic Livestock	All species
500	**Fire**	**All species**
800	**Logging/TSI/Other human**	**All species**
811	Imbedded objects - wire, nails	All species
850	**Land Use Conversion**	**All species**
860	**Chemical**	**All species**
900	**Unknown/uncoded Dead**	**All species**
901	Unknown/uncoded Defoliation	All species
902	Unknown/uncoded Discoloration	All species
903	Unknown/uncoded Decline/Dieback	All species
904	Unknown/uncoded Breakage	All species
905	Unknown/uncoded Abnormal Growth or Form in Crown	All species
906	Unknown/uncoded Canker	All species
907	Unknown/uncoded Crack	All species
908	Unknown/uncoded Abnormal Growth or Form on the Bole	All species

5.19 CAUSE OF DEATH

Record a cause of death for all trees that have died or been cut since the previous survey. If cause of death cannot be reliably estimated, record unknown/not sure.

When Collected: All TREE STATUS = 1 at time 1 and TREE STATUS = 2 or 3 at time 2

NC Note: All trees with Tree Status=2 on subplots 101 and higher. In Indiana and Illinois all trees on subplots 1-4 with a downloaded tree status of 1 and a current tree status equal to 2.

Field width: 2 digits
Tolerance: No errors
MQO: At least 80% of the time
Values:

10	Insect
20	Disease
30	Fire
40	Animal
50	Weather
60	Vegetation (suppression, competition, vines/kudzu)
70	Unknown/not sure/other (include notes)
80	Human-caused (cultural, logging, accidental, etc.)
90	Physical (hit by falling tree)

5.20 MORTALITY YEAR

Record the estimated year that remeasured trees died or were cut. For each remeasured tree that has died or been cut since the previous inventory, record the 4-digit year in which the tree died. Mortality year is also recorded for trees on land that has been converted to a nonforest land use, if it can be determined that a tree died before the land was converted.

When Collected: All TREE STATUS = 1 at time 1 and TREE STATUS = 2 or 3 at time 2
Field width: 4 digits
Tolerance: +/- 1 year for remeasurement cycles of 5 years
+/- 2 years for remeasurement cycles of > 5 years
MQO: At least 70% of the time
Values: 1995 or higher

NC Note: Not recorded in NC until re-measurement of a National Core manual is being done.

5.21 DECAY CLASS (DECA)

Record for each standing dead tally tree, 5.0 inches in diameter and larger, the code indicating the trees stage of decay.

When Collected: All standing dead tally trees $\geq$ 5.0 in DBH/DRC

NC Note: Not collected on subplots 101 and higher.

Field width: 1 digit
Tolerance: +/- 1 class
MQO: At least 90% of the time
Values: Use the following table for guidelines:

Decay class stage (code)	Limbs and branches	Top	% Bark Remaining	Sapwood presence and condition*	Heartwood condition*
1	All present	Pointed	100	Intact; sound, incipient decay, hard, original color	Sound, hard, original color
2	Few limbs, no fine branches	May be broken	Variable	Sloughing; advanced decay, fibrous, firm to soft, light brown	Sound at base, incipient decay in outer edge of upper bole, hard, light to reddish brown
3	Limb stubs only	Broken	Variable	Sloughing; fibrous, soft, light to reddish brown	Incipient decay at base, advanced decay throughout upper bole, fibrous, hard to firm, reddish brown
4	Few or no stubs	Broken	Variable	Sloughing; cubical, soft, reddish to dark brown	Advanced decay at base, sloughing from upper bole, fibrous to cubical, soft, dark reddish brown
5	None	Broken	Less than 20	Gone	Sloughing, cubical, soft, dark brown, OR fibrous, very soft, dark reddish brown, encased in hardened shell

* Characteristics are for Douglas-fir. Dead trees of other species may vary somewhat. Use this only as a guide.

5.22 UTILIZATION CLASS (UTIL)

Record the code to identify cut trees that have been removed from the site.

When Collected: All TREE STATUS = 3
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0 Not utilized - can still be found on the site
1 Utilized – some portion of the tree cannot be found on site, assumed to have been removed

5.23 LENGTH TO DIAMETER MEASUREMENT POINT(CORE OPTIONAL) (DIAH)

Record this item when tree diameter measurement locations are not monumented. For those trees measured directly at 4.5 ft above the ground, leave this item blank. If the diameter is not measured at 4.5 ft, record the actual length from the ground, to the nearest 0.1 in, at which the diameter was measured for each tally tree, 1.0 in DBH and larger. Leave this item blank for western woodland species measured for diameter at root collar.

When Collected: **NC Note:** All live and dead tally trees (when not at 4.5 ft) $\geq$ 1.0 in DBH
CORE OPTIONAL: All live and dead tally trees (except western woodland species) $\geq$ 1.0 in DBH

Field width: 3 digits
Tolerance: +/- 0.2 ft
MQO: At least 90% of the time
Values: 0.1 – 15.0

5.24 ROUGH CULL (CORE OPTIONAL)

For each live tally tree 5.0-in DBH/DRC and larger, record the percentage of sound, dead cubic-foot volume to the nearest 1 percent. When estimating volume loss (tree cull), only consider the cull on the merchantable bole/portion of the tree, from a 1-ft stump to a 4-inch top. For western woodland species, the merchantable portion is between the point of DRC measurement to a 1-inch DOB top. Refer to local defect guidelines as an aid in determining cull volume for various damages such as fire, frost crack, etc.

When Collected: CORE OPTIONAL: All live tally trees ≥ 5.0 in DBH/DRC

5.25 MISTLETOE CLASS (CORE OPTIONAL)

When Collected: CORE OPTIONAL: All live conifer (except juniper) tally trees ≥ 1.0 in DBH/DRC
Field width: 1 digit
Tolerance: +/- 1 class
MQO: At least 90% of the time
Values: 0 to 6

5.27NC NC SPECIAL DAMAGE CODING FOR MISSOURI (MOAG)

In Missouri because we have not completed an inventory using the old North Central method of damage coding, we will use the old method until all plots in this cycle are done. Only one of these will be recorded per tree.

When Collected: All live trees on subplots 1-4
Field width: 3 digit
MQO: None
Values: 000-909

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/Loopers	Hardwoods	>20% foliage affected
103	Leaf Miners & Skeletonizers	Hardwoods	>20% foliage affected
104	Sawflies	Pines	>20% foliage affected
113	Gypsy Moth	Hardwoods	Any occurrence on foliage
114	Fall Webworm	Hardwoods	>20% foliage affected
115	Datana (Walnut) Caterpillar	Hardwoods	>20% foliage affected
120	Variable Oakleaf Caterpillar	Hardwoods	>20% foliage affected
121	Eastern Tent caterpillar	Hardwoods	>20% foliage affected
122	Walking Stick	Hardwoods	>20% foliage affected
123	Bagworm	Conifers	>20% foliage affected
130	Shoot and Branch Insects	All species	Any occurrence on leader , >20% shoots/branches affected
132	Tip Moths	Pines	>20% branches affected
135	Pine Needle Scale	Pines	>20% branches affected
136	Oyster Shell Scale	Hardwoods	>20% branches affected
138	Pine Shoot Beetle	Pines	Any occurrence on shoots/branches

CODE	DAMAGE OR DEATH	HOSTS	SEVERITY
140	Branch Gall Insects	All species	>20% branches affected
141	Ash Flower Gall Mite	Fraxinus	>20% branches affected
142	Gouty/Horned Oak Gall	Quercus	>20% branches affected
150	Bole Borers	All species	Any occurrence on bole
151	Two Lined Chestnut Bore	Quercus	>20% of crown dead/dying (flagging)
157	Ash Borer	Fraxinus	Any occurrence
158	Asian Long-horned Beetle	Hardwoods	Any occurrence
170	Bark Beetles	Conifers	>20% crown dead/dying
171	Ips spp.	Conifers	>20% crown dead/dying
173	Black Turpentine Beetle	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	Needlecasts	Conifers	>20% foliage affected
202	Anthracnose	Hardwoods	>20% foliage affected
205	Dogwood Anthracnose	Dogwood	Any occurrence
206	Powdery Mildew	Dogwood	>20% foliage affected
208	Scirrhia Needlecasts	Pines	>20% foliage affected
209	Apple Scab	Rosaceae	>20% foliage affected
210	Shoot Blights	All Species	Any occurrence on leader, >20% shoots affected
213	Fire Blight	Rosaceae	Any occurrence on leader, >20% shoots affected
214	Diplodia Tip Blight	Pines	Any occurrence on leader, >20% shoots affected
215	Juniper Blights	Junipers	Any occurrence on leader, >20% shoots affected
220	Mistletoe	All Species	Any occurrence
230	Foliar Rusts	All Species	>20% foliage affected
233	Gall Rusts	All Species	>20% branches affected
235	Cedar/Apple Rust	Eastern Red Cedar	>20% foliage affected
236	Cedar/Quince Rust	Rosaceae	>20% branches affected
240	**Bole Rust**	**Pines**	**Any occurrence on bole**
250	**Bole Cankers**	**Hardwoods**	**Any occurrence on bole**
251	*Eutypella* Canker	Maple	Any occurrence on bole
252	*Hypoxylon* Canker	Oaks	20% circumference affected
254	*Nectria* Canker	Hardwoods	Any occurrence on bole
256	Strumella Canker	Oaks	Any occurrence on bole
257	Butternut Canker	Butternut	Any occurrence on tree
260	Stem Decay (heartrot)	All species	Any occurrence on bole
264	Pereniporia Fraxinophilia	Ashes	Any occurrence on bole
271	Ash Yellows	Ashes	Any occurrence
273	Beech Bark disease	Beech	Any occurrence
274	Oak decline	Oaks	>20% crown affected
276	Hickory decline	Hickories	>20% crown affected
277	White pine root decline	White Pine	Any occurrence
278	Ash decline	Ashes	>20% crown affected
281	Dutch Elm Disease	Elms	Any occurrence
282	Oak Wilt	Oaks	Any occurrence

CODE	DAMAGE OR DEATH	HOSTS	SEVERITY
283	Pine Wilt Nematode	Pines	Any occurrence
285	Verticillium Wilt	Hardwoods	Any occurrence
291	*Annosus* Root Rot	Conifers	Any occurrence
292	*Armillaria* Root Rot	All species	>20% crown dieback, *rhizomorphs/fan in root collar*
300	**Weather**	**All species**	**>20% crown affected; Any damage to leader; Any damage to bole cambium**
301	Hail	All species	>20% crown affected
302	Wind	All species	>20% crown affected; Any damage to bole cambium or leader
303	Lightning	All species	20% crown affected; Any damage to bole cambium or leader
304	Frost Cracks	All species	Any damage to bole cambium or leader
305	Frost Kill (foliage and shoots)	All species	>20% crown affected
306	Winter drying	conifers	20% crown affected
307	Flooding	All species	20% crown affected; Any damage to bole cambium or leader
308	Drought	All species	>20% crown affected
309	Ice/Snow	All species	>20% crown damage; Any damage to bole cambium or leader
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
405	Squirrel	All species	>20% circumference of bole affected
408	Sapsucker	All species	>20% circumference of bole affected
409	Cattle/Domestic Livestock	All species	>20% circumference of bole affected
500	**Fire**	**All species**	**>20% crown affected; Any damage to leader; Any damage to bole cambium**
760	Vine damage	All species	>20% of crown covered
800	**Logging/TSI/Other human**	**All species**	**>20% crown affected; Any damage to leader; Any damage to bole cambium**
810	Mechanical Damage	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
811	Imbedded objects-wire, nails	All species	Any occurrence
830	Vehicle damage	All species	>20% crown affected
860	Chemical	All species	>20% crown affected
862	Air pollution	All species	>20% foliage affected

CODE	DAMAGE OR DEATH	HOSTS	SEVERITY
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 Crown	All species	>20% crown affected
906	Unknown/uncoded Canker	All species	Any occurrence on bole
907	Unknown/uncoded Crack	All species	Any open crack on bole
908	Unknown/uncoded Abnormal Growth or Form on the Bole	All species	Any occurrence on the butt log or any abnormal growth for that species causing a volume loss
909	Unknown/uncoded flagging/shoot damage	All species	>20% crown affected. Any occurrence on bole

5.26 TREE NOTES

Record notes pertaining to an individual tree as called for to explain or describe another variable.

When collected: All live and dead tally trees $\geq$ 1.0 in DBH/DRC
Field width: Alphanumeric character field **NC Note:** Limited to one line between quotes.
Tolerance: N/A
MQO: N/A
Values: English language words, phrases and numbers

6.0 SEEDLING DATA

Stocking and regeneration information are obtained by counting seedlings within the 6.8 ft radius microplot located 90 degrees and 12.0 ft from each subplot center within each of the four subplots. Conifer seedlings must be at least 6.0 inches in length and less than 1.0 in at DBH/DRC in order to qualify for tallying. Hardwood seedlings must be at least 12.0 inches in length and less than 1.0 in at DBH/DRC in order to qualify for tallying. For western woodland species, each stem on a single tree must be less than 1.0 inch in DRC. Seedlings are counted in groups by species and condition class, up to 5 individuals per species. Counts beyond 5 are coded as 6. Species are coded in order from most abundant to least abundant when SEEDLING COUNT is coded as 6. Only count seedlings occurring in accessible forest land condition classes.

6.1 SUBPLOT NUMBER
Use the procedures outlined in Section 4.1.

When Collected: All counts of seedlings

6.2 SPECIES (SPP)
Use the procedures outlined in Section 5.8.

When Collected: All counts of seedlings
Field width: 3 digits
Tolerance: No errors for genus, no errors for species
MQO: At least 90% of the time for genus, At least 85% of the time for species
Values: See Appendix 4

6.3 CONDITION CLASS (CON#)
Use the procedures outlined in Section 2.0.

When Collected: All counts of seedlings

6.4 SEEDLING COUNT
NC Note: Replaced with NC seedling count in the North Central FIA region.

6.5NC NCSEEDLING COUNT (SED#)

Record the number of seedlings of each species, by condition class. Count up to 99 individuals by species; code 99 if there are more than 99 individuals of any given species in any given condition class. Code species in order from most abundant to least abundant.

When Collected: Each accessible forest land condition class on each microplot
Field width: 2 digits
Tolerance: No errors up to count of 5, + or – 20% after count of 5.
MQO: At least 95% of the time
Values:

1 to 98	Exact count
99	More than 99 individuals.

7.0 SITE TREE INFORMATION

Site trees are a measure of site productivity expressed by the height to age relationship of dominant and co-dominant trees. If suitable site trees are available, site tree data are required for every accessible forest land condition class defined on a plot. An individual site tree may be used for more than one condition class where differences in condition classes are not the result of differences in site productivity. For example, when different condition classes are caused solely due to differences in reserved status, owner class, and/or disturbance-related differences in density (e.g., heavily thinned vs. unthinned), a site tree may be used for more than one condition class. When in doubt, do not use a site tree for more than one condition class.

7.1 SITE TREE SELECTION

Select at least 1 site tree for each accessible forest land condition class; select tree from a species common to the condition class being sampled, based on regional or local tree species selection criteria (Appendix 5 lists preferred site tree species by region). Select trees off the subplot where possible. Use only trees that have remained in a dominant or co-dominant crown position throughout their entire life span. If possible, trees should be 5.0 inches in diameter, or larger, and at least 20 years old. Trees that are visibly damaged, trees with ring patterns that exhibit signs of suppression, and trees with rotten cores should be rejected. If there are no acceptable site trees, record that in the plot notes and leave this section blank.

NC Note: In the North Central FIA region 2 site trees will be collected for each accessible forest land condition. The same trees may be used for more than one condition, when appropriate.

7.2 SITE TREE DATA VARIABLES

7.2.10NC NC SITE INDEX METHOD (NCSI)

Suitable site trees may not be available. When this occurs there is a still need to know something about the site. If suitable site trees are not available but a young or very old tree is available you should record them. If no tree is available you must make an estimate of site index for the site based on your best knowledge.

When code 2 or 3 is used the only data needed on the site record are NC site index method(NCSI), NC field site index (SITR), Condition Class List (CONL), species (SPP).

When Collected: All plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 Site tree collected
2 Intercept method
3 Estimated site index

GROWTH INTERCEPT METHOD In the event suitable trees are not available for use with site index curves the growth intercept method of measuring site index may be an alternative. This method has been proposed and tables developed for some tree species that have limbs showing distinct annual whorls (ex. Red pine and southern pines). This method is applied in situations where only young trees (less than 25 year old) of these species are available for site index indicators.

Growth Intercept
For red Pine:

Height growth during Last 5 years	Site Index (estimated)
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

7.2.11NC NC FIELD SITE INDEX (SITR)
Record the site index for a selected tree species. Using provided site index curves.

When Collected: Only when NC Site Index Method is 2 or 3.
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 000 to 999

7.2.1 CONDITION CLASS LIST (CONL)
List all CONDITION CLASSES that the site index data from this tree represent.

When Collected: All site trees
Field width: 5 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 to 9 or 10000 to 98765

7.2.2 SPECIES (SPP)
Use the same procedures described in Section 5.8 (Appendix 5 lists preferred site tree species by region).

When Collected: All site trees

7.2.3 DIAMETER (DBH)
Use the same procedures described in Section 5.9.
When Collected: All site trees

7.2.4 SITE TREE LENGTH (HGHT)
With a clinometer or other approved instrument, measure the total length of the site tree from the ground to the top of the tree. Record to the nearest 1.0 ft. SITE TREE LENGTH must be measured; no estimates are permitted on site trees.

When Collected: All site trees
Field width: 3 digits
Tolerance: +/- 10% of true length
MQO: At least 90% of the time
Values: 001 to 999

7.2.5 TREE AGE AT DIAMETER (AGE)

Record the tree age as determined by an increment sample. Bore the tree at the point of diameter measurement (DBH/DRC) with an increment borer. Count the rings between the outside edge of the core and the pith. Do not add years to get total age.

When Collected: All site trees
Field width: 3 digits
Tolerance: +/- 5 years
MQO: At least 95% of the time
Values: 001 to 999

7.2.6 SITE TREE NOTES

Record notes pertaining to an individual site tree.

When collected: All site trees as necessary
Field width: alphanumeric character field **NC Note:** Limited to one line between quotes.
MQO: N/A
Values: English language words, phrases and numbers

7.2.7 SUBPLOT NUMBER (CORE OPTIONAL) (SUB#)

Record the subplot number to which the site tree is referenced.

When Collected: All site trees **NC Note:** All site trees
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1	Center subplot
2	North subplot
3	Southeast subplot
4	Southwest subplot

7.2.8 AZIMUTH (CORE OPTIONAL) (AZM)

Record the AZIMUTH from the subplot center; sight the center of the base of each tree with a compass. Record AZIMUTH to the nearest degree. Use 360 for north.

When Collected: All site trees **NC Note:** All site trees
Field width: 3 digits
Tolerance: +/- 10 degrees
MQO: At least 90% of the time
Values: 001 to 360

7.2.9 HORIZONTAL DISTANCE (CORE OPTIONAL) (DIST)

Record the measured HORIZONTAL DISTANCE, to the nearest 0.1 ft, from the subplot center to the pith of the tree at the base.

When Collected: All site trees **NC Note:** All site trees
Field width: 4 digits (xxx.y)
Tolerance: +/- 5 ft
MQO: At least 90% of the time
Values: 000.1 to 200.0

8.0 NONFOREST/DENIED ACCESS/HAZARDOUS PLOTS

8.1 OVERVIEW

This section describes field procedures for attempted, field-visited nonforest, denied access, and hazardous plots. These plots are of interest from the standpoint that they may once have been forest, or that they may revert to forest or become accessible in the future. Thus, they are monitored to account for lands that move into and out of the forest land base. Only basic plot identification data are recorded on these plots.

A plot is considered nonforest if no part of it is currently located in forest land (CONDITION CLASS STATUS = 1). A plot is inaccessible if access is prevented to the entire plot by the land owner or because of some hazardous situation.

No ground plots are monumented at nonforest or inaccessible sample locations. If a forest plot has been converted to nonforest or becomes inaccessible, the previous data are reconciled and an attempt is made to visit the plot during the next inventory. If a nonforest plot becomes forest or access is gained to a previously inaccessible plot, a new forest ground plot is installed. All nonforest and inaccessible plots are visited if there is any reasonable chance that they might include some forest land condition class.

8.2 PROCEDURE

Trees on previously forest land plots will be reconciled at data processing. There is a distinction between plots that have been clearcut, and plots that have been converted to another land use. A clearcut plot is considered to be forest land until it is actively converted to another land use. The procedures in this section do not apply to clearcuts unless and until the land is converted to a nonforest use. Additional information concerning land use classifications is contained in Section 2.3.

In cases where a plot is inaccessible, but obviously contains no forest land, assign the plot to the appropriate nonforest land use. Access-denied and hazardous land uses are utilized only if there is a possibility the plot contains forest.

It is not necessary to establish or maintain any starting points, witness trees, boundaries, etc., on nonforest or inaccessible plots.

8.3 DATA RECORDED

8.3.1 STATE (ST)

Record the unique FIPS (Federal Information Processing Standard) code identifying the State where the plot center is located.

When Collected: All Nonforest/Denied Access/Hazardous plots.
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: See Appendix 1

8.3.19NC NC UNIT (UNIT)

Record the unique one digit North Central code identifying the unit where the plot center is located.

When collected: All plots
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: See Appendix 1

8.3.2 COUNTY (CNTY)

Record the unique FIPS (Federal Information Processing Standard) code identifying the county (or unit in AK) where the plot center is located.

When Collected: All Nonforest/Denied Access/Hazardous plots
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: See Appendix 1

8.3.3 PLOT NUMBER (PLT#)

Record the identification number for each plot, unique within a county (survey unit in AK).

When Collected: All Nonforest/Denied Access/Hazardous plots
Field width: 4 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 0001 to 9999

8.3.20NC NC CYCLE (CYCL)

This is the number assigned by state for each group of 5 panels which will complete one full state inventory. This number is in all downloaded plot files and on all plotsheets and should never be changed in the field.

When collected: All plots (assigned and set with download data)
Field width: 2 digits
Tolerance: No Errors
MQO: None
Values:

State	Cycle	State	Cycle	State	Cycle
Illinois	5	Michigan	6	North Dakota	4
Indiana	5	Minnesota	12	South Dakota	5
Iowa	4	Missouri	5	Wisconsin	6
Kansas	5	Nebraska	4		

8.3.21NC NC SUBCYCLE (SUBC)

Each cycle is broken down to 5 sub-cycles and these are the sub-cycles assigned to each state for this year of data collection. . This number is in all downloaded plot files and on all plotsheets and should never be changed in the field.

When collected: All plots (assigned and set with download data)
Field width: 2 digits
Tolerance: No Errors
MQO: None
Values:

State	SubCycle	State	SubCycle	State	SubCycle
Illinois	2	Michigan	2	North Dakota	2
Indiana	4	Minnesota	4	South Dakota	2
Iowa	4	Missouri	4	Wisconsin	3
Kansas	2	Nebraska	2		

8.3.4 SAMPLE KIND (SK)
Record the code that describes the kind of plot being installed.

When collected: All Nonforest/Denied Access/Hazardous plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 **Initial plot establishment** - field-visited or remotely classified.

2 **Remeasurement** of a previously established National design plot - field visited or remotely classified.

3 **Replacement plot** - a previously established National design plot that was replaced with a new plot because the original plot could not be relocated or because plot data were lost.

8.3.22NC NC SAMPLE KIND (NCSK)
The NC sample kind indicates the information to be collected on plot types that are unique to North Central Research Station FIA.

When collected: All plots
Field width: 1 digit
MQO: No errors, 100% of the time
Values:

0 **New plot/Lost plot** – This is a first time visit to the location to install a plot. If ground evidence of an old plot could not be found and there has been no major disturbance to the area, change the NCSK on the plot to zero.

6 **Partial Re-measurement Relocate**. Measure all old trees on subplots 101-105.

8 **No Re-measurement Relocate**. Do not measure old plot just use old plot information to locate subplot center to begin installation of new plot design.

33 **Replacement plot**. No old subplots are measured here.

8.3.5 MANUAL VERSION
Record the version number of the National Core Field Guide that was used to collect the data on this plot. This will be used to match collected data to the proper version of the field manual.

When collected: All plots **NC Note:** The manual version will be applied by St. Paul after the field data is returned.
Field width: 2 digits (x.y)
Tolerance: No errors
MQO: At least 99% of the time
Values: 1.1 (Maine 1999) and higher

8.3.6 CURRENT DATE
Record the year, month, and day that the current plot visit was completed as follows:

8.3.6.1 YEAR (YEAR)
Record the year that the plot was completed.

When collected: All Nonforest/Denied Access/Hazardous plots
Field width: 4 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: Beginning with 1998, constant for a given year

8.3.6.2 MONTH (MONT)
Record the month that the plot was completed.

When collected: All Nonforest/Denied Access/Hazardous plots
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

January	01	May	05	September	09
February	02	June	06	October	10
March	03	July	07	November	11
April	04	August	08	December	12

8.3.6.3 DAY (DAY)
Record the day of the month that the plot was completed.

When collected: All Nonforest/Denied Access/Hazardous plots
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 01 to 31

8.3.7 DECLINATION (CORE OPTIONAL)

8.3.8 QA STATUS (CORE OPTIONAL) (QAST)
Record the code to indicate the type of plot data collected, using the following codes:

NC NOTE: Collected in North Central FIA region.

When collected: All Nonforest/Denied Access/Hazardous plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Standard production plot
2 Cold check
3 Reference plot (off grid)
4 Training/practice plot (off grid)
5 Botched plot file (disregard during data processing)
6 Blind check
7 Production plot (hot check)

8.3.9 CREW TYPE (CORE OPTIONAL) (CRTY)

Record the code to specify what type of crew is measuring the plot.

NC NOTE: Collected in North Central FIA region.

When collected: All Nonforest/Denied Access/Hazardous plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Standard field crew
2 QA crew (any QA crew member present collecting data)

8.3.10 GPS COORDINATES

Use a global positioning system (GPS) unit to determine the plot coordinates and elevation of all field visited plot locations.

8.3.10.1 GPS UNIT SETTINGS, DATUM, and COORDINATE SYSTEM

Consult the GPS unit operating manual or other regional instructions to ensure that the GPS unit internal settings, including Datum and Coordinate system, are correctly configured.

Each FIA unit will determine the Datum to be used in that region. Most will use the NAD 27 Datum (also known as NAS-C or NA 27 CONUS/CLK66), but coordinates collected using any appropriate datum can be converted back to a national standard for reporting purposes.

Each FIA unit will also determine which coordinate system to use. Regions using a Geographic system will collect coordinates in Degrees, Minutes, and Seconds of Latitude and Longitude; those using the UTM coordinate system will collect UTM Easting, Northing, and Zone.

NC Note: North Central FIA collects all GPS coordinates in the field using NAD 83.

8.3.10.2 COLLECTING READINGS

Collect at least 180 GPS readings at the plot center. These may be collected in a file for post processing or may be averaged by the unit. Each individual position should have an error of less than 70 ft if possible (the error of all the averaged readings is far less).

Soon after arriving at plot center, use the GPS unit to attempt to collect coordinates. If suitable positions (180 readings at error $\leq$ 70 ft) cannot be obtained, try again before leaving the plot center.

If it is still not possible to get suitable coordinates from plot center, attempt to obtain them from a location within 200 ft of plot center. Obtain the azimuth and horizontal distance from the "offset" location to plot center. If a PLGR unit is used, use the Rng-Calc function in the PLGR to compute the coordinates of the plot center. If another type of GPS unit is used, record the azimuth and horizontal distance in Sections 8.3.10.12 and 8.3.10.13.

Coordinates may be collected further than 200 ft away from the plot center if a laser measuring device is used to determine the horizontal distance from the "offset" location to plot center. Again, if a PLGR unit is used, use the Rng-Calc function in the PLGR to compute the coordinates of the plot center. If another type of GPS unit is used, record the azimuth and horizontal distance in Sections 8.3.10.12 and 8.3.10.13.

In all cases try to obtain at least 180 positions before recording the coordinates.

8.3.10.3 GPS UNIT (UNIT)

Record the kind of GPS unit used to collect coordinates. If suitable coordinates cannot be obtained, record 0.

When collected: All field visited plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

0 GPS coordinates not collected
1 Rockwell Precision Lightweight GPS Receiver (PLGR)
2 Other brand capable of field averaging
3 Timble GeoExplorer or Pathfinder Pro
4 Recreational GPS (Garmin, Magellan, etc.)

8.3.10.4 GPS SERIAL NUMBER (GPS#)

Record the last six digits of the serial number on the GPS unit used.

When collected: When GPS UNIT > 0
Field width: 6 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 000001 to 999999

8.3.10.5 COORDINATE SYSTEM

Record a code indicating the type of coordinate system used to obtain readings.

NC Note: North Central FIA region always collects using code 1 : Geographic coordinate system (Latitude and Longitude).

When collected: When GPS UNIT > 0
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1 Geographic coordinate system
2 UTM coordinate system

8.3.10.6 LATITUDE (N:)

Record the latitude of the plot center to the nearest hundredth second, as determined by GPS.

NC Note: Collected in degrees and decimal minutes. Record decimal minutes to the 3rd decimal place and do not round.

When collected: When COORDINATE SYSTEM = 1
Field width: 8 digits (DDMMSSSS) **NC Note:** 7 digits collected as Degrees and decimal minutes.
Tolerance: +/- 140 ft
MQO: At least 99% of the time
Values:

8.10.3.7 LONGITUDE (W:)

Record the longitude of the plot center, to the nearest hundredth second, as determined by GPS.

NC Note: Collected in degrees and decimal minutes. Record decimal minutes to the 3rd decimal place and do not round.

When collected: When COORDINATE SYSTEM = 1
Field width: 9 digits: (DDDMMSSSS) **NC Note:** 8 digits collected as Degrees and decimal
Tolerance: +/- 140 ft
MQO: At least 99% of the time
Values:

8.3.10.8 UTM ZONE

Record a 2-digit and 1 character field UTM ZONE as determined by GPS.

When collected: When COORDINATE SYSTEM = 2
Field width: 3 digits: (##C)
Tolerance: No errors
MQO: At least 99% of the time
Values: 03-19Q and 03-19W

NC NOTE: Not collected in North Central FIA region.

8.3.10.9 EASTING (X) UTM

Record the Easting coordinate of the plot center as determined by GPS.

When collected: When COORDINATE SYSTEM = 2
Field width: 7 digits
Tolerance: +/- 140 ft
MQO: At least 99% of the time
Values:

NC NOTE: Not collected in North Central FIA region.

8.3.10.10 NORTHING (Y) UTM

Record the Northing coordinate of the plot center as determined by GPS.

When collected: When COORDINATE SYSTEM = 2
Field width: 7 digits
Tolerance: +/- 140 ft
MQO: At least 99% of the time
Values:

NC NOTE: Not collected in North Central FIA region.

8.3.10.11 CORRECTION FOR "OFFSET" LOCATION

As described in Section 1.18.2, coordinates may be collected at a location other than the plot center (an “offset” location). If a PLGR unit is used all offset coordinates will be "corrected" back using the Rng/Calc function. If a GPS unit other than a PLGR is used, then record items 8.3.10.12 and 8.3.10.13.

8.3.10.12 AZIMUTH TO PLOT CENTER (AZM)

Record the azimuth from the location where coordinates were collected to actual plot center. If coordinates are collected at plot center, record 000.

When collected: When GPS UNIT = 2, 3 or 4
Field width: 3 digits
Tolerance +/- 3 degrees
MQO: At least 99% of the time
Values: 000 when coordinates **are** collected at plot center
001 to 360 when coordinates **are not** collected at plot center

8.3.10.13 DISTANCE TO PLOT CENTER (DIST)

Record the horizontal distance in feet from the location where coordinates were collected to the actual plot center. If coordinates are collected at plot center, record 000. As described in Section 8.3.10.2, if a Laser range finder is used to determine DISTANCE TO PLOT CENTER, offset locations may be up to 999 ft from the plot center. If a range finder is not used, the offset location must be within 200 ft.

When collected: When GPS UNIT = 2, 3 or 4
Field width: 3 digits
Tolerance: +/- 6 ft
MQO: At least 99% of the time
Values: 000 when coordinates **are** collected at plot center
001 to 200 when a Laser range finder **is not** used to determine distance
001 to 999 when a Laser range finder **is** used to determine distance

8.3.10.14 GPS ELEVATION (ELEV)

Record the elevation above mean sea level of the plot center, in feet, as determined by GPS.

When collected: When GPS UNIT = 1, 2 or 4
Field width: 6 digits
Tolerance:
MQO: At least 99% of the time
Values: -00100 to 20000

8.3.10.15 GPS ERROR (ERRS)

Record the error as shown on the GPS unit to the nearest foot. As described in Section 8.3.10.2, make every effort to collect readings only when the error $\leq$ 70 ft. However, if after trying several different times during the day, at several different locations, this is not possible, record reading with an error of up to 999 ft.

When collected: When GPS UNIT =1 or 2
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 0 to 70 if possible
71 to 999 if an error of less than 70 cannot be obtained

8.3.10.16 NUMBER OF READINGS (READ)

Record a 3-digit code indicating how many readings were averaged by the GPS unit to calculate the plot coordinates. Collect at least 180 readings if possible.

When collected: When GPS UNIT = 1 or 2
Field width: 3 digits
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 to 999

8.3.10.17 GPS FILENAME (CORE OPTIONAL)

Record the filename containing the GPS positions collected on the plot.

When collected: When GPS UNIT = 3
Field width: 8 characters.3 characters e.g. R0171519.ssf
Tolerance: No errors
MQO: At least 99% of the time
Values: Letters and numbers

NC Note: Not collected in the North Central FIA region.

8.3.11 CONDITION STATUS 1

Record the CONDITION STATUS at the center of Subplot 1. Record the code that describes the status of the condition. Record for all condition classes sampled on a plot. The instructions in Section 2.2 and 2.3 apply when delineating condition classes that differ by CONDITION STATUS.

When collected: All condition classes, all Nonforest/Denied Access/Hazardous plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values:

1. Accessible forest land
2. Nonforest land
3. Noncensus water
4. Census water
5. Denied access area
6. Area too hazardous to visit
7. Area that is not in the sample, e.g., in Canada or Mexico.

8.3.18NC NC LAND USE (NCLU)

All conditions defined will also receive an NC Land Use. This item is not a condition class defining variable and will only be added to the ancillary data collected on a condition.

When collected: All condition classes, all Nonforest/Denied Access/Hazardous plots
Field width: 2 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

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 for Christmas trees.

The following NC landuse codes of 50-58 must have one or more trees, 5.0 inches DBH or larger, within the visual acre surrounding the subplot center.

50 **Reserved, nonforest with trees** Nonforest land with trees that is withdrawn from timber utilization, by a public agency or by law.

51 **Cropland with trees** Cropland with scattered inclusions of single trees or small groups of trees. Orchards are also included in this class.

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 forest land (code 20, 21, 22, 40, 41, 45) 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.

58 **Shelterbelt** A group of trees, less than 120 feet wide, used for the protection of soil and crop fields. Do not confuse this land use with an old fence line between two fields that contains a few trees.

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.**

The following NC Land Uses must have no tree species present 5.0 inch DBH or larger, within the visual acre surrounding the subplot center.

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. Do not confuse with non-stocked forest land.

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, power lines, 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 30 feet wide but less than 200 feet, and one acre in size but less than 4.5 acres in size (normal water level)

89 **Noncensus Water** (reserved)

90 **Census Water** A body of water greater than 200 feet wide and greater than 4.5 acres (normal water level).

96 **Inaccessible plot** When any portion of a forest plot cannot be reached or measured because permanent physical conditions prohibit **safe** access (e.g. steep slopes) no field measurements are required. Explain in notes why the plot is inaccessible.

97 **Dropped plot** Determined in office by field supervisor or crew leader.

98 **Lost (not relocated) plot**

99 **Denied access plot**

NC Table 2
Chart of valid NC Land Use Codes with Condition Status Codes

	Condition Status						
NC Land Use	**1**	**2**	**3**	**4**	**5**	**6**	**7**
46		X					
50		X					
51		X					
52		X					
53		X					
54		X					
55		X					
56		X					
58		X					
72		X					
79							X
61		X					
62		X					
64		X					
65		X					
66		X					
67		X					
68		X					
69		X					
80			X				
90				X			
96						X	
97							X
98	**This plot will not have a new 4-point plot.**						X
99					X		

8.3.12 CONDITION STATUS 2 (CORE OPTIONAL)

Record the CONDITION STATUS at the center of Subplot 2. Use the same procedure described in Section 8.3.11.

When collected: All Nonforest/Denied Access/Hazardous plots

8.3.13 CONDITION STATUS 3 (CORE OPTIONAL)

Record the CONDITION STATUS at the center of Subplot 3. Use the same procedure described in Section 8.3.11.

When collected: All Nonforest/Denied Access/Hazardous plots

8.3.14 CONDITION STATUS 4 (CORE OPTIONAL)

Record the CONDITION STATUS at the center of Subplot 4. Use the same procedure described in Section 8.3.11.

When collected: All Nonforest/Denied Access/Hazardous plots

8.3.15 PLOT-LEVEL NOTES

Use these fields to record notes pertaining to the entire plot. If the notes apply only to a specific subplot or other specific aspect of the plot, then make that clear in the notes.

When collected: All plots
Field width: Unlimited alphanumeric character field **NC Note:** Limited to one line between quotes.
Tolerance: N/A
MQO: N/A
Values: English language words, phrases and numbers

8.3.16 P3 HEXAGON NUMBER

Record the unique code assigned to each Phase 3 (former FHM) hexagon.

NC Note: This data item will be attached to the data by St. Paul after the data is collected.

When collected: All Phase 3 plots
Field width: 7 digits
Tolerance: No errors
MQO: At least 99% of the time
Values:

8.3.17 P3 PLOT NUMBER

Record the P3 PLOT NUMBERS that are used to identify individual plots within the same Phase 3 (former FHM) hexagon.

NC Note: This data item will be attached to the data by St. Paul after the data is collected.

When collected: All Phase 3 plots
Field width: 1 digit
Tolerance: No errors
MQO: At least 99% of the time
Values: 1 to 9

8.3.19NC NC RE-MEASUREMENT-TREE STATUS (STAT on downloaded trees)

Record a tree status code of 0 on all downloaded trees located in a denied access condition. These will be trees on subplot 101 and higher for most States and subplot 1-4 in Indiana or Illinois.

When collected: Any tree downloaded on a condition that is now denied status.
Field width: 1 digit
Tolerance: n/a
MQO: n/a
Values:0

NC Note: All Nonforest/Denied Access/Hazardous plots require the following information for subplot data entered on the data recorder:

Subplot Center Condition (SCEN)
Microplot Center Condition (MCEN)

APPENDICES

1. FIPS Codes for all States and Counties

   These are the standard federal 2- and 3-digit codes for States and Counties respectively.

2. Forest Type Codes

   These are the codes that correspond to the National FIA Forest typing algorithm. Definitions for the types will be included in a future draft. Units may choose to also add local forest type groupings.

3. Invasive Plants/Noxious Weeds Checklist Species

   List of species, in preparation.

4. Tree Species List

   This list includes all species deemed to be tally trees with western woodland trees measured for DRC indicated.

5. Site Tree Selection Criteria and Species by Region

6. Determination of Stocking Values for Land Use Classification

7. Glossary

8. Figures – Easy Reference Pages (Removed from Field Manual)

9. Tolerance / MQO / Value / Units Table

10. North Central Regional Help

11. North Central GPS

12. North Central Data Recorder

13. North Central Tatum Guides

14. North Central Example of plot sheet

Appendix 1. State and County FIPS Codes

Illinois	**(17)**
Unit 1	
Alexander	3
Franklin	55
Gallatin	59
Hamilton	65
Hardin	69
Jackson	77
Johnson	87
Massac	127
Perry	145
Pope	151
Pulaski	153
Randolph	157
Saline	165
Union	181
White	193
Williamson	199
Unit 2	
Bond	5
Calhoun	13
Clark	23
Clay	25
Clinton	27
Crawford	33
Cumberland	35
Edwards	47
Effingham	49
Fayette	51
Greene	61
Jasper	79
Jefferson	81
Jersey	83
Lawrence	101
Macoupin	117
Madison	119
Marion	121
Monroe	133
Montgomery	135
Richland	159
St.Clair	163
Shelby	173
Wabash	185
Washington	189
Wayne	191
Unit 3	
Adams	1
Boone	7
Brown	9
Bureau	11
Carroll	15
Cass	17
Champaign	19
Christian	21
Coles	29
Cook	31
DeKalb	37
De Witt	39
Douglas	41
DuPage	43
Edgar	45
Ford	53
Fulton	57
Grundy	63
Hancock	67
Henderson	71
Henry	73
Iroquois	75
JoDaviess	85
Kane	89
Kankakee	91
Kendall	93
Knox	95
Lake	97
La Salle	99
Lee	103
Livingston	105
Logan	107
Macon	115
Marshall	123
Mason	125
McDonough	109
McHenry	111
McLean	113
Menard	129
Mercer	131
Morgan	137
Moultrie	139
Ogle	141
Peoria	143
Piatt	147
Pike	149
Putnam	155
Rock Island	161
Sangamon	167
Schuyler	169
Scott	171
Stark	175
Stephenson	177
Tazewell	179
Vermilion	183
Warren	187
Whiteside	195
Will	197
Winnebago	201
Woodford	203

Indiana	**(18)**
Unit 1	
Clay	21
Daviess	27
Gibson	51
Greene	55
Knox	83
Martin	101
Parke	121
Pike	125
Posey	129
Putnam	133
Sullivan	153
Vanderburg	163
Vermillion	165
Vigo	167
Unit 2	
Brown	13
Clark	19
Crawford	25
Dubois	37
Floyd	43
Harrison	61
Jackson	71
Lawrence	93
Monroe	105
Morgan	109
Orange	117
Owen	119
Perry	123
Scott	143
Spencer	147
Warrick	173
Washington	175
Unit 3	
Dearborn	29
Fayette	41
Franklin	47
Jefferson	77
Jennings	79
Ohio	115
Ripley	137
Switzerland	155
Union	161
Unit 4	
Adams	1
Allen	3
Bartholome	5
Benton	7
Blackford	9
Boone	11
Carroll	15

Indiana (18)

Unit 4

Cass	17
Clinton	23
Decatur	31
De Kalb	33
Delaware	35
Elkhart	39
Fountain	45
Fulton	49
Grant	53
Hamilton	57
Hancock	59
Hendricks	63
Henry	65
Howard	67
Huntington	69
Jay	75
Johnson	81
Kosciusko	85
Lagrange	87
Lake	89
La Porte	91
Madison	95
Marion	97
Marshall	99
Miami	103
Montgomery	107
Newton	111
Noble	113
Porter	127
Pulaski	131
Randolph	135
Rush	139
St. Joseph	141
Shelby	145
Starke	149
Steuben	151
Tippecanoe	157
Tipton	159
Wabash	169
Warren	171
Wayne	177
Wells	179
White	181
Whitley	183

Iowa (19)

Unit 1

Allamakee	5
Benton	11
Black Hawk	13
Bremer	17
Buchanan	19
Butler	23
Cedar	31
Chickasaw	37
Clayton	43
Clinton	45
Delaware	55
Dubuque	61
Fayette	65
Floyd	67
Grundy	75
Howard	89
Jackson	97
Johnson	103
Jones	105
Linn	113
Mitchell	131
Scott	163
Tama	171
Winneshiek	191

Unit 2

Appanoose	7
Boone	15
Clarke	39
Dallas	49
Davis	51
Decatur	53
DesMoines	57
Guthrie	77
Hamilton	79
Hardin	83
Henry	87
Iowa	95
Jasper	99
Jefferson	101
Keokuk	107
Lee	111
Louisa	115
Lucas	117
Madison	121
Mahaska	123
Marion	125
Marshall	127
Monroe	135
Muscatine	139
Polk	153
Poweshiek	157
Story	169
Van Buren	177
Wapello	179
Warren	181
Washington	183
Wayne	185
Webster	187

Unit 3

Adair	1
Adams	3
Audubon	9
Carroll	27
Cass	29
Crawford	47
Fremont	71
Greene	73
Harrison	85
Mills	129
Monona	133
Montgomery	137
Page	145
Pottawatta	155
Ringgold	159
Shelby	165
Taylor	173
Union	175
Woodbury	193

Unit 4

Buena Vist	21
Calhoun	25
Cerro Gord	33
Cherokee	35
Clay	41
Dickinson	59
Emmet	63
Franklin	69
Hancock	81
Humboldt	91
Ida	93
Kossuth	109
Lyon	119
O'Brien	141
Osceola	143
Palo Alto	147
Plymouth	149
Pocahontas	151
Sac	161
Sioux	167
Winnebago	189
Worth	195
Wright	197

Kansas (20)

Unit1

Atchison	5
Brown	13
Clay	27
Dickinson	41
Doniphan	43
Douglas	45
Franklin	59
Geary	61
Jackson	85
Jefferson	87
Johnson	91
Leavenwort	103
Marshall	117

Kansas (20)

Unit1

Miami	121
Nemaha	131
Osage	139
Pottawatomie	149
Riley	161
Shawnee	177
Wabaunsee	197
Washington	201
Wyandotte	209

Unit 2

Allen	1
Anderson	3
Bourbon	11
Butler	15
Chase	17
Chautauqua	19
Cherokee	21
Coffey	31
Cowley	35
Crawford	37
Elk	49
Greenwood	73
Labette	99
Linn	107
Lyon	111
Marion	115
Montgomery	125
Morris	127
Neosho	133
Wilson	205
Woodson	207

Unit 3

Barber	7
Barton	9
Cheyenne	23
Clark	25
Cloud	29
Comanche	33
Decatur	39
Edwards	47
Ellis	51
Ellsworth	53
Finney	55
Ford	57
Gove	63
Graham	65
Grant	67
Gray	69
Greeley	71
Hamilton	75
Harper	77
Harvey	79
Haskell	81
Hodgeman	83
Jewell	89
Kearny	93
Kingman	95
Kiowa	97
Lane	101
Lincoln	105
Logan	109
McPherson	113
Meade	119
Mitchell	123
Morton	129
Ness	135
Norton	137
Osborne	141
Ottawa	143
Pawnee	145
Phillips	147
Pratt	151
Rawlins	153
Reno	155
Republic	157
Rice	159
Rooks	163
Rush	165
Russell	167
Saline	169
Scott	171
Sedgwick	173
Seward	175
Sheridan	179
Sherman	181
Smith	183
Stafford	185
Stanton	187
Stevens	189
Sumner	191
Thomas	193
Trego	195
Wallace	199
Wichita	203

Michigan (26)

Unit 1

Alger	3
Chippewa	33
Delta	41
Luce	95
Mackinac	97
Menominee	109
Schoolcraft	153

Unit 2

Baraga	13
Dickinson	43
Gogebic	53
Houghton	61
Iron	71
Keweenaw	83
Marquette	103
Ontonagon	131

Unit 3

Alcona	1
Alpena	7
Antrim	9
Arenac	11
Bay	17
Benzie	19
Charlevoix	29
Cheboygan	31
Clare	35
Crawford	39
Emmet	47
Gladwin	51
Grand Traverse	55
Iosco	69
Isabella	73
Kalkaska	79
Lake	85
Leelanau	89
Manistee	101
Mason	105
Mecosta	107
Midland	111
Missaukee	113
Montmorenc	119
Newaygo	123
Oceana	127
Ogemaw	129
Osceola	133
Oscoda	135
Otsego	137
Presque Isle	141
Roscommon	143
Wexford	165

Unit 4

Allegan	5
Barry	15
Berrien	21
Branch	23
Calhoun	25
Cass	27
Clinton	37
Eaton	45
Genesee	49
Gratiot	57
Hillsdale	59
Huron	63
Ingham	65
Ionia	67
Jackson	75
Kalamazoo	77
Kent	81

Michigan (26)

Unit 4

Lapeer	87
Lenawee	91
Livingston	93
Macomb	99
Monroe	115
Montcalm	117
Muskegon	121
Oakland	125
Ottawa	139
Saginaw	145
St. Clair	147
St. Joseph	149
Sanilac	151
Shiawassee	155
Tuscola	157
Van Buren	159
Washtenaw	161
Wayne	163

Minnesota (27)

Unit 1

Carlton	17
Cook	31
Koochiching	71
Lake	75
St. Louis	137

Unit 2

Aitkin	1
Becker	5
Beltrami	7
Cass	21
Clearwater	29
Crow Wing	35
Hubbard	57
Itasca	61
Lake of the Woods	77
Mahnomen	87
Roseau	135
Wadena	159

Unit 3

Anoka	3
Benton	9
Carver	19
Chisago	25
Dakota	37
Douglas	41
Fillmore	45
Goodhue	49
Hennepin	53
Houston	55
Isanti	59
Kanabec	65
Le Sueur	79
Mille Lacs	95
Morrison	97
Olmsted	109
Otter Tail	111
Pine	115
Ramsey	123
Rice	131
Scott	139
Sherburne	141
Stearns	145
Todd	153
Wabasha	157
Washington	163
Winona	169
Wright	171

Unit 4

Big Stone	11
Blue Earth	13
Brown	15
Chippewa	23
Clay	27
Cottonwood	33
Dodge	39
Faribault	43
Freeborn	47
Grant	51
Jackson	63
Kandiyohi	67
Kittson	69
Lac qui Parle	73
Lincoln	81
Lyon	83
McLeod	85
Marshall	89
Martin	91
Meeker	93
Mower	99
Murray	101
Nicollet	103
Nobles	105
Norman	107
Pennington	113
Pipestone	117
Polk	119
Pope	121
Red Lake	125
Redwood	127
Renville	129
Rock	133
Sibley	143
Steele	147
Stevens	149
Swift	151
Traverse	155
Waseca	161
Watonwan	165
Wilkin	167
Yellow Medicine	173

Missouri (29)

Unit 1

Bollinger	17
Butler	23
Carter	35
Crawford	55
Dent	65
Iron	93
Madison	123
Oregon	149
Reynolds	179
Ripley	181
St. Francois	187
Shannon	203
Washington	221
Wayne	223

Unit 2

Barry	9
Christian	43
Douglas	67
Howell	91
McDonald	119
Newton	145
Ozark	153
Stone	209
Taney	213
Texas	215
Webster	225
Wright	229

Unit 3

Benton	15
Camden	29
Cedar	39
Dallas	59
Hickory	85
Laclede	105
Maries	125
Miller	131
Morgan	141
Phelps	161
Polk	167
Pulaski	169
St. Clair	185

Unit 4

Adair	1
Andrew	3
Atchison	5
Audrain	7
Barton	11
Bates	13
Buchanan	21
Caldwell	25
Carroll	33

Missouri (29)

Unit 4

Cass	37
Chariton	41
Clark	45
Clay	47
Clinton	49
Cooper	53
Dade	57
Daviess	61
DeKalb	63
Gentry	75
Greene	77
Grundy	79
Harrison	81
Henry	83
Holt	87
Jackson	95
Jasper	97
Johnson	101
Knox	103
Lafayette	107
Lawrence	109
Lewis	111
Lincoln	113
Linn	115
Livingston	117
Macon	121
Marion	127
Mercer	129
Monroe	137
Nodaway	147
Pettis	159
Pike	163
Platte	165
Putnam	171
Ralls	173
Randolph	175
Ray	177
Saline	195
Schuyler	197
Scotland	199
Shelby	205
Sullivan	211
Vernon	217
Worth	227

Unit 5

Boone	19
Callaway	27
Cape Girar	31
Cole	51
Dunklin	69
Franklin	71
Gasconade	73
Howard	89
Jefferson	99
Mississippi	133
Moniteau	135
Montgomery	139
New Madrid	143
Osage	151
Pemiscot	155
Perry	157
St. Charle	183
St. Louis	189
Ste. Genev	186
Scott	201
Stoddard	207
Warren	219
St. Louis	510

Nebraska (31)

Unit 1

Adams	1
Boone	11
Buffalo	19
Burt	21
Butler	23
Cass	25
Cedar	27
Clay	35
Colfax	37
Cuming	39
Custer	41
Dakota	43
Dawson	47
Dixon	51
Dodge	53
Douglas	55
Fillmore	59
Franklin	61
Frontier	63
Furnas	65
Gage	67
Gosper	73
Greeley	77
Hall	79
Hamilton	81
Harlan	83
Hitchcock	87
Howard	93
Jefferson	95
Johnson	97
Kearney	99
Lancaster	109
Madison	119
Merrick	121
Nance	125
Nemaha	127
Nuckolls	129
Otoe	131
Pawnee	133
Phelps	137
Pierce	139
Platte	141
Polk	143
Red Willow	145
Richardson	147
Saline	151
Sarpy	153
Saunders	155
Seward	159
Sherman	163
Stanton	167
Thayer	169
Thurston	173
Valley	175
Washington	177
Wayne	179
Webster	181
York	185

Unit 2

Antelope	3
Arthur	5
Banner	7
Blaine	9
Box Butte	13
Boyd	15
Brown	17
Chase	29
Cherry	31
Cheyenne	33
Dawes	45
Deuel	49
Dundy	57
Garden	69
Garfield	71
Grant	75
Hayes	85
Holt	89
Hooker	91
Keith	101
Keya Paha	103
Kimball	105
Knox	107
Lincoln	111
Logan	113
Loup	115
McPherson	117
Morrill	123
Perkins	135
Rock	149
Scotts Bluff	157
Sheridan	161
Sioux	165
Thomas	171
Wheeler	183

N.Dakota	**(38)**
Unit 1	
Adams	1
Barnes	3
Benson	5
Billings	7
Bottineau	9
Bowman	11
Burke	13
Burleigh	15
Cass	17
Cavalier	19
Dickey	21
Divide	23
Dunn	25
Eddy	27
Emmons	29
Foster	31
Golden Valley	33
Grand Fork	35
Grant	37
Griggs	39
Hettinger	41
Kidder	43
LaMoure	45
Logan	47
McHenry	49
McIntosh	51
McKenzie	53
McLean	55
Mercer	57
Morton	59
Mountrail	61
Nelson	63
Oliver	65
Pembina	67
Pierce	69
Ramsey	71
Ransom	73
Renville	75
Richland	77
Rolette	79
Sargent	81
Slope	87
Sheridan	83
Sioux	85
Stark	89
Steele	91
Stutsman	93
Towner	95
Traill	97
Walsh	99
Ward	101
Wells	103
Williams	105

S.Dakota	**(46)**
Unit 1	
Aurora	3
Beadle	5
Bennett	7
Bon Homme	9
Brookings	11
Brown	13
Brule	15
Buffalo	17
Campbell	21
Charles Mi	23
Clark	25
Clay	27
Codington	29
Corson	31
Davison	35
Day	37
Deuel	39
Dewey	41
Douglas	43
Edmunds	45
Faulk	49
Grant	51
Gregory	53
Haakon	55
Hamlin	57
Hand	59
Hanson	61
Hughes	65
Hutchinson	67
Hyde	69
Jackson	71
Jerauld	73
Jones	75
Kingsbury	77
Lake	79
Lincoln	83
Lyman	85
Marshall	91
McCook	87
McPherson	89
Mellette	95
Miner	97
Minnehaha	99
Moody	101
Perkins	105
Potter	107
Roberts	109
Sanborn	111
Spink	115
Stanley	117
Sully	119
Todd	121
Tripp	123
Turner	125
Union	127
Walworth	129
Yankton	135
Ziebach	137
Unit 2	
Butte	19
Custer	33
Fall River	47
Harding	63
Lawrence	81
Meade	93
Pennington	103
Shannon	113

Wisconsin	**(55)**
Unit 1	
Florence	37
Forest	41
Langlade	67
Lincoln	69
Menominee	78
Marinette	75
Oconto	83
Oneida	85
Shawano	115
Vilas	125
Unit 2	
Ashland	3
Barron	5
Bayfield	7
Burnett	13
Douglas	31
Iron	51
Polk	95
Price	99
Rusk	107
Sawyer	113
Taylor	119
Washburn	129
Unit 3	
Adams	1
Chippewa	17
Clark	19
Eau Claire	35
Jackson	53
Juneau	57
Marathon	73
Marquette	77
Monroe	81
Portage	97
Waupaca	135
Waushara	137
Wood	141
Unit 4	
Buffalo	11
Crawford	23

Wisconsin (55)

Unit 4	
Dunn	33
Grant	43
Iowa	49
La Crosse	63
Lafayette	65
Pepin	91
Pierce	93
Richland	103
St. Croix	109
Sauk	111
Trempealeau	121
Vernon	123

Unit 5	
Brown	9
Calumet	15
Columbia	21
Dane	25
Dodge	27
Door	29
Fond du La	39
Green	45
Green Lake	47
Jefferson	55
Kenosha	59
Kewaunee	61
Manitowoc	71
Milwaukee	79
Outagamie	87
Ozaukee	89
Racine	101
Rock	105
Sheboygan	117
Walworth	127
Washington	131
Waukesha	133
Winnebago	139

Appendix 2. U.S. Forest Type Codes

This following list includes all forest types in the Continental U.S. and Alaska Types designated East/West are commonly found in those regions, although types designated for one region may occasionally be found in another.

East	West	Code	Species Type
E			**White / Red / Jack Pine Group**
E		101	Jack pine
E		102	Red pine
E		103	Eastern white pine
E		104	Eastern White pine / Eastern hemlock
E		105	Eastern hemlock
E			**Spruce / Fir Group**
E		121	Balsam fir
E		122	White spruce
E		123	Red spruce
E		124	Red spruce / balsam fir
E		125	Black spruce
E		126	Tamarack
E		127	Northern white-cedar
E			**Longleaf / Slash Pine Group**
E		141	Longleaf pine
E		142	Slash pine
E			**Loblolly / Shortleaf Pine Group**
E		161	Loblolly pine
E		162	Shortleaf pine
E		163	Virginia pine
E		164	Sand pine
E		165	Table-mountain pine
E		166	Pond pine
E		167	Pitch pine
E		168	Spruce pine
	W		**Pinyon / Juniper Group**
E		181	Eastern redcedar
	W	182	Rocky Mountain juniper
	W	183	Western juniper
	W	184	Juniper woodland
	W	185	Pinyon juniper woodland
	W		**Douglas-fir Group**
	W	201	Douglas-fir
	W	202	Port-Orford-cedar
	W		**Ponderosa Pine Group**
E	W	221	Ponderosa pine
	W	222	Incense cedar
	W	223	Jeffrey pine / Coulter pine / bigcone Douglas-fir
	W	224	Sugar pine

East	West	Code	Species Type
	W		**Western White Pine Group**
	W	241	Western white pine
	W		**Fir / Spruce / Mountain Hemlock Group**
	W	261	White fir
	W	262	Red fir
	W	263	Noble fir
	W	264	Pacific silver fir
	W	265	Engelmann spruce
	W	266	Engelmann spruce / subalpine fir
	W	267	Grand fir
	W	268	Subalpine fir
	W	269	Blue spruce
	W	270	Mountain hemlock
	W	271	Alaska-yellow-cedar
	W		**Lodgepole Pine Group**
	W	281	Lodgepole pine
	W		**Hemlock / Sitka Spruce Group**
	W	301	Western hemlock
	W	304	Western redcedar
	W	305	Sitka spruce
	W		**Western Larch Group**
	W	321	Western larch
	W		**Redwood Group**
	W	341	Redwood
	W	342	Giant sequoia
	W		**Other Western Softwoods Group**
	W	361	Knobcone pine
	W	362	Southwest white pine
	W	363	Bishop pine
	W	364	Monterey pine
	W	365	Foxtail pine / bristlecone pine
	W	366	Limber pine
	W	367	Whitebark pine
	W	368	Misc. western softwoods
	W		**California Mixed Conifer Group**
	W	371	California mixed conifer
E	W		**Exotic Softwoods Group**
E		381	Scotch pine
E	W	382	Australian pine
E	W	383	Other exotic softwoods
E		384	Norway Spruce
E		385	Introduced larch
E			**Oak / Pine Group**
E		401	Eastern white pine / N. red oak / white ash
E		402	Eastern redcedar / hardwood

East	West	Code	Species Type
E		403	Longleaf pine / oak
E		404	Shortleaf pine / oak
E		405	Virginia pine / southern red oak
E		406	Loblolly pine / hardwood
E		407	Slash pine / hardwood
E		409	Other pine / hardwood
E			**Oak / Hickory Group**
E		501	Post oak / blackjack oak
E		502	Chestnut oak
E		503	White oak / red oak / hickory
E		504	White oak
E		505	Northern red oak
E		506	Yellow-poplar / white oak / N. red oak
E		507	Sassafras / persimmon
E		508	Sweetgum / yellow-poplar
E		509	Bur oak
E		510	Scarlet oak
E		511	Yellow-poplar
E		512	Black walnut
E		513	Black locust
E		514	Southern scrub oak
E		515	Chestnut oak / black oak / scarlet oak
E		519	Red maple / oak
E		520	Mixed upland hardwoods
E			**Oak / Gum / Cypress Group**
E		601	Swamp chestnut oak / cherrybark oak
E		602	Sweetgum / Nuttall oak / willow oak
E		605	Overcup oak / water hickory
E		606	Atlantic white-cedar
E		607	Baldcypress / water tupelo
E		608	Sweetbay / swamp tupelo / red maple
E			**Elm / Ash / Cottonwood Group**
E		701	Black ash / American elm / red maple
E		702	River birch / sycamore
E	W	703	Cottonwood
E	W	704	Willow
E		705	Sycamore / pecan / American elm
E		706	Sugarberry / hackberry / elm / green ash
E		708	Red maple / lowland
E	W	709	Cottonwood / willow
E	W	722	Oregon ash
E			**Maple / Beech / Birch Group**
E		801	Sugar maple / beech / yellow birch
E		802	Black cherry
E		803	Cherry / ash / yellow-poplar
E		805	Hard maple / basswood
E		807	Elm / ash / locust
E		809	Red maple / upland
E	W		**Aspen / Birch Group**

East	West	Code	Species Type
E	W	901	Aspen
E	W	902	Paper birch
E	W	904	Balsam poplar
	W		**Alder / Maple Group**
	W	911	Red alder
	W	912	Bigleaf maple
	W		**Western Oak Group**
	W	921	Gray pine
	W	922	California black oak
	W	923	Oregon white oak
	W	924	Blue oak
	W	925	Deciduous oak woodland
	W	931	Coast live oak
	W	932	Canyon live oak / interior live oak
	W		**Tanoak / Laurel Group**
	W	941	Tanoak
	W	942	Califonia laurel
	W	943	Giant chinkapin
	W		**Other Western Hardwoods Group**
	W	951	Pacific madrone
	W	952	Mesquite woodland
	W	953	Cercocarpus woodland
	W	954	Intermountain maple woodland
	W	955	Misc. western hardwood woodlands
E			**Tropical Hardwoods Group**
E		981	Sable palm
E		982	Mangrove
E		989	Other tropical
E	W		**Exotic Hardwoods Group**
E		991	Paulownia
E		992	Melaluca
E	W	993	Eucalyptus
E	W	995	Other exotic hardwoods
E	W	999	Non stocked

Eastern Forest Type Descriptions

WHITE/RED/JACK PINE GROUP

101 Jack pine: Associates – red pine, northern pin oak, quaking and bigtooth aspen, paper birch, black spruce, and white spruce. Sites--generally driest, most porous sands but also on more moist, sandy soils near swamps and on rocky hills and lodges.

102 Red pine: Associates – white, jack, or pitch pine; northern pin oak; white oak; red maple; paper birch; quaking and bigtooth aspen, chestnut oak, northern red oak, and hemlock. Sites--spotty distribution in Northeast and sandy and gravelly locations or dry sandy loam soils; often in plantations.

103 Eastern white pine: Associates – pitch pine, gray birch, aspen, red maple, pin cherry, white oak, paper birch, sweet birch, yellow birch, black cherry, white ash, northern red oak, sugar maple, basswood, hemlock, northern white-cedar, yellow-poplar, white oak, chestnut oak, scarlet oak, and shortleaf pine. Sites--wide variety, but best development on well drained sands and sandy loams.

NEW 104 Eastern white pine/ Eastern hemlock: Associates – beech, sugar maple, basswood, red maple, yellow birch, black cherry, white ash, paper birch, sweet birch, northern red oak, white oak, chestnut oak, yellow-poplar, and cucumbertree. Sites--wide variety but favors cool locations, moist ravines, and north slopes.

105 Eastern hemlock: Associates – beech, sugar maple, yellow birch, basswood, red maple, black cherry, white ash, white pine, paper birch, sweet birch, northern red oak, and white oak. Sites--cool locations, moist ravines, and north slopes.

SPRUCE/FIR GROUP

121 Balsam fir: Associates – black, white, or red spruce; paper or yellow birch; quaking or bigtooth aspen, beech; red maple; hemlock; tamarack; black ash; or northern white-cedar. Sites--upland sites on low lying moist flats and in swamps.

122 White spruce: Associates – b lack spruce, balsam fir, quaking aspen, paper birch, jack pine, red spruce, sugar maple, beech, and yellow birch. Sites--moist, sandy loam or alluvial soils--found on many different sites but especially typical of stream banks, lake shores, and adjacent slopes.

NEW 123 Red Spruce: Associates – vary widely and may include red maple, yellow birch, eastern hemlock, eastern white pine, white spruce, northern white-cedar, paper birch, pin cherry, gray birch, mountain ash, beech, striped maple, sugar maple, northern red oak, red pine, and aspen. Sites--include moderately well drained to poorly drained flats and thin-slopes and on varying acidic soils in abandoned fields and pastures. This code should be used where red spruce comprises a plurality or majority of the stand's stocking but where balsam fir is either nonexistent or has very little stocking. Otherwise the plot would be coded 124, red spruce/balsam fir.

NEW 124 Red spruce/balsam fir: Associates – red maple, paper birch, white pine, hemlock, white spruce, and northern white-cedar. Sites--moderately drained to poorly drained flats or on thin-soiled upper slopes.

125 Black spruce: Associates – white spruce, balsam fir, jack pine, quaking aspen, paper birch, tamarack, northern white-cedar, black ash, or red maple. Sites--acid peat swamps but also on moist flats and uplands.

126 Tamarack (eastern larch): Associates – northern white cedar, red maple, black ash, and quaking aspen. Sites--wet swamps.

127 Northern white-cedar: Associates – tamarack, yellow birch, paperbirch, black ash, red maple, white pine, and hemlock. Sites--slow drainage (not stagnant bogs) areas that are not strongly acid.

LONGLEAF/SLASH PINE GROUP

NEW 141Longleaf pine: Longleaf pine occurs as a pure type or comprises a majority of the trees in the overstory. Associates-slash, loblolly and shortleaf pine, southern red oak, blackjack oak, water oak, persimmon, and sweetgum. Sites--those areas that can and do burn on a periodic basis--usually occurs on middle and upper slopes with a low severity of hardwood and brush competition. Regional distribution--coastal plain and piedmont units.

NEW 142 Slash pine: Slash pine is pure or provides a majority of the stocking. Associates--on moist sites; a wide variety of moist-site hardwoods, pond pine, and pondcypress. On dry sites; a wide variety of dry-site hardwoods, longleaf, loblolly, and sand pine. Sites--both moist and well-drained flatwoods, and bays. Regional distribution--coastal plain and piedmont units from North Carolina to Florida.

LOBLOLLY/SHORTLEAF PINE GROUP

NEW 161 Loblolly pine: Associates – sweetgum, southern red oak, post oak, blackjack oak, blackgum, yellow-poplar, and pond pine. Sites--in Delaware and Maryland both on upland soils with abundant moisture but good drainage and on poorly drained depressions.

162 Shortleaf pine: Associates – white oak, southern red oak, scarlet oak, black oak, hickory, post oak, blackjack oak, blackgum, red maple, pitch pine, and Virginia pine. Sites--low, well drained ridges to rocky, dry, south slopes and the better drained spur ridges on north slopes and also on old fields.

163 Virginia pine: Associates – shortleaf pine, white oak, chestnut oak, southern red oak, black oak, sweetgum, red maple, blackgum, and pitch pine. Sites--dry sites, often abandoned fields.

NEW 164 Sand pine: Sand pine occurs in pure stands or provides a majority of the stocking. Associates--dwarf live oak, dwarf post oak, turkey oak, persimmon, and longleaf pine. Sites--dry, acidic, infertile sands. Regional distribution--found chiefly in the central peninsula and panhandle of Florida, although planted stands extend into the sandhills of Georgia and South Carolina.

NEW 165 Table-mountain pine: Associates – chestnut oak, scarlet oak, pitch pine, pine, and black oak. Sites--poor, dry, often rocky slopes.

NEW 166 Pond pine: Associates – loblolly pine, sweetgum, baldcypress, and Atlantic white-cedar. Sites--rare, but found in southern New Jersey, Delaware, and Maryland in low, poorly drained acres, swamps, and marshes.

NEW 167 Pitch pine: Associates – chestnut oak, scarlet oak, table-mountain pine, black oak, and blackgum. Sites--relatively infertile ridges, dry flats, and slopes.

NEW 168 Spruce pine: Spruce pine comprises a majority of the stocking. Associates--any of the moist site softwood or hardwood species. Sites--moist or poorly drained areas.

Regional distribution--this type is rarely encountered and is found almost exclusively in the coastal plain.

PINYON / JUNIPER GROUP

NEW 181 Eastern redcedar: Associates – gray birch, red maple, sweetbirch, Virginia Pine, shortleaf pine, oak. Sites--usually dry uplands and abandoned fields on limestone outcrops and other shallow soils but can grow well on good sites.

PONDEROSA PINE GROUP

221 Ponderosa pine

EXOTIC SOFTWOODS GROUP

NEW 381 Scotch pine: plantation type, not naturally occurring.

NEW 382 Australian pine:

NEW 383 Other exotic softwoods

NEW 384 Norway spruce: plantation type, not naturally occurring

NEW 385 Introduced Larch: plantation type, usually Japanese larch, European larch, or a hybrid of the two (Dunkeld larch) - not naturally occurring. Sites--well-drained uplands; heavy plantation in New York.

OAK/PINE GROUP

NEW 401 Eastern white pine/northern red oak/white ash: Associates – red maple, basswood, yellow birch, bigtooth aspen, sugar maple, beech, paper birch, black cherry, hemlock, and sweet birch. Sites--deep, fertile, well-drained soil.

402 Eastern redcedar/hardwood: Associates – oak, hickory, walnut, ash, locust, dogwood, blackgum, hackberry, winged elm, shortleaf pine, and Virginia pine. Sites--usually dry uplands and abandoned fields.

NEW 403 Longleaf pine/oak: Longleaf pine and scrub oaks-primarily turkey, bluejack, blackjack, and dwarf post oak--comprise the type. Associates--southern scrub oaks in the understory. Sites--common on sandhills where soils are dry, infertile, and coarse textured. Regional distribution-- coastal plain and piedmont units.

404 Shortleaf pine/oak: Associates - (oaks generally include white, scarlet, blackjack, black, post, and southern red) hickory, blackgum, sweetgum, Virginia pine, and pitch pine. Sites--generally in dry, low ridges, flats, and south slopes.

NEW 405 Virginia pine/southern red oak: Associates – black oak, scarlet oak, white oak, post oak, blackjack oak, shortleaf pine, blackgum, hickory, pitch pine, table-mountain pine, chestnut oak. Sites--dry slopes and ridges.

NEW 406 Loblolly pine/hardwood: Associates – wide variety of moist and wet site hardwoods including blackgum, sweetgum, yellow-poplar, red maple, white and green ash, and American elm; on drier sites associates include southern and northern red oak, white oak, post oak, scarlet oak, persimmon, and hickory. Sites--usually moist to very moist though not wet all year but also on drier sites.

NEW 407 Slash pine/hardwood: Slash pine and a variable mixture of hardwoods comprise the type. Associates-- codominant with the slash pine component are sweetbay, blackgum, loblolly-bay, pondcypress, pond pine, Atlantic white-cedar, red maple, ash, and water oak. Sites--undrained or poorly drained depressions such as bays or pocosins and along pond margins. Regional distribution--primarily coastal plain units.

NEW 409 Other pine/hardwood:

OAK/HICKORY GROUP

501 Post oak/blackjack oak: Associates – blackjack oak, hickory, southern red oak, white oak, scarlet oak, shingle oak, live oak, shortleaf pine, Virginia pine, blackgum, sourwood, red maple, winged elm, hackberry, chinkapin oak, shumard oak, dogwood, and eastern redcedar. Sites--dry uplands and ridges.

NEW 502 Chestnut oak: Associates – scarlet oak, white oak, black oak, post oak, pitch pine, blackgum, sweetgum, red maple, red oak, shortleaf pine, Virginia pine. Sites--rocky outcrops with thin soil, ridge tops.

503 White oak/red oak/hickory: Associates – scarlet oak, bur oak, pinoak, white ash, sugar maple, red maple, walnut, basswood, locust, beech, sweetgum, blackgum, yellow-poplar, and dogwood. Sites--wide variety of well drained upland soils.

NEW 504 White oak: Associates – black oak, northern red oak, bur oak, hickory, white ash, yellow-poplar. Sites--scattered patches on upland, loamy soils but on drier sites than type 503.

NEW 505 Northern red oak: Associates – black oak, scarlet oak, chestnut oak, and yellow-poplar. Sites--spotty distribution on ridge crests and north slopes in mountains but also found on rolling land, slopes, and benches on loamy soil.

NEW 506 Yellow-poplar/white oak/northern red oak: Associates – blackoak, hemlock, blackgum, and hickory. Sites--northern slopes, coves, and moist flats.

507 Sassafras/persimmon: Associates – elm, eastern redcedar, hickory, ash, sugar maple, yellow-poplar, and oaks. Sites--abandoned farmlands and old fields.

NEW 508 Sweetgum/yellow-poplar: Associates – red maple, white ash, green ash, and other moist site hardwoods. Sites--generally occupies moist, lower slopes.

509 Bur oak: Associates—northern pin oak, black oak, chinkapin oak, and eastern redcedar in northern and dry upland sites; shagbark hickory, black walnut, eastern cottonwood, white ash, American elm, swamp white oak, honey locust, and American basswood in southern and lowland sites. Sites – drier uplands to moist bottomlands with the drier uplands more common in the northern part of the range and the moist bottomlands more common in the southern part of the range.

NEW 510 Scarlet oak: Associates – black oak, southern red oak, chestnut oak, white oak, post oak, hickory, pitch pine, blackgum, sweetgum, black locust, sourwood, dogwood, shortleaf pine, and Virginia pine. Sites--dry ridges, south- or west-facing slopes and flats but often moister situations probably as a result of logging or fire.

NEW 511 Yellow-poplar: Associates – black locust, red maple, sweet birch, cucumbertree, and other moist-site hardwoods (except sweetgum, see type 562) and white oak and northern red oak (see type 560). Sites--lower slopes, northerly slopes, moist coves, flats, and old fields.

NEW 512 Black Walnut: Associates – yellow-poplar, white ash, black cherry, basswood, beech, sugar maple, oaks, and hickory. Sites--coves and well-drained bottoms.

NEW 513 Black locust: Associates – many species of hardwoods and hardpines may occur with it in mixture, either having been planted or from natural seeding. Sites--may occur on any well-drained soil but best on dry sites, often in old fields.

NEW 514 Southern scrub oak: This forest cover type consists of a mixture of scrub oaks that may include several of the following species: turkey oak, bluejack oak, blackjack oak, dwarf post oak, and dwarf live oak. Sites--dry sandy ridges-the type frequently develops on areas formerly occupied by longleaf pine. Regional distribution--common throughout all coastal plain units and into the lower piedmont.

515 Chestnut oak / black oak / scarlet oak: Associates—northern and southern red oaks, post oak, white oak, sourwood, shagbark hickory, pignut hickory, yellow-poplar, blackgum, sweetgum, red maple, eastern white pine, pitch pine, Table Mountain pine, shortleaf pine, and Virginia pine. Sites—dry upland sites on thin-soiled rocky outcrops on dry ridges and slopes.

NEW 519 Red maple / oak: Associates – the type is dominated by red maple and some of the wide variety of central hardwood associates include upland oak, hickory, yellow-poplar, black locust, sassafras as well as some central softwoods like Virginia and shortleaf pines. Sites -- uplands.

NEW 520 Mixed upland hardwoods: Associates – Any mixture of hardwoods of species typical of the upland central hardwood region, should include at least some oak. Sites--wide variety of upland sites.

OAK/GUM/CYPRESS GROUP

601 Swamp chestnut oak/cherrybark oak: Associates – white ash, hickory, white oak, shumard oak, blackgum, sweetgum, southern red oak, post oak, American elm, winged elm, yellow-poplar, and beech. Sites--within alluvial flood plains of major rivers on all ridges in the terraces and on the best fine sandy loam soils on the highest first bottom ridges.

NEW 602 Sweetgum/Nuttall oak/willow oak: Associates – green ash, American elm, pecan, cottonwood, red maple, honeylocust, and persimmon. Sites--very wet.

NEW 605 Overcup oak/water hickory: Associates – willow oak, American elm, green ash, hackberry, persimmon, and red maple. Sites--in South within alluvial flood plains in low, poorly drained flats with clay soils; also in sloughs and lowest backwater basins and low ridges with heavy soils that are subject to late spring inundation.

NEW 606 Atlantic white-cedar: Associates – North includes gray birch, pitch pine, hemlock, blackgum, and red maple. South includes pond pine, baldcypress, and red maple. Sites--usually confined to sandy-bottomed, peaty, interior, and river swamps, wet depressions, and stream banks.

NEW 607 Baldcypress/water tupelo: Associates – willow, red maple, American elm, persimmon, overcup oak, and sweetgum. Sites--very low, poorly drained flats, deep sloughs, and swamps wet most all the year.

NEW 608 Sweetbay/swamp tupelo/red maple: Associates – blackgum, loblolly and pond pines, American elm, and other moist-site hardwoods. Sites--very moist but seldom wet all year--shallow ponds, muck swamps, along smaller creeks in Coastal Plain (rare in Northeast).

ELM/ASH/COTTONWOOD GROUP

701 Black ash/American elm/red maple: Associates – silver maple, swampwhite oak, sycamore, pin oak, blackgum, white ash, and cottonwood. Sites--moist to wet areas, swamps, gullies, and poorly drained flats.

NEW 702 River birch/sycamore: Associates – red maple, black willow, and other moist-site hardwoods. Sites--moist soils at edges of creeks and rivers.

703 Cottonwood: Associates – willow, white ash, green ash, and sycamore. Sites--streambanks where bare, moist soil is available.

704 Willow: Associates – cottonwood, green ash, sycamore, pecan, American elm, red maple, and boxelder. Sites--streambanks where bare, moist soil is available.

NEW 705 Sycamore/pecan/American elm: Associates – boxelder, green ash, hackberry, silver maple, cottonwood, willow, sweetgum, and river birch. Sites--bottomlands, alluvial flood plains of major rivers.

NEW 706 Sugarberry/hackberry/elm/green ash: Associates – pecan, blackgum, persimmon, honeylocust, red maple, hackberry, and boxelder. Sites--low ridges and flats in flood plains.

NEW 708 Red maple/lowland

NEW 708 Red maple/lowland:

NEW 709 Cottonwood/willow: Associates – white ash, green ash sycamore, American elm, red maple and boxelder. Sites – stream banks where bare, moist soil is available.

NEW 722 Oregon ash:

MAPLE/BEECH/BIRCH GROUP

801 Sugar maple/beech/yellow birch: Associates – basswood, red maple, hemlock, northern red oak, white ash, white pine, black cherry, sweet birch, American elm, rock elm, and eastern hophornbeam. Sites--fertile, moist, well-drained sites.

NEW 802 Black cherry: Associates – sugar maple, northern red oak, red maple, white ash, basswood, sweet birch, butternut, American elm, and hemlock. Sites--fertile, moist, well-drained sites.

803 Cherry/ash/yellow-poplar: Associates – sugar maple, American beech, northern red oak, white oak, blackgum, hickory, cucumbertree, and yellow birch. Sites -- fertile, moist, well-drained sites.

805 Hard maple/basswood: Associates – white ash, northern red oak, eastern hophornbeam, American elm, red maple, eastern white pine, eastern hemlock. Sugar maple and basswood occur in different proportions but together comprise the majority of the stocking. Sites -- fertile, moist, well-drained sites.

NEW 807 Elm/ash/locust: Associates – Locust, silver maple, boxelder, elm, red maple, green ash predominate. Found in North Central region, unknown in Northeast. Sites--upland

NEW 809 Red maple/upland: Associates – the type is dominated by red maple and some of the wide variety of northern hardwood associates include sugar maple, beech, birch, aspen, as well as some northern softwoods like white pine, red pine, and hemlock; this type is often man-made and may be the result of repeated cuttings. Sites -- uplands. (See Type 519 under oak/hickory group)

ASPEN/BIRCH GROUP

901 Aspen: Associates – paper birch, pin cherry, bur oak, green ash, American elm, balsam poplar, and boxelder. Sites--all kinds of soils except very driest sands and wettest swamps; found on burns, clearcuts, and abandoned land.

902 Paper birch: Associates – aspen, white pine, yellow birch, hemlock, red maple, northern red oak, and basswood. Sites--wide range of upland site, common on burns or clearcuts.

904 Balsam poplar: Associates – balsam fir, white spruce, black spruce, tamarack, aspen, and paper birch. Sites – uplands and flood plains.

EXOTIC HARDWOODS GROUP

NEW 991 Paulownia:

NEW 992 Melaluca:

NEW 993 Eucalyptus:

NEW 995 Other exotic hardwoods:

NEW 999 Non stocked--the site qualifies as forest but is presently stocked with too few trees to assign a forest type.

Appendix 3. Invasive Plants / Noxious Weeds Checklist Species

(In preparation)

Appendix 4. U.S. Tree Species Codes

This following list includes all tree species tallied in the Continental U.S and Alaska. Species designated East/West are commonly found in those regions, although species designated for one region may occasionally be found in another. Woodland species designate species where DRC is measured instead of DBH.
NC Note: Most Western only species have been removed from the North Central Regional manual. They are available from field suppervisors and headquarters.

East	West	Woodland	Code	Common Name	Genus	Species
E	W		10	fir spp.	Abies	spp.
E	W		12	balsam fir	Abies	balsamea
	W		15	white fir	Abies	concolor
E			16	Fraser fir	Abies	fraseri
E			43	Atlantic white-cedar	Chamaecyparis	thyoides
E	W		57	redcedar / juniper	Juniperus	spp.
E			61	Ashe juniper	Juniperus	ashei
	W	w	66	Rocky Mountain juniper	Juniperus	scopulorum
E			67	southern redcedar	Juniperus	silicicola
E			68	eastern redcedar	Juniperus	virginiana
E	W		70	larch (introduced)	Larix	spp.
E	W		71	tamarack (native)	Larix	laricina
E	W		90	spruce spp.	Picea	spp.
E			91	Norway spruce	Picea	abies
	W		93	Engelmann spruce	Picea	engelmannii
E	W		94	white spruce	Picea	glauca
E	W		95	black spruce	Picea	mariana
E	W		96	blue spruce	Picea	pungens
E			97	red spruce	Picea	rubens
E			105	jack pine	Pinus	banksiana
E			107	sand pine	Pinus	clausa
	W		108	lodgepole pine	Pinus	contorta
E			110	shortleaf pine	Pinus	echinata
E			111	slash pine	Pinus	elliottii
	W		113	limber pine	Pinus	flexilis
E			115	spruce pine	Pinus	glabra
E			121	longleaf pine	Pinus	palustris
E	W		122	ponderosa pine	Pinus	ponderosa
E			123	Table Mountain pine	Pinus	pungens
E			125	red pine	Pinus	resinosa
E			126	pitch pine	Pinus	rigida
E			128	pond pine	Pinus	serotina
E			129	eastern white pine	Pinus	strobus
E			130	Scotch pine	Pinus	sylvestris
E			131	loblolly pine	Pinus	taeda
E			132	Virginia pine	Pinus	virginiana
E			136	Austrian pine	Pinus	nigra
	W		202	Douglas-fir	Pseudotsuga	menziesii
E			221	baldcypress	Taxodium	distichum
E			222	pondcypress	Taxodium	distichum var.nutans

East	West	Woodland	Code	Common Name	Genus	Species
E			241	northern white-cedar	Thuja	occidentalis
E			252	Florida torreya	Torreya	taxifolia
E	W		260	hemlock spp.	Tsuga	spp.
E			261	eastern hemlock	Tsuga	canadensis
E			262	Carolina hemlock	Tsuga	caroliniana
E			270	Australian pine	Causarina	spp.
E	W		299	Unknown dead conifer	UNKNOWN	UNKNOWN
	W	w	300	acacia	Acacia	spp.
E	W		310	maple spp.	Acer	spp.
E			311	Florida maple	Acer	barbatum
E	W		313	boxelder	Acer	negundo
E			314	black maple	Acer	nigrum
E			315	striped maple	Acer	pensylvanicum
E			316	red maple	Acer	rubrum
E			317	silver maple	Acer	saccharinum
E			318	sugar maple	Acer	saccharum
E			319	mountain maple	Acer	spicatum
E			320	Norway maple	Acer	platinoides
	W	w	321	Rocky Mountain maple	Acer	douglasii
E			323	chalk maple	Acer	leucoderme
E	W		330	buckeye, horsechestnut	Aesculus	spp.
E			331	Ohio buckeye	Aesculus	glabra
E			332	yellow buckeye	Aesculus	octandra
E			334	Texas buckeye	Aesculus	glabra var. arguta
E			341	ailanthus	Ailanthus	altissima
E			345	mimosa, silktree	Albizzia	julibrisson
E	W		351	red alder	Alnus	rubra
E			355	European Alder	Alnus	glutinosa
E			356	serviceberry	Amelanchier	spp.
E			367	pawpaw	Asimina	triloba
E	W		370	birch spp.	Betula	spp.
E			371	yellow birch	Betula	alleghaniensis
E			372	sweet birch	Betula	lenta
E			373	river birch	Betula	nigra
E			374	water birch	Betula	occidentalis
E	W		375	paper birch	Betula	papyrifera
E			378	northwesternpaper birch	Betula	papyrifera var.subcordata
E			379	gray birch	Betula	populifolla
E			381	chittamwood,gum bumelia	Bumelia	lanuginosa
E			391	American hornbeam,musclewood	Carpinus	caroliniana
E			400	hickory spp.	Carya	spp.
E			401	water hickory	Carya	aquatica
E			402	bitternut hickory	Carya	cordiformis
E			403	pignut hickory	Carya	glabra
E			404	pecan	Carya	illinoensis

East	West	Woodland	Code	Common Name	Genus	Species
E			405	shellbark hickory	Carya	laciniosa
E			406	nutmeg hickory	Carya	myristiciformis
E			407	shagbark hickory	Carya	ovata
E			408	black hickory	Carya	texana
E			409	mockernut hickory	Carya	tomentosa
E			410	sand hickory	Carya	pallida
E			421	American chestnut	Castanea	dentata
E			422	Allegheny chinkapin	Castanea	pumila
E			423	Ozark chinkapin	Castanea	ozarkensis
E			450	catalpa spp.	Catalpa	spp.
E			451	southern catalpa	Catalpa	bignonioides
E			452	northern catalpa	Catalpa	speciosa
E	W		460	hackberry spp.	Celtis	spp.
E			461	sugarberry	Celtis	laevigata
E			462	hackberry	Celtis	occidentalis
	W		463	netleaf hackberry	Celtis	reticulata
E			471	eastern redbud	Cercis	canadensis
E			481	yellowwood	Cladrastis	kentukea
E			491	flowering dogwood	Cornus	florida
E			500	hawthorn	Crataegus	spp.
E			501	cockspur hawthorn	Crataegus	crus-galli
E			502	downy hawthorn	Crataegus	mollis
E	W		510	eucalyptus	Eucalyptus	spp.
E			521	common persimmon	Diospyros	virginiana
E			531	American beech	Fagus	grandifolia
E	W		540	ash spp.	Fraxinus	spp.
E			541	white ash	Fraxinus	americana
E			543	black ash	Fraxinus	nigra
E			544	green ash	Fraxinus	pennsylvanica
E			545	pumpkin ash	Fraxinus	profunda
E			546	blue ash	Fraxinus	quadrangulata
E			548	Carolina ash	Fraxinus	caroliniana
E			551	waterlocust	Gleditsia	aquatica
E			552	honeylocust	Gleditsia	triacanthos
E			555	loblolly-bay	Gordonia	lasianthus
E			571	Kentucky coffeetree	Gymnocladus	dioicus
E			580	silverbell	Halesia	spp.
E			591	American holly	Ilex	opaca
E	W		600	walnut	Juglans	spp.
E			601	butternut	Juglans	cinerea
E	W		602	black walnut	Juglans	nigra
E			605	Texas walnut	Juglans	microcarpa
E			611	sweetgum	Liquidambar	styraciflua
E			621	yellow-poplar	Liriodendron	tuliperfia
E			641	Osage-orange	Maclura	pomifera
E			650	magnolia spp.	Magnolia	spp.
E			651	cucumbertree	Magnolia	acuminata
E			652	southern magnolia	Magnolia	grandiflora

East	West	Woodland	Code	Common Name	Genus	Species
E			653	sweetbay	Magnolia	virginiana
E			654	bigleaf magnolia	Magnolia	macrophylla
E			655	mountain magnolia	Magnolia	fraseri
E	W		660	apple spp.	Malus	spp.
E			661	Oregon crab apple	Malus	fusca
E			680	mulberry spp.	Morus	spp.
E			681	white mulberry	Morus	alba
E			682	red mulberry	Morus	rubra
E			691	water tupelo	Nyssa	aquatica
E			692	Ogechee tupelo	Nyssa	ogechee
E			693	blackgum	Nyssa	sylvatica
E			694	swamp tupelo	Nyssa	sylvatica var. biflora
E			701	eastern hophornbeam	Ostrya	virginiana
E			711	sourwood	Oxydendrum	arboreum
E			712	paulownia, empress-tree	Paulownia	tomentosa
E			721	redbay	Persea	borbonia
E			722	water-elm, planertree	Planera	aquatica
E	W		730	California sycamore	Platanus	racemosa
E			731	sycamore	Platanus	occidentalis
E	W		740	cottonwood and poplar spp.	Populus	spp.
E	W		741	balsam poplar	Populus	balsamifera
E			742	eastern cottonwood	Populus	deltoides
E			743	bigtooth aspen	Populus	grandidentata
E			744	swamp cottonwood	Populus	heterophylla
	W		745	plains cottonwood	Populus	deltoides ssp. monilifera
E	W		746	quaking aspen	Populus	tremuloides
	W		749	narrowleaf cottonwood	Populus	angustifolia
E			752	silver poplar	Populus	alba
E	W		760	cherry and plum spp.	Prunus	spp.
E			761	pin cherry	Prunus	pensylvanica
E			762	black cherry	Prunus	serotina
E			763	chokecherry	Prunus	virginiana
E			765	Canada plum	Prunus	nigra
E			766	wild plum	Prunus	americana
E	W		800	oak – deciduous	Quercus	spp.
E			802	white oak	Quercus	alba
E			804	swamp white oak	Quercus	bicolor
E			806	scarlet oak	Quercus	coccinea
E			808	Durand oak	Quercus	durandii
E			809	northern pin oak	Quercus	ellipsoidalis
E			812	southern red oak	Quercus	falcata var.falcata
E			813	cherrybark oak	Quercus	falcata var.pagodifolia
E			816	bear oak, scrub oak	Quercus	ilicifolia
E			817	shingle oak	Quercus	imbricaria
E			819	turkey oak	Quercus	laevis

East	West	Woodland	Code	Common Name	Genus	Species
E			820	laurel oak	Quercus	laurifolia
E			822	overcup oak	Quercus	lyrata
E			823	bur oak	Quercus	macrocarpa
E			824	blackjack oak	Quercus	marilandica
E			825	swamp chestnut oak	Quercus	michauxii
E	W		826	chinkapin oak	Quercus	muehlenbergii
E			827	water oak	Quercus	nigra
E			828	Nuttall oak	Quercus	nuttallii
E			830	pin oak	Quercus	palustris
E			831	willow oak	Quercus	phellos
E			832	chestnut oak	Quercus	prinus
E			833	northern red oak	Quercus	rubra
E			834	Shumard oak	Quercus	shumardii
E			835	post oak	Quercus	stellata
E			836	Delta post oak	Quercus	stellata var. mississippiensis
E			837	black oak	Quercus	velutina
E			838	live oak	Quercus	virginiana
E	W		839	interior live oak	Quercus	wislizeni
E			840	dwarf post oak	Quercus	stellata var. margaretta
E			841	dwarf live oak	Quercus	minima
E			842	bluejack oak	Quercus	incana
	W		845	Dwarf chinakapin oak	Quercus	prinoides
E	W		901	black locust	Robinia	pseudoacacia
E			911	Palmetto spp.	Sabal	spp.
E			919	western soapberry	Sapindus	drummondii
E			920	willow	Salix	spp.
E			921	peachleaf willow	Salix	amygdaloides
E			922	black willow	Salix	nigra
E			927	white willow	Salix	alba
E			931	sassafras	Sassafras	albidum
E			935	American mountain-ash	Sorbus	americana
E			936	European mountain-ash	Sorbus	aucuparia
E			950	basswood spp.	Tilia	spp.
E			951	American basswood	Tilia	americana
E			952	white basswood	Tilia	heterophylla
E			953	Carolina basswood	Tilia	americana var. caroliniana
E			970	elm spp.	Ulmus	spp.
E			971	winged elm	Ulmus	alata
E			972	American elm	Ulmus	americana
E			973	cedar elm	Ulmus	crassifolia
E			974	Siberian elm	Ulmus	pumila
E			975	slippery elm	Ulmus	rubra
E			976	September elm	Ulmus	serotina
E			977	rock elm	Ulmus	thomasii
E			989	mangrove	Rhizophora	mangle

East	West	Woodland	Code	Common Name	Genus	Species
E			992	melaleuca	Melaleuca	quinquenervia
E			993	chinaberry	Melia	azedarach
E			994	Chinese tallowtree	Sapium	sebiferum
E			995	tung-oil-tree	Aleurites	fordii
E			996	smoketree	Cotinus	obovatus
	W		997	Russian-olive	Elaeagnus	angustifolia
E			999	Unknown dead hardwood	UNKNOWN	UNKNOWN

Appendix 5 - Site Tree Selection Criteria and Species List

A. Eastern U.S. Site-Tree Selection Criteria

Ideally, site trees in the eastern U.S. should be between 20-70 years old. If preferred trees cannot be found in this age range, expand the age range to 15-120 years. Reject trees outside the 15-120 year age range, trees that exhibit signs of damage, trees with ring patterns that show signs of suppression, trees less than 5.0 inches DBH, trees with abnormalities at DBH, and trees with rotten cores. A list of preferred site-tree species are provided below. Site trees should be selected in the following order of preference:

1st Choice: representative of the stand, on the list below for your region.
2nd Choice: representative of the stand, on the list below for an adjoining eastern region.
3rd Choice: not representative of the stand, on the list below for your region.
4th Choice: not representative of the stand, on the list below for an adjoining eastern region.
Last Choice: any suitable non-woodland tree on the general tree list.

Note: NE = Northeast, NC = North Central, SO = Southern
NC Note: Site curves are located in a separate manual in order by Figure number.

Code	Common Name	Region	NC Figure Number
	Softwood Species		
012	balsam fir	NE, NC	55
043	Atlantic white-cedar	NE	
068	eastern redcedar	NE, NC	58
070	larch (introduced)	NE	
071	tamarack (native)	NE, NC	60
091	Norway spruce	NE	
094	white spruce	NE, NC	67
095	black spruce	NE, NC	70
097	Red spruce	NE	
105	jack pine	NE, NC	74
107	sand pine	SO	
110	shortleaf pine	NE, SO	79
111	slash pine	SO	
121	longleaf pine	SO	
125	red pine	NE, NC	95
128	pond pine	NE, SO	
129	eastern white pine	NE, NC, SO	103
130	Scotch pine	NE, NC	108
131	loblolly pine	NE, SO	109
132	Virginia pine	NE, SO	125
241	northern white cedar	NE, NC	126
261	eastern hemlock	NE	
	Hardwood Species		
316	Red maple	NE, NC	1
317	silver maple	NE, NC	1
318	sugar maple	NE, NC	3
371	yellow birch	NE, NC	6
375	paper birch	NE, NC	9

Code	Common Name	Region	NC Figure Number
402	bitternut hickory	NE, NC	10
407	shagbark hickory	NE, NC	10
462	hackberry	NE	53
531	American beech	NE	11
541	white ash	NE, NC	13
543	black ash	NE, NC	14
544	green ash	NE, NC	15
602	black walnut	NC	16
611	sweetgum	NE, SO	21
621	yellow-poplar	NE, SO	25
742	eastern cottonwood	NE, NC,SO	28
743	bigtooth aspen	NE, NC	32
746	quaking aspen	NE, NC	34
762	black cherry	NC	34
802	white oak	NE, NC,SO	41
806	scarlet oak	NE, SO	42
812	southern red oak	NE, SO	
813	cherrybark oak	NE, SO	48
817	shingle oak	NE, SO	49
827	water oak	NE, SO	
830	pin oak	NE, SO	49
832	chestnut oak	NE, SO	46
833	northern red oak	NE, NC, SO	48
835	post oak	NE, SO	41
837	black oak	NE, NC, SO	49
901	black locust	NE	50
951	American basswood	NE, NC	51
972	American elm	NE, NC	53

B. Western U.S. Site-Tree Selection Criteria

Ideally, site trees in the western U.S. should be between 35-80 years old. If preferred trees cannot be found in this age range, expand the age range to 15-250 years. Reject trees outside the 15-250 year age range, trees that exhibit signs of damage, trees with ring patterns that show signs of suppression, trees less than 5.0 inches DBH, trees with abnormalities at DBH, trees with rotten cores, and woodland species. A list of preferred site-tree species are provided below. Site trees should be selected in the following order of preference:

1st Choice: representative of the stand, on the list below for your region.
2nd Choice: representative of the stand, on the list below for an adjoining western region.
3rd Choice: not representative of the stand, on the list below for your region.
4th Choice: not representative of the stand, on the list below for an adjoining western region.
Last Choice: any suitable non-woodland tree on the general tree list.

Note: PNW = Pacific Northwest FIA, RMRS = Rocky Mountain FIA

Code	Common Name	Region
	---------- Softwood Species ----------	
011	Pacific silver fir	PNW
015	White fir	RMRS, PNW
017	Grand fir	RMRS, PNW
018	Corkbark fir	RMRS
019	Subalpine fir	RMRS, PNW
020	California red fir	RMRS, PNW
021	Shasta red fir	PNW
022	Noble fir	PNW
073	Western larch	RMRS, PNW
081	Incense-cedar	RMRS, PNW
093	Engelmann spruce	RMRS, PNW
094	White spruce	RMRS, PNW
095	black spruce	PNW
096	Blue spruce	RMRS
098	Sitka spruce	PNW
104	Foxtail pine	RMRS
108	Lodgepole pine	RMRS, PNW
109	Coulter pine	PNW
112	Apache pine	RMRS
116	Jeffrey pine	RMRS, PNW
117	Sugar pine	RMRS, PNW
119	Western white pine	RMRS, PNW
120	Bishop pine	PNW
122	Ponderosa pine	RMRS, PNW
135	Arizona pine	RMRS
201	Bigcone Douglas-fir	PNW
202	Douglas-fir	RMRS, PNW
211	Redwood	PNW
231	Pacific yew	PNW
242	Western redcedar	RMRS, PNW
263	Western hemlock	RMRS, PNW
264	Mountain hemlock	RMRS, PNW

Code	Common Name	Region
	---------- Hardwood Species ----------	
312	Bigleaf maple	PNW
351	Red alder	PNW
375	Paper birch	RMRS, PNW
741	Balsam poplar	RMRS, PNW
745	Plains cottonwood	RMRS
746	Quaking aspen	RMRS, PNW
747	Black cottonwood	RMRS, PNW
748	Fremont poplar	RMRS
749	Narrowleaf cottonwood	RMRS

Appendix 6. Determination of Stocking Values for Land Use Classification

Stocking values are required to determine if a CONDITION STATUS = 1 (accessible forest land) exists on a plot. This will determine which data items must be recorded for the condition. When the CONDITION STATUS is in question (usually a nonforest area that is in the process of reverting to forest land or a marginal site that can only support a low number of trees) the crew must determine if there is sufficient stocking to classify the condition as forest. A minimum stocking value of 10% is required for accessible forest land (unless the condition was previously forested, such as a recent clear cut).

The following tables show the number of trees per acre needed to achieve this minimum stocking value. In the determination of stocking for this purpose the field crew should consider the condition over its entire area, not just the trees and seedlings that would be tallied on the subplots and microplots, especially when the condition straddles the plot. Also, for stocking purposes only consider a clump of trees (e.g., stump sprouts) less than 5 in DBH to be a single tree.

The number of trees per acre need to obtain minimum stocking depends on the DBH of largest tree in the condition (not necessarily a tally tree) and the forest type of the condition, and the size of the trees. If the condition occurs on all 4 subplots and the trees are distributed fairly evenly over the entire condition area, the following steps can be used to determine if the condition has the minimum number of trees per acre for forest land:

Observe the diameter of the largest tree on the condition and classify the condition into one of the following groups, 5+, 4.0-4.9, 3.0-3.9, 2.0-2.9, 1.0-1.9 and < 1.0 in DBH classes. If a 5 in or larger tree is present, Table A6b will be used, otherwise use Table A6a.

Determine the appropriate forest type of the condition based on the tree species present in the condition and/or the forest type of similar conditions in the area. Forest type may be hard to determine, however if it is determined that the condition is forest, then a forest type must be assigned to the condition.

Estimate the number of trees per acre by the diameter classes shown from the appropriate table. When a condition exists on all 4 of the 24-ft radius subplots each tally tree (DBH $\geq$ 5.0 in) represents 6 trees per acre and each sapling (DBH $\geq$ 1.0 in to < 5.0 in) or seedling observed on the 4 microplots represents 75 trees per acre.

In sparse stands of smaller trees, a more accurate observation of trees per acre can be determined by observing trees < 5.0 in DBH on the 24-ft radius subplot. In many forest types no more than 180 trees per acre of the largest diameter class are needed to meet the minimum stocking requirements, a total of 30 trees on all 4 subplots, 7 or 8 smaller trees on each subplot will provide minimum stocking.

When trees of more than one diameter class are present, their contribution towards meeting the minimum must be combined. For example:

In a lodgepole pine forest type, largest tree in the condition is 5.0+ in DBH. If 15 or more 5.0-6.9 in trees are found on the four subplots the minimum of 90 trees per acre (Table A6b, 5th row, 6th column) would be met. In the same condition only 3 tally trees in the 13.0-14.9 in DBH class equal the18 trees per acre in that diameter class. If the tally were three 5.0-6.9 in trees (18/90 = 1/5 the minimum) and two 13.0-14.9 in DBH class trees (12/18=2/3 the minimum) the combined stocking does not meet the minimum (1/5 +2/3 < 1) and the condition would be classified nonforest.

Other things observed on the plot will influence in the determination of condition status. In the last lodgepole pine example, evidence of a recent disturbance that reduced the stocking (cutting, fire, etc.) should be considered. Also, a very uneven distribution of the trees across the condition may have can greatly change the observed number of trees per acre on plots installed across the condition.

If the condition does not cover all four subplots entirely, trees per acre must be expanded by an expansion factor. The expansion factor is equal to 400/sum of the percent of subplot area (%ARE) for the condition. The trees per acre value of every diameter class is multiplied by this expansion factor.

If the trees are not uniformly distributed throughout the condition or the condition occurs on only a small portion of the plot, (half the plot or less), use your best judgment in assigning status. You may place several additional temporary subplots in the condition in order to get a larger sample to base stocking on. When additional temporary subplots 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 subplots in a condition:

A. Consider locations 120.0 ft horizontal distance from the highest numbered subplot in the condition. First consider the location 0^{o} azimuth from the subplot center. If this location is unsuitable, consider in order locations at azimuth 120^{o}, and 240^{o}. When a suitable location has been found, establish the temporary subplot. Temporary subplots should be entirely within the condition (locations should not be within 24.0 ft of a mapped boundary).

B. If Step A fails to yield a suitable subplot location, repeat Step A at each of the next highest numbered regular subplot in the condition.

C. If Steps A and B have been exhausted and a suitable temporary subplot still has not been found, repeat Step A at each temporary subplot in turn beginning with the first temporary subplot that was established.

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

- Install the lowest temporary subplot off the highest established subplot, until all the established subplots have been exhausted.
- Then establish the lowest temporary subplot 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.

Table A6a. Number of trees per acre needed for minimum stocking (stocking value 10%) of forest land in conditions with no trees > 5 in DBH.

	DBH of largest tree in the condition														
	4.0-4.9					3.0-3.9				2.0-2.9			1.0-1.9		<1.0
	DBH of tally tree														
Forest type	4.0-4.9	3.0-3.9	2.0-2.9	1.0-1.9	<1.0	3.0-3.9	2.0-2.9	1.0-1.9	<1.0	2.0-2.9	1.0-1.9	<1.0	1.0-1.9	<1.0	<1.0
Spruce-fir	120	150	200	300	620	120	160	240	490	120	180	370	120	250	120
Western larch	150	190	260	410	990	160	220	340	800	170	270	600	180	400	200
Black spruce	120	150	190	260	430	110	140	200	340	100	140	260	90	170	90
Jack pine	90	110	150	240	530	90	130	190	420	100	150	320	100	210	110
Lodgepole pine	170	220	290	460	1090	180	250	380	870	190	300	660	200	440	220
Shortleaf pine	120	150	210	330	840	130	170	280	670	140	220	500	150	340	170
Slash pine	110	140	200	320	870	120	170	270	700	140	220	520	150	350	170
W. white pine	200	260	360	560	1350	220	300	460	1080	230	360	810	250	540	270
Long leaf pine	80	100	130	200	400	80	110	160	320	80	120	240	80	160	80
Ponderosa pine	140	180	240	380	910	150	200	310	730	160	240	550	170	360	180
Red pine	120	160	210	330	770	130	180	280	620	140	210	460	150	310	150
Pond pine	80	100	140	220	510	90	120	180	410	90	140	310	100	210	100
E. white pine	110	140	180	280	580	110	150	220	470	110	170	350	110	230	120
Loblolly pine	100	130	180	280	670	110	150	230	530	120	180	400	120	270	130
Douglas fir	120	150	200	310	670	120	170	250	540	130	190	400	130	270	130
N. white cedar	140	180	250	400	990	150	210	330	790	170	260	600	180	400	200
Eastern hemlock	120	150	210	360	1110	130	190	310	890	150	250	660	180	440	220
Western hemlock	180	220	300	480	1100	190	250	390	880	200	300	660	210	440	220
Redwood	220	280	380	600	1400	240	320	500	1120	250	380	840	260	560	280
Red maple	90	110	140	220	470	90	120	180	380	90	140	280	90	190	90
Red alder	70	90	110	170	340	70	90	140	270	70	100	200	70	130	70
Maple-beech-birch	80	100	140	230	590	90	120	190	480	100	150	360	110	240	120
Paper birch	80	110	150	240	640	90	130	200	510	100	160	380	110	250	130
Oak-hickory	70	90	120	190	430	80	100	160	350	80	120	260	80	170	90
Black walnut	60	80	110	160	340	70	90	130	270	70	100	210	70	140	70
Sweet gum	130	160	220	360	950	140	190	310	760	150	240	570	170	380	190
Aspen	70	90	120	190	380	70	100	150	300	80	110	230	80	150	80
Cherry-ash-y. poplar	80	100	130	180	310	80	100	140	250	70	100	190	70	120	60
Basswood	100	120	170	290	840	110	150	250	670	120	200	500	140	330	170
Elm-ash-cottonwood	80	100	140	230	600	90	120	190	480	100	150	360	110	240	120

Table A6b. Number of trees per acre needed for minimum stocking (stocking value 10%) of forest land in conditions with at least one tree 5 in DBH or larger.

	DBH of tally tree																	
Forest type	<1.0	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+
Spruce-fir	740	350	230	170	140	60	40	27	20	16	13	10	9	8	7	6	5	5
Western larch	1190	490	310	230	180	80	50	30	21	16	12	10	8	7	6	5	4	4
Black spruce	510	310	220	170	140	70	50	35	29	24	21	18	16	15	13	12	11	10
Jack pine	630	280	180	130	110	50	30	19	14	11	9	7	6	5	4	4	3	3
Lodgepole p.	1310	550	350	250	200	90	50	34	24	18	14	12	10	8	7	6	5	5
Shortleaf pine	1010	390	240	180	140	60	30	22	15	11	9	7	6	5	4	3	3	3
Slash pine	1040	380	230	170	130	60	30	20	13	10	7	6	5	4	3	3	2	2
W. white pine	1620	660	420	300	240	110	60	40	28	21	17	13	11	9	8	7	6	5
Long leaf pine	480	240	160	120	90	40	30	19	14	11	9	7	6	5	5	4	4	3
Ponderosa p.	1090	450	280	210	160	70	40	27	19	14	11	9	7	6	5	5	4	4
Red pine	930	400	250	180	150	70	40	25	18	14	11	9	7	6	5	5	4	4
Pond pine	620	260	170	120	100	40	30	17	12	9	7	6	5	4	3	3	3	2
E. white pine	700	330	220	160	130	60	40	24	18	14	11	9	8	7	6	5	5	4
Loblolly pine	800	330	210	150	120	60	30	20	14	11	8	7	6	5	4	3	3	3
Douglas fir	800	370	240	180	140	70	40	27	19	15	12	10	8	7	6	5	5	4
N. white ced.	1190	470	290	210	170	80	40	27	19	14	11	8	7	6	5	4	4	3
E. hemlock	1330	420	250	180	140	60	30	19	12	9	6	5	4	3	3	2	2	2
W. hemlock	1320	560	360	260	210	100	50	36	26	19	15	12	10	9	7	7	6	5
Redwood	1680	710	450	330	260	120	70	45	32	24	19	15	13	11	9	8	7	6
Red maple	560	260	170	130	100	50	30	19	14	11	9	7	6	5	4	4	4	3
Red alder	400	200	130	100	80	40	20	16	12	10	8	7	6	5	4	4	3	3
Map.-beech-bir.	710	270	170	120	90	40	20	15	10	7	6	4	4	3	3	2	2	2
Paper birch	760	280	170	130	100	50	20	15	10	7	6	4	4	3	3	2	2	2
Oak-hickory	520	230	150	110	80	40	20	15	11	8	7	5	4	4	3	3	2	2
Black walnut	410	190	130	90	80	30	20	14	11	8	7	6	5	4	4	3	3	2
Sweet gum	1150	430	260	190	150	70	40	23	16	12	9	7	6	5	4	3	3	3
Aspen	460	220	150	110	90	40	20	17	13	10	8	7	6	5	4	4	3	3
Cher.-ash-y. p.	370	220	150	120	100	40	30	23	18	15	13	11	10	9	8	7	7	6
Basswood	1000	340	200	150	110	50	30	16	11	8	6	4	4	3	2	2	2	2
Elm-ash-ctwd.	720	270	170	120	90	40	20	15	10	7	6	4	4	3	3	2	2	2

Appendix 7. Glossary

Accessible Forest Land – Land that is within sampled area (the population of interest), is accessible and can safely be visited, and meets at least one of the two following criteria:

(a) the condition is at least 10-percent stocked by trees of any size (appendix 3) or has been at least 10-percent stocked in the past. Additionally, the condition is not subject to nonforest use(s) that prevent normal tree regeneration and succession such as regular mowing, grazing, or recreation activities, or
b) in several western woodland types where stocking cannot be determined, and the condition has at least 5 percent crown cover by trees of any size, or has had at least 5 percent cover in the past. Additionally, the condition is not subject to nonforest use that prevent normal regeneration and succession such as regular mowing, grazing, or recreation activities.

ACTUAL LENGTH – For trees with broken or missing tops. The actual length of the tree is recorded to the nearest 1.0 ft from ground level to the highest remaining portion of the tree still present and attached to the bole. If the top is intact, this item may be omitted. Forked trees should be treated the same as unforked trees.

Agricultural Land – Land managed for crops, pasture, or other agricultural use. Evidence includes geometric field and road patterns, fencing, and the traces produced by livestock or mechanized equipment. The area must be at least 1.0 ac in size and 120.0 ft. wide at the point of occurrence.

Annular Plot – A circular, fixed area plot with a radius of 59.0 feet. Annular plots may be used for sample intensification or for sampling relatively rare events.

ARTIFICIAL REGENERATION SPECIES – Indicates the predominant species that is planted or seeded in an artificially regenerated condition.

Blind check – a re-installation done by a qualified inspection crew without production crew data on hand; a full re-installation of the plot for the purpose of obtaining a measure of data quality. The two data sets are maintained separately. Discrepancies between the two sets of data are not reconciled. Blind checks are done on production plots only.

Bole – The main stem of a tree, extending from one foot above the ground to the point on the tree where DOB reaches 4 inches

Boundary – The intersection of two or more conditions on a subplot or microplot. Each boundary is described by recording the azimuth and horizontal distance from the subplot or microplot center to the left and right points of where the boundary intersects the perimeter of the subplot or microplot. An azimuth and distance to a corner point may also be described, if one exists. If multiple boundaries exist at a subplot, they are recorded in the order of their occurrence on the subplot, starting from north and proceeding around the compass.

Census Water – Rivers and streams that are more than 200 feet wide and bodies of water that are greater than 4.5 acres in size.

Certification plot – a plot installed by a certification candidate. It may be a training plot or a production plot. The candidate working alone installs the plot.

Cold check – an inspection done either as part of the training process, or as part of the ongoing QC program. Normally the installation crew is not present at the time of inspection. The inspector has the completed data in-hand at the time of inspection. The inspection can include the whole plot or a subset of the plot. Data errors are corrected. Cold checks are done on production plots only.

CONDITION CLASS – The combination of discrete landscape and forest attributes that identify and define different strata on the plot. Examples of such attributes include condition status, forest type, stand origin, stand size, owner group, reserve status and stand density.

Cropland – Land under cultivation within the past 24 months, including orchards and land in soil improving crops, but excluding land cultivated in developing improved pasture.

CROWN CLASS – A classification of trees based on dominance in relation to adjacent trees within the stand as indicated by crown development and the amount of sunlight received from above and sides.

CUBIC-FOOT CULL – An assessment of the rotten, missing, or otherwise defective portions of a tree bole that are unsuitable for industrial wood products. Cubic-foot cull is expressed as a percentage of the entire bole.

Cull – Portions of a tree that are unusable for industrial wood products because of rot, form, or other defect. (See cubic-foot cull.)

Diameter at Breast Height (DBH) – The diameter of the bole of a tree at breast height (4.5 feet above the ground), measured outside of the bark.

Diameter at Root Collar (DRC) – The diameter of a tree measured at the ground line or stem root collar, measured outside of the bark.

Diameter Outside Bark (DOB) – A diameter that may be taken at various points on a tree, or log, **outside** of the bark. Diameter Outside Bark is often estimated.

Face -- A section of the tree surface (usually within the butt sixteen feet) that is ¼ of the circumference of the tree and extending the full length of the log.

Federal Information Processing Standard (FIPS) – A unique code identifying U.S. States and counties (or units in Alaska).

Forest Industry Land – Land owned by companies or individuals that operate wood-using plants.

Forest Land – Land that is at least 10 percent stocked by forest trees of any size, or land formerly having such tree cover, and is not currently developed for a nonforest use. The minimum area for classification as forest land is one acre. Roadside, stream-side, and shelterbelt strips of timber must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams and other bodies of water, or natural clearings in forested areas shall be classified as forest, if less than 120 feet in width or an acre in size. Grazed woodlands, reverting fields, and pastures that are not actively maintained are included if the above qualifications are satisfied. (Also see definitions of nonforest land, idle farmland and improved/maintained pasture.)

Forest Trees – Plants having a well-developed, woody stem and usually more than 12 feet in height at maturity.

FOREST TYPE – A classification of forest land based upon the trees or tree communities that constitute the majority of stocking on the site.

GPS – Global Positioning System. Information from this system is collected and used to determine the latitude and longitude of each plot.

Hardwoods – Dicotyledonous trees, usually broad-leaved and deciduous.

Hot check – an inspection normally done as part of the training process. The inspector is present on the plot with the trainee and provides immediate feedback regarding data quality. Data errors are corrected. Hot checks can be done on training plots or production plots.

Idle Farmland -- Former cropland or pasture that has not been tended within the last 2 years and that has less than 10 percent stocking with live trees.

Improved Pasture -- Land that is currently maintained and used for grazing. Evidence of maintenance, besides the degree of grazing, includes condition of fencing, presence of stock ponds, periodic brush removal, seeding, irrigation, or mowing.

Inclusion – An area that would generally be recognized as a separate condition, except that it is not large enough to qualify. For example, a ½ acre pond within a forested stand.

Industrial Wood – All roundwood products, except firewood.

Inspection crew – a crew of qualified QC/QA individuals whose primary responsibility is the training, certification and inspection of production crews.

Land Area – As defined by the Bureau of the Census: The area of dry land and land temporarily or partially covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean tide); streams, sloughs, estuaries and canals less than 200 feet in width, and ponds less than 4.5 acres in area.

Limbs – That part of a tree above the stump which does not meet the requirements for sawlog and upper-stem portions, including all live, sound branches to a minimum of 4 inches DOB at the knot collar.

Maintained Road – Any road, hard topped or other surfaces, that is plowed or graded periodically and capable of use by a large vehicle. Rights-of-way that are cut or treated to limit herbaceous growth are included in this area.

Marsh – Low, wet areas characterized by heavy growth of weeds and grasses and an absence of trees.

Measurement Quality Objective (MQO) – Describes the acceptable tolerance for each data element. MQOs consist of two parts: a statement of the tolerance and a percentage of time when the collected data are required to be within tolerance.

Merchantable Sawtimber Top – The point on the bole of sawtimber trees above which a sawlog cannot be produced. Minimum merchantable top is 7.0 inches DOB for softwoods and 9.0 inches DOB for hardwoods.

Microplot – A circular, fixed-radius plot with a radius of 6.8 feet that is used to sample trees less than 5.0 inches at DBH, as well as other vegetation.

National Forest Land – Federal lands which have been legally designated as National Forests or purchase units, and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones Title III lands.

Native American (Indian) Land – Tribal lands held in fee, or trust, by the Federal government but administered for Indian tribal groups and Indian trust allotments. This land is considered “Private Lands”, Owner Group 40.

Net volume – Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

Non-census Water – Bodies of water from 1 to 4.5 acres in size and water courses from 30 feet to 200 feet in width.

Nonforest Land -- Land that does not support, or has never supported, forests, and lands formerly forested where use for timber management is precluded by development for other uses. Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining rights-of-way, power line clearings of any width, and noncensus water. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and clearings, etc., more than one acre in size, to qualify as nonforest land.

Nonstockable – Areas of forest land that are not capable of supporting trees because of the presence of rock, water, etc.

Other Federal Lands – Federal land other than National Forests. These include lands administered by the USDI Bureau of Land Management, USDI National Park Service, USDI Fish and Wildlife Service, Department of Defense, Department of Energy, Army Corps of Engineers, and military bases.

Overgrown Knot – The scar left in the bark by a limb that has been completely overgrown, but still outlined by the circular configuration in the bark.

OWNER CLASS -- A variable that classifies land into fine categories of ownership.

OWNER GROUP – A variable that classifies land into broad categories of ownership; Forest Service, Other Federal Agency, State and Local Government, and Private. Differing categories of Owner Group on a plot require different conditions.

Phase 1 (P1) – FIA activities done as part of remote-sensing and/or aerial photography.

Phase 2 (P2) – FIA activities done on the network of ground plots formerly known as FIA plots.

Phase 3 (P3) – FIA activities done on a subset of Phase 2 plots formerly known as Forest Health Monitoring plots. Additional ecological indicator information is collected from Phase 3 plots.

Plot – A cluster of four subplots that samples approximately 1/6 acre. The subplots are established so that subplot 1 is centered within the sample and the centers of subplots 2, 3,and 4 are located 120 feet from the center of subplot 1 at azimuths of 360, 120, and 240 degrees, respectively. Each subplot has an associated microplot and annular plot

PRIVATE OWNER INDUSTRIAL STATUS – Indicates whether Private land owners own and operate a wood processing plant.

Production crew – a crew containing at least one certified individual. The crew is involved in routine installation of plots.

Production plot – a plot that belongs to the 6000-acre grid database. It may also be used for training purposes.

REGENERATION STATUS – A stand descriptor that indicates whether a stand has been naturally or artificially regenerated.

Regional drift – the tendency for standards, methods and interpretations to drift apart over time as each unit implements the FIA core protocol.

Reserved Land – Land that is withdrawn from timber utilization by a public agency or by law.

RESERVE STATUS – An indication of whether the land in a condition has been reserved.

Rotten Cull Tree – A live tree with less than 1/3 of its gross board-foot volume in logs that meet size, soundness and grade requirements, and more than ½ of the board-foot cull is due to rot. Or, a live poletimber size that prospectively will have less than 1/3 of its gross board-foot volume in logs that meet size, soundness and grade requirements, and more than ½ of the board-foot cull is due to rot.

Rough Cull Tree – A live tree with less than 1/3 of its gross board-foot volume in logs that meet size, soundness and grade requirements, and more than ½ of the board-foot cull is due to sound defects such as sweep, crook, etc. Or, a live poletimber size that prospectively will have less than 1/3 of its gross board-foot volume in logs that meet size, soundness and grade requirements, and more than ½ of the board-foot cull is due to sound defects such as sweep, crook, etc.

Roundwood Products – Logs, bolts or other round sections cut from trees for industrial or consumer uses. (Note: includes sawlogs veneer logs and bolts; cooperage logs and bolts; pulpwood, fuelwood; pilings; poles; posts; hewn ties; mine timbers; and various other round, split, or hewn products.)

Saplings – Live trees 1.0 to 4.9 inches DBH.

Seedlings – Live trees less than 1.0 DBH that are at least one foot tall.

Site Class – A classification of forest land that indicates the potential capacity to grow crops of industrial wood based on fully stocked natural stands.

Softwoods – Coniferous trees, usually evergreen having needles or scale-like leaves.

STAND AGE – A stand descriptor that indicates the average age of the live trees not overtopped in the predominant stand size-class of a condition.

STAND DENSITY – A stand descriptor that indicates the relative tree density of a condition class. The classification is based on the number of stems/unit area, basal area, tree cover, or stocking of all live trees in the condition which are not overtopped, compared to any previously defined condition class tree density.

STAND SIZE – A stand descriptor that indicates which size-class of trees that are not overtopped constitutes the majority of stocking in the stand.

State, County and Municipal Lands – Lands owned by states, counties, and local public agencies or municipalities, or lands leased to these government units for 50 years or more.

Stocking – The relative degree of occupancy land by trees, measured as basal area or the number of trees in a stand by size or age and spacing, compared to the basal area or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard.

Sound Knot or Limb – Knots or limbs that are intergrown, or encased, with the surrounding wood, and that show no sign s of decay. Bark may not be present on the limbs.

Subplot – A circular, fixed-area plot with a radius of 24.0 feet. Each subplot represents ¼ of the fixed plot sample unit.

TOTAL LENGTH – The total length of the tree, recorded to the nearest 1.0 ft from ground level to the tip of the apical meristem. For trees growing on a slope, measure on the uphill side of the tree. If the tree has a broken or missing top, the total length is estimated to what the length would be if there were no missing or broken top. Forked trees should be treated the same as unforked trees

Training plot – a plot established for training or certification purposes only. It does NOT belong to the 6000-acre grid database.

Transition Zone – An area where a distinct boundary between two or more different conditions cannot be determined.

Appendix 9. Tolerance / MQO / Value / Units Table

Core optional variables are in italics. n/a is not applicable.

Variable Name	Tolerance	MQO	Values	Units
Plot Level Data				
STATE	No errors	at least 99% of the time	Appendix 1	n/a
COUNTY	No errors	at least 99% of the time	Appendix 1	n/a
PLOT NUMBER	No errors	at least 99% of the time	0001 to 9999	n/a
SAMPLE KIND	No errors	at least 99% of the time	1 to 3	n/a
MANUAL VERSION	No errors	at least 99% of the time	1.1 and higher	n/a
YEAR	No errors	at least 99% of the time	Beginning with 1998, constant for a given year	year
MONTH	No errors	at least 99% of the time	Jan – Dec	month
DAY	No errors	at least 99% of the time	01 to 31	day
DECLINATION	*No errors*	*at least 99% of the time*	*-359.0 to 359.0*	*degrees*
TRAILS OR ROADS	No errors	at least 90% of the time	0 to 5	n/a
HORIZONTAL DISTANCE TO IMPROVED ROAD	No errors	at least 90% of the time	1 to 9	n/a
ROAD ACCESS	No errors	at least 90% of the time	0 to 4, 9	n/a
PUBLIC USE RESTRICTIONS	No errors	at least 90% of the time	0 to 3, 9	n/a
RECREATION USE 1	No errors	at least 90% of the time	0 to 7, 9	n/a
RECREATION USE 2	No errors	at least 90% of the time	0 to 7, 9	n/a
RECREATION USE 3	No errors	at least 90% of the time	0 to 7, 9	n/a
WATER ON PLOT	No errors	at least 90% of the time	0 to 5, 9	n/a
QA STATUS	No errors	at least 99% of the time	1 to 7	n/a
CREW TYPE	No errors	at least 99% of the time	1, 2	n/a
GPS UNIT	No errors	at least 99% of the time	0 to 4	n/a
GPS SERIAL NUMBER	No errors	at least 99% of the time	000001 to 999999	n/a
COORDINATE SYSTEM	No errors	at least 99% of the time	1,2	n/a
LATITUDE	+/- 140 ft	at least 99% of the time		degrees, seconds
LONGITUDE	+/- 140 ft	at least 99% of the time		degrees, seconds
UTM ZONE	No errors	at least 99% of the time	03-19Q and 03-19W	
EASTING (X) UTM	+/- 140 ft	at least 99% of the time		
NORTHING (Y) UTM	+/- 140 ft	at least 99% of the time		
AZIMUTH TO PLOT CENTER	+/- 3 degrees	at least 99% of the time	000 at plot center 001 to 360 not at plot center	degrees
DISTANCE TO PLOT CENTER	+/- 6 ft	at least 99% of the time	000 at plot center 001 to 200 if a Laser range finder not used 001 to 999 if a Laser range finder is used	feet
GPS ELEVATION		at least 99% of the time	-00100 to 20000	feet

Variable Name	Tolerance	MQO	Values	Units
GPS ERROR	No errors	at least 99% of the time	0 to 70 if possible 71 to 999 if an error < 70 cannot be obtained	feet
NUMBER OF READINGS	No errors	at least 99% of the time	1 to 999	n/a
GPS FILENAME	*No errors*	*at least 99% of the time*	*English, alpha-numeric*	*n/a*
PLOT-LEVEL NOTES	n/a	n/a	English, alpha-numeric	n/a
P3 HEXAGON NUMBER	No errors	at least 99% of the time		n/a
P3 PLOT NUMBER	No errors	at least 99% of the time	1 to 9	n/a
Condition Class Information				
CONDITION CLASS NUMBER	No errors	at least 99% of the time	1 to 9	n/a
CONDITION CLASS STATUS	No errors	at least 99% of the time	1 to 7	n/a
RESERVED STATUS	No errors	at least 99% of the time	0, 1	n/a
OWNER GROUP	No errors	at least 99% of the time	10, 20, 30, 40	n/a
FOREST TYPE	No errors	at least 99% of the time in group at least 95% of the time in type	Appendix 2	n/a
STAND SIZE CLASS	No errors	at least 99% of the time	0 to 6	class
REGENERATION STATUS	No errors	at least 99% of the time	0, 1	n/a
TREE DENSITY	No errors	at least 99% of the time	1 to 3	n/a
OWNER CLASS	No errors	at least 99% of the time	11-13; 21-25; 31-33; 41-45	class
PRIVATE OWNER INDUSTRIAL STATUS	No errors	at least 99% of the time	0, 1	n/a
ARTIFICIAL REGENERATION SPECIES	No errors	at least 99% of the time	Appendix 4	n/a
STAND AGE	+/- 10%	at least 95% of the time	000 to 997, 998, 999	year
DISTURBANCE 1	No errors	at least 99% of the time	00; 10; 20; 30-32;40-46; 50-54; 60; 70; 80	n/a
DISTURBANCE YEAR 1	+/- 1 year for 5-year measure. cycles +/ 2years for > 5-year measure. cycles	at least 99% of the time	Since the previous plot visit, or the past 5 years for plots visited for the first time; 9999 if disturbance occurs continuously over time	year
DISTURBANCE 2	No errors	at least 99% of the time	00; 10;20; 30-32;40-46; 50-54; 60; 70; 80	n/a

Variable Name	Tolerance	MQO	Values	Units
DISTURBANCE YEAR 2	+/- 1 year for 5-year measure. cycles +/ 2years for > 5-year measure. cycles	at least 99% of the time	Since the previous plot visit, or the past 5 years for plots visited for the first time; 9999 if disturbance occurs continuously over time	year
DISTURBANCE 3	No errors	at least 99% of the time	00; 10;20; 30-32;40-46; 50-54; 60; 70; 80	n/a
DISTURBANCE YEAR 3	+/- 1 year for 5-year measure. cycles +/ 2years for > 5-year measure. cycles	at least 99% of the time	Since the previous plot visit, or the past 5 years for plots visited for the first time; 9999 if disturbance occurs continuously over time	year
TREATMENT 1	No errors	at least 99% of the time	00, 10, 20, 30, 40, 50	n/a
TREATMENT YEAR 1	+/- 1 year for 5-year measure. cycles +/- 2 years for >5-year measure. cycles	at least 99% of the time	Since the previous plot visit, or the past 5 years for plots visited for the first time	year
TREATMENT 2	No errors	at least 99% of the time	00, 10, 20, 30, 40, 50	n/a
TREATMENT YEAR 2	+/- 1 year for 5-year measure. cycles +/- 2 years for >5-year measure. cycles	at least 99% of the time	Since the previous plot visit, or the past 5 years for plots visited for the first time	year
TREATMENT 3	No errors	at least 99% of the time	00, 10, 20, 30, 40, 50	n/a
TREATMENT YEAR 3	+/- 1 year for 5-year measure. cycles +/- 2 years for >5-year measure. cycles	at least 99% of the time	Since the previous plot visit, or the past 5 years for plots visited for the first time	year
PHYSIOGRAPHIC CLASS	No errors	at least 80% of the time	xeric: 11, 12, 13, 19 mesic: 21, 22, 23, 24, 25, 29 hydric: 31, 32, 33, 34, 35, 39	n/a
PAST NONFOREST / INACCESSIBLE LAND USE	No errors	at least 99% of the time	10-15; 20; 30-33; 40; 90-94	n/a
PRESENT NONFOREST LAND USE	No errors	at least 99% of the time	10-15; 20; 30-33; 40; 90-94	n/a

Variable Name	Tolerance	MQO	Values	Units
NONFOREST YEAR	+/- 1 year for 5-year measure. cycles +/- 2 years for > 5-year measure. cycles	at least 70% of the time	1999 or higher	year
NC LAND USE	No errors	At least 99% of the time	20,21,22,40,41,45,50, 51,52,53,54,55,56,57, 58,59,71,72,79,61,62, 64,65,66,67,68,69,80, 89,90,96,98,99	
Boundary Data				
SUBPLOT NUMBER	No errors	at least 99% of the time	1 to 4	n/a
PLOT TYPE	No errors	at least 99% of the time	1 to 3	n/a
BOUNDARY CHANGE	No errors	at least 99% of the time	0 to 3	n/a
CONTRASTING CONDITION	No errors	at least 99% of the time	1 to 9	n/a
LEFT AZIMUTH	+/- 10 degrees	at least 90% of the time	001 to 360	degrees
CORNER AZIMUTH	+/- 10 degrees	at least 90% of the time	000 to 360	degrees
CORNER DISTANCE	+/- 1 ft	at least 90% of the time	microplot: 1 to 7 subplot: 1 to 24 annular plot: 1 to 59	feet
RIGHT AZIMUTH	+/- 10 degrees	at least 90% of the time	001 to 360	degrees
Subplot Information				
SUBPLOT NUMBER	No errors	at least 99% of the time	1 to 4	n/a
SUBPLOT CENTER CONDITION	No errors	at least 99% of the time	1 to 9	n/a
MICROPLOT CENTER CONDITION	No errors	at least 99% of the time	1 to 9	n/a
SUBPLOT SLOPE	+/- 10 %	at least 90% of the time	000 to 155	percent
SUBPLOT ASPECT	+/- 10 degrees	at least 90% of the time	000 to 360	degrees
SNOW/WATER DEPTH	+/- 0.5 ft	At the time of measurement	0.0 to 9.9	feet
SUBPLOT/ANNULAR PLOT STATUS	No errors	at least 99% of the time	0, 1	n/a
SUBPLOT/ANNULAR PLOT CONDITION LIST	*No errors*	*at least 99% of the time*	*1000 to 9876*	*n/a*
Tree and Sapling Data				
SUBPLOT NUMBER	No errors	at least 99% of the time	1 to 4	n/a
TREE RECORD NUMBER	No errors	at least 99% of the time	000, 001 to 999	n/a
CONDITION CLASS NUMBER	No errors	at least 99% of the time	1 to 9	n/a
AZIMUTH	+/- 10 degrees	at least 90% of the time	001 to 360	degrees

Variable Name	Tolerance	MQO	Values	Units
HORIZONTAL DISTANCE	microplot:+/- 0.2ft subplot: +/- 1.0 ft annular plot: +/- 3.0 ft	at least 90% of the time	microplot: 00.1 to 6.8 subplot: 00.1 to 24.0 annular plot: 00.1 to 58.9	feet
TREE STATUS	No errors	at least 95% of the time	0 to 4	n/a
NEW TREE RECONCILE	No errors	at least 95% of the time	1 to 4	n/a
MORTALITY	*No errors*	*at least 85% of the time*	*0, 1*	*n/a*
LEAN ANGLE	No errors	at least 99% of the time	0, 1	n/a
SPECIES	No errors	at least 99% of the time for genus at least 95% of the time for species	Appendix 4	n/a
DIAMETER	+/- 0.1 inch per 20 inches of diameter on trees with a measured diameter	at least 95% of the time	0001 to 9999	inches
DIAMETER CHECK	No errors	at least 99% of the time	0 to 2	n/a
ROTTEN / MISSING CULL	+/- 10%	at least 90% of the time	0 to 99	percent
TOTAL LENGTH	+/- 10% of true length	at least 90% of the time	005 to 400	feet
ACTUAL LENGTH	+/- 10% of true length	at least 90% of the time	005 to 400	feet
LENGTH METHOD	No errors	at least 99% of the time	1 to 3	n/a
CROWN CLASS	No errors	at least 85% of the time	1 to 5	n/a
UNCOMPACTED LIVE CROWN RATIO	+/- 10%	at lest 90% of the time	00 to 99	percent
COMPACTED CROWN RATIO	+/- 10%	at least 80% of the time	00 to 99	percent
DAMAGE LOCATION 1	+/- 1 location class	at least 80% of the time	0 to 9	class
DAMAGE TYPE 1	No errors	at least 80% of the time	1-5; 11-13; 20-25; 31	n/a
DAMAGE SEVERITY 1	No errors	at least 80% of the time	Defined for each DAMAGE TYPE	class
DAMAGE LOCATION 2	+/- 1 location class	at least 80% of the time	0 to 9	class
DAMAGE TYPE 2	No errors	at least 80% of the time	1-5; 11-13; 20-25; 31	n/a
DAMAGE SEVERITY 2	No errors	at least 80% of the time	Defined for each DAMAGE TYPE	class
CAUSE OF DEATH	No errors	at least 80% of the time	10 to 90	n/a
MORTALITY YEAR	+/- 1year for 5-year measure. cycles +/- 2years for > 5-year measure. cycles	at least 70% of the time	1995 or higher	year
DECAY CLASS	+/- 1 class	at least 90% of the time	1 to 5	class
UTILIZATION CLASS	No errors	at least 99% of the time	0, 1	n/a
LENGTH TO DIAMETER MEASUREMENT POINT	*+/- 0.2 ft*	*at least 90% of the time*	*0.1 to 15.0*	*inches*

Variable Name	Tolerance	MQO	Values	Units
PERCENT ROUGH CULL	*+/- 10 %*	*at least 90% of the time*	*00 to 99*	*percent*
MISTLETOE CLASS	*+/- 1 class*	*at least 90% of the time*	*0 to 6*	*class*
NC TREE CLASS	No errors	at least 90% of the time	20,30,31,40-45	n/a
NC TREE GRADE	No errors	at least 90% of the time		n/a
NC DAMAGE AGENT	No errors	at least 90% of the time		n/a
NC MOAG	No errors	at least 90% of the time		n/a
TREE NOTES	n/a	n/a	English, alpha-numeric	n/a
Seedling Data				
SUBPLOT NUMBER	No errors	at least 99% of the time	1 to 4	n/a
SPECIES	No errors	at least 99% of the time for genus at least 95% of the time for species	Appendix 4	n/a
CONDITION CLASS				
SEEDLING COUNT	No errors	at least 95% of the time	1 to 5 exact count 6 more than 5 individuals by species by condition class	number
Site Tree Information				
CONDITION CLASS LIST	No errors	at least 99% of the time	1 to 9 or 10000 to 98765	n/a
SPECIES	No errors	at least 99% of the time for genus at least 95% of the time for species	Appendix 5	n/a
DIAMETER	+/- 0.1 inch per 20 inches of diameter on trees with a measured diameter	at least 95% of the time	0001 to 9999	inches
SITE TREE LENGTH	+/- 10% of true length	at least 90% of the time	001 to 999	feet
TREE AGE AT DIAMETER	+/- 5 years	at least 95% of the time	001 to 999	year
SITE TREE NOTES	n/a	n/a	English, alpha-numeric	n/a
SUBPLOT NUMBER	No errors	at least 99% of the time	1 to 4	n/a
AZIMUTH	+/- 10 degrees	at least 90% of the time	001 to 360	degrees
HORIZONTAL DISTANCE	+/-5 ft	at least 90% of the time	000.1 to 200.0	feet

Appendix 10. North Central Regional Helps

List of specific instructions on re-measurement by State

Indiana and Illinois-

Trees:

If the last measure was cycle 4 there was a 4 point plot installed at the plot location. All old trees must be accounted for on the subplot and any new trees that grew into the subplot. All Tree status codes are valid. The microplot done on the plot at cycle 4 will not be re-measured, install the microplot in the new offset position and measure all trees less than 5.0 inches.

If the last cycle the plot was done was prior to cycle 4 then the old subplots are not being measured and a new 4 point plot (1-4) is being installed. No old trees. Only tree status codes of 1 & 2 are valid.

If the tree was live the first time the plot was measured with the 4 point design and has since died Total Length (THGT) will be recorded on the tree.

Condition examples:

The following are some examples of how to handle conditions that change or boundaries that change from one measurement to the next.

Example 1:
two previous conditions which occur on subplots 1-4
the second condition has changed so that it is now the same as the condition it was previously separated from

What to do:
Record one condition. This plot will be sent out with only one condition the next time it is measured.

Example 2:
more than one condition in the previous measure
still the same conditions and you agree with the mapping within the manual guidelines

What to do:
Record as was recorded last measure but increase the age to reflect time.

Example 3:
more than one condition occurs on the plot
more than one condition was recorded on the plot last measure
this visit the condition boundaries are totally different

What to do:
Record the conditions as you see them and do not worry about matching the last measure.

List of data items collected on trees by tree status and subplot number for Indiana an Illinois.

	Tree Status Codes (Four-Point plot installed before 10/1/1999)											
Tree Data Items	**NEW SUBPLOTS** 1-4 dbh < 5.0"	Totally NEW SUBPLOTS 1-4 dbh ≥ 5.0"		OLD SUBPLOTS 1-4**** dbh < 5.0"	OLD SUPLOTS 1-4 REMEASURED dbh ≥ 5.0"							OLD SUBPLOTS 101-105 AND 112-115
	1	**1**	**2**		**1**	**2**	**3**	**4**	**0**			
Sub#	X	X	X	Not re-measured	X	X	X	X	X			Not re-measured
Tree#	X	X	X		X	X	X	X	X			
TYPE	X	X	X		X	X	X	X				
DIST	X	X	X		X	X	Z	Z	Z			
DBH	X	X	X		X	X	X[V]	X[V]				
DIAH	X	X	X		X	X						
DCHE	X	X	X		X	X						
SPP	X	X	X		X	X	Z	Z	Z			
LEAN		X	X		X	X						
TCC/DEC	X	X	X		X	X						
STAT	X	X	X		X	X	X	X	X			
UTIL							X					
DECA			X			X*						
CRC	X	X			X							
CCC	X	X			X							
AZM	X	X	X		X	X	Z	Z	Z			
CON#	X	X	X		X	X	X	X	X			
THGT	P3	X	X		X							
ACTU	P3	X	X		X	X*						
METH	P3	X	X		X							
TRGD		X			X							
ROTT		X			X							
CAUS						W	W					
LOC12		X			X							
DAM12		X			X							
SEV12		X			X							
NCD12		X			X							

**** No microplots will be re-measured if they were placed at subplot center in the past visit.
X = record this data for tree status and subplot listed
X* = only if standing dead; not for re-measured tree now down and dead
Z = leave old data in this field (unless on status 3 trees you are able to measure the DBH)
W = only record this if the tree was live at time 1 (first time the tree was recorded)
X[V] = record DBHO if unable to measure current DBH

Iowa, Wisconsin, Michigan, Minnesota, Missouri –

Trees:

Following the SK and NCSK rules: All old trees with past DBH 5.0" or larger will be re-measured on subplots 101-105. On subplots 101-103 all old trees with past DBH 1.0" to 4.9" will be re-measured within a 6.8' radius of the subplot center.

A new 4 point plot (subplots 1-4) with the offset microplot will be installed at each sample location, unless the SK=0 and NCSK=0.

Conditions:

All old conditions on the 10 point plot will be redefined as new on the 4 point plot.

Boundary:

Mapping of the 10 point plot will not be remapped, subplots 101-105 should have no Boundary Data. All conditions are mapped as new on the 4 point plot.

Subplots that were rotated:

All subplots 101-105 will be re-measured in the location they were last measured at. This may be in a rotated location. See the old plot map to determine where these subplots may be located.

North Dakota, Kansas, Nebraska, South Dakota

All plots in these states outside the Black Hills of South Dakota are new plots with no re-measurement or re-location of any old plot data.

The Black Hills National Forest of South Dakota does have re-measurement plots that were last measured with the modified four-point design. They were done as a fixed radius subplot of 24.0 feet radius with a microplot located at subplot center with a radius of 6.8 feet. All trees on the subplot will be re-measured and treated as re-measurement trees (All tree status codes are valid). The old microplot will not be re-measured. All trees less than 5.0 inches DBH will be tallied on the new microplot location, 12 feet at 90 degrees from subplot center.

Procedure to calibrate your eye for tree length estimation:

A suggested process of estimated and actually measured heights would be as follows:

- Trees 1 and 2. Estimate height first, then measure height. Make adjustment based on original estimate and ensuing actual measurement. Adjust ensuing height estimates by correction factor.
- Trees 3 and 4. Estimate height.
- Tree 5. Estimate height first, then measure height. Make adjustment based on original estimate and ensuing actual measurement. Adjust ensuing height estimates by correction factor.
- Trees 6 through 9. Estimate height.
- Tree 10. Estimate height first, then measure height. Make adjustment based on original estimate and ensuing actual measurement. Adjust ensuing height estimates by correction factor.
- Trees 11 through 15. Estimate height.
- Tree 16. Estimate height first, then measure height. Make adjustment based on original estimate and ensuing actual measurement. Adjust ensuing height estimates by correction factor.
- Estimate heights on all remaining trees on plot.

This process of estimation and checking with measurement should be initiated on a daily basis. Each day the field crew member should check their estimates and incorporate their correction factor.

To calculate the correction factor, use the following:

$$\text{Correction factor} = \frac{\text{Actual height measurement}}{\textbf{Estimated height}}$$

For example, tree number one's height is estimated to be 50 feet. After the height is estimated, the tree is measured with an actual height measurement of 45 feet. In this example, the correction factor would be 45/50 = 0.9. If a similar result is obtained for tree number 2 (a correction factor of ~0.9), the estimated heights for trees 3 and 4 should be corrected by a factor of 0.9. If tree 3 is estimated to be 60 feet in height, applying a correction factor of 0.9 would give a tree height of 54 feet. Continue to use the most recent correction factor until a new correction factor is determined by actual height measurements for tree numbers 5, 10, and 16. After a sufficient number of trees have been estimated and actually measured, the field crew member should be able to incorporate their correction factor into their original height estimate.

Cochran, W.G. 1963. **Sampling techniques second edition**. P. 327-354. John Wiley and Sons, Inc. New York.

Stubbendieck, J.; Schacht, W. 1986. **Rangeland analysis laboratory manual**. Lincoln, NE: University of Nebraska-Lincoln, Department of Agronomy. 98 p.

Tree Grade & Tree Class

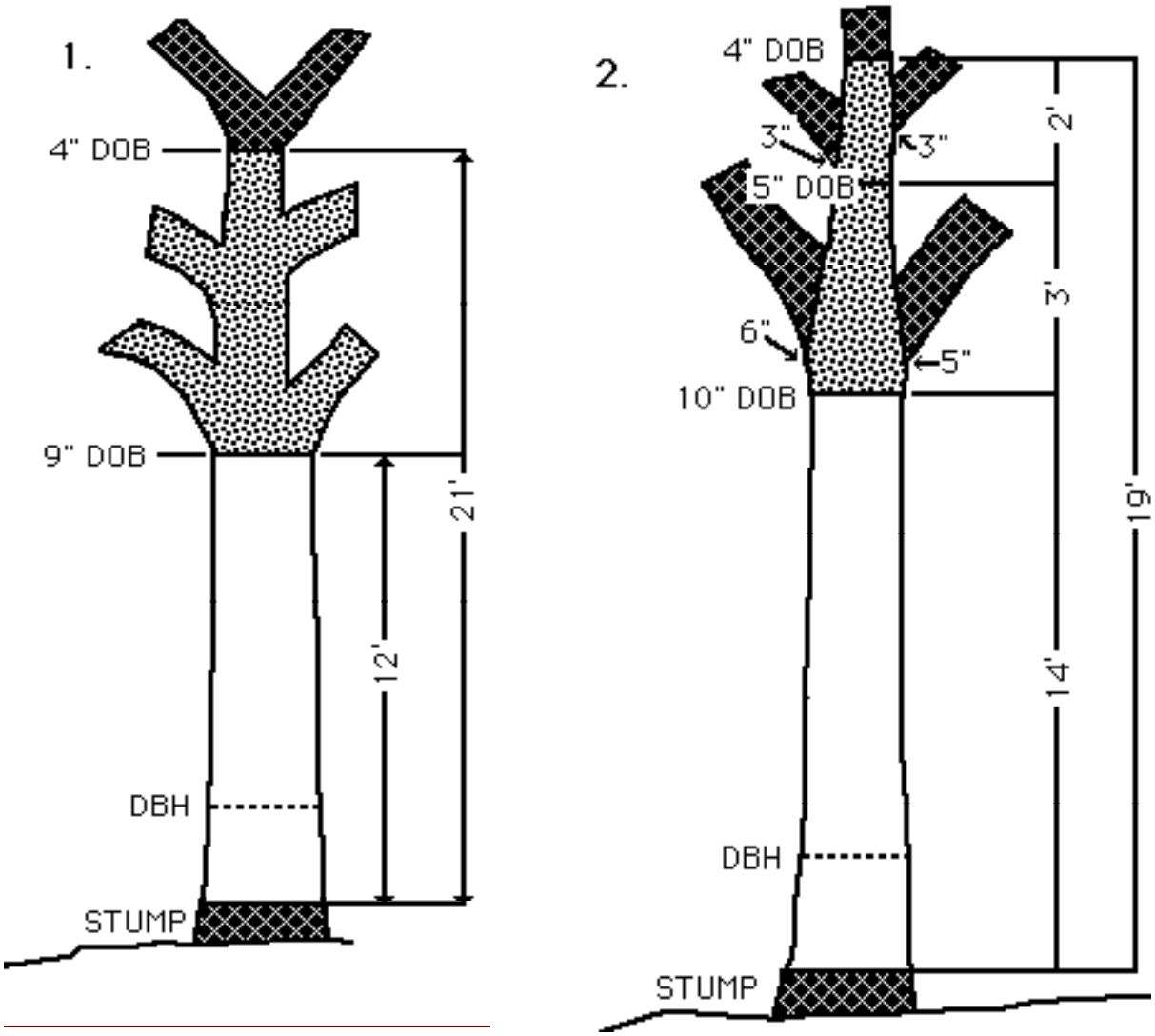
On the following pages are examples explaining tree classification

1. Tree class decision trees for pole or large sapling sized trees
2. Tree class decision tree for saw-log sized trees
3. Figures 10.1 – 10.5 Hardwood trees are represented in the figures, however softwoods may be implied using a minimum 7.0" saw-log top DOB.

There are also several pages on tree grading including:

4. Tree grading: defects
5. Tree grade decision tree for hardwood grades
6. Tree grade decision tree for softwood grades

Figure 10.1



1. A GROWING-STOCK HARDWOOD SAWTIMBER TREE

Sawlog length terminates at 9" top DOB. The sawlog meets both minimum log-grade specifications and the minimum12-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

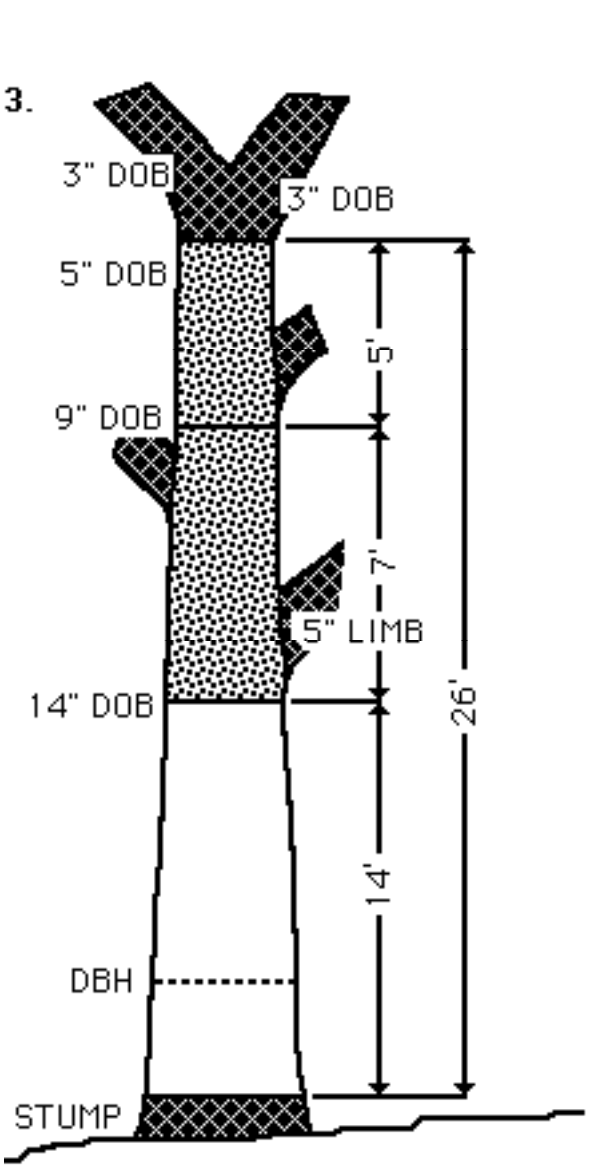
Upper stem (Pulpwood)

1-foot stump, top, and limbs

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

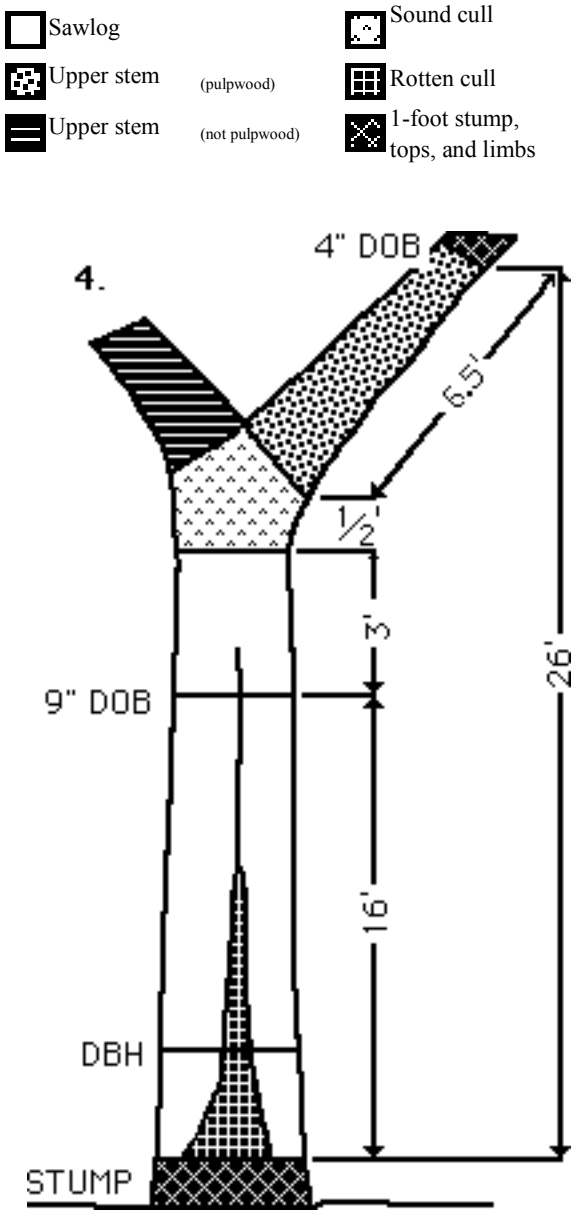
Sawlog portion is terminated by limbs creating a full diameter stopper. Each limb is over 2" in diameter, and their sum exceeds the diameter at the stopping point (10" DBH). The sawlog contains no cull and meets minimum grade specifications. Sawlog length is 14 feet. The upper-stem portion contains no 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 10.2



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

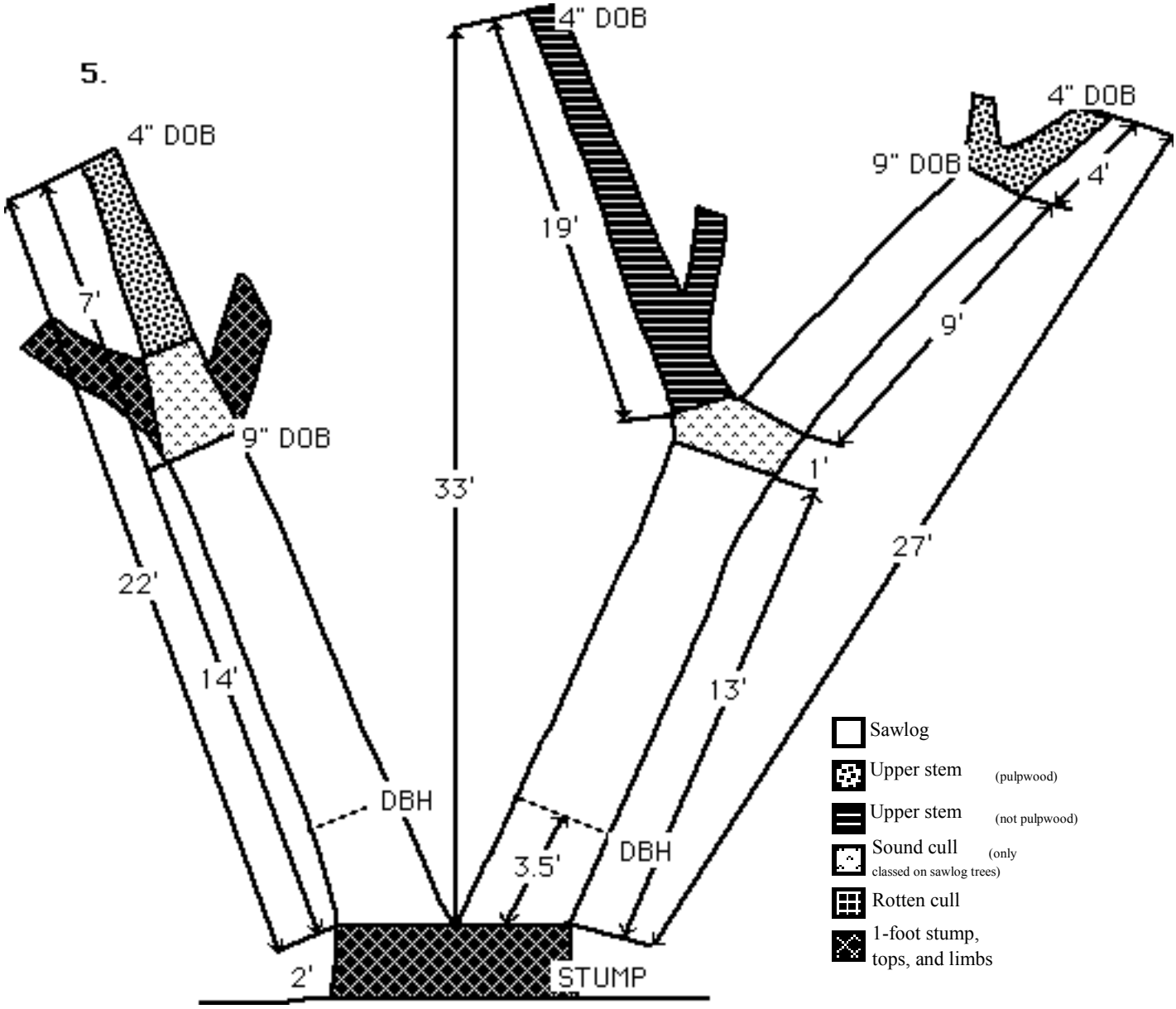
There are no sawlogs in the 21-foot sawlog portion that have minimum clear-panel length to meet hardwood factory log-grade 3 specifications, but the bottom 14 feet contain no rot or sweep and meets hardwood construction-grade 4 specifications. The sawlog terminates at 14 feet, because the 5-inch diameter 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 10.3

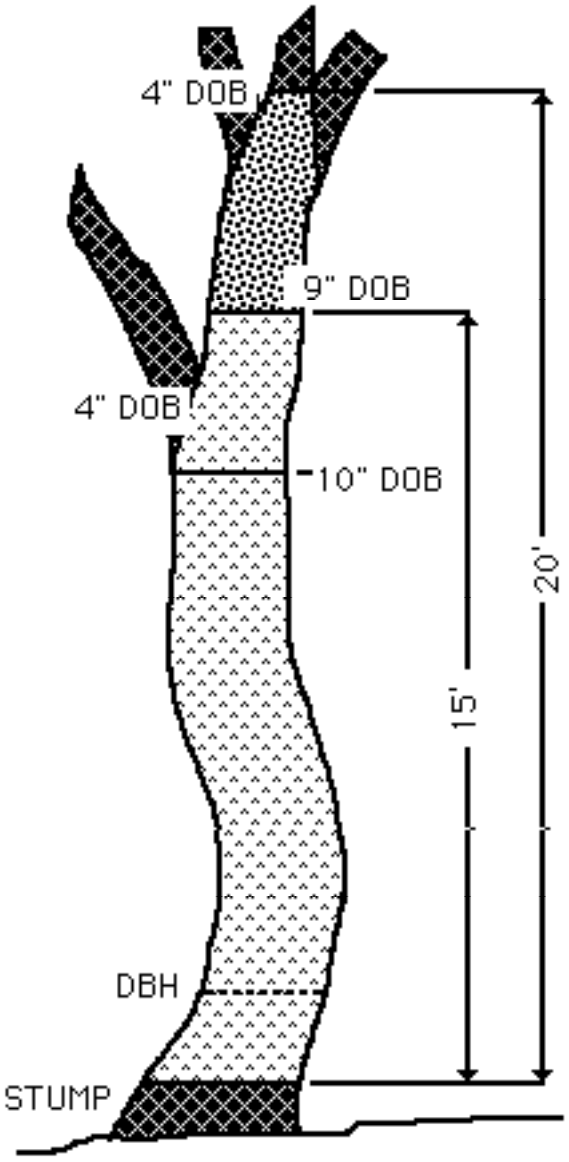


5. TWO HARDWOOD SAWTIMBER TREES

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.

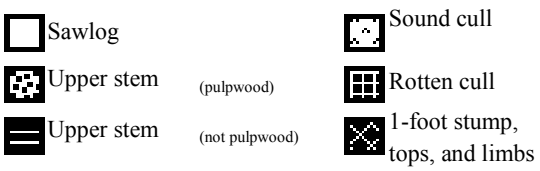
In the right-hand tree, a 13-foot merchantable sawlog, plus a 9-foot merchantable sawlog in the right-hand fork (with an intervening one-foot section of sound cull) is recorded as 23 feet of sawlog length. A 4-foot section of the right-hand fork meets pulpwood specifications, making the bole length 27 feet. 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.

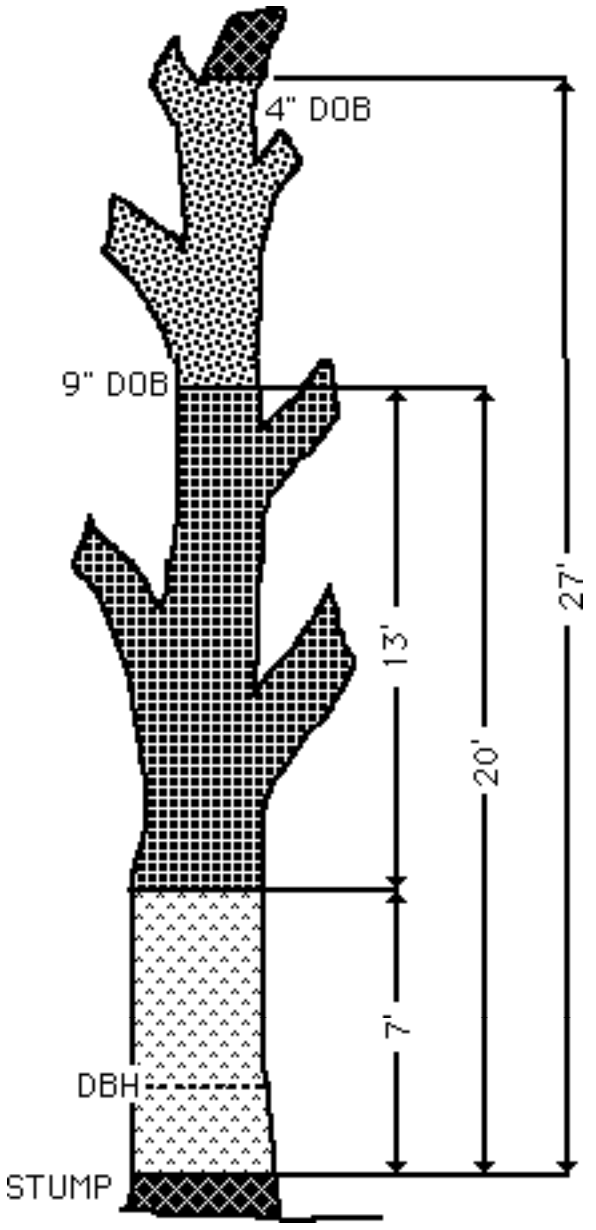
Figure 10.4



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). Bole length is taken 20 feet to the 4-inch DOB. Cull cubic foot is zero.

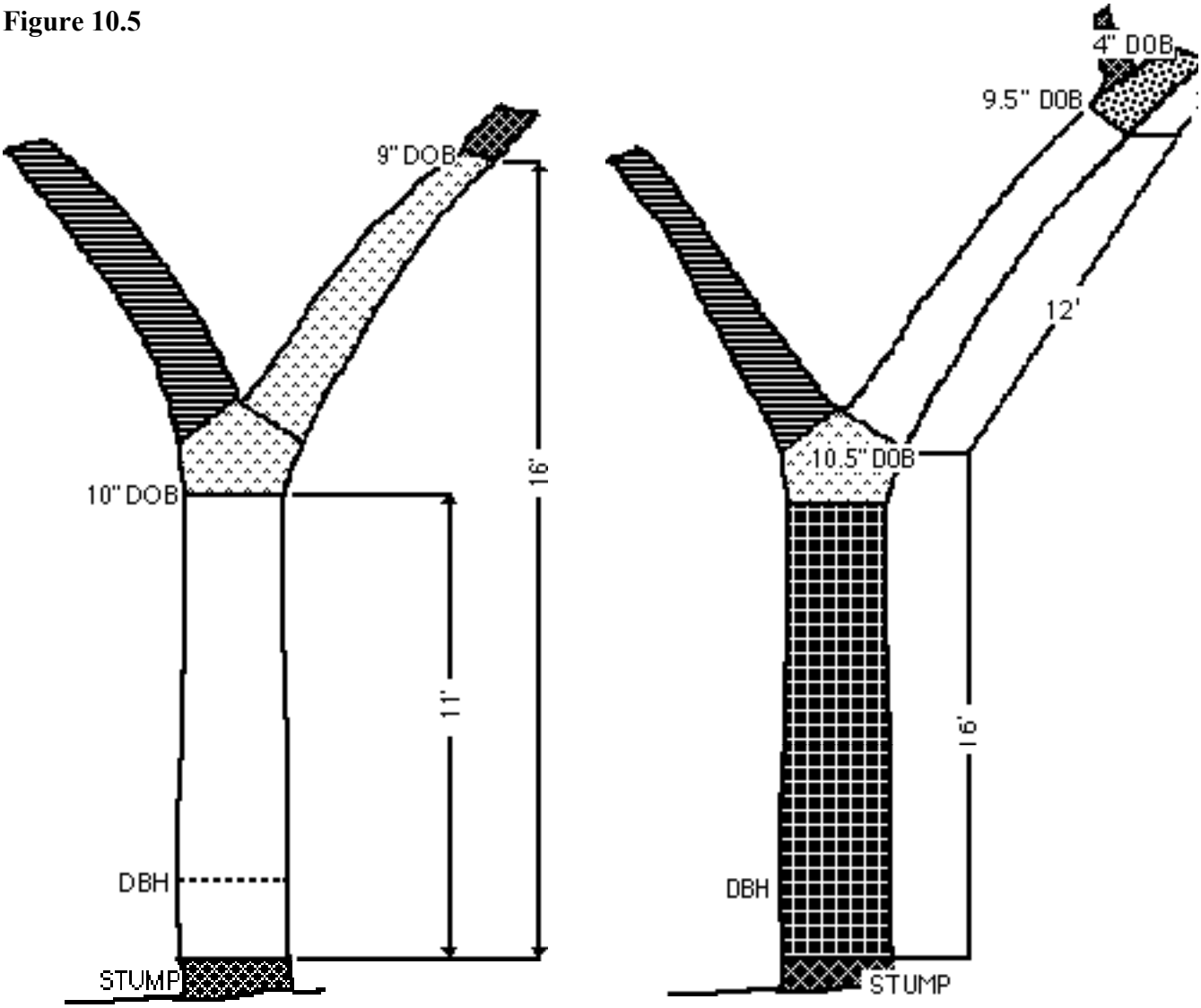




7. A ROTTEN HARDWOOD SAWTIMBER TREE

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). Bole length is 27 feet and cubic-foot cull represents only the rotten cubic-foot volume within the 13-foot rotten section.

Figure 10.5



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. 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
Upper stem (pulpwood)
Upper stem (not pulpwood)
Sound cull
Rotten cull
1-foot stump, tops, and limbs

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.
Bole length and cubic-foot cull are handled in the same way as for other trees, culling out for rot and missing wood only.

TREE GRADING : DEFECTS

1-BIRD PECK

- 4 per sq. foot are needed to be considered a defect
- not a defect in softwoods
- a grade 3 log can not be dropped to a grade 4 solely due to bird peck

2- <u>BUMPS</u>

- Need to have 1" rise in a 1' section to be considered a defect – in all species

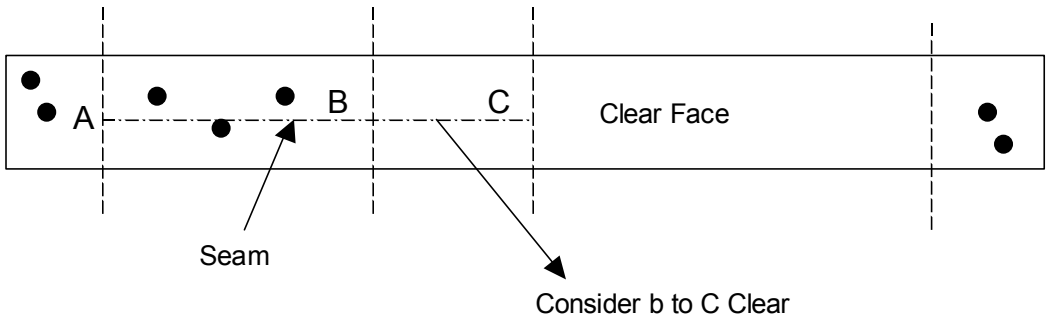
3- <u>SEAMS / FROST CRACKS / ECT…</u>

- tight seams contain no rot
- All seams are considered unsound and not permited for grade 4.

*try to put a straight seam on the boundary of 2 of your faces
if you can, thus eliminating it as a defect

*when a seam enters a clear cutting it can be overlaid with
your clear cutting 1/3 of its length

- **THIS IS THE 1/3 RULE:**

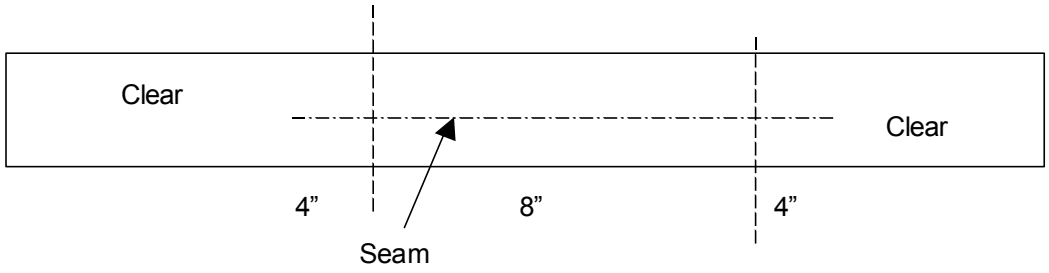


A >>B = 8"
B >> C = 4"
A >> C = 12"

- we are allowed to extend our clear face 4" into the 12" seam
- so we would consider "b>>c" clear!!!

- if a seam falls entirely inside a clear face , you can enter the seam ¼ of its total length on each end.

- **THIS IS CALLED TO ¼ RULE:**



4- **OVER GROWTH OF UNCERTAIN ORIGIN**

- faint or indistinct breaks in the normal bark pattern.
- no distinctive outline that allows us to tell what happened from surface appearance

REQUIREMENTS:

- if a distortion breaks up the bark pattern & stands out as being different from the rest of the bole (heavy)

  a defect on all trees and grades

- if the distortion is starting to blend in with the normal bark pattern on the bole (light)

  ** not a defect at all**

5 – WOUNDS:

- injuries that expose sapwood / heartwood

** new wounds (less than 1 year old) are disregarded as long as deterioration is not visible

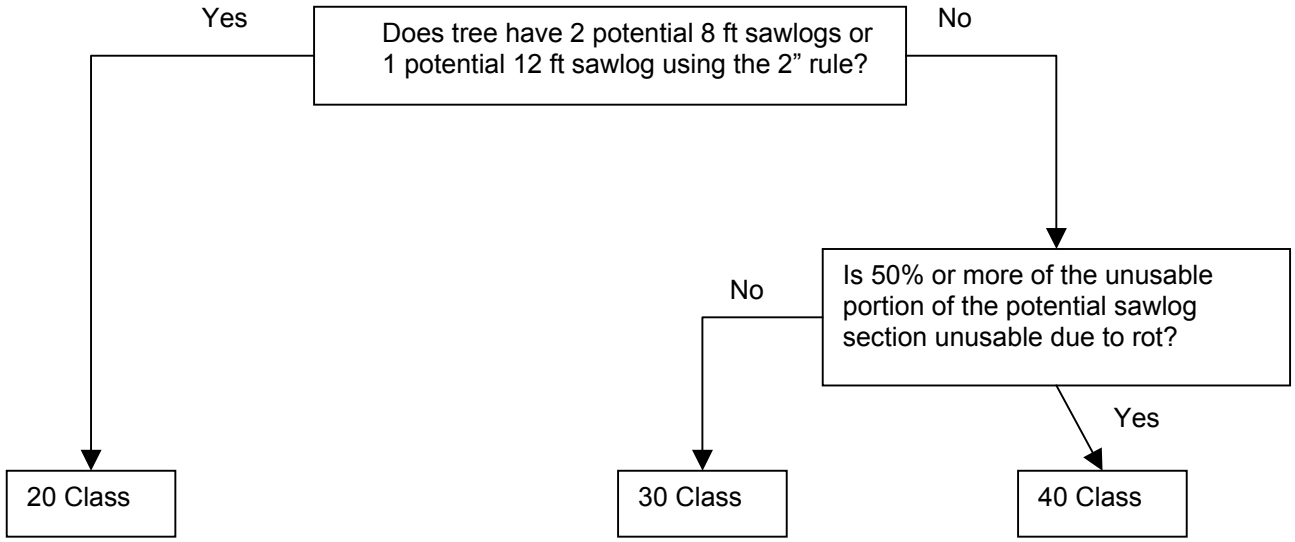
** old wounds are commonly associated with stain / decay / insects >>>> the affected area becomes a defect

** if new or old wounds look superficial just disregard them

6- BURLS:

- A SOUND WOODY PROTUBERANCE ON THE BOLE

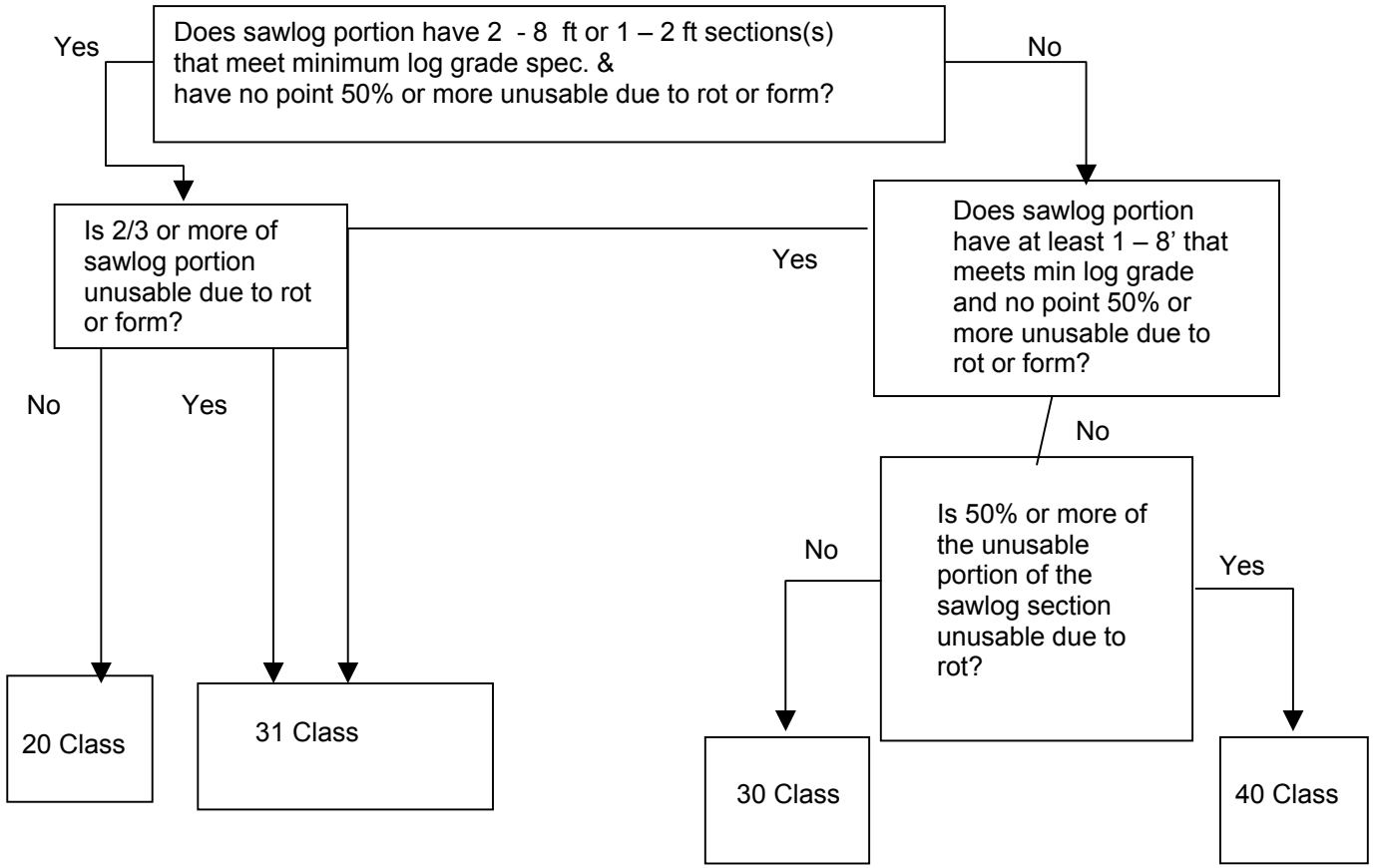
Tree Class Decision Tree
Pole or large sapling sized trees



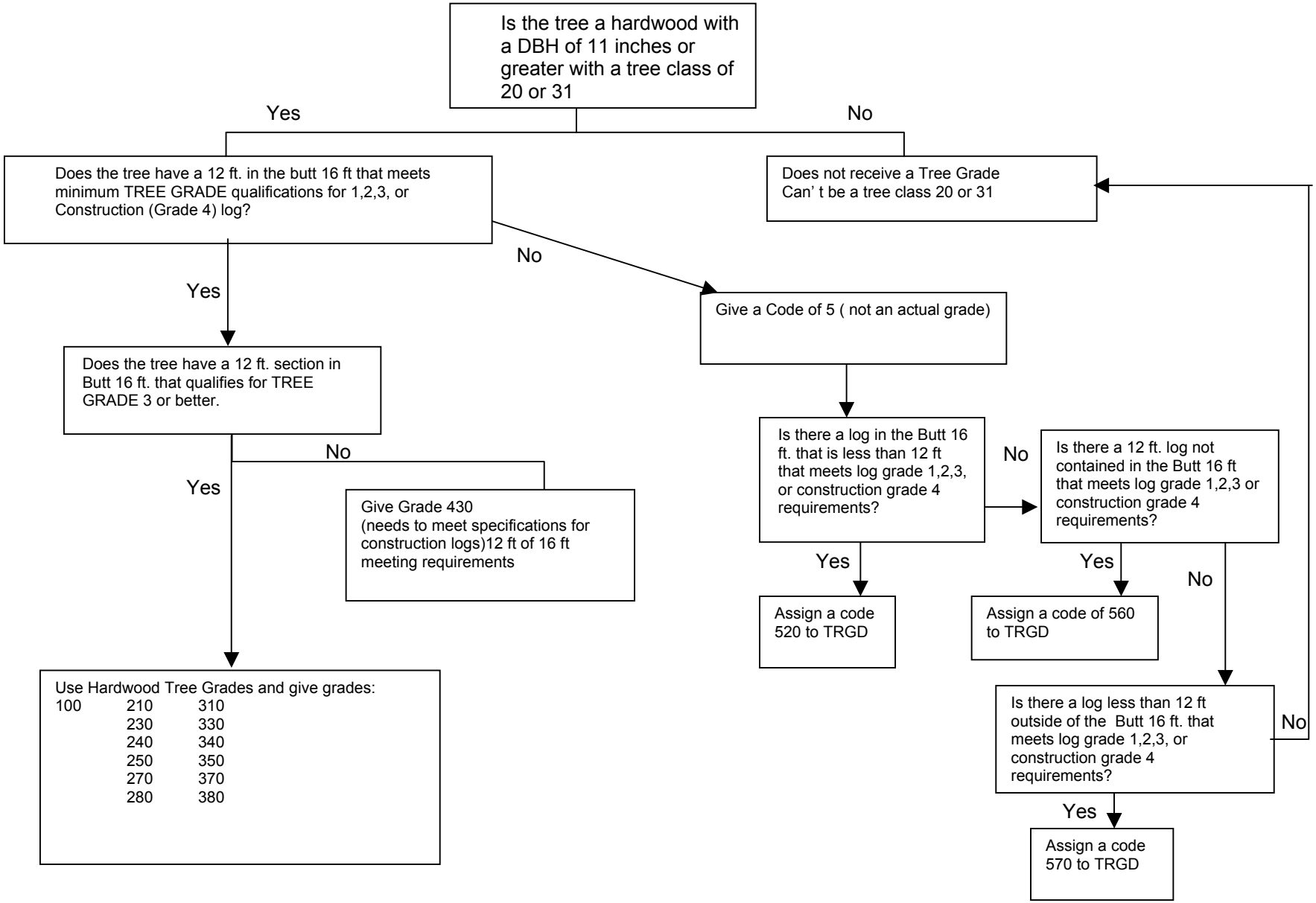
The 2 inch Rule:

Assume all trees will attain sawlog size
Assume that the trees diameter increases uniformly along its bole.
Subtract 2" from the trees current DBH this would be the DOB of the saw log top

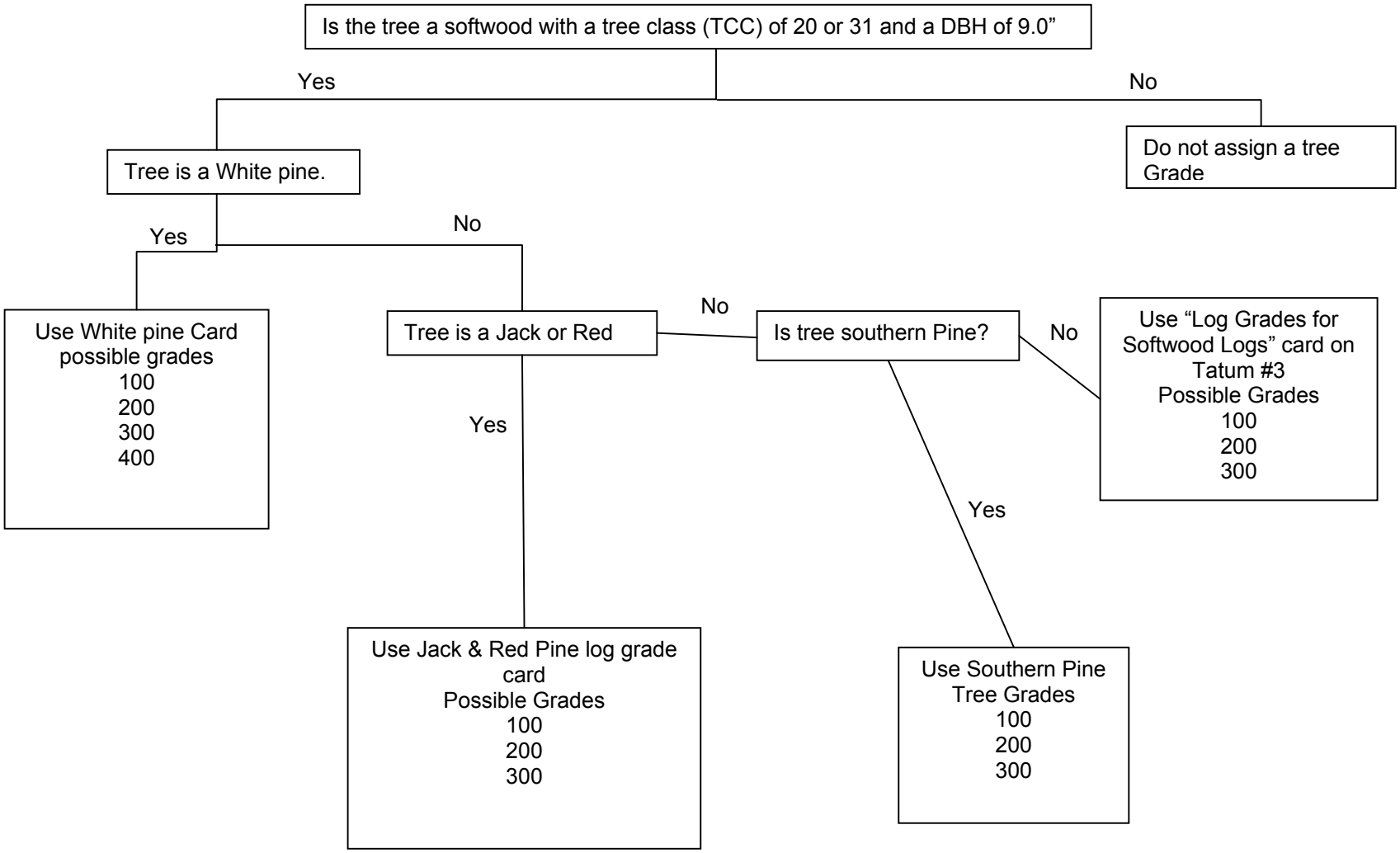
Tree Class Decision Tree
Sawlog sized tree



Hardwood Grades



Log Grades for Softwoods



Appendix 11. North Central GPS

Rockwell Global Positioning System (GPS) instructions

Exact geographic coordinates will need to be obtained for each field plot. The coordinates will aid in the analysis of the plot data and locating the plot for the next survey. The Precision Lightweight GPS Receiver (PLGR's - pronounced "Plugger"), manufactured by Rockwell International, will be used for this task. Instructions for use can be found in the accompanying "Operations and Maintenance Manual", however, it contains much extraneous information that we do not have to be concerned with. Below is a synopsis for the day to day use of the "Plugger" unit.

Setup Instructions

Setting up the "Plugger", with the correct parameters needs only be done once. However, the unit should be checked each day for correct settings.

After turning the unit on, press the "Menu" button (key 3). The main menu will be displayed:

⇦move⇨	⇳ select
STATUS	SETUP
INIT	TEST
HELP	<more>⇳ P

One of the menu items will be flashing, move to the "SETUP" menu by pressing the arrow-right or arrow-left button (keys 4 or 6) and select the item by pressing the page-down button (key 5). The first page of the SETUP menu will be displayed:

	Explanation
SETUP MODE: **STBY**	**St**and **By** power saving mode
No tracking, low power.	
SV - TYPE: **all-Y** ⇳ P	Track only Y-code signals

The items in bold in the above menu page are the options that can be set. Move to each item by pressing one of arrow keys (keys 4 or 6), the item will begin to flash when it is active. When you have moved to the desired item, press the page-down button (key 5) until the correct option is displayed. The above mode should be set to **STBY** (Stand By) just for setting up the unit and would not be used in normal field operations. The SV-TYPE may need to be set to "mixed" if an error message stating "insufficient number of satellites…" appears when using the unit. However, the "all-Y" option is the most accurate and should be used whenever possible.

To proceed to the next menu page, press an arrow key until the ⇳ appears next to the "P". Press the page-down button (key 5) again to move on to the next page: (Note if any item is flashing, continue to press an arrow key (keys 4 or 6) until nothing is flashing and the page-up/down symbols appear next to the "⇳" in the lower right corner - nothing on the screen should be flashing when you desire to move to the next menu page.). The next page is **VERY IMPORTANT**, set the units according to the display below:

	Explanation
SETUP UNITS	**L**atitude / **L**ongitude displayed in Degrees and
L/L-dm. English	minutes. Use **English** units (miles, feet, mph)
ELev : **feet MSL**	Elevation above **M**ean **S**ea **L**evel in **feet**.
ANGL : **Deg Mag** ⇳ P	Azimuths in **Deg**rees from **Mag**netic north

Move on to the next page when the page appears as above.

The next page is:

	Explanation
SETUP MAGVAR	Magnetic Variation is
TYPE : **C**alc deg	**Calc**ulated by the system in degrees
WMM 1995	
	⇳ P

Set the page as shown above. Next, page-down to the next menu page.

	Explanation
SETUP	
ELHold : **automatic**	Auto- calculates when to hold elevation constant
TIME : **Zulu**	Time will display in 24 hour clock (i.e.1:00PM=1300)
ERR : **+/- ft**	⇳ P Error displayed as plus or minus in feet

Set the page as shown above. Next, page-down to the next menu page.

	Explanation
SETUP DTM : **NAR**	Datum set to the North American 1983
No Amer-83/GRS80	using the GRS spheroid
AUTOMATIC OFF	The unit will automatically turn off in 20 minutes
TIMER : **20 min** ⇳ P	

The above page is **VERY IMPORTANT**, please make sure the Datum is set to "**NAR**".

Set the page as shown above. Next, page-down to the next menu page.

	Explanation
SETUP I/O	Input/out parameters for the serial port.
SERIAL : **Standard**	However, we will not use it.
HAVEQUICK : **Off**	
1PPS : **Off**	⇳ P

This page should already be as shown, if not please make the appropriate changes and continue on to the next page.

	Explanation
SETUP AUTOMARK	This option would automatically take a point at a
MODE : **off** WP000	specified time or interval in time. However, it
##-##-## ####Z	should be set to off.
REPEAT 0000	⇳ P

Make sure that the MODE is set to **off**, that is the only thing to worry about on this page. This is the last page in the setup menu. Paging to the next page will bring you back to the first page of the setup menu. If not, press page-down key (5) until the first page does appear. Press menu to display the main menu.

Operations in the Field

Acquiring a Daily Almanac

The first time the PLGR is turned on each day, known as a "Cold Start", the PLGR starts searching for Satellite Vehicles(SVs). The first information the PLGR receives from each satellite (health, ephermis, etc.) is picked up from the CA-code signal. The PLGR looks for the best geometry among the SVs in view and locks on to them. Your receiver will not instantly obtain a precise and accurate position fix. You should be prepared to **allow 15 to 20 minutes** for the receiver to obtain the daily almanac (at the start of the day) before it will collect accurate position data. The longer the PLGR has been in storage the more time it will take to determine a precise position. During this time the receiver must be set to CONTINUOUS (CONT) mode. Begin by turning the PLGR on:

Action	KEY #
Turn the PLGR on	Key 1

Upon turning the unit on, the battery status will be displayed. A warning will be given if it is low on power. **Always** carry a spare battery pack with you! After the start up test is performed by the unit, the POSITION page will be displayed:

FIX OLD
N 44° 59.089'
W 93° 11.092'
Elh +00941 ft ⇳ P

The receiver mode can be viewed in the upper left corner of the first position to be displayed. When the unit is first turned on it will be in the quick "FIX" mode (if it is using only battery power).

The receiver will need to be in to the **CONT** mode, begin by going to the main menu:

Action	KEY #	Screen	
Display Main Menu Page	Key 3	⇦move⇨	⇳ select
		STATUS	**SETUP**
		INIT	TEST
		HELP	<more> ⇳ P

Move to the "SETUP" menu item by pressing one of the arrow buttons (keys 4 or 6), it will be active when it is flashing, then select the SETUP menu by pressing the down key (key 5). The first page of the SETUP menu will be displayed:

Action	KEY #	Screen	Menu Explanation
Display Setup Menu	Keys 6,5	SETUP MODE: FIX	Obtains a quick fix of position,
		Quick POS fix,	then goes to stand-by mode,
		then STBY	and eventually turns off
		SV-Type: all Y ⇳ P	Track only Y-code signals

Change the Mode to the Continuous Mode:

Action	KEY #	Screen	Menu Explanation
Change Mode to (**CONT**)inuous	Keys 6,2	SETUP MODE: **CONT** Continuous POS and VEL update	Calculates its position and velocity continuously
		SV-Type: all Y ⇳ P	Tracks only Y-code signals

The items in **bold** in the above menu page are the options that can be set. Move to each item by pressing one of arrow keys (keys 4 or 6), the item will begin to flash when it is active. When you have moved to the desired item, press the page-down button (key 5) until the correct option is displayed. The above mode should be set to **CONT** (Continuos), this is just for the "cold start" up of the unit and should not be used for acquiring the position of the plot center.

When you have changed the receiver to the CONT mode, press the "POS" button (key 8). Check the error in the upper right hand corner of the position screen, it will probably be very high for a few minutes. After about 5 minutes the error should have dropped somewhat. Also check the almanac age by pressing the page-up button (key 2) - while the position screen is displayed. When it states that the age is 1 day, the receiver is ready to collect the plot coordinates. This may take some time so be patient. The unit will turn itself off if left untouched for 10 minutes, so while you are waiting for it to acquire the almanac, it would be wise to press the "POS" key every 5 minutes or so to prevent this. When the almanac has been obtained, you may switch the unit off and proceed to the plot center or, if you are already at the plot center, proceed with the next section - Collecting the Plot Center Coordinate. If the above was done correctly, the Almanac Age should be one day.

Collecting the Plot Center Coordinate

When you have found or established the pin at plot center, stand over the pin holding the receiver - preferably facing south. If you have not acquired the almanac for the day do so by completing the above section. If the almanac has been acquired (that is the almanac age is one day, - check this by pressing the "POS" button (key 8) and then the page-down button (key 5) twice) proceed…

change the operating mode to **AVG**, to do this:

Press the "Menu" button (key 3). The main menu will be displayed:

⇦move⇨	⇳ select
STATUS	**SETUP**
INIT	TEST
HELP	<more> ⇳ P

One of the menu items will be flashing, move to the "SETUP" menu by pressing one of the arrow keys (keys 4 or 6) and select the item by the page-down button (key 5). Next the first page of the SETUP menu will be displayed:

	Menu Explanation
SETUP MODE: **AVG**	The **AV**ERA**G**ING mode continuously records a
Static POS fix,	new position and averages with previous
better accuracy	1positions. DO NOT MOVE the PLGR.
SV - TYPE: all Y ⇳ P	Track only Y-code signals

The items in **bold** in the above menu page are the options that can be set. Move to the mode item by pressing the right-arrow button (key 6), the item will begin to flash when it is active. When you have moved to the "MODE" item, press the page-down button (key 5) until the **AVG** option is displayed. The averaging mode will continually record a position and average them together, it is therefore very important that you **DO NOT MOVE** the PLGR unit while it is averaging. After the AVG mode is displayed, press the "POS" button (key 8). "AVG" will now be displayed in the upper left corner of the screen. After approximately 15 seconds (or several minutes) the unit will display the number of positions it has averaged together and continually update the resulting "average" coordinate. Allow the unit to collect at least 180 points (this will take about 3 minutes). After which the coordinates for the plot center may be entered into the HUSKY and recorded onto the plot sheet. The coordinates are in degrees and decimal minutes for the latitude and longitude, enter and record the full number to the 3rd decimal place of the minutes, **DO NOT ROUND**! After you have entered and recorded the coordinates the PLGR unit may be turned off by pressing the off button twice.

The PLGR unit screen will look like this:

AVG 00180 ±36Ft
N11^{0}11,111^0
W 011^{0}11,111^0
EL ±11111ft ⇳P

The GPS Error (ERRS) to record in the data recorder for the plot is 36 in the above example.

What to Do When You Can't Get to Plot Center

If plot center happens to be inaccessible, go to a point from which you know the distance and azimuth to plot center. At this point, obtain the coordinates as you would for the PC explained above. When the unit has averaged over 180 points into its calculation, copy the averaged coordinate displayed onto a sheet of paper exactly as it is displayed (**DO NOT ROUND!**).

Next press the "WP" button (key 7). The Way Point menu will appear:

WP ⇦move⇨ ⇳ sel
ENTER EDIT COPY
SR-CALC **RNG-CALC**
DIST CLEAR ROUTE

Move to the "ENTER EDIT" item and enter the coordinate–creating a Way Point. Next, return to the Way Point menu and move to "RNG-CALC" item with the arrow buttons (keys 4 or 6) and press the page-down button (key 5) when the "RNG-CALC" item flashes. The following screen will appear:

CALC from WP000
RNG 0000.0 ft
AZ 360.0(M
EL +00000 ft ⇳ P

This is the coordinate calculation screen. Here you will enter the distance (range) and azimuth to the plot center. Move to the way point item with the arrow-right button (key 6), when the "000" flashes next to the "WP", press the page-down button (key 5), the way point number of the coordinate you have just entered should appear. If not, continue pressing the down button until it does. When you have the correct way

point number displayed, move to the range (RNG) item with the arrow-right key (key 6) so that the "0000" will flash, then press the page-down button (key 5) and the first digit will begin to flash. If your distance is less than 1000 feet, move on to the next digit by pressing the arrow-right button (key 6). When the appropriate digit flashes select the correct number with the page-down or page-up buttons (keys 2 or 5). Next, move to the (AZ)imuth item and enter the azimuth to the PC in the same way. Move past the (EL)evation item to the (P)age so that the page-up and down arrow (⇳) appears next to the P symbol. Next, press the page-down button (key 5). The calculated coordinates for the PC will now appear on the screen.

Maintenance

The "Plugger" unit uses 8 AA Alkaline power batteries good for about four hours of operation and will need to be replaced every few days. Power batteries can be accessed by removing the power battery cover at the top of the unit. The "Plugger" unit also has one AA size lithium memory battery that is located at the bottom end of the unit. The memory battery is only replaced as a maintenance action annually and is used to maintain power to the memory for critical information - **NEVER REMOVE THIS BATTERY**! This removes the encryption codes and reduces the accuracy of position coordinates.

Keep the unit clean and dry as you would the HUSKY. Unless you are about to be overrun by the enemy - **NEVER EVER PRESS THE "NUM LOCK" BUTTON AND THE "MARK'BUTTON SIMULTANEOUSLY**! This will clear all the special encryption codes from the unit and it will have to be returned to the Missoula Technology Development Center for recoding - costing you money and the severance of your index and middle fingers! To check that encryption codes are in the unit press the "Menu" key twice. You should see the following menu with "CRPTO" displayed in the lower left of the screen:

Data-XFR	SV-SEL
DOP-CALC	ALERTS
SINCGARS	KOI-18
CRPTO	<more> ⇳ P

From time to time, way points should be cleared out of the memory. This can be done by pressing the WP button and moving down to the "CLEAR" item. Select it and enter the range of way points you wish to clear, then move to and select the "Activate" item to clear them.

LOCATING FIELD PLOTS WITH THE ROCKWELL PLUGGER:

This out line describes how we are using the GPS to locate “New Samples” (where the coordinates are provided by St. Paul). The concepts listed below also apply to other situations, which occur in the field, and are not limited to use with new samples.

OVERVIEW:

A. *Acquire the daily almanac*
B. Pick an sp tree, collect 180 readings and save the coordinates as WP # 1 (this is what is put on the plot sheet)
C. *Manually enter your destination (provided) coordinates, save it as WP # 2*
D. *Now we want to navigate to our destination (PC)*
E. *When you get close to your destination(about 100’) you will need to take another wp, just like we did at SP. Call this WP # 3.*
F. Calculate the distance and azimuth between WP #3 and WP #2, then chain out the distance provided to arrive at PC (WP# 2) without any biases.
G. If the location you arrive at is different than the location on the image provided adjust your location on the ground to match the image.

GENERAL STEP BY STEP DIRECTIONS:

Establishment of New Samples plots using GPS:
Your Plot sheet will provided you with the plot center coordinates for all plots. To begin this process you will need to manually enter the plot coordinates in the GPS unit. The following list will walk you through the buttons to push to enter these coordinates:

The first 3 steps are part of our current normal plot procedures, which all employees are familiar with

A Acquire the daily almanac

Acquire the daily almanac. See Rockwell Plugger or Garmin GPS unit instructions.

B Pick an SP tree, collect 180 readings and save the coordinates as WP # 1

Collect coordinates at your SP tree, save this as a WP (WP1). To collect a waypoint we must be in “AVG” mode:

C Manually enter your destination (provided) coordinates, save it as WP # 2

To begin, manually enter the plot coordinates in to the GPS unit. The following list will walk you through the buttons to push to enter to enter the coordinates:

hit the WP key (key 7)
the screen should now appear like this:
With the “enter” key flashing
WP <move> sel
ENTER EDIT COPY
SR-CALC RNG-CALC
DIST CLEAR ROUTE

Use the right / left arrows to highlight ENTER and press the down arrow (key 5)

The screen will look like this:

WP000 UNUSED000
N 90 00.000'
E 00 00.000'
No EL CLR ^P

Note the WP number in the upper left corner of the screen. This will be the waypoint the coordinates are stored as and to which you will be navigating, so it is important number. It is good idea to change the waypoint number to coincide with your SP tree (WP1), your PC location (WP2) and your 100-200' from your destination WP as (WP3). To do this, right arrow until the WP #### is blinking. Hit NUM LOCK and using the keypad, enter the plot number (last 3 digits) or what ever number you want to call the waypoint. Now right arrow to the next line.

Right arrow over N to 90. Hit NUM Lock and enter the coordinates for North/ Latitude. Once these numbers have been entered, hit NUM LOCK and right arrow to the next line. Down arrow to change the E to a W. This is critical! Once you have changed the E to a W, right arrow to the 000 and hit NUM LOCK. Enter the West / longitudinal coordinates.

Once the coordinates have been entered, turn off NUM LOCK and right arrow to the P. Down arrow to store the waypoint. It will be saved as the waypoint you designated earlier.

D Now we want to navigate to our destination (PC)

Now, click on NAV. The screen will look like this:

SLOW DIRECT

WP001 MARK002

^P

Use the right / left arrow keys (keys 4/6) to make the "SLOW" feature blink.

Use the up / down arrow keys (2/5) to choose either CUSTOM OR 2D FAST (THIS IS WHAT THE SOUTH SAYS TO DO. WE HAVE HAD BETTER LUCK WITH "SLOW")navigation methods.

Right arrow to WP and enter the waypoint which you wish to navigate to. This is why you numbered it when you entered it. The screen should look like:

SLOW DIRECT

WP 002 *(if you are going to WP2)* Mark 002

Right arrow to P and then hit the down arrow

The next screen will tell you where you need to go. The variables may not be the same for everyone but you will need to at least have a AZ and RNG to tell you where you need to go and how far it is.

NOTE: THE NAV FUNCTION WILL NOT WORK IF PLUGGER IS STILL IN AVG MODE.

E When you get close to your destination (about 100') you will need to take another WP, just like we did at SP.

Follow the GPS until you are within 100-200 feet of the plot, you know this by the RNG reading on your screen. Set the GPS down and hold the POS button until the screen says AVG and the unit begins taking hits. Again, you must collect at least 180 points for the coordinates to be accurate. Once the GPS has recorded at least 180 points store the current position as a waypoint, assign it a number as we did in step 3 (WP3).

F Calculate the distance and azimuth between WP #3 and WP #2, then chain out the distance provided to arrive at PC (WP# 2) without any biases

Hit the WP key

WP <move> ^sel

Enter Edit Copy

SR-CALC RNG-CALC

DIST CLEAR ROUTE

Right arrow to DIST and then hit the down arrow

The screen should look like this:

DIST WP003>>002

RNG ##.##FEET

AZ ###.# DEGREES

This screen allows you to calc the horizontal distance between you last waypoint (3), which is between 100-200 feet from you destination (WP1) plot center. You will have to use the up/down arrows to choose the WP you want to calc between.

You can use this same screen to get a dist and az from your sp to pc waypoints. This would be recorded on your plot sheet. This will also give you some guide lines on pacing into a plot if you loose your satellites

Once you have this dist and az you will need to chain as we have chained in the past. This is to ensure that there is no bias in the final pin position

G Check location on the image with location you are at.

Once you arrive at the location, check the image provided with the plot. If you are in the same location as is indicated on the image collect the GPS coordinates here and record them for the field plot location.

If you are not at the location on the image, make the adjustment so that you are there then collect a GPS reading.

GARMIN INSTRUCTIONS

Collecting SP and PC Coordinates on a Plot That Has Been Established
(Buttons on GPS in caps and items on screen and plot sheet in "—")

1. Find the SP (Starting Point) tree that the old crew established.
2. Measure the DBH and record it, along with a brief description of where the tree is located, on the top left of the plot sheet in the "SP description" section.
3. Re-paint SP so the next crew can relocate the tree easier.
4. Turn the GPS on and allow it to track satellites automatically.
5. Once the GPS has moved from the satellite page to the position page (see manual to see examples of these pages), the SP (starting point) data can be collected. Place the GPS at the base of the SP tree and hit the MARK button. This will give you the "Waypoint" screen.

To set Waypoints and Name Them:

6. The waypoint number will need to be changed. To do this, use the DOWN arrow to highlight the number given to it automatically (auto # should range from 001-999). Once it is highlighted, hit the ENTER key. This will allow the use of the UP, DOWN, RIGHT, or LEFT arrow keys to rename the waypoint. The new number should be the last four digits of the plot number plus 'SP' (starting point). Ex. 0123SP. Later, when the instructions refer back to this, use the last four digits plus 'PC' (point center).
7. After the waypoint has been renamed, hit the ENTER key.
8. Now, use the UP or DOWN arrow keys to highlight "Average?" at the bottom of the screen and hit the ENTER key.
9. Allow the GPS to collect data for **3 to 5 minutes**. This will ensure the position is near exact.
10. After the time has passed, highlight "Save?" at the bottom of the page and hit "ENTER".
11. Once this is done, hit PAGE three times to get to the "Main Menu". Highlight "Waypoint List" and hit ENTER. Use the UP and DOWN arrows to highlight the waypoint you stored for 'SP' and hit ENTER. This will display the coordinates for 'SP'.
12. Write the coordinates on the top right portion of the plot sheet and this will complete the info for the starting point.
13. Use the course to sample data that the old crew provided to navigate from Starting Point to Point Center.
14. Once the PC (Point Center) pin has been located, the actual point center is now located on the ground and we need to mark the new coordinates. Place the GPS on the pin that was found in the ground and hit MARK. Now refer to the numbers 6-9 from above once again. This point will be named 'PC'. **Before the waypoint is saved, note the error (+ or – xx.x from this screen) on the back of the plot sheet**. This will need to be entered into the data recorder later.
15. Once the error note is made continue with numbers 10 and 11 from above and begin entering the Latitude and Longitude into the data recorder.
16. In order to get the elevation, go back to the position menu (hit "PAGE" 4 times and read "ALT" to get the elevation in feet.
17. Enter the last 6 digits of the 8-digit serial number for (GPS #).
18. Enter "2" for GPS UNIT (UNIT) because it is an "other brand".
19. Enter the error (+ or – xx.x) that you noted earlier.
20. Enter "180" for # of readings in the data recorder. This # is established by waiting 3-5 min.

Navigation With Coordinates for a New Plot

(Buttons on GPS in caps and items on screen and plot sheet in "__")

1. Find a suitable SP (starting point) tree that is close to the plot and recognizable on the photo or DOQ.
2. Measure DBH and paint an "SP" near DBH and at the base of the tree. Then document the DBH and location on the front of the plot sheet in the "SP Description" section.
3. Turn the GPS on and allow it to track satellites automatically.
4. Once the GPS has moved from the satellite page to the position page (see manual to see examples of these pages), the SP (starting point) data can be collected. Place the GPS at the base of the SP tree and hit the MARK button. This will give you the "Waypoint" screen.

To set Waypoints and Name Them:

5. The waypoint number will need to be changed. To do this, use the DOWN arrow to highlight the number given to it automatically (auto # should range from 001-999). Once it is highlighted, hit the ENTER key. This will allow the use of the UP, DOWN, RIGHT, or LEFT arrow keys to rename the waypoint. The new number should be the last four digits of the plot number plus 'SP' (starting point). Ex. 0123SP. Later, when the instructions refer back to this, use the last four digits plus 'PC' (point center), 'MP' (mid point), or 'C' (center) respectively.
6. After the waypoint has been renamed, hit the ENTER key.
7. Now, use the UP or DOWN arrow keys to highlight "Average?" at the bottom of the screen and hit ENTER.
8. Allow the GPS to collect data for **3 to 5 minutes**. This will ensure the position is near exact.
9. After the time has passed, highlight "Save?" at the bottom of the page and hit ENTER.
10. Once this is done, hit PAGE three times to get to the "Main Menu". Highlight "Waypoint List" and hit ENTER. Use the UP and DOWN arrows to highlight the waypoint you stored for 'SP' and hit ENTER. This will display the coordinates for 'SP'.

11. Write the coordinates on the top right portion of the plot sheet and this will complete the info for the starting point.
12. While in this screen, use the UP arrow to highlight "NEW?" and hit ENTER. This is where the 'PC' (point center) coordinates from the back of the plot sheet are entered.
13. Name it the same way "SP" was named only with a 'PC'. Once the name is complete, hit ENTER. This will automatically enter the coordinates of your current location. Don't panic! This can be changed. Use the DOWN arrow key to highlight the coordinates and hit ENTER. Now use the UP, DOWN, RIGHT, and LEFT arrow keys to change the info to the PC coordinates. Hit ENTER twice and this saves it.
14. Hit GOTO and use the UP and DOWN arrows to highlight the waypoint with 'PC' at the end. Hit ENTER again and this will give the distance and azimuth from 'SP' to 'PC'. Write this information at the top of the plot sheet in the "Course to Sample Location" section.
15. Now is the time to start following the bearing "BRG" and distance "DST" that the GPS is displaying.
16. Once the GPS beeps, and gives the message that 'PC' is approaching, continue until the unit reads within 0.04 mi. Here is where we will want to stop and mark a middle point. Hit MARK and refer to numbers 5-9 from above. This point will be named 'MP'.
17. Hit GOTO again, highlight 'PC', and hit ENTER. Note the distance and azimuth from 'MP' to 'PC'. This is the "Course to Sample" **that needs to be chained** with a tape. Use a compass and measuring tape to go the exact measurements **(0.04 mi = 211.2 ft, 0.03 mi =158.4 ft, 0.02 mi =105.6 ft, and 0.01 mi =52.8 ft)**. The exact location that you stop at on the measuring tape will be where the pin is placed. The reason for this is to take the bias out of using the GPS for the point center location. **Note: Be sure to cross reference the ground location with the photo or DOQ to be sure there is not a major mistake in navigating from 'SP' to 'PC'. Re-evaluate if the locations differ more than 33 feet.**
18. This brings us down to the last operation. Actual point center is now located on the ground and we need to mark the new coordinates. Place the GPS on the pin that was placed in the ground and hit MARK. Now refer to the numbers 5-8 from above once again. This point will be named 'C' for center.

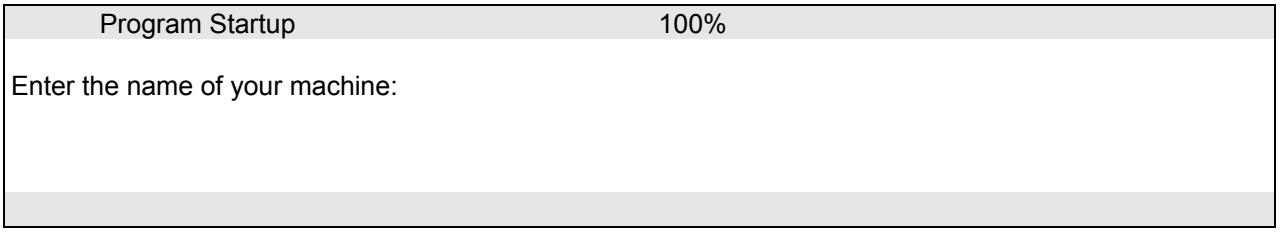
Before the waypoint is saved, note the error (+ or – xx.x from this screen) on the back of the plot sheet. This will need to be entered into the data recorder later.

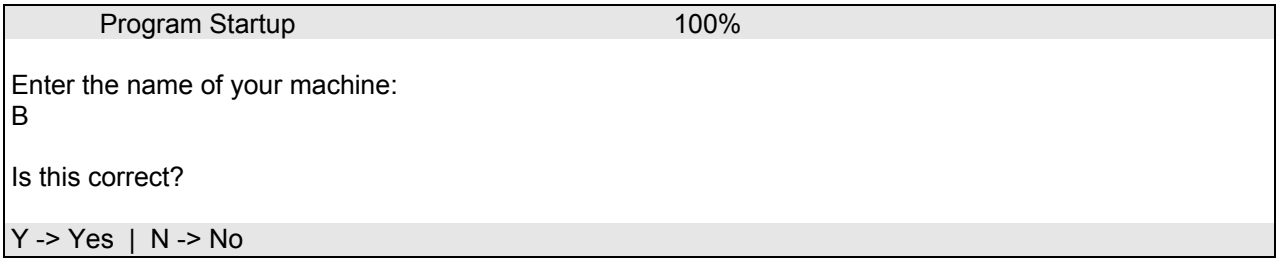
19. Once the error note is made continue with numbers 9 and 10 from above and begin entering the Latitude and Longitude into the data recorder.
20. In order to get the elevation, go back to the position menu, hit PAGE four times, and read "ALT" to get the elevation in feet.
21. Enter the last 6 digits of the 8-digit serial number for (GPS #).
22. Enter "2" for GPS UNIT (UNIT) because it is an "other brand".
23. Enter the error (+ or – xx.x) that you noted earlier.
24. Enter "180" for # of readings in the data recorder. This # is established by waiting 3-5 minutes.

Appendix 12 – North Central (Husky) Data Recorder Quick Reference

NatField Hot Keys

1) **F1** - Menu Down
2) **F2** - Menu Up
3) **F3** - Main Menu
4) **F4** – Next Consecutive Tree Number
5) **Del No** - Clear Number
6) **^,v,<,>** - The Up, Down, Left, and Right Arrows
7) *** - HUSKY Paw Key** for Overriding Errors
8) **PgUp** - Previous Tree
9) **PgDn** - Next Tree
10) **Y** - Slope Corrections
11) **A** - First Tree
12) **B** - Last Tree
13) **H** - Cursor Home
14) **X** - Edit Current Menu
15) **T** – Help Menus





Change State	100%
Enter your state code:	

Change Measurement Type	100%
Are you collecting P2 or P3 data?	
2 = P2 | 3= P3	

Change Cycle	100%
Enter your cycle:	

Change SubCycle	100%
Enter your subcycle:	

```
NatField              ***MAIN MENU****              v2.6

1. Data Entry              6. Print Plot
2. Delete Plot             7. Slope Corrections
3. Send Plot               8. Husky options
4. Receive Plot            9.Configure Driver
5. Ecit Program            S. DOS Shell
F1. Plot Type [27-Minnesota, P2,12,3]
```

```
0030001               ***PLOT MENU****              100%

1. plot data               6. Edit plot
2. Condition data          7. Plot map
3. Sub plot data           8. Husky options
4. Site index data         9.Copy trees
5. Save plot               0. Next tree number
F1.  Digits -> No    F2. Owner data
                      Selection >>>
```

```
Owner Data                                          100%

First Name
Last Name
Street
City
State                      Zip
Phone #
Press ESC to Exit
```

Quick Load Instructions for NatField Components

The following is a quick list of the files needed to run the data collection program (NatField.exe) on the Husky data recorders. The list includes the files needed and the directory on the Husky they should be in.

Distribution Products

FS/2 Components

Loaded to Directory on Husky -C:

1) Autoexec.bat
2) Cdisk.sys
3) Config.drv
4) Config.ndr
5) Config.sys
6) Hcs.com
7) Hook611.com
8) Start.bat

Loaded to Directory on Husky -C:\C

Each state has one Legals and one Prompts file for each subcycle of a cycle and a new set for each P3 cycle and subcycle.

9) Legals
10) Prompts

Loaded to Directory on Husky -C:\field.dat

11) NatField.exe

Troubleshooting

Program Bombs or Freezes

If the NATField program bombs out or freezes, you'll need to follow these steps:

A) Turn the power off. If the power switch is disabled you can unscrew the battery cap to bring down the power, then screw the cap back on.

B) Hold down the X and P keys simultaneously for a couple of seconds.

C) With the X and P keys depressed, turn the power on and then release all the keys. The system should then reboot.

D) If the system doesn't reboot then repeat steps A, B, and C.

:: After a program crash, you may need to repeat these steps many times before the data recorder reboots.

E) Once the system reboots, it should restart normally and start NATField.

1) At the Main Menu, select choice 1, Data Entry. This will bring up the Data Entry plots list.

2)You should **arrow down to the BOMBFIL#** file and hit the left or right arrows to select. The BOMBFIL# is a file containing all the data you've entered on the plot excluding the data you just entered on the last menu before the program bombed.

:: You must load the BOMBFIL# right after the program restarts if you don't want to lose your data. If you pick another plot instead, the BOMBFIL# file will be erased and written over with the data from this new plot.

3) After you load the BOMBFIL#, you should skim through the menus to make sure the data is alright.

It's possible - although highly unlikely - that when the system reboots, you get the message:

Verify failed sector: xx
Potential data corruption detected
Please contact your system provider

If this happens, something very unfortunate may have happened, which, although you can recover from it, **you may lose EVERYTHING stored on the machine** except the system programs that are stored in ROM. To recover from this there are 3 things you can try:

1) **Emergency Breakout.**

A) Turn the power off. If the power switch is disabled you can unscrew the battery cap to bring down the power, then screw the cap back on.

B) Hold down the X and P keys simultaneously for a couple of seconds.

C) With the X and P keys depressed, turn the power on and then release all the keys. The system should then reboot.

D) If the system doesn't reboot then repeat steps A, B, and C.

:: After a program crash, you may need to repeat these steps many times before the data recorder reboots.

E) If the system reboots, but you get the same message, or you're unable to get the system to reboot then go to step 2 on the next page.

2) **Emergency Hardware Reset.**

A) While holding down both SHIFT keys, press and hold the power button. Hold down all three keys for at least 4 seconds.

B) This should reboot the data recorder, but you will probably get a message like - possible loss of data. You will most likely be able to ignore this message and continue on. If however NATField doesn't run properly after doing this or if this step doesn't reboot the machine, go to step 3.

:: Since step 3 erases everything on the machine, you should only use this as a last resort!!

3) **Disk Corruption.**

A) At the Failed Sector message type **56580**

This is the emergency breakout password. When you type this the data recorder will prompt:

Default disk (lose all data) Y/N?

B) Type **Y**

You will then be prompted:

All data has been erased
Use UTIL to format fixed disk

C) Type **UTIL**

This will take you into HUSKY's FS/2 utility programs.
Here you should select Format Fixed Disk.

D) After the disk has been formatted you will have to reload all the NATField programs - see the **Quick Load Instructions for NatField Components.**
.

:: If none of these work, you'll have to contact the Husky technical support service.

:: Because of the possibility that you could lose all your data, I would strongly suggest that you back up your data as often as possible. Even though it's very unlikely that anything like this would happen, it's better to be safe than sorry.

RAM Cartridge Not Responding on FS/2

If you're sure you've loaded the CDISK driver and you have your config.sys file configured properly, I would suggest that you reboot the data recorder using the X-P keys. To do this:

1) Exit NATField.

2) Turn the power off. If the power switch is disabled you can unscrew the battery cap to bring down the power, then screw the cap back on.

3) Hold down the X and P keys simultaneously for a couple of seconds.

4) With the X and P keys depressed, turn the power on and then release all the keys. The system should then reboot.

5) If the system doesn't reboot go back to step 2.

This should clear the device and allow you access the RAM cartridge. If the RAM cartridge still doesn't respond then you should select the Reconfigure Driver Option from the main menu and enable the CDISK driver.

If the cartridge still doesn't respond you may have a corrupted CDISK.SYS file, inwhich case you'll need to reload this file onto the data recorder – see the **Quick Load Instructions for NatField Components**. Once you've reloaded this file you'll need to reboot the machine to reinitialize the driver.

If you're still unable to access the RAM cartridge, you may have a bad cartridge and you should contact the Husky technical support service.

:: The batteries in the RAM cartridges only last about 2-3 years and need to be replaced by Husky.

RAM Cartridge Not Responding on PC

Make sure you have a copy of CDISK.SYS on your PC's hard disk and that you have the following line in your config.sys file - located at the root directory of your boot drive (usually c:\):

```
Device=c:\path\cdisk.sys /b4 /c1
```

You should then reboot your PC. As the system comes up the following message should scroll by on your screen:

```
CDISK v1.3
Cartridge Installed as Drive D:
Using COM1 at 19200 baud
Hardware Detected: PC Compatible
```

If the RAM cartridge still doesn't respond, you should try using a lower baud. If the cartridge still doesn't respond, you'll need to contact the Husky technical support service.

Not Able to Read the Entire Screen or Menu

If one or more of the screens or menus comes up with part of the screen scrolled up and out of sight so that your not able to see all of the information displayed, you should try and get to the Main Menu so that you can exit the program. Once your out of the program type **autoexec**. This will restart NATField using the DOS **call** command. If your unable to get out of the program gracefully from the Main Menu, then you can follow the Emergency Breakout sequence described earlier in Troubleshooting.

I found in writing the program that this problem only comes up during program start-up and that by using the call command you should be able to avoid this problem all together. I've only run into this problem on the FS/2 and I suspect it's a glitch in HUSKY's hardware design.

Runtime Error 101

If the program crashes and displays the message *Runtime error 101*, then you have run out of disk space on the machine. I encountered this error while developing this program even though I hadn't actually filled the machine's hard disk. I found that by reformatting the fixed disk I could get back the

lost space. There appears to be a glitch in the FS/2; so, in case this should happen again you can follow these steps:

1) Follow the Emergency Breakout under the section Program Bombs or Freezes.

2) If you have crashed out of the program and gotten the message *Runtimeerror 101*, then you'll have to first back up all your data. To do this:

A) Type **cd \field.dat**

:: This is the directory where you should be running the program and saving your data.

B) Insert the RAM cartridge into the RS232 port.

C) At the DOS prompt type **copy *.* d:**

:: This will copy the PAINSDUN file, the BOMBFIL# files, and all your plots to the RAM cartridge. If there isn't enough room on one cartridge, you'll need to either use multiple cartridges or copy the files onto a PC and then delete the files from the cartridge to up some space. Also, you'll need to copy each file over to the RAM cartridge individually by typing

copy *filename* d:.

If you copy the files individually, be sure to copy **ALL** the files in the field.dat directory.

3) Once the data is backed up, type **util**. This will start HUSKY's utilities program.

4) Using the left or right arrow keys, move to **Format Fixed Disk** and hit enter. This will delete all the programs and data on the machine and reformat the disk. You will be asked if you're sure you want to do this.

5) Once the disk is formatted you will need to:

A) Reload all the software - see the **Quick Load Instructions for NatField Components**.

B) Reload all the plots you backed up in step 2 back into the field.dat directory on the FS/2.

Low Battery Warning Keeps Coming Up Even After Inserting New Batteries

The best way to avoid getting the low battery warning is to check the battery level every now and then so that you can get the % power remaining on the batteries. When the battery level gets down to about 10-15% you should put in new batteries - this could vary in cold temperatures though. After you change thebatteries you must do a Paw-H from the Husky Options on the Main Menu and bump the % power up to 100%.

When you do a Paw-H, you should get a screen like below:

Time: 13:05:35 Date: 04 Mar 93 V1.04c
Caps lock: Off Num lock:Off Power: 95%
Drive C: 588k Drive D: 0k
Charge authorization level:1
Screen

Keyboard
Power

Arrow down to the Power selection and hit enter. This will bring up the message:

Advanced Power management (APM) : Yes

If it reads No, then you'll need to use the arrow keys to change APM to Yes.
Hitting enter will bring up another screen that should look like:

Power Parameters	
Power remaining:	95%
Low power warning onset:	10%
Battery chargeable:	No
Battery capacity:	1500 mAh
Charging authorization:	Level 1

When you **add new batteries**, you **MUST** arrow to the Power remaining item and then use the arrows to **bring the power % up to 100**. You should leave all the other items as they are listed above. Then hit ENTER to accept the changes. Hit ESC to exit.

:: If things go really bad, you may need to also see the instructions for ProgramBombs or Freezes under the Troubleshooting section.

BATTERY CAUTION

If the battery level drops too low the data recorder will lock up, as I have found first hand. **If this happens you risk losing all the data on your machine.** So I highly recommend that you don't let the batteries run down below 10-15%. **Also** if you do not reset the power remaining % to 100% when you change the **batteries, as I have indicated above, the data recorder will act as though you never changed your batteries and the machine will lock up.**

If your machine locks up because of low battery power:

1) Change the batteries.

2) Follow the **Emergency Hardware Reset** on page 27 of this manual.

3) When the system reboots you may get a data corruption error, which you can try and ignore. You should do a Paw-H and reset the power parameters as I have indicated above.

4) If you notice that NATField doesn't seem to be working properly, you will have to reformat the hard disk (see page 30 steps 3, 4, and 5) and reload the programs (see loading software). Before you do this though you should try and use HCOM to download the plots from the field.dat directory on the FS/2 so that you don't lose all your data.

Appendix 13 Tatum Guides

Plot Data

Trails or Roads (RTYP)

Code	Type
0	None within 1 mile
1	Paved or highway
2	Improved Gravel road
3	Improved dirt
4	Unimproved dirt
5	Human access Trail

Horizontal Distance Roads (RDIS)

Code	Distance
1	= or <100 ft
2	101'-300'
3	301'-500'
4	501'- 1000'
5	1001'-1/2 mile
6	½ to 1 mile
7	1 to 3 miles
8	3 to 5 miles
9	Greater than 5 miles

Road Access (RACC)

Code	Road Access
0	None
1	Road Blocked gate/cable
2	Road Blocked human-made
3	Road blocked natural
4	Posted no moterized
9	Other-specify in field notes

Public Use Restrictions (REST)

Code	Use Restrictions
0	None
1	Keep out / No trespassing
2	No hunting/fishing
3	No dumping
9	Other - specify in field notes

Recreation Use (RECU)

Code	Use
0	None
1	Motor vehicle
2	Horse or dog trails
3	Camping
4	Hiking
5	Hunting/shooting
6	Fishing
7	Boating
8	Other

Water on Plot(WTYP)

Code	Water
0	None
1	Permanent Streams small
2	Permanent water (non-census)
3	Ditch/Canal
4	Temporary streams
5	Flood zones
9	Other temporary water

QA Status (QAST)

Code	QA Status
1	Standard Production plot
2	Cold Check
3	Reference plot (off grid)
4	Training / Practice plot (off grid)
5	Botched plot file
6	Blind check
7	Production plot (hot check)

Crew Type (CRTY)

Code	Crew type
1	Standard field crew
2	QA crew

GPS Unit (UNIT)

Code	GPS Unit
0	Not collected
1	Rockwell (PLGR)
2	Other Brand
3	Trimble GeoExplorer or Pathfinder Pro
4	Recreational GPS (Garmin)

GPS

Last 6 digits of serial number

Condition Data

Condition Number (CON#)

Record a number assigned to the defined condition.

Condition Status (STAT)

Code	Status
1	Accessible forest land
2	Nonforest land
3	Noncensus water
4	Census water
5	Denied access
6	Hazardous
7	Not in the sample

Reserve Status (RESV)

Code	Reserved Status
0	Not Reserved
1	Reserved

Owner Group (OWNG)

Code	Owner Group
10	Forest Service
20	Other Federal
30	State and Local Government
40	Private

Forest Type (FTYP)

Code	Forest Type
101	Jack Pine
102	Red Pine
103	White Pine
104	E Whie pine/E Hemlock
105	Eastern Hemlock
121	Balsam fir
122	White Spruce
123	Red spruce
124	Red spruce/balsam fir
125	Black Spruce
126	Tamarack
127	Northern white-cedar
141	Longleaf pine
142	Slash pine
161	Loblolly pine
162	Shortleaf pine
163	Virginia pine
164	Sand pine
165	Table-mountain pine
166	Pond pine
167	Pitch pine
168	Spruce pine
181	Eastern Redcedar
182	Rocky Mountain juniper
221	Ponderosa pine
381	Scotch pine
382	Australian pine
383	Other exotic softwoods
384	Norway spruce
385	Introduced larch
401	EWP/N RedOak/White ash
402	Eastern redcedar-hardwood
403	Longleaf pine/oak
404	Shorleaf pine-/oak
405	Virginia pine/southern red oak
406	Loblolly pine/hardwood
407	slash pine/hardwood
409	Other pine/hardwood
501	Post-blackjack
502	Chestnut oak
503	White oak-red oak-hickory
504	White oak
505	Nothern red oak
506	Yellow-poplar/white oak/n. red oak
507	Sassafras-persimmon
508	Sweetgum/yellow-poplar
509	Bur oak
510	Scarlet oak
511	Yellow-poplar
512	Black walnut
513	Black locust
514	Southern scrub oak
515	Chestnut-black-scarlet oak
519	Red maple/ oak
601	Swamp chestnum oak-cherrybark oak
602	Sweetgum/Nuttall oak/willow oak
605	Overcup oak /water hickory
606	Atlantic white-cedar
607	Baldcypress / water tupelo
608	Sweetby /swamp tupelo/red maple
701	Black ash/ American elm/ red maple
702	River birch/ sycamore
703	Cottonwood
704	Willow
705	Sycamore/ pecan/ American elm
706	Sugarberry/ hackberry/ elm/ green ash
708	Red maple / lowland
709	Cottonwood/ willow
710	Oregon ash
801	Sugar maple/-beech-/ yellow birch
802	Black cherry
803	Cherry-ash-yellow poplar
805	Hard maple/ basswood
807	Elm/ ash/ upland
809	Red maple/ upland
901	Aspen
902	Paper birch
904	Balsam poplar
991	Paulownia
992	Melaluca
993	Eucalyptus
995	Other exotic hardwoods
999	Non stocked

Stand-Size Class (STSZ)

Code	Size Class
0	Non-stocked
1	0.0 – 4.9 in
2	5.0 – 8.9(soft),5.0-10.9(hard)
3	9.0-19.9(soft), 11.0-19.9(hard)
4	20.0-39.9
5	40.0 +
6	Cover trees (non-tallied)

Regeneration Status (SORI)

Code	Regeneration Status
0	Natural
1	Artificial

Tree Density (DENS)

Code	Tree Density
1	Initial density class
2	Density class 2 - density different than 1
3	Density class 3 - density different than 1 and 2

Treatment (TRE1,2,3)

Code	Treatment
00	None
10	Cutting
20	Site preparation
30	Artificial Regeneration
40	Natural Regeneration
50	Other silvicultural treatment

Private Owner Industrial Status (INDU)

Code	Owner Class
0	Land not owned by industrial owner
1	land owned by industrial owner

Owner Class (OWNC)

Code	Owner Class
11	National Forest
12	National Grassland
13	Other Forest Service
21	National Park Service
22	Bureau of Land Management
23	Fish and Wildlife Service
24	Departments of Defense/Energy
25	Other Federal
31	State
32	Local (County, Municipality, etc.)
33	Other Non Federal Public
41	Corporate
42	Non Governmental Conservation/Natural Resources Organization
43	Unincorporated Local Partnerships/ Associations/Clubs
44	Native American (Indian)
45	Individual

NC Owner Acres (NCPA)

Code	Acres
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+

Disturbance (DIS1,2,3)

Code	Distrurbance
00	None
10	Insects
20	Disease
30	Fire
31	Ground Fire
32	Crown Fire
40	Animal damage
41	Beaver
42	Porcupine
43	Deer/ungulate
46	Domestic animal/livestock
50	Weather
51	Ice
52	Wind
53	Flooding
54	Drought
70	Unknow/not sure / other
80	Human-caused

Physiographic Class (PHYS)

Code	Physiographic Class
11	Dry Tops.
12	Dry Slopes
13	Deep Sands
19	Other Xeric.
21	Flatwoods
22	Rolling Uplands
23	Moist Slopes and Coves
24	Narrow Floodplains/Bottomlands
25	Broad Floodplains/Bottomlands.
29	Other Mesic
31	Swamps/Bogs
32	Small Drains
33	Bays and wet pocosins
34	Beaver ponds.
35	Cypress ponds.
39	Other hydric.

NC Land USE (NCLU)

Code	Land Use
20	Timberland
21	Pastured Timberland
22	Plantations
40	Unproductive forest land
41	Reserved forest land-unproductive
45	Reserved forest land-productive
57	Wide windbreaks (> 120')
59	Wooded pasture
46	Christmas tree plantations
50	Reserved nonforest with trees
51	Cropland with trees
52	Improved pasture w/ trees
53	Wooded strip (natural)
54	Idle farmland with trees
55	Marsh with trees
56	Narrow windbreaks (< 120')
58	Shelterbelt
71	Urban forest land
72	Urban and other with trees
61	Cropland
62	Improved pasture
64	Idle farmland
65	Marsh
66	Other farmland
67	Urban and other areas
68	Rights-of-way
69	Nonforest (reserved)
80	Noncensus water
89	Noncensus water (reserved)
90	Census water
97	Dropped plot
98	Lost (not relocated) plot
99	Denied access plot

Tree Data

Plot Type/NC Plot Type (TYPE)

Code	Plot Type
1	subplot
2	microplot

Condition Number (CON#)

Record the condition number that the tree is a part of.

Tree Status (STAT)

Code	Status
0	No history
1	Live tree
2	Dead tree
3	Removal
4	Missing

Azimuth (AZM)

Record as compass degrees

Tree Lean Angle (LEAN)

Code	Lean Angle
0	Standing < or = 45 degrees
1	Down > 45 degrees

Diameter Check (DCHE)

Code	Diameter Check
0	Measured accurately
1	Estimated
2	Different location

Some have been removed for space.

Tree Species (SPP)

Code	Species
12	balsam fir
15	white fir
16	Fraser fir
43	Atlantic white-cedar
57	redcedar / juniper
61	Ashe juniper
66	Rocky Mountain juniper
67	southern redcedar
68	eastern redcedar
70	larch (introduced)
71	tamarack (native)
91	Norway spruce
93	Engelmann spruce
94	white spruce
95	black spruce
96	blue spruce
97	red spruce
105	jack pine
107	sand pine
108	lodgepole pine
110	shortleaf pine
111	slash pine
113	limber pine
115	spruce pine
121	longleaf pine
122	ponderosa pine
123	Table Mountain pine
125	red pine
126	pitch pine
128	pond pine
129	eastern white pine
130	Scotch pine
131	loblolly pine
132	Virginia pine
136	Austrian pine
202	Douglas-fir
221	baldcypress
222	pondcypress
241	northern white-cedar
252	Florida torreya
260	hemlock spp.
261	eastern hemlock
262	Carolina hemlock
270	Australian pine
299	Unknown dead conifer
300	acacia
313	boxelder
314	black maple
315	striped maple
316	red maple
317	silver maple
318	sugar maple
319	mountain maple
320	Norway maple
321	Rocky Mountain maple
323	chalk maple
330	buckeye, horsechestnut
331	Ohio buckeye
332	yellow buckeye
334	Texas buckeye
341	ailanthus
345	mimosa, silktree
351	red alder
355	European Alder
356	serviceberry
367	pawpaw
371	yellow birch
372	sweet birch
373	river birch
374	water birch
375	paper birch
378	northwesternpaper birch
379	gray birch
381	chittamwood,gum bumelia
391	American hornbeam,musclewood
401	water hickory
402	bitternut hickory
403	pignut hickory
404	pecan
405	shellbark hickory
406	nutmeg hickory
407	shagbark hickory
408	black hickory
409	mockernut hickory
410	sand hickory
421	American chestnut
422	Allegheny chinkapin
423	Ozark chinkapin
451	southern catalpa
452	northern catalpa
461	sugarberry
462	hackberry
463	netleaf hackberry
471	eastern redbud
481	yellowwood
491	flowering dogwood
500	hawthorn
501	cockspur hawthorn
502	downy hawthorn
510	eucalyptus
521	common persimmon
531	American beech
541	white ash
543	black ash
544	green ash
545	pumpkin ash
546	blue ash
548	Carolina ash
551	waterlocust
552	honeylocust
555	loblolly-bay
571	Kentucky coffeetree
580	silverbell
591	American holly
600	walnut
601	butternut
602	black walnut
605	Texas walnut
611	sweetgum
621	yellow-poplar
641	Osage-orange
650	magnolia spp.
651	cucumbertree
653	sweetbay
654	bigleaf magnolia
655	mountain magnolia
660	apple spp.
661	Oregon crab apple
680	mulberry spp.
681	white mulberry
682	red mulberry
691	water tupelo
692	Ogechee tupelo
693	blackgum
694	swamp tupelo
701	eastern hophornbeam
711	sourwood
712	paulownia, empress-tree
721	redbay
722	water-elm, planertree
730	California sycamore
731	sycamore
741	balsam poplar
742	eastern cottonwood
743	bigtooth aspen
744	swamp cottonwood
745	plains cottonwood
746	quaking aspen
749	narrowleaf cottonwood
752	silver poplar
760	cherry and plum spp.
761	pin cherry
762	black cherry
763	chokecherry
765	Canada plum
766	wild plum
802	white oak
804	swamp white oak
806	scarlet oak
808	Durand oak
809	northern pin oak
812	southern red oak
813	cherrybark oak
816	bear oak, scrub oak
817	shingle oak
819	turkey oak
820	laurel oak
822	overcup oak
823	bur oak
824	blackjack oak
825	swamp chestnut oak
826	chinkapin oak
827	water oak
828	Nuttall oak
830	pin oak
831	willow oak
832	chestnut oak
833	northern red oak
834	Shumard oak
835	post oak
836	Delta post oak
837	black oak
838	live oak
839	interior live oak
840	dwarf post oak
841	dwarf live oak
842	bluejack oak
845	Dwarf chinakapin oak
901	black locust
911	Palmetto spp.
919	western soapberry
920	willow
921	peachleaf willow
922	black willow
927	white willow
931	sassafras
935	American mountain-ash

Tree Species (SPP)

Code	Species
936	European mountain-ash
951	American basswood
952	white basswood
970	elm spp.
971	winged elm
972	American elm
973	cedar elm
974	Siberian elm
975	slippery elm
976	September elm
977	rock elm
992	melaleuca
993	chinaberry
994	Chinese tallowtree
995	tung-oil-tree
996	smoketree
997	Russian-olive
999	Unknown dead hardwood

NC Tree Class/Decay Class (TCC)

Code	Tree Class
20	Growing Stock
30	Rough Cull, Salvable, and Salvable-down
31	Short-log Cull
40	Rotten Cull
41	Solid
42	Solid punky
43	Punky
44	Disintegrating
45	Gone

Percent Rotten/Missing Cull (ROTT)

Record the percent rotten or missing cubic foot cull on all live and dead trees as a percent.

Total Lenth (THGT)

Record to the nearest 1.0 ft.
P2 – all live trees > or = 5.0 in
P3 – all live trees > or = 1.0 in

Actual Length (ACTU)

Record the actual length to the nearest 1.0 ft.
P2 – all live and standing dead tally trees > or = 5.0 in
P3 - – all live tally trees > or = 1.0 in
Only record for trees with broken or missing tops

Length Method (METH)

Code	Length method
1	Total and actual lengths are field measured with a measurement instrument (e.g., clinometer, relascope)
2	Total length is visually estimated, actual length is measured with an instrument.
3	Total and actual lengths are visually estimated.

Crown Class(CCC)

Code	Description
1	Open Grown
2	Dominant
3	Codominant
4	Intermediate
5	Overtopped

Compacted Crown Ratio (CRC)

Record as percent

Damage Location (LOC1, 2)

Code	Damage Location
0	No damage
1	Roots (exposed) and
2	Roots, stump, and lower bole
3	Lower bole
4	Lower and upper bole
5	Upper bole
6	Crownstem
7	Branches
8	Buds and Shoots
9	Foliage

Damage Type (DAM1, DAM2)

Code	Damage Type
01	Canker, gall
02	Conks, fruiting bodies, and signs of advanced decay
03	Open wounds
04	Resinosis or gummosis
05	Cracks and seams
11	Broken bole or roots
12	Brooms
13	Broken or dead roots
20	Vines in the crown
21	Loss of apical dominance, dead terminal
22	Broken or dead
23	Excessive branching or brooms
24	Damaged Buds, shoots or foliage
25	Discoloration of Foliage
31	Other

Damage Severity (SEV1, SEV2)

Code	Severity
0	01-09
1	10-19
2	20-29
3	30-39
4	40-49
5	50-59
6	60-69
7	70-79
8	80-89
9	90-99

Damage Agents (NCD1, 2)

Code	Damage
000	Healthy
100	Insect defoliators
112	Gypsy Moth
130	Shoot and Branch Insects
140	Branch Gall Insects
150	Bole Borers
170	Bark Beetles
190	Root/Root Collar Insects
200	Roliage Diseases
210	Shoot Blights
220	Mistletoe
240	Bole Rusts
250	Bole Cankers
251	Eutypella Canker
252	Hypoxylon Canker
254	Nectria Canker
257	Butternut Canker
260	Stem Decay (heartrot)
271	Ash Yellows
281	Dutch Elm Disease
282	Oak Wilt
290	Root/Butt Rot
291	Annosus Root Rot
292	Armillaria Roo Rot
300	Weather
400	Animal Damage
500	Fire
800	Logging/TSI/Other human
860	Chemical

MN Damage Agents (NCD1,2)

CODE	DAMAGE
000	Healthy
100	Insect defoliators
101	Budworms
110	Forest Tent Caterpillar
113	Gypsy Moth
130	Shoot and Branch Insects
131	White Pine Weevil
140	Branch Gall Insects
150	Bole Borers
170	Bark Beetles
190	Root/Root Collar Insects
200	Foliage Diseases
210	Shoot Blights
212	*Scleroderris*
220	Mistletoe
240	Bole Rusts
241	White Pine Blister Rust
250	Bole Cankers
251	*Eutypella* Canker
252	*Hypoxylon* Canker
254	*Nectria* Canker
257	Butternut Canker
260	Stem Decay (heartrot)
261	*Phellinus pini*
262	*Phellinus tremulae*
263	*Inonotus obliquus*
271	Ash Yellows
281	Dutch Elm Disease
282	Oak Wilt
290	Root/Butt Rot
291	*Annosus* Root Rot
292	*Armillaria* Root Rot
300	Weather
302	Wind
307	Flooding
309	Ice/Snow
400	Animal Damage
402	Moose/Elk/Deer
404	Beaver
409	Cattle/Domestic Livestock
500	Fire
800	Logging/TSI/Other human
811	Imbedded objects - wire, nails
850	Land Use Conversion
860	Chemical
900	Unknown/uncoded Dead
901	Unknown/uncoded Defoliation
902	Unknown/uncoded Discoloration
903	Unknown/uncoded Decline/Dieback
904	Unknown/uncoded Breakage
905	Unknown/uncoded Abnormal Growth or Form in Crown
906	Unknown/uncoded Canker
907	Unknown/uncoded Crack
908	Unknown/uncoded Abnormal Growth or Form on the Bole

Cause of Death (CAUS)

Code	Cause of death
10	Insect
20	Disease
30	Fire
40	Animal
50	Weather
60	Vegetation
70	Unknown/not sure/other
80	Human-caused damage
90	Physical

Utilization Class (UTIL)

Code	Class
0	Not Utilized
1	Utilized (STAT=3 only)

MO Damage Agents (MOAG)

Code	Damage
000	Healthy
100	Insect defoliators
102	Cankerworms/Loopers
103	Leaf Miners & Skeletonizers
104	Sawflies
113	Gypsy Moth
114	Fall Webworm
115	Datana (Walnut) Caterpillar
120	Variable Oakleaf Caterpillar
121	Eastern Tent caterpillar
122	Walking Stick
123	Bagworm
130	Shoot and Branch Insects
132	Tip Moths
135	Pine Needle Scale
136	Oyster Shell Scale
138	Pine Shoot Beetle
140	Branch Gall Insects
141	Ash Flower Gall Mite
142	Gouty/Horned Oak Gall
150	Bole Borers
151	Two Lined Chestnut Borer
157	Ash Borer
158	Asian Long-horned Beetle
170	Bark Beetles
171	Ips spp.
173	Black Turpentine Beetle
190	Root/Root Collar Insects
200	Foliage Diseases
201	Needlecasts
202	Anthracnose
205	Dogwood Anthracnose
206	Powdery Mildew
208	Scirrhia Needlecasts
209	Apple Scab
210	Shoot Blights
213	Fire Blight
214	Diplodia Tip Blight
215	Juniper Blights
220	Mistletoe

MO Damage Agents (MOAG)

Code	Damage
230	Foliar Rusts
233	Gall Rusts
235	Cedar/Apple Rust
236	Cedar/Quince Rust
240	Bole Rust
250	Bole Cankers
251	*Eutypella* Canker
252	*Hypoxylon* Canker
254	*Nectria* Canker
256	Strumella Canker
257	Butternut Canker
260	Stem Decay (heartrot)
264	Pereniporia Fraxinophilia
271	Ash Yellows
273	Beech Bark disease
274	Oak decline
276	Hickory decline
277	White pine root decline
278	Ash decline
281	Dutch Elm Disease
282	Oak Wilt
283	Pine wilt nematode
285	Verticillium wilt
291	Annosus root rot
292	Armillaria root rot
300	Weather
301	Hail
302	Wind
303	Lightning
304	Frost cracks
305	Winter drying
307	Flooding
308	Drought
309	Ice/snow
400	animal damage
402	Moose/elk/deer
405	Squirrel
408	Sapsucker
409	Cattle/Domestic livestock
500	Fire
760	Vine damage
800	Logging/TSI/Other human
810	Mechanical damage
811	Imbedded objects-wire,nails
830	Vehicle damage
860	Chemical
862	air pollution
900	Unknown/uncoded Dead
901	Unknown/uncoded Defoliation
902	Unknown/uncoded Discoloration
903	Unknown/uncoded Decline/Dieback
904	Unknown/uncoded Breakage
905	Unknown/uncoded Abnormal Growth or Form in Crown
906	Unknown/uncoded Canker
907	Unknown/uncoded Crack
908	Unknown/uncoded Abnormal Growth or Form on the Bole

Decay Class (DECA)

Decay class stage (code)	Limbs and branches	Top	% Bark Remaining	Sapwood presence and condition*	Heartwood condition*
1	All present	Pointed	100	Intact; sound, incipient decay, hard, original color	Sound, hard, original color
2	Few limbs, no fine branches	May be broken	Variable	Sloughing; advanced decay, fibrous, firm to soft, light brown	Sound at base, incipient decay in outer edge of upper bole, hard, light to reddish brown
3	Limb stubs only	Broken	Variable	Sloughing; fibrous, soft, light to reddish brown	Incipient decay at base, advanced decay throughout upper bole, fibrous, hard to firm, reddish brown
4	Few or no stubs	Broken	Variable	Sloughing; cubical, soft, reddish to dark brown	Advanced decay at base, sloughing from upper bole, fibrous to cubical, soft, dark reddish brown
5	None	Broken	Less than 20	Gone	Sloughing, cubical, soft, dark brown, OR fibrous, very soft, dark reddish brown, encased in hardened shell

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.

c Grade 2 trees can be 10 inches DIB at top of grading section if otherwise meeting surface requirements for small grade 1s.

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 %.

NOTE: The tree grading in this table is based on measuring DBH to the nearest inch, since FIA measures to the higher 10^{th} of a inch use diameter classes, i.e. for grade 1, DBH can be 15.5" and for grade 2, DBH can be 12.5" for this table. Also FIA uses 11 inch as the minimum DBH to record tree grades so there only grade 1 and 2 are affected by diameter classes.

Code	Limiting Factor
00	Not applicable, already a grade 1, all softwoods
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

FOREST SERVICE STANDARD SPECIFICATIONS FOR HARDWOOD CONSTRUCTION (GRADE 4) LOGS		
Position in tree		Butt & Upper.
Min. diameter, small end		8 inches +.
Min. length, without trim		8 feet +.
Clear cuttings		No requirements.
Sweep allowance, absolute		1/4 d.i.b. of small end for half logs, 1/2 d.i.b. for logs 16 feet long.
Sound surface defects permitted	Single knots	Any number, if no one knot has an average collar diameter over 1/3 of log diameter at point of occurrence.
	Whorled knots	Any number, if sum of collar diameters does not exceed 1/3 of the log diameter at point of occurrence.
	Holes	Any number provided none has a diameter over 1/3 of log diameter at point of occurrence and none extends over 3 inches into included timber.
Unsound defects permitted	Surface	Any number and size if they do not extend into included timber. If they do, they can't exceed size, number, and depth, or limits of sound knots.
	Interior	None allowed; log must be sound internally, but will permit 1 shake not to exceed 1/3 the scaling diameter and a longitudinal split not extending over 5 inches into the contained timber. No center rot.

FOREST SERVICE STANDARD GRADES FOR HARDWOOD FACTORY LUMBER LOGS									
Grading Factors*		Log grades							
		F1			F2				F3
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Scaling diameter, inches		13-15[b]	16-19	20+	11+[c]	12+			8+
Length without trim, feet		10+			10+	8-9	10-11	12+	8+
Required clear[d] cuttings of each of 3 best faces[e]	Min. length, feet	7	5	3	3	3	3	3	2
	Max. number	2	2	2	2	2	2	3	No limit
	Min. proportion of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Maximum sweep & crook allowance	For logs with less than 1/4 of end in sound defects	15%			30%				50%
	For logs with more than 1/4 of end in sound defects	10%			20%				35%
Maximum scaling deduction		40%[f]			50%[g]				50%

[a] From USDA Forest Service Research FPL. 63
[b] Ash and Basswood butts can be 12 inches if otherwise meeting the requirements for small No. 1's
[c] Ten-inch logs of all species can be #2 if they if otherwise meeting the requirements for small No. 1's
[d] A Clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth the surface of the log as divided lengthwise.
[e] A face is ¼ of the surface of the log as divided lengthwise
[f] Otherwise No. 1 logs with 41-60 percent cull can be No. 2.
[g] Otherwise No. 2 logs with 51-60 percent cull can be No. 3.

EASTERN WHITE PINE SAW-LOG GRADE SPECIFICATIONS

GRADING FACTOR	LOG GRADE 1	LOG GRADE 2	LOG GRADE 3	LOG GRADE 4
1 MINIMUM SCALING	14[1]	6	6	6
2 MINIMUM LOG LENGTH (feet)	10[2]	8	8	8
3 MAXIMUM WEEVIL INJURY (number)	NONE	NONE	2 INJURIES[3]	NO LIMIT
	Two full length or four 50% length good faces.*4* (In addition, log knots	NO GOOD FACES REQUIRED. Maximum diameter of log knots on three best faces:	Includes all logs not qualifying for No. 3 or better and judged to	
4 MINIMUM FACE REQUIREMENTS	on balance of faces shall not exceed size limitations of grade 2 logs.)	SOUND RED KNOTS not to exceed 1/6 scaling diameter and 3 inch maximum. DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/12 scaling diameter and 1 1/2 inch maximum.	SOUND RED KNOTS not to exceed 1/3 scaling diameter and 5 inch maximum. DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/6 scaling diameter and 2 1/2 inch maximum	have at least one third of their gross volume in sound wood suitable for manufacture into standard lumber.
5 MAXIMUM SWEEP OR CROOK ALLOWANCE (percent)	20	30	40	66 2/3
6 MAXIMUM TOTAL SCALING DEDUCTION (percent)	50	50	50	66 2/3

After the tentative log grade is established from face examination, the log will be reduced in grade whenever the following defects are evident:

7 CONKS, PUNK KNOTS, AND PINE BORER DAMAGE ON BARK SURFACE[5]

Degrade one grade if present on one face
Degrade two grades if present on two faces
Degrade three grades if present on three or more faces

8 LOG END DEFECTS: RED ROT, RING SHAKE, HEAVY STAIN AND PINE BORER DAMAGE OUTSIDE THE HEART CENTER OF THE LOG [5]

Consider log as having a total of 8 quarters (4 on each end) and degrade as indicated below:
Degrade one grade if present in 2 quarters of log ends.
Degrade two grades if present in 3 or 4 quarters of log ends.
Degrade three grades if present in 5 or more quarters of log ends.

1 12 and 13 inch logs with four full length good faces are acceptable.
2 8 foot logs with four full length good faces are acceptable.
3 8 foot Number 3 logs limited to one weevil injury.
4 Minimum 50% length good face must be at least 6 feet.
5 Factors 7 and 8 are not cumulative (total degrade based on more serious of the two). No log to be degraded below grade 4 if net scale is at least one third of gross scale.

LOG GRADES FOR SOFTWOOD LOGS

Grade 1

1. Logs must be 16" d.i.b. or larger, 10' or longer, and with deduction for defect, not over 30 %of gross scale.
2. Logs must be at least 75 % clear on each of three faces.
3. All knots outside clear cutting must be sound and not over 2 1/2" large.

Grade 2

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

Grade 3

1. Logs must be 6" d.i.b. or larger, 8' or longer, and with a net scale after deduction for defect of at least 50 % of the gross contents of the log.

Notes: Diameters are d.i.b. at small end of log
% clear refers to % clear in one continuous section

JACK PINE AND RED PINE LOG GRADES

GRADE 1 Logs with 3 or 4 clear faces *
GRADE 2 Logs with 1 or 2 clear faces.
GRADE 3 Logs with no clear faces.

After the tentative log grade is established from above, the log will be degraded one grade for each of the following defects, except that no log can be degraded below grade 3. Net scale after deduction for defect must be at least 50 percent of the gross contents of the log.

1. **SWEEP** Degrade any tentative 1 or 2 log one grade if sweep amounts to 3 or more inches and equals or exceeds one third the diameter inside bark at the small end.

2. **HEART ROT** Degrade any tentative 1 or 2 log one grade if conk, massed hyphae, or other evidence of advanced heart rot is found anywhere in the log.

---

* A face is one fourth of the circumference in width extending the full length of the log. Clear faces are those free of: knots measuring more than 1/2 inch in diameter, overgrown knots of any size, and holes more than 1/4 inch in diameter. Faces may be rotated to obtain the maximum number of clear ones.

SOUTHERN PINE TREE GRADES

Always grade the bottom 16-foot log, or the first merchantable log 12 feet or longer in the tree.

Clear face - free of knots measuring more than 1/2 inch in diameter, overgrown knots of any size, holes more than 1/4 inch in diameter. The faces may be rotated if necessary to obtain the maximum number of clear ones.

Overgrown knot - a knot overgrown and buried beneath the log surface, but indicated by a surface bump or distribution of bark pattern.

Tentative Grades

Grade 1 - trees with 3 or 4 clear faces
Grade 2 - trees with 1 or 2 clear faces
Grade 3 - trees with no clear faces

Degrade for Sweep or Heart Rot

(1) Degrade any tentative grade 1 or 2 tree one grade if sweep in the lower 12 feet of the grading sections amount to 3 or more inches and equals or exceeds one-fourth the DBH.

(2) Degrade any tentative 1 or 2 tree one grade if conks, punk knots, or otherwise evidence of advanced heart rot is found anywhere on the tree stem.

1995, FIA-S

Appendix 14 Example of North Central Plot sheet

State/Unit/County/Plot: **county** Page 1

Township Range Section Subdivision Cycle Subcycle Intensity Past Date Date (MM/DD/YYYY)

Sample Kind NC Sample Kind P3 Plot Photo# Scale Cruiser Name Tallier Name

Starting Point Description:

Course to Sample Location:

Direction: _____

Distance: _____

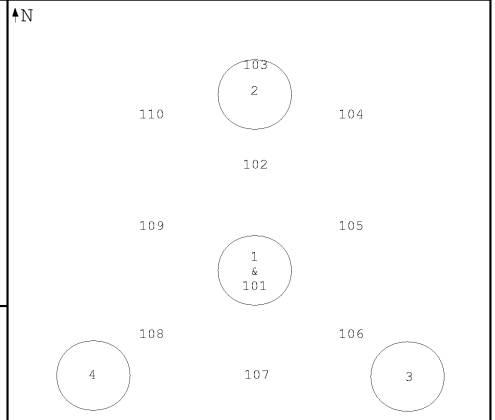
to subplot: _____

	Date	Initials
Office edit		
Field edit		

Starting Point Map:

Latitude: _____ Longitude: _____

Notes (plot, site tree):



Witness Trees: Subplot#: _____

Spp	DBH	Dist	Azm

Reference Trees:

Sub#	Spp	DBH	Dist	Azm	Mark

Owner name: _____

Address/phone: _____

_____

Comment: _____

Type of contact: Personal__ Phone__ Other__

Version 2.08 Printed on 10-NOV-2000

This is an example of the North Central FIA data collection plot sheet. When a sheet goes to the field the top sections would be filled out with information to assist in locating and identifying the plot. The plot packet sent to the field would consist of pages to collect information on the current visit to the plot and a copy of the last plot visit plot sheets. The “tree sheet” includes a list of the trees on the plot, some for re-measurement and some to assist in finding the subplots but will not be re-measured.

State/Unit/County/Plot: **county**

Cruiser	Tallier	Water Type	Road Type	Road Distance	Road Access	Restrictions	Rec Use	QA Status	Crew Type
XXX (CRUI)	XXX (TALL)	X (WTYP)	X (RTYP)	X (RDIS)	X (RACC)	X (REST)	XXX (RECU)	X (QAST)	X (CTYP)

Lat/Long Record:

Latitude	Longitude	Elevation	GPS Unit	Error	Readings
DD MM.MMM (N:)	DDD MM.MMM (W:)	XXXXX (ELEV)	X-XXXXXX (GPS:)	XXX (ERR)	XXX (RDNG)

Plot Location:

Latitude Longitude

Condition Records:

Condition#	NC Land Use	Condition Status	Reserve Status	Physiographic	Stand Origin	Stand Origin Spp	Forest Type	Stand Size	Stand Age	Tree Density	Owner Group	Owner Class	NC Owner Acres	Industrial Status	Nonf Land Use	Past Nonf Land Use	Disturbance 1	Disturbance Yr 1	Disturbance 2	Disturbance Yr 2	Disturbance 3	Disturbance Yr 3	Treatment 1	Treatment Yr 1	Treatment 2	Treatment Yr 2	Treatment 3	Treatment Yr 3
CON#	NCLU	STAT	RESV	PHYS	SORI	SOSP	FTYP	STSZ	SAGE	DENS	OWNG	OWNC	NCPA	INDU	CLU	OLU	DIS1	DYR1	DIS2	DYR2	DIS3	DYR3	TRE1	TYR1	TRE2	TYR2	TRE3	TYR3
x	xx	x	x	xx	x	xxx	xxx	x	xxx	x	xx	xx	x	x	xx	xx	xx	xxxx	xx	xxxx	xx	xxxx	xx	xxxx	xx	xxxx	xx	xxxx

Subplot Records:

Subplot#	Subplot Ctr Cond	Microplot Ctr Cond	Percent Slope	Aspect	Snow/Water Depth
	SCEN	MCEN	SLOP	ASP	SWD
xxx	x	x	xxx	xxx	xxx

Boundary Records:

Subplot#	Contrasting Cond	Plot Type	Percent Area	Left Azimuth	Right Azimuth	Corner Azimuth	Corner Distance	Boundary Change
	CCON	TYPE	%ARE	LAZM	RAZM	CAZM	CDIS	CHNG
xxx	x	x	xxx	xxx	xxx	xxx	xxx	x

Site Tree Records:

Tree#	DBH	Species	Length	Tree Age	Subplot#	Distance	Azimuth	Condition List
TR#	DBH	SPP	HGHT	AGE	SUB#	DIST	AZM	CONL
xx	xxxx	xxx	xxx	xxx	xxx	xxx	xxx	xxxxx

Example “NC tree sheet”.

State/Unit/County/Plot: 27 2 001 0040 **Aitkin county**

Straddler: N **PI Land Use:** 20 Forest Land
Previous Condition Status: 1 **Previous Stand Age:** 27 **P3 Hex:** **P3#:**
Next Consecutive Tree Number on subplot 1: 10 **subplot 2:** 1 **subplot 3:** 1 **subplot 4:** 1

Tree Records:

Subplot#	Tree#	Species	Distance	Azimuth	DBH	Status
101	1	972	3.0	8	3.6	LIVE
101	2	543	2.0	46	1.6	LIVE
101	3	12	6.0	141	1.1	LIVE
101	4	543	4.0	167	2.1	LIVE
101	5	543	7.0	173	1.2	LIVE
101	6	12	4.0	212	1.9	LIVE
101	7	543	5.0	230	1.7	LIVE
101	8	543	3.0	242	1.1	LIVE
101	9	241	11.0	252	17.8	LIVE
102	1	12	6.0	10	1.3	LIVE
102	2	241	16.0	18	16.2	LIVE
102	3	12	6.0	46	2.7	LIVE
102	4	12	7.0	65	2.1	LIVE
102	5	543	3.0	142	2.3	LIVE
102	6	241	7.0	152	14.2	LIVE
102	7	12	6.0	170	6.0	LIVE
102	8	543	5.0	242	1.0	LIVE
102	9	543	3.0	250	2.4	LIVE
102	10	12	1.0	303	3.1	LIVE
103	1	12	6.0	52	4.7	LIVE
103	2	12	7.0	75	1.6	LIVE
103	6	12	7.0	246	2.8	LIVE
103	7	12	7.0	276	2.9	LIVE
103	8	12	4.0	284	1.5	LIVE
Not for remeasurement						
104	1	12	5.0	78	1.2	LIVE
104	2	12	4.0	103	1.2	LIVE
104	3	12	4.0	118	1.4	LIVE
104	4	543	2.0	135	2.0	LIVE
104	5	12	5.0	200	2.1	LIVE
104	6	12	0.0	226	1.7	LIVE
104	7	12	1.0	230	1.0	LIVE
104	8	543	5.0	276	2.4	LIVE
104	9	12	6.0	280	1.1	LIVE
104	10	12	3.0	310	1.8	LIVE
104	11	12	2.0	315	4.4	LIVE
104	12	12	5.0	325	1.7	LIVE
104	13	12	5.0	346	1.0	LIVE
105	1	543	6.0	15	1.6	LIVE
105	2	12	6.0	39	1.3	LIVE
105	3	12	4.0	80	2.9	LIVE
105	4	12	4.0	121	2.1	LIVE
105	5	543	3.0	133	3.3	LIVE
105	6	12	3.0	147	1.9	LIVE

Subplot#	Tree#	Species	Distance	Azimuth	DBH	Status
105	7	12	5.0	154	2.2	LIVE
105	8	12	5.0	240	1.4	LIVE
105	9	543	6.0	257	1.1	LIVE
105	10	12	3.0	307	2.4	LIVE
106	1	12	6.0	5	2.1	LIVE
106	2	12	7.0	17	1.7	LIVE
106	3	241	2.0	22	4.7	LIVE
106	4	12	3.0	25	1.0	LIVE
106	5	12	4.0	39	1.2	LIVE
106	6	12	4.0	108	1.6	LIVE
106	7	12	5.0	153	2.2	LIVE
106	8	12	2.0	176	1.5	LIVE
106	9	12	1.0	198	1.7	LIVE
106	10	241	9.0	222	11.8	LIVE
106	11	12	6.0	247	1.6	LIVE
106	12	12	5.0	274	2.0	LIVE
106	13	12	6.0	301	1.6	LIVE
106	14	12	5.0	304	1.2	LIVE
106	15	12	5.0	312	1.6	LIVE
106	16	241	7.0	325	8.1	LIVE
107	1	241	3.0	34	4.3	LIVE
107	2	543	1.0	112	1.2	LIVE
107	3	543	4.0	160	1.1	LIVE
107	4	12	3.0	177	1.9	LIVE
107	5	12	5.0	225	1.7	LIVE
107	6	241	9.0	243	8.4	LIVE
107	7	241	14.0	250	14.0	LIVE
108	1	543	5.0	18	2.4	LIVE
108	2	543	1.0	85	1.9	LIVE
108	3	241	20.0	266	13.5	LIVE
109	1	12	2.0	35	1.3	LIVE
109	2	543	6.0	80	11.7	LIVE
109	3	241	14.0	148	13.0	LIVE
109	4	543	4.0	249	9.2	LIVE
109	5	543	19.0	280	13.3	LIVE
109	6	241	12.0	301	14.1	LIVE
110	1	12	6.0	155	1.2	LIVE
110	2	543	8.0	243	1.2	LIVE
110	3	12	5.0	248	1.6	LIVE
110	4	12	5.0	253	1.2	LIVE
110	5	241	9.0	340	6.4	LIVE
110	6	12	7.0	355	3.6	LIVE

NEW PLOT# 00956 OLD PLOT# 065 STATE/UNIT/COUNTY 27 2/01 PAGE 2 OF 6

STARTING POINT DESCRIPTION: (03)
BLACK ASH - 8.9" DBH SCRIBED ON
NW FACE
TREE - 20' E OF NE CORNER OF
LARGE OPENING / LOWLAND AREA (MUCH
LARGER THAN SHOWN ON PHOTO) TREE VERY TALL

COURSE TO SAMPLE LOCATION: (03)
DIRECTION
DISTANCE
TO

FIELD CREW:
DATA RECORDER
CRUISER
TALLYER
DATE 6/23/89

OWNERS NAME: (01) TAX FORFEITED - STATE OF MN
ADDRESS Dept of Natural Resources
St. Paul, MN.

PHOTO LOCATION MN DNR
HILL CITY, MN

FIELD EDIT: JD DATE:
OFFICE EDIT: DATE:

ACCURACY:

	UNKNOWN	POOR	GOOD
ORES			✓
CLASS			✓
TENURE			✓

STARTING POINT MAP: