

**NATIONAL_NC
FOREST INVENTORY AND MONITORING
CORE FIELD GUIDE
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NATIONAL FOREST INVENTORY AND MONITORING CORE FIELD GUIDE

VOLUME I: FIELD DATA COLLECTION PROCEDURES FOR ALL PLOTS
Version 3/99 -National Core
Version 10/99 North Central

INTRODUCTION

This document describes standards, codes, methods, and definitions for National 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 as specified in this manual. It is expected that all items in this Volume can be measured by a two person crew in less than a single day, on average, including time spent walking 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 will be integration of the FIA program with the 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 will be called Phase 3 plots. The resulting program is called Forest Inventory and Monitoring (FIM).

The focus of Volume I is on data which are collected in the field on all Phase 2 plots in the FIM sample. Volume II of the series will describe an 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 which are merged into the FIA database, and core compilation and analysis algorithms. When complete, the three volume set will describe all data measured consistently across the country and comprising the core FIM program.

All items which have a "NC" on them have been added or used to supplement the National FIM Manual from the North Central Research Station FIM/FIA unit.

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 Non Forest / Access Denied 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>

Field width: X digits

MQO: <measurement quality objective>

Values: <legal values for coded variables>

Field width designates the number of columns (or spaces) needed to properly record the data element. Measurement Quality Objective (MQO) describes the acceptable tolerance for each data element. MQOs consist of two parts: a statement of the tolerance, and a percent of time where the collected data are required to be within tolerance.

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

Percent 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 as the primary unit system. Metric equivalents are included in parentheses. Measurement units may be field recorded in either English or Metric units at the discretion of the individual Research Stations.

Plot Dimensions:

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

Radius = 59.0 ft. (18.0 m.)
Area = 10,935.88 sq. ft. (1,017.88 sq. m.) or 0.25 ac. (0.10 ha.)

Subplot - for selecting trees with diameter > 5.0 in. (12.70 cm.)

Radius = 24.0 ft. (7.32 m.)
Area = 1,809.56 sq. ft. (168.33 sq. m.) or 0.04 ac. (0.017 ha.)

Microplot - for selecting seedlings and saplings

Radius = 6.8 ft. (2.07 m.)
Area = 145.27 sq. ft. (13.46 sq. m.) or 0.003 ac. (0.001 ha.)

Distance between subplots is 120.0 ft. (36.58 m).

The minimum area needed to qualify as forest land is 1.0 acre (0.40 ha).

The minimum width to qualify as forest land is 120.0 ft. (36.58 m)

Tree Limiting Dimensions:

	English	Metric
breast height	4.5 ft.	1.37 m.
stump height	1.0 ft.	30.48 cm.
merchantable top	4.0 in.	10.16 cm.
minimum conifer seedling height	6.0 in.	15.24 cm.
minimum hardwood seedling height	12.0 in.	30.48 cm.
seedling/sapling DBH/DRC break	1.0 in.	2.54 cm.
sapling/tree DBH/DRC break	5.0 in.	12.70 cm.
softwood large/medium DBH break	9.0 in.	22.86 cm.
hardwood large/medium DBH break	11.0 in.	27.94 cm.
western woodland large/med. DRC break	9.0 in.	22.86 cm.

0.0 GENERAL DESCRIPTION

The CORE field plot consists of four subplots approximately 1/24 ac. (1/60 ha.) with 24.0 ft. radius (7.32 m.). The center subplot is subplot 1. Subplots 2, 3, and 4 are located 120.0 ft. (36.58 m.) at azimuths of 360, 120, and 240 degrees from the center of subplot 1. Subplots are used to collect data on trees with a diameter at breast height (DBH) of 5.0 in. (12.7 cm.), or greater. Throughout this manual, use of the word 'plot' refers to the entire set of four subplots. 'Plot Center' (PC) is defined as the center of subplot 1.

Each subplot contains a microplot of approximately 1/300 ac. (1/743 ha.) with radius 6.8 ft. (2.07 m.). The center of the microplot is offset 90 degrees and 12.0 ft. (3.66 m) from plot 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 in.).

As a CORE OPTION, the field plot may also include a annular plots of approximately 1/4 ac. (0.10 ha.) with radius 59.0 ft. (18.0 m.) with the annular plot center coinciding with the 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 to provide a better sample of rare population elements.

Data are collected on each field plot 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. Examples of such attributes include condition status, forest type, stand size, stand origin, owner group, reserved 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 diameter 1.0 in. (2.54 cm.) to 4.9 in. (12.45 cm.), and trees with diameter μ 5.0 in. (12.70 cm.).
Seedling	Data describing trees with diameter < 1.0 in. (2.54 cm.) and at least 6.0 in. (15.24 cm.) (softwoods) in length or 12.0 in. if hardwood.
Site Tree	Data describing site trees.

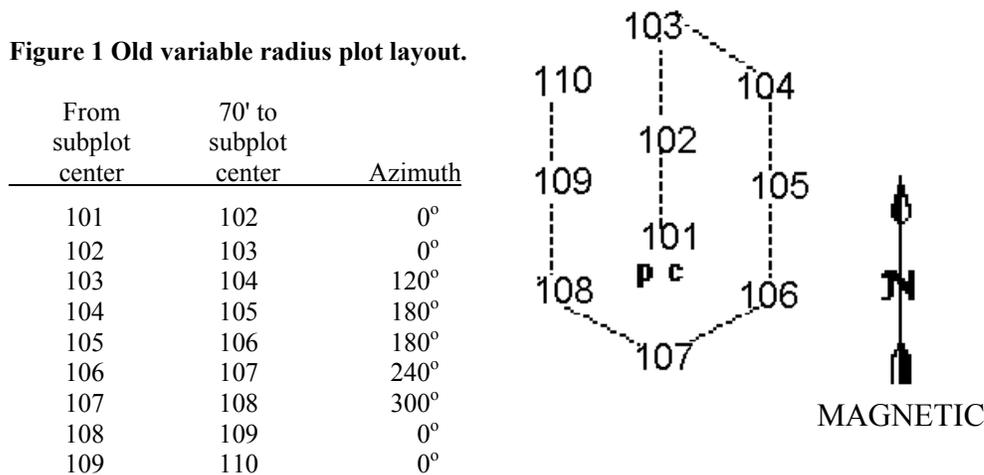
0.1 PLOT SETUP

0.1.1NC Old Variable Radius plot

The basic old variable radius plot consists of 10 subplots. The layout of these subplots is shown in figure 1. Plot center is the term applied to the point used to locate the plot. It is the ground location that corresponds to the pin prick on the photography. The centers of the subplots are referred to as subplot centers. Subplot center 101 is the same as plot center. Each subplot consists of a variable radius (37.5 BAF) plot to sample trees 5.0 inches and larger. A fixed radius micro plot (6.8 ft. radius) to sample trees less than 5.0 inches was measured at subplots 101, 102 and 103 in IL and IN and at all subplots in IA, KS, MI, MN, MO, NB, ND, SD, and WI. In MO, MI, IA and some of MN, when a subplot center was in a different land use than plot center, subplots were rotated so that all ten subplots fell in forest land or were not established if plot center fell in non-forest land. Figure 1 does not apply for these plots. Instead refer to the plot sheets for subplot location.

The pattern of the old variable radius plot was designed to obtain a uniform distribution of subplots over approximately one acre of forest land. Distances between sequential subplot centers is 70 horizontal feet. (fig. 1).

Figure 1 Old variable radius plot layout.



After subplot center 101 has been relocated, establish, locate, and mark 101-105 subplot centers with metal pins and flagging in the **same** location that they were last measured. All trees measured in the previous inventory will be remeasured (except saplings on subplots 104 & 105). Previously rotated subplots (101-105) will be remeasured in their rotated locations, see plot sheet for this location. In some cases both the rotated and the unrotated subplot will be measured see Appendix 9. No additional rotating or unrotating will be done.

0.1.1.1NC Plot Location Procedure For Remeasurement Plots

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

Once the SP tree is located, inspect to see that it is suitable. If the SP is suitable, the cruiser rescribes (not in reserved areas), repaints (not in reserved areas), and remeasures DBH. The tallier checks the "Course to Sample Location" on the plot sheet to see if it seems reasonable. The tallier then transfers the original course to sample location, SP description, and the remeasured DBH to 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, cannot be found, or the plot location is visible. Record the course to sample location, SP description, and SP DBH on the new plot sheet. After re-establishing the SP, chain the computed azimuth and distance along the approach line and mark the location.

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

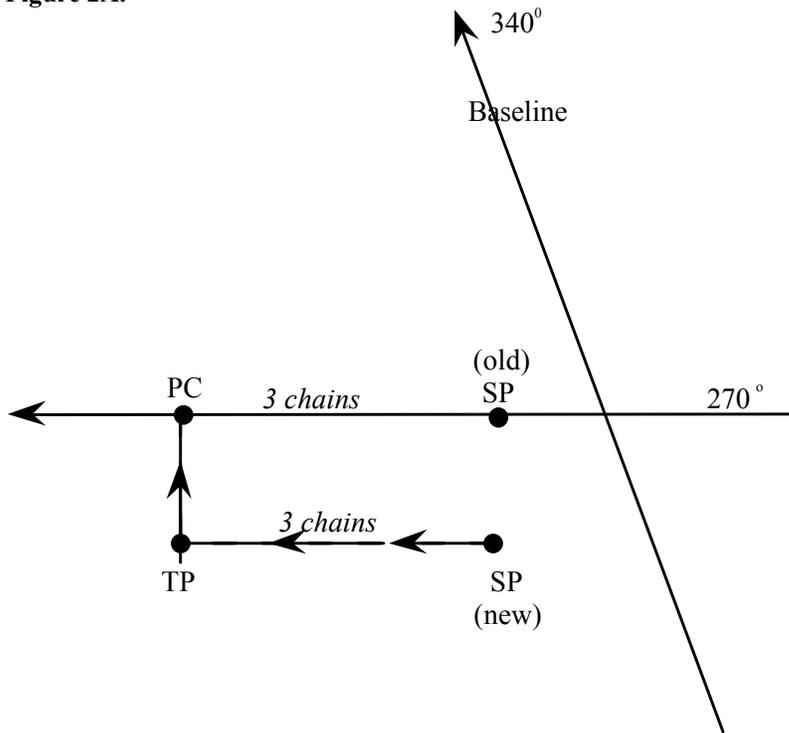
After finding plot center, establish a turning point if the distance between plot center and the end of the approach line exceeds 3% of the chaining distance.

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

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

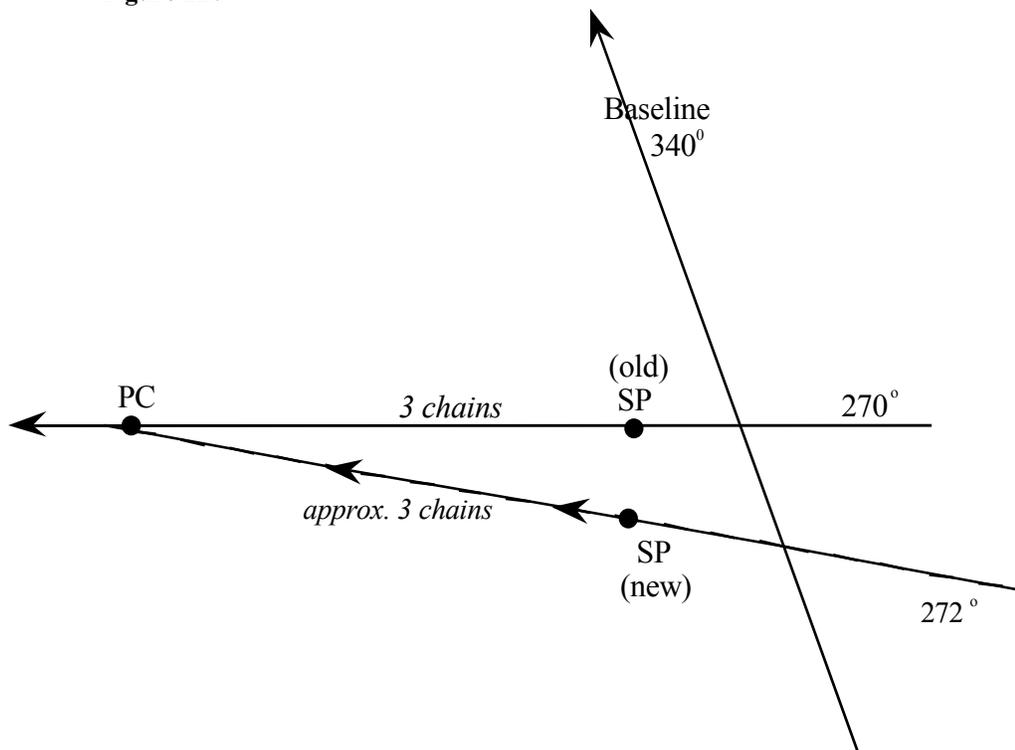
An easy way to establish a new SP, when needed, is to inspect the vicinity of the original SP for a suitable replacement. The following three options are available once you've found a replacement (fig. 2A, 2B, 2C). Note that fig. 4 shows the plot sketch—east-west azimuths would need to be reversed if drawn on the back of the photo.

Figure 2A.



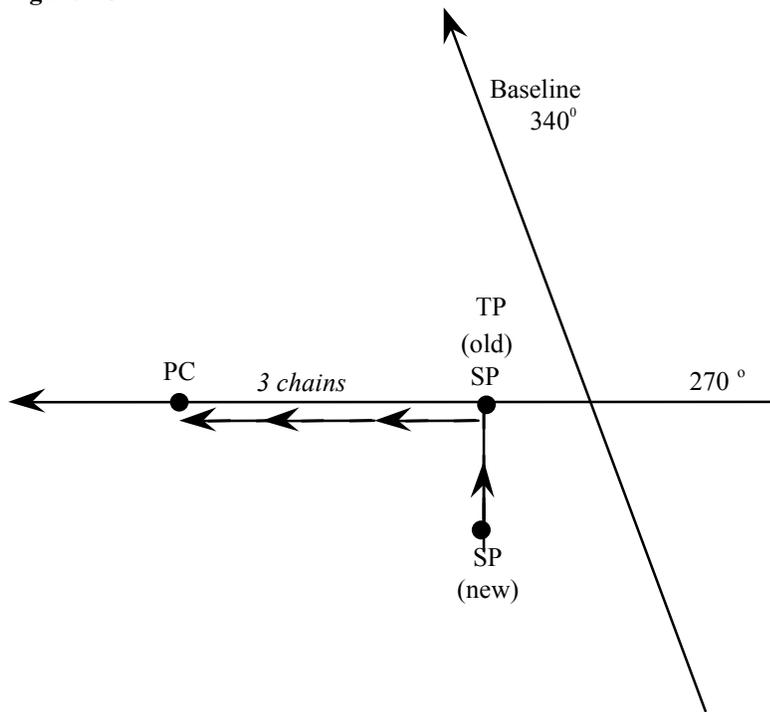
If the new SP is close by, pick the tree on the photo and use the original course to sample location. Leave a marker at your destination and look for plot center. It should be approximately the same distance and azimuth that the old SP is from the new SP. Once PC is found, make a turning point from your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

Figure 2B.



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 2C.



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.

0.1.1.2NC Subplot Location

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 old data for trees on the original plot data. Once it is determined to which subplot the trees belong, use triangulation to find the subplot center, marked with a piece of galvanized or aluminum wire--bent into a loop with a piece of blue flagging tied through it.

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

If there is an 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 the FIA plot, use the location of the FIA plot to do all work on the old trees. Then install the new plot using the location of the FHM plot. Make a note on the plot sheet about where the FHM plot is located in relation to the FIA plot. If there was a 4 point FIA plot installed at a different location than the FHM plot remeasure the FIA plot where it was installed.

After finding the old pin, 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 as accurately as possible. Finding each subplot is a challenge—most of the flagging disintegrates, the wires rust and appear just like twigs or roots. The best method is to run out 70 feet from the last 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 to search.

0.1.1.3NC If unable to locate a remeasurement plot

If you and your partner can't find a re-measurement plot, bring it to the attention of the person in charge. After the crew has thoroughly searched for the plot without success, the crew will establish the plot using the following guidelines.

When there has been a major disturbance (such as the area has been clearcut and bulldozed) and it is obvious that the plot can not be relocated because all or most of the old trees have been removed, a re-measurement plot is established as near as possible to the old PC.

No new trees will be measured on subplot numbers 101-105. Transfer original tree data to the data recorder and collect any current data that is possible, ie status, lean, utilization, dbh(same as original).

When there has been no major disturbance to the area, two plots will be created. The first plot retains the old plot number, is given SK=0 and NCSK=0 and State, unit, county, plot codes, send this data and the old plot sheet. The second plot is a new plot that is established to replace the old lost plot. Give the new plot a SK=3 and NCSK=0, complete the whole plot. Call the contact in St. Paul for a new plot number.

0.1.1.4NC Re-measurement plot in the wrong location

If a re-measurement plot was established in the wrong location (i.e. not in the same location as the photo pinprick), re-establish the plot in that wrong location. If the error is 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 of needs clarification for the next crew is that the current pinprick is on the north side of the road only 1 chain away but the plot is on the south side of the road. In this case please re-pinprick the new photo.

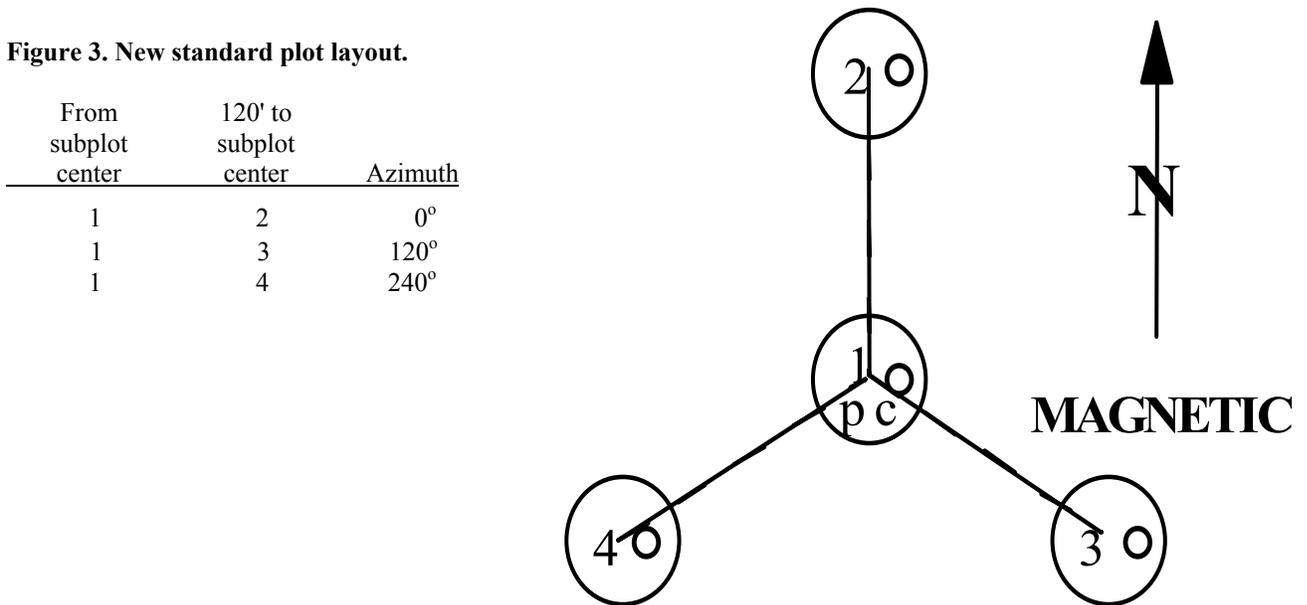
In the "Notes" section of the plot sheet, indicate that the plot was put in a different location. Record the distance and azimuth (use photo scale) from the original pinprick on the new photo to where the plot is actually located. Bring such plots to the attention of the person in charge. It is assumed that the plot is located in the correct location, unless evidence of the plot is found in the wrong place (i.e., pins, paint or flagging).

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

0.1.2NC New standard plot

The new standard plot design consists of a series of fixed-area, circular subplots tied to a cluster of four points that are spaced 120 ft (36.6 m) apart (fig. 0.1.2). The sampling unit for most tree measurements (trees > 5.0" DBH) is the 1/24-acre (1/60 hectare) subplot. The radius of this plot is 24.0 ft (7.32 m). A tree is on the subplot if its center (at the base of the tree) is within 24.0 ft of subplot center. Each subplot also includes a 1/300-acre (1/750 hectare) micro-plot located 12 feet and 90° from the (6.8 ft (2.07 m) radius) subplot center. Seedlings and saplings are measured on the micro-plot. 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.

Figure 3. New standard plot layout.



0.1.3NC Establish Baseline

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

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

0.1.4NC Starting Point

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

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

Pinprick the starting point on the aerial photograph on which the sample location is pinpricked. Label and circle the pinprick "SP" on the back of the photograph. 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 7.

0.1.4.1NC 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 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. Note when painting deviates from normal procedures. In reserved areas do not use paint, unless the manager of 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 telling what was used to mark if reserved areas are not marked 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 so do not paint.*

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.(appendix 7)

0.1.4.2NC 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.

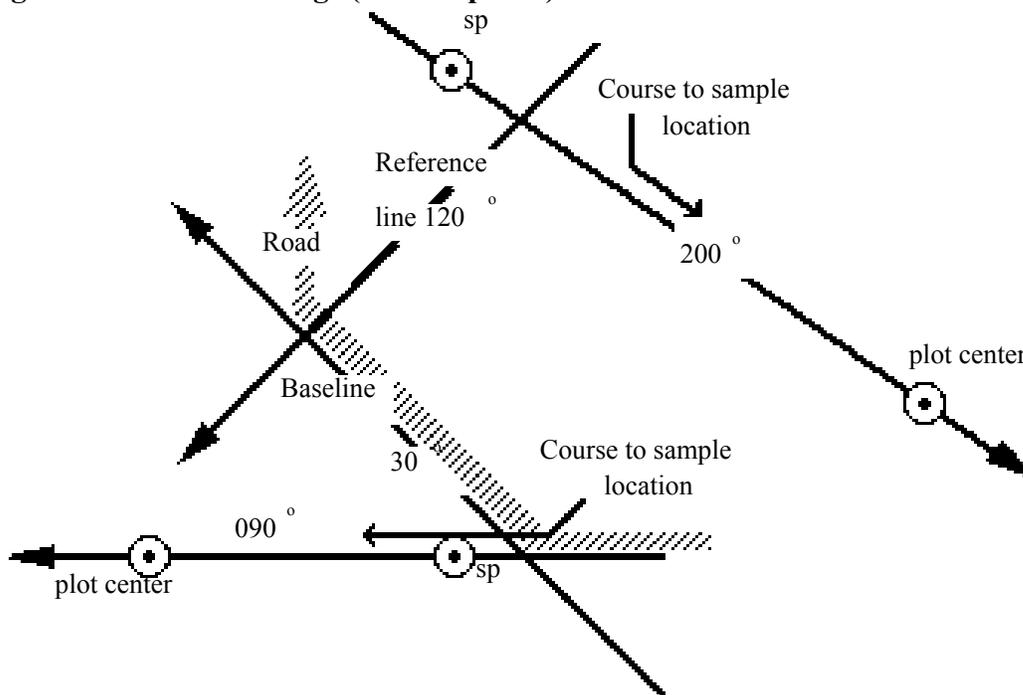
Be sure to use an inverted 360⁰ protractor or flip a standard 360⁰ protractor over. Align the 360-degree protractor over the azimuth of the baseline to get the azimuth of the sample location line. The azimuth is read directly off the protractor once the azimuth of the baseline is correctly aligned on 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: East-west azimuths are reversed when working on back of photo with standard protractor. Inverted protectors are available.

Refer to Figure 4. 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 4. Azimuth settings (back of photo)



0.1.4.3NC Chaining

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

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

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

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

0.1.4.4NC 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 site, place a second pin at the correct location. Note the azimuth and distance from the initial pin to the relocated pin and record these items under "Course to Sample Location" on the plot header sheet and remove the first pin. The initial pin is referred to as a turning point. The second pin becomes the location of the plot.

0.1.4.5NC 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 200⁰, 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 0°, 140 ft (the distance and azimuth from plot center to subplot 103). Establish another turning point and complete the original course (200°, for the remaining 100 ft) to reach subplot 103.

0.2 PLOT INTEGRITY

Each FIM 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 on subplots so that plot centers can be relocated easily.
- * boring of trees on subplots to determine site index to obtain estimates of inherent productivity associated with area within the subplots.
- * boring of trees tallied on subplots to determine their age, to provide a better basis for assigning age on other individual tallied trees, and to improve the estimation of stand age associated with area within the subplots.
- * nailing and tagging of trees on microplots and subplots so that these trees can be identified and relocated efficiently and positively at times of remeasurement.
- * nailing, scribing, or painting microplot and subplot 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 is prohibited. When possible, vines should be pried off of trunks to enable accurate measure. If this is not possible, alternate tools (calipers, biltmore sticks) should be used.

1.0 PLOT LEVEL DATA

1.0.1NC Subplot center Monumentation

Subplot centers are marked with wire, bent into a loop and wrapped with blue flagging. Leave about two inches of the wire projecting above the ground. In reserved areas do not attach flagging to the wire. All subplot centers are marked, 101 - 105 and 1-4.

1.0.2NC Subplot witness trees and Monumentation

Designate a witnessed subplot on all established plots. Use Plot Center (subplot 1) with three or more witness trees if possible. Witness trees should have the following characteristics:

- located within 120 feet of the witness 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).

Subplots 2, 3, or 4 can be used to witness when subplot 1 has no suitable witness trees. Witness subplots should be within forest conditions if possible.

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

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

Some items require measurements to decimal fractions of inches or feet. For these items, the last digit represents a decimal fraction. For example, a tree DBH of 23.4 inches is coded 234. Decimal points are never placed in coded entries. Mark each witness tree above DBH and at the base with a scribe and paint "X" on the side of the tree facing the witness subplot center. In reserved areas nail a tag with the letter X on it to the base of the tree facing subplot center.

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

For remeasurement plots, find and inspect the witness trees established on the last survey. Remeasure and rescribe at DBH and the base if they are still suitable witness trees. If the witness trees are missing or in poor shape (not expected to live until the next survey), select new witness trees. Remove the witness paint --scrape the old paint off-- if new witness trees are used.

1.1 PLOT LEVEL DATA PROCEDURE

Plot level data are recorded from the center of subplot 1. In general, they apply to the entire plot.

NC Note: All Plot level data items are collected on all plots with the exception of a plot described in 0.1.3NC.

1.2 PLOT LEVEL DATA ITEMS

1.2.1 PLOT NUMBER (PLT#)

Record the identification number for each location, unique within a county (survey unit in AK).

Field width: 4 digits

Measurement Quality Objective (MQO): No errors allowed, 100% of the time.

Values: 0001 to 9999

1.2.2 SAMPLE KIND (SK)

Record the code that describes the kind of plot being installed.

Field width: 1 digit

MQO: No errors allowed, 100% of the time.

Values:

- 0 Not a new standard plot (NC)
- 1. Initial plot establishment -- field-visited or remotely classified
- 2. Remeasurement of previously established plot -- field-visited or remotely classified
- 3. Replacement plot -- previously established plot replaced with a new plot because the plot could not be relocated or because plot data was lost.

1.2.2NC NC SAMPLE KIND (NCSK)

The NC sample kind indicates the information to be collected on two plot types that are unique to North Central Research Station FIA. All other plots will get a NCSK=0.

- 8 Partial Remeasurement Relocated. Measure a new standard plot (subplots 1-4). Do not measure old plot just use old plot information to locate subplot 1 and start with a new plot.
- 10 Partial Remeasurement Relocate. Measure all old trees on subplots 101-105 **do not** install a new standard plot (subplots 1-4). If this code is entered then SK must be 0 (zero).

1.2.2.1NC Special cases for plots outside Hexagon

In the St. Paul office, plot locations will be looked at to determine the distance the selected FIA plot is from the Hexagon center of the new grid design. If the distance from our old FIA plot is outside the hexagon, greater than 3041 meters, then the field crew will remeasure the 5 points of the old 10 point plot where it is as a NC sample kind 10. The new standard plot (1-4) will be installed at hexagon center as a sample kind 1 with a new plot number.

1.2.3 STATE (ST)

Record the unique FIPS code identifying the State where the plot center is located.

Field width: 2 digits

MQO: No errors allowed, 100% of the time.

Values: See appendix 1 for complete list

1.2.3NC NC UNIT (UNIT)

Unit is a one digit code which refers a division of a State that the plot and county are in (see the listed codes in the appendix 1)

Field width: 1 digits

MQO: No errors allowed, 100% of the time.

Values: See appendix ? for complete list.

1.2.4 COUNTY (CNTY)

Record the unique FIPS code identifying the county (or unit in AK) where the plot center is located.

Field width: 3 digits

MQO: No errors allowed, 100% of the time.

Values: See appendix 1 for complete list.

1.2.5 CURRENT DATE

Record the current year, month, and day that the current plot visit occurred as follows:

1.2.5.1 YEAR (YEAR)

Record the year that the plot visit occurred.

Field width: 4 digits

MQO: No errors allowed, 100% of the time.

Values: Beginning with 1998, constant for a given year.

1.2.5.2 MONTH (MONT)

Record the month that the plot visit occurred:

Field width: 2 digits

MQO: No errors allowed, 100% of the time.

Values:

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

1.2.5.3 DAY (DAY)

Record the day of the month that the plot visit occurred.

Field width: 2 digits

MQO: No errors allowed, 100% of the time.

Values: 01 to 31

1.2.6 GPS LATITUDE/LONGITUDE/ELEVATION (CORE OPTIONAL)

Use a GPS receiver to determine latitude, longitude, and elevation of the plot center in the field as follows:

NC GPS will be entered as the GPS readings. See appendix item 7 NC GPS directions.

~~Upon locating plot, use the GPS unit at the plot center to determine latitude, longitude, and elevation. Take at least 180 readings to obtain the GPS coordinates. Along with the latitude, longitude, and elevation, record the GPS unit ID number on the plot record. Use the NAD 27 datum (also known as NAS-C or NA 27 CONUS/CLK66 in some systems).~~

~~If it is not possible to get a position fix from plot center, attempt to obtain a fix from a location as near the plot center as possible and document so in the field notes. If the position fix is collected off the plot center, obtain the azimuth and horizontal distance from the point of fix to plot center and compute and record the coordinates of plot center. If the fix is taken at another subplot center, record the subplot number.~~

1.2.6.1 GPS LATITUDE (CORE OPTIONAL) (N:)

~~Record the latitude of the plot center, to the nearest hundredth second, as determined by GPS using the NAD 27 datum. This variable is not to be recorded in the field if a GPS is not used or if a reading cannot be obtained according to procedures.~~

~~Field width: 8 digit field (DDMMSSSS)~~

~~MQO: +/- 65 ft. (20 m), at least 95% of the time.~~

~~Values:~~

1.2.6.2 GPS LONGITUDE (CORE OPTIONAL) (W:)

~~Record the longitude of the plot center, to the nearest hundredth second, as determined by GPS using the NAD 27 datum. This variable is not to be recorded in the field if a GPS is not used or if a reading cannot be obtained according to procedures.~~

~~Field width: 9 digit field: DDDMMSSSS~~

~~MQO: +/- 65 ft. (20 m), at least 95% of the time.~~

~~Values:~~

1.2.6.3 GPS ELEVATION (CORE OPTIONAL) (ELEV)

~~Record the elevation above mean sea level of the plot center, in feet, as determined by GPS using the NAD 27 datum. This variable is not to be recorded in the field if a GPS is not used or if a reading cannot be obtained at plot center.~~

~~Field width: 5 digits~~

~~MQO: +/- 65 ft (20 m), at least 95% of the time~~

~~Values: 00100 to 20000~~

1.2.6B TRUE AZIMUTH CORRECTION (CORR)

~~All azimuths are assumed to be magnetic azimuths unless otherwise designated. The PNW FIA units have historically corrected all compass readings for true north. This field is to be used only in cases where units are adjusting azimuths to correspond to true north; for units using magnetic azimuths, this field will always be set = 0 in the office. AZIMUTH CORRECTION is defined as +~~

~~TRUE AZIMUTH CORRECTION = (TRUE NORTH - MAGNETIC NORTH)~~

~~Field width: 4 digits including sign.~~

~~MQO: No errors 100% of the time.~~

~~Values: -359 to 359~~

~~{NOTE: THE FOLLOWING FIELDS ARE COLLECTED ONLY ON FORESTED PLOTS}~~

1.2.6NC GPS UNIT NUMBER (GPS:)

Record the identification number on the GPS unit.

1.2.8 TRAILS OR ROADS (RTYP)

Record the trail or road nearest, or on, the field location. Use the plot photo, maps, and observations from the plot to code the highest quality road or trail for human access, within 1 mile (straight line distance) of the plot center. If two or more roads are equal distant, code the higher quality (lower code number).

NC Note: Record the nearest unless there is a tie then record the highest quality.

Field width: 1 digit

MQO: No errors 90% of the time.

Values:

<u>Code</u>	<u>Trails or Roads</u>
0	None within 1 mile
1	Paved road or highway
2	Gravel road
3	Improved dirt road (has culverts, signs, reflectors, or other improvements)
4	Unimproved dirt road/Jeep road -- 4-wheel drive road
5	Trail -- primarily for recreational use

1.2.9 HORIZONTAL DISTANCE TO IMPROVED ROAD (RDIS)

Determine the distance from the plot center to the nearest improved road and record the corresponding code. Consider only paved roads, gravel roads, or improved dirt roads (i.e. codes 1, 2, or 3 of TRAILS OR ROADS) regularly maintained for long-term continuing use. Measure the "straight-line" distance on the topographic map or photo. If the nearest improved road is not on the map or photo, estimate the "straight-line" distance.

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

Field width: 1 digit

MQO: No errors 90% of the time.

Values:

<u>Code</u>	<u>Horizontal Distance</u>
1	100 ft. or less
2	101 ft. to 300 ft.
3	301 ft. to 500 ft.
4	501 ft. 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

1.2.10 PUBLIC USE RESTRICTIONS 1 and 2 (2 variables) (REST)

Record the first public road access restrictions (primary) encountered while traveling to the plot. These restrictions limit car and truck access to the plot area, and may occur on ownerships encountered before reaching the plot area. Record the restriction posted near or on the plot area that limits use of the plot area; if more than one restriction occurs for the plot area, record the lowest number restriction present (5-7, 9).

Field width: 2 digits

MQO: No errors, at least 90% of the time.

Values:

<u>Code</u>	<u>Road Access Primary</u>
1	None - no road access restrictions
2	Road Blocked by locked gate or cable across road
3	Road blocked by human-made obstruction across road (ditch, mound, etc.)
4	Road blocked by natural occurrences (tree blown over onto road, road or bridge washed out)
5	Posted no motorized vehicles; road present, but restricted area such as Wilderness or National Park where vehicles are not allowed.
9	Other - specify in notes

<u>Code</u>	<u>Public Use Restrictions Secondary</u>
1	None - use restrictions
6	Keep out/No trespassing
7	No hunting/fishing
8	No dumping
9	Other - specify in field notes

The first digit is the primary and the second digit is secondary (e.g. 21)

1.2.11 RECREATION USE 1, 2, and 3 (3 variables) (RECU)

Recreation Use 1, 2, and 3. Record up to 3 signs of recreation use encountered within any of the four annular plots (59.0 ft radius fixed area surrounding each subplot center), based on evidence such as campfire rings, compacted areas (from tents), hiking trails, bullets or shotgun casings, tree stands, etc. Record the recreation use that has had the most significant impact on the field location first, then the second and third use. For example, in general numerous jeep 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 8. Physical recreation evidence must be present to code 1-8. Also, disregard litter or 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.

Field width: 3 digits

MQO: 2 of 3 correct, at least 90% of the time.

Values:

<u>Code</u>	<u>Recreation Use</u>
0	None
1	Motor vehicle (ATV, jeep, snowmobile)
2	Horse or dog trails
3	Camping
4	Hiking
5	Hunting/shooting
6	Fishing
7	Boating
8	Other - specify in field notes

1.2.13 WATER ON PLOT (WTYP)

This variable may be used for recreation, wildlife, hydrology, and timber availability studies. Record the water source that has the greatest impact on the area within the annular plots (59.0 ft radius fixed area surrounding each subplot center). The coding hierarchy is listed in order from large permanent water to temporary water.

Field width: 1 digit

MQO: No errors, at least 90% of the time.

Values:

<u>Code</u>	<u>Water on Plot</u>
0	None (no water within any annular plot)
1	Census water
2	Noncensus water
3	Permanent streams or ponds too small to qualify for noncensus water
4	Permanent water in the form of deep swamps, bogs, marshes with or without standing trees present.
5	Ditch/Canal - human made channels used as a means of moving water, such as irrigation or drainage.
6	Temporary streams
7	Flood zones - evidence of flooding when bodies of water exceed their natural banks.
8	Other temporary water - specify in field notes.

2.0 CONDITION CLASS

The Forest Inventory and Monitoring (FIM) plot is cluster of four subplots in a fixed pattern. Subplots are never reconfigured or moved in order to confine them to a single condition. 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: Conditions will be defined based on subplots 1-4, any old conditions will be redefined and mapped. Special cases see Appendix 9.

2.1 *Determination of when to collect data:*

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. Non-Census water
4. Census water
5. Area denied access
6. Area too hazardous to visit
7. Area that is out of the inventory, e.g. in Canada or Mexico.

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

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

1. Forest Type
2. Stand Size
3. Stand Origin
4. Reserve Status
5. Tree Density
6. Owner Group

At time of re-inventory, two additional attributes, "Past nonforest use" and "Present nonforest use" are mapped to delineate new conditions if sampled area on a plot has changed to or from accessible forest land (See Sections 2.4.42 and 2.4.43). This allows tracking of land use changes without requiring us to always map all non-forest conditions on all plots.

No other attribute shall be the basis for recognizing contrasting condition classes. For each condition class recognized, several 'ancillary attributes' which help describe the condition will be collected, but will not be used for mapping purposes (see Section 2.4).

NC Note: In Indiana and Illinois the 4-point plot will be remeasured so there are some specific examples on how to handle these in Appendix 9.

General instructions for delineating condition classes:

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 conditions 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 mapped 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 conditions: Separate conditions 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.

2.2 General instructions for determining 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 forest land and nonforest land conditions classes are recognized only if each of the two prospective conditions are at least 1.0 ac. (0.40 ha.) in size, and each is at least 120.0 ft. (36.58 m.) in width. These size and width minimums apply to both accessible forest land and nonforest land.

Within a forest land condition, unimproved roads, rock outcrops, and natural nonforest openings less than 1.0 ac. (0.40 ha.) in size and 30.0 ft. (9.15 m.) in width at the point of occurrence are considered forest land and are not delineated and classified as a separate nonforest condition.

Within a nonforest land condition, forested areas or linear strips of trees less than 1.0 ac. (0.40 ha.) in size and 120.0 ft. (36.58 m.) in width at the point of occurrence are considered part of the nonforest condition.

Three exceptions to these size and width requirements apply:

1. Distinct, alternating strips of forest and nonforest land: this situation occurs when a plot or subplot samples a condition that is less than 1.0 ac. (0.40 ha.) in size and 120.0 ft. (36.58 m.) in width. The condition is one of a series of parallel strips of forest and nonforest land in which none of the strips meet the minimum width requirement. 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. 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.

2. Developed nonforest inclusions: human-caused nonforest land conditions that are less than 1.0 ac. (0.40 ha.) in size and 120.0 ft. (36.68 m.) in width and are surrounded by forest land. All extensions from developed nonforest inclusions are nonforest conditions regardless of length or width. There are three kinds of developed nonforest inclusions 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. Unimproved traces and roads created for skidding logs are part of forest land.

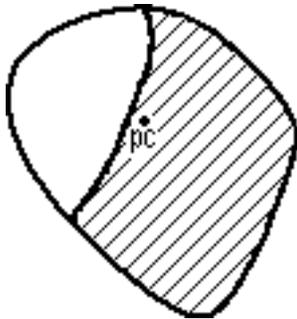
- b) Maintained rights-of-way: corridors created for railroads, power lines, gas lines, and canals that are periodically treated to limit the establishment and growth of trees and shrubs.

- c) Developments: structures and the maintained area next to a structure, all less than 1.0 ac. (0.40 ha.) 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.

3. 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 non-census water to be nonforest area. Therefore, a linear

water feature must be at least 30 ft. (9.15 m.) wide and cover at least 1 ac. (0.40 ha.). 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 non-census 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. (0.40 ha.) requirement; use professional judgment and common sense on any linear water feature.

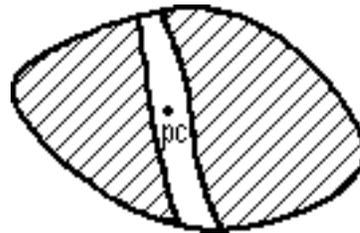
Figure 5. The following examples have been included to aid in assigning Condition Status to subplot centers. Shaded areas represent forest.



1.

Forest (STAT=1)

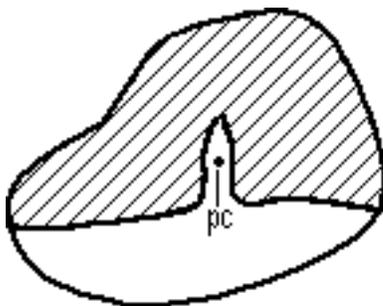
Subplot Center falls on forest land larger than one acre in size.



2.

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.



3.

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.

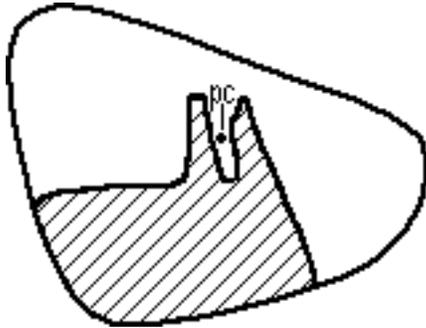


4.

Forest (STAT=1)

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

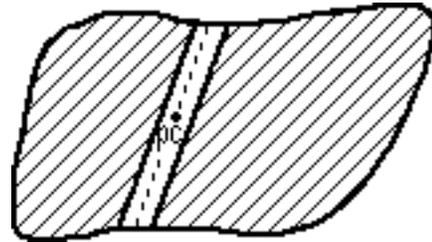
Figure 5 CONTINUED



5.

Forest (STAT=1)

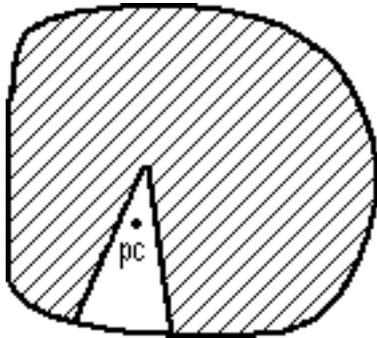
Subplot Center falls in area of more than two adjacent strips of clearly defined forest and nonforest land (each strip less than 120 feet in width). As the band of strips in the acre is comprised of more forest than nonforest, the classification is forest.



6.

Nonforest (STAT=2)

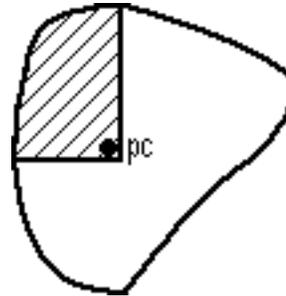
Subplot Center falls in improved road less than 120 feet wide. Improved roads and power line clearings of any width are nonforest.



7.

Forest (STAT=1)

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



8.

Forest (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.

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

2.3 General instructions: Determining condition classes within accessible forest land:

Accessible forest land is subdivided into condition classes that are based on differences in forest type, stand size, stand origin, owner group, reserved 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.

'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. (0.40 ha.) in size and at least 30 ft. (9.15 m.) in width at the point of occurrence. 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.

2.4 CONDITION CLASS ATTRIBUTES

A condition class number and a classification for condition status is required for every condition class sampled on a plot.

All Conditions

2.4.1 Condition Number

2.4.2 Condition Status

For each condition class classified as accessible forest land, a classification is required for each of the following attributes (gaps in code numbers signify placeholders for variables still in development).:

Accessible forest land

Attributes where change causes mapping

2.4.3 Forest Type

2.4.4 Stand Size

2.4.5 Stand Origin

2.4.6 Reserve Status

2.4.7 Tree density

2.4.8 Owner Group

Ancillary - changes do not force mapping

2.4.44NC NC Land Use

2.4.8NC NC Owner Acres

2.4.9 Owner Class

2.4.10 Private Owner Industrial Status

2.4.11 Stand species origin

2.4.12 Stand age

2.4.14 Disturbance (up to 3 coded)

2.4.15 Disturbance Year (1 per disturbance)

2.4.20 Treatment (up to 3 coded)

2.4.21 Treatment Year (1 per treatment)

2.4.29 Physiographic Class

Two additional attributes require classification in very specific situations:

NC Note: These two attributes may occur and be recorded on any plot.

2.4.42 Past non-forest land use (for area afforested since last inventory).

2.4.43 Present non-forest land use (for area converted from forest land to nonforest land since last inventory).

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 a maximum of 60.0 ft. (18.3 m.) fixed radius plot center.

Specific instructions for the classification of each attribute follow.

2.4.1 CONDITION CLASS NUMBER (CON#)

On a plot, each condition class sampled is assigned a unique identifying number. 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 which can change at remeasurement to reflect new conditions on the plot.

Field width: 1 digit
MQO: No errors, 100% of time
Values: 1 to 9

CLASS DEFINING (MAPPING) VARIABLES:

2.4.2 CONDITION 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 2.1 and 2.2 apply when delineating condition classes that differ by condition status.

Field width: 1 digit
MQO: No errors, 100% of time
Values:

- 1 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;

~~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.~~

To qualify as forest land, the prospective condition must be at least 1.0 ac. (0.40 ha.) in size and 120.0 ft. (36.58 m.) wide measured stem-to-stem. Wooded strips must be 120.0 ft. (36.58 m.) wide for a continuous length of at least 363.0 ft. (110.64 m.) in

order to meet the acre threshold. Wooded strips that do not meet these requirements are classified as part of the adjacent nonforest land.

Treated strips - Occasionally, crews will come across plantations of trees in which rows of trees alternate with strips of vegetation that has 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.

- 2 Nonforest land - Any land within the sample and that does not meet the definition of forest land. To qualify, the area must be at least 1.0 ac. (0.40 ha.) in size and 120.0 ft. (36.58 m.) wide, with exceptions discussed below (see Guidelines). 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.
- 3 Noncensus water - Lakes, reservoirs, ponds, and similar bodies of water 1.0 ac. (0.40 ha.) to 4.5 ac. (1.82 ha.) in size. Rivers, streams, canals, etc., 30.0 ft. (9.1 m.) to 200 ft. (61.0 m.) wide.
- 4 Census water - Lakes, reservoirs, ponds, and similar bodies of water 4.5 ac. (1.82 ha.) in size and larger; and rivers, streams, canals, etc., more than 200 ft. (9.1 m.) wide (1990 U.S. Census definition).
- 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 reexamined at the next occasion to determine if access is available.
- 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, 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.
- 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 (in most cases, within the legal boundaries of the US). Examples: area within Mexico or Canada. A condition outside the sample area remains in the sample 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.

2.4.3 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. Record only on condition classes that are accessible forest land.

Field width: 3 digits

MQO: No errors in group 100% of time; No errors in type at least 95% of time

Values: See appendix 2 for complete list of codes.

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

The following are examples of differences in forest type that would require delineating condition classes and mapping boundaries if each condition meets the minimum size and width requirements.

- * An area dominated by softwood tree species bordering an area dominated by hardwood species.
- * A pure pine stand adjacent to a mixed conifer stand.
- * A hardwood stand principally composed of dry site hardwood species that borders a stand dominated by wet site hardwood tree species.

2.4.4 STAND-SIZE CLASS (STSZ)

Record the code that best describes the predominant size class of the live trees that are not overtopped in the condition. Record only on condition classes that are accessible forest land.

The instructions in section 2.1 and 2.3 apply when delineating, on accessible forest land, contrasting conditions based on differences in stand-size.

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.

Field width: 1 digit

MQO: No errors 100% of time

Values:

<u>Code</u>	<u>Stand-Size Class</u>	<u>Description</u>
1	Large diameter:	<p>≥ 10 percent stocking of trees of any size; > 50 percent of the stocking is in trees with diameters ≥ 5.0 in. (12.70 cm.); and the stocking of large diameter trees [softwoods ≥ 9.0 in. (22.86 cm.), hardwoods ≥ 11.0 in. (27.94 cm.)] exceeds the stocking of medium diameter trees.</p> <p>For forest types where stocking standards are not available, ≥ 5 percent cover of trees of any size; > 50 percent of the cover is in trees with diameters ≥ 5.0 in. (12.70 cm.); and the cover of large diameter trees [diameter ≥ 9.0 in. (22.94 cm.)] exceeds the cover of medium diameter trees.</p>
2	Medium diameter:	<p>≥10 percent stocking by trees of any size; > 50 percent of the stocking is in trees with diameters ≥ 5.0 in. (12.70 cm.); and the stocking of medium diameter trees [softwoods 5.0 in. (12.70 cm.) to 8.9 in. (22.61 cm.), hardwoods 5.0 in. (12.70 cm.) to 10.9 in. (27.69 cm.)] exceeds the stocking of large diameter trees.</p> <p>For forest types where stocking standards are not available, ≥ 5 percent cover of trees of any size; > 50 percent of the cover is in trees with diameters ≥ 5.0 in. (12.70 cm.); and the cover of medium diameter trees [diameters 5.0 in. (12.70 cm.) to 8.9 in. (22.61 cm.)] exceeds the cover of large diameter trees.</p>
3	Small diameter:	<p>≥ 10 percent stocking by trees of any size, and > 50 percent of the stocking is in trees with diameters < 5.0 in. (12.70 cm.)</p> <p>For forest types where stocking standards are not available, ≥ 5 percent cover by trees of any size, and > 50 percent of the cover is in trees with diameters < 5.0 in. (12.70 cm.).</p>
4	Chaparral:	< 10 percent stocking by trees of any size, and ≥ 5 percent crown cover of species that comprise chaparral communities.
5	Nonstocked:	<p>Meeting the definition of forest land, and one of the following applies:</p> <p>a) < 10 percent stocked by trees of any size, and not classified as chaparral,</p> <p>or</p> <p>(b) for forest types where stocking standards are not available, < 5 percent cover of trees of any size.</p>

2.4.4 ARTIFICIAL REGENERATION (SORI)

Record the code that best describes how the stand originated. Record only on condition classes that are accessible forest land.

Field width: 1 digit

MQO: No errors 100% of time

Values:

<u>Code</u>	<u>Stand Origin</u>	<u>Description</u>
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 stand origin.

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.

2.4.11 ARTIFICIAL REGENERATION SPECIES (SOSP)

Record only when artificial regeneration (2.4.4) is coded "1". Record the species code of the predominant tree species planted or seeded in an artificially regenerated condition. This attribute is ancillary; that is, contrasting conditions are never delineated based on variation in this attribute. Record only on condition classes that are accessible forest land.

Field width: 3 digits

MQO: No errors 100% of time

Values: See list of species appendix 4

2.4.6 RESERVE STATUS (RESV)

Record the code that identifies the reserved designation for the condition. Record only on condition classes that are accessible forest land.

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.

Field width: 1 digit
 MQO: No errors 100% of time
 Values:

<u>CODE</u>	<u>RESERVE STATUS</u>
0	Not reserved
1	Reserved

2.4.7 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, compared to any previously defined condition class tree density. Record only on condition classes that are accessible forest land.

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 mapped 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.

Field width: 1 digit
 MQO: No errors 100% of time
 Values:

<u>CODE</u>	<u>TREE DENSITY</u>
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. Density is tied to the main stand (same used in stand-size, etc.). Lower dense stand must be at least 50% of higher density stand. Example: if one is 100 ft² of basal area, to map, adjacent stand must be either < 50 ft² or > than 200 ft².

Examples of valid contrasting conditions defined by differences in tree density are forest land conditions with the same type, origin, stand size, ownership, and reserve 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 acre) while the other portion is undisturbed (with 100 sq. ft. basal area per acre).

2.4.8 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 mapped 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. Record only on condition classes that are accessible forest land.

NC Note: Owner Name, address and contact must be recorded, see Appendix 12.

Field width: 2 digit

MQO: No errors 100% of time

Values:

<u>CODE</u>	<u>OWNER GROUP</u>
10	Forest Service
20	Other Federal
30	State and Local Government
40	Private

ANCILLARY (NON-MAPPING) VARIABLES

2.5.8NC NC PRIVATE ACRES (NCPA)

For Ownership Class code 40, record the acres owned using the code that indicates ownership size (commercial forest land only) in the United States.

Field width: 1 digit

MQO: No errors 100% of time

Values:

Code	Acres of commercial 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+

2.4.9 OWNER CLASS (OWNC)

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

Field width: 2 digit

MQO: No errors 100% of 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/NaturalResources Organization
- 43 Unincorporated Local Partnerships/Associations/Clubs
- 44 Native American (Indian)
- 45 Individual

2.4.10 PRIVATE OWNER INDUSTRIAL STATUS (INDU)

Record the code identifying the status of the owner with regard to whether or not they are considered 'industrial'. Record only on condition classes that are accessible forest land when the owner group is private (40 series).

NOTE: Unit headquarters will have to maintain a list of recognized 'industrial owners' within a state for crews to use when making these determinations.

Field width: 1 digit

MQO: No errors 100% of time

Values:

<u>CODE</u>	<u>PRIVATE OWNER INDUSTRIAL STATUS</u>
1	Owned by company with wood processing facility
2	Not owned by company with a wood processing facility.

2.4.11 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. This attribute is ancillary; that is, contrasting conditions are never delineated based on variation in this attribute. Record only on condition classes that are accessible forest land. Record 000 for non stocked stands.

An estimate of stand age is required for every forested 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 range back to the time of tree establishment (e.g., not age at DBH). 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).

Determination of stand age involves the extraction of tree cores. Cores should not be taken from trees within 24.0 ft (7.3 m) of any subplot center. This is required to protect subplot trees from potential damage caused by the coring process. Trees should be cored off the subplots, yet still within the same condition class to which the age data apply.

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 DBH and count the rings from the outside edge of the core to the pith. Add in the number of years that passed from germination until the tree reached DBH to determine the total age of the tree. Unless more specific information is provided at training, 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:

$$(34 \times 0.25) + (62 \times 0.60) + 59 \times (0.15) = 55 \text{ years.}$$

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 nonstocked forest type is assigned, a stand size of nonstocked and stand age of 000 must also be assigned.

Field width: 3 digits
MQO: +/- 10%, 95% of time
Values: 000 to 999

2.4.14 DISTURBANCE (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 acre in size. Record up to three different disturbances per condition class from most important to lesser important as best as can be determined. This attribute is ancillary; that is, contrasting conditions are never delineated based on variation in this attribute. Record only on condition classes that are accessible forest land.

For initial forest plot establishment (initial grid activation or newly forested plot locations), the disturbance must be within the last 5 years. For remeasured plot locations, recognize only those disturbances that have occurred since the previous inventory.

Some of the disturbance codes below require "any visible evidence" others require "significant threshold". Significant threshold implies:

(1) mortality and/or damage to 25 percent of individual trees, serious enough to meet minimum threshold requirements (see section 5.18), and

(2) 25% of all trees in the stand are impacted.

Field width: 2 digits

MQO: No errors 100% of time

Values:

Code	Definition
00	None - No observable disturbance.
10	Insects - Significant threshold damage from insects.
20	Disease - Significant threshold damage from disease.
30	Weather - Significant threshold damage from weather other than the following: 31 Ice - Significant threshold damage from ice. 32 Wind - Significant threshold damage from wind (includes hurricane, tornado). 33 Flooding - Significant threshold damage from weather-induced flooding. 34 Drought - Significant threshold damage from drought.
40	Fire - Any visible evidence of crown and ground fire, either prescribed or natural. 41 Ground Fire - Visible evidence of ground fire. 42 Crown Fire - Visible evidence of crown fire.
50	Domestic animal - Visible evidence of domestic livestock (includes grazing).
60	Wild Animal - Significant threshold damage from wild animals other than the following: 61 Beaver - Significant threshold damage from beaver (includes flooding). 62 Porcupine - Significant threshold damage from porcupines.
70	Human - Any significant threshold human-caused damage not described in the disturbance codes listed above or the treatment codes listed below.
80	Other natural - Any significant threshold natural damage, not described in the disturbance codes listed above.

2.4.15 DISTURBANCE YEAR 1 (DYR1)

Record the year in which Disturbance 1 occurred.

2.4.16 DISTURBANCE 2 (DIS2)

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

2.4.17 DISTURBANCE YEAR 2 (DYR2)

Record the year in which Disturbance 2 occurred.

2.4.18 DISTURBANCE 3 (DIS3)

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

2.4.19 DISTURBANCE YEAR 3 (DYR3)

Record the year in which Disturbance 3 occurred.

2.4.20 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 acre in size. Record up to three different treatments per condition class from most important to lesser important as best as can be determined. This attribute is ancillary; that is, contrasting conditions are never delineated based on variation in this attribute. Record only on condition classes that are accessible forest land.

For initial forest plot establishment (initial grid activation or newly forested plot locations), the treatment must be within the last 5 years. For remeasured plot locations, recognize only those treatments that have occurred since the previous inventory.

The term 'merchantable stand' refers to stands at least 50% stocked with live or salvable dead trees 5.0 inches DBH or larger.

Field width: 2 digits

MQO: No errors 100% of time

Values:

<u>Code</u>	<u>Definition</u>	
00	None	No observable treatment.
10	Cutting	The removal of trees from a merchantable 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	Natural Regeneration	The establishment of a new stand by natural means on forest or nonforest land where the stocking of all live trees is now greater than 50%.
40	Artificial Regeneration	The establishment of a new stand by artificial means on forest or nonforest land where the stocking of all live trees is now greater than 50%.
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.

2.4.21 TREATMENT YEAR 1 (TYR1)

Record the year in which Treatment 1 occurred.

2.4.22 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.

2.4.23 TREATMENT YEAR 2 (TYR2)

Record the year in which Treatment 2 occurred.

2.4.24 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.

2.4.25 TREATMENT YEAR 3 (TYR3)

Record the year in which Treatment 3 occurred.

2.4.29 PHYSIOGRAPHIC CLASS (PHYS)

Land form, topographical position, and soil generally determine physiographic class. As a rule of thumb, look out 60 feet from the subplot centers when determining physiographic class, but always use your best judgement when assessing any condition level variables.

Field width: 2 digits

MQO: No errors, 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.

<u>Code</u>	<u>Description</u>
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 mountain/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, ridges and flats in the South, sites along the beach and shores of lakes and streams.
14	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.

<u>Code</u>	<u>Description</u>
21	Flatwoods. - Flat or fairly level sites outside of 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 floodplains.
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 Floodplains/Bottomlands. - Floodplains 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 mile limit. Excludes swamps, sloughs, and bogs.
25	Broad Floodplains/Bottomlands. - Floodplains 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 within a 1/4-mile limit. Excludes swamps, sloughs,

and bogs with year-round water problems within the 1/4-mile limit.

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

Hydric -- Sites which 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"

<u>Code</u>	<u>Description</u>
31	Swamps/Bogs. - Low, wet, flat forested areas usually quite extensive which are flooded for long periods or 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.
34	Beaver ponds.
35	Cypress ponds.
36	Other hydric. - All other hydric physiographic sites

2.4.42 PAST NONFOREST/INACCESSIBLE LAND USE (OLU)

Record and map on this attribute ONLY when a condition classified at last inventory as nonforest is now accessible forest land. The area that has changed is a new, separate condition class. Instructions in Sections 2.1 and 2.2 apply. When classifying these cases, select the classification that, within the sampled area, indicates what the majority of this changed area was at the time of previous inventory.

Example: At previous inventory, subplot 2 was classified as entirely nonforest land. The other subplots sampled accessible forest land. At that time, 55 percent of area on subplot 2 was pasture, and 45 percent, cropland. (Note: these two nonforest classes were not actually mapped, but rather the entire subplot represented a condition class that was simply classified as nonforest land).

At revisit, 60 percent of subplot 2, including all that was pasture within the subplot, is found planted to pines and now forest land. The other subplots remained forest land. The portion of subplot 2 that changed from nonforest to forest is mapped and recorded as a new condition class. This "new" forest land should not be considered part of, and lumped with forest land condition class(es) sampled on the other subplots. Because it is a condition that changed from nonforest to forest, the attribute "Past nonforest land use" must be coded; the appropriate classification is pasture, the majority nonforest use --at last inventory-- within the mapped portion of this new condition class.

Sampled area that shifts from access-denied, hazardous, outside-the-sample, or other uses to accessible forest land are treated in like manner. Codes 91, 92, 93, and 40 apply.

Field width: 2 digits

MQO: No errors, 100% of time

Values:

Code Description

- 10 Agricultural land - Land managed for crops, pasture, or other agricultural use; the area must be at least 1.0 ac (0.40 ha) in size and 120.0 ft. (36.58 m.) wide at the point of occurrence. Use the 10 code only for cases not better described by one of the following:
 - 11 Cropland
 - 12 Pasture (improved through cultural practices)
 - 13 Idle farmland
 - 14 Orchard
 - 15 Christmas tree plantation

- 20 Rangeland - Land primarily composed of grasses, forbs, or shrubs. This includes lands vegetated naturally or artificially to provide a plant cover managed like native vegetation and does not meet the definition of pasture. The area must be at least 1.0 ac (0.40 ha) in size and 120.0 ft. (36.58 m.) wide at the point of occurrence.

- 30 Developed - Land used primarily by humans for purposes other than forestry or agriculture. Use the 30 code only for land not better described by one of the following:
 - 31 Cultural: business, residential, and other places of intense human activity.
 - 32 Rights-of-way: improved roads, railway, power lines, maintained canal
 - 33 Recreation: parks, skiing, golf courses

- 40 Other - Land parcels greater than 1.0 ac. (0.40 ha.) in size and greater than 120.0 ft. (36.58 m.) wide, that do not fall into one of the uses described above. Examples include undeveloped beaches, barren land (rock, sand), non-census water, marshes, bogs, ice, and snow.

- 90 Not sampled - Land areas that are not sampled. Use the 90 code only for land not better described by one of the following:
 - 91 Denied access: access denied by the owner.
 - 92 Hazardous: land could not be safely accessed by crews.
 - 93 Not in sample: area outside the population of interest, e.g. census water, land in Mexico or Canada.

2.4.43 PRESENT NONFOREST/INACCESSIBLE LAND USE (CLU)

Record this attribute when area sampled and classified at last inventory as accessible forest land is now nonforest land. The area that has changed is a new, separate condition class; it should not be considered part of, and

lumped with nonforest land condition class(es) sampled at previous inventory that are still present. Instructions in Sections 2.1 and 2.2 apply. When classifying these cases, select the classification that, within sampled area, indicates what the majority of this changed area is now if more than one nonforest classes are present. Use the codes and classifications listed in 2.4.42; note that the 90 codes will not apply.

Sampled area that shifts from access-denied, hazardous, outside the sample, or other uses to accessible forest land are treated in like manner. Codes 91, 92, 93, and 40 apply.

~~(CORE OPTIONAL) - Record the Present Nonforest Land Use for all nonforest conditions (Condition Status 2), regardless of past condition. Use the codes and classifications listed in 2.4.42.~~

Field width: 2 digits
MQO: No errors, 100% of time
Values: Same as 2.4.42

2.4.44NC NC LAND USE (NCLU)

All conditions defined will also receive an NC Land Use. This list is the same one used by NC in the past but it no longer determines which data items are collected.

<u>Code</u>	<u>Description</u>
-------------	--------------------

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, 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 commercial forest land 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.
- 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.
- 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.
- 71 **Urban forest land** Locationally reserved land that normally would meet the criteria for commercial forest land, but is in an urban-suburban area surrounded by commercial, industrial, or residential development. It is extremely unlikely that such land is used for timber products on a continuing basis. Example: wooded creek bottom surrounded by houses. Includes forested areas on military bases, depots, or proving grounds where access and use are restricted because of certain activities.
- 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.**
- 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 more than 120 feet wide, and one acre in size, but less than 10 chains wide and 40 acres in size (normal water level). Linear water features at least 30 feet wide between mean high-water marks are also included.
- 80 **Noncensus Water** (reserved)
- 90 **Census Water** A body of water greater than 10 chains wide and greater than 40 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** Will only be assigned in St. Paul after data collection.
- 99 **Denied access plot**

Chart of valid NC Land Use Codes with Condition Status Codes

NC Land Use	Condition Status						
	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					
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					
80			X				
90				X			
96						X	
97							X
98	This plot will not have a new 4-point plot.						
99					X		

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 101-115.)

NC Note: In Indiana and Illinois the 4-point plot will be remeasured so there are some specific examples on how to handle these in Appendix 9.

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 (FIGURE 6). 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.

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 (FIGURE 7). 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 2.1 for general mapping guidelines. The following additional rules apply when referencing a boundary within a subplot, microplot, or annular plot:

- 1 When a boundary between forest land and nonforest land or between two contrasting forest land conditions 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 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 conditions is not clearly marked, map along the stems of the contrasting condition. When the boundary between two contrasting forest land conditions 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 downloaded boundary data that was recorded at last inventory. If 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 no longer distinct.

Figure 6. Case with two conditions on a plot and a distinct condition boundary that cuts through subplots 1 and 2.

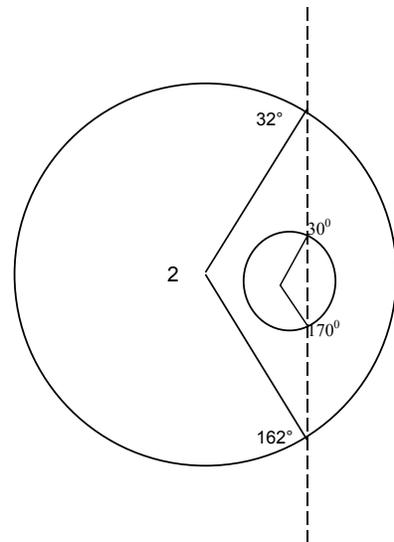
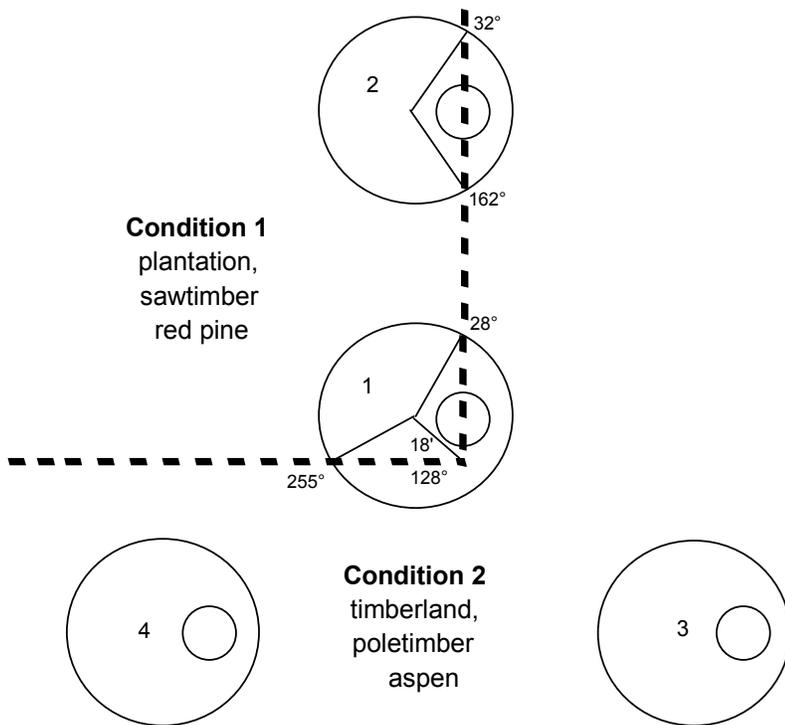


Figure 7 Enlargement of subplot 2 from figure 6 to show how to map the microplot.

3.2 BOUNDARY DATA

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

NC Note: Data is required for this menu only when there is a boundary.

3.2.1 SUBPLOT NUMBER

Record the code corresponding to the number of the subplot.

Field width: 1 digit

MQO: No errors, 100% of time

Values:

- 1 center subplot
- 2 north subplot
- 3 southeast subplot
- 4 southwest subplot

3.2.2 PLOT TYPE (TYPE)

Specify whether the boundary data is for a subplot, microplot, or annular plot.

Field width: 1 digit

MQO: No errors 100% of time

Values:

<u>CODE</u>	<u>PLOT TYPE</u>
1	subplot boundary
2	microplot boundary
3	annular plot boundary (coded only when annular plots are taken)

3.2.3 BOUNDARY CHANGE (CHNG)

(Remeasurement locations only)

Record the appropriate code to indicate if the data for a boundary are being copied from the previous crew's data.

Field width: 1 digit

MQO: No errors 100% of time

Values:

<u>CODE</u>	<u>BOUNDARY CHANGE</u>
0	No change - boundary is presently the same as indicated on the plot map.
1	Boundary has been changed to reflect a difference(s) from the boundaries recorded, if any, at last visit.
2	Boundary has been changed in data to correct an error from previous crew
3	Boundary has been changed to reflect a change in variable definition

3.2.4 CONTRASTING CONDITION (CCON)

Record the condition class that contrasts with the condition class located at the subplot center (e.g., the condition class on the other side of the boundary line).

Field width: 1 digit

MQO: No errors 100% of time

Values:

<u>CODE</u>	<u>CONTRASTING CONDITION</u>
1	Condition Class 1
2	Condition Class 2
.	
.	
.	
9	Condition Class 9

3.2.5 LEFT AZIMUTH (LAZM)

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

Field width: 3 digits

MQO: +/- 15 degrees, at least 90% of time

Values: 001 to 360

3.2.6 CORNER AZIMUTH (CAZM)

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

Field width: 3 digits

MQO: +/- 15 degrees, at least 90% of time

Values: 000 to 360

3.2.7 CORNER DISTANCE (CDIS)

Record the horizontal distance, to nearest 0.10 ft. (0.01 m), from the subplot center to a boundary corner point.

Field width: 3 digits (xx.y)

MQO: +/- 0.1 ft, at least 90% of time

Values:

subplot	0.1 to 24.0 ft. (0.01 to 7.31 m)
microplot	0.1 to 6.8 ft. (0.01 to 2.07 m)
annular plot	0.1 to 59.0 ft. (0.01 to 18.0 m)

3.2.8 RIGHT AZIMUTH (RAZM)

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

Field width: 3 digits

MQO: +/- 15 degrees, at least 90% of time

Values: 001 to 360

4.0 SUBPLOT INFORMATION

4.1 SUBPLOT PROCEDURE

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.

NC Note: Subplot data will not be collected in the field for any subplot numbers 101 - 115.

4.2 SUBPLOT DATA ITEMS

4.2.1 SUBPLOT NUMBER

Record the code corresponding to the number of the subplot.

NOTE: This item is displayed on the data recorder screen and is not something entered by the crew collecting data on the plot

Field width: 1 digit

MQO: No errors, 100% of time

Values:

<u>CODE</u>	<u>SUBPLOT NUMBER</u>
1	center subplot
2	north subplot
3	southeast subplot
4	southwest subplot

4.2.2 SUBPLOT CENTER CONDITION (SCEN)

Record the condition class at the subplot center. Use the same procedures described for Contrasting Condition number in Section 3.2.4.

4.2.3 MICROPLOT CENTER CONDITION (MCEN)

Record the condition class at the microplot center. Use the same procedures described for Contrasting Condition number in Section 3.2.4.

4.2.4 PERCENT SLOPE (SLOP)

Record the angle of slope of the condition to the nearest 1 percent. Percent 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 Percent 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. The use of other scales requires conversion to percent. Record 999 when there is more than 1 distinct slope on the subplot.

Field width: 3 digits

MQO: +/- 10%, at least 90% of the time

Values:

<u>CODE</u>	<u>PERCENT SLOPE</u>
000	0 percent slope
001	1 percent slope
002	2 percent slope
.	.
155	155 percent slope
999	indeterminate slope (at least 30 percent difference between slopes)

4.2.5 ASPECT (ASP)

Record the aspect, to the nearest 1 degree. Aspect is based on magnetic north, and not true north. Aspect is determined along the direction of slope for land surfaces with at least 5 percent slope in a generally uniform direction. Aspect is measured with a hand compass along the same direction used to determine slope. If there is no general direction (e.g., the condition straddles a ridge or river bottom), record 999 for indeterminate.

Field width: 3 digits

MQO: +/- 10 degrees, at least 90% of time

Values:

<u>CODE</u>	<u>ASPECT</u>
000	no aspect, slope < 5 percent
001	1 degree
002	2 degrees
.	.
.	.
360	360 degrees, due north
999	indeterminate (no obvious slope on the condition)

4.2.6 SNOW/WATER DEPTH (SWD)

Field width: 3 digits

MQO: No MQO this is just for information/check curising

Values:0-999

5.0 TREE AND SAPLING DATA

5.1 TREE AND SAPLING PROCEEDURE

* Trees at least 5.0 in. (12.70 cm.) in diameter are sampled within the subplot. All live and standing dead trees 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 less than 5.0 in. (12.70 cm.), but at least 1.0 in. (2.54 cm.), termed saplings, are sampled within the microplot. All live saplings 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. (12.70 cm.) or larger, at which time they are tallied on the 24.0 ft. (7.32 m.) subplot.

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 are tracked until they fall down. Crews should exercise extreme caution while working around dead standing trees which pose a safety hazard. Trees which are deemed unsafe to measure should be noted as such and left alone.

To qualify as a standing dead tally tree, dead trees must be upright with no part of the bole touching the ground, at least 4.5 ft. (1.37 m.) tall and be at least 5.0 in. (12.70 cm.) in diameter. For western woodland species (appendix 3), at least one stem must be upright, at least 1.0 ft. (0.30 m.) in height, and at least 5.0 in. (12.70 cm.) in diameter.

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.

NC Remeasurement Trees:

If the plot is a lost plot do to the reasons in section 0.1.1.3NC - "When there has been no major disturbance" old trees will receive no new data.

All Sample kinds(SK):

Remeasure the trees listed on the download data file or sheet (see Appendix 9). No new trees are measured on the old 10-point plot all States. Plots with a SK=1 will have no old tree data.

NC Sample Kind (NCSK) 8 (remeasured plots)

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.

NC Sample Kind (NCSK) 10 (remeasured plots)

No new subplots (1-4). Tally all old trees on the download data (sheets or data recorder file). Trees 5.0" and greater on subplots and trees less than 5.0" on microplots 101-103.

The following elements are tallied for all trees unless noted.

5.2 TREE AND SAPLING DATA

List of data items collected on trees by tree status and subplot number.

Tree Data Items	Tree Status Codes													
	NEW SUBPLOTS 1-4 dbh < 5.0"		NEW SUBPLOTS 1-4 dbh μ 5.0"		OLD SUBPLOTS 1-4* dbh < 5.0" OLD SUPLOTS 1-4* dbh μ 5.0" INDIANA only See Appendix	OLD SUBPLOTS 101-105 AND 112-115 < 5.0"		OLD SUBPLOTS 101-105 AND 112-115 (μ 5.0")						
	1	2	1	2		1	2	1	2	3	4	5	6	7
Sub#	X	X	X			X	X	X	X	X				X
Tree#	X	X	X			X	X	X	X	X				X
TYPE	X	X	X			X	X	X	X	X				X
DIST	X	X	X			X	X	Z	Z	Z				Z
DBH	X	X	X			X	X	X	X	Z				Z
DIAH	X	X	X											
DCHE	X	X	X											
SPP	X	X	X			X	X	X	X	X				Z
LEAN	X	X	X			X	X							
TCC/DEC	X	X	X			X	X							
STAT	X	X	X			X	X	X	X	X				X
UTIL	X	X				X		X						
DECA			X											
CCR		X						X						
CCC		X						X						
AZM	X	X	X			X	X	Z	Z	Z				Z
CON#	X	X	X			X	X	X	X	X				X
THGT		X												
ACTU		X	X											
METH		X	X											
TRGD		X												
ROTT		X												
CAUS			X				X		X					
MOYR														
LOC123	X	X												
DAM123	X	X												
SEV123	X	X												
NCD123	X	X												

* Only the State of Indiana for Oct 1, 1999 – September 30, 2000 See special notes in appendix 9
 ** Tree status codes of 4,5 and 6 are not used on any of the old 10 point subplots.
 *** Live at time 1 (first time tree was recorded)
 X = record this data for tree status and subplot listed
 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)

5.2.1 SUBPLOT NUMBER

Record the subplot number where the tree occurs. Use the procedures as described in Section 4.1.

5.2.1NC NC PLOT TYPE (TYPE)

Record whether the tree is on the subplot (μ 5.0" dbh) or microplot (< 5.0" dbh).

Field width: 1 digit

MQO: No errors 100% of time

Values:

<u>CODE</u>	<u>PLOT TYPE</u>
1	subplot tree
2	microplot tree+

5.2.2 TREE RECORD NUMBER (TR#)

Record a 3 digit code to uniquely and permanently identify each tree on a given subplot. The tree record numbers must be unique within a subplot - that 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 which are subsequently found to be extra will be dropped and not reused.

Field width: 3 digits

MQO: No errors, 100% of time

Values: 001 to 999

5.2.2NC SUBPLOT REFERENCE TREES

On many plots, certain subplots within the plot lack information useful in determining their location on future surveys. Examples subplots where only seedlings are tallied, and subplots that fall in a nonforest land use. All established subplots without data that could be used to re-establish its location (i.e. no azimuth or distances to any tree) must be referenced. Mark reference trees above DBH and at the base with a scribe mark and paint on the side of the tree facing the subplot center. Unlike witness trees, there is no set rule for painting a reference tree, but it is best to paint the tree with a number corresponding to the 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 a tag with the subplot number is nailed to the base of each reference tree.

There is no need to reference subplots that fall entirely within a nonforest condition. In many cases this would be impossible. For example, there would be no reason to reference a subplot that is entirely in cropland.

Reference trees should have the following characteristics:

- located within 70 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).

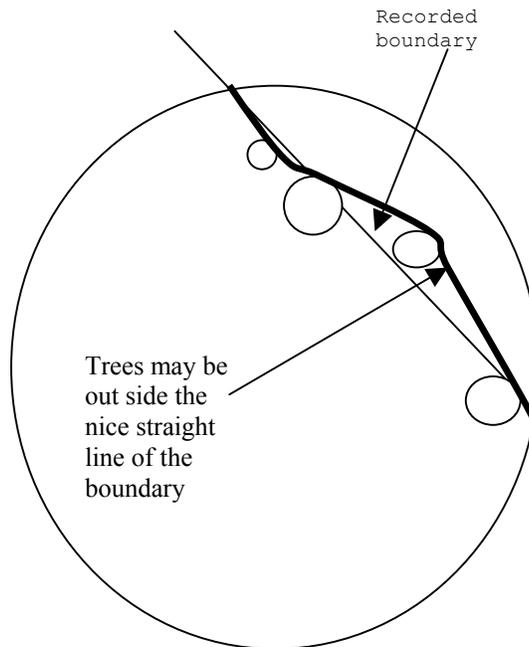
Record the subplot number, azimuth, slope distance to the center at the base (to the nearest tenth of a foot), and DBH (to the nearest tenth of an inch) for the reference tree in the "Reference Tree" grid of the plot sheet.

5.2.3 CONDITION CLASS (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. (See figure 8.)

Figure 8 Trees are assigned to actual condition in which they lie regardless of recorded approximate boundary.

NC Note: All old subplot trees will receive CON# of 1



5.2.4 AZIMUTH (AZM)

From subplot center, sight the center of the base of each tree with a compass; sight to 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) as a 3-digit code ranging from 001 to 360. Use 360 for north.

Field width: 3 digits

MQO: +/- 10 degrees, at least 90% of time

Values: 001 to 360

5.2.5 HORIZONTAL DISTANCE (DIST)

Record the measured horizontal distance, to the nearest .1 ft. (.01 m.), from the subplot center to the pith at the base of the tree. For all multi-stemmed western woodland trees (woodland species indicated in appendix 3), the horizontal distance is measured from the "geographic center" of the tree to the subplot center. The geographic center is a point of equal distance between all tallied stems for a given woodland tree.

Field width: 3 digits (xx.y)

MQO: Microplot: +/- 0.2 ft. (0.6.1 cm..) , at least 90% of time
 Subplot: +/- 1.0 ft. (0.3 m.) , at least 90% of time
 Annular plot: +/- 3.0 ft. (1.0 m), at least 90% of the time
 Values: 00.1 to 24.0

5.2.6 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.

NC Note: All codes are valid for Trees on subplots 101-105, only codes 1 & 2 are valid for subplots 1-4.

Field width: 1 digit
 MQO: No error, 100% of time
 Values:

<u>Code</u>	<u>Description</u>
1	Live tree - a live tree tallied at initial plot establishment, or a live remeasure tree
2	Dead tree - a tree that has died due to natural causes (not human-caused); includes ingrowth mortality.

The following codes are only used on remeasured plots:

- 3 Removal - a tree that has been cut or killed by cultural activity, e.g., harvesting, silviculture operations, and any other direct human activity. The tree may, or may not, have been utilized. Use this code only on remeasured plots.
- 4 Missed live tree - live at time of previous inventory, live now.
- 5 Missed mortality tree - live at time of previous inventory, dead now.
- 6 Missed dead tree - dead at time of previous inventory, dead now.
- 7 No history - tree is not presently in the sample. Tree was incorrectly tallied at the previous survey, was physically moved off the plot (natural causes such as a landslide), or currently is not tallied due to definition or procedural change.

~~<note: for microplot trees (saplings) which become trees, we will need to have crews collect new azimuth and distance information from the subplot center>~~

5.2.7 LEAN ANGLE (LEAN)

Record the code that describes the angle of leaning of the tree. Trees supported by other trees or by their own branches are considered standing or leaning. Dead trees which are "down" at first measurement are not recorded.

Field width: 1 digit
 MQO: No error, 100% of time
 Values:

<u>CODE</u>	<u>LEAN ANGLE</u>
0	Standing (less than 45 degrees of lean)
1	Leaning (more than 45 degrees of lean but not touching the ground)
2	Down (some part of the bole touching the ground)

5.2.8 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, 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 the generic spp. code only when you encounter a tree where you know tree species but the species is not on the species list.

Field width: 3 digits

MQO: Seedlings: Correct genus at least 90% of time, correct species at least 85% of the time
Trees and Saplings: Correct genus at least 100% of time, correct species at least 95% of time

Values: See Appendix 4

5.2.9 DIAMETER

Record the actual diameter for each tallied tree to the last whole 0.1 in. (0.25 cm.). Diameter is either diameter at breast height (DBH) or diameter at the root collar (DRC). Species requiring DRC are noted in appendix 3.

Diameter on trees missing a portion of bark or bole at the point of diameter measurement is recorded to the nearest inch (centimeter).

Remeasurement trees:

The diameter measurement must be taken at the same point on the tree as the previous measurement, if possible. The point of diameter measurement should not be moved unless the crew cannot physically remeasure that point (e.g., forks converge, tree buried by mudslide).

If there was an obvious recording error in previous measurement (e.g., past crew measured 31.0 but recorded 13.0), crews should estimate and record the appropriate past diameter using local procedures.

For trees on the 24.0 ft. (7.32 m.) radius subplot, measure single-stemmed trees 5.0 in. (12.70 cm.) in diameter, or larger, ~~and multi-stemmed western woodland trees with a cumulative DRC of at least 5.0 in. (12.70 cm.), or larger. For multi-stemmed western woodland trees, measure all stems 1.0 in. (2.54 cm.) in diameter and larger, and at least 1.0 ft. (0.30 m.) in height. (See formula on page --- to compute DRC.)~~

For trees on the 6.8 ft. (2.07 m.) radius microplot, measure single-stemmed trees between 1.0 in. (2.54 cm.) and 4.9 in. (12.69 cm.) in diameter, ~~and multi-stemmed western woodland trees with a cumulative DRC between 1.0 in. (2.54 cm.) and 4.9 in. (12.69 cm.) in diameter. For multi-stemmed western woodland trees, measure all stems 1.0 in. (2.54 cm.) in diameter and larger, and at least 1.0 ft. (0.30 m.) in height. (See formula on page --- to compute DRC.)~~

Field width: 4 digits (xxx.y)

MQO: +/- 0.1 in. (0.25 cm.) per 20.0 in. (50.8 cm.) of diameter on trees with a measured diameter. For example: a tree with a diameter of 41.0 in. (104.14 cm.) would have a tolerance of plus or minus 0.3 in. (0.75 cm.).

Values: 0001 to 9999

5.2.9NC DIAMETER ORIGINAL (DBHO)

The diameter for each tree tallied in the previous survey to the last whole 0.1 in. (0.25 cm.). Diameter is either diameter at breast height or diameter at the specified height in the "DBH high or low" spot on the plot sheet.

5.2.9.1 DIAMETER AT BREAST HEIGHT (DBH)

For trees requiring diameter at breast height, measure DBH at 4.5 ft. (1.37 m.) above the ground unless one of the special DBH situations listed below is present. Figure 5.2.9.1 shows the proper use of the diameter tape.

Special DBH situations (see Figure 5.2.9):

- 1 Tree with butt-swell or bottleneck: Measure these trees 1.5 ft. (0.46 m.) above the end of the swell or bottleneck if the swell or bottleneck extends 3.0 ft. (.91 m.) or more above the ground. (example # 7)
- 2 Forked tree: If the point of pith separation is at or above 4.5 ft. (1.37 m.), consider the tree as one tree. Measure the diameter below the swell, as near as possible to 4.5 ft. (1.37 m.) above the ground on the uphill side. If the point of pith separation is below 4.5 ft. (1.37 m.) above the ground, but above 1.0 ft. (.30 m.), consider each fork as a separate tree. For diameter measurement, measure each fork at 3.5 ft. (1.07 m.) above the point of pith separation, or as near as possible to this point. (examples 4 & 5)
- 3 Tree with irregularities at DBH: On trees with swellings, bumps, depressions, branches, etc. at DBH, diameter will be measured immediately above the irregularity at the place it ceases to affect normal stem form. (example 6)
- 4 Tree on slope: Measure diameter at 4.5 ft. (1.37 m.) from the ground along the bole on the uphill side of the tree. (example 1)
- 5 Leaning tree: Measure diameter at 4.5 ft. (1.37 m.) from the ground along the bole. The 4.5 ft. (1.37 m.) distance is measured along underside face of the bole. (example 3)
- 6 Turpentine tree: On trees with turpentine face extending above 4.5 ft. (1.37 m.), estimate the diameter at 10.0 ft. (3.05 m.) above the ground and multiply by 1.1 to estimate DBH outside bark.
- 7 Independent trees that grow together: Continue to treat them as two trees.

Figure 5.2.9 Diameter breast height measurement in a variety of situations

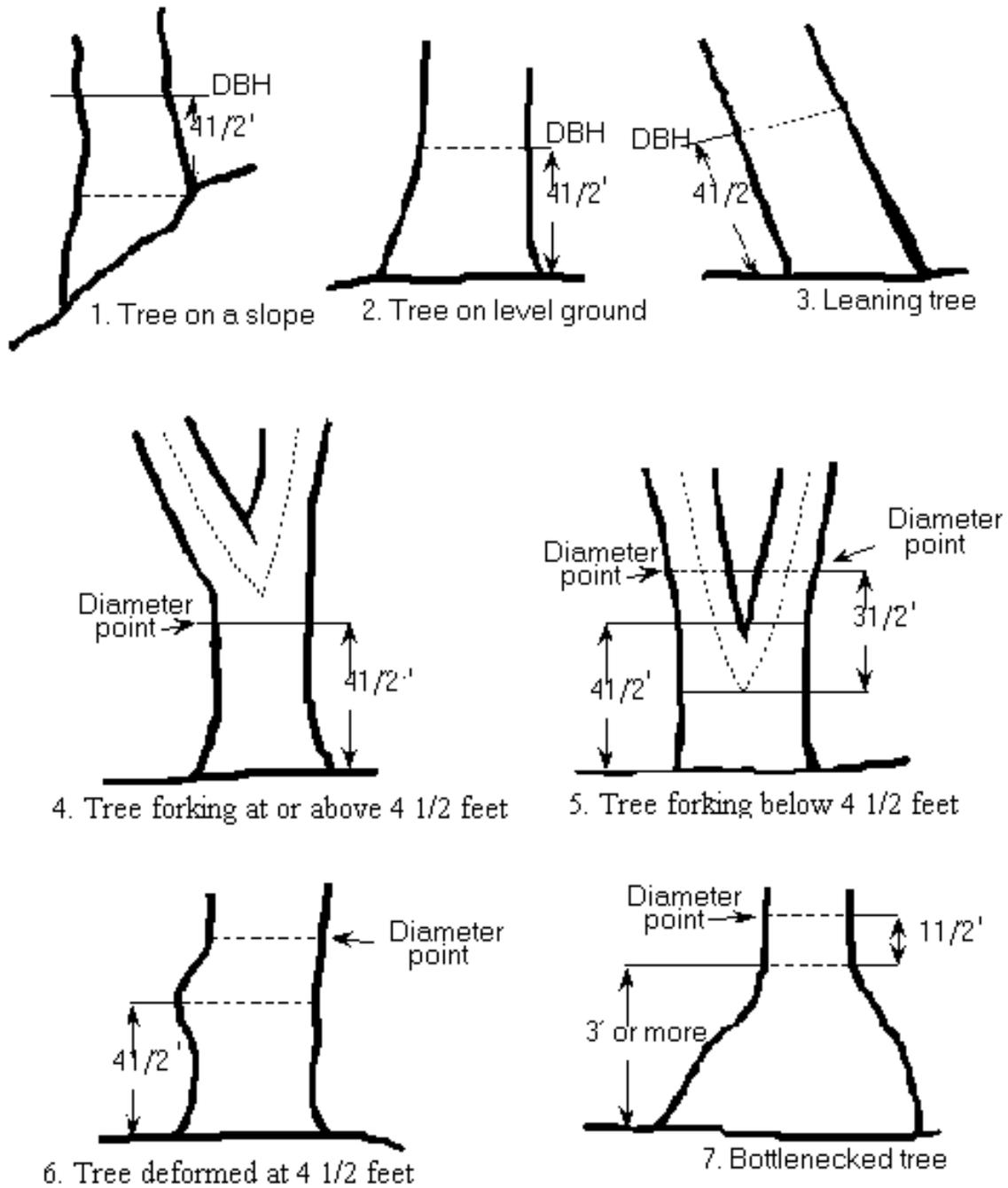
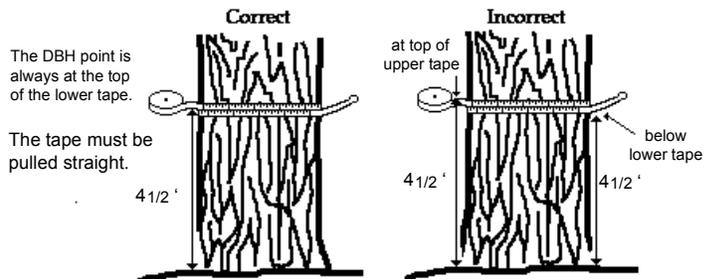
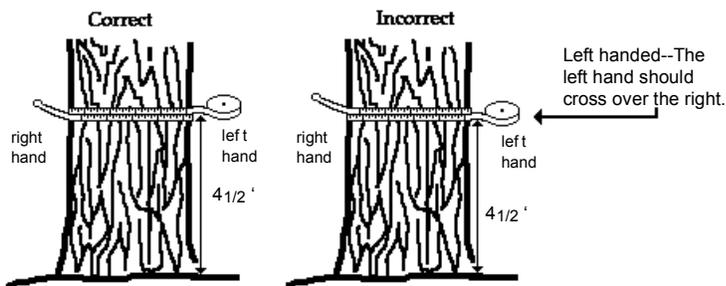
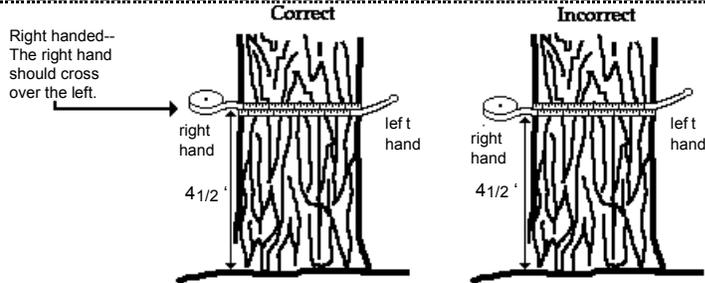
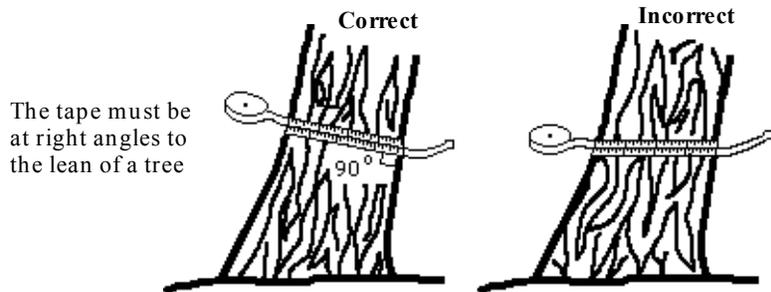
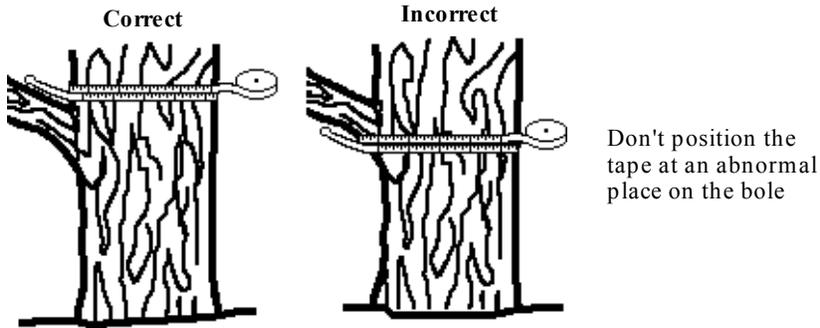


Figure 5.2.9.1 Using the diameter tape



5.2.9.2 DIAMETER AT ROOT COLLAR (DRC)

~~For species requiring diameter at the root collar (refer to appendix 3), DRC is measured 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. For multi-stemmed trees, compute and record a cumulative DRC (see below); record individual stem diameters 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. (0.30 m.) in height and 1.0 in. (2.54 cm.) in diameter to qualify for measurement; stems that are missing due to cutting or damage must have previously been at least 1.0 ft. (0.30 m.) in height.~~

~~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 recorded to the nearest 1.0 in. (2.54 cm.) class.~~

~~Additional instructions for DRC measurements are illustrated in figure ---.~~

~~2 Computing and Recording DRC: For all tally trees requiring DRC, with at least one stem 1.0 in. (2.54 cm.) 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:~~

$$\text{DRC} = \sqrt{\text{SUM}(\text{stem diameter}^2)}$$

~~Round the result to the nearest 1.0 in. (0.25 cm.). For example, a multi-stemmed woodland tree with stems of 12.20, 13.20, 3.80, and 22.10 would be calculated as:~~

$$\begin{aligned} \text{DRC} &= \sqrt{12.20^2 + 13.20^2 + 3.80^2 + 22.10^2} \\ &= \sqrt{825.93} \\ &= 28.75 \end{aligned}$$

5.2.9.3 DIAMETER MONUMENTING

Each unit will apply methods that allow remeasurement of diameter (DBH or DRC) at the same point on the tree bole at successive visits. Valid methods include measuring distance from the ground to point of diameter, or marking the point of measurement with an aluminum nail, scribe mark, crayon mark, or paint spot. If scribing is used, the mark should not penetrate the cambium. If a mark or nail is used, the diameter should not be taken until the mark or nail is in place. Do not scribe or nail trees less than 3.0 in. (8 cm.) in diameter.

Do not nail or scribe tree species, such as aspen, that are highly susceptible to damaging agents introduced by these practices. Most sample trees are scribed and painted to mark the location of the DBH measurement.

NC Note: Subplots 101-105 are handled differently than subplots 1-4.

For subplots 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 remeasurement in the event the tree is cut. Paint but do not scribe small, thin-barked trees and trees < 3.0" DBH. Scribe marks should not penetrate the cambium.

For subplots 101-105, scribe only at the point where DBH is measured. Scribe marks should not penetrate the cambium.

In reserved areas mark 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).

5.2.21 HEIGHT TO DIAMETER (CORE OPTIONAL) (DIAH)

~~Record this item when tree diameters are not monumented. For those trees measured directly at of 4.5 ft. (1.37 m.) above the ground, leave this item blank. If the diameter is not measured at 4.5 ft. (1.37 m.), record the actual height from the ground, to the nearest 0.3 in ft. (0.01 m.), at which the diameter was measured for each tally tree, 1.0 in. (2.54 cm.) DBH and larger, when the diameter is not measured at the standard height of 4.5 ft. (1.37 m.). Leave this item blank for western woodland species measured for diameter at root collar.~~

Record this item on all trees. For those trees measured directly at 4.5 ft above the ground leave this item blank.
 Field width: 3 digits
 MQO: +/- 0.5 ft, at least 90% of the time
 Values:

5.2.10 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. **NC Note:** Do not record on re-measurement trees (subplots 101-115).

Field width: 1 digits
 MQO: No errors, 100% of time
 Values:

<u>Code</u>	<u>Description</u>
0	Diameter measured at standard measurement locations - accurate. E.g., measured at 4.5', or 3.5' above fork, or at root collar.
1	Diameter estimated at standard measurement locations - estimated. E.g., estimated at 4.5' (fused stems, large swell at bh)
2	Diameter measured at non-standard location - accurate. E.g., measured just above swells, cankers, etc.
3	Diameter estimated at non-standard location - estimate. E.g., estimated above butt swell.
4	Diameter measured at nonstandard location on tree, but not same location as previous measurement (remeasurement trees only)

5.2.11 PERCENT ROTTEN/MISSING CULL (ROTT)

Record the percent rotten or missing cubic-foot cull for all tally trees, live and dead. **NC Note:** Do not record on re-measurement trees (subplots 101-115) also not on dead trees the first time they are measured on any subplot.

Field width: 3 digits
 MQO: +/- 10%, at least 90% of the time
 Values: 000 to 100

For each tally tree 5.0-inch DBH/DRC and larger, record the percentage of rotten and missing cubic-foot volume, to the nearest 5 percent. When estimating volume loss (tree cull) only consider the cull on the merchantable bole/portion of the tree, from a 1 ft. (30 cm.) stump to a 4 inch (10.16 cm.) 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 when struck with an ax.
- Large dead limbs, esp. those with frayed ends.
- Sawdust around the base of the tree.

NC NOTE: This is very similar to when we collected Cubic-Foot Cull in previous inventories except you will be recording this as a percent of the tree volume to the 4.0" diameter. See Tatum Guides and Appendix 6 for tables of volume and deductions.

5.2.12 TOTAL LENGTH (THGT)

Record the total length of the tree, to the nearest 1.0 ft. (0.30 m.) 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. **NC Note:** Do not record on re-measurement trees (subplots 101-115), or any dead trees the first time they are measured on any subplot. Do record on trees that were live when first recorded but dead at this time (only Indiana or Illinois).

Field width: 3 digits

MQO: +/- 10% of true length, at least 90% of the time

Values: 005 to 400

5.2.13 ACTUAL LENGTH (ACTU)

Record the actual length of the tree if it has a missing top; if the top is intact, this item may be omitted. **NC Note:** Do not record on re-measurement trees (subplots 101-115). Do record on all dead trees to the highest standing portion of the tree.

Field width: 3 digits

MQO: +/- 10% of true length, at least 90% of the time

Values: 005 to 400

5.2.14 LENGTH METHOD (METH)

Record the code that indicates the method used to determine tree length.

NC Note: Do not record on re-measurement trees (subplots 101-115).

Field width: 1 digit

MQO: No errors, 100% of time

Values:

<u>CODE</u>	<u>LENGTH METHOD</u>
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.

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:

$$\text{Correction factor} = \frac{\text{Actual height measurement}}{\text{Estimated height}}$$

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.

5.2.15 CROWN CLASS (CCC)

Rate tree crowns in relation to the sunlight received and proximity to neighboring trees.

Field width: 1 digit

MQO: No errors, at least 85% of the time

Values:

- 1 Open Grown: Trees with crowns which 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 Codominant: 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, codominant trees have small-sized crowns and are crowded on the sides.
- 4 Intermediate: These trees are shorter than dominants and codominants, but their crowns extend into the canopy of codominant 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.

5.2.17 COMPACTED CROWN RATIO (CCR)

Record the compacted crown ratio for each live tally tree, 1.0 in. (2.54 cm.) and larger. Crown ratio is that portion of the tree supporting live foliage and is expressed as a percent of the actual tree height. To determine compacted crown ratio, occularly transfer lower live branches to fill in large holes in the upper portion of the tree until a full, even crown is visualized.

Field width: 3 digits

MQO: +/- 10%, at least 80% of the time

Values: 00 to 100 percent

5.2.18 TREE DAMAGE

Damage is characterized according to three attributes: location of damage, type of damage, and severity of damage. Up to three different damages can be recorded per tree. 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 1-7.

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 three damages are recorded for each tree. If a tree has more than three damages that meet the threshold levels, the first three 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 02, meets the threshold and has a conk growing in it, record only the canker. Another example is, if an open wound meets threshold and also has resinosis, record only the open wound.

NC Note: Do not record on re-measurement trees (subplots 101-115). Only record on Live trees on subplots 1-4.

5.2.18.1 DAMAGE LOCATION 1 (LOC1)

This is the location on the tree where DAMAGE TYPE 1 is found. 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 5.4**). 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.

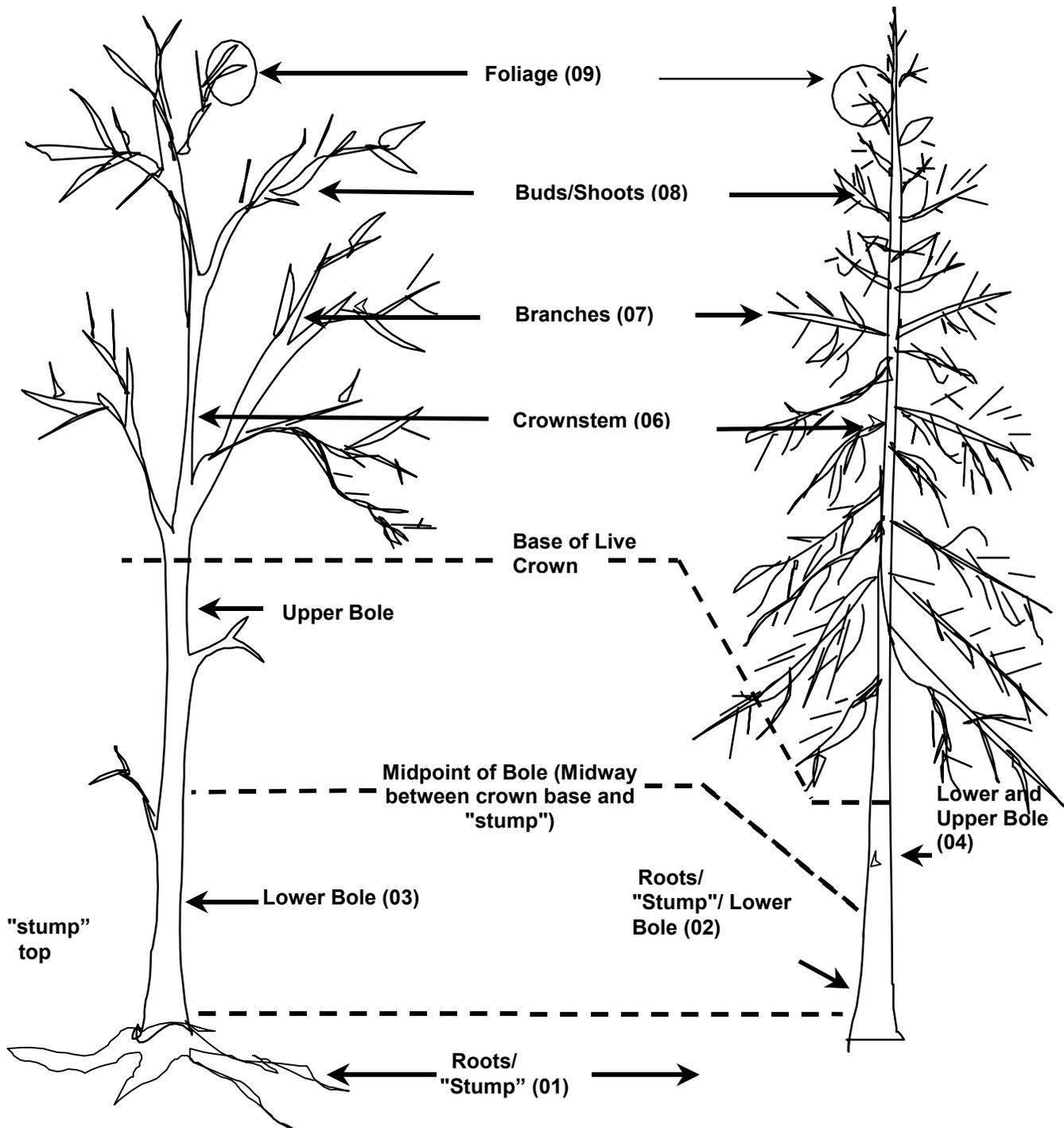
Field width: 1 digits

MQO: +/- 1, at least 80% of the time

Values:

<u>CODE</u>	<u>DAMAGE LOCATION</u>
0	No damage
1	Roots (exposed) and stump (12 inches (0.3 m) 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 crown1)
7	Branches (>1 in. at the point of attachment to the main crown stem within the live crown area1)
8	Buds and shoots (the most recent year's growth)
9	Foliage

Figure 5.4 Location codes for damage data item.



NC Note: The following section is for use in determining Live Crown for Damage locations only.

Live Crown Base

The live crown base is an imaginary horizontal line drawn across the trunk from the bottom of the lowest live foliage of the "obvious live crown" for trees and from the lowest live foliage of the lowest twig for saplings. The "obvious live crown" is described as the point on the tree where most live branches/twigs above that point are continuous and typical for a tree species (and/or tree size) on a particular site. Include most crown branches/twigs, but exclude epicormic twigs/sprigs and straggler branches that usually do not contribute much to the tree's growth. The base of the live branch/twig bearing the lowest foliage may be above or below this line.

For trees only, if any live branch larger than 1 inch (2.5 cm) in diameter at the point of trunk attachment is within 5 ft below this "obvious live crown" line, a new horizontal line is established. Create the new line at the base of the live foliage on that branch. Continue this evaluation process until no live branches, 1 inch diameter or greater, are found within 5 ft of the foliage of the lowest qualifying branch (figure 2-1).

Occasionally, all original major crown branches/twigs are dead or broken and many new twigs/sprigs develop. These situations are likely to occur in areas of heavy thinning, commercial clearcuts and severe weather damage:

- Trees, that had an "obvious live crown" with live branches, have no crown to measure until new live twigs reach 1 inch in diameter (become live branches). The previous "obvious live crown" base here would be dead branches, while many of the new live branches may be below this point. When new branches reach 1 inch in diameter, draw the crown base to the live foliage of the lowest live branch that now meets the 5 ft rule.
- Saplings and small trees that had only live twigs should establish the crown base at the base of the live foliage on the new lowest live twig. If no live twigs are present, there is no crown to measure.

DETERMINING CROWN BASE & USE OF 5' RULE

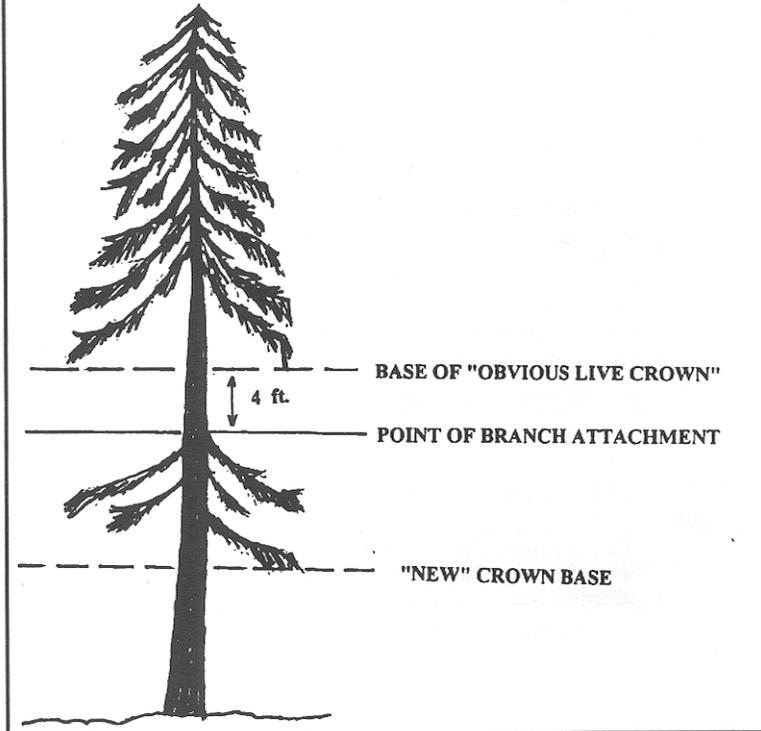


Figure 2-1. Determining the base of the live crown.

5.2.18.2 DAMAGE TYPE 1 (DAM1)

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

Field width: 2 digits

MQO: No errors, at least 80% of the time

Values:

<u>CODE</u>	<u>DAMAGE TYPE</u>
01	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).

02 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.

03 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.

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

05 Cracks and seams.

Cracks in trees are separations along the radial plane. 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 feet (0.91 m) from bole.
Broken roots within 3 feet (0.91 m) of 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 feet (0.91 m.)).

Roots beyond 3 feet (0.91 m) of bole that are broken or dead.

- 20 Vines in the crown.

Kudzu, grapevine, ivy, dodder, etc. smothers tree crowns. Vines are rated as a percent 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. Snag branches (those 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 and 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 notes section on the plot sheet." 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 5.18.3, DAMAGE SEVERITY.

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 (>5 feet in length)
- 11 Broken bole or roots less than 3 feet (0.91 m) from bole - any occurrence.
- 12 Brooms on roots or bole - any occurrence.
- 13 Broken or dead roots - exceeds 20% of roots, beyond 3 feet (0.91 m) of 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 (>5 feet in length)
- 11 Broken bole or roots less than 3 feet (0.91 m) from bole - any occurrence.
- 12 Brooms on roots or bole - any occurrence.
- 13 Broken or dead roots - exceeds 20% of roots, beyond 3 feet (0.91 m) of 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 (>5 feet in length)
- 11 Broken bole or roots less than 3 feet (0.91 m) 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 (>5 feet in length).
- 21 Loss of apical dominance, dead terminal any occurrence.
- 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, >5 feet in length 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.

5.2.18.3 DAMAGE SEVERITY 1 (SEV1)

This is the amount of affected area (above threshold) in DAMAGE LOCATION 1 recorded for TREE DAMAGE1. Severity codes vary depending on the type of damage recorded.

Field width: 2 digits

MQO: No errors, at least 80% of the time

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 foot (0.91 m) 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 feet (0.91 m), respectively, must be affected, then record in 10% classes.

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

<u>Classes</u>	<u>Code</u>
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 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 foot (0.91 m) 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 feet (0.91 m), respectively, must be affected, then record in 10% classes. See Figure 5.5.

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

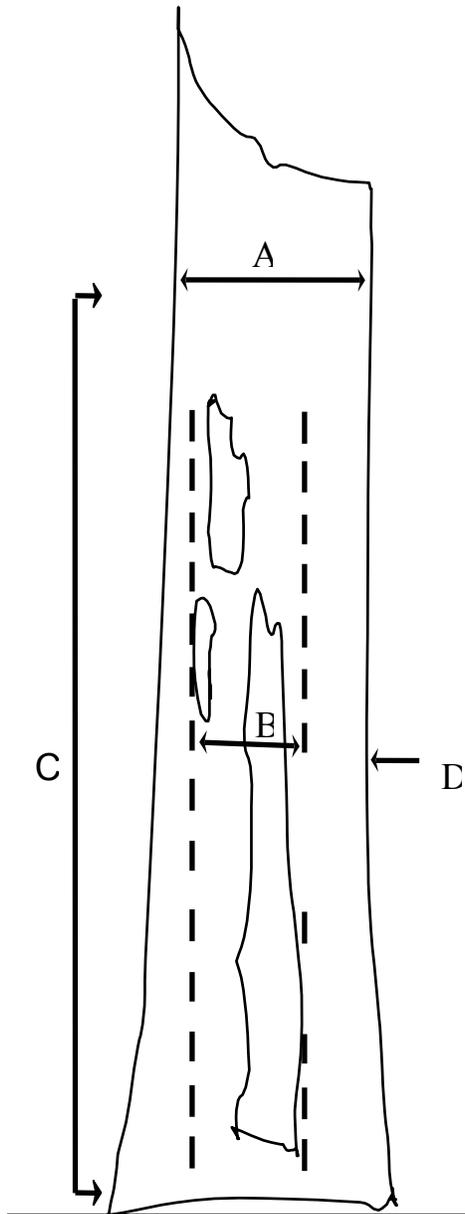


Figure 5.5.

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 occurrence 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 feet (0.91 m), respectively, must be affected, then record in 10% classes.

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

<u>Classes</u>	<u>Code</u>
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 (>5', 1.52 m in length)

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 feet (0.91 m), respectively, must be affected, then record in 10% classes.

DAMAGE TYPE Code 11 - Broken bole or roots less than 3 feet (0.91 m) 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 feet (0.91 m) of bole that are broken or dead.

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

<u>Classes</u>	<u>Code</u>
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):

<u>Classes</u>	<u>Code</u>
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 class in the area or look for the detached portion of 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:

<u>Classes</u>	<u>Code</u>
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):

<u>Classes</u>	<u>Code</u>
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):

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

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:

<u>Classes</u>	<u>Code</u>
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 24:

<u>Classes</u>	<u>Code</u>
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 notes.

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. (0.91 m) 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 foot (0.91 m) 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 foot (0.91 m) section (Figure 3-2).

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 (see Figure 3-4). If the cumulative area affected within a 3 foot (0.91 m) 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 % affected.

5.2.18.4 DAMAGE LOCATION 2 (LOC2)

This is the location on the tree where TREE DAMAGE 2 is found. Follow the same procedures as for DAMAGE LOCATION 1.

5.2.18.5 DAMAGE TYPE 2 (DAM2)

This is the second damage observed that meets the damage threshold definition in the lowest location. Follow the same procedures as for DAMAGE TYPE 1.

5.2.18.6 DAMAGE SEVERITY 2 (SEV2)

This is 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

5.2.18.7 DAMAGE LOCATION 3 (LOC3)

This is the location on the tree where TREE DAMAGE 3 is found. Follow the same procedures as for DAMAGE LOCATION 1.

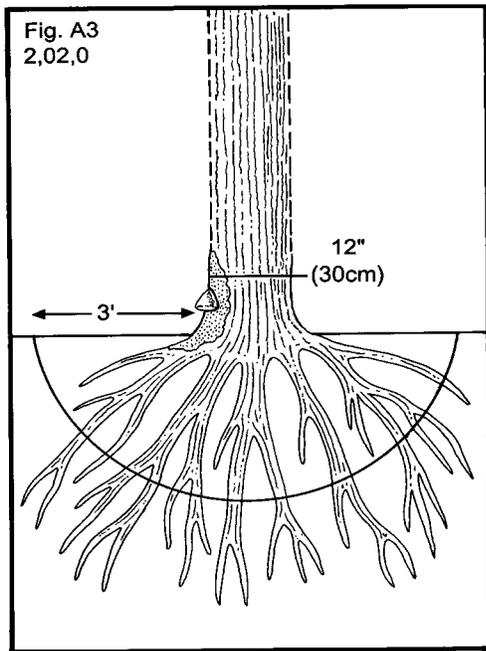
5.2.18.8 DAMAGE TYPE 3 (DAM3)

This is the second damage observed that meets the damage threshold definition in the lowest location. Follow the same procedures as for DAMAGE TYPE 1.

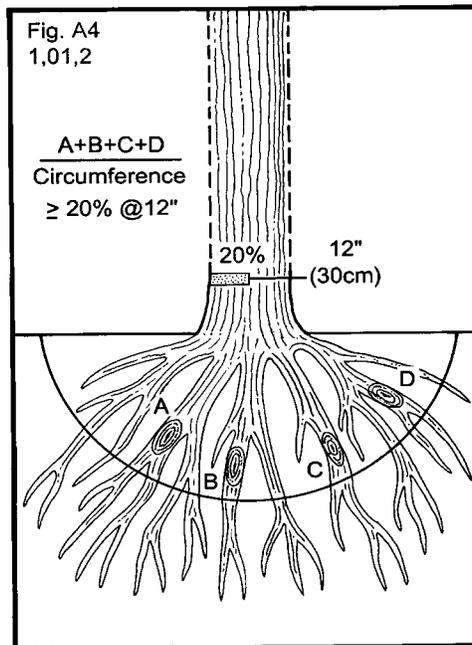
5.2.18.9 DAMAGE SEVERITY 3 (SEV3)

This is the amount of affected area (above threshold) in DAMAGE LOCATION 3 recorded for DAMAGE TYPE 3. Follow the same procedures as for DAMAGE SEVERITY 1

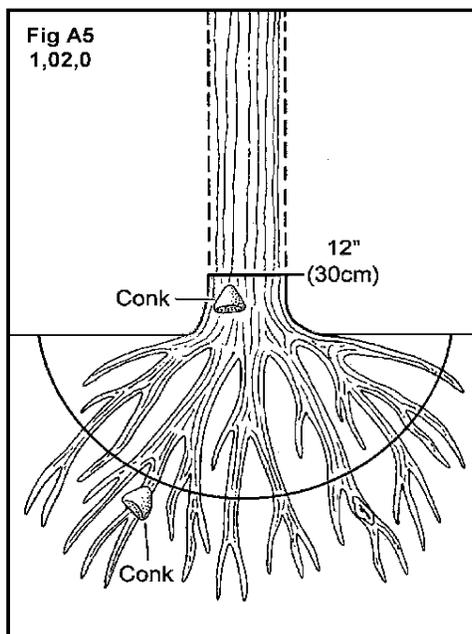
Damage figures



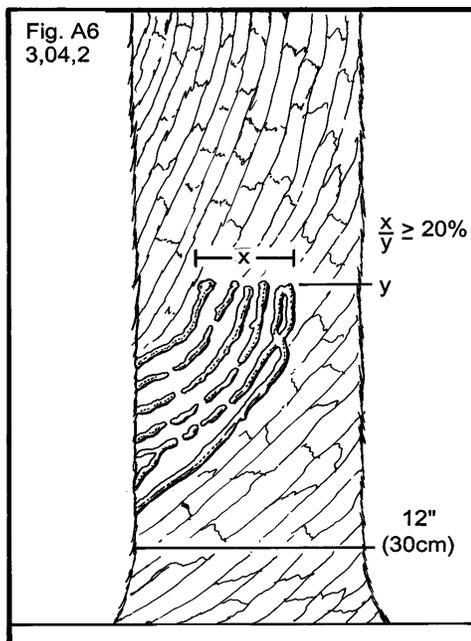
02 - Decay indicator on roots and lower bole



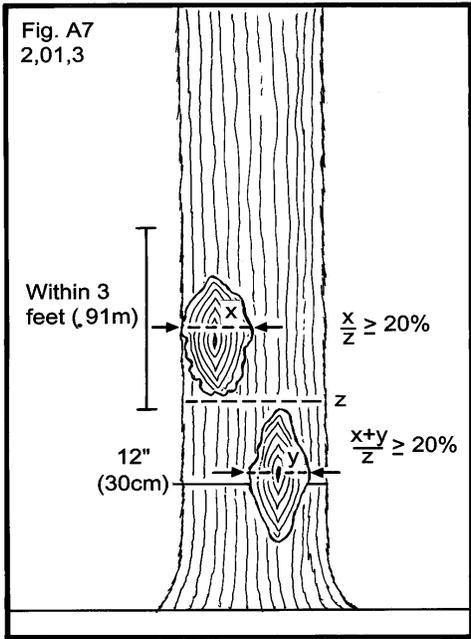
01 - Canker / gall on roots (within 3' of bole)



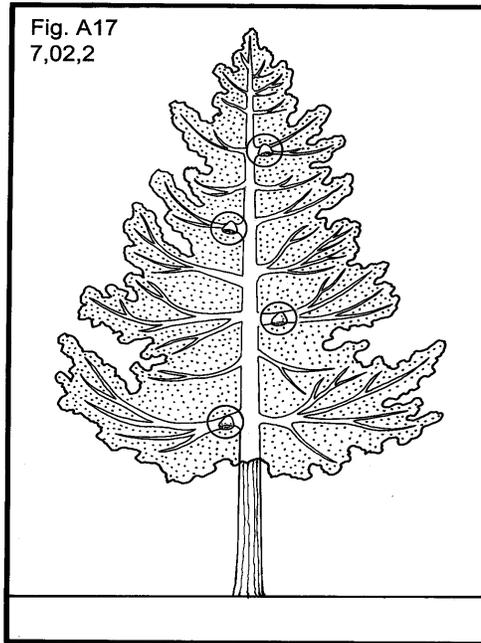
02 Indicator of decay within 3' of bole. Beyond 3' of bole, indicators must affect $\mu 20\%$ of roots (see fig 12)



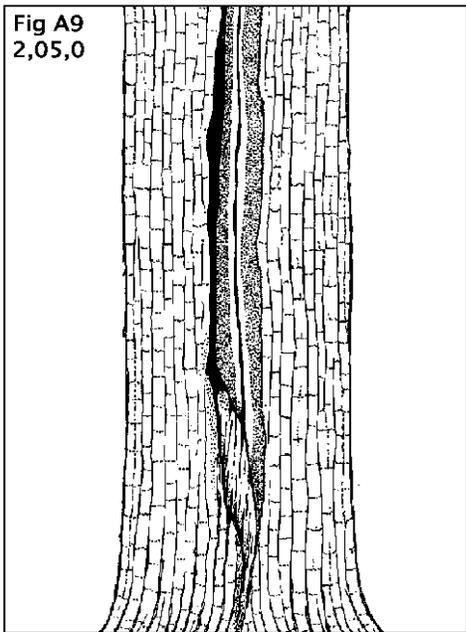
04 - Origin of resinosis in lower bole



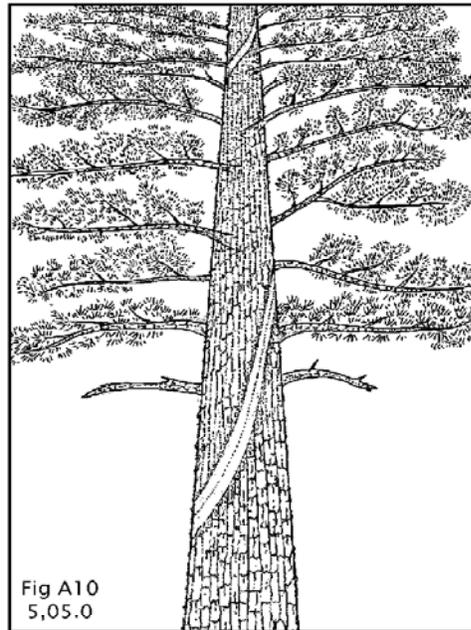
01 - Additive cankers within 3' in roots and lower bole



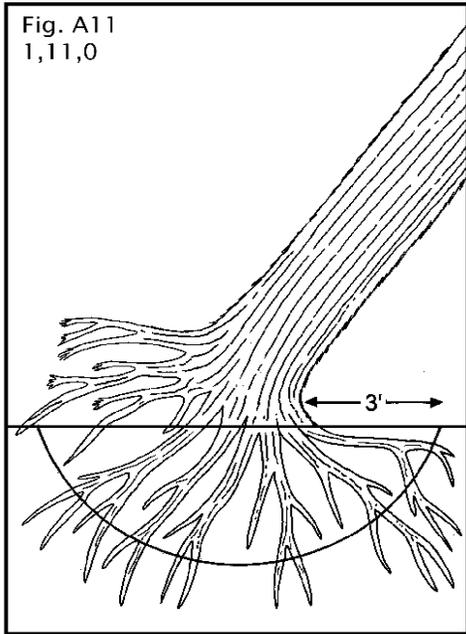
02 - Conks on ≥ 20% of branches



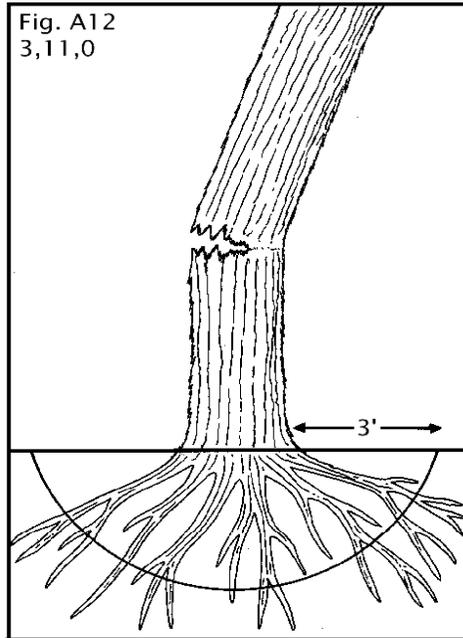
05 Cracks and seams



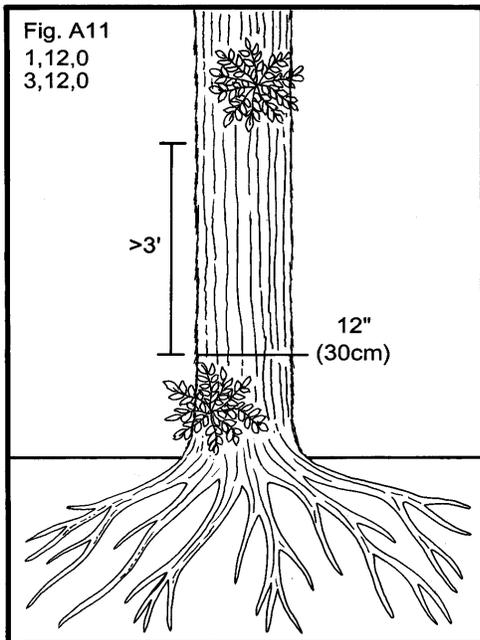
05 Lightning strike



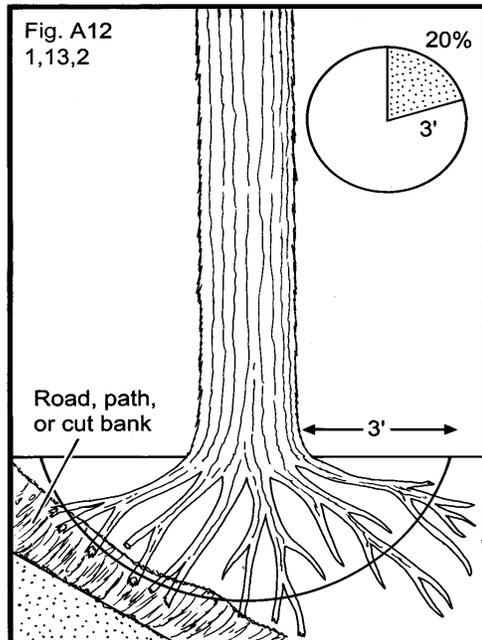
11 Broken bole or roots <3' from bole
broken roots must be visible



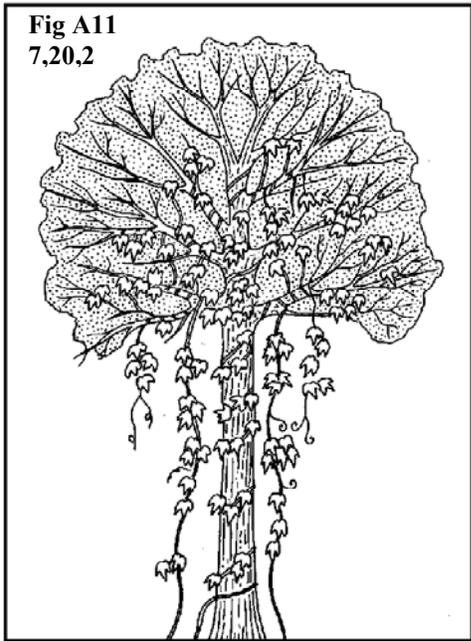
11 Broken bole or roots <3' from bole



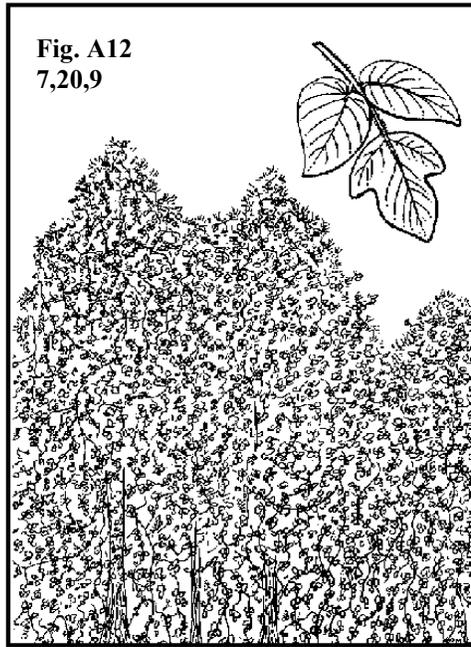
12 - Brooms on roots or bole



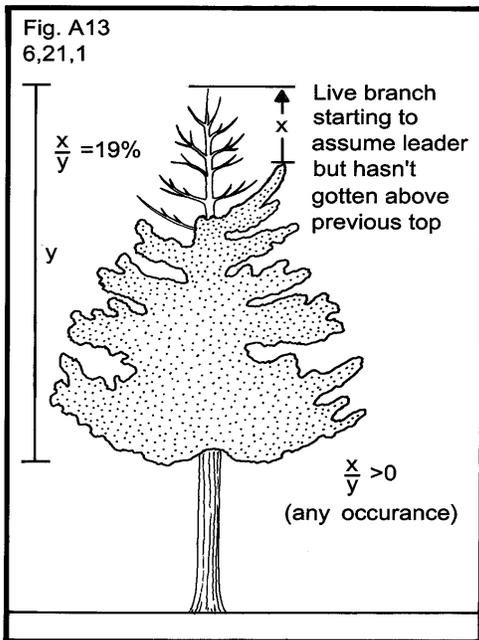
13 - Broken or dead roots >3' from bole



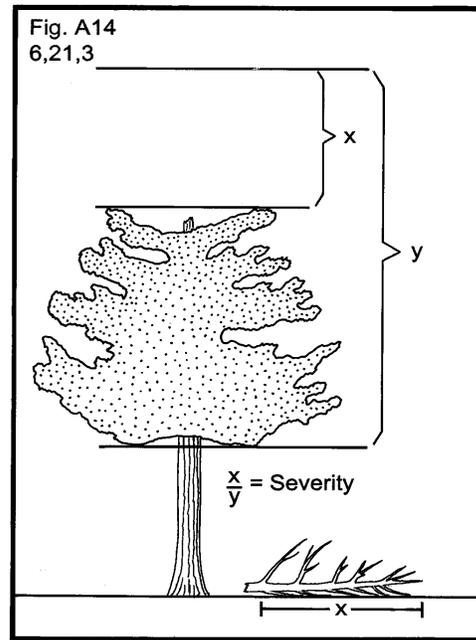
20 - Vines in the crown



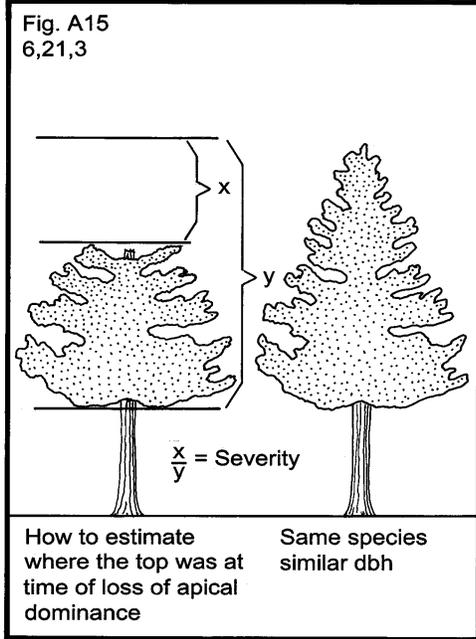
20 - vines in the crown



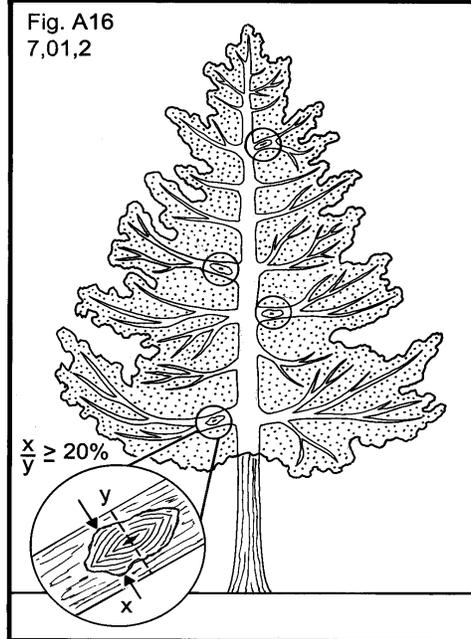
21 - Loss of apical dominance



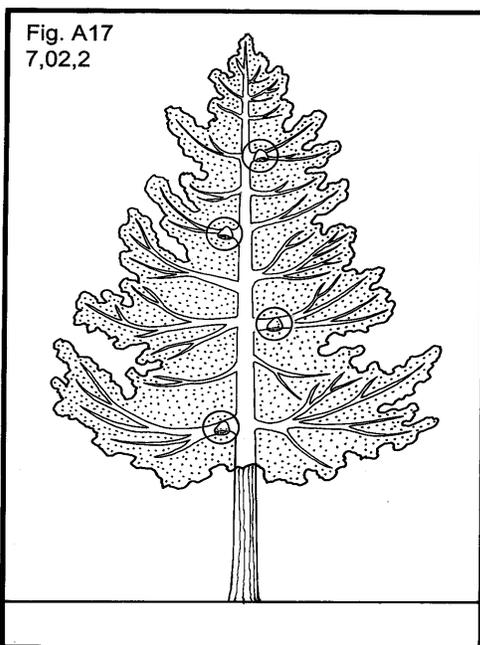
21 - Loss of apical dominance, look for old top to estimate the top of x and y



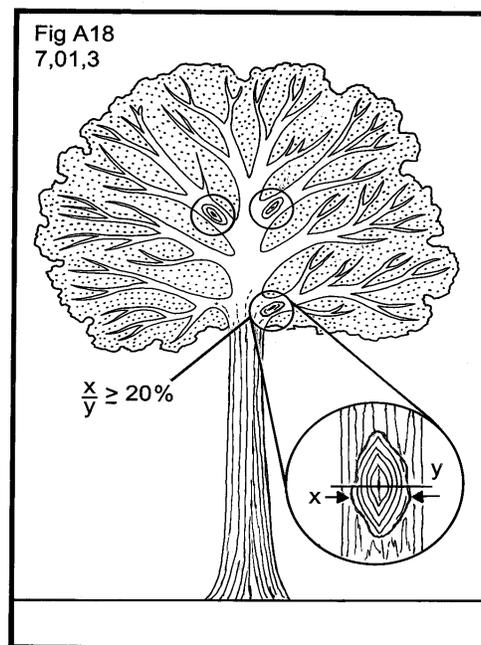
21 - Loss of apical dominance, look for same species of similar dbh



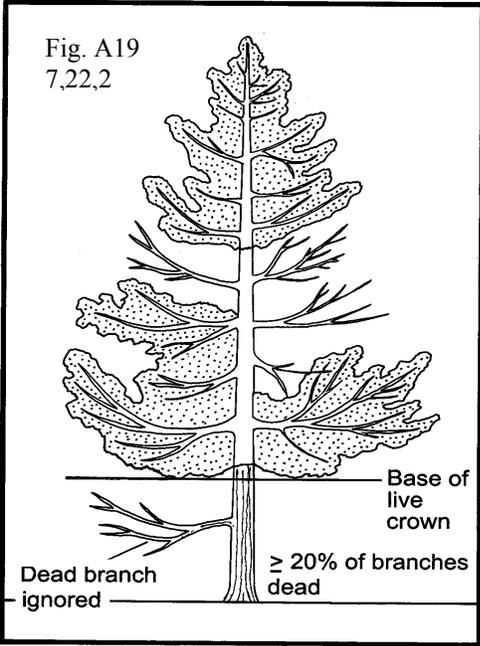
01 - Cankers above the threshold on $\geq 20\%$ of branches



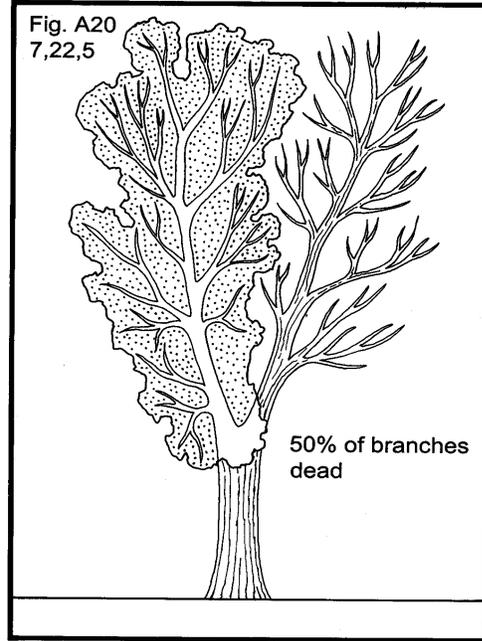
02 - Conks on $\geq 20\%$ of branches



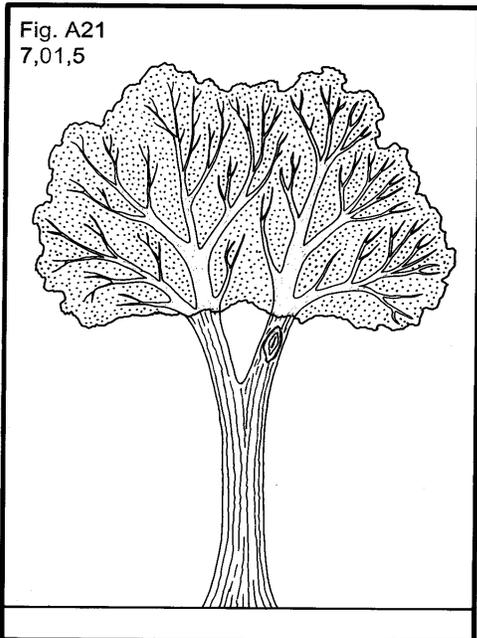
01 - Cankers above threshold on $\geq 20\%$ of branches



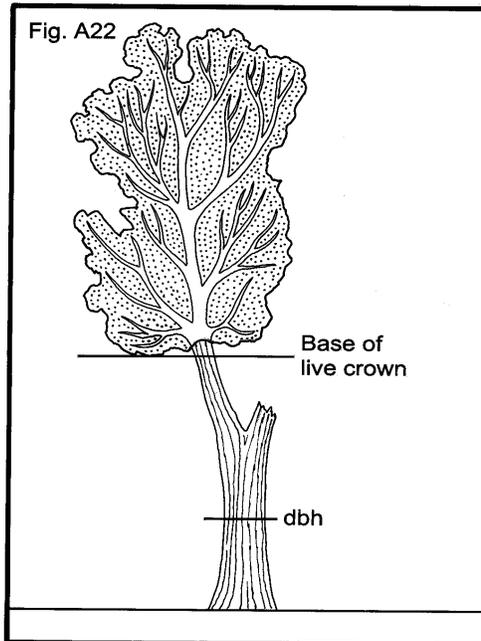
22 - Dead branches within the live crown area. If branches cannot easily be counted, estimate % area of live crown affected



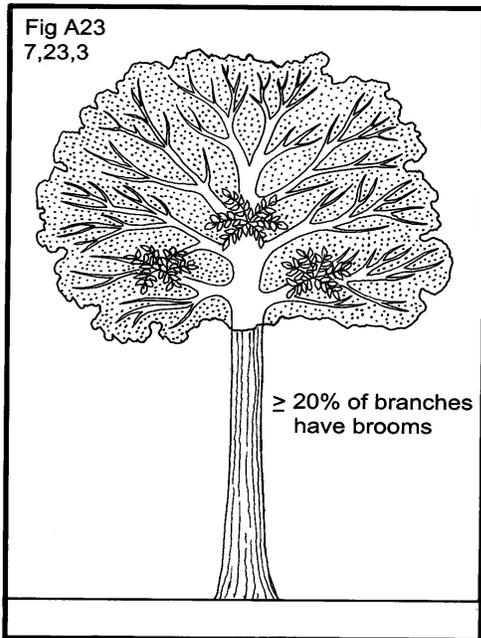
22 - Dead branches; only 2 branches present within live crown area



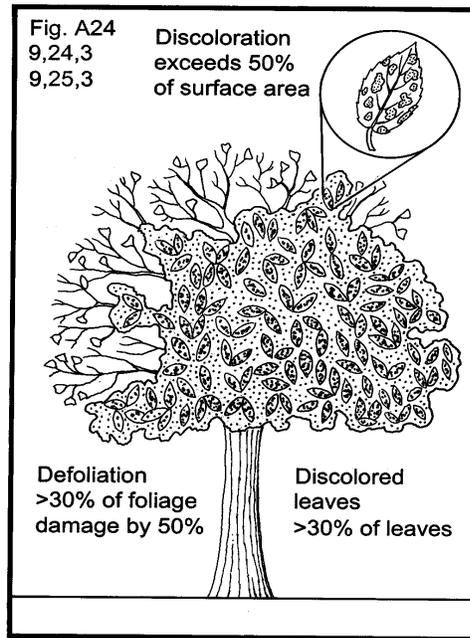
01 - Canker; no crown stem and only 2 branches present



No damage - base of live crown is above old fork



23 - Excessive branching or brooms in crown



24 - Defoliation, 25 - Discoloration

5.2.19 CAUSE OF DEATH (CAUS)

- 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. NC Note: Record on all dead trees.

Field width: 2 digits

MQO: at least 80% agreement

Values:

CODE	CAUSE OF DEATH
10	Insect damage
20	Disease damage
30	Fire damage
40	Animal damage
50	Weather damage
60	Vegetation (suppression, competition, vines/kudzu)
70	Unknown/not sure/other (include notes)
80	Human-caused damage (cultural, logging, accidental damage, etc.)
90	Physical (hit by falling tree)

5.20 MORTALITY YEAR (MOYR)

For each downloaded tree that has died or been cut since the previous inventory, record the 4-digit year in which the tree died.

Field width: 4 digits
MQO: 85% @ +/- 2 years.
Values: Year (i.e. 1997)

5.2.19NC 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.

All trees on all subplots will be given a NC Tree Class/Decay Class.

Field width: 2 digits
MQO: None
Values: 20, 30, 31, 40, 41, 42, 43, 44, 45

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

Remeasurement trees only(see description)

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

20--Growing Stock

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

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

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

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

Any tree of noncommercial species is a rough cull

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

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

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

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

40--Rotten Cull

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

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 sawlog 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 sawlog is present, the tree class is 31. If no sawlog is present, the tree class is either 30 or 40. If a pole-size tree does not have the potential to meet sawlog standards, it is either tree class 30 or 40.

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	Tree lean	Tree/Decay Class								
		20	30	31	40	41	42	43	44	45
1,4	0,1,2	Yes	Yes	Yes	Yes	NO	NO	NO	NO	NO
2,5,6	0,1	NO	Yes	NO	Yes*	NO	NO	NO	NO	NO
2	2	NO	Yes**	NO	NO	Yes	Yes	Yes	Yes	Yes

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

** Trees μ 5.0" DBH only

5.2.20 DECAY CLASS (DECA)

record for each standing dead tree, 5.0-inch in diameter and larger, indicating the trees stage of decay. **NC Note:** Do not record on re-measurement trees (subplots 101-115).

Field width: 1 digit

MQO: ±1 class, at least 90% of the time.

Values: Use the following table for guidelines:

Decay 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.

NC Note: Species may vary, but apply the codes above the same.

5.2.20B UTILIZATION CLASS (UTIL)

Code to identify cut trees which have been removed from the site.

Field width: 1 digits

MQO: No errors, 100% of the time

Values:

<u>CODE</u>	<u>UTILIZATION CLASS</u>
0	Not utilized (can be found on the site)
1	Utilized - cut and removed from the site.

~~5.2.22 PERCENT ROUGH CULL (CORE OPTIONAL) (ROUG)~~

~~For each tally tree 5.0 inch DBH/DRC and larger, record the percentage of sound dead cubic foot volume, to the nearest 5 percent. When estimating volume loss (tree cull) only consider the cull on the merchantable bole/portion of the tree. Refer to local defect guidelines as an aid in determining cull volume for various damages, such as fire, frost crack, etc.~~

~~Field width: 3 digits~~

~~MQO: +/- 10%, at least 90% of the time~~

~~Values: 000 to 100~~

5.2.25NC NC TREE GRADE (TRGD)

Grade qualifying sawlog trees (20 and 31 class) on all new subplots (1-4) in **all States**.

First digit For a hardwood sawtimber tree (tree class 20), grade the sawlog portion of the tree using "Hardwood Tree Grades for Factory Lumber" (USDA Forest Service Research Paper NE-333). The table on 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 sawtimber 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 sawtimber 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 sawtimber (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 sawlog length for tree grades is 12 feet and for log grades is 8 feet. Sawlog 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.

Field width: 1 digit
 MQO: None
 Values: 0 to 5

<u>1st digit Code</u>	<u>valid species</u>
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".

Field width: 2 digits
 MQO: NOne
 Values: 00 to 80 (only even 10s)

<u>Code</u> <u>2nd & 3rd</u>	<u>Limiting Factor</u>
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

Field width: 3 digits
 MQO: None
 Values:

000,100,200,300 for softwoods &	310	hardwoods
400 in White Pine	330	hardwoods
000	340	hardwoods
100	350	hardwoods
210	370	hardwoods
230	380	hardwoods
240	430	hardwoods
250	520	hardwoods
260	560	hardwoods
270	570	hardwoods
280		hardwoods

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 %.
- Use diameter classes, i.e. for grade 1, DBH can be 15.5" and for grade 2, DBH can be 12.5".

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+
Required clear ^d cuttings of each of 3 best faces ^e	Min. length, feet	7	5	3	3	3	3	2
	Max. number	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
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 1/4 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.			

5.2.23 MISTLETOE CLASS (CORE OPTIONAL) (MIST)

Rate all live conifer species, except juniper species, 1.0 in. (2.54 cm) and larger, for dwarf mistletoe (*Arceuthobium* spp.) infection. Use the Hawksworth six-class rating system: divide the live crown into thirds, and rate each third using the following scale:

- 0 No visible infection
- 1 Light infection < 50 percent of the total branches infected
- 2 Heavy infection > greater than 50 percent of the total branches infected

Sum the three individual ratings to obtain a total mistletoe class (0 to 6) for the tree.

Field width: 1 digit

MQO: +/- 1 class, at least 90% of the time

Values: 0 to 6

5.2.24 DAMAGE AGENTS (CORE OPTIONAL) (NCD1,NCD2,NCD3)

For each DAMAGE TYPE (DAM1,2,3) noted, identify a likely causal agent from the National list. Minnesota see codes in Appendix 9.

North Central will adopt this data item but at this time is using the old North Central FIA Standard Damage Agent code list.

Field width: 3 digit

MQO: None

Values: 000-909

Standard NC Damage Agent codes

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	<i>Eutypella</i> Canker	Maple
252	<i>Hypoxylon</i> Canker	Aspens
254	<i>Nectria</i> Canker	Hardwoods
257	Butternut Canker	Butternut
260	Stem Decay (heartrot)	All species
271	Ash Yellowings	Ashes
281	Dutch Elm Disease	Elms
282	Oak Wilt	Oaks
290	Root/Butt Rot	All species
291	<i>Annosus</i> Root Rot	Conifers
292	<i>Armillaria</i> 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
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5.2.25 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.

Field width: 3 digit
 MQO: None
 Values: 000-909

Missouri damage codes and coding criteria

CODE	DAMAGE OR DEATH	HOSTS	SEVERITY
000	Healthy	All species	<20% crown affected. No volume/degrade loss
100	Insect defoliators	All species	>20% foliage affected
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
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 Borer	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	Anthrachnose	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

CODE	DAMAGE OR DEATH	HOSTS	affected SEVERITY
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	<i>Eutypella</i> Canker	Maple	Any occurrence on bole
252	<i>Hypoxylon</i> Canker	Oaks	20% circumference affected
254	<i>Nectria</i> 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
283	Pine Wilt Nematode	Pines	Any occurrence
285	Verticillium Wilt	Hardwoods	Any occurrence
291	<i>Annosus</i> Root Rot	Conifers	Any occurrence
292	<i>Armillaria</i> Root Rot	All species	>20% crown dieback, <i>rhizomorphs/fan in root collar</i>
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
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
CODE	DAMAGE OR DEATH	HOSTS	SEVERITY
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

6.0 SEEDLING DATA

6.1 SEEDLING PROCEDURE

Stocking and regeneration information are obtained by counting seedlings within the 6.8 ft. (2.07 m.) radius microplot located 90 degrees and 12.0 ft. (3.66 m) from plot center within each of the four subplots, . Conifer seedlings must be at least 6.0 in. (15.24 cm.) in length and less than 1.0 in. (2.54 cm.) at DBH in order to qualify for tallying. Hardwood seedlings must be at least 12.0 in. (30.48 cm.) in length and less than 1.0 in. (2.54 cm.) at DBH in order to qualify for tallying. ~~For western woodland species, each stem on a single tree must be less than 1.0 in. (2.54 cm.) in DRC. Seedlings are counted in groups by species and condition class, up to 5 individuals per species. Counts beyond 5 are coded with 6. Species are coded in order from most abundant to least abundant.~~

6.2 SEEDLING DATA

6.2.1 SUBPLOT NUMBER

Use the procedures outlined in Section 4.1.

6.2.2 SPECIES (SPP)

Use the procedures outlined in Section 5.8.

6.2.3 CONDITION CLASS (CON#)

Use the procedures outlined in Section 2.1.1

6.2.4 ~~SEEDLING COUNT~~

~~Record the number of seedlings of each species, by condition class. Count up to 5 individuals by species; code 6 if there are more than 5 individuals of any given species in any given condition class. Code species in order from most abundant to least abundant.~~

~~Field width: 2 digit1~~

~~MQO: No errors, at least 95% of time~~

~~Values:~~

~~CODE SEEDLING COUNT~~

~~1 to 5 Exact count~~

~~6 More than 5 individuals by species by condition class.~~

North Central FIA will report this using the above codes and computing it from NC Seedling count.

6.2.5 NC SEEDLING COUNT (SED#)

Record the number of seedlings of each species, by condition class. Count up to 5 individuals by species; if there are more than 5 individuals of any given species in any given condition class estimate . Code species in order from most abundant to least abundant.

Field width: 2 digit1

MQO: Code 1-5 No errors; Code 6-99 +/- 5, at least 95% of time

Values:

CODE SEEDLING COUNT

1 to 98 Exact count

99 More than 99 individuals by species by condition class.

7.0 SITE TREE INFORMATION

Site trees are a measure of site productivity expressed by the height to age relationship of dominant and codominant trees. If suitable site trees are available, site tree data are required for every forest land condition class defined on a plot. An individual site tree may be used for more than one condition class where differences in conditions are not the result of differences in site productivity. For example, when different conditions are caused solely due to differences in reserve status, owner class, and/or disturbance-related differences in density (e.g., thinned vs. unthinned), a site tree may be used for more than one condition. When in doubt, do not use a site tree for more than one condition.

7.1 SITE TREE (PROCEDURE) SELECTION

Select at least 1 site tree for each accessible forest land condition; select tree from a species common to the condition class being sampled, based on regional or local tree species selection criteria (Appendix 5 lists acceptable site tree species by region). Select trees off the subplot where possible. Use only trees that have remained in a dominant or codominant crown position throughout their entire life span. If possible, trees should be 5.0 in. (12.70 cm.) 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 species trees, record so in the plot notes and leave this section blank.

7.2 SITE TREE DATA VARIABLES

7.2.1 SITE TREE NUMBER (TR#)

Record the corresponding record number of the site tree within the plot, beginning with 1 for the first site tree. Note that since site trees are generally not tally trees, this number will generally be different from TREE NUMBER.

Field width: 3 digits
MQO: No errors, 100% of time
Values: 001 to 999

7.2.2 SUBPLOT NUMBER (SUB#)

Use the same procedures described for subplot number in Section 5.1.

7.2.3 CONDITION CLASS LIST (CONL)

List all condition classes that the site index data from this tree represents.

Field width: 5 digits
MQO: No errors, 100% of time
Values: list of integers

7.2.4 SPECIES (SPP)

Use the same procedures described for subplot trees in Section 5.1.7.

7.2.5 DIAMETER (DBH)

Use the same procedures described for subplot trees in Section 5.1.8.

7.2.6 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. (0.30 m.). Must be measured; no estimates permitted on site trees.

Field width: 3 digits

MQO: +/- 10% of true length, 90% of the time

Values:
to 999

7.2.7NC NC HORIZONTAL DISTANCE (DIST)

Record the measured horizontal distance, to the nearest 1 ft., from the subplot center to the pith at the base of the tree. Trees should be selected off the subplot, outside the 24.0 foot radius.

Field width: 3 digits (xxx)

MQO: +/- 5.0 ft. (0.3 m.) , at least 90% of time

Values: +/- 10⁰

7.2.8NC NC AZIMUTH (AZM)

From site tree to a subplot center (entered in 7.2.2), sight the center of the base of each tree with a compass; Record azimuth (to the nearest degree) as a 3-digit code ranging from 001 to 360. Use 360 for north.

Field width: 3 digits

MQO: +/- 10 degrees, at least 90% of time

Values: 001 to 360

7.2.7 TREE AGE AT DIAMETER (AGE)

Bore the tree at the point of diameter measurement (DBH/DRC) with an increment borer. Count the rings from the outside edge of the core to the pith. Do not add years to get total age.

Field width: 3 digits

MQO: +/- 5 years, 90% of time

Values:
001 to 999

8.0 NONFOREST/DENIED ACCESS/HAZARDOUS PLOTS

8.1 OVERVIEW

This section describes field procedures for nonforest and inaccessible 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 (Current Plot 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 established at nonforest or inaccessible sample locations. If a forest plot has been converted to nonforest or becomes inaccessible, the previous data is 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.

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 non-forest use. Additional information concerning land use classifications is contained in Sections 2.4.2.

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

NC Note: A SP tree will be located and all information filled out for the SP mapping.

8.3.1 PLOT NUMBER (PLT#)

Use the same procedures described for forest plots in Section 1.1

8.3.2 SAMPLE KIND (SK)

Use the same procedures described for forest plots in Section 1.2.

8.3.2NC NC SAMPLE KIND (NCSK)

Use the same procedures described for forest plots in Section 1.2.2NC

8.3.3 STATE (ST)

Use the same procedures described for forest plots in Section 1.3

8.3.3NC NC UNIT (UNIT)

Unit is a one digit code which refers a division of a State that the plot and county are in (see the listed codes in the appendix)

Field width: 1 digits

MQO: No errors allowed, 100% of the time.

Values: See appendix ? for complete list.

8.3.4 COUNTY (CNTY)

Use the same procedures described for forest plots in Section 1.4

8.3.5 CURRENT DATE

Use the same procedures described for forest plots in Section 1.5.

8.3.6 CONDITION STATUS (STAT)

Use the same procedures described for forest plots in Section 2.1.1.

8.3.7 PRESENT NONFOREST LAND USE (CORE OPTIONAL) (CLU)

Record the appropriate land use at the center of each subplot using the procedures described in sections 2.1 and 2.2.

8.3.8NC NC Land Use (NCLU)

Record the appropriate NC land use at the center of each subplot using the procedures described in section 2.4.44NC.

Definition Of Terms

The following are definitions of terms used in this handbook.

Bureau of Land Management Land Federal land administered by the Bureau of Land Management.

Clear Panel A section of hardwood tree surface one-fourth the circumference of the tree and at least two feet long free of limbs, knots, bumps and other indications of defect which preclude clear cuttings.

Commercial Forest Land Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization. (Note: Areas qualifying as commercial forest land have the capability of producing in excess of 20 cubic feet per acre per year of industrial wood under management. Same as timberland)

Cull Portions of a tree that are unusable for industrial wood products, because of rot, form, or other defect.

Crown Class A classification of trees based on dominance in relation to adjacent trees in the stand as indicated by crown development and amount of light received from above and the sides. Crown classes recognized by Forest Survey include:

Open Grown Tree receiving full light from above and from all sides throughout all or most of the life of the tree, particularly during early development.

Dominant Trees Tree with well-developed crown extending above the general level of the crown cover and receiving full light from above and partly from the sides.

Codominant Trees Tree crown forming the general level of the crown cover and receiving full light from above, but comparatively little from the sides. Typically medium-sized crowns, more or less crowded on the sides.

Intermediate Trees Tree crown either below or extending into the crown cover formed by codominant and dominant trees, receiving little direct light from above, and none from the sides. Typically a small crown, considerably crowded on the sides.

Overtopped Tree crown entirely below the general level of the crown cover, receiving no direct light either from above or from the sides.

Face A section of the tree surface one-fourth the circumference of the tree extending the full length of the log.

Farm Either a place operated as a unit of 10 or more acres from which the sale of agricultural products totals \$50 or more annually or a place operated as a unit of less than 10 acres from which the sale of agricultural products for a year amounts to at least \$250. Places having less than the \$50 or \$250 minimum estimated sales in a given

year are also counted as farms if they can normally be expected to produce products in sufficient quantity to meet the requirements of the definition.

Forest Industry Land Land owned by companies or individuals operating wood-using plants.

Forest Land Land not currently developed for nonforest use and having a stocking value of at least 10.0 of all live forest trees of any size or formerly having a stocking value of at least 10.0. Unimproved roads and trails, streams or other bodies of water or clearings in forest areas will be classed as forest if less than 120 feet wide. The minimum area for classification of forest land is one acre and 120 feet in width. Roadside, streamside, and shelterbelt strips of timber must be at least 120 feet wide to qualify as forest land. Also see definitions for land area, commercial forest land, non-commercial forest land, productive-reserved forest land, stocking, unproductive forest land, and water.

Forest Trees Woody plants having a well-developed stem and usually more than 12 feet in height at maturity.

Forest Type A classification of forest land based upon the species forming a plurality of live "tree stocking".

Growing-stock Volume Net volume in cubic feet of growing stock trees five inches DBH and over from a one-foot stump to a minimum four-inch top diameter outside bark of the central stem or to the point where the central stem no longer meets pulpwood specifications.

Hardwoods Dicotyledonous trees, usually broadleaved and deciduous.

Idle Farmland Includes former croplands, orchards, improved pastures and farm sites not tended within the past two years and presently having a stocking value of less than 10.0 in all live trees.

Improved Pasture Land currently improved for grazing by cultivation, seeding, irrigation, or clearing of trees or brush.

Indian Land Tribal lands held in fee or trust by the Federal government but administered for Indian tribal groups and Indian trust allotments.

Land Area

Bureau of the Census The area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than 1/8 of a statute mile in width; and lakes, reservoirs, and ponds less than 40 acres in area.

Forest Survey The same as the Bureau of Census, except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is one acre.

Limb The part of the tree above the stump that does not meet the requirement for sawlogs and upper-stem portions, including all live, sound branches to a minimum of four inches DOB.

Linear Water Feature Natural water courses that are linear in shape such as streams and rivers. These flowages are treated as a nonforest land use if they are perennial and are at least 30 feet wide. Stream width is measured between mean high-water marks as indicated by the presence of perennial terrestrial vegetation.

Logging Residues The unused portions of trees cut or killed by logging.

Macro plot A 24.0 ft. fixed radius plot (measured horizontally to the center of the tree at DBH) that samples trees 5.0 inches DBH and larger.

Maintained Road Any road, hard topped or other surfaces, that is plowed or graded periodically and capable of use by a large vehicle. Right of ways that are cut or treated to limit herbaceous growth are included in this area.

Mean High-water Mark The start of perennial terrestrial vegetation next to aquatic ecosystems.

Merchantable Refers to a pulpwood or sawlog section that meets pulpwood or sawlog specifications, respectively.

Micro plot A 6.8 ft. fixed radius plot (measured horizontally to the center of the tree at the base) that samples trees less than 5.0 inches DBH.

National Forest Land Federal lands that have been legally designated as National Forest or purchase units, and other lands under the administration of the Forest Service, including experimental areas and Bankhead Jones Title III lands.

Net Volume Gross volume minus deductions for rot, sweep, or other defect affecting use for timber products.

Nonforest Land Land that has never supported forests and lands formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, power line clearings of any width, and one-to-40 acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and more than one acre in size, to qualify as nonforest land.)

Nonstocked Forest Land Commercial forest land with a stocking value of less than 10.0 in growing-stock trees but may be greater than 10.0 in all live trees.

Other Federal Lands Federal lands not administered by the US Forest Service, including lands administered by the Bureau of Land Management, Bureau of Indian Affairs, and other Federal Agencies.

Overgrown Knot The scar left in the bark by a limb completely overgrown, but still outlined by the circular configuration in the bark.

Overstocked Area Areas where growth of trees is significantly reduced by excessive numbers of trees.

Ownership Property owned by one owner, regardless of the number of parcels in a specified area.

Poletimber Trees Growing-stock trees of commercial species at least five inches in DBH, but smaller than sawtimber size. (see sawtimber trees)

Productive-Reserved Forest Land Forest land sufficiently productive to qualify as commercial forest land, but withdrawn from timber utilization through statute, administration, designation, or exclusive use for Christmas-tree production as indicated by annual shearing.

Prospectively As used in this manual it refers to the moment when the tree reaches sawtimber size at DBH it can be considered saw log.

Rangeland Land on which the natural plant cover is composed principally of native grasses, forbs, or shrubs valuable for forage.

Primitive Roads Roads that are not maintained and are primarily used by vehicles not intended for highway use (i.e., old logging roads).

Rotten Trees Live trees of commercial species that do not contain at least one 12-foot sawlog or two sawlogs eight feet or longer, now or prospectively, and/or do not meet Regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

Rough Trees Live trees of commercial species that do not contain at least one 12-foot sawlog or two sawlogs 8 feet or longer, now or prospectively, and/or do not meet Regional specifications for freedom from defect primarily because of roughness or poor form. Also, all live trees of noncommercial species.

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; piling; poles; posts; hewn ties; mine timbers; and various other round, split, or hewn products.)

Saplings Live trees one inch to 4.9 inches in diameter at breast height (DBH).

Sawlog A log meeting minimum standards of diameter, length and defect, including logs at least 8 feet long, sound and straight and with a minimum diameter outside bark for softwoods of 7 inches (9 inches for hardwoods) or other combinations of size and defect specified by Regional standards.

Sawlog Portion That part of the bole of sawtimber trees between the stump and the sawlog top, being nine inches DOB for hardwoods and seven inches DOB for softwoods whenever they are present. (Does not refer to sections meeting minimum log grade specifications.)

Sawlog Top The point on the bole of sawtimber trees above which a sawlog cannot be produced. The minimum sawlog top is seven inches DOB for softwoods and nine inches DOB for hardwoods.

Sawtimber Trees Live trees of commercial species containing at least a 12-foot sawlog or two sawlogs eight feet or longer, and meeting Regional specifications for freedom from defect. Softwoods must be at least nine inches in diameter breast height. Hardwoods must be at least 11.0 inches in diameter.

Sawtimber Volume Net volume of the sawlog portion of live sawtimber in board feet International 1/4-inch rule.

Seedlings Live trees less than one inch in diameter at breast height (DBH).

Site Class A classification of forest land with inherent capacity to grow crops of industrial wood based on fully stocked natural stands.

Softwoods Coniferous trees, usually evergreen having needles or scale-like leaves.

Sound Knot or Limb Knots or limbs intergrown or encased with the surrounding wood and with no indication of decay. Bark may not be present on the limbs.

Stand-Size Class A classification of forest land based on the size class of all live trees on the area; that is, sawtimber, poletimber or seedlings and saplings.

Large Diameter Stands Stands with a stocking value of at least 10.0 in growing-stock trees, with half or more of total stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Medium Diameter Stands Stands with a stocking value of at least 10.0 in growing-stock trees of which half or more of this stocking is in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

Small Diameter Stands Stands with a stocking value of at least 10.0 in growing-stock trees of which more than half of the stocking is saplings and/or seedlings.

State, County, and Municipal Lands Lands owned by states, counties, and local public agencies, or municipalities, or lands leased to these governmental units for 50 years or more.

Stocking The degree of occupancy of land by trees, measured by basal area and/or the number of trees in a stand by size or age and spacing, compared to the basal area and/or number of trees required to fully utilize the growth potential of the land that is, the stocking standard.

Timber Products Roundwood products and plant byproducts. (Note: Timber products output includes roundwood products cut from growing stock on commercial forest land; from other sources, such as cull trees, salvable dead trees, limbs, and saplings; from trees on noncommercial and nonforest lands, and from plant byproducts.)

Tree Grades A classification sawtimber size trees based on external characteristics as indicators of quality or value.

Tree Size Class A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Unproductive Forest Land Forest land incapable of producing 20 cubic feet per acre of industrial wood under natural conditions because of adverse site conditions. (Note: Adverse conditions include sterile soils, dry climate, poor drainage, high elevation steepness, and rockiness.)

Upper Stem Portion That part of the bole of sawtimber trees above the sawlog top to a minimum top diameter of four inches outside bark or to the point where the central stem breaks into limbs.

Variable radius plot A 37.5 BAF prism plot that samples trees 5.0 inches DBH and larger.

Water

Bureau of the Census: Streams, sloughs, estuaries, and canals more than 1/8th of a statute mile in width; and lakes, reservoirs, and ponds more than 40 acres in area.

Forest Survey: The same as the Bureau of the Census, except minimum width of linear water features (streams, rivers, etc.) is 30 feet and the minimum area of lakes, etc. is one acre.

APPENDICES

Appendix 1. FIPS Codes for all States and Counties.

These are the standard federal 2- and 3-digit codes for States and Counties respectively. Full list will be included in the final draft.

Illinois	(17)	Brown	9	Scott	171
Unit 1		Bureau	11	Stark	175
Alexander	3	Carroll	15	Stephenson	177
Franklin	55	Cass	17	Tazewell	179
Gallatin	59	Champaign	19	Vermilion	183
Hamilton	65	Christian	21	Warren	187
Hardin	69	Coles	29	Whiteside	195
Jackson	77	Cook	31	Will	197
Johnson	87	DeKalb	37	Winnebago	201
Massac	127	De Witt	39	Woodford	203
Perry	145	Douglas	41		
Pope	151	DuPage	43	Indiana	(18)
Pulaski	153	Edgar	45	Unit 1	
Randolph	157	Ford	53	Clay	21
Saline	165	Fulton	57	Daviess	27
Union	181	Grundy	63	Gibson	51
White	193	Hancock	67	Greene	55
Williamson	199	Henderson	71	Knox	83
Unit 2		Henry	73	Martin	101
Bond	5	Iroquois	75	Parke	121
Callhoun	13	JoDaviess	85	Pike	125
Clark	23	Kane	89	Posey	129
Clay	25	Kankakee	91	Putnam	133
Clinton	27	Kendall	93	Sullivan	153
Crawford	33	Knox	95	Vanderburg	163
Cumberland	35	Lake	97	Vermillion	165
Edwards	47	La Salle	99	Vigo	167
Effingham	49	Lee	103	Unit 2	
Fayette	51	Livingston	105	Brown	13
Greene	61	Logan	107	Clark	19
Jasper	79	Macon	115	Crawford	25
Jefferson	81	Marshall	123	Dubois	37
Jersey	83	Mason	125	Floyd	43
Lawrence	101	McDonough	109	Harrison	61
Macoupin	117	McHenry	111	Jackson	71
Madison	119	McLean	113	Lawrence	93
Marion	121	Menard	129	Monroe	105
Monroe	133	Mercer	131	Morgan	109
Montgomery	135	Morgan	137	Orange	117
Richland	159	Moultrie	139	Owen	119
St.Clair	163	Ogle	141	Perry	123
Shelby	173	Peoria	143	Scott	143
Wabash	185	Piatt	147	Spencer	147
Washington	189	Pike	149	Warrick	173
Wayne	191	Putnam	155	Washington	175
Unit 3		Rock Island	161	Unit 3	
Adams	1	Sangamon	167	Dearborn	29
Boone	7	Schuyler	169		

Indiana (18)

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
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)

Unit 1	
Atchison	5
Brown	13
Clay	27
Dickinson	41
Doniphan	43
Douglas	45
Franklin	59
Geary	61
Jackson	85
Jefferson	87
Johnson	91
Leavenworth	103
Marshall	117
Miami	121
Nemaha	131
Osage	139
Pottawatom	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 Travers	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 Is	141
Roscommon	143
Wexford	165
Unit 4	
Allegan	5
Barry	15
Berrien	21

Michigan (26)

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
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
Koochichin	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 Pa	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 Med	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. Franco	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

Missouri (29)

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
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

Nebraska (31)

Keya Paha	103
Kimball	105
Knox	107
Lincoln	111
Logan	113
Loup	115
McPherson	117
Morrill	123
Perkins	135
Rock	149
Scotts Blu	157
Sheridan	161
Sioux	165
Thomas	171
Wheeler	183

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

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

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 Val	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

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

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

Wisconsin (55)

Winnebago 139

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
Dunn	33
Grant	43
Iowa	49
La Crosse	63
Lafayette	65
Pepin	91
Pierce	93
Richland	103
St. Croix	109
Sauk	111
Trempealea	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

Appendix 2. Forest Type Codes

These are the codes which correspond to the National FIM Forest typing algorithm.

Forest types are divided into 3 regions, Lake States, Central States and Plains States. At the end of each forest type definition there is a list of the regions that forest type should be used in.

Lake States (lake) include - Minnesota, Michigan and Wisconsin.

Central States (central) include - Indiana, Illinois, Iowa and Missouri

Plains States (plains) include - Kansas, Nebraska, North Dakota and South Dakota

Code	Forest type
101	Jack pine Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.) Lake, Plains
102	Red pine Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch, and maple.) Lake, Plains
103	White pine Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch, and maple.) Lake, Central
105	Eastern Hemlock Forests in which eastern hemlock comprises a plurality of the stocking. (Common associates include eastern white pine, beech, sugar maple, yellow birch, basswood, northern red oak, black cherry and white ash) Lake
121	Balsam fir Forests in which balsam fir and white spruce comprise a plurality of the stocking with balsam fir the most common. (Common associates include white spruce, aspen, maple, birch, northern white-cedar, and tamarack.) Lake
122	White spruce Forests in which white spruce and balsam fir comprise a plurality of the stocking with white spruce the most common. (Common associates include balsam fir, aspen, maple, birch, northern white-cedar, and tamarack.) Lake
125	Black spruce Forests in which swamp conifers comprise a plurality of the stocking with black spruce the most common. (Common associates include tamarack and northern white-cedar.) Lake
126	Tamarack Forests in which swamp conifers comprise a plurality of the stocking with tamarack the most common. (Common associates include black spruce and northern white-cedar.) Lake
127	Northern white-cedar Forests in which swamp conifers comprise a plurality of the stocking with northern white-cedar the most common. (Common associates include tamarack and black spruce.) Lake
162	Shortleaf pine Forests in which shortleaf pine comprises a plurality of the stocking. Central

- 163 **Virginia pine** Forests in which Virginia pine comprises a plurality of the stocking. Central
- 181 **Eastern redcedar** Forests in which eastern redcedar comprises a plurality of the stocking. Central, Plains
- 182 **Rocky Mountain juniper** Forests in which rocky mountain juniper comprises a plurality of the stocking. Plains
- 221 **Ponderosa pine** Forests in which ponderosa pine comprises a plurality of the stocking. Plains
- 402 **Eastern redcedar-hardwood** Forests in which hardwoods comprise 50 percent of the stocking and eastern redcedar comprises at least 25 percent. Central, Plains
- 380 **Exotic Conifers** Forests in which conifer species not native to the Lake States comprise a plurality of the stocking. (Mostly Scotch pine in plantations.) Lake, Plains
- 400 **Pine/oak Group** Forests in which oaks/hardwoods comprise 50 percent of the stocking and pines at least 25 percent. Central
- 404 **Shortleaf pine-oak** Forests in which oaks/hardwoods comprise 50 percent of the stocking and shortleaf pine comprises at least 25 percent. Central
- 500 **Oak-hickory** Forests in which oaks and hickories comprise a plurality of the stocking. Along with all the oaks and hickories, sassafras, eastern red cedar and white ash are included in this type. Lake
- 501 **Post-blackjack** Forests in which oaks/hardwoods comprise a plurality of the stocking and post oak and blackjack oak predominate. Central, Plains
- 503 **White oak-red oak-hickory** Forests in which oaks/hickories comprise a plurality of the stocking and white oaks, red oaks, and hickories predominate. Includes all the hickories, northern red oak, chinkapin oak, northern pin oak, shingle oak, Shumard oak, and southern red oak. Central, Plains
- 504 **White oak** Forests in which oaks/hardwoods comprise a plurality of the stocking and *Quercus alba* (white oak) predominates. Central
- 507 **Sassafras-persimmon** Forests in which sassafras and persimmon comprise 50 percent of the stocking. Central
- 509 **Bur oak** Forests in which oaks/hardwoods comprise a plurality of the stocking and bur oak predominates. Central, Plains
- 515 **Chestnut-black-scarlet oak** Forests in which oaks/hardwoods comprise a plurality of the stocking and chestnut oak, black oak, and scarlet oak predominate. Central
- 600 **Oak-gum-cypress** Forests in which bottomland hardwoods comprise a plurality of the stocking and baldcypress, sweetgum, and swamp tupelo predominate. Central
- 601 **Swamp chestnut oak-cherrybark oak** Forests in which bottomland hardwoods comprise a plurality of the stocking and wet site oaks such as swamp chestnut, pin, cherrybark and overcup predominate. Central
- 700 **Elm-ash-cottonwood** Forests in which low-land hardwoods comprise a plurality of the stocking. Typing species include black ash, silver maple, boxelder, riverbirch, hackberry, cottonwood and black willow. If a lowland site (physiographic class 31-36) red maple, green ash and the elms are included. Lake

- 701 **Elm-ash-soft maple** Forests in which lowland hardwoods comprise a plurality of the stocking and elm, ash and soft maple predominate. Includes boxelder, silver maple, Ohio buckeye, river birch, hackberry, black ash, honey locust, and sycamore. If a lowland site (physiographic class 31-36) American elm, slippery elm, green ash, and red maple are included in this type. Central, Plains
- 703 **Cottonwood** Forests in which cottonwood comprises 50 percent of the stocking. Central, Plains
- 704 **Willow** Forests in which willow comprises 50 percent of the stocking. Central, Plains
- 800 **Maple-beech-birch group** Forests in which upland hardwoods comprise a plurality of the stocking. Typing species include sugar maple, black maple, basswood, black walnut, butternut and black cherry. If a upland site (physiographic class 21-26) red maple, green ash, and all the elms are included. Lake
- 801 **Maple-beech-yellow birch** Forests in which upland hardwoods comprise a plurality of the stocking and hard maple, beech, yellow birch, basswood, and butternut predominate. Hard maple includes black and sugar maple. If an upland site (physiographic class 21-26) American elm, slippery elm, green ash, and red maple are included in this type. Central
- 803 **Cherry-ash-yellow poplar** Forests in which upland hardwoods comprise a plurality of the stocking and black cherry, black walnut, white ash and yellow-poplar predominate. Central
- 805 **Maple-basswood** Forests in which sugar maple, basswood, walnut and hackberry, singly or in combination, comprise a plurality of the stocking. Plains
- 900 **Aspen/Birch Group** Forests in which quacking aspen, bigtooth aspen, balsam poplar or paper birch comprise a plurality of the stocking. Central, Plains, Lake
- 901 **Aspen** Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir, and paper birch.) Lake
- 902 **Paper birch** Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen, and balsam fir.) Lake
- 904 **Balsam poplar** Forests in which balsam poplar comprises a plurality of the stocking. (Common associates aspen, elm and ash.) Lake

Appendix 3. Invasive Plants/Noxious Weeds Checklist Species

List of species, in preparation.

Appendix 4. Tree Species List

This list includes all species deemed to be tally trees with western woodland trees measured for DRC indicated. The defining reference for this list is Little, E.L. 1981. Check list of native and naturalized trees of the United States. (Agric. Handb.541. Washington, DC; U.S. Department of Agriculture, Forest Service. 385 p.)

Code	Common Name	Genus	species
010	fir spp.	Abies	spp.
012	balsam fir	Abies	balsamea
015	white fir	Abies	concolor
057	redcedar / juniper	Juniperus	spp.
066	Rocky Mountain juniper	Juniperus	scopulorum
068	eastern redcedar	Juniperus	virginiana
070	larch (introduced)	Larix	spp.
071	tamarack (native)	Larix	laricina
090	spruce spp.	Picea	spp.
091	Norway spruce	Picea	abies
093	Engelmann spruce	Picea	engelmannii
094	white spruce	Picea	glauca
095	black spruce	Picea	mariana
105	jack pine	Pinus	banksiana
108	lodgepole pine	Pinus	contorta
110	shortleaf pine	Pinus	echinata
113	limber pine	Pinus	flexilis
122	ponderosa pine	Pinus	ponderosa
125	red pine	Pinus	resinosa
129	eastern white pine	Pinus	strobus
130	Scotch pine	Pinus	sylvestris
131	loblolly pine	Pinus	taeda
132	Virginia pine	Pinus	virginiana
136	Austrian pine	Pinus	nigra
202	Douglas-fir	Pseudotsuga	menziesii
221	baldcypress	Taxodium	distichum
241	northern white-cedar	Thuja	occidentalis
260	hemlock spp.	Tsuga	spp.
261	eastern hemlock	Tsuga	canadensis
300	acacia	Acacia	spp.
310	maple spp.	Acer	spp.
313	boxelder	Acer	negundo
314	black maple	Acer	nigrum
315*	striped maple	Acer	pensylvanicum
316	red maple	Acer	rubrum
317	silver maple	Acer	saccharinum
318	sugar maple	Acer	saccharum
319*	mountain maple	Acer	spicatum
321	Rocky Mountain maple	Acer	glabrum
331	Ohio buckeye	Aesculus	glabra
332	yellow buckeye	Aesculus	octandra
334	Texas buckeye	Aesculus	glabra var. arguta
341*	ailanthus	Ailanthus	altissima
345	mimosa, silktree	Albizzia	julibrissin
355	European Alder	Alnus	glutinosa

Code	Common Name	Genus	species
367	pawpaw	Asimina	triloba
370	birch spp.	Betula	spp.
371	yellow birch	Betula	alleghaniensis
372	sweet birch	Betula	lenta
373	river birch	Betula	nigra
374	water birch	Betula	occidentalis
375	paper birch	Betula	papyrifera
379	gray birch	Betula	populifolia
381	chittamwood,gum bumelia	Bumelia	lanuginosa
391*	American hornbeam,musclewood	Carpinus	caroliniana
400	hickory spp.	Carya	spp.
401	water hickory	Carya	aquatica
402	bitternut hickory	Carya	cordiformis
403	pignut hickory	Carya	glabra
404	pecan	Carya	illinoensis
405	shellbark hickory	Carya	laciniosa
407	shagbark hickory	Carya	ovata
408	black hickory	Carya	texana
409	mockernut hickory	Carya	tomentosa
421	American chestnut	Castanea	dentata
423	Ozark chinkapin	Castanea	ozarkensis
450	catalpa spp.	Catalpa	spp.
452	northern catalpa	Catalpa	speciosa
460	hackberry spp.	Celtis	spp.
461	sugarberry	Celtis	laevigata
462	hackberry	Celtis	occidentalis
463	netleaf hackberry	Celtis	reticulata
471	eastern redbud	Cercis	canadensis
481	yellowwood	Cladrastis	kentukea
491	flowering dogwood	Cornus	florida
500*	hawthorn	Crataegus	spp.
521	common persimmon	Diospyros	virginiana
531	American beech	Fagus	grandifolia
540	ash spp.	Fraxinus	spp.
541	white ash	Fraxinus	americana
543	black ash	Fraxinus	nigra
544	green ash	Fraxinus	pennsylvanica
545	pumpkin ash	Fraxinus	profunda
546	blue ash	Fraxinus	quadrangulata
551	waterlocust	Gleditsia	aquatica
552	honeylocust	Gleditsia	triacanthos
571	Kentucky coffeetree	Gymnocladus	dioicus
591	American holly	Ilex	opaca
600	walnut	Juglans	spp.
601	butternut	Juglans	cinerea
602	black walnut	Juglans	nigra
605	Texas walnut	Juglans	microcarpa
611	sweetgum	Liquidambar	styraciflua
621	yellow-poplar	Liriodendron	tuliperfia
641	Osage-orange	Maclura	pomifera
651	cucumbertree	Magnolia	acuminata
660	apple spp.	Malus	spp.
680	mulberry spp.	Morus	spp.

Code	Common Name	Genus	species
681	white mulberry	Morus	alba
682	red mulberry	Morus	rubra
691	water tupelo	Nyssa	aquatica
693	blackgum	Nyssa	sylvatica
694	swamp tupelo	Nyssa	sylvatica var. biflora
701*	eastern hophornbeam	Ostrya	virginiana
712	paulownia, empress-tree	Poulownia	tomentosa
731	sycamore	Platanus	occidentallis
740	cottonwood and poplar spp.	Populus	spp.
741	balsam poplar	Populus	balsamifera
742	eastern cottonwood	Populus	deltoides
743	bigtooth aspen	Populus	grandidentata
744	swamp cottonwood	Populus	heterophylla
745	plains cottonwood	Populus	deltoides ssp. monilifera
746	quaking aspen	Populus	tremuloides
749	narrowleaf cottonwood	Populus	angustifolia
752	silver poplar	Populus	alba
760	cherry and plum spp.	Prunus	spp.
761*	pin cherry	Prunus	pensylvanica
762	black cherry	Prunus	serotina
763*	chokecherry	Prunus	virginiana
765*	Canada plum	Prunus	nigra
766*	wild plum	Prunus	americana
800	oak -- deciduous	Quercus	spp.
802	white oak	Quercus	alba
804	swamp white oak	Quercus	bicolor
806	scarlet oak	Quercus	coccinea
809	northern pin oak	Quercus	ellipsoidalis
812	southern red oak	Quercus	falcata var. falcata
813	cherrybark oak	Quercus	falcata var. pagodifolia
817	shingle oak	Quercus	imbricaria
822	overcup oak	Quercus	lyrata
823	bur oak	Quercus	macrocarpa
824	blackjack oak	Quercus	marilandica
825	swamp chestnut oak	Quercus	michauxii
826	chinkapin oak	Quercus	muehlenbergii
827	water oak	Quercus	nigra
830	pin oak	Quercus	palustris
831	willow oak	Quercus	phellos
832	chestnut oak	Quercus	prinus
833	northern red oak	Quercus	rubra
834	Shumard oak	Quercus	shumardii
835	post oak	Quercus	stellata
837	black oak	Quercus	velutina
845	Dwarf chinakapin oak	Quercus	prinoides
901	black locust	Robinia	pseudoacacia
919	western soapberry	Sapindus	drummondii
920	willow	Salix	spp.
921*	peachleaf willow	Salix	amygdaloides
922	black willow	Salix	nigra
927	white willow	Salix	alba
931	sassafras	Sassafras	albidum
935*	American mountain-ash	Sorbus	americana
950	basswood spp.	Tilia	spp.

Code	Common Name	Genus	species
951	American basswood	Tilia	americana
952	white basswood	Tilia	heterophylla
970	elm spp.	Ulmus	spp.
971	winged elm	Ulmus	alata
972	American elm	Ulmus	americana
974	Siberian elm	Ulmus	pumila
975	slippery elm	Ulmus	rubra
977	Rock elm	Ulmus	thomasii
996	smoketree	Cotinus	obovatus
997	Russian-olive	Elaeagnus	angustifolia

* Trees of noncommercial species

Appendix 5 Site Tree selection criteria and species by region.

Site index curves will be in the back of the manual. Use the curves recommended for the state you are working in.

Recommended Site Index Curves for Lake States

Species		GTR NC-128	Source
Code	Common Name	Fig. #	
012	Balsam fir	55	Carmean & Hann 1981
068	Eastern redcedar	58	Hampf 1965
071	Tamarack	60	Gevorkiantz 1957
094	White spruce	67	Carmean & Hann 1981
095	Black spruce	70	Gevorkiantz 1957
105	Jack pine	74	Gevorkiantz 1956
125	Red pine	95	Gevorkiantz 1957
129	White pine	103	Gevorkiantz 1957
130	Scotch pine	108	Hannah 1971
241	N. White Cedar	126	Gevorkiantz 1957
313	Boxelder	01	Use red maple curve
314	Black maple	03	Use sugar maple curve
316	Red maple	01	Carmean 1978
317	Silver maple	01	Use red maple curve
318	Sugar maple	03	Carmean 1978
371	Yellow birch	06	Carmean 1978
373	River birch	09	Use paper birch curve
375	Paper birch	09	Carmean 1978
402	Bitternut hickory	10	Hampf 1965
407	Shagbark hickory	10	Hampf 1965
462	Hackberry	53	Use American elm curve
541	White ash	13	Carmean 1978
543	Black ash	14	Carmean 1978
544	Green ash	15	Broadfoot 1969
601	Butternut	16	Use black walnut curve
602	Black walnut	16	Kellogg 1939
741	Balsam poplar	32	Use aspen curve
742	Cottonwood	28	Neebe and Boyce 1959
743	Bigtooth aspen	32	Carmean 1978
746	Quaking aspen	32	Carmean 1978
762	Black cherry	34	Carmean 1978
802	White oak	41	Carmean 1972
804	Swamp white oak	41	Use white oak curve
809	N. pin oak	49	Use black oak curve
823	Bur oak	41	Use white oak curve
833	N. red oak	48	Carmean 1978
837	Black oak	49	Carmean 1971
951	American basswood	51	Carmean 1978
972	American elm	53	Carmean 1978
975	Slippery elm	53	Use American elm curve
977	Rock elm	53	Use American elm curve

Source: Carmean, W.H., J.T. Hahn, and R.D. Jacobs. 1989. Site index curves for forest tree species in the Eastern United States. North Central Forest Expt. Stn. Gen. Tech. Report NC-128.

Recommended Site Index Curves for Illinois and Indiana

Species		GTR NC-128	Source
Code	Common Name	Fig. #	
068	Eastern redcedar	58	Hampf 1965
110	Shortleaf pine	79	Schumacher and Coile 1960
125	Red pine	95	Gevorkiantz 1957
129	White pine	103	Gevorkiantz 1957
131	Loblolly pine	109	USDA Publication 1929
132	Virginia pine	125	Kulow, Sowers, and Heesch 1966
313	Boxelder	01	Use red maple curve
314	Black maple	03	Use sugar maple curve
316	Red maple	01	Carmean 1978
317	Silver maple	01	Use red maple curve
318	Sugar maple	03	Carmean 1978
371	Yellow birch	06	Carmean 1978
373	River birch	09	Use paper birch curve
375	Paper birch	09	Carmean 1978
379	Gray birch	09	Use paper birch curve
402	Bitternut hickory	10	Hampf 1965
403	Pignut hickory	10	Hampf 1965
404	Pecan	10	Hampf 1965
405	Shellbark hickory	10	Hampf 1965
407	Shagbark hickory	10	Hampf 1965
408	Black hickory	10	Hampf 1965
409	Mockernut hickory	10	Hampf 1965
461	Sugarberry	53	Use American elm curve
462	Hackberry	53	Use American elm curve
531	Beech	11	Carmean 1978
541	White ash	13	Carmean 1978
543	Black ash	14	Carmean 1978
544	Green ash	15	Broadfoot 1969
546	Blue ash	14	Use black ash curve
601	Butternut	16	Use black walnut curve
602	Black walnut	16	Kellogg 1939
611	Sweetgum	21	Broadfoot and Krinard 1959
621	Yellow-poplar	25	Schlaegel 1969
691	Water tupelo	26	Applequist 1959
693	Black tupelo	27	Applequist 1959
731	Sycamore	53	Use American elm curve
741	Balsam poplar	32	Use aspen curve
742	Cottonwood	28	Neebe and Boyce 1959
743	Bigtooth aspen	32	Carmean 1978
744	Swamp cottonwood	28	Use cottonwood curve
746	Quaking aspen	32	Carmean 1978
762	Black cherry	34	Carmean 1978
802	White oak	41	Carmean 1972
804	Swamp white oak	41	Use white oak curve
806	Scarlet oak	42	Carmean 1972
809	N. pin oak	49	Use black oak curve
812	S. red oak	49	Use black oak curve
813	Cherrybark oak	48	Use northern red oak curve
817	Shingle oak	49	Use black oak curve
822	Overcup oak	41	Use white oak curve
823	Bur oak	41	Use white oak curve
824	Blackjack oak	49	Use black oak curve

Species		GTR NC-128	Source
Code	Common Name	Fig. #	
825	Swamp chestnut oak	41	Use white oak curve
826	Chinkapin oak	41	Use white oak curve
830	Pin oak	49	Use black oak curve
831	Willow oak	49	Use black oak curve
832	Chestnut oak	46	Carmean 1971
833	N. red oak	48	Carmean 1978
834	Shunard oak	48	Use northern red oak curve
835	Post oak	41	Use white oak curve
837	Black oak	49	Carmean 1971
901	Black locust	50	Kellogg 1939
922	Black willow	28	Use cottonwood curve
931	Sassafras	53	Use American elm curve
951	American basswood	51	Carmean 1978
952	White basswood	51	Use American basswood curve
971	Winged elm	53	Use American elm curve
972	American elm	53	Carmean 1978
974	Siberian elm	53	Use American elm curve
975	Slippery elm	53	Use American elm curve
977	Rock elm	53	Use American elm curve

Source: Carmean, W.H., J.T. Hahn, and R.D. Jacobs. 1989. Site index curves for forest tree species in the Eastern United States. North Central Forest Expt. Stn. Gen. Tech. Report NC-128.

Appendix 6. Volume and deduction tables.

TWO VARIABLE CUBIC FOOT LOOKUP VOLUME TABLE

DBH	MERCHANTABLE HEIGHT (FEET)																		
	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44
5	1.0	1.1	1.3	1.5	1.6	1.8	1.9	2.1	2.2	2.4	2.5	2.7	2.8	2.9	3.1	3.2	3.3	3.4	3.5
6	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.7	3.9	4.1	4.3	4.4	4.6	4.8
7	1.8	2.1	2.3	2.6	2.9	3.1	3.4	3.6	3.9	4.1	4.4	4.6	4.8	5.1	5.3	5.5	5.8	6.0	6.2
8	2.3	2.6	2.9	3.3	3.6	3.9	4.2	4.5	4.8	5.1	5.5	5.8	6.1	6.4	6.7	7.0	7.3	7.6	7.9
9	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.5	5.9	6.3	6.7	7.1	7.4	7.8	8.2	8.6	8.9	9.3	9.7
10	3.3	3.8	4.3	4.8	5.3	5.7	6.2	6.6	7.1	7.6	8.0	8.5	9.0	9.4	9.9	10.3	10.8	11.3	11.7
11	4.0	4.5	5.1	5.6	6.2	6.8	7.3	7.9	8.4	9.0	9.5	10.1	10.6	11.2	11.7	12.3	12.8	13.4	14.0
12	4.6	5.3	5.9	6.6	7.2	7.9	8.5	9.2	9.8	10.5	11.1	11.8	12.4	13.1	13.7	14.4	15.0	15.7	16.4
13	5.3	6.1	6.8	7.6	8.3	9.1	9.8	10.6	11.3	12.1	12.8	13.6	14.4	15.1	15.9	16.7	17.4	18.2	19.0
14	6.0	6.9	7.8	8.6	9.5	10.4	11.2	12.1	13.0	13.8	14.7	15.6	16.5	17.3	18.2	19.1	20.0	20.9	21.8
15	6.8	7.8	8.8	9.8	10.7	11.7	12.7	13.7	14.7	15.7	16.7	17.7	18.7	19.7	20.7	21.7	22.8	23.8	24.9
16	7.6	8.7	9.8	11.0	12.1	13.2	14.3	15.4	16.5	17.7	18.8	19.9	21.1	22.2	23.4	24.5	25.7	26.9	28.1
17	8.5	9.7	11.0	12.2	13.5	14.7	16.0	17.2	18.5	19.7	21.0	22.3	23.6	24.9	26.2	27.5	28.8	30.1	31.5
18	9.4	10.8	12.2	13.6	14.9	16.3	17.7	19.1	20.5	22.0	23.4	24.8	26.2	27.7	29.1	30.6	32.1	33.6	35.1
19	10.3	11.9	13.4	14.9	16.5	18.0	19.6	21.1	22.7	24.3	25.9	27.4	29.0	30.6	32.3	33.9	35.6	37.2	38.9
20	11.3	13.0	14.7	16.4	18.1	19.8	21.5	23.3	25.0	26.7	28.5	30.2	32.0	33.8	35.6	37.4	39.2	41.0	42.9
21	12.3	14.2	16.1	17.9	19.8	21.7	23.6	25.5	27.4	29.3	31.2	33.1	35.1	37.0	39.0	41.0	43.0	45.1	47.1
22	13.4	15.5	17.5	19.5	21.6	23.6	25.7	27.8	29.9	31.9	34.1	36.2	38.3	40.5	42.6	44.8	47.0	49.3	51.5
23	14.5	16.7	19.0	21.2	23.4	25.7	27.9	30.2	32.5	34.7	37.0	39.3	41.7	44.0	46.4	48.8	51.2	53.6	56.1
24	15.7	18.1	20.5	22.9	25.4	27.8	30.2	32.7	35.2	37.6	40.1	42.7	45.2	47.7	50.3	52.9	55.6	58.2	60.9
25	16.9	19.5	22.1	24.7	27.4	30.0	32.7	35.3	38.0	40.7	43.4	46.1	48.9	51.6	54.4	57.2	60.1	63.0	65.9
26	18.1	20.9	23.8	26.6	29.4	32.3	35.1	38.0	40.9	43.8	46.7	49.7	52.7	55.7	58.7	61.7	64.8	67.9	71.1
27	19.4	22.4	25.5	28.5	31.6	34.7	37.7	40.8	43.9	47.1	50.2	53.4	56.6	59.8	63.1	66.4	69.7	73.1	76.5
28	20.7	24.0	27.3	30.5	33.8	37.1	40.4	43.7	47.1	50.4	53.8	57.2	60.7	64.2	67.7	71.2	74.8	78.4	82.1
29	22.1	25.6	29.1	32.6	36.1	39.6	43.2	46.8	50.3	53.9	57.6	61.2	64.9	68.6	72.4	76.2	80.0	83.9	87.8
30	23.5	27.2	31.0	34.7	38.5	42.3	46.1	49.9	53.7	57.6	61.4	65.3	69.3	73.3	77.3	81.4	85.5	89.6	93.8
31	25.0	28.9	32.9	36.9	40.9	45.0	49.0	53.1	57.2	61.3	65.4	69.6	73.8	78.1	82.4	86.7	91.1	95.5	100.0
32	26.4	30.7	34.9	39.2	43.5	47.8	52.1	56.4	60.7	65.1	69.5	74.0	78.5	83.0	87.6	92.2	96.9	101.6	106.4
33	28.0	32.5	37.0	41.5	46.1	50.6	55.2	59.8	64.4	69.1	73.8	78.5	83.3	88.1	92.9	97.9	102.8	107.8	112.9
34	29.6	34.3	39.1	43.9	48.7	53.6	58.4	63.3	68.2	73.2	78.1	83.2	88.2	93.3	98.5	103.7	109.0	114.3	119.7
35	31.2	36.2	41.3	46.4	51.5	56.6	61.7	66.9	72.1	77.4	82.6	87.9	93.3	98.7	104.2	109.7	115.3	120.9	126.7
36	32.8	38.2	43.6	48.9	54.3	59.7	65.2	70.6	76.1	81.7	87.2	92.9	98.5	104.3	110.0	115.9	121.8	127.8	133.8
37	34.6	40.2	45.9	51.5	57.2	62.9	68.7	74.4	80.2	86.1	92.0	97.9	103.9	110.0	116.1	122.2	128.5	134.8	141.2
38	36.3	42.3	48.2	54.2	60.2	66.2	72.3	78.3	84.5	90.6	96.8	103.1	109.4	115.8	122.2	128.8	135.3	142.0	148.7
39	38.1	44.4	50.6	56.9	63.2	69.6	76.0	82.4	88.8	95.3	101.8	108.4	115.1	121.8	128.6	135.4	142.4	149.4	156.5
40	39.9	46.5	53.1	59.7	66.4	73.0	79.7	86.5	93.2	100.1	107.0	113.9	120.9	127.9	135.1	142.3	149.6	157.0	164.4

TWO VARIABLE CUBIC FOOT LOOKUP VOLUME TABLE (continued)

DBH	MERCHANTABLE HEIGHT (FEET)																	
	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
5	3.6	3.7	3.9	4.0	4.1	4.2	4.3	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.9	5.0	5.1	5.2
6	4.9	5.1	5.3	5.4	5.6	5.7	5.9	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	7.5
7	6.4	6.7	6.9	7.1	7.3	7.6	7.8	8.0	8.2	8.4	8.7	8.9	9.1	9.3	9.5	9.8	10.0	10.2
8	8.2	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.1	12.4	12.7	13.0	13.3
9	10.1	10.4	10.8	11.2	11.6	12.0	12.4	12.7	13.1	13.5	13.9	14.3	14.7	15.1	15.6	16.0	16.4	16.8
10	12.2	12.7	13.1	13.6	14.1	14.6	15.0	15.5	16.0	16.5	17.0	17.5	18.1	18.6	19.1	19.6	20.2	20.7
11	14.5	15.1	15.7	16.2	16.8	17.4	18.0	18.6	19.2	19.8	20.4	21.1	21.7	22.3	23.0	23.7	24.3	25.0
12	17.1	17.7	18.4	19.1	19.8	20.5	21.2	22.0	22.7	23.4	24.2	24.9	25.7	26.5	27.2	28.0	28.9	29.7
13	19.8	20.6	21.4	22.2	23.1	23.9	24.7	25.6	26.4	27.3	28.2	29.1	30.0	30.9	31.9	32.8	33.8	34.8
14	22.8	23.7	24.6	25.6	26.5	27.5	28.5	29.5	30.5	31.5	32.5	33.6	34.6	35.7	36.8	37.9	39.1	40.2
15	25.9	27.0	28.1	29.2	30.3	31.4	32.5	33.7	34.8	36.0	37.2	38.4	39.6	40.9	42.1	43.4	44.7	46.1
16	29.3	30.5	31.7	33.0	34.2	35.5	36.8	38.1	39.4	40.8	42.1	43.5	44.9	46.4	47.8	49.3	50.8	52.3
17	32.8	34.2	35.6	37.0	38.4	39.9	41.4	42.8	44.3	45.9	47.4	49.0	50.6	52.2	53.9	55.5	57.2	59.0
18	36.6	38.2	39.7	41.3	42.9	44.5	46.2	47.8	49.5	51.3	53.0	54.8	56.6	58.4	60.2	62.1	64.1	66.0
19	40.6	42.3	44.1	45.8	47.6	49.4	51.3	53.1	55.0	56.9	58.9	60.9	62.9	64.9	67.0	69.1	71.3	73.4
20	44.8	46.7	48.6	50.6	52.6	54.6	56.6	58.7	60.8	62.9	65.1	67.3	69.5	71.8	74.1	76.4	78.8	81.3
21	49.2	51.3	53.4	55.6	57.8	60.0	62.3	64.5	66.9	69.2	71.6	74.0	76.5	79.0	81.6	84.1	86.8	89.5
22	53.8	56.1	58.5	60.8	63.2	65.7	68.1	70.7	73.2	75.8	78.4	81.1	83.8	86.6	89.4	92.2	95.1	98.1
23	58.6	61.1	63.7	66.3	68.9	71.6	74.3	77.0	79.8	82.7	85.5	88.5	91.4	94.5	97.5	100.7	103.8	107.1
24	63.6	66.4	69.2	72.0	74.9	77.8	80.7	83.7	86.8	89.8	93.0	96.2	99.4	102.7	106.1	109.5	112.9	116.5
25	68.9	71.8	74.9	77.9	81.1	84.2	87.4	90.7	94.0	97.3	100.7	104.2	107.7	111.3	114.9	118.7	122.4	126.3
26	74.3	77.5	80.8	84.1	87.5	90.9	94.4	97.9	101.5	105.1	108.8	112.5	116.4	120.2	124.2	128.2	132.3	136.4
27	79.9	83.4	86.9	90.5	94.2	97.8	101.6	105.4	109.2	113.2	117.1	121.2	125.3	129.5	133.8	138.1	142.5	147.0
28	85.8	89.5	93.3	97.2	101.1	105.1	109.1	113.2	117.3	121.5	125.8	130.2	134.6	139.1	143.7	148.4	153.1	158.0
29	91.8	95.8	99.9	104.1	108.3	112.5	116.8	121.2	125.7	130.2	134.8	139.5	144.3	149.1	154.0	159.0	164.1	169.3
30	98.1	102.4	106.7	111.2	115.7	120.2	124.9	129.6	134.3	139.2	144.1	149.1	154.2	159.4	164.7	170.1	175.5	181.1
31	104.5	109.1	113.8	118.5	123.3	128.2	133.1	138.2	143.3	148.4	153.7	159.1	164.5	170.1	175.7	181.4	187.3	193.2
32	111.2	116.1	121.1	126.1	131.2	136.4	141.7	147.0	152.5	158.0	163.6	169.3	175.1	181.1	187.1	193.2	199.4	205.8
33	118.1	123.3	128.6	134.0	139.4	144.9	150.5	156.2	162.0	167.9	173.9	179.9	186.1	192.4	198.8	205.3	212.0	218.7
34	125.2	130.7	136.3	142.0	147.8	153.7	159.6	165.7	171.8	178.0	184.4	190.8	197.4	204.1	210.9	217.8	224.9	232.0
35	132.5	138.3	144.3	150.3	156.4	162.6	169.0	175.4	181.9	188.5	195.2	202.1	209.0	216.1	223.3	230.7	238.1	245.8
36	140.0	146.2	152.5	158.8	165.3	171.9	178.6	185.4	192.3	199.3	206.4	213.6	221.0	228.5	236.1	243.9	251.8	259.9
37	147.7	154.2	160.9	167.6	174.5	181.4	188.5	195.6	202.9	210.3	217.8	225.5	233.3	241.2	249.3	257.5	265.9	274.4
38	155.6	162.5	169.5	176.6	183.8	191.2	198.6	206.2	213.9	221.7	229.6	237.7	245.9	254.3	262.8	271.5	280.3	289.3
39	163.7	171.0	178.4	185.9	193.5	201.2	209.0	217.0	225.1	233.3	241.7	250.2	258.9	267.7	276.7	285.8	295.1	304.6
40	172.0	179.7	187.5	195.3	203.3	211.5	219.7	228.1	236.6	245.3	254.1	263.1	272.2	281.4	290.9	300.5	310.3	320.2

Appendix 7. 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	Stand 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	Latitude / Longitude displayed in Degrees and minutes. Use English units (miles, feet, mph)
L/L-dm. English	Elevation above Mean Sea Level in feet .
ELev : feet MSL	Azimuths in Degrees from Magnetic north
ANGL : Deg Mag ⇅ P	

Move on to the next page when the page appears as above.

The next page is:

	Explanation
SETUP MAGVAR	Magnetic Variation is
TYPE : Calc deg	Calculated by the system in degrees
WMM 1995	
	⇅ P

Set the page as shown above. Next, page-down to the next menu page.

	Explanation
SETUP	Auto- calculates when to hold elevation constant
ELHold : automatic	Time display in "Zulu" time
TIME : Zulu	⇅ P Error displayed as plus or minus in feet
ERR : +/- ft	

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	

1The 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.

SETUP I/O	Explanation
SERIAL : Standard	Input/out parameters for the serial port.
HAVEQUICK : Off	However, we will not use it.
1PPS : Off	⇕ P

This page should already be as shown, if not please make the appropriate changes and continue on to the next page.

SETUP AUTOMARK	Explanation
MODE : off WP000	This option would automatically take a point at a specified time or interval in time. However, it should be set to off.
##-##-## #####Z	⇕ P
REPEAT 0000	

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 SVs (Satellite Vehicles). 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:

<u>Action</u>	<u>KEY #</u>
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:

<u>Action</u>	<u>KEY #</u>	<u>Screen</u>	
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:

<u>Action</u>	<u>KEY #</u>	<u>Screen</u>	<u>Menu Explanation</u>
Display Setup Menu	Keys 6,5	SETUP MODE: FIX Quick POS fix, then STBY SV-Type: all Y ⇕ P	Obtains a quick fix of position, then goes to stand-by mode, and eventually turns off Track only Y-code signals

Change the Mode to the Continuous Mode:

<u>Action</u>	<u>KEY #</u>	<u>Screen</u>	<u>Menu Explanation</u>
Change Mode	Keys 6,2	SETUP MODE: CONT	Calculates its position

to **(CONT)**inuous

Continuous POS
and VEL update

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:

	<u>Menu Explanation</u>
SETUP MODE: AVG	The AVERAGING 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.

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 "Pluggger" 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 "Pluggger" 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
SINGGARS	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.

Appendix 8 Number of trees required to achieve 50% stocking, by diameter

Table Number of Trees Required for 50 % stocking¹, by DBH Class

DBH Class ²		Size of Area				
Inches	Centimeters	1 Acre	1/24 Acre	Number Trees/Subplot ³	1 Hectare	1/60 Hectare
Seedlings		300	13	3	743	13
2	5	280	12	2.4	694	12
4	10	230	10	2	570	10
6	15	170	7	1.4	421	7
8	20	120	5	1	297	5
10	25	78	3	3/5	193	3
12	30	58	2	2/5	144	2
14	35	45	2	2/5	111	2
16	40	36	2	2/5	89	2
18	45	30	1	1/5	74	1
20	50	26	1	1/5	64	1

¹ 10% stocking can be obtained by dividing tree counts by 5.

² Seedlings, 2 inch, and 4 inch trees occurring in clumps are counted as 1.

³ This column is for 10% stocked

Appendix 9. List of specific instructions on remeasurement by States

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 remeasured, 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, %Rotten/missing (ROTT), Total Length (THGT) and Board Foot Cull (CULB) 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. When recording the boundary data use appropriate code in "boundary change(CHNG) field to indicate what happened.

List of data items collected on trees by tree status and subplot number for Indiana (any state where the new 4 point plot has been installed and is being remeasured).

Tree Data Items	Tree Status Codes												OLD SUBPLOTS 101-105 AND 112-115	
	NEW SUBPLOTS 1-4 dbh < 5.0"		NEW SUBPLOTS 1-4 dbh μ 5.0"		OLD SUBPLOTS 1-4**** dbh < 5.0"		OLD SUPLOTS 1-4* dbh μ 5.0"							
	1		1	2	1	2	1	2	3	4	5	6		7
	X		X	X			X	X	X	X	X	X	X	Not recorded in Indiana
Sub#	X		X	X			X	X	X	X	X	X	X	
Tree#	X		X	X			X	X	X	X	X	X	X	
TYPE	X		X	X			X	X	X	X	X	X	X	
DIST	X		X	X			X	X	Z	X	X	X	Z	
DBH	X		X	X			X	X	Z	X	X	X		
DIAH	X		X	X			X	X		X	X	X		
DCHE	X		X	X			X	X		X	X	X		
SPP	X		X	X			X	X	X	X	X	X	Z	
LEAN	X		X	X			X	X		X	X	X		
TCC/DEC	X		X	X			X	X		X	X	X		
STAT	X		X	X			X	X	X	X	X	X	X	
UTIL	X		X				X		X	X				
DECA				X				X			X	X		
CCR			X				X			X				
CCC			X				X			X				
AZM	X		X	X			X	X	Z	X	X	X	Z	
CON#	X		X	X			X	X	X	X	X	X	X	
THGT			X				X	W		X				
ACTU			X	X			X	X		X	X	X		
METH			X	X			X	X		X	X	X		
TRGD			X				X			X				
ROTT			X				X	W		X				
CAUS				X				X	X		X	X		
MOYR								X						
LOC123	X		X				X			X				
DAM123	X		X				X			X				
SEV123	X		X				X			X				
NCD123	X		X				X			X				

* Only the State of Indiana for Oct 1, 1999 – September 30, 2000 See special notes in appendix 9
 ** Tree status codes of 4,5 and 6 are not used on any of the old 10 point subplots.
 **** No old microplots on subplots 1-4 will be remeasured at this time.
 X = record this data for tree status and subplot listed
 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)

Iowa, Wisconsin, Michigan -

Trees:

All old trees with past dbh 5.0" or larger will be remeasured on subplots 101-105. On subplots 101-103 all old trees with past dbh 1.0" to 4.9" will be remeasured 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 NC sample kind is 10.

Conditions:

All old conditions on the 10 point plot will be redefined as new on the 4 point plot.

Boundary:

All old mapping of the 10 point plot will be remapped as new on the 4 point plot.

Subplots that were rotated:

In the last cycle subplots were removed from their rotated positions and all subplots 101-105 should be in the true 10 point positions.

Minnesota –

Trees:

If the last measure was cycle 5-11 all old trees with a past dbh 5.0” or larger will be remeasured on subplots 101-105 and 112-115. On subplots 101-103,112 and 113 all old trees with a past dbh 1.0” to 4.9” will be remeasured.

NC Damage Agent codes will be specific to Mn. Use the following NCD1,2,3 codes for MN:

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
200	Foliage Diseases	All species
210	Shoot Blights	All Species
212	<i>Scleroderris</i>	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	<i>Eutypella</i> Canker	Maple
252	<i>Hyoxylon</i> Canker	Aspens
254	<i>Nectria</i> Canker	Hardwoods
257	Butternut Canker	Butternut
260	Stem Decay (heartrot)	All species
261	<i>Phellinus pini</i>	Conifers
262	<i>Phellinus tremulae</i>	Aspens
263	<i>Inonotus obliquus</i>	Birches
271	Ash Yellows	Ashes
281	Dutch Elm Disease	Elms
282	Oak Wilt	Oaks
290	Root/Butt Rot	All species
291	<i>Annosus</i> Root Rot	Conifers
292	<i>Armillaria</i> 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

CODE	DAMAGE OR DEATH	HOSTS
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

Conditions:

All old conditions on the 10 point plot will be redefined as new on the 4 point plot.

Boundary:

All old mapping of the 10 point plot will be remapped as new on the 4 point plot.

Subplots that were rotated:

At one time subplots were rotated to a new position and then in a latter survey were unrotated. If this occurred on the plot then both locations will be remeasured. If the data includes any subplot numbers 112-115 this has occurred. Treat these subplots as you would subplots 101-105.

Appendix 10 Tolerance limits on data items

	Tolerance	Collected on Forest STAT=1	Collected on Nonforest STAT=2-7
	Level		
PLOT LOCATION			
Plot in wrong location	None		
Subplot in wrong location	+/- 10'		
PLOT LEVEL VARIABLES			
State	None	x	x
NC Unit	None	x	x
County	None	x	x
Number	None	x	x
Sample kind	None	x	x
NC Sample kind	None	x	x
Year	None	x	x
Month	None	x	x
Day	None	x	x
GPS Lat	+/- 65'	x	X (except stat 5,6,7)
GPS Long	+/- 65'	x	X (except stat 5,6,7)
GPS Elevation	+/- 200'	x	X (except stat 5,6,7)
Trails or Roads	+/- 1 class	x	
Horizontal Distance to improved Road	+/- 1 class	x	
Public Use Restrictions	1 of 2 correct	x	
Recreation Use	2 of 3 correct	x	
Water on plot	None	x	
<hr/>			
	Tolerance	Forest	Nonforest
CONDITION LEVEL VARIABLES			
Condition Class Number	None	x	x
Condition Status	None	x	x
NC Ground land use	None	x	x
Forest type	None	x	
Stand-size class	None	x	
Stand origin	None	x	
Stand origin species	None	x	
Reserve status	None	x	x
Tree density	None	x	
Owner Group	None	x	x
Owner class	None	x	
NC owner acres	None	x	
Private owner industrial status	None	x	
Stand age	+/- 10%	x	
Physiographic class	None	x	

	Disturbance1	None	x	
	Disturbance year 1	+/- 5 years	x	
	Disturbance2	None	x	
	Disturbance year 2	+/- 5 years	x	
	Disturbance3	None	x	
		Tolerance	Forest	Nonforest
	Disturbance year 3	+/- 5 years	x	
	Treatment 1	None	x	
	Treatment year 1	+/- 5 years	x	
	Treatment 2	None	x	
	Treatment year 2	+/- 5 years	x	
	Treatment 3	None	x	
	Treatment year 3	+/- 5 years	x	
	Past nonforest/inaccessible land use	None	x	
	Present nonforest/inaccessible land use	None	x	x
<hr/>				
Boundary				
	Plot type	None	x	
	Boundary change	None	x	
	Contrasting condition	None	x	
	Left azimuth	+/- 15 ⁰	x	
	Right azimuth	+/- 15 ⁰	x	
	Corner azimuth	+/- 15 ⁰	x	
	Corner distance	+/- 1'	x	
<hr/>				
Subplot	(Count on 4 new subplots)			
	Record present for all subplots	None	x	x
	Subplot center condition	None	x	x
	Microplot center condition	None	x	
	Percent slope	+/- 10%	x	
	Aspect	+/- 10 ⁰	x	
<hr/>				
Tree/sapling				
	NC Plot Type	None	x	
	Subplot/Tree record number	None	x	
	Condition class	None	x	
	Horizontal distance			
	Trees	+/- 1'	x	
	Saplings	+/- 0.2'	x	
	Azimuth	+/- 10 ⁰	x	
	Species	None	x	
	Diameter at breast height	+/- 0.1"	x	
	Diameter check	None	x	
	Height to diameter	+/- 0.3'	x	
	NC tree class	None	x	
	Tree status	None	x	

Crown class	None	x	
Compacted crow ratio	+/- 10%	x	
Lean angle	None	x	
Percent rotten/missing cull	+/- 10%	x	
Total length	+/- 10%	x	
Actual length	+/- 10%	x	
Length method	None	x	
Damage location 1	+/- one class	x	
Damage type 1	None	x	
	Tolerance	Forest	Nonforest
Damage severity 1	None	x	
Damage agent	None	x	
Damage location 2	+/- one class	x	
Damage type 2	None	x	
Damage severity 2	None	x	
Damage agent	None	x	
Damage location 3	+/- one class	x	
Damage type 3	None	x	
Damage severity 3	None	x	
Damage agent	None	x	
Cause of death	None	x	
Decay class	+/- 1 class	x	
Utilization class	None	x	
Damage agent (MO only)	None	x	
NC tree grade	None	x	
<hr/>			
Missed Trees (total number)		x	
Saplings	+/- 1	x	
Live >4.9"	+/- 1	x	
Dead > 4.9"	+/- 1	x	
<hr/>			
Seedling			
# Subplot Seedling records	None	x	
Species	None	x	
Condition class	None	x	
Seedling count			
1-10	None	x	
>10	+/- 5	x	
<hr/>			
Site tree			
Subplot number	None	x	
Species	None	x	
Diameter	+/- 0.1"	x	
Site tree length	+/- 10%	x	
Tree age at diameter	+/- 15%	x	
Distance/Azimuth	+/-5' & 15°	x	
Condition class list	None	x	
<hr/>			

Starting Point Information			
SP tree DBH	+/- 0.1"	x	x
SP Description		x	x
SP Lat	+/- 65'	x	x
SP Long	+/- 65'	x	x
Map (road names,north arrow,pc,sp,disances)	None	x	x
<hr/>			
Course to plot			
Distance	+/- 15'	x	x
Azimuth	+/- 5 ⁰	x	x
<hr/>			
	Tolerance	Forest	Nonforest
Witness Tree Information			
Subplot number	None	x	
Species	None	x	
DBH	+/- 0.1"	x	
Distance	+/- 0.3'	x	
Azimuth	+/- 10 ⁰	x	
Mark	None	x	
<hr/>			
Photo Work			
Baseline	None	x	x
SP tree Pin Pricked	None	x	x
<hr/>			
Owner			
Name	None	x	*
Address	None	x	*
<hr/>			

* If owner name and address was found record in the same way forested plots are.

Appendix 11 How To Collect Ownership Information

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

All conditions where the Condition Status is 1 need the following data recorded on the plot sheet and in some electronic form.

Owner contact : Indicate on plot sheet if personal contact with the landowner was made while gaining permission to measure the plot.

Owner name: Full name of land owner.

Owner address: street address is written on the plot sheet and then entered into some electronic form. Ownership Group. Street addresses are not needed for ownership classes 11 –13 & 21-25, or 31 (State).

NOTE: For large Forest Industry** please use the address from the State Forest Industries Directory if available. If the Directory is not available please locate address as mentioned earlier in this section.

** Large Forest Industry is any company on the list of large forest industries provided at the start of the state inventory. This list may not be available in all states.

Appendix 12 Data Recorder

Changes Made to the Data Recorder Program

(Now Called NatField)

- NatField is written in the C programming language.
- Each state has its own legals and prompts file. When loading the program onto the Husky, be sure to load the legals and prompts files for the state you will be working in. Pages 153 and 154 have instructions on how to load the program.
- When the program starts the user needs to enter the state code that he/she will be working in. This state code can be changed from the Main Menu using the F1 Current State option.
- If changes have been made to the data, then the program will force the user to completely edit the data before the plot can be saved. When the user selects Save Plot from the Plot Menu, the program will automatically initiate the plot editing routine if changes have been made to the data since the last save. In order to save the data, the editing routine must completely edit the plot returning you to the Plot Menu, at which time you can select Save Plot again to save the data.
- There is ##% in the upper right hand corner of the data entry menus, this is the % power remaining on the batteries. Husky's power management doesn't seem to work very well so this is only an approximation.
- There are two screens of data for the condition and tree menus. The up, down, left and right arrows allow you to move between the two screens of data fields.
- The procedure for downloading plots from the PC to the Husky using Datacomm has changed. The following pages have the new procedure listed in detail.

Quick Load Instructions for NatField Components

Distribution Products

FS/2 Components

- 1) Autoexec.bat
- 2) Cdisk.sys
- 3) Config.drv
- 4) Config.ndr
- 5) Config.sys
- 6) Hcs.com
- 7) Hook611.com
- 8) Start.bat
- 9) Legals.(IA, IL, IN, KS, MI, MO, MN, ND, NE, SD, WI)
- 10) NatField.exe
- 11) Prompts.(IA, IL, IN, KS, MI, MO, MN, ND, NE, SD, WI)

Laptop Components - (NatDatacomm)

- 1) cmdhcom.cfg
- 2) cmdhcom.exe
- 3) cmdhcom.log
- 4) NatDatacomm.exe
- 5) Wordpad.exe

FS/2 Program Load Instructions (Loading from a Floppy Disk)

For First Time Installation

- 1) Download all the files and plots on the FS/2 that you want to keep.
- 2) At the DOS prompt type *util* then enter. This will start Husky's *Field System Utility*.
- 3) Use the right or left arrow keys to position the highlighted line over *Format Fixed Disk* and hit enter. This will start the *Format Fixed Disk* utility.
- 4) Use the up or down arrows to change the *no* to *yes* and hit enter.
- 5) Make sure the *Amount of memory for DOS:* is set to *640*. Use the up or down arrows to change this value. Also make sure the *Amount of memory for EMS:* is set to *0* and *Use BIOS ram block:* is *no*. When all the settings are ok, hit enter.
- 6) The FS/2 should tell you that the format was successful, then press any key to continue.
- 7) Reboot the Husky.
- 8) Move to the root directory by typing *cd * then hit enter.
- 9) Create a directory for the program to reside in by typing *mkdir c* then hit enter.
- 10) On the Husky start Hcom by typing *hcom* then enter.
- 11) Connect your Husky to a PC and start Hcom on your PC.

12) After the machines have made a connection, change the Hcom drive on the PC by typing **L** then **A** and enter. This makes the active drive on the PC the A: drive - be sure to have a NatField Distribution disk in the floppy drive.

13) In Hcom on the PC, under **Local PC**, select the following files:

- 1) Autoexec.bat
- 2) Cdisk.sys
- 3) Config.driv
- 4) Config.ndr
- 5) Config.sys
- 6) Hcs.com
- 7) Hook611.com
- 8) Start.bat

Use the up and down arrows and enter key to select and deselect files.

14) After the files are selected type **T** to transfer the tagged files.

::NOTE - If you already have copy of the program loaded on the machine, such as when you are loading a program revision, you should not need to reformat the hard disk and load the distribution files, you should be able to go directly to the next step, **Load Program**.

Load Program

1) While still connected to the PC, see steps 10-12 from above, use the right or left arrow to move the highlighted line to the **Remote Husky** panel in Hcom.

2) Move the highlight line to C <DIR> and hit enter.

3) Use the right or left arrow keys to move the highlight line back to the **Local PC** panel in Hcom.

4) Unmark any files selected in steps 1-14 under For **First Time Installation**.

5) Mark the following files:

- 1) Legals.(IA, IL, IN, KS, MI, MO, MN, ND, NE, SD, WI)
- 2) NatField.exe
- 3) Prompts.(IA, IL, IN, KS, MI, MO, MN, ND, NE, SD, WI)

Use the up and down arrows and enter key to select and deselect files.

6) After the files are selected type **T** to transfer the tagged files.

7) After all the files have been loaded onto the Husky you **MUST REBOOT THE HUSKY**. Husky's patch file **Hook611.com** starts when the system is rebooted and this patch must be running for the program to work correctly.

:: NOTE - The files must be loaded in the correct directories for the program to work correctly.

NatDatacomm

Datacomm Changes for National Program

There is a new version of Datacomm, called NatDatacomm.exe, for the new data recorder program, NatField.exe. There is only one change in the data communications procedures for the national survey. This change allows the user to download more than one file at a time from the PC to the FS/2. Below are the quick instructions detailing the new download procedure.

Quick Instructions for Downloading Files from the PC to FS/2

- 1) Connect the PC to the FS/2 with a file transfer cable.
- 2) Start *NatDatacomm* on the PC.
- 3) From the main menu on the FS/2, select option **4. Receive Plot**.
- 4) At the prompt, "**Do you wish to use the RAM Cartridge, HCOM, or Datacomm?**", select option **3, Datacomm**.
- 5) On the PC, select option **2. Send Files**, from the main menu of NatDatacomm. The NatDatacomm will generate a plot list of available plots on *A:\Plots*.
- 6) NatDatacomm will then prompt:

File not found

Enter T to transfer the plot list to the Husky.

Enter Q to quit.

::NOTE - The "File not found" is a bookkeeping message and should be ignored.

- 7) Select **T** to send the plot list to the Husky.
- 8) After the plot list is loaded onto the Husky, press **esc** on the FS/2 to view the plot list.
- 9) Press Husky key **FI** to select a plot to load on the Husky from the PC *A:\Plots* directory. You can select more than one plot.
- 10) When you have selected all the plots you want to load onto the Husky, press the **Husky PAW(*) key** to download the data.
- 11) The FS/2 will prompt:

Continue to copy these files onto Husky?

Plot list...
- 12) Type **Y** to proceed and **N** to cancel.
- 13) If you've selected yes then press **S** on the PC to initiate the file transfer.

Record Formats

Plot Data

Menu Number (1)
Point Number (0)
Record Number (0)
State Code
Unit Code
County Code
New Plot #
Cycle Number
Sub Cycle
Sample Kind
NC Sample Kind
Cruiser
Tallier
Water Type
Road Type
Road Distance
Restrictions
Recreation Use
Month
Day
Year
Measurement Type
Original Year
Version Control Number
Db Cycle Number
Db Sub Cycle

LatLong Data

Menu Number (7)
Point Number (0)
Record Number (0)
Latitude
Longitude
Elevation
GPS Unit #
Office Latitude
Office Longitude
Previous Latitude
Previous Longitude

Condition Data

Menu Number (6)
Point Number (0)
Record Number
Condition #
NC Land Use
Condition Status
Reserve Status
Physiographic
Stand Origin
Stand Origin Species
Forest Type
Stand Size
Stand Age
Tree Density
Owner Group
Owner Class
NC Private Area
Industrial Status
Current Land Use
Previous Land Use
Disturbance 1
Disturbance Year 1
Disturbance 2
Disturbance Year 2
Disturbance 3
Disturbance Year 3
Treatment 1
Treatment Year 1
Treatment 2
Treatment Year 2
Treatment 3
Treatment Year 3

Seedling Data

Menu Number (2)
Point Number
Record Number
Species
Seedling Count
Condition #

Point Data

Menu Number (8)
Point Number
Record number (0)
Subplot Center Condition
Microplot Center Condition
Slope
Aspect

Boundary Data

Menu Number (4)
Point Number
Record Number
Contrasting Condition
Plot Type
Percent Area
Left Azimuth
Right Azimuth
Corner Azimuth
Corner Distance
Boundary Change

Site Tree Data

Menu Number (5)
Point Number (0)
Record Number
Tree #
Diameter
Species
Height
Tree Age
Subplot #
Distance
Azimuth
Condition List
Database Subplot Number
Database Tree #
Database Distance
Database Azimuth
Database Species

Tree Data

Menu Number (3)
Point Number
Record Number
Tree #
NC Plot Type
Distance
Diameter
Height to Diameter
Diameter Check
Species
Lean Angle
NC Current Tree Class
Tree Status
Utility Class
Decay Class
Crown Ratio
Crown Class
Azimuth
Condition #
Total Height
Actual Height
Height Method
NC Tree Grade
Rotten Cull
BdFt Cull
NC Original Tree Class
NC Original DBH
Cause Of Death
Damage Location 1
Damage Type 1
Damage Severity 1
NC Damage 1
Damage Location 2
Damage Type 2
Damage Severity 2
NC Damage 2
Damage Location 3
Damage Type 3
Damage Severity 3
NC Damage 3
Database Tree #
Database Species
Next Consecutive Number
Database Distance
Database Azimuth

Tree Data (MO Only)

Menu Number (3)
Point Number
Record Number
Tree #
NC Plot Type
Distance
Diameter
Height To Diameter
Diameter Check
Species
Lean Angle
NC Current Tree Class
Tree Status
Utility Class
Decay Class
Crown Ratio
Crown Class
Azimuth
Condition #
Total Height
Actual Height
Height Method
NC Tree Grade
Rotten Cull
BdFt Cull
NC Original Tree Class
NC Original DBH
Cause Of Death
MO Damage Agents
Damage Location 1
Damage Type 1
Damage Severity 1
NC Damage 1
Damage Location 2
Damage Type 2
Damage Severity 2
NC Damage 2
Damage Location 3
Damage Type 3
Damage Severity 3
NC Damage 3
Database Tree #
Database Species
Next Consecutive Number
Database Distance
Database Azimuth

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 if 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, in which 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 *Runtime error 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 free 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 the batteries 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 Program Bombs 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

List of tatum guides

Plot and condition tatum (2 pages)

Tree tatum

Tatum #2 – Slope corrections, tree grade

Tatum #3 – More tree grade

Tatum #4 – Sweep and Crook tables (2 pages)

Tatum #5 – Cubic foot volume