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Introduction

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

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

> "Anyone who establishes a permanent plot should recognize that he or she hereby assumes responsibility for furnishing workers with a complete picture of conditions on the plot at the time of its establishment. Not only must each plot be properly marked and all measures be in near perfect order, but all notes and records must be complete. Otherwise, the plots may fail to yield the desired results and those who in later years become responsible for their care and for the analysis of the data, may be led to serious mistakes."
>
> (US. Department of Agriculture, Forest Service 1935)

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

Field Equipment

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

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

Overview Of The Plot Designs

Starting in 1996 a different field plot design was instituted. This new design is being adopted by FIA nationwide in an effort to establish a uniform system across the country. In order to institute this change, and to be able to obtain information about tree growth, field measurements will consist of two parts, 1) the remeasurement of 5 points of the old variable radius plot that was measured in the previous inventory (a cluster of 10, 37.5 BAF variable radius subplots) and 2) the establishment of the new standard plot (a cluster of 4, 1/24th acre fixed radius subplots). These two plots will be measured at the same ground location by a single field crew, on a single visit. In 1998 FIA started implementing annual inventories. In addition to measuring plots annually, this inventory design overlays a systematic grid of hexagons across the North Central region. Within each approximately 5937 acre hexagon one plot is selected for measurement. Photo interpreters will ensure that each selected plot is located in the correct hexagonl. If the plot is outside the hex the old 10-point plot will be remeasured at its current location (this plot will have a sample kind = 10) and a new standard plot will be established at hex center (this plot will have a sample kind = 7). Trees tallied on the new standard plot will be permanently marked with paint (except in reserved areas). Blue paint will be used to mark all trees tallied on the new standard plot, trees remeasured on the old variable radius plot will not be repainted. A brief overview of these two plot designs follows.

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 1 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 1, 2 and 3 in IL and IN and at 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-fore s not apply for these plots. Instead refer to the plot sheets for subplot l

The pattern of the old variable radius plo ain a uniform distribution of subplots over approximately one acre of between sequential subplot centers is 70 horizontal feet. (fig. 1).

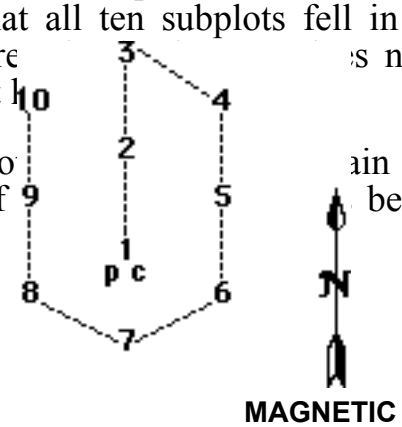


Figure 1. Old variable radius plot layout.

From subplot center	70' to subplot center	Azimuth
1	2	0°
2	3	0°
3	4	120°
4	5	180°
5	6	180°
6	7	240°
7	8	300°

8	9	0º
9	10	0º

After subplot center 1 has been relocated, establish, locate, and mark 1-5 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 4 & 5). Previously rotated subplots (1-5) will be remeasured in their rotated locations. No additional rotating or unrotating will be done.

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. 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 centered at the same points (6.8 ft (2.07 m) radius). Seedlings, saplings, and other vegetation 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 21-24 and the old 10-point subplots will be numbered 1-10.

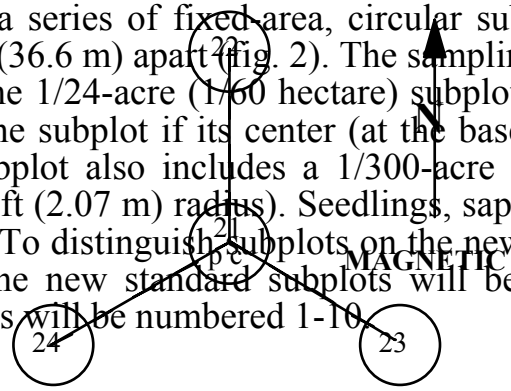


Figure 2. New standard plot layout.

From subplot center	120' to subplot center	Azimuth
21	22	0°
21	23	120°
21	24	240°

Plot record

A number of data items are collected or assigned for plot center, that is, they are only collected once for any plot. These data items apply to both the new standard plot and the old variable radius plot because they share the same plot center. In general, items in the plot record identify the plot, help to locate the plot, or describe some attribute of plot center. These data items are:

Cycle **
Panel number **
State *
Unit *
County *
New plot number *
Old plot number *
Dot number **
Sample kind *
PI land use **
Cruiser code
Tallier code
County name *
Type of closest water *
Township *
Range *
Section *
Subdivision *
Office - Photo number *
Office - Photo scale *
Plot center GPS Latitude
Plot center GPS Longitude
Starting point description
Direction to first subplot
Distance to first subplot
First subplot number
Data recorder
Cruiser name

Area of closest water *	Tallier name
Distance from closest water *	Date
Type of closest road *	Owner name
Distance from closest road *	Owner address
National Forest *	Owner contact
Ranger district *	Hexagon **
Original date *	Hex Latitude **
Current date	Hex Longitude **
Stradler PI indicator **	FHM plot **

* These data items are collected or assigned in the office and only verified in the field.
** Entered in office, do not change.

Condition data

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

1) It can be identified by a change in land use, forest type, stand size class, or stand origin, stand history, and
2) It is at least one acre in size, and
3) It is at least 120 ft in width (except in the case of rights of way, wooded strips, narrow windbreaks, shelter belts, linear water features and urban and other)

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

Data items are grouped into records for data entry purposes. The group of data items that directly describe a condition make up the Condition Record. The group of data items that describe the location of a condition or the border between two conditions make up the Subplot Record. The Tree Record is made up of data items collected on trees and the Shrub Record is made up of data items collected on shrubs. Trees and shrubs are measured within conditions. Also, a special Site Tree Record is used to record the information needed to compute the site index of a condition from the site tree measurements. The data items contained in each of these records are listed below with complete descriptions in later sections of this manual.

Condition record

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

Condition number (CON#)	Stand origin (SORI)
Original ground land (plot sheet only)	Stand history (SHIS)

Current ground land use (GLUC)
Reason for land use change (REAS)
Aspect (ASP)
Slope percent (SLP)
Physiographic class (PHYS)
Forest type-stand size class (FTS)
Stand age (AGE)
Site index (SI)
Site index species (SISP)
Ownership class (OWNC)

Any of these data items may be different from one condition to the next. A condition boundary must involve a change in one or more of the following variables: land use, stand origin, stand history, forest type, or stand size class. A condition needs to be at least one acre in size and at least 120 feet wide (except in the case of rights-of-way, linear water features, wooded strips, narrow windbreaks, shelterbelts and urban and other).

Subplot record

The data items in the subplot record identify and map the conditions that occur on each subplot. There will be at least 4 subplot records for every completed plot and an additional 5 subplot records if it is a remeasured plot and not a sample kind of 8. The first subplot record for a subplot corresponds to the condition present at subplot center. Whenever the boundary between any two conditions clearly cuts through the area defined by a 24 ft radius circle around any subplot center, an additional subplot record must be recorded for that subplot. This additional subplot record identifies the additional condition and locates its boundary. If two adjacent subplots are in different conditions and the boundary between these two conditions does not clearly cut through the 24 ft circle it will be assumed that the boundary occurs between the two subplots. When only one subplot record is entered for a subplot it is assumed that the entire subplot is within the condition identified at subplot center. The data items that make up the subplot record are:

Subplot number (SUB#)
Condition number (CON#)
Percent of subplot area (%ARE)
Cover class (COVC)
Azimuth left (AZML)
Azimuth right (AZMR)
Azimuth corner (AZMC)
Distance corner (DISC)

Shrub record - (not starting until May 1999)

The data items in the shrub records describe the shrubs that are measured. Shrubs are measured (only from May 1 to September 30 Starting May of 1999) in the NE quadrant of the micro plots only on new subplots (21-24) on plots designated FHM plots. The data items in the shrub record are:

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

Tree record

The data items in the tree records describe the trees that are measured. Trees < 5.0 inches DBH are measured on a micro plot (6.8 ft. fixed radius at base of tree-horizontal distance) trees 5.0 and larger inches are measured on either the 1/24th acre fixed radius plot (new subplots) or the variable radius (37.5 BAF) plot (old subplots). The data items in the tree record are:

Subplot number (SUB#)
Tree number (TR#)*
Distance (DIST)
DBH original (DBHO)
DBH current (DBHC)
Species (SPP)
Damage/cause of death (DAM)
Tree class original (TCO)
Tree class current (TCC)
Tree history (THIS)
Crown ratio original (CRO)
Crown ratio current (CRC)
Crown class original (CCO)
Crown class current (CCC)
Azimuth (AZM)
Condition number (CON#)
Tree cavity/Number of seedlings (TCAV)
Tree grade (TGRD) subplots 21-24 only
Total tree height (THGT) subplot 21 only

* Do not change.

Site tree record

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

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

Field Procedures

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

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

Plot numbers identify sample plot locations on aerial photographs. The 10 digit plot number is recorded by the photo interpreters. A new plot sheet is completed for all plots sent to the field offices.

For each plot, field crews receive new plot sheets and aerial photographs, with the sample location marked. A remeasurement plot also includes the copies of original plot sheets or the printout of the scanned original plot sheet and aerial photographs if found. Use the location of plots on old photos rather than new photos if the locations differ. For remeasurement plots,

check that the plot number on the original plot sheet matches the "Old plot number" on the new plot sheet.

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

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

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

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

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 sample kind 10. The new standard plot (21-24) will be installed at hexagon center as a sample kind 7 with a new plot number. Use the location on the photo as location for GPS reading for the plot.

Monumentation

It is important to be able to relocate plots, subplots, and trees measured during the inventory. The following instructions, along with detailed but concise sketches and notes, will make subsequent relocation easier. Plot sheets are now being scanned and stored in a data base so please use dark black lines to produce sketch maps . In well-traveled areas, on private lands, and especially in reserved areas less visible field markings are appropriate.

Starting point tree

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 otherwize. 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.

Subplot center

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, 1 - 5 and 21-24.

Subplot witness trees

Designate a witnessed subplot on all established plots. Use Plot Center (subplot 21) 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 22, 23, or 24 can be used to witness when subplot 21 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 <u>above</u> 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.

Subplot reference trees

On many plots, certain subplots within the plot lack information useful in determining their location on future surveys. Examples of this are cover classed subplots, 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.

Sample trees

Most sample trees are scribed and painted to mark the location of the DBH measurement. **Note that subplots 21-24 are handled differently than subplots 1-5.**

For subplots 21-24, scribe and paint a **blue** 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 1-5, 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 Diameter Height (DIAH).

Plot Record: Items 2-5, 68-73, kind codes and their descriptions.

Sample Kind: Item 2

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

Code	Sample kind
0	Lost (can't be relocated) or denied access plot.
1	Full New Measurement. Install and measure a new standard plot (subplots 21-24). Also, on subplot 21 only, measure total tree height (item 74) if leaves are off deciduous trees.
2	Full Remeasurement Relocate. Measure all old trees on the old subplots 1-5. Install and measure a new standard plot (subplots 21-24). Take total tree height measurements as in Sample Kind #1.
6	Partial Remeasurement Relocate. Measure all old trees on the old subplots 1-5. Install and measure a new standard plot (subplots 21-24). Total tree heights (item 74) are not measured.
7	Partial New Measurement. Install and measure a new standard plot (subplots 21-24). Total tree heights (item 74) are not measured.
8	Partial Remeasurement Relocated. Measure a new standard plot (subplots 21-24). Do not measure old plot just use old plot information to locate subplot 21 and start with a new plot. Total tree heights (item 74) are not measured.
10	Partial Remeasurement Relocate. Measure all old trees on subplots 1-5 **do not** install a new standard plot. Total tree heights(item 74) are not measured.

Note: for sample kind 2, 6 and 10 previous inventory data should be uploaded to the data recorder prior to going to the field. See auxiliary manuals for upload instructions.

Plot Location: Item 3

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.

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.

Azimuth and Distance Computation

On the back of the photograph, connect the pinpricks for the starting point and plot center with a straight line. Extend this line to intersect the baseline. Lines should extend well beyond the intersection to allow reading the backsight off the 360-degree protractor to check the accuracy of the angle being measured.

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

Be sure to use an inverted 360^0 protractor or flip a standard 360^0 protractor over. Align the 360-degree protractor over the azimuth of the baseline to get the azimuth of the sample location line. The azimuth is read directly off the protractor once the azimuth of the baseline is correctly aligned on the inverted protractor. This is because east-west azimuths are reversed 180 degrees when working on the back of the photographs. Repeat this procedure if an additional line (reference line) is needed to intersect the course to sample location. To minimize error, check the backsights of both base and course to sample location lines. This is a check to see if the protractor is precisely aligned.

Important: E photo with standard protractor. Inv

Refer to Figu ng point (SP) to the plot center (P scale. (Photo scales, corresponding up to the light and carefully mea other. (Sometimes it helps to use y irection on the back of the photogr l".

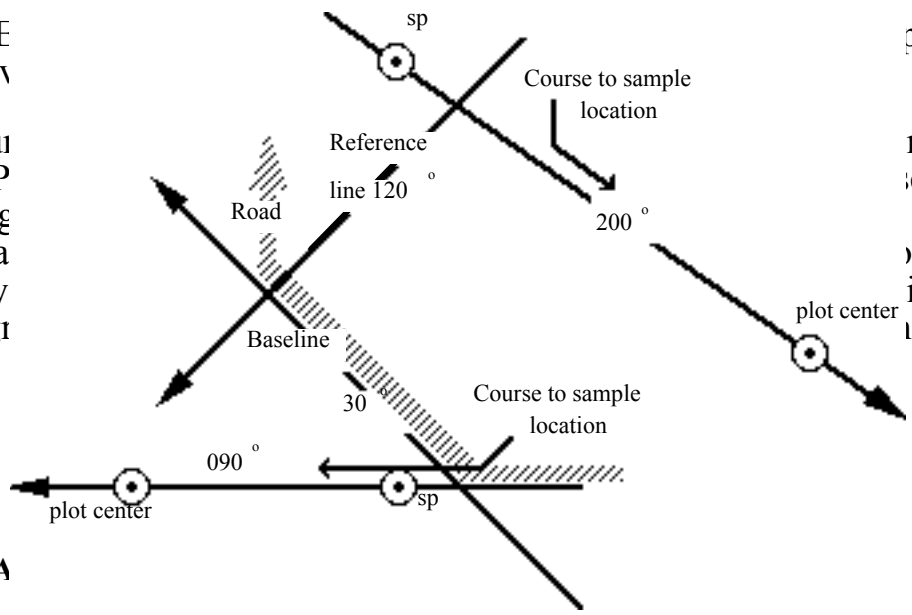


Figure 3. A

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)

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

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

<u>Location Correction</u>

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.

<u>Chaining to Other Than PC</u>

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

A turning point can also be used at any point when chaining to reach another subplot center. At any point while chaining, establish a turning point, chain the distance and azimuth from plot center to the subplot you wish to chain to, and then continue on your original course. For example, the course from the starting point to plot center is 200^0, 700 ft. After chaining 600 ft

you can see that plot center will be in a river and it would be best to chain to subplot 3. At 600 ft, establish a turning point and go 0^0, 140 ft (the distance and azimuth from plot center to subplot 3). Establish another turning point and complete the original course (200^0, for the remaining 100 ft) to reach subplot 3.

Plot Location Procedure For Remeasurement Plots

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

Once the SP tree is located, inspect to see that it is suitable. If the SP is suitable, the cruiser rescribes (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 item 3 on the new plot sheet. On the new photo, pinprick the SP and record the course to sample location on the back of the photo.

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. 4A, 4B, 4C). Note that fig. 3 shows the plot sketch—east-west azimuths would need to be reversed if drawn on the back of the photo.

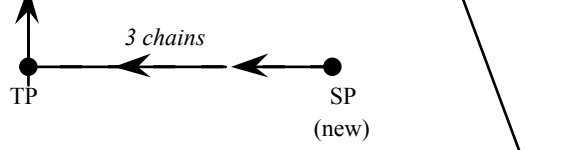
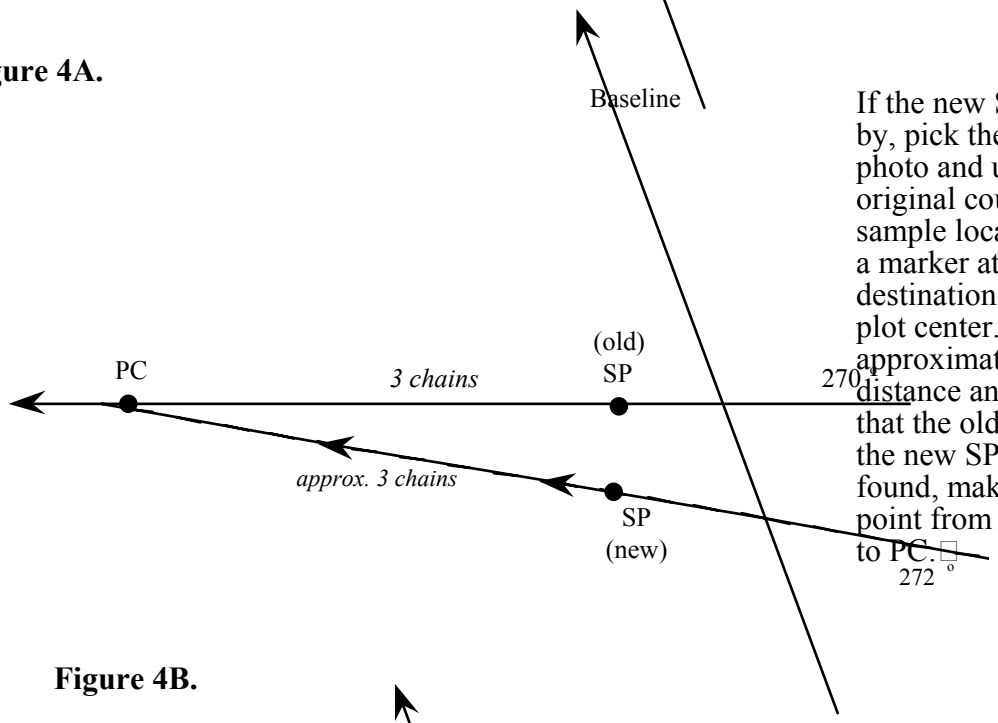
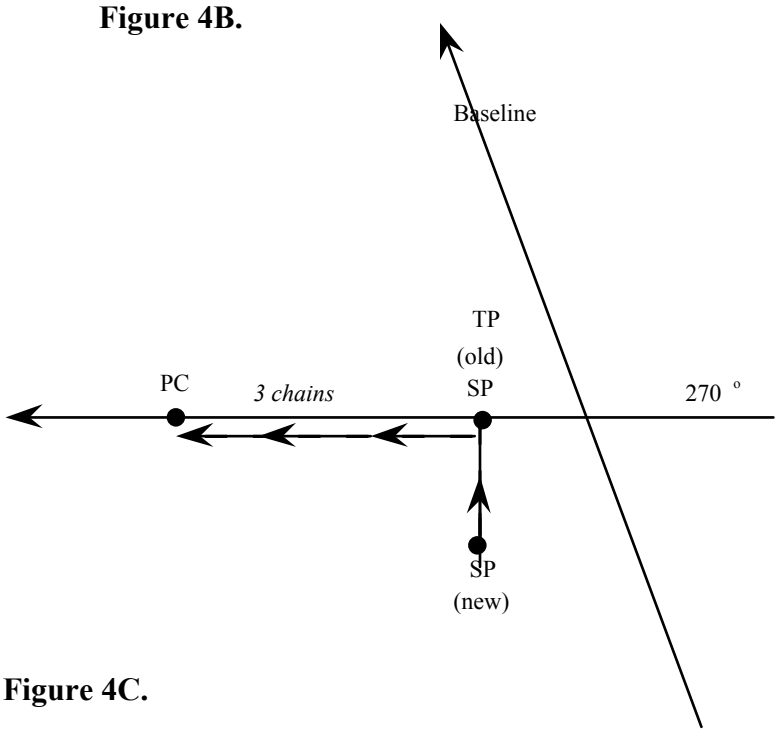


Figure 4A.



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 4B.



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 4C.

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.

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.

Subplot Location

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

Match by comparing current tree species, azimuths, distances, and DBH to the old figures for trees on the original plot sheet. Once it is determined to which 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 back azimuths and distances of several known trees from the old plot sheet. The intersection of these back azimuths and distances provides a small area in which to search for the wire pin marking each respective subplot center.

If there is an FHM plot installed on the location already and the location of the FHM point one does not mesh with subplot one of the FIA plot, use the location of the FIA plot to do all work. Make a note on the plot sheet about where the FHM plot is located in relation to the FIA plot.

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.

If unable to locate a remeasurement plot

If you and your partner can't find a remeasurement plot, bring it to the attention of the person in charge. After two crews have thoroughly searched for the plot without success, the second crew will establish the plot 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 remeasurement plot is established as near as possible to the old PC. All new trees receive a tree history reflecting ingrowth or ongrowth (31 or 61). Transfer original tree data to the data recorder and collect current data for them indicating whether they have been

cut or have died. See Tree History, item 33, for details about tally items needed for these trees.

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

Remeasurement plot in the wrong location

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

Denied access plot

When the land owner refuses to give you permission to access a plot, bring it to the attention of the person in charge. When all attempts to obtain permission to take the plot have failed, the **plot** is given SK=0 and GLUC=99. Check the section in manual entitled "Required Data Items By Ground Land Use" for the list of items to record. **NOTE**: When any portion of a plot is denied access the whole plot is denied access.

State (ST) 2 digits: Item 72

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

Unit (UNIT) 1 digit: Item 72

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

County (CTY) 3 digits: Item 72

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

Cycle (CYCL) 2 digits: Item 72

Cycle indicates what year the inventory work was done. Record the cycle that corresponds with the state you are in from the chart below.

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

Panel (PANEL) 1 digits

An inventory cycle consists of multiple panels of plots. All plots in a given panel are measured in the same year. This item is assigned in St.Paul and does not get changed in the field.

PI Land Use (PILU): Item 4

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

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

Stradler 1 digit each: Item 5

The straddler call is assigned by the photo interpreter to identify plots that have both forest and non-forest conditions on them. A value of 1 indicates that portions of the plot appear to extend into a different land use than plot center. Plots that are entirely within forest or non-forest conditions will have a zero(0) in this item. All plots with a 1 in this item will be sent to the field.

Current Date (CDAT) 4 digits: Item 68

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

First two digits		Second two digits	
Code	Month	Code	Year
01	January	98	1998
02	February	99	1999
03	March	00	2000
04	April	01	2001
05	May	02	2002
06	June	03	2003
07	July	04	2004
08	August		
09	September		
10	October		
11	November		
12	December		

Example: A plot completed in June, 1999 is coded as 0699.

Nearest Water: Item 69

Determine the permanent water source nearest to the sample plot location. A permanent water source is present year-round, as opposed to an intermittent stream. A lake, swamp, pond, or reservoir must meet the minimum area requirements of 120 feet in width and one acre in size. There is no minimum-size requirement for a stream or flowage.

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

Type Of Water (WTYP) 1 digits

Code	Type of Water (WTYP)
1	Streams and Flowages (Permanent natural watercourse where water is present in the flow channel all year.)
2	Lakes (Natural body of standing water including ponds.)
3	Swamps (Wet, spongy land, saturated and covered with open water, supporting natural vegetation (predominantly shrubs and/or trees)).
4	Farm ponds (Artificially ponded water held for such uses as domestic livestock, fishing, and irrigation.)
5	Reservoirs (A body of water held back by a dam, dike, floodgate, or any other barrier. Primary uses are flood control and recreation.)

Area Of Water (WARE) 3 digits

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

Distance To Nearest Water (WDIS) 4 digits

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

Nearest Road: Item 70

Type Of Road (RTYP) 1 digits

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

Code	Type of Road
1	Paved—Four lanes
2	Paved—Two lanes
3	Improved—gravel

Distance To Nearest Road (RDIS) 4 digits

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

Sketch And Notes: Item 71

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

Note: New aerial photos are the property of the project. Old aerial photos are usually not the property of the project.

Plot center GPS Location (GPSN) 7 digits: Item 76

Plot center GPS Location (GPSW) 8 digits: Item 76

GPS Unit ID (GPSW): Item 76

Upon locating plot center, use the GPS unit to determine latitude (GPSN) and longitude (GPSW). Record the values in the plot record along with the GPS unit's ID. If the canopy causes poor reception, move to a nearby opening where the GPS unit can locate satellites. Enter these readings and the GPS Way Point (WP) number in the notes and be sure to also record distance and direction **from the location of the GPS reading to plot center**. Additional instructions are in the Appendix.

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

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

Hexagon 7 digits

The EPA defined a systematic grid of hexagon shapes across the United States. The hexagon number identifies which EPA hexagon (approximatly 5937 acres) that the plot is located in. This item is put on in St. Paul and does not get changed in the field. Not on sk=10 plots.

Hexagon Latitude (HexLat) 7 digits

This is the Latitude in degrees and decimal minutes of the Hexagon center. This item is put on in St. Paul and does not get changed in the field. . Not on sk=10 plots.

Hexagon Longitude (HexLong) 8 digits

This is the Longitude in degrees and decimal minutes of the Hexagon center. This item is put on in St. Paul and does not get changed in the field. . Not on sk=10 plots.

FHM Plot

This is a code which identifies if the plot is on the FHM (Forest Health Monitoring) grid. This item is put on in St. Paul and does not get changed in the field. If the plot is a FHM plot it will be completed between June 1 and August 31 only. It will also have additional data collected on it which will be added to this manual later.

If there is an FHM plot installed on the location already and the location of the FHM point one does not mesh with subplot one of the FIA plot, use the location of the FIA plot to do all work.

NOTE: None of these plots will be done in 1998.

Code	FHM
1	Not an Forest Health Monitoring plot
2	Forest Health Monitoring plot

Condition Records: Items 1, 6, 8, 16-19, 54, 59, 62-64, 66, 75

Ownership Class (OWN) 2 digits: Item 1

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

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

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

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

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

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

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+ (Include actual number of acres owned for all tracts 5000+ acres in the "Notes" section.)

How To Collect Ownership Information

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

Ownership Class is recorded for the following conditions:

- All conditions where the Ground Land Use (GLU) 20, 21, 22, 40, 41, 45, 46, 57 or 59.

Owner contact is noted on the plot sheet for:

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

Owner name and address:

There is a computer program* for entering and storing ownership names and addresses. The data entered is periodically sent to the St. Paul office (usually when the data file has become large enough to fill a diskette).

Full name and street address is written on the plot sheet and then entered into the ownership program for the first forested condition.

Enter into the ownership program full name and street address for all field plots and modeled plots that require an Ownership Class. Street addresses are not needed for ownership class 11 (National Forest), 12 (Bureau of Land Management), or 15 (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.

* Directions for running the ownership program are in your field office or the St. Paul office.

** 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.

How to handle plots that may straddle two ownerships.

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

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

When multiple ownerships are recorded a note should be made on the plot sheet. For example, if the PC is in timberland (GLU = 20) owned by the State (OWN = 15) but part of the plot extends into cropland (GLU = 61) privately owned (OWN = 76) it should be noted in the notes section on page one of the plot sheet. A short note such as "cropland portion of this plot has ownership class 76" would be sufficient in this case. If the plot covers two miscellaneous private owners, record the same ownership code for every condition found on the plot.

Ground Land Use: Item 6

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

Forest land

Forest land is land not currently developed for nonforest use and has (or formerly had) at least a stocking value of 10.0 of all live forest trees of any size. Roadside or streamside strips of trees must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, bodies of water, or clearings in forest areas are classed as forest if less than 120 feet wide. Streams less than 30 feet wide between mean high-water are classed as forest. The minimum area for classification of forest land is one acre and 120 feet in width. (See definitions--especially nonstocked forest land.) Codes 20, 21 and 22 are referred to as "commercial forest land uses", codes 40, 41, 45 and 46 are "noncommercial forest land uses" and codes 57 and 59 are “noncommercial forest land uses (nonforest land with trees)”.

Use one of the following two-digit codes:

Commercial forest land

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.

Noncommercial forest land

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, 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.

Ground Land Use

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.

Note: All commercial 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.

Noncommercial forest land (Nonforest Land with Trees)

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.

Nonforest Land with Trees

Nonforest land is land currently developed for use other than growing trees; and/or land that never had a stocking value of 10.0 or larger in forest trees of 5.0" DBH or larger. Some locations interpreted as nonforest on aerial photographs require a field check. Some locations, interpreted as forest on aerial photographs, turn out to be nonforest upon field examination.

These areas are nonforest conditions that have one or more trees, 5.0" DBH or larger, within the condition. The condition must be in the same land use. When trees have been planted to create a nonforest with tree land use such as narrow windbreaks (GLU 56), wide windbreaks (GLU 57), or shelterbelts (GLU 58), the 5.0" DBH rule does not apply. Planted windbreaks and shelterbelts with trees of any size are recorded as windbreaks and shelterbelts, not nonforest without trees. Windbreaks and shelterbelts (56-58) do not need to be planted, they can be of natural origin. If they are of natural origin they must have one or more 5.0" DBH tree within the condition, otherwise they are nonforest without trees. Also guard against placing undo emphasis on a few scattered trees. If the trees 5.0" DBH or larger in the condition are from isolated inclusions or pockets that don't represent the overall situation, then nonforest without trees might be a more appropriate choice.

Ground Land Use

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

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.**

Nonforest Land without Trees

Ground Land Use

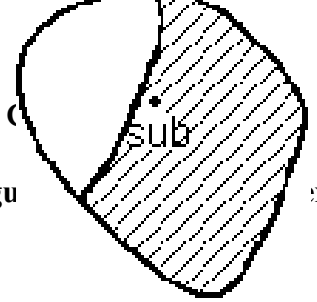
These areas are nonforest conditions (see Nonforest Land with Trees) that have no tree species present 5.0" DBH or larger. If there are widely scattered, individual trees or small, isolated inclusions of trees, nonforest without trees may still be an appropriate choice. Use your best judgment.

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

61 **Cropland without trees** Presently cropped or fallow up to two years.
62 **Pasture and rangeland without trees**
64 **Idle farmland without trees** Farmland that has not been tended within the last two years and has no trees. 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.
89 **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**
99 **Denied access plot**

A right of way or a linear water feature, may create a strip of trees less than 120 feet wide that would otherwise be forest land if the right of way were not there. In this case the field crew should use its judgment to determine if the strip that has been created is being managed the same as the forest on the other side of the right of way or not. If it is being managed or is likely to be managed the same (just as likely to be harvested or receive other treatment) consider it part of the forest on the other side of the right of way. If there is reason to believe that the strip will not be managed the same it should receive a land use of wooded strip. For example, a strip of trees about 40 feet wide between a railroad line and a major highway should be given a land use of wooded strip because it would probably not be harvested with the forest on the other side of the railroad or the highway. However, a strip 100 feet wide between a gravel county or township road and very narrow utility right of way would probably receive the same management as the forest on the other side of the right of way and should be give a land use of forest. See figure 5 for some examples of determining ground land use.

Figu **xamples have bee** **ning Ground Land Use to plot represent forest.**



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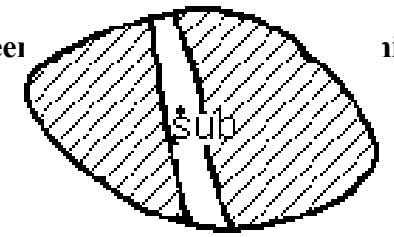

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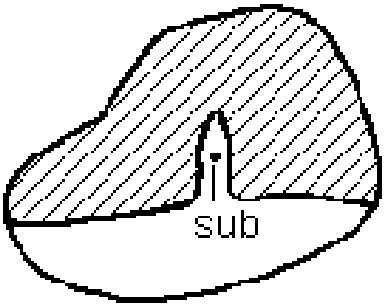
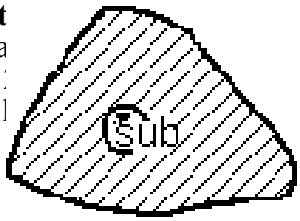


3.

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

Forest
Dot fa est land (less than 1 is bounded by forest l es.

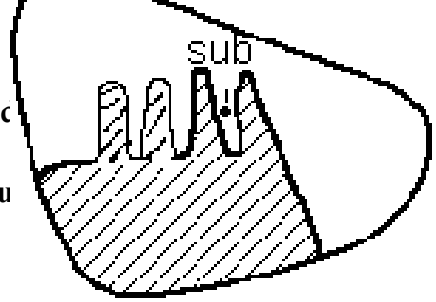


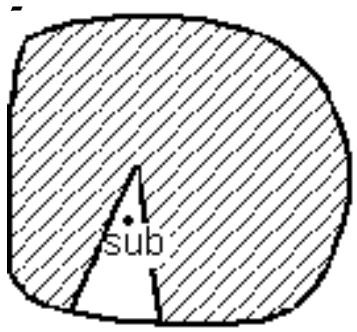
4.

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

Ground

Figu





an two adjacent
st and nonforest
) feet in width).
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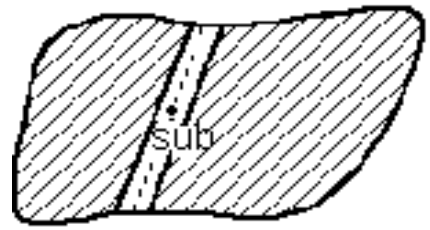
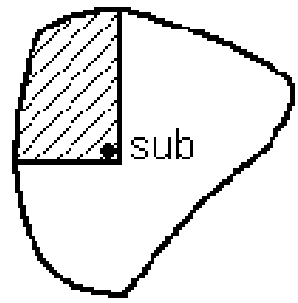
nonforest, the

7.

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





l road less than 120
oads and power line
are nonforest.

8.

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

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

How to calculate stocking for land use determination

Stocking values are required to determine the land use of a condition and decide what items must be recorded for that condition. When the land use is in question, assign stocking values to each tally tree on the new standard plot (subplots 21-24) based on each tree's diameter, the diameter of the largest tree in the condition and the portion of the plot that is in the condition. These stocking values are not recorded on the plot sheet or in the data recorder. They are only used to determine land use. Stocking is computed using table 2. All trees on subplots 21-24, in a condition must be tallied to calculate stocking.

Table 2. Stocking values for tally trees on subplots 21-24

	DBH of largest tree in the condition					
Tree DBH	5.0+	4.0-4.9	3.0-3.9	2.0-2.9	1.0-1.9	seedling
seedlings*	0.5	1.0	1.5	2.0	2.5	7.5
1.0-1.9*	2.5	3.7	5.0	6.2	7.5	
2.0-2.9*	3.7	5.0	6.2	7.5		
3.0-3.9*	5.0	6.2	7.5			

Ground Land Use		
4.0-4.9*	6.2	7.5
5.0-6.9	1.1	
7.0-8.9	1.7	
9.0-10.9	2.3	
11.0-12.9	3.1	
13.0-14.9	4.0	
15.0-16.9	4.9	
17.0-18.9	6.0	
19.0+	7.0	

* Consider a clump of trees less than 5" DBH to be a single tree for stocking.

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

1. On subplots 21-24, assign each live tally tree in the condition the appropriate stocking value based on its DBH and the diameter of the largest tree in the condition (visual 1 acre area). Any clump of trees less than 5.0" DBH is considered a single tree for stocking purposes.

2. Sum up the total live stocking for each subplot.

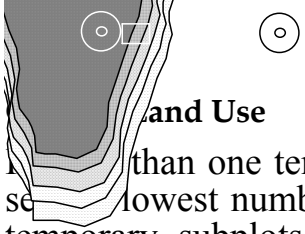
3. If the total live stocking for a subplot is greater than 20.0, reduce the stocking value of every tree on the subplot so that the total stocking is 20.0. This is done by multiplying each stocking value by the adjustment factor of 20.0/total live stocking.

4. If the condition does not cover subplots 21-24 entirely, stocking must be expanded by an expansion factor. The expansion factor is equal to 400/sum of the percent of subplot area (%ARE) for the condition. The stocking value of every tree is multiplied by this expansion factor.

5. The stocking for each tree class is computed by summing the stocking values for each tree in that tree class.

6. If the condition occurs on only a small portion of the plot, (half the plot or less), use your best judgment in assigning a land use. You may place several additional temporary subplots in the condition in order to get a larger sample to base stocking on. When additional temporary subplots or judgment is used to assign land use, a note should be made on the plot sheet. Use the following procedure to establish these temporary subplots in a condition:

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



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

> Install the lowest temporary subplot off the highest established subplot, until all the established subplots have been exhausted.
>
> Then establish the lowest temporary subplot yet to be established off the lowest one already established (lowest off highest, then lowest off lowest).

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

Figure 6. Here the dark shaded area is trees, surrounded by a treeless area or an area with only scattered trees. It could be a forest island surrounded by marsh/bog, a wooded draw in a grazed area, or a farm woodlot that is invading an abandoned field. Between the forest and the nonforest is a transition zone that is about 40 to 80 ft. wide. Because there is a transition zone, not an abrupt forest/nonforest edge, no mapping is done. Subplots 21 and 23 are recorded as 100% in condition 1 and subplots 22 and 24 are put in condition 2. To determine the stocking in condition 2 you could exclude subplot 22 because it is in a transition zone. If needed, several temporary subplots could be installed off subplot 24 to have an adequate sample for determining the stocking of condition 2. Similarly, to get a stocking for condition 1, subplot 21 would be excluded and, if needed, several temporary subplots could be installed off subplot 23.

Simplest case: One condition, no subplot exceeds 20.0 total live stocking.

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

SUB#	TR#	DBH	TCC	Stocking value from the table	Total subplot stocking
21	1	15.3	20	4.9	4.9
22	1	3.5	20	5.0	
	2	4.5	20	6.2	11.2
23	1	9.3	30	2.3	
	2	10.2	30	2.3	4.6
24	--	--	--	--	--
				All live stocking	20.7
				Growing-stock stocking	16.1
				Cull stocking	4.6

The total all live stocking here is 20.7, which exceeds the minimum stocking value for forest land. If the condition meets the other standards for timberland (minimum site index and is not being grazed) it should be given a land use of 20 or 22. If there is evidence of grazing the land use should be 59 because the total stocking in growing stock trees (16.1) is less than 25.0.

Ground Land Use

More difficult case: One condition on the plot, subplot 23 exceeds 20.0 total live stocking.

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

SUB#	TR#	DBH	TCC	Stocking value from the table	Total subplot stocking	Adj. factor	Adj. stocking value	Total subplot stocking
21	1	7.5	20	1.7	1.7	--	1.7	1.7
22	1	10.3	30	2.3	2.3	--	2.3	2.3
23	1	7.3	30	1.7			1.6	
	2	12.2	20	3.1			2.9	
	3	15.7	30	4.9		20/	4.5	
	4	17.3	30	6.0		21.7	5.5	
	5	18.2	30	6.0	21.7	= .92	5.5	20.0
24	--	--	--	--	--	--	--	--
							All live stocking	24.0
							Growing-stock stocking	4.6
							Cull stocking	19.4

The total all live stocking here is 24.0, which exceeds the minimum stocking value for forest land. If the condition meets the other standards for timberland (minimum site index and is not being grazed) it should be given a land use of 20 or 22. If there is evidence of grazing the land use should be 59 because the total stocking in growing stock trees (4.6) is less than 25.0.

Ground Land Use

Most difficult case: Two conditions on the plot, subplot 23 exceeds 20.0 total live stocking.

Live tally trees and computation of stocking for this most difficult case are shown below. A sketch of this plot is also shown in figure 7.

SUB #	TR #	DBH	TCC	Stock. value from table	Total sub-plot stock.	Adj. factor	Adj. stock. value	%ARE in cond. 1	Expan. factor	Expan. stock.	Total expan. stock.
21	1	5.2	20	1.1		--	1.1		1.43	1.6	
	2	6.1	20	1.1		--	1.1		1.43	1.6	
	3	5.7	30	1.1	3.3	--	1.1	100	1.43	1.6	4.8
22	--	--	--	--	--	--	--	--	--	--	--
23	1	5.3	20	1.1		--	1.1		1.43	1.6	
	2	5.9	20	1.1		--	1.1		1.43	1.6	
	3	6.6	20	1.1	3.3	--	1.1	80	1.43	1.6	4.8
24	1	9.3	20	2.3			1.9		1.43	2.7	
	2	17.2	20	6.0		20/	5.1		1.43	7.3	
	3	10.2	20	2.3		23.6	1.9		1.43	2.7	
	4	18.1	20	6.0		=	5.1		1.43	7.3	
	5	21.5	30	7.0	23.6	0.85	6.0	100	1.43	8.6	28.6

Sum = 280

Expansion factor = 400/280 = 1.43

All live stocking	38.2
Growing-stock stocking	28.0
Cull stocking	10.2

The total all live stocking here is 38.2, which exceeds the minimum stocking value for forest land. If the condition meets the other standards for timberland (minimum site index and is not being grazed) it should be given a land use of 20 or 22. If there is evidence of grazing the land use could be 21 because the total stocking in growing stock trees (28.0) is at least 25.0. Because this condition occurs on only half the plot and had there been one less growing stock tally tree the land use would have been 59, judgment can be used and/or additional temporary subplots could be installed to increase the sample in condition 1. If the field crew goes beyond the information in the tallied trees to assign a land use it should be noted on the field sheet. For example, the field crew may have observed that the plot was in a corner of the pasture with more trees than the rest of the pasture. Therefore they assigned a land use of 59.

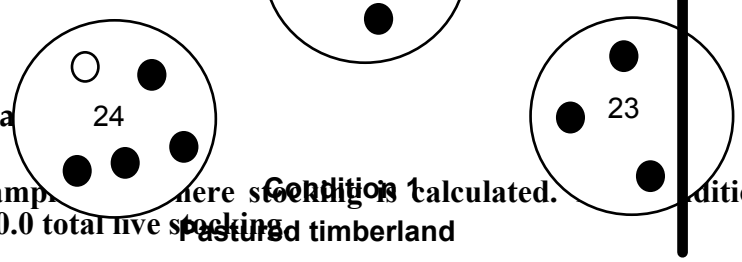

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Figure 7. Examp here stocking is calculated. ditions exist on the plot, subplot 24 exceeds 20.0 total live stocking.

Ground Land Use Original (GLUO) 2 digits

With the exception of the new GLU code, 50 (Nonforest with trees (reserved)), the meaning of ground land use original codes are identical to current ground land use codes. Original ground land use will be printed on the plot sheet for only the first condition unless the plot was done with the mapped design in the last cycle. This data item will not be entered into the data recorder.

Ground Land Use Current (GLUC) 2 digits

Record the observed ground land use existing at point center on the condition record. The condition found at plot center (subplots 1 and 21) is always condition number 1. If additional ground land uses are observed in the area, record them as different conditions.

On remeasured 5 points of the variable radius plots determine GLUC on each subplot. If any are different than condition number 1, record a new condition number. Likewise determine GLUC on each of the 1/24 ac subplots. **NOTE:** The same condition numbers should be used for subplots from either design sharing the same conditions.

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

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

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

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

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

1) There is a transition from an upland forest (an aspen stand) and to a marsh without trees (cat-tails and tag alder). You may be tempted to define a narrow strip of marsh with trees between the forest and the nonforest, but it would be less than 120 ft wide. Do not even try to map the edge of the forest. The forest canopy probably does not

have a clearly defined drip line. At each subplot center simply decide which side of the center of the transition zone you are on and put the whole subplot in that land use. Don't worry if you call a subplot 100% marsh without trees and there happens to be a couple of trees within the 24 ft macro-plot. These trees are simply part of the transition zone and because you say they are part of a nonforest condition you do not need to tally them. You may want to use them as reference trees.

2) There is a transition from wooded pasture or pastured timberland to pasture without trees. Cattle are grazing the entire area, but the slope has trees that give way to grass in the flat area. Subplot 22 is clearly in an area with enough stocking to be wooded pasture or pastured timberland, and subplots 23 and 24 are out in the grass (pasture and range without trees). Subplot 21 is in a transition zone of seedlings and saplings and even a few scattered trees over 5" DBH that is not wide enough to have its own land use. At each of these subplot centers simply decide which side of the center of the transition zone you are on and put the whole subplot in one land use. Don't worry if you call a subplot 100% pasture and range without trees and there happens to be a couple of trees within the 24 ft macro-plot. Again, these trees are simply part of the transition zone and because you say they are part of a nonforest condition you do not need to tally them. You may want to use them as reference trees.

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

Reason For Change (REAS) 1 digit: Item 6

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

Code	Reason that caused the land use change
0	No change.
1	Definition - Use only if current GLU code was unavailable on prior survey or if a definitional change is the cause for the GLU change (e.g. a change in the limiting width for linear water features). (See section in manual on: Ground Land Use Original and GLU codes.)
2	Legislation.
3	Natural.
4	Disagree with the previous crew about the location of the plot (old photo usually is not available),or GLU. Explain in the "Notes" section of the plot sheet.
5	Clearing, not utilized - Land cleared by mechanical, chemical, or hand means (or a combination of these), but timber not utilized.
6	Clearing, utilized - Includes land clearing where timber is utilized, and commercial clearcuts.
7	Partial timber cut.
8	Planting.
9	Other, Man - Includes fencing to exclude livestock.

Ground Land Use

For SK 1,7 and 8 (new subplots), no reason for change is recorded.

* If the plot was previously mapped, more than one condition could have changed, otherwise only condition one will be printed on the plotsheet and allowed a reason for change.

Required Data Items By Ground Land Use

If any portion of a subplot falls on timberland (code 20, 21 or 22), unproductive forest land (code 40), reserved forest land (code 41 or 45), wide windbreak (code 57) or wooded pasture (code 59) then the plot must be established and the trees within these land uses must be tallied. In this case the field crew must collect values for all data items described in this manual (the collection of some data items depends further on sample kind).

If no portion of any subplot falls on one of these ground land uses (20, 21, 22, 40, 41, 45, 57 or 59) then the plot does not need to be fully established. The plot center condition is the only condition that needs to be recorded. All required information for that land use must be recorded. For these plots, establish and paint a starting point (SP) the same as you would a plot that is fully established, include the starting point map on the plot sheet. Each of these plots will also be given a GPS location at plot center and starting point (SP). Every plot sent to the field is a permanent plot that will be re-established at exactly the same location at the next inventory and will be checked to see if the condition has changed to GLU 20, 21, 22, 40, 41, 45, 57, or 59.

Ground land use 20, 21, 22, 40, 41, 45, 57, or 59:

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

Ground land use 46,50-56, 58, 71, 72:

Required plot center data items:

New plot number	Tallier code	Subdivision
Old plot number	County name	Photo number
Dot number	National Forest	Photo scale
State	Ranger district	Data recorder
Unit	Original date	Cruiser name
County	Current date	Tallier name
Cycle	Township	Date
Sample kind	Range	Hex number
PI land use	Section	Hex latitude
Cruiser code	FHM plot	Hex longitude
	Panel number	

Plot center GPS coordinates are required

Required condition data items:

Condition number	Reason for ground land use change	Stand size class
Ground land use	Forest type	

Ground land use 61-69, 80-99:

Required plot center data items:

New plot number	County name	Section
Old plot number	National Forest	Subdivision
Dot number	Ranger district	Photo number
State	Original date	Photo scale

Ground Land Use

Unit	Current date	Data recorder
County	Stradler PI indicator	Cruiser name
Cycle	Township	Tallier name
Sample kind	Range	Date
PI land use	FHM plot	Hex number
Cruiser code	Panel number	Hex latitude
Tallier code		Hex longitude

Plot center GPS coordinates are required. (except for GLU=99)

Required condition data items:

Condition number	GLU Reason for use change
Ground land use (current)	

For denied access (GLU 99), download any old tree data or enter old trees and assign them a "no status" tree history and change sample kind to zero. See Tree History, item 33, for details about accounting for old trees in unusual situations.

Condition Number (CON#) 1 digit: Item 8

Condition number identifies the condition that exists within a subplot and is used to reference the condition number in the condition record. The value of CON# is always 1 for the condition at Plot Center. Additional conditions are given different numbers, but any given condition has the same CON# regardless of the subplot on which it occurs. If the condition was mapped in the previous cycle you will have some data printed on the plot sheet which you should check. If these data items are still valid use them to define the same condition on this plot.

Aspect, Slope: Item 16

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

Aspect (ASP) 3 digits

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

Slope (SLP) 2 digits

Slope is the average percent deviation from horizontal over all of the subplots within the condition. The recorded code is a measure of this percentage. For example, record 35 percent slope as 35. Slope percentages >99% receive code 99.

Physiographic Class (PHYS) 1 digit: Item 17

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

Code	Physiographic Class
3	**Xeric sites** Very dry soils where excessive drainage and/or very limited precipitation seriously limit both growth and species occurrence. Lake States habitats include jack pine on sandy outwash plains. Central States habitats include ridge tops with very dry, shallow soil and only limited tree occurrence, e.g. eastern redcedar, hardwood barrens. Plain states habitats include ponderosa pine and eastern redcedar on ridgetops and south or southwest aspects.
4	**Xeromesic sites** Moderately dry soils where excessive drainage limits growth and species occurrence to some extent. Lake States habitats include dry oak ridges and red pine-jack pine associations on sandy and gravelly soils. Central States habitats include ridges with thin dry soils where upland oaks such as post oak commonly occur. Plain states habitats include Eastern redcedar, upland elm-ash-locust, hackberry, bur oak, and Chinkapin oak, and north slopes with ponderosa pine in Nebraska and upland hardwoods in western Kansas and Nebraska.
5	**Mesic sites** Deep, well-drained soils. Soil and water relationship most favorable to management opportunities. Growth and species occurrence is limited only by

climate. Lake States habitats include well-drained aspen, maple-birch-basswood, and oak-hickory stands. Central States habitats include well-drained soils where white oak, northern red oak, black oak, and hickory commonly occur. Plain states habitats include well-drained red oak-bur oak-hickory, black walnut, hackberry, and basswood.

6 **Hydromesic sites** Moderately wet soils where insufficient drainage limits growth and species occurrence to some extent. Lake States habitats include poorly drained aspen. Central States habitats include better drained bottomland hardwood sites found in upper benches along streams where silver maple, American elm, pin oak, and sweet gum commonly occur. Plain states habitats include silver maple, cottonwood, green ash, boxelder, lowland hardwoods, pin oak, and pecan in southern Kansas.

7 **Hydric sites** Very wet sites where excess water seriously limits both growth and species occurrence. These sites typically have soils with a high organic content such as peat or muck. Lake States habitats include tamarack, northern white-cedar, and black spruce bogs. Central States habitats include sloughs and swamps with interior drainage where willow and cottonwood and sometimes cypress occur. Plain states habitats include lowland willow, sometimes cottonwood with interior drainage and in fringes around potholes.

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

Stand Origin (SORI) 1 digit: Item 18

Record the stand origin of the condition using the following one-digit codes. Consider only trees in the predominant stand size class of the condition. If the condition was mapped in the last cycle, this item will be printed on the plotsheet, reenter if still valid.

Code	Stand Origin
1	Natural stand with no evidence of artificial regeneration in the predominant size class.
2	40% or more of the sample trees originating from artificial regeneration.
3	Less than 40% of the sample trees originating from artificial regeneration.
4	Planting has occurred in a non-predominant size class (for example, underplanting).

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

Stand History (SHIS) 2 digits: Item 19

Stand history reflects the kind of disturbance on half or more of the subplots within the condition. For new sample plots, stand history reflects this disturbance over the last 20 years. For remeasurement plots, this code reflects the most significant disturbance in the current stand since the last inventory. When GLU changes from nonforest to forest, the most significant disturbance is an 8 or 9. Record an 8 or 9 unless there is evidence that the pin prick has moved. In which case stand history should be something other than 8 or 9 and reason for GLU change should be 4 (previous GLU incorrect). Stand history cannot exceed the remeasurement period.

1st digit Use the appropriate code for the first digit to classify the disturbance.

0 **No Disturbance** No evidence to indicate any of the following.

1 **Grazing** Significant disturbance caused by livestock grazing. Evidence of livestock grazing includes: absence of an understory, exposed tree roots and mineral soil, dead standing timber, severe erosion, and cow pies.

2 **Timber Stand Improvement** There is evidence that some trees have been killed or removed (or vines cut) through some type of pre-commercial thinning, pruning, or selective firewood harvest. May include the removal of unwanted or undesirable cull trees.

3 **Clear Cut** More than 50% of merchantable stems have been removed. Some large diameter cull-trees may have been left, but generally all merchantable material has been removed.

4 **Partial Harvest Cut** An intermediate stand treatment has removed sufficient merchantable volume to be a commercial harvest. Usually only large diameter, old, or otherwise high value stems are removed in this type of cut.

5 **Natural** Significant disturbance from fire, wind, flooding, insect or disease.

6 **Man-caused** Significant disturbance has resulted directly or indirectly as a result of human activities, i.e. alteration of natural drainage, chemical spraying, salt damage from oil wells, or acid water run off, etc.

7 **Planting of Forest Land**

8 **Planting of Non-Forestland** Areas that were once old field sites, reclaimed strip mines, pasture, or crop land that were planted to commercial tree species (usually about 300 or more trees per acre).

9 **Natural Regeneration of Non-Forestland** Areas that are reverting to forest vegetation. Areas that were once old field sites, marshes, etc.

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

2nd digit Use the following codes for the second digit to indicate how long ago the disturbance took place.

0 No disturbance
1 1-4 years
2 5-10 years
3 11-15 years
4 16-20 years

Site Index (SI) 3 digits: Item 59

Site Tree Species (SPP) 3 digits: Item 54

Record the appropriate site index and site tree species for each condition from the site tree record.

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

If the plot was mapped in the last cycle this item will be printed on the plotsheet. If this still describes the condition reenter this data for the same condition number.

Forest type (first and second digit)

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

Stand Size Class (third digit)

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

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

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

Code	Stand size class
1	Sawtimber stands
2	Poletimber stands
3	Sapling and Seedling stands
4	Nonstocked forest stands

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

Stand Age (AGE) 3 digits: Item 63

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

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

Subplot Records: Items 7-14

The purpose of the subplot records is to identify and map the conditions that occur on the macro plots. At least one subplot record must be recorded for each of the 5 subplots of the old design and the 4 subplots of the new design. The information in the subplot records is used to compute the percent of the area that each condition covers within the sample.

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

Subplot center

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

Subplot number	Percent of subplot area
Condition number	Cover class (if no trees are present)

Subplot Number (SUB#) 2 digits: Item 7

Subplot number is a 2 digit number. For example 01 corresponds to subplot one, 05 corresponds to subplot five, and 21 corresponds to the subplot at PC in the new design.

Condition Number (CON#) 1 digit: Item 8

Record the condition number of the condition at subplot center.

Cover Class (COVC) 2 digits: Item 9

Cover class is only recorded at subplot centers of subplots 21-24, in conditions where the ground land use is 20, 21, 22, 40, 41, 45, 57, or 59, and no live trees are found on the subplot. When this happens the micro-plot (6.8 ft. radius) should be examined and one of the following codes recorded:

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

Subplots that are cover classed should be referenced to assist in their relocation (see subplot Reference under item 15, Plot Design).

For remeasurement plots

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

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

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

Percent Of Subplot Area (%ARE) 3 digits: Item 10

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

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

Additional conditions on a subplot

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

Subplot number	Azimuth corner (if needed to describe an irregular boundary)
Condition number	Dist. corner (if needed to describe an irregular boundary)
Azimuth left	Percent of subplot area
Azimuth right	

Condition Number (CON#) 1 digit: Item 8

Record the condition number of this additional condition.

Percent Of Subplot Area (%ARE) 3 digits: Item 10

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

Azimuth Left (AZML) 3 digits: Item 11

Azimuth Right (AZMR) 3 digits: Item 12

Azimuth Corner (AZMC) 3 digits: Item 13

Distance Corner (DISC) 2 digits: Item 14

Azimuth left, azimuth right, azimuth corner and distance corner are used to describe the location of the condition boundary within the subplot. A condition boundary within the subplot must be approximated as either a straight line, or a line with one corner. If the boundary is approximated as a straight line record azimuth left and azimuth right. Azimuth corner and distance corner should be left blank. When the boundary is approximated by a line with one corner also record azimuth corner and distance corner.

When a condition boundary cuts through a subplot it may be useful to place pins or flagging at the subplot boundary every 60°. Marking the plot this way will help you visualize where the condition boundary intersects the subplot boundary. Azimuth are recorded from subplot center to the point where the condition boundary intersects the subplot boundary. Left azimuth should be the intersection to your left as you face the condition boundary and right azimuth is the intersection to your right. If there is a corner in the boundary record the horizontal distance between the corner and subplot center to the nearest foot (enter 1 for all distances less than 1 foot) and the azimuth to the corner from subplot center. For azimuth left, right and center use 360° for due north.

Note: Only when a well defined abrupt boundary between two conditions cuts through a subplot should an additional subplot record be recorded. This entry identifies the other condition and locates the boundary. When two adjacent subplots are in different conditions and the boundary between th[illegible]nditions is a transition zone, assume that the boundary occurs between the subplots.

Note: If the subplot has b[illegible]ped in a previous cycle you will left and right azimuths on the plot sheet printout. Use last cycle data azimuths if you agree to ± 15^0 degrees.

<u>Simple example of a plot that contains two conditions but only one condition on any subplot.</u>

In figure 10 two conditi[illegible]hown on the plot but the condition boundary does not cut through a subplot. Both [illegible]are timberland and the condition boundary does not follow a change in ownership so [illegible] both conditions receive the same land use and ownership class. Condition 1 is a s[illegible]er red pine stand, condition 2 is a poletimber aspen stand. Subplots 2[illegible]d 24 are in conditi[illegible] subplot 22 is in condition 2. The boundary between t[illegible]ditions does not cle[illegible]ough any of the macro plots. Therefore every subplot is [illegible]hin the condition a[illegible]enter. The condition and subplot records for this exampl[illegible]own in figure 11.

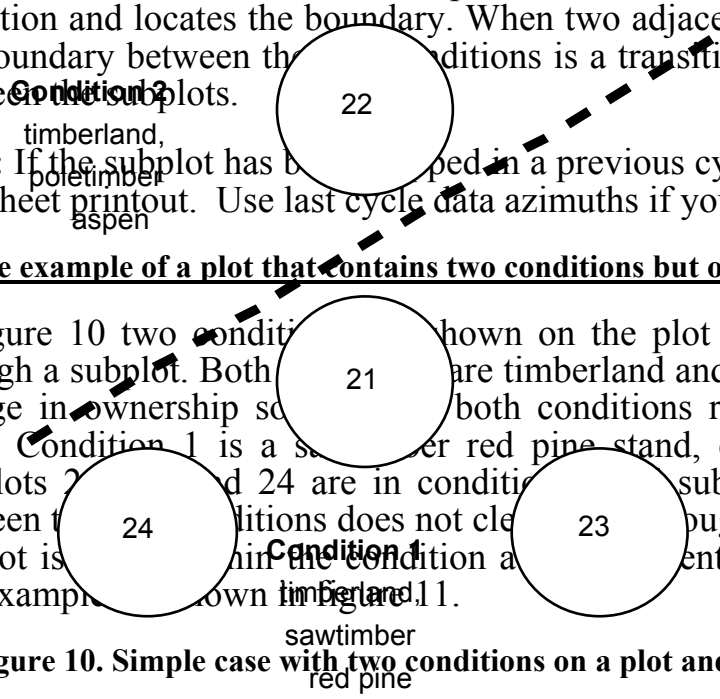


Figure 10. Simple case with two conditions on a plot and each subplot in one condition.

Figure 11. Condition and subplot records for example shown in figure 10.

CONDITION RECORDS

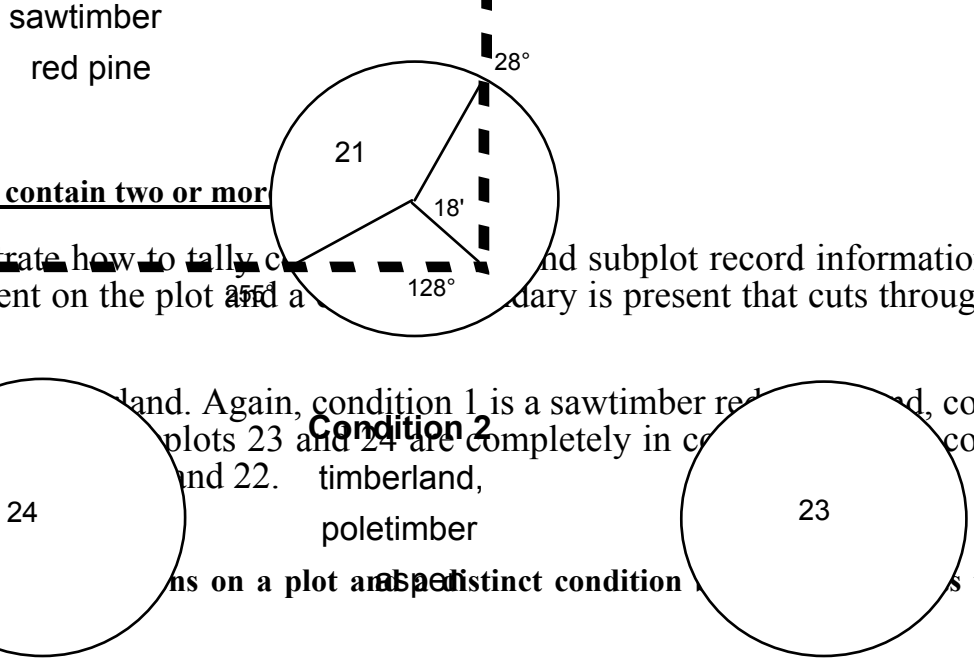
CON# (8)	GLUO (6)	GLUC (6)	REAS (6)	ASP (16)	SLP (16)	PHYS (17)	SORI (18)	SHIS (19)	FTS (62)	AGE (63)	SI (59)	SISP (54)	OWNC (1)
XX	XX	XX	X	XXX	XX	X	X	XX	XX-X	XXX	XXX	XXX	XX
1	20	20	0	1	5	4	1	00	021	64	070	125	26
2		20		35	2	5	1	00	912	24	080	746	26
3													

SUBPLOT RECORDS

SUB# (7)	CON# (8)	%ARE (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	100					
22	2	100					
23	1	100					
24	1	100					

In figure 10 the boundary between the two conditions is shown as an abrupt line, however it may be a wide transition zone between the two stands. When these transition zones are wide, it may be somewhat difficult to determine the condition a subplot is in. The following procedures should be used by the field crew in determining which condition a subplot center falls in:

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



Examples of subplots that contain two or mor

Figures 12 and 13 illustrate how to tally c nd subplot record information when two conditions are present on the plot and a dary is present that cuts through some of the subplots.

Here both conditions land. Again, condition 1 is a sawtimber re d, condition 2 is a poletimber a plots 23 and 24 are completely in c condition boundary cuts thr nd 22.

Figure 12. Case ns on a plot and a distinct condition s through subplots 21 an

Figure 13. Condition and subplot records for example shown in figure 12.

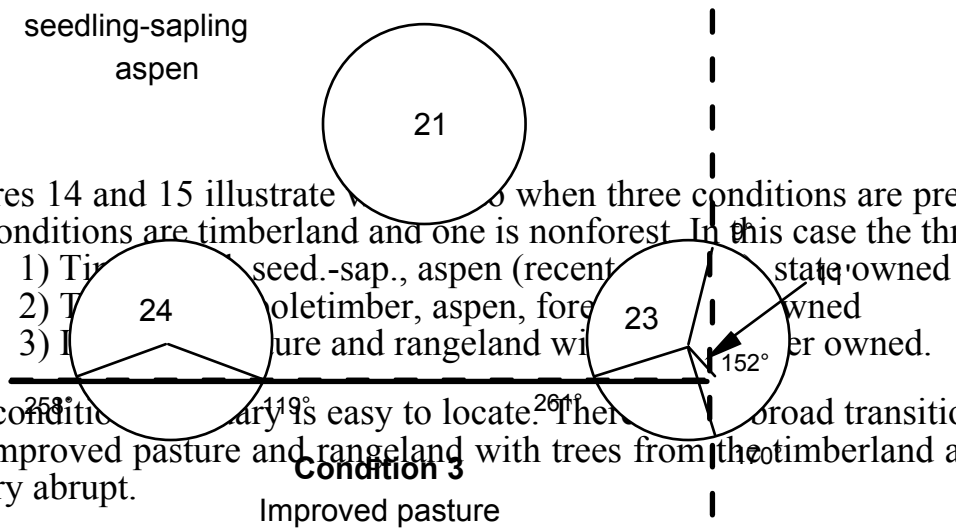
CONDITION RECORDS

CON# (8)	GLUO (6)	GLUC (6)	REAS (6)	ASP (16)	SLP (16)	PHYS (17)	SORI (18)	SHIS (19)	FTS (62)	AGE (63)	SI (59)	SISP (54)	OWNC (1)
XX	XX	XX	X	XXX	XX	X	X	XX	XX-X	XXX	XXX	XXX	XX
1	**20**	**22**	**0**	**1**	**5**	**4**	**2**	**00**	**021**	**64**	**070**	**125**	**15**
2		**20**		**35**	**2**	**5**	**1**	**00**	**912**	**24**	**080**	**746**	**26**
3													

SUBPLOT RECORDS

SUB# (7)	CON# (8)	%ARE (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	70					
21	2	30		28	255	128	18
22	1	80					
22	2	20		32	162		
23	2	100					
24	2	100					

Note: At subplot 21 and 22 the condition that is at subplot center (condition 1) is always recorded first and the second condition on the subplot (in this case condition 2) is always recorded second and contains the azimuth and distance information. It is very important that this is done correctly. Remember, the first subplot record is for the condition that occurs at subplot center and does not get any azimuth or distance entries. Additional subplot records are made for each additional condition that occurs on the subplot. Azimuth and distance entries must be made for these conditions to define where the condition boundary intersects the subplot boundary. Be sure to get the azimuth and distance information with the correct condition. Remember, when you are standing at subplot center to take the azimuth information that these azimuths go with the condition you are looking out at, not the one you are standing in.



Figures 14 and 15 illustrate [illegible] when three conditions are present on a plot. Here two of the conditions are timberland and one is nonforest. In this case the three conditions are:

1) Ti[illegible] seed.-sap., aspen (recent[illegible] state owned
2) T[illegible] oletimber, aspen, fore[illegible] wned
3) I[illegible] ure and rangeland wi[illegible] er owned.

The conditi[illegible] ary is easy to locate. Ther[illegible] broad transition zones. A fence separates the improved pasture and rangeland with trees from the timberland and the edge of the clearcut is very abrupt.

Figure 14. Case with three conditions on a plot and distinct condition boundaries that cut through subplots 23 and 24.

Figure 15. Condition and subplot records for example shown in figure 14.

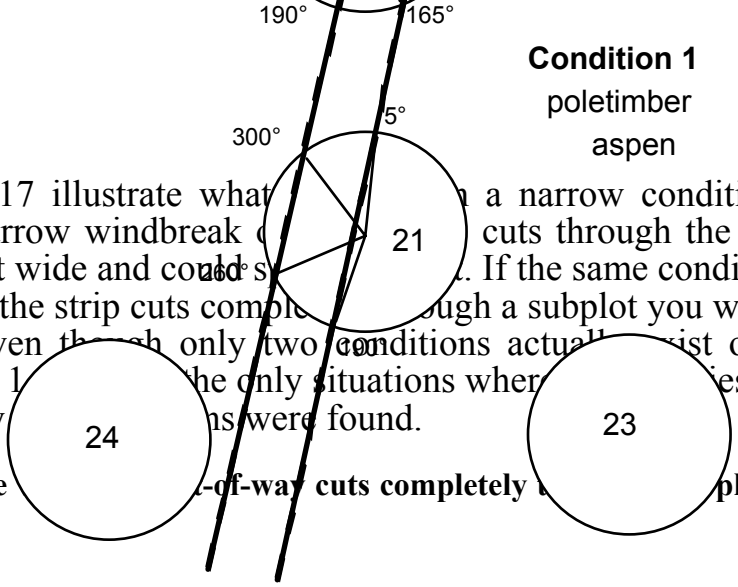
CONDITION RECORDS

CON# (8)	GLUO (6)	GLUC (6)	REAS (6)	ASP (16)	SLP (16)	PHYS (17)	SORI (18)	SHIS (19)	FTS (62)	AGE (63)	SI (59)	SISP (54)	OWNC (1)
XX	XX	XX	X	XXX	XX	X	X	XX	XX-X	XXX	XXX	XXX	XX
1	**20**	**20**	**0**	**1**	**5**	**4**	**1**	**31**	**913**	**3**	**078**	**746**	**15**
2		**20**		**35**	**2**	**5**	**1**	**00**	**912**	**24**	**078**	**746**	**28**
3		**52**							**501**				
4													

SUBPLOT RECORDS

SUB# (7)	CON# (8)	%ARE (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	100					
22	1	100					
23	1	45					
23	2	35		9	170		
23	3	20		170	261	152	11
24	1	70					
24	3	30		119	258		

The corner azimuth recorded for condition 3, subplot 23, illustrates that the corner azimuth does not have to be between the left and right azimuths.



Figures 16 and 17 illustrate what [illegible] a narrow condition (such as a right of way, wooded strip, narrow windbreak [illegible] cuts through the plot. These land uses can be less than 120 feet wide and could s[illegible]. If the same condition exists on each side of the narrow strip and the strip cuts comple[illegible]ugh a subplot you will have to make three subplot record entries even though only two conditions actually exist on the subplot. The situation shown at subplot 1[illegible] the only situations wher[illegible]ies should be made on a subplot where really only [illegible]ns were found.

Figure 16. Case [illegible]-of-way cuts completely [illegible] plot, dividing a condition into two pieces.

Figure 17. Condition and subplot records for example shown in figure 16.

CONDITION RECORDS

CON# (8)	GLUO (6)	GLUC (6)	REAS (6)	ASP (16)	SLP (16)	PHYS (17)	SORI (18)	SHIS (19)	FTS (62)	AGE (63)	SI (59)	SISP (54)	OWNC (1)
XX	XX	XX	X	XXX	XX	X	X	XX	XX-X	XXX	XXX	XXX	XX
1	**20**	**20**	**0**	**35**	**2**	**5**	**1**	**00**	**912**	**24**	**080**	**746**	**26**
2		**68**											
3													

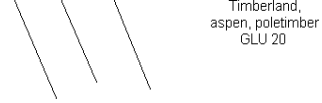
SUBPLOT RECORDS

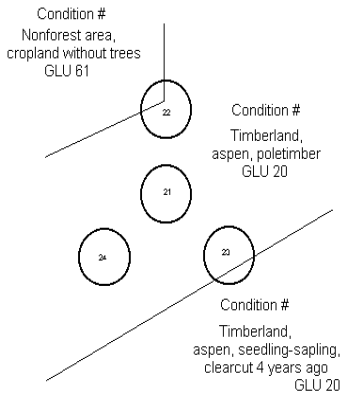
SUB# (7)	CON# (8)	%ARE (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	60					
21	2	35		190	5		
21	1	5		260	300		
22	2	40					
22	1	15		40	165		
22	1	45		190	5		
23	1	100					
24	1	100					

Mapping nonforest conditions

Plots without any land use 20, 21, 22, 40, 41, 45, 57 or 59 are not mapped, even if they contain more than one condition. Record only the condition at plot center. For these plots you just need to enter one condition record, and no subplot records. For example, plot center falls on a wooded strip and the rest of the plot is partly in cropland and partly in pasture and range without trees. Record the wooded strip as condition 1, get a forest type, stand size class and stand area and go to your next plot. No need to record any other conditions, enter any subplot records or do any mapping.

When subplots do contain land use 20, 21, 22, 40, 41, 45, 57 or 59 only these land uses and any adjacent nonforest conditions need to be recorded. Consider everything beyond the adjacent nonforest condition to have the same land use. This can easily happen with a right of way (see figure 17a). For example subplots 21 and 23 could be in timberland, and the rest of the plot in cropland without trees, except for subplot 24, which is partially into a right of way. Do not record the right of way as a condition, although you would want to draw it on the sketch map for future reference.





:. These sketch maps will be scanned in St. Paul and ırk pencil or pen to create these. This map must show at pass through the plot. Conditions should be labeled ɣas used to distinguish them. Figure 18 is an example ciated condition and subplot records. Boundaries that refully with a straight edge to show the location of the ɛtch maps will be helpful in resolving problems in the moved plots.

Figure 19. Condition and subplot records for plot shown in figure 18.

CONDITION RECORDS

CON# (8)	GLUO (6)	GLUC (6)	REAS (6)	ASP (16)	SLP (16)	PHYS (17)	SORI (18)	SHIS (19)	FTS (62)	AGE (63)	SI (59)	SISP (54)	OWNC (1)
XX	XX	XX	X	XXX	XX	X	X	XX	XX-X	XXX	XXX	XXX	XX
1	**20**	**20**	**0**	**35**	**2**	**5**	**1**	**00**	**912**	**24**	**080**	**746**	**26**
2		**61**											
3		**20**		**35**	**2**	**5**	**1**	**31**	**913**	**4**	**080**	**746**	**26**
4													

SUBPLOT RECORDS

SUB# (7)	CON# (8)	%ARE (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	100					
22	1	85					
22	2	15		270	350	230	8
23	1	85					
23	3	15		120	240		
24	1	100					

Shifted subplot centers

If subplot center falls within a tree trunk, shift the subplot center back, along the approach line, a distance of two feet from the edge of the tree trunk and mark with a pin or stake. Measure

distance to the next subplot center from the pin or stake. Record such changes in the "Notes" section of the plot sheet.

Tree Records: Items 30-43, 74

Sample Kind 0 (Lost)

All old trees will receive a tree history of no-status (00).

Sample Kind 1 and 7 (new plots)

All live and standing-dead trees 5.0" DBH and larger within 24.0 feet of subplot center are tallied on new standard plots. If the **center of the tree at its base** is within 24.0 ft (horizontal distance) of subplot center, the tree is tallied. In addition, tally all live saplings (trees ≥1.0" DBH, but < 5.0" DBH) within the micro plot. The micro plot radius of 6.8 ft is measured as the horizontal distance from the pin to the **center of the tree at its base.** See item 39, Tree Class, for more information on tallying dead trees.

Count or estimate the number of seedlings (trees < 1.0" DBH) by species and damage class that are on the micro plot. Record totals in item 42, Tree Cavities/Number of Seedlings. The Minimum height required to be considered a seedling is one foot for **ALL SPECIES**. DBH for seedlings is recorded as 000. See item 42 for additional instructions.

Sample Kind 2 and 6 (remeasured plots)

NOTE : There will be no new trees measured on points 1-5 of the old 10-point plot all States.

Indiana -

Remeasure the new 4 point plot only (points 21-24) if the last measure was cycle 4. All old trees must be accounted for and any new trees that grew into either the 6.8 ft micro plot or 24.0 ft fixed radius plot must be tallied.

If the last cycle the plot was done was prior to cycle 4 then remeasure subplots 1-5. Remeasure all old trees with past dbh of 5.0" or larger on subplots 1-5. On subplots 1-3 remeasure all old trees with past dbh 1.0" to 5.0". Install a new 4 point plot (21-24).

Missouri,Minnesota, and Iowa -

Remeasure all old trees with past dbh 5.0" or larger on subplots 1-5. On subplots 1-3 remeasure all old trees with past dbh 1.0" to 5.0".

Install a new 4 point plot (point 21-24).

Note: There is no need to use the prism to determine if a tree is in or not on the old 10-point plot of which only 5 are being remeasured in any state.

Sample Kind 8 (remeasured plots)

Tally trees on the new subplots (21-24) according to the same rules as just described for SK 1 and 7, all trees are treated as new trees (tree history of 01 or 05). Plot center will be determined

by the location of plot center of an old 10 point plot but the old ten point plot will not be re-measured. 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 (21-24). **OLD TREES WILL NOT BE MEASURED.** Old tree information will not be provided.

Sample Kind 10 (remeasured plots)

No new subplots (21-24). Account for all trees tallied in the previous survey plus trees that have grown large enough to sample. Tally trees on the old subplots (1-5) according to the same rules as just described for SK 2 and 6. These plot sheets will not have any hexagon information on them.

Checking trees when subplot center is inaccessible

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

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

Subplot Number (SUB#) 2 digits: Item 30

Record the subplot number for each entry in the tree record.

Tree Number (TR#) 2 digits: Item 31

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

For remeasurement plots

All old trees 5.0" DBH and larger (live or dead but not stumps) are retallied using the old tree number. On subplots 1-3, remeasure all trees ≥ 1.0" DBH using original tree numbers. On subplots 4-5 remeasure trees ≥ 5.0" DBH using original tree numbers. Stumps, seedlings, and saplings on subplots 4-5 are disregarded, and their old tree numbers are not used. **Use old tree numbers as printed on the new plot sheet, do not change them.** In Indiana the next available tree number to use on subplots 21-24 will be printed on the plot sheet.

Tree Species (SPP) 3 digits: Item 32

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

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

Tree History (THIS) 2 digits: Item 33

New plots (Subplots 21-24)

Code	Tree History
01	Live
05	Standing-dead

Live (Tree history 01)

If the tree is alive at breast height, it is considered a live tree. For a tree dead at breast height but with a new leader originating below breast height, record the new leader as a live tree. The DBH of this leader determines its size class.

Standing-dead (Tree history 05)

Standing-dead A dead tree that is ≥5.0" DBH and is free standing to a height of 4.5'.

Enter data for these items:

- Subplot number
- Tree number
- Distance
- DBH (current)
- Species
- Damage/Death
- Decay Class (current)
- Tree History
- Azimuth
- Condition number
- Tree Cavity

Remeasurement plots

Code	Tree History
00	No status
01	Live
05	Standing-dead
06	Down-dead (only on previously measured trees)
07	Stump of salvable-dead
08	Stump utilized
09	Stump not utilized

Remeasurement of Subplots 21-24 only:

31	Ingrowth live
35	Ingrowth standing-dead
61	Ongrowth live
65	Ongrowth standing-dead

Code	Tree History No Longer Used
04	Salvable-dead

Tree History Descriptions for remeasurement plots (subplots 1-5)

On remeasurement plots tree history is used to identify the tree's status in the current inventory. It is used in processing to divide trees into three groups:

old sample trees (first digit = 0),

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

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

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

Prior to 1987, the micro-plot was installed only on subplots 1-3. On subplots 4-10 trees less than 5.0" were only measured if they were needed for stocking or they were picked up on the variable radius plot. Not every tree within the micro plot was inventoried.

No status (Tree history 00)

These are previously measured trees that meet one of the following descriptions. They receive a tree history of 00:

Trees on lands that have changed land use. The land use change is from one where trees were measured (20, 21, 22, 57, or 59) to a land use where trees are not measured (anything else). Every old live, standing-salvable-dead, or standing-dead tally tree must be accounted for when there is a land use change. If a tree was cut as a part of the land use change it would get a tree history that reflects the cutting of the tree. If the tree is still alive (or died/cut after the land use change and unrelated to the land use change) it should get a current tree history of no status. If the tree is still standing-salvable-dead or standing-dead it should get a current tree history of no status.

A tree was tallied last survey, but should not have been, and should not be tallied now. It is given a history of no status. Put reason in the note section of the plot sheet. Scrape the old paint off the tree.

Trees tallied during the previous survey and displaced from the plot are considered no status trees.

Live (Tree history 01)

If the tree is alive at breast height, it is considered a live tree. For a tree dead at breast height but with a new leader originating below breast height, record the new leader as a live tree The DBH of this leader determines its size class.

Dead trees (Tree histories 05 and 06)

Standing-dead A dead tree that is ≥ 1.0" DBH (subplots 1-3) or ≥ 5.0" DBH (subplots 1-5) and is free standing to a height of 4.5'.

Down-dead A dead tree that is ≥ 1.0" DBH (subplots 1-3) or ≥ 5.0" DBH (subplots 1-5) and is not free standing to a height of 4.5'. Dead trees that are leaning and supported by another tree are tallied as down-dead.

Stumps (Tree histories 07, 08, and 09)

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

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

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

Ingrowth (Tree histories 31 and 35) Valid on subplots 21-24 only

Ingrowth trees are trees (alive) that were not tallied (or were seedlings) on the previous survey. They are now being tallied and occur on the micro plot. A new live tally tree that is within 6.8' of the pin (measured horizontally to the center of the **base** of the tree) should be given an ingrowth tree history. Dead ingrowth trees <5.0" DBH are not measured. Tally all live trees≥ 1.0" DBH on subplots 21-24.

If a tree tallied at the last survey is dead at breast height but a new leader has originated below breast height, record the new leader as ingrowth if it is within the micro plot. Record the old tree as mortality.

Ongrowth (Tree histories 61 and 65) Valid on subplot 21-24 only

Ongrowth trees are new tally trees (alive or dead) that are outside of the micro plot **(measured horizontally to the center of the base of the tree)**. They are now ≥ 5.0" DBH and occur on the fixed-radius plot. Tally all ongrowth trees on subplots 21-24.

If an original tree is now dead at breast height and has a new leader ≥ 5.0" DBH, record the leader as ongrowth and the original tree as dead.

The following are instructions for tallying trees on remeasurement plots and assigning tree history codes.

1. **Trees where land use was forest and is now nonforest (Tree history code 00)**

If the tree is still alive (or its death/cut occurred after a land use change (to nonforest) and was unrelated to the land use change) it should get a current tree history of no status. Enter data for these items:

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

2. **Original live tally trees still alive (Tree History Code 01)**

Account for all trees tallied as alive during the previous survey and currently alive. Transfer old tree number, DBH, crown ratio and crown class from the plot sheet to the data recorder, and complete all new items to survey standards.

3. **Original live tally trees now dead and still standing (Tree History Code 05)**

Enter the following data.

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

- Subplot number
- Tree number
- Distance
- DBH (original and current)
- Species
- Damage/Death
- Tree Class (original)
- Tree Class (current)
- Tree History
- Azimuth
- Condition number
- Tree Cavity
- Crown Ratio (original)
- Crown Class (original)

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

- Subplot number
- Tree number
- Distance
- DBH (original and current)
- Species
- Damage/Death
- Tree Class (original)
- Tree Class (current)
- Tree History
- Azimuth
- Condition number
- Crown Ratio (original)
- Crown Class (original)

A smaller DBHC than DBHO is acceptable.

4. **Original live tally trees now down (Tree History Code 06)**

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

- Subplot number
- Tree number
- DBH (original and current*)
- Species
- Damage/Death
- Tree Class (orig. tree class)
- Decay Class
- Tree History
- Condition number
- Crown Ratio (original)
- Crown Class (original)

*** Use original DBH for current.**

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

- Subplot number
- Tree number
- DBH (original and current*)
- Species
- Damage/Death
- Tree Class (original)
- Decay Class
- Tree History
- Condition number
- Crown Ratio (original)
- Crown Class (original)

*** Use original DBH for current.**

5. **Original dead tally trees still standing (Tree History Code 05)**

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

- Subplot number
- Tree number
- Distance
- DBH (original and current)
- Species
- Tree Class (original)
- Tree Class (current)
- Tree History
- Azimuth
- Condition number

- Damage/Death (use code 900)
- Tree Cavity

A smaller DBHC than DBHO is acceptable.

6. Original dead tally trees now down (Tree History Code 06)

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

- Subplot number
- Tree number
- DBH (original and current*)
- Species
- Damage/Death (use code 900)
- Tree Class (orig. tree class)
- Decay Class
- Tree History
- Condition number

*** Use original DBH for current.**

7. Trees now cut and either alive or dead at the last survey (Tree History Codes 07, 08, and 09)

For trees tallied as live on the last survey that have since been cut, enter data for the items listed below (trees dead at the last survey will not have an original Crown Ratio or Crown Class):

- Subplot number
- Tree number
- DBH (original and current)
- Species
- Damage/Death (07 only)
- Tree History
- Condition number
- Tree Class (original)
- Crown Ratio (original)
- Crown Class (original)

For salvable-dead stumps (07), record cause of death. If there is no way to determine cause of death, record unknown (code 900) but make an effort, especially with recently dead trees. If current DBH can not be measured (that section of tree has been removed) enter the original DBH.

When the land use was Forest and is now Nonforest and the tree was cut as part of the land use change, assign a tree history that reflects the cutting of the tree. Enter the following:

- Subplot number
- Tree number
- DBH (original and current)
- Species
- Damage/Death (07 only)
- Tree History
- Condition number
- Tree Class (original)
- Crown Ratio (original)
- Crown Class (original)

8. New live trees (Tree History Codes 31 and 61)

For ingrowth and ongrowth live trees, tally all required items with the exception of original tree data (DBH, tree class, crown ratio, and crown class). These items are zeroed out. All seedlings receive an ingrowth tree history (31).

9. New dead trees (Tree History Codes 35 and 65)

For ingrowth and ongrowth dead trees, tally the following items:

Sawtimber-size and pole-sized trees (DBH ≥ 5.0"), enter data for the items listed below:

- Subplot number
- Tree number
- Distance
- DBH (current)
- Species
- Damage/Death
- Tree Class (current)
- Tree History
- Azimuth
- Condition number
- Tree Cavity

Trees under 5.0" DBH are not measured.

10. Trees tallied or omitted from the last survey by error

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

Tree History codes 00 If a tree was tallied last survey, but should not have been, and should not be tallied now, record tree history 00 and old information. Put reason in the note section of the plot sheet, scrape the old paint off the tree, and check instruction 1 for items to record.

Tree History codes 01, 05, 06, 07, 08, and 09 If a tree was tallied last survey, but should not have been, and should be tallied now, transfer old information and regard as if the tree was tallied correctly.

Tree History codes 31 and 61 (subplots 21-24 only) If a tree was not tallied last survey, but should have been, and should be tallied now, record the tree as ingrowth or ongrowth.

11. Displaced trees (Tree History Codes 00, 31, 35, 61, and 65)

A tree may have been physically moved either onto or off of the plot by logging or wind. For trees **displaced onto** the plot and not tallied on the last survey, tally all current items and assign a tree history of ingrowth or ongrowth (see instruction 8 and 9).

Trees tallied during the previous survey and **displaced off** the plot are considered no status trees. They receive a tree history of 00 (see instruction 1). No current information needs to be recorded for these trees. Be sure to adequately explain the exact circumstances in the "Notes" section of the plot sheet. Trees tallied as live during the last survey, now dead and displaced off of the plot, are tallied as dead trees.

Special Instructions for trees in forest conditions where plot center was nonforest at the last measurement

Unless the previous nonforest land use was wooded pasture or wide windbreak, do not reestablish the old plot. Carefully determine stand history and reason for change (see Stand History) and record them in condition 1.

If the previous land use was wooded pasture or wide windbreak, reestablish the old plot and retally trees from the previous survey. Also determine stand history and reason for change (see Stand History) and record them in condition 1.

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

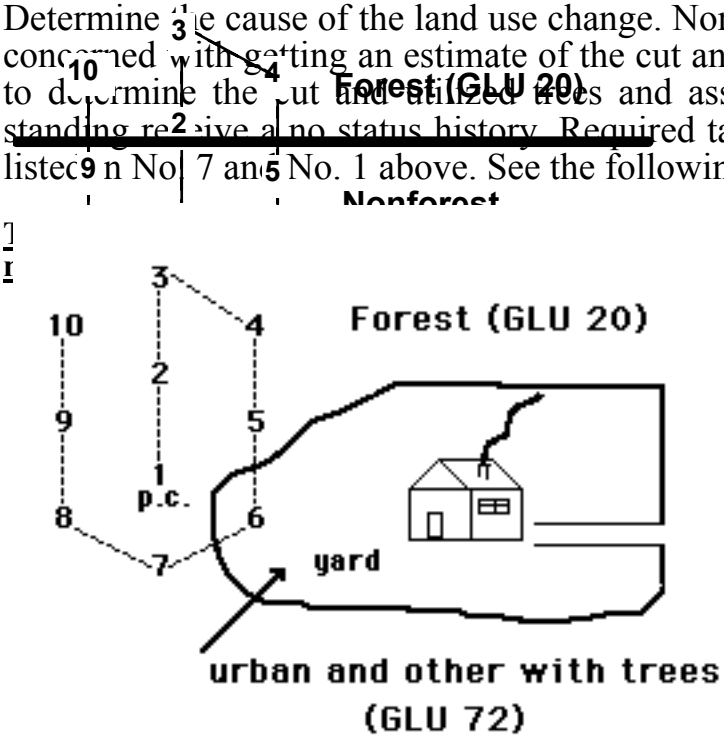
When a previously measured condition no longer needs to be measured because of a land use change, the original trees are accounted for according to the following guidelines.

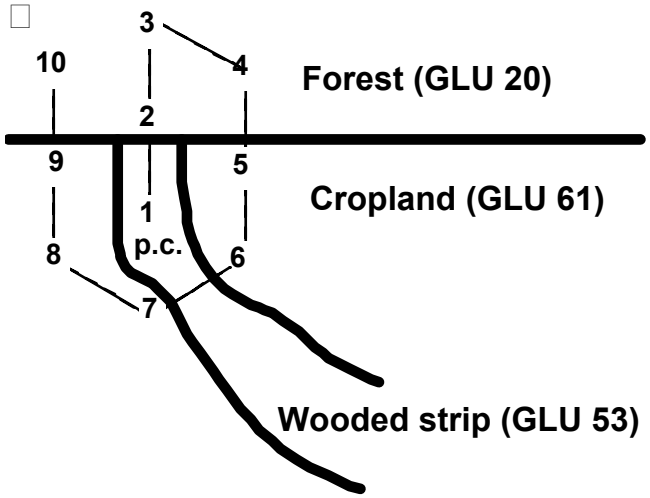
- **Nonforest areas that are a result of clearing (CGLU 61 - 69, 80, or 90)**

Trees are assigned a tree history of 08 or 09 depending on whether or not the cleared trees were utilized. Use your best estimate from owner contact, field examination, etc. if utilization isn't clear. Example: Owner says all the larger oaks were utilized and the other trees were pushed to the side of the field. All larger oaks receive a tree history of cut and utilized and other trees receive a not utilized tree history. The required tally items for stumps are listed in No. 7.

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

Determine the cause of the land use change. North Central data processing personnel are mainly concerned with getting an estimate of the cut and utilized portion of the sample. Make an effort to determine the cut and utilized trees and assign a cut and utilized tree history. Trees still standing receive a no status history. Required tally items for stumps and for no status trees are listed in No. 7 and No. 1 above. See the following examples.





Example 1

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

Example 2

The land use of the yard area has changed and we now have two conditions. In the yard assign trees that were not cut a tree history of 00 and any tree that has been removed a tree history of cut and utilized or cut and not utilized. Remeasure trees that are still in the timberland condition (outside of the yard) and give them their normal two digit tree histories and other measurements.

Example 3

Here we have gone from one condition to 3 conditions. Assign trees still alive and standing in the

wooded strip a tree history of no status tree (00). Remeasure trees that are still in the timberland condition (subplots 2, 3, 4, and 10) and give them their normal two digit tree histories. Assign any tree that has been removed a tree history of cut and utilized or cut and not utilized.

Tree Distance (DIST) 2 digits: Item 34

Record distances for all live and dead trees tallied (except seedlings). The distance recorded is the slope distance to the nearest foot from subplot center to the near face of each tree at its base. Record a two-digit code.

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

Diameter Breast Height (DBHO, DBHC) 3 digits

Height Diameter (DIAH) 3 digits: Item 35

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

It is essential that the measurements are accurate since trees are determined as "in" or "out" of the sample, depending in part on their DBH. For remeasured plots, it is important that DBH measurements are taken at the same point as in the last inventory. Missing paint, sloughing bark, cracks, splits, and other degradation may make it difficult to measure DBH of standing-dead trees. Estimate the likely location of breast height and measure DBH there. DBHC may be smaller than DBHO because of shrinkage, lost bark, or lost wood.

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

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

another fork then use the largest fork to continue up to 3.5' to measure DBH on that fork. Where this fork occurs exactly at 3.5' measure the diameter of this tree below the swell at the place where the fork ceases to affect that stem (see diagram).

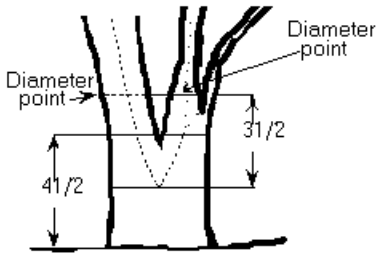
Tree forked again below 3 ½ feet

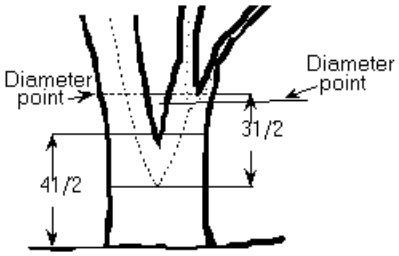
Tree forked again at 3 ½ feet

Important: Use care in determining where the tree forks--extend the centerlines of the two stems to their junction. Don't equate the point where daylight can be seen with the point where the tree forks. Figures 21 and 22 illustrate the proper methods for measuring DBH.

DBH for remeasurement plots

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





Current Check to see that the original DBH was taken in the correct place. If correct, remeasure, rescribe, and repaint this original measurement. It is extremely important to measure the same place if the measurement was initially correct; look carefully for evidence of paint at DBH. If DBH was not measured in the correct place, remeasure DBH at the original location and enter in the husky. **Record diameter height in feet and tenths of a foot in "DIAH" (3 digits).** Measure DBH at the correct place on the bole if the previous measurement was taken on a deformity or can not be relocated. **If DBH decreases more than 1.0" note the cause of the decrease.**

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

Forked trees may present unusual situations. If the original tree was measured as one stem, but it is obvious that the fork is below 4.5', then the DBH may decrease on this tree and the other stem will be a new tree if it is big enough to measure. When a tree was considered two trees at the last measurement but the fork occurs at 4.5' or higher, then one of the stems gets the new DBH (which will be much larger than the original DBH) and the other stem gets no status. When any of these situations occur make a comment in the notes section of the plot sheet.

DIAH - When diameter is measured above or below 4.5 feet on the tree, record the height that it was measured at. If the diameter was measured at 4.5 feet leave this data field blank or enter a zero.

6. Tree deformed at 4 1/2 feet

7. Bottlenecked tree

pulled straight.

the lean of a tree

Figure 2

Tree Azimuth (AZM): Item 36

Record azimuth on all live and standing dead trees tallied (except seedlings) The azimuth recorded is a three-digit code representing the magnetic azimuth from point center to the center of the tree at its base. Examples: 9° is recorded as 009; 89° is recorded as 089; 347° is recorded as 347. Zero-degree azimuth is not used. Any tree at 0° azimuth is tallied as 360.

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

For remeasurement plots

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

Condition Number (CON#) 1 digit: Item 37

Record the condition number of the condition the tree occurs in. This item is required for all trees, including seedlings, stumps, dead trees and no status trees. On plots that were mapped in the last cycle, there will be a previous condition number which identies the condition it was in last time the tree was measured. If conditon is still the same this will not change. This data is not entered into the data recorders.

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

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

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

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

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

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

Death codes are the same as damage codes, when coding the cause of death, choose a code from the list of damage codes. If the tree is dead and the cause can be determined, code the cause of death. If the cause is unknown, and the tree is salvageable, code the damage rather than unknown death, if there is damage. Trees dead at the previous survey should receive a damage code of 900.

Priority

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

Cull trees (except noncommercial species) must have a damage code other than 000. Seedlings and saplings are considered growing stock, unless a specific damage is observed. Excessive

sweep and crook is not considered a specific damage code for seedlings and small saplings (< 3.0" DBH).

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

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

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.

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 of commercial species that is sawtimber size and has no merchantable sawlog. Over one-half of the volume in the sawlog portion does not meet minimum log-grade specifications

because of roughness, excessive sweep or crook, splits, cracks, limb stoppers, or forks the 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 ≥ 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.

Tree History	Tree/Decay Class								
	20	**30**	**31**	**40**	**41**	**42**	**43**	**44**	**45**
01	yes	yes	yes	yes	no	no	no	no	no
05	no	yes	no	yes*	no	no	no	no	no
06	no	yes**	no	no	yes	yes	yes	yes	yes
07	yes	yes	yes	yes	no	no	no	no	no
08	yes	yes	yes	yes	no	no	no	no	no
09	yes	yes	yes	yes	no	no	no	no	no
31	yes	yes	yes	yes	no	no	no	no	no
35	no	yes	no	yes	no	no	no	no	no
61	yes	yes	yes	yes	no	no	no	no	no
65	no	yes	no	yes	no	no	no	no	no

* use this class for standing-dead trees < 5.0" DBH
** trees ≥ 5.0" DBH only

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

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

of its total height, by ocularly transferring branches to produce a full crown, the crown ratio might be 40 percent.

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

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

Crown Class (CCO, CCC): Item 41

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

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

In multiple-age stands with understory trees of younger age classes, crown classification is often difficult. As a general rule, the crown class for each tree should be judged in the context of its immediate environment; that is, those trees affecting it or being affected by it in terms of crown competition. For example, the intermediate and overtopped crown classes are intended to include only trees seriously affected by direct competition from adjacent trees.

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

Tree Cavities

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

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

First Digit

Code	Size of opening (inches)
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9+

Second Digit

Code	Location of cavity (feet above ground)
1	0 - 1
2	2 - 5
3	6 - 9
4	10 - 19
5	20 - 29
6	30 - 39
7	40 - 49
8	50 - 59
9	60+

Number Of Seedlings

Seedlings are tallied on the micro plot by condition number, species and damage class. To be a seedling it must be a tree species and have a height of ≥1 foot tall. This item is used to record the number of seedlings of a given species-damage class tallied on the plot. When more than 5 seedlings are on the fixed radius plot, the number of seedlings can be estimated. The accuracy of these estimates should be plus or minus 25%. For example, if you tally 40 seedlings, you should be confident that the true number of seedlings is between 30 and 50. For seedlings record condition number, species, damage, tree history, tree class, and total count. If more than 99 seedlings-record 99.

Tree Grade (TGRD) 3 digits: Item 43

Grade qualifying sawlog trees (20 and 31 class) on all new subplots (21-24) 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.
- 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.

Second and third digit For hardwoods given a grade 2, 3, 4, or 5, record the limiting quality factor that is keeping the log from moving into a better quality grade. When a grade 5 is given to a hardwood log, the second digit is a 2 or 7 when an 8' log is present. If a 12' upper log is present assign a second digit of 6. For softwoods, the second and third digits are always "00".

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

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

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

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

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

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

e Unlimited.

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

g 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

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

Total Tree Height (THGT) 3 digits: Item 74

From leaf fall until leaf flush measure the total height of all live trees with DBH ≥ 1.0" (subplot 21 only). Height is measured from ground level to the tip of the main stem. For trees with excessive lean visually "up - right" the tree and for downed trees, measure height along the ground. Height is measured to the nearest whole foot. For trees up to 30 feet in height, use the 30-foot height pole. Use a clinometer and tape for trees greater than 30 feet. Make a visual estimate of tree height before choosing the scale on the clinometer. Choose a place to stand that gives you a clear view of both the top and base of the tree. The distance from where you stand to the base of the tree should be approximately equal to the total tree height. Try to keep the sun at your back.

Site Tree Records: Items 51-59

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

Site trees should be selected to represent the average site potential of the condition. Do not select site trees from small inclusions in the condition such as a small high or low spot in the topography.

Site Tree Data

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

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

For remeasurement plots, a new site index is recorded.

Site Tree Selection

For each condition (or conditions that you decide have the same site index) measure a minimum of two site index trees of the same species. Use tree species that are of the forest type and represent the site from the condition you are sampling. Additional trees of the same or different species can be measured if desired. For example, if the condition is a forest type of aspen, try to use aspen for site index trees. If none are available, use any suitable tree, as long as a site index curve is available for its species.

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

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

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

Site trees should be well distributed over the plot area. If there are no suitable site trees on the plot, select nearby trees from the same general aspect, elevation, and soil type. Collect and record data on more than one species if it is needed to get a good site index estimate. Do not select permanent tally trees nor high value trees.

Note the locations of the site trees on the subplot diagram.

Growth Intercept Method

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

For red pine:

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

Minimum Stand Productivity

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

Species	Minimum Site Index
N. white cedar	15
Black spruce	20
Tamarack	20
E. red cedar	25
All other species	35

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

Techniques of Site Data Collection

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

Tree Height (HGHT) 3 digits: Item 55

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

Bored Age (BAGE) 3 digits: Item 56

Total Age (TAGE) 3 digits: Item 57

Years Added To Bored Age (YADD) 2 digits: Item 58

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

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

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

Site Index (SI) 3 digits: Item 59

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

Site Tree Species (SPP) 3 digits: Item 54

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

Definition Of Terms

The following are definitions of terms used in this handbook.

Acceptable Trees Growing-stock trees of commercial species that meet specified standards of size and quality.

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)

Commercial Species Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality such as hawthorn and sumac).

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.

Supracanopy Usually a mature or over-mature tree, with crown at least 25% taller than the majority of dominant and codominant trees in the stand.

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

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.

Farm Operator A person who operates a farm, either doing the work themselves or directly supervising the work.

Farmer-Owned Land Land owned by farm operators. (Note: This excludes land leased by farm operators from nonfarm owners, such as railroad companies and states.)

Farmer-Owned Leased Land owned by farm operators, but leased to forest industry.

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". (Note: Types shall be determined on the basis of species plurality of all live commercial trees that contribute to stocking; that is, up to maximum of value of 12.0 on each subplot.)

Growing-stock Trees Live trees of commercial species qualifying as acceptable trees. (Note: excludes rough, rotten, and dead trees.)

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 (Private driveways are not included).

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.

Miscellaneous Federal Lands Federal lands other than National Forest or lands administered by the Bureau of Land Management.

Miscellaneous Private Lands Privately owned lands other than forest-industry

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.

Noncommercial Forest Land Forest land that is classified as either unproductive forest land or productive-reserved forest land (see detailed definitions of these terms).

Noncommercial Species Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood 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.)

Nonstockable Areas of forest land not capable of supporting seedlings of commercial species, because of the presence of rock, water, etc.

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 other than National Forests, 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 Stands (See stand-size class.)

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.)

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

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

Sapling-Seedling Stands (See stand-size class.)

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 Stands (See stand-size class.)

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.

Sawtimber 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.

Poletimber 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.

Sapling-Seedling 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.

Standing-dead Trees A dead tree free standing to a height of 4.5'.

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. (Note: see stocking explanation in section 21.5 of Forest Survey Handbook.)

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.

Appendix

Data Recorder

Hot keys

Key	Action
F1	Menu down
F2	Menu up
F3	Main menu
F4	Select first or last data item
Del	Clear number
No	
↑↓←→	Move up, down, left, right
*	(Husky Paw key) Override errors
PgUp	Previous tree
PgDn	Next tree
A	Add a duplicate tree or biomass
C	Duplicate trees from point 1 to point 21
D	Slope corrections (When in tree data screen this will tell you if the tree is within the limiting distance after you've entered the DBH.)
F	First tree
M	When in Subplot screen, draws condition map. Husky paw and ↑↓ keys move the map, yes key returns to Subplot screen.
L	Last tree
H	Cursor home
X	Edit current menu

Screens

Startup

```
Welcome to the
North Central Forest Exp. Station's
FIA
Field Data Entry Environment

Hit any key to continue.
```

Identification

```
Enter the name of your machine:
PBUNYON

Is this correct? (Y/N)
```

Shrub setup

```
Are you going to be collecting shrub
data? [Not needed in winter] (Y/N)
```

Main menu

```
     Main Menu   FIAField v3.04 Pascal
1. Enter/Edit data  6. Print a plot
2. Delete a plot    7. Slope corrections
3. Transmit a plot  8. Reset Keyboard
4. Receive a plot   9. Battery Level
5. Exit from prog   0. Reconfigure
                    S. DOS Shell
     Choice (0-9,S):
```

Plot selection

```
=>00000000 NEW PLOT  Enter/Edit
  10010012   Printed
  10100123   Dumped      Edited(16)   Printed
  20030004   Edited(4)    Printed
  20070258
  20130003   Edited(12)
```

Plot data

```
Plot Header
ST   17     UNIT  1      CNTY    1       PLT#  12
OLD# 16  SK    2        CRUZ    29      TALY  30
```

```
WTYP 1   WARE  33  WDIS    35      RTYP  2
RDIS 25   NFRD  0      ODAT  785    CDAT  795
CYCL  4
```

GPS location

```
     Plot Lat-Long Coordinates

N: 00°00.000'
W: 000°00.000'
GPS:  0
```

Condition records

```
CONDITION CLASSES
CON# 1    GLUC  2    REAS  3    ASP   4
SLP    5    PHYS   6    SORI   7    SHIS  8
CFTS  9    SAGE  10  SI        11   SISP  12
OWN  13


# CONDITIONS ENTERED IS 2 YOU'RE ON # 1
```

Tree records (remeasured plots)

```
TREE DATA PT# 1
TR#     1     DIST    2     DIAH   0     DBHC  3
SPP     4      DAM   5     TCC     6     THIS    7
CRC    8      CCC    9      AZM   10    CON#  11
TCAV 12    TGRD 13    THGT 14    DBHO  15
TCO   16     CRO    17    CCO   18

# TREES ENTERED IS  1 YOU'RE ON TREE  1
```

Tree records (new plots)

```
TREE DATA PT# 21
TR#     1    DIST   2     DIAH  3    DBHC  4
SPP      5   DAM   6    TCC    7     THIS    8
CRC    9   CCC    10    AZM   11   CON#   12
```

```
TCAV  13  TGRD 14  THGT  15


# TREES ENTERED IS  1 YOU'RE ON TREE  1
```

Subplot records

```
SUB PLOTS PT# 1       On 1 of 1
COND 1   %ARE  100 COV   3   LAZM  4
RAZM 5   CAZM  6     CDIS  7
```

Biomass records

```
BIOMASS DATA PT# 21
SNUM 1   SPP     2   SHIS     3   COV   4
DIAC  5    FREQ  6   BROW  7




# SHRUBS ENTERED IS  1 YOU'RE ON #  1
```

Site tree records

```
SITE INDEX DATA
TR#     2     CDBH  3   SPP       4      HGHT  5
BAGE 6     TAGE   7   ADYR  8      SI         9
CON# 10



# TREES ENTERED IS 1 YOU'RE ON TREE # 1
```

Plot menu

```
                ***PLOT MENU***
1. Plot  data                  7. Plot Map
2. Condition classes        8. Reset Keyboard
3. Sub plot data             9. Power Level
4. Site index data         F1. Digits -> Yes
```

```
5. Save plot          F2. Shrubs -> Yes
6. Edit the plot      F3. Heights -> No
          Select from menu >>>
```

Troubleshooting

Program Bombs or Freezes

If the FIAField 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 FIAField.

1) At the Main Menu, select choice 1, Enter/Edit data. This will bring up the Enter/Edit plots list.
2) You should arrow down to the BOMBFIL# file and hit the left or right arrows to select it. 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 OK. 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 options you can try:

   a) **Emergency Breakout** (repeat steps A-E above). If this fails try option b.
   b) **Emergency Hardware Reset**.

i) While holding down both SHIFT keys, press and hold the power button. Hold down all three keys for at least 4 seconds.
ii) 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 FIAField doesn't run properly after doing this or if this step doesn't reboot the machine, try option c.

c) **Disk Corruption**. Use only as a last resort because machine contents will be erased.
i) 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?
ii) Type Y
You will then be prompted:
All data has been erased
Use UTIL to format fixed disk
iii) Type UTIL
This will take you into HUSKY's FS/2 utility programs. Here you should select Format Fixed Disk.
iv) After the disk has been formatted you will have to reload all the FIAField programs - see Loading Software in the Husky Field User Guide.
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.

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 you are 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 you are out of the program type *autoexec*. This will restart FIAField using the DOS call command. If you are 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 section Load Software in the Husky Field User Guide.
   b) Reload all the plots you backed up in step 2 back into the field.dat directory on the FS/2.

Low Battery Warning Even with 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 (see Husky Field User Guide for details) and bump the % power up to 100%.

When you do a Paw-H, you should get a screen similar to 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 similar to:

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 badly, you may need to also see the instructions for Program Bombs or Freezes.

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.
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 FIAField doesn't seem to be working properly, you will have to reformat the hard disk (see Husky Field User Guide) 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.

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** No tracking, low power.	**St**and **By** power saving mode
SV - TYPE: **all-Y** ⇳ P	Track only Y-code signals

The items in bold in the above menu page are the options that can be set. Move to each item by pressing one of arrow keys (keys 4 or 6), the item will begin to flash when it is active. When you have moved to the desired item, press the page-down button (key 5) until the correct option is displayed. The above mode should be set to **STBY** (Stand By) just for setting up the unit and would not be used in normal field operations. The SV-TYPE may need to be set to "mixed" if an error message stating "insufficient number of satellites…" appears when using the unit. However, the "all-Y" option is the most accurate and should be used whenever possible.

To proceed to the next menu page, press an arrow key until the ⇳ appears next to the "P". Press the page-down button (key 5) again to move on to the next page: (Note if any item is flashing, continue to press an arrow key (keys 4 or 6) until nothing is flashing and the page-up/down symbols appear next to the "⇳" in the lower right corner - nothing on the screen should be flashing when you desire to move to the next menu page.). The next page is **VERY IMPORTANT**, set the units according to the display below:

	Explanation
SETUP UNITS **L/L-dm. English**	**L**atitude / **L**ongitude displayed in Degrees and minutes. Use **English** units (miles, feet, mph)

ELev : **feet MSL**	Elevation above **M**ean **S**ea **L**evel in **feet**.
ANGL : **Deg Mag** ⇕ P	Azimuths in **Deg**rees from **Mag**netic north

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

The next page is:

	Explanation
SETUP MAGVAR	Magnetic Variation is
TYPE : **Calc** deg	**Calc**ulated by the system in degrees
WMM 1995	
⇕ P	

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

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

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

	Explanation
SETUP DTM : **NAR**	Datum set to the North American 1983
No Amer-83/GRS80	using the GRS spheroid
AUTOMATIC OFF	The unit will automatically turn off in 20 minutes
TIMER : **20 min** ⇕ P	

The above page is **VERY IMPORTANT**, please make sure the Datum is set to "**NAR**".

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

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

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

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

Make sure that the MODE is set to **off**, that is the only thing to worry about on this page. This is the last page in the setup menu. Paging to the next page will bring you back to the first page of the setup menu. If not, press page-down key (5) until the first page does appear. Press menu to display the main menu.

Operations in the Field

Acquiring a Daily Almanac

The first time the PLGR is turned on each day, known as a "Cold Start", the PLGR starts searching for 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:

Action	KEY #
Turn the PLGR on	Key 1

Upon turning the unit on, the battery status will be displayed. A warning will be given if it is low on power. **Always** carry a spare battery pack with you! After the start up test is performed by the unit, the POSITION page will be displayed:

```
FIX          OLD
N 44° 59.089'
W 93° 11.092'
Elh +00941 ft     ⇳ P
```

The receiver mode can be viewed in the upper left corner of the first position to be displayed. When the unit is first turned on it will be in the quick "FIX" mode (if it is using only battery power).

The receiver will need to be in to the **CONT** mode, begin by going to the main menu:

Action	KEY #	Screen	
Display Main Menu Page	Key 3	⇦move⇨	⇳ select

STATUS	**SETUP**
INIT	TEST
HELP	<more> ⇳ P

Move to the "SETUP" menu item by pressing one of the arrow buttons (keys 4 or 6), it will be active when it is flashing, then select the SETUP menu by pressing the down key (key 5). The first page of the SETUP menu will be displayed:

Action	KEY #	Screen	Menu Explanation
Display Setup Menu	Keys 6,5	SETUP MODE: FIX 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:

Action	KEY #	Screen	Menu Explanation
Change Mode to (**CONT**)inuous	Keys 6,2	SETUP MODE: **CONT** Continuous POS and VEL update SV-Type: all Y ⇳ P	Calculates its position and velocity continuously Tracks only Y-code signals

The items in **bold** in the above menu page are the options that can be set. Move to each item by pressing one of arrow keys (keys 4 or 6), the item will begin to flash when it is active. When you have moved to the desired item, press the page-down button (key 5) until the correct option is displayed. The above mode should be set to **CONT** (Continuos), this is just for the "cold start" up of the unit and should not be used for acquiring the position of the plot center.

When you have changed the receiver to the CONT mode, press the "POS" button (key 8). Check the error in the upper right hand corner of the position screen, it will probably be very high for a few minutes. After about 5 minutes the error should have dropped somewhat. Also check the almanac age by pressing the page-up button (key 2) - while the position screen is displayed. When it states that the age is 1 day, the receiver is ready to collect the plot coordinates. This may take some time so be patient. The unit will turn itself off if left untouched for 10 minutes, so while you are waiting for it to acquire the almanac, it would be wise to press the "POS" key every 5 minutes or so to prevent this. When the almanac has been obtained, you may switch the unit off and proceed to the plot center or, if you are already at the plot center, proceed with the next section - Collecting the Plot Center Coordinate. If the above was done correctly, the Almanac Age should be one day.

Collecting the Plot Center Coordinate

When you have found or established the pin at plot center, stand over the pin holding the receiver - preferably facing south. If you have not acquired the almanac for the day do so by completing the above section. If the almanac has been acquired (that is the almanac age is one day, - check this by pressing the "POS" button (key 8) and then the page-down button (key 5) twice) proceed…

change the operating mode to **AVG**, to do this:

Press the "Menu" button (key 3). The main menu will be displayed:

⇦move⇨	⇳ select
STATUS	**SETUP**
INIT	TEST
HELP	<more> ⇳ P

One of the menu items will be flashing, move to the "SETUP" menu by pressing one of the arrow keys (keys 4 or 6) and select the item by the page-down button (key 5). Next the first page of the SETUP menu will be displayed:

	Menu Explanation
SETUP MODE: **AVG**	The **AV**ERA**G**ING mode continuously records a
Static POS fix,	new position and averages with previous
better accuracy	positions. 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 "Plugger" unit uses 8 AA Alkaline power batteries good for about four hours of operation and will need to be replaced every few days. Power batteries can be accessed

by removing the power battery cover at the top of the unit. The "Plugger" unit also has one AA size lithium memory battery that is located at the bottom end of the unit. The memory battery is only replaced as a maintenance action annually and is used to maintain power to the memory for critical information - **NEVER REMOVE THIS BATTERY**! This removes the encryption codes and reduces the accuracy of position coordinates.

Keep the unit clean and dry as you would the HUSKY. Unless you are about to be overrun by the enemy - **NEVER EVER PRESS THE "NUM LOCK" BUTTON AND THE "MARK'BUTTON SIMULTANEOUSLY**! This will clear all the special encryption codes from the unit and it will have to be returned to the Missoula Technology Development Center for recoding - costing you money and the severance of your index and middle fingers! To check that encryption codes are in the unit press the "Menu" key twice. You should see the following menu with "CRPTO" displayed in the lower left of the screen:

Data-XFR	SV-SEL
DOP-CALC	ALERTS
SINCGARS	KOI-18
CRPTO	<more> ⇳ P

From time to time, way points should be cleared out of the memory. This can be done by pressing the WP button and moving down to the "CLEAR" item. Select it and enter the range of way points you wish to clear, then move to and select the "Activate" item to clear them.

RECORD FORMAT FOR HUSKY DATA

Plot Level Record

1) Record Type (1)
2) Point Number (0)
3) Record Number (0)
4) State
5) Unit
6) County
7) New Plot Number
8) Old Plot Number
9) Sample Kind
10) Cruizer
11) Tallier
12) Water Type
13) Water Area
14) Water Distance
15) Road Type
16) Road Distance
17) National Forest Ranger District
18) Original Date
19) Current Date
20) Cycle Number
21) Empty (0)
22) Empty (0)
23) Empty (0)
24) Empty (0)

Condition Record

1) Record Type (6)
2) Point Number (0)
3) Record Number (0)
4) Condition Number
5) Current Land Use
6) Reason for Change
7) Aspect
8) Slope
9) Physiographic Class
10) Stand Origin
11) Stand History
12) Forest Type Size
13) Stand Age
14) Site Index
15) Site Species
16) Owner Class
17) Empty (0)
18) Empty (0)
19) Empty (0)
20) Empty (0)
21) Empty (0)
22) Empty (0)
23) Empty (0)

Biomass Record

1) Record Type (2)
2) Point Number
3) Record Number
4) Shrub Number
5) Species
6) Shrub History
7) Cover Class
8) Diameter Class
9) Frequency
10) Browse
11) Empty (0)

Area Record

1) Record Type (4)
2) Point Number
3) Record Number
4) Condition Number
5) % Area
6) Cover Class
7) Left Azimuth
8) Right Azimuth
9) Corner Azimuth
10) Corner Distance
11) Empty (0)

Site Index Record

1) Record Type (5)
2) Point Number (0)
3) Record Number
4) Tree Number
5) DBH
6) Species
7) Height
8) Base Age
9) Total Age
10) Years Added
11) Site Index
12) Condition Number

Tree Record

1) Record Type (3)
2) Point Number
3) Record Number
4) Tree Number
5) Distance
6) Diameter Height
7) Current DBH
8) Species
9) Damage
10) Current Tree Class
11) Tree History
12) Current Crown Ratio
13) Current Crown Class
14) Azimuth
15) Condition Number
16) Tree Cavities
17) Tree Grade
18) Tree Height
19) Original DBH
20) Original Tree Class
21) Original Crown Ratio
22) Original Crown Class
23) Empty (0)
24) Empty (0)
25) Empty (0)
26) Empty (0)
27) Empty (0)
28) Empty (0)

LatLong Record

1) Record Type (7)
2) Point Number (0)
3) Record Number (0)
4) Latitude
5) Longitude
6) GPS Number
7) Empty (0)

Codes

Biomass Study "Shrubs" (SPP): Item 24	Page
Minnesota	Minnesota codes 1
Missouri	Missouri codes 1
Tree Species (SPP): Item 32	
Minnesota	Minnesota codes 2
Missouri	Missouri codes 2
Damage Or Cause Of Death (DAM): Item 38	
Minnesota	Minnesota codes 4
Missouri	Missouri codes 4
Forest Type (FTS): Item 62	
Minnesota	Minnesota codes 6
Missouri	Missouri codes 6
County (CTY): Item 72	
Minnesota	Minnesota codes 7
Missouri	Missouri codes 7
National Forest-Ranger District (NFRD): Item 73	
Minnesota	Minnesota codes 9
Missouri	Missouri codes 9

Additional Information

Tatum Guides #1 - #6

Recommended Site Index Curves

Site Index Curves

State District Foresters, State Forests, and Recreation Areas

Field plot sheets

Shrub Records: Items 22-29 (May 1, 1999)

The following information is recorded for forest subplots (21, 22, 23, and 24) in the NE quadrant, 0° to 90°, of the micro plot from leaf flush to leaf fall (May 1 to September 30). All information is recorded on the shrub record. It is assumed that all shrubs are in the condition present at subplot center, therefore condition is not recorded in the shrub record.

Subplot Number (SUB#) 2 digits: Item 22

Record the subplot number for each entry in the shrub record.

Shrub Number (SNUM) 2 digits: Item 23

For each subplot, number sequentially from 1. Each species-diameter class combination (tall woody perennials and tree seedlings) or species (other perennials) on a subplot is given a new shrub number. Begin to number shrubs at 1 on each subplot.

Species (SPP) 3 digits: Item 24

See tree species list (seedlings) and shrub species list (others) in the appendix.

Shrub History (SHIS) 2 digits: Item 25

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

Diameter Class (DIAC) 2 digits: Item 26

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

Shrub History 80

Code	Diameter (measured along stem six inches from the ground)
01*	0.0 - .19" or less than 6" tall
02	.2 - .29"
03	.3 - .39"
04	.4 - 49"
05	.5 - .99"
10	1.0 - 1.49"
15	1.5 - 1.99"
20	2.0 - 2.49"
25…45	1/2" diameter classes continue

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

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

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

Percent Cover (COV) 1 digit: Item 28

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

Shrub History 81

Code	Percent ground cover
1	solitary plant, less than 1%
2	1 - 10%
3	11 - 20%
4	21 - 40%
5	41 - 70%
6	More than 70%

Evidence Of Browsing (BROW) 3 digits: Item 29

The percent of the number of stems by species and stem diameter class for tall woody perennials and the percent of the ground cover by species for other perennials that show evidence of the stems, twigs and foliage being browsed. This data helps determine the impact of deer and other browsing animals on regeneration, species composition, and the lower vegetation layer. Record general percent categories (1-100%).