

2.000 PLOT ESTABLISHMENT

This chapter describes how new sample plots are established and how remeasure sample plots are re-established. Most remeasure plots that are revisited during this inventory have previous starting point and course-to-plot information. On these plots, this **previous information should be used and followed unless there has been considerable change to the area**; or there is a more efficient way to access plot center.

PLOT PHOTO -- The imagery used to aid in establishing sample plots can vary from state to state. Generally, when aerial photography is being used, it will most often be products from the National Aerial Photography Program (NAPP). NAPP products are usually 10" by 10" contact prints with a nominal scale of 1:40,000. They may be color infrared, or black and white.

The following procedures are used to orient the photography to magnetic north.

- Align the photograph so that the edge with the identification information is on top as you look at it. That edge is the northern edge of the photo.
- Select two features that can be identified on the photo; and on the ground, or on a map. Individual trees, road intersections, straight sections of road, buildings, field edges, or unique locations along lakes and ponds, are good choices. Avoid railroad beds and power lines because of their effect on compasses.
- Using a pen, lightly connect the two selected features with a straight line (reference line). Be careful when writing on the photos as the emulsion of the photo can be easily scratched.
- Take a compass reading between the two selected features (magnetic azimuths are used).
- Record the azimuth, and place an arrow at the end of the reference line, to show the direction of the azimuth.
- Record reference line and all photo calculations on page 4 of the tally sheet in the "Calculations" section.

The establishment of a photo reference line is required for all plots.

2.110 STARTING POINT — The starting point (SP) marks the beginning of the traverse to sample plot center (PC) and is required for all plots. The SP should be:

- **Easily identifiable on both the plot photo and the ground**
- **Likely to remain unaltered prior to the next inventory**
- **Minimum of 200 ft from the plot whenever possible**
- **Pinprick and label it as SP on the back of the photo**

Witness the starting point with **two** trees or other nearby features, and record the pertinent information. If SP and/or the witness features are trees, mark them with a bark scribe. Place two parallel diagonal scribe marks, each about 4 inches long and 4 inches apart, at 5-1/2 ft above ground, and near the ground, below an imaginary 1 ft high stump. The lower scribes are referred to as stump scribes. Place the stump scribes on the downhill side of the tree whenever possible. Scribe marks on witness trees will face the SP. (If the witness tree is located on a slope, stump scribes should be placed on the downhill side of the tree.) On SP trees, they will face the direction of approach so that future crews may readily find them. **Never place scribes of any type on trees located on a landowner's yard without permission from landowner.**

Make the scribe marks in the outer bark layer of the tree. **DO NOT CUT THROUGH THE CAMBIUM.** It is important that scribe marks be made carefully so that they do not expose or penetrate the cambium of the tree.

Scribe marks that penetrate the cambium may provide a vector for insects or disease. And, on thin-barked trees, can cause deformities that may interfere with diameter measurements at subsequent inventories. Use tree paint on thin-barked trees such as beech, and on smaller sized trees of all species.

Illustrations of Scribing



Witness tree



Line tree



Crew passed tree on the left side.

2.120 COURSE TO PLOT – There are two methods to establish a course to plot: aerial photography and Global Positioning System (GPS) coordinates.

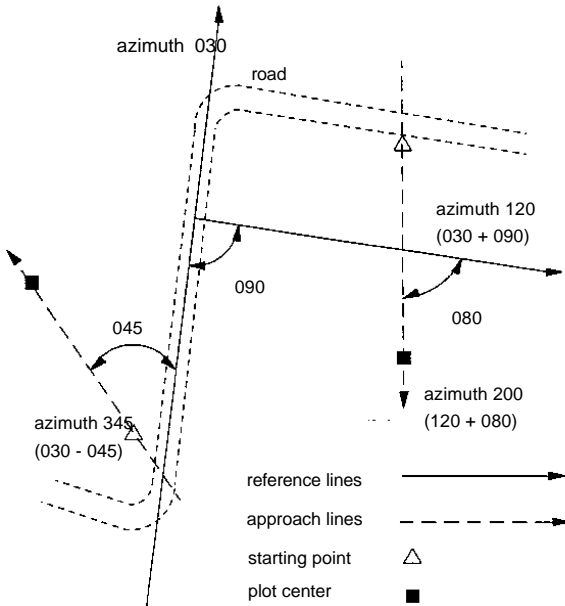
Remeasure plots were established and are re-established by using aerial photography. When plots are being re-established, the original photography and photo scale is used, if available. Draw a thin line on the photograph connecting the SP and the PC. Measure the length of this line to the nearest 1/50 of an inch and multiply that number by the conversion factor (40 for 1:24,000 and 66.7 for 1:40,000 photograph). This is the distance to be traversed. Check your calculations carefully. Record the distance in the space provided in Section 2.120 on page 3 of the tally sheet. **Any remeasure plot that has a new course-to-plot established must be documented with calculations, photo work and why the old course-to-plot was not used. Lack of documentation is considered unsatisfactory work.**

Warning: If a remeasure plot is located using the old course-to-plot information, do not calculate a new course-to-plot from SP and PC coordinates unless this distance has been traversed on the ground. The reason is that the calculated distance and azimuth from GPS coordinates has an associated error for SP to PC. If this new course-to-plot is not traversed, the next crew may not find the exact ground location especially if there has been major change to the area and witness trees and tally trees have been removed. The same is true for new plots. If you complete a course-to-plot and decide there is an easier route to the plot by creating a new SP, this new course-to-plot must be traversed on the ground.

If the course-to-plot is not traversed on the ground, the tally record is noted (e.g., C to P not run).

PHOTO CALCULATIONS PROCEDURE -- Extend the line from SP to PC so that it intersects with the reference line. With a protractor, measure, to the nearest degree, the angle between the two lines. Add or subtract this angle to the known azimuth of the reference line to determine the azimuth from SP to PC. If the two lines do not intersect, draw offset lines that will provide intersections. Check your calculations carefully. Record the azimuth in the space provided in Section 2.120 on page 3 of the tally sheet. Proceed with the traverse to PC.

Azimuth Calculations



New plots are established by using GPS coordinates. The Precision Lightweight GPS Receiver (PLGR) will be used for new plot establishment.

Each morning while traveling to the plot in the vehicle the PLGR requires a “warm-up” prior to its first use of the day. Connect the PLGR to the cigarette lighter adapter and external antenna and run it for 15 minutes or until the horizontal error is less than ± 70 ft appears on the <POS> screen. This step is only necessary before the first plot of the day. Once this step has been completed, the PLGR may be turned off until it is needed at the plot.

It is important that this effort to “warm-up” the PLGR be taken every morning. It is equally important that the PLGR is kept charged and that a full set of backup batteries is kept with each unit. Recent changes in the way sample plots will be established will cause crews to rely on their GPS receivers more than they have in the past. **A functioning fully charged GPS receiver will be the key to having a successful day in the field.**

At SP, start the PLGR and wait (3 to 5 minutes) until the horizontal error of less than ± 70 ft appears on the <POS> screen. Switch the

PLGR to “average” mode. Wait until the unit logs approximately 180 fixes (± 10 fixes) and record the latitude and longitude displayed on the screen in the “SP GPS” section on page 3 of the tally sheet.

Press the <WP> key and ENTER this SP coordinate as a new waypoint. Press <WP> key again and ENTER the “plot coordinates” from the label on the Page 3 tally sheet. Press <WP> again and toggle to <DIST>. Press the down arrow key and change the first WP number to SP and the second WP number to PC. The PLGR will calculate the range and azimuth to traverse on the ground to reach PC. Record this information in variable 2.120 on page 3 of the tally sheet. Proceed with the traverse to PC. For new plots established by GPS coordinates, crews must be within **100.0 ft** of the label coordinates for satisfactory plot establishment.

CHAINING TO THE PLOT – Using a compass and a 100 ft tape, begin the traverse to the plot. For all new plots, use the course to plot calculations from the previous section to eliminate any bias of the PC ground location. Two people, a head chainperson and a rear chainperson, are needed for accurate measurements. The head chainperson, by using a compass, must keep themselves and the tape on the correct bearing line at all times. In areas with dense undergrowth, or an extreme amount of slope, it will often be necessary for the rear chainperson to direct the traverse. Be careful to avoid tangles, loops, or bends in the tape.

Once the rear chainperson reaches the new station, select a tree (or other feature) for line reference. For trees record:

- Appropriate species code
- Diameter at breast height (DBH), estimated to the nearest even two-inch diameter class
- Estimated distance, in feet, from the station to the line tree
- Direction from the station to the line tree, using the clock system, with the direction of the traverse as 12 o'clock

Scribe line trees at about 5-1/2 ft high and facing the direction of approach. Slant the bottom of the scribes to the left “//” or the right “\” to indicate which side of the line tree the crew passed. Stump scribes are not used on line trees.

Make note of when the line of travel crosses streams, fences, or other unique features. To avoid confusion with trees tallied on the sample

plot, do not mark any line tree within the last 150 to 200 ft of the course.

In rough terrain, it may be necessary to "break chain", i.e., to use short sections of the tape to aid in holding a level line. Record descriptive notes in these cases. In mountainous country where horizontal distance cannot be chained directly, measure slope distances and convert to horizontal measurements as described in the next section.

CHAINING SLOPE DISTANCES -- The forward chainperson proceeds up or down slope for the full length of the 100 ft tape. The rear chainperson then uses the clinometer to determine the slope percentage between his or her position and that of the forward chainperson. Knowing the percentage of slope and the distance (usually 100 ft), determine the slope correction from the prepared tables in Appendix 10. The rear chainperson then makes the adjustment by adding the proper distance to the nearest 1/10 ft to the 100 ft tape. Then the forward chainperson stretches the tape taut again **along the slope** and sets the new distance. Record the slope correction, in actual feet and tenths of feet, in the Course to Plot information found on page 3 of the tally sheets. Slope corrections are always added **along the slope**, never subtracted.

The example **below** illustrates how to record course to plot information on page 3 of the tally sheet.

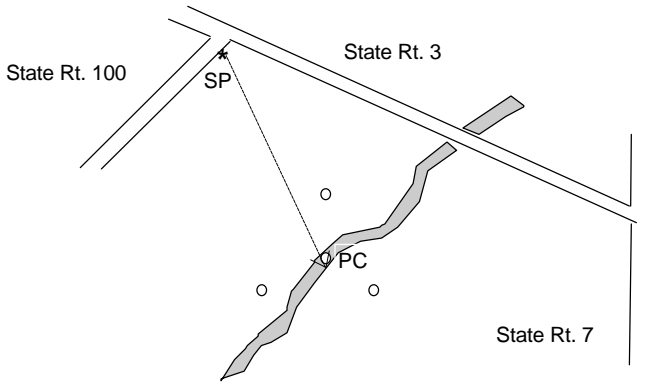
2.120 COURSE TO PLOT

DISTANCE			AZIMUTH			
350 FEET			200 DEG			
DIST	SC	SPP	DBH	DIS	DIR	NOTES
000	----	SP				
100	000	802	12	9	1	
160	-----	STREAM	-----			
200	024	403	8	2	10	1 OF 2
300	016	NO	SCRIBE			
350	----	PC				

ESTABLISHING SUBPLOTS 2 - 4 WHEN SUBPLOT 1 IS INACCESSIBLE -- At times, subplot 1 can be inaccessible due to unsafe conditions such as heavily traveled roads or deep bodies of water. The following example illustrates how to locate subplots 2 - 4 when subplot 1 is inaccessible.

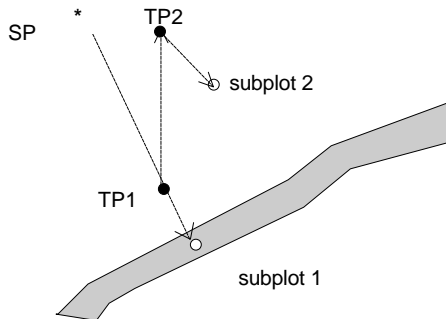
In the example **on the next page**, the stream is noncensus water that is too deep to access or cross. The crew establishing the plot does not

know that the subplot is inaccessible until they encounter the stream while chaining from SP to PC.



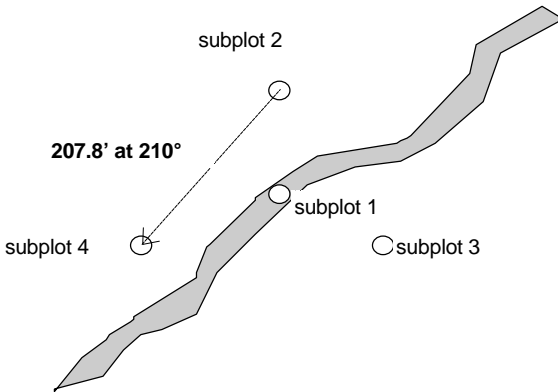
Originally, the course to plot was 534 ft at 150° . The crew chains 500 ft to the edge of the stream and they realize that they cannot occupy subplot 1.

To establish subplot 2 without occupying subplot 1, the crew should establish a turning point (TP1) at the 400 ft station of the course to plot and proceed due north for 120 ft. Here a second turning point (TP2) is established and the crew should proceed 134 ft at the original course to plot azimuth of 150° . This is the proper location of subplot 2. Note that TP1 could be established at any subplot along the original traverse as long as the distance from TP2 to subplot 2 is adjusted as well.

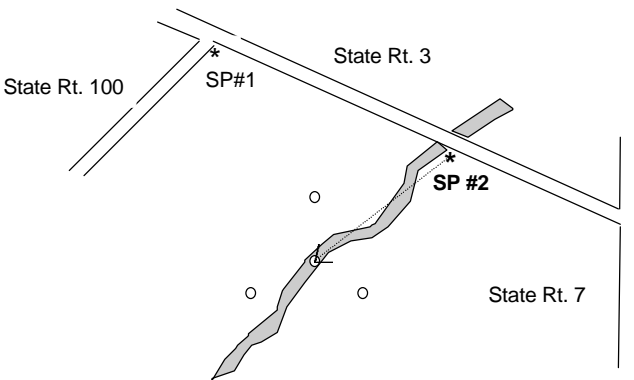


After completing the tally at subplot 2, subplots 3 and 4 now need to be established. Since the creek divides subplot 3 from the rest of the plot, and the stream cannot be safely crossed, subplot 3 will have to be accessed from the opposite side of the creek.

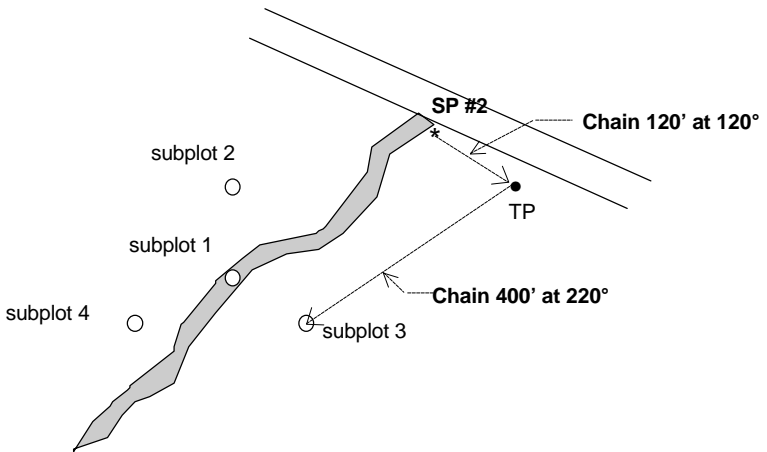
As for subplot 4, it can be accessed directly from subplot 2. The distance and azimuth from subplot 2 to subplot 4 is 207.8 ft at 210°. (See table in 3.140 on page 24.)



Finally to complete subplot 3, the crew will need to access this subplot from the other side of the stream. A second SP and course to plot is established using the aerial photography. (Note: If this procedure is followed for a new plot, you must first accurately pinprick the PC ground location and orient the photo.) Example below: SP #2 to PC is 400 ft at 220°.



However, we cannot occupy P.C. and the goal in establishing a second SP and course to plot is to establish subplot 3. This can be accomplished by proceeding 120° for 120 ft from SP #2 to a turning point. This turning point represents the relative location of subplot 3 to subplot 1. From the turning point, proceed on the calculated course to plot of 400 ft for 220° to locate subplot 3. This procedure uses the same techniques as used to locate subplot 2 from the original course to plot.



Several other methods can be used to get to the same point locations. This is just one example to illustrate locating subplots without occupying subplot 1. Crews should implement a method that is most efficient given various conditions that exist on the photo and plot area.

Whenever subplots are established without occupying subplot 1, a detailed description of the methods used must be written in the general notes and course to plot sections of the tally sheet. Photos with more than one SP and course to plot must be properly labeled. Also whenever subplot 1 is not physically occupied, **the crew should monument one of the subplots (2-4) with witness trees and collect GPS coordinates at this point. These coordinates are recorded in the General Notes on page 4 of the tally sheet.**

AT PLOT CENTER -- For a new plot you will need to pinprick the PC ground location on the photography. (To accurately pinprick PC, use ground observation, photo reference line, scale and stereoscope.) If you cannot accurately pinprick PC, the plot record should be noted. For example, "Accuracy of PC pinprick questionable due to extreme change and/or age of photography." The PC pinprick is utilized for other office applications such as forest fragmentation studies and remote sensing.

Even when you have found a plot that is being remeasured, it is important to check to see where you are on the photograph. Although the previous instructions may have taken you right to plot center, the plot may still be in a different location than the one marked on the photograph. If you determine that the plot is located incorrectly on the photograph, correct the pinprick not the plot's physical location. Changes should be documented on the back of the photograph and the General Notes.

If the ground location does not agree with the photo location, consider the following:

- Was the starting point correctly identified and marked on the photo?
- Was the photo distance measured correctly, or were the correct GPS coordinates used?
- Is the photo scale correct for the local area?

The scale of the photo can be determined by solving the following formula for X. Remember to convert the photo distance and the ground distance to the same units of measure.

$$\frac{1}{X} = \frac{\text{photo distance}}{\text{ground distance}}$$

If the actual scale of the photograph is 1:38,000, then the conversion factor would be 63.33 ft per .02 inches. For each 100 ft of traverse, this would be a 3.3 ft difference, less than calculated, from a nominal scale of 1:40,000.

- Are the reference line and course to plot azimuths correct?

An error of 1 degree would cause a 1.7 ft deviation, left or right, per 100 ft of traverse. A 5 degree error would, over a mile, end a course 20 ft behind and more than 460 ft to the right or left of the true location.

- Were slope corrections added along the course?

In previous inventories, a procedure of locating plots "by inspection" may have been practiced. In this procedure the crew that originally established the plot did not set up a course to plot with a distance and azimuth calculated from SP to PC. Most plots established in this matter were located immediately off a road edge or in small wood lots where locating PC directly from the photo seemed sufficient. **This**

procedure is no longer acceptable. Plots determined to have been established by inspection will be rated as a failed plot.

Never locate plots “by inspection.”

When a plot cannot be relocated, write a thorough description of where you looked and your conclusions. Most likely, a different crew, or a supervisor, will try to relocate the plot. This information will be very helpful to them.

Remeasured plots, where PC has never been established and witnessed, must match the old “office” pinprick location. (This pertains to remeasured plots where the original course-to-plot was established using photography and not GPS coordinates.) For example, the old photo pinprick indicates that the plot fell in cropland 200 ft from the edge. The old course-to-plot places you 200 feet into the forest. Do not establish the plot in the forest. Place a turning point in the course-to-plot so that the ground location matches the old photo location.

2.160 PLOT CENTER WITNESS -- In the space provided, note that a wooden dowel was used to monument plot center. Also, select two witness trees that are:

- Close to the dowel and spaced approximately at right angles from the dowel.
- Easily recognized species that stand out from others in the area.
- At least 3 inches DBH -- larger if possible.
- Not expected to die, or be cut, in the next 10 years

For each witness tree, record:

- The horizontal distance, to the nearest .1 (1/10) feet, from the dowel to the center of the base of the tree.
- The azimuth, to the nearest degree, from the dowel to the center of the base of the tree.
- The appropriate species code.
- The DBH (round measurement down to the last whole .1 (1/10) inch)

- Under notes, anything distinctive about the tree, example: “forks at 4 ft”, “clump of 3”, etc.

Enter the tree number if the witness tree is also a tally tree. This is determined during the tally procedure. If no witness trees are available, use some other features and record descriptive notes.

Any subplot that does not have at least two trees tallied on the subplot should be referenced. Subplot witnesses are used whenever there is a concern that the next crew may have a problem locating a subplot. Make complete notes of everything that you do so that it will be clear to the next crew.

NOTE: Wooden dowels are used to monument subplot centers and metal pins are used to monument microplot centers. If a dowel or pin cannot be placed, then it should be noted on the plot record.

2.170 PLOT DIAGRAMS -- Use this space to show the location of contrasting condition classes, and any unique features on or near the plot that may be helpful in relocating the plot at the next inventory. It is important that condition class boundaries be sketched in accurately to avoid problems on the next inventory when these boundaries will be remeasured. **See Plot Diagram Rules in Appendix 5.**

2.181 SKETCH MAP OF PLOT LOCATION -- **A sketch map of the general area surrounding the plot must be drawn for all plots.** The sketch must contain enough information for someone to find the starting point of the course to the plot, without the aid of the aerial photograph. It must include:

- References to the two nearest towns;
- Names and/or numbers (if available) for all roads shown on the sketch along with house or box numbers, when appropriate;
- Intersections and other easily identified landmarks.
- Location of SP and PC.
- Record distances between road intersections from an originating intersection or town to SP. Distances are recorded in miles, tenth's of mile, chains, or feet.

2.182 GENERAL NOTES -- Use this area to write notes about the plot that others may find helpful when checking or processing the plot, or even when re-establishing the plot during the next inventory. **The value of good notes cannot be overemphasized.**

FIELD EDIT – The quality control process begins with the initial field edit by the crew. A crew is expected to complete an edit after the completion of each subplot and a final plot edit before leaving the plot area. If a crew is using a personal data recorder (PDR), then data errors should be at a minimum.

The current PDR edit routine lists “warning” and “error” messages. When a crew reviews the message list, they can either accept or change data with warnings. Errors indicate conflicting or invalid data. These require the data to be changed unless the crew believes the error message is wrong. If the latter is true, a crew needs to contact their supervisor. The *Hammerhead* tally program will still allow a crew to “archive” plots with errors, however, the *Paravant* tally program will not.

2.210 FIELD EDIT -- Before leaving the plot, complete a thorough edit to make sure that all required fields are complete, all entries are reasonable, and all photo work is complete. Enter the three-digit code that identifies the person that edited the plot for errors and completeness. This is usually done by the person who cruised the plot.

2.220 FIELD EDIT / MONTH – Record the two-digit code for the month that the edit was completed.

2.230 FIELD EDIT / DAY -- Record the two-digit code for the day of the month that the edit was completed.

2.240 FIELD EDIT / YEAR – Record the two-digit code for the year that the edit was completed

OFFICE EDIT – As the name implies an office edit is completed off plot by the field crew, QA staff or a state supervisor. All paper tally and printouts are reviewed for errors. If an error is correctable in the office, the correction is made with a red pencil, initialed by the editor and dated. If an error cannot be corrected in the office, the crew will need to return to the plot to correct the error.

When a county is completed and sent to Newtown Square, Information Management personnel review all plots and modify the electronic plot file, if applicable. **It is very important that all corrections are clearly marked, so there is no room for misinterpretation.**

2.310 OFFICE EDIT -- Before returning the plot to the main office (i.e., Newtown Square), complete a thorough edit to make sure that all required fields are complete, all entries are reasonable, and all photo work is complete. This is usually done by a crew

leader, QA staff, or field supervisor. Enter the three-digit code that identifies the person that edited the plot for errors and completeness.

2.320 OFFICE EDIT / MONTH -- Record the two-digit code for the month that the edit was completed.

2.330 OFFICE EDIT / DAY -- Record the two-digit code for the day of the month that the edit was completed.

2.340 OFFICE EDIT / YEAR -- Record the two-digit code for the year that the edit was completed

The quality standards for this chapter are in the preceding text and Appendix 8.