

The Garmin Etrex Legend: An Introductory Handbook for Extension Agents

Prepared by: *The Virginia Geospatial Extension Program in partnership with Mike Clifford, Sr. Extension Agent Emeritus*

GPS: An Introduction and the Basics

This handbook is intended to provide you with a basic understanding of how your Garmin Legend GPS receiver can help to support your day to day extension business needs. For detailed information about this receiver, refer to the owner's manual that is included with you GPS receiver (a digital version of your owner's manual can also be downloaded from the Geospatial Extension Program Website: <http://www.cnr.vt.edu/gep/tools.pl>).

The Garmin Legend GPS receiver was selected to support the needs of all extension agents in Virginia. Under the extension agent GPS program, these GPS receivers are not being distributed to single individuals...the are being assigned to local extension offices (as well as AREC's and 4-H Centers). All extension agents at each local office should have equal access to these receivers.

The Legend GPS receivers are fairly rugged. However, these receivers are small computers, and they should therefore be treated with care. For example, never store the GPS receiver in direct sunlight or in hot areas (car trunks). When you are not using your GPS receiver for long periods of time (over 2 months), it is recommended that you remove the batteries. The Legend GPS is fully waterproof and dust proof, however, it does not float! You should clean the outside of your GPS receiver by simply running cool water over it, or by wiping it off with a moist rag.

In addition, it should be noted that the GPS has an internal antennae. The antennae is located behind the logo (the globe) at the top of the GPS receiver. Do not obstruct the antennae when you are operating your GPS!

Most GPS receivers do not work inside, underground, or underwater. In order to get the best reception,

your GPS receiver will require an unobstructed view of the sky!

Marketing material suggests that this GPS receiver will require new batteries (#2 AA) after approximately 32 hours of use. Personal experience, however, suggests that batteries last approximately 17 hours of use. You may want to keep spare batteries handy.

Your GPS Packet comes with a detailed owner's manual, and a quick start user's guide. In addition, your GPS receiver also comes with a detachable serial cable. This cable can be attached to your computer (or to your iPAQ using a USB adaptor). This will enable you to download coordinates, and can facilitate field data collection.

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Some Tricks of the Trade and things to remember...

- √ You know enough to be dangerous! Please note that this workshop is intended to give you a working knowledge of GPS to the degree that you can collect data for use in agriculture and natural resources inventories, and planning. This workshop does not give you the skills or authority of a licensed land surveyor. Applications of GPS for recording property boundaries, zoning boundaries and other legal boundaries such as setbacks requires the involvement of a licensed land surveyor. Likewise, legally binding calculations of property area must also be performed by licensed surveyors. Measurements taken with this GPS do contain errors. These measurements should be considered to be estimates!
- √ Update your software. The Garmin website [www.garmin.com] provides free software updates for the Legend (and other models). To maximize its area measurement capabilities, be sure that software version 3.40 (or higher) has been installed in your receiver. To check this, go to: MAIN MENU > SETUP > SYSTEM > highlight & click on Option Menu button at the top > select & click on SOFTWARE VERSION. If needed, download the latest software version to your computer, then upload it to your Legend using the supplied PC connector.
- √ Enabling WAAS (Wide Area Augmentation System) will usually improve accuracy of your unit's area calculations. *However, if you have difficulty in maintaining contact with the WAAS satellite (#35 in our area) because of tree cover or other terrain obstacles, you may be better off to disable WAAS.* To enable/disable WAAS, go to: MAIN MENU > SETUP > SYSTEM > WAAS.
- √ Wait for accuracy after you turn on your Legend. Before marking waypoints or laying tracks, give your receiver time (usually just a minute or two) to "settle down" and make full contact with the available satellites. When the accuracy reading on the satellite page becomes relatively steady - usually at 20-25 ft. (6-8 m) or so - then you are ready to put it to work. If WAAS is enabled, wait until satellite #35 is providing differential correction - small D's will show up on several satellite strength bars. You should then get accuracy readings of about 10 ft (3 m) in the open with a clear view of the southern sky.
- √ The Legend allows measurements to be displayed in your choice of units. Go to: MAIN MENU > SETUP > UNITS > DISTANCE/SPEED to initially select from Nautical, Statute, Metric, and Yards. If you wish to change from one measurement system to another, the Legend automatically and instantly handles the conversions. Options include: square feet, square yards, square meters, acres, hectares, square kilometers, square miles, and square nautical miles.
- √ You can connect your Garmin Legend to an iPAQ or other hand-held device using the download cable. You may also require an adaptor, depending on the type of port that is supported by your handheld device.
- √ You can connect your Garmin Legend directly to any USB port, by connecting download cable (provided) to a serial to USB adaptor cable (which costs ~\$20).

Understanding Your GPS Receiver

There are six buttons on your Etrex Legend that you need to be familiar with (Figure 1). These buttons include:

1. The Power Button
2. The Page Button
3. The Zoom-in Button
4. The Zoom-out Button
5. The Search Button
6. The Click Stick

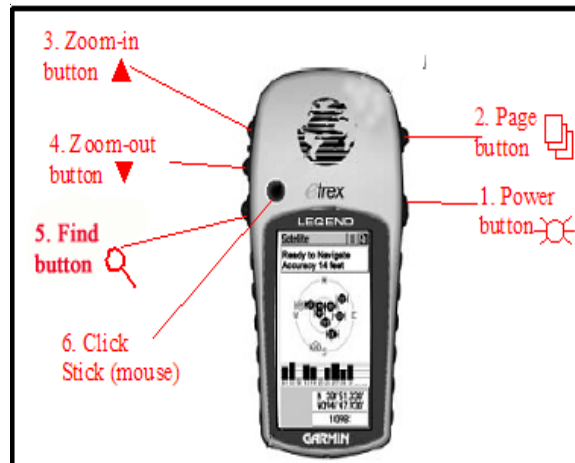


Figure 1

1. The Power button is the button that turns your GPS receiver on and off. This button will also turn on the backlight (so that you can use your receiver at night). Note that using the backlight will consume your batteries faster!!!
2. The Page button is used to scroll through various pages (i.e. screens) on the GPS receiver. There are five different pages that you can cycle through by pressing this button (Figure 2). These different pages include the:
 - Satellite Page
 - Map Page
 - Navigation Page
 - Trip Computer Page
 - Main Menu Page

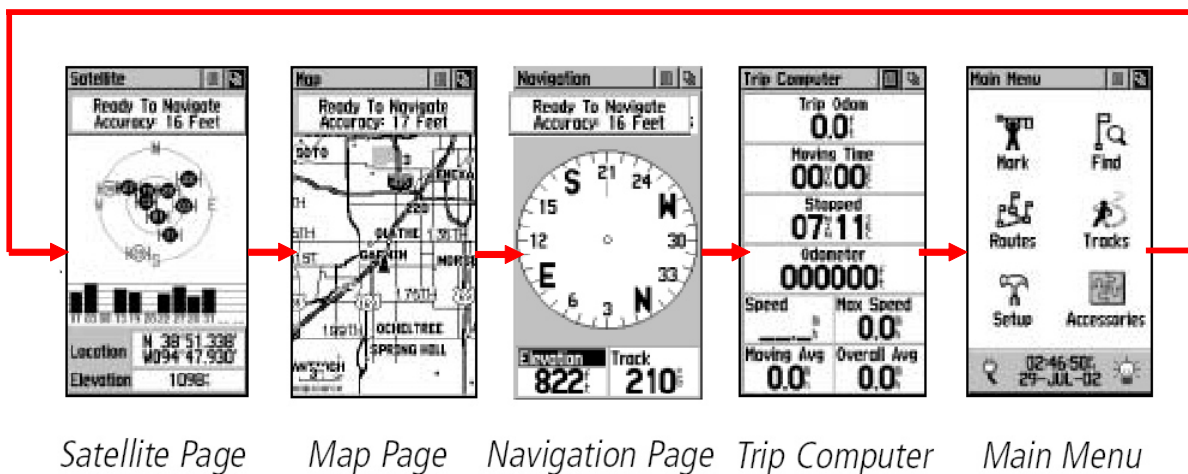


Figure 2: By pushing the Page Button, the user can open one of five GPS “pages” or screens.

The applications (functionalities) associated with these different pages are summarized in the next section (GETTING STARTED: USING YOUR GPS RECEIVER).

2. The **Zoom-in button**: The zoom-in button only works on the Map Page. Pressing this button will enable you to zoom closer on the map.
3. The **Zoom-out button**: The zoom-out button only works on the Map Page. This button will enable you to zoom out on the map.
4. The **Find button**: Allows you to locate or “goto” a predefined waypoint
5. The **Click-stick (mouse)**: The click-stick (Figure 3) is very similar to a computer mouse. The Click-stick will enable you to navigate to different menu options by pushing the click-stick in a direction (left or right; up or down).

Furthermore, you can use the click-stick as a button (by pressing it straight down or “in”) to activate highlighted selections. Pushing the click-stick “in” is similar to clicking your mouse, or hitting the “enter” key on a computer keyboard.



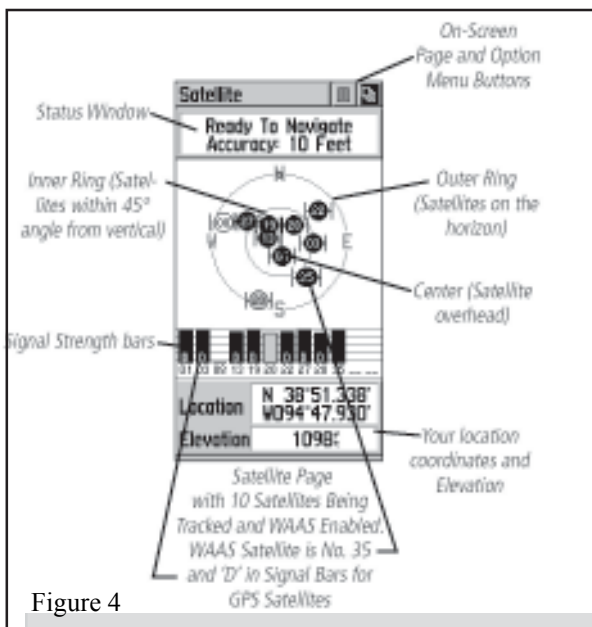
Figure 3
The Click-stick works like a computer mouse.

Getting Started: Using Your GPS Receiver

Your GPS receiver has many capabilities and functionalities. This section of the handbook is intended to show you how to get started using the GPS and to introduce you to some of the major GPS capabilities that can directly support your day to day extension needs. After you become comfortable with the basic GPS capabilities that are listed in this handbook, you may want to refer to your owner's manual to learn even more about your GPS receiver!

Getting started...

Turn on your GPS receiver by pushing the power button. You should then press the Page button until the satellite page appears (Figure 4).



It normally takes a couple of minutes for the GPS receiver to “home-in” on the satellites, and to determine a location. Initially, the status window may read: *Wait...tracking satellites*. The GPS receiver can not be used until it reads: *Ready to Navigate*.

Once the GPS receiver is ready to navigate, a location should appear in the lower section of the satellite page, along with the elevation.

Your GPS receiver has now been initialized, and is ready for use to support your extension application needs. The GPS receiver can be used, for example, to:

- identify and “mark” areas within fields for future reference (research plots, areas of infestation, etc.).
- estimate area measurements of a field (estimate fertilizer application needs)
- estimate the perimeter of a field (estimating fence line lengths)

Application #1: Marking and Saving Waypoints

Waypoints enable you to mark and record your current location as a waypoint. A waypoint is a “virtual” location marker. Once a waypoint is established and saved, you can easily navigate back to the waypoint using the GPS. This can be helpful to locate research plots in a large field, identify and relocate potential pollution sources, or to identify and mark specific areas within a field that have been impacted by blight or disease (that you may want to return to at a later date). It is also possible to upload Waypoints to a desktop computer (using GIS Utility or similar software program) or an iPAQ.

To mark and save your current location as a waypoint:

1. Make sure that the GPS receiver is ready to navigate, by going to the *SATELLITE PAGE* and looking at the *status window* (it should read *ready to navigate*).
2. Walk to the point where you want to obtain a waypoint (a location on a field experiencing drainage problems, an area within an orchard that may require additional attention, etc.).
3. Press down and hold the Click-stick until the *Waypoint Page* appears (See Figure 5).
4. This GPS automatically assigns 3 digit numbers to waypoints (in this example, it assigned 001 as the waypoint name). You can customize the name of the waypoint. To change the name of the Waypoint, use the Click-stick to highlight the waypoint name field (in Figure 14, the name field is 001).
5. Type the new name for the waypoint, using the Click-stick to select and enter the characters from the on-screen keyboard (Figure 6).
6. You can also change the marker symbol associated with the waypoint by selecting the marker (with the click stick) and scrolling through the different options.
7. Use the click-stick to scroll down to the OK button, and select the OK button to save the Waypoint.

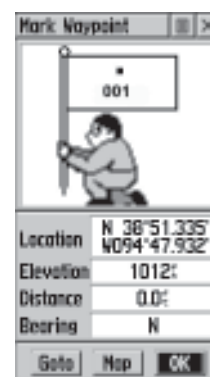


Figure 5



Figure 6

Application #2: Finding (navigating to) a Waypoint

Your GPS can serve as an “automatic pilot” to navigate you back to a previously defined Waypoint! To navigate back to a previously defined waypoint, follow these steps...

1. Press the *FIND* button on the left side of the GPS receiver.
2. On the *FIND* menu, select *Waypoints* using the Click-stick (Figure 7)
3. Use the Click-Stick to select the desired waypoint from the list (Waypoints are typically listed alphabetically).
4. Select the ‘GOTO’ option to create a direct line of travel to the Waypoint.

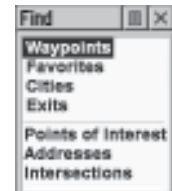


Figure 7

The arrow in the center of the compass serves as the bearing pointer, which directs you to the destination waypoint (in this example, the destination waypoint is ReaPlot1 [research plot #1]). The Navigation page also informs you that you are .72 miles from the waypoint. At your current speed, you will reach the waypoint in approximately 30 minutes (Figure 8).

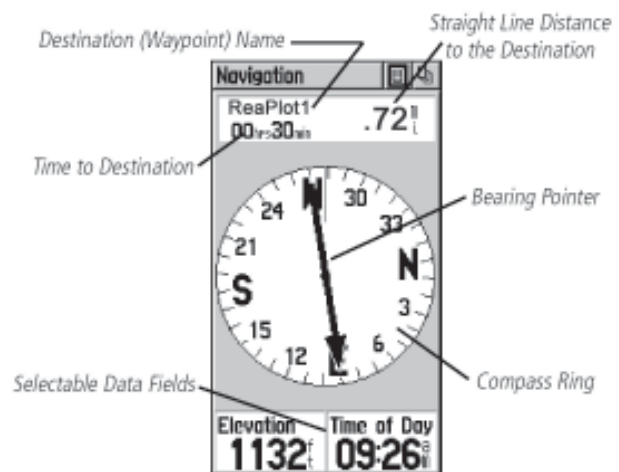


Figure 8

Application #3: Finding (navigating to) a Waypoint that was defined by someone else

You may need to navigate to a Waypoint that was defined by someone else (ie. a landowner or other constituent, a county official, a fellow extension agent or fellow extension specialist). This person may have used a different GPS receiver (or even model) and may therefore provide you with coordinate information (or, you can also obtain coordinate information off of a Geographic Information System or other map).

Obviously, your GPS receiver can not navigate you to a coordinate pair (i.e. lat./ long, utm, etc.) if the coordinates are not stored on your GPS receiver as a waypoint. However, you can create a waypoint by **manually entering coordinate information** (i.e. lat/ long., UTM, etc.) into the GPS receiver.

To create a waypoint by manually by entering its coordinates, follow these steps:

1. Press in and hold the Click-stick to access the *Mark Waypoint Page*
2. Using the Click-stick, highlight the *Location Field* on the *Mark Waypoint Page*.
3. Enter the new coordinates using the numerical keyboard on the screen. Highlight and press 'OK' when finished (See Figure 9).

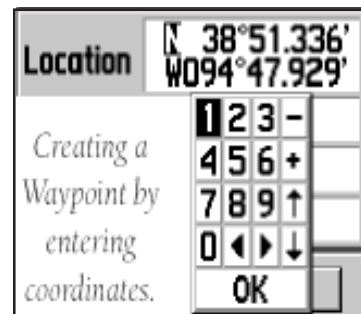


Figure 9

Important Tip: In the United States, the first (latitudinal) coordinate will always have a “N” as a prefix (as we are north of the equator). The second (longitudinal) coordinate will always have a “W” as a prefix (as we are west of the prime meridian). In addition, the first digit after the “W” should be entered as a “zero” (see illustration above). It is very important to identify and select these prefixes when manually entering waypoints on your GPS!

4. Once the Waypoint coordinates have been manually entered and saved, you can then use the *GOTO* or *FIND* function (see previous page) to navigate to that waypoint!

Application #4: Estimating Area Measurements

Estimating area measurements in a field is a necessary task for many application areas of extension including agriculture, business planning, and natural resource management. This GPS receiver has the capability to estimate area measurements, even of curved and irregularly shaped polygons! The following procedure will not only generate area measurements, but will also provide perimeter measurements as well.

There are two techniques for estimating area measurements. These techniques include:

- The Track Log Method
- The Route Method

While the Track Log Method is used most often, both of these techniques are easy to learn, and are described in this section.

Estimating Area Measurements: The Track Log Method (Option #1)

As you travel the perimeter of an area, the eTrex Legend records track points and uses the resulting GPS track log to internally calculate the size of the enclosed tract. This method works well when you can reasonably transport the receiver directly along the boundary of the tract. [If swamps, lakes, cliffs, gorges, or grizzly bears get in your way, you may need to use the route technique as an alternative!]. A recent software update increased the active track log to 10,000 points.

On small and irregularly shaped tracts of land, you might want to increase the track log interval - the frequency at which tracks points are recorded. Otherwise, you will lose accuracy when the receiver occasionally “cuts corners” as you travel the boundary. Go to: MAIN MENU > TRACKS > highlight & click on Option Menu button at the top > select SETUP TRACK LOG. You have choices here. The default setting is Record Method: *Auto* (a combination of distance and time) and Interval: *Normal*. If you choose to keep the *Auto* setting, you can set the Interval to *More Often* or *Most Often* to increase the frequency of track points. Instead of *Auto*, you can choose to record by *Distance* or *Time*, each with its own Interval choices.

Follow these steps to estimate area measurements:

1. Generally you should clear the current active track log just before you begin laying tracks. Go to: MAIN MENU > TRACKS > CLEAR. [If you wish to save the previous track log, first select SAVE, then clear the log].
2. Make sure that the GPS receiver is ready to navigate, by going to the *SATELLITE PAGE* and looking at the *status window*.
3. When you have confirmed that the GPS receiver is ready to be used, push the Page button until you reach the *Main Menu Page* (Figure 10).

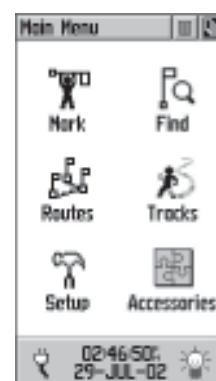


Figure 10

4. Use the Click-stick to scroll down and highlight the *Accessories* option.

5. Press the Click-stick straight down to select the *Accessories* option. The *Accessories Page* will appear (Figure 11). Use the Click-stick to highlight and select the *Area Calc.* option on the Accessories Page.

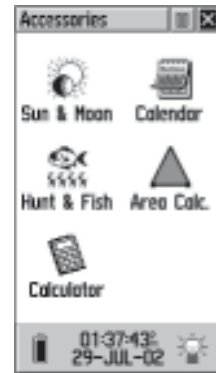


Figure 11

6. The Area Calculation page should open (see Figure 12).



Figure 12



7. You may need to reset the Area Calculation. This is done by highlighting the OPTIONS selection and selecting RESET.

8. Press <Start> and begin walking around the perimeter of the field/parking lot / forest plot / etc. that you want to calculate an area calculation. The screen displays your progress. Zoom in or out as appropriate to view your tracks.

9. Slightly before you return to your starting point, click on STOP. Your receiver will automatically complete the loop with a straight shot from your current position to your starting point. **Both perimeter distance and enclosed area values will be displayed in appropriate units.** To change area units, highlight and click on the unit abbreviation to bring up a selectable list of choices (square feet, square yards, square meters, hectares, square miles, etc.).

10. If the calculated solution is of value to you, name and SAVE the track. However, *before* you hit save, you should record the data elsewhere. Once a track log is saved, the total number of track points is condensed (to max. of 750) and less precision is displayed (fractions are rounded to one decimal point). The eTrex Legend allows a maximum of ten saved tracks.

11. Don't despair if heavy tree cover causes you to occasionally lose contact with the satellites as you track. The Legend will "connect the dots" and link your recorded track points in an attempt to estimate the enclosed area. View the saved track screen to decide whether or not the integrity of the track was maintained.

12. To view all of your saved tracks, go to: MAIN MENU > TRACKS.

Estimating Area Measurements: The Route Method (Option #2)

For area calculation purposes, a route is a sequential set of perimeter waypoints linked together to describe the boundary of a tract of land. The route method of area calculation has some definite advantages. You don't need to travel along the entire border of the tract, as long as you can mark the major corners and turns of the boundary line. For very large tracts and for areas with severe terrain restrictions, this may be the only practical GPS technique in the field. The route method also allows you to perform estimated acreage comparisons of several tracts while in the field.

Accuracy of the route method depends largely on your ability to locate and mark all the key twists and turns that enclose the tract. It works best on rectangular areas with straight-line boundaries. Irregularly bordered, oddly shaped tracts are more difficult to work with, requiring a much larger number of waypoints to accurately describe the tract. A recent software update increased the maximum number of waypoints in a route to 125.

To set up a route for area calculation, first mark and save the key perimeter waypoints that you will need. Go to: MAIN MENU > ROUTE. Click on NEW and then on the highlighted blank to insert the first waypoint. Continue adding sequential waypoints until the route is complete.

You are not required to re-enter the starting point again as the ending point. The Legend will automatically close the loop for you when calculating route area.

To view the resulting area calculation, highlight & click on the Option Menu button and select Route Area. You can display the solution in whatever units you select.

By using the Route Method to calculate area, a series of Waypoints are identified (Figure 13) at corners, at turns, and other definition points along the area to be measured.

Figure 13



The Waypoints are then associated with a Route, and the GPS receiver calculates perimeter and area measurements for that particular route, based on the associated Waypoints (Figure 14).

Figure 14



Application #5: The Trip Computer Page

The Trip Computer Page can also be used to estimate perimeter, or distance measurements. The Trip Computer Page is not as applicable to extension agents as the previous described options for estimating area and perimeter (see Application #4). However, this functions associated with the Trip Computer Page is something that you should be familiar with. To estimate perimeter or distance using the Trip Computer Page, follow these steps.

1. Make sure that the GPS receiver is ready to navigate, by going to the *SATELLITE PAGE* and looking at the *status window*.
2. You may need to configure your GPS, to ensure that perimeter measurements are calculated in yards (by default, the units of measure are in miles). To change the measurement units, navigate to the MAIN MENU page (Figure 15).

Note: If the default “statute” option is used, you will get Trip Odometer measurements in feet until the distance reaches 528' (0.1mi.), at which time the receiver automatically switches to hundredths of a mile (without yards ever being used).

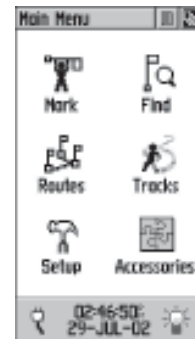


Figure 15

If the “yards” option is selected, you will get Trip Odometer measurements in yards until the distance reaches 1000 yards, at which time the receiver automatically switches to hundredths of a mile (without feet ever being used). **For these reasons, it is suggested that you use the techniques outlined in Application #4 for estimating area and perimeter measurements.**

- a. While on the Main Menu Page, use the Click-stick to select SETUP. On the SETUP MENU page, select UNITS, and the UNITS Page will appear (Figure 16).

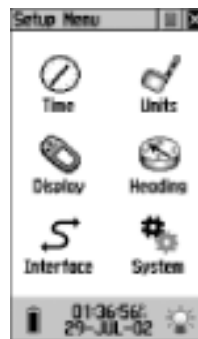


Figure 16

- b. On the UNITS Page (Figure 17), use the Click-stick to scroll down and highlight Distance/Speed. Press the Click-stick, and a menu will appear. From the menu items, select YARDS. This will enable you to view the perimeter measurements in yards (measurements in feet is not an option). You are now ready to use the GPS receiver to calculate the perimeter of an area.

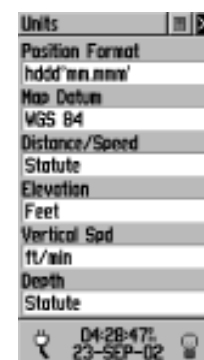



Figure 17

3. When you have confirmed that the GPS receiver is ready to be used, and after you have configured the unit to measure the perimeter in yards (as opposed to miles) push the Page button until you reach the *TRIP COMPUTER PAGE* (Figure 18).



Figure 18

4. To estimate the perimeter of an  area, you will be working with the *Trip Odometer* function on the TRIP COMPUTER PAGE.

5. Make sure that before you begin, that the *Trip Odometer* is set to “zero”. If the odometer is not set to zero, then follow these steps:
 - a. Use the Click-stick (mouse) to highlight the OPTIONS Button in the upper right hand corner of the TRIP COMPUTER PAGE. The OPTIONS selection looks like this:

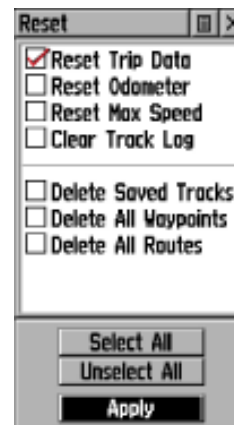


Figure19

- b. Press straight down on the Click-stick to open the OPTIONS page. This will open the RESET ODOMETER page. The RESET ODOMETER page is illustrated in Figure 19.

- c. Use the Click-stick to highlight the *RESET TRIP DATA* option. Press down on the Click-stick to select it (note: the *Odometer* only displays units in miles).
- d. Then use the Click-stick to scroll down to the Apply button, and press down on the Click-stick to reset the odometer.

- e. Your *TRIP Odometer* is now set to zero and is ready for use! Press the PAGE BUTTON and navigate to the TRIP COMPUTER PAGE (Figure 20).

6. Now that your Trip Odometer is set to zero, begin walking around the field (parking lot, or any feature...). Notice that the odometer changes as you walk. When you complete walking around the field, you will need to make note of the Trip Odometer reading.



Figure 20

The MAP Page

So far, you have seen how the different pages on the GPS receiver can support some of your day to day business application needs. The MAP PAGE, however, is a page that has not been summarized yet. The MAP PAGE enables you to visualize your WAYPOINTS and TRACKS as maps that are located on screen. You have the ability to zoom in and out of these maps to obtain more or less detail.

Your GPS receiver has some reference data (major streets and interstates) built into the GPS receiver. You can also obtain (i.e. purchase) digital topographic maps that can be downloaded to your GPS unit for reference purposes (from GARMIN). However, you need to be aware that the topographic maps available for your GPS receiver are only available at 1:100,000 (and are accurate to +/- 166 feet), and therefore not as detailed and accurate as the topographic maps that are most often used by the extension community (1:24,000).

For additional information about the Extension Agent GPS Program, please contact:

John McGee
Virginia Geospatial Extension Specialist
319 Cheatham Hall (0324)
Blacksburg, VA 24061
<http://www.cnr.vt.edu/gep>
(540) 231-2428
jmcg@vt.edu

The Extension Agent GPS Program is supported by Virginia Cooperative Extension and the Virginia Geospatial Extension Program



in partnership with:

The Virginia Tech Department of Forestry

**Virginia Tech College of
Natural Resources**

Additional Acknowledgements:

Mike Clifford, Sr. Extension Agent Emeritus, c/o Nottoway Extension Office, Nottoway, VA 23955
The Virginia Space Grant Consortium
The New Hampshire Geospatial Extension Program

The Virginia Geospatial Extension Program