

## Virginia Geospatial Extension Program

# The Garmin eTrex Legend: An Introductory Handbook for Natural Resource Professionals and Educators

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### GPS: An Introduction and the Basics

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

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 (such as car trunks). When you are not using your GPS receiver for long periods of time (over 2 months), you should 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.

The GPS has an internal antenna. The antenna is located behind the logo (the globe) at the top of the GPS receiver. Do not obstruct the antenna 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 the Legend GPS receiver will require new batteries (2 AAs) after approximately 32 hours of use. Personal experience, however, suggests that batteries last for approximately 12 to 17 hours of use. You may want to keep spare batteries handy.

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

This GPS is compatible with several freeware software programs including: GPS Utility, DNR Garmin, and USAPhotoMaps. Additional information about these user-friendly software programs is available from the Virginia Geospatial Extension Program website: [www.cnr.vt.edu/gep/tools.pl](http://www.cnr.vt.edu/gep/tools.pl).

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

- You now know enough to be dangerous! Please note that this is a recreational-grade GPS receiver. While the receiver can support data collection efforts for agriculture and natural resources management, planning, and other applications, this GPS receiver is not survey grade! 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. GPS measurements should be considered estimates at best!

- Update your software. The Garmin website ([www.garmin.com](http://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 on your receiver. To check this, go to “Main Menu” > “Setup” > “System” > “Option Menu” (at the top) > “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 the 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 disabling 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 to 25 feet (6 to 8 meters) or so – then you are ready to put it to work. If WAAS is enabled, wait until reception from a satellite with an ID-number higher than 32 is acquired (denotes a WAAS satellite) to provide differential correction – small Ds will show up on several satellite strength bars. You should then get accuracy readings of about 10 feet (3 meters) 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. This 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 the download cable (provided) to a serial or USB adaptor cable (which costs ~\$20).

This particular GPS works well in open areas. It is not as effective in areas with dense tree canopy. You may want to consider purchasing a GPS with a Sirf III chipset if you intend to work in areas with a dense tree canopy.

## Understanding your GPS Receiver

There are six buttons on your eTrex Legend (Figure 1). These buttons are:

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

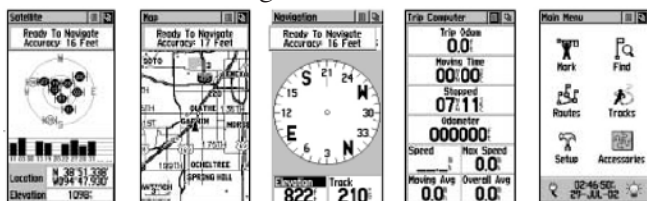


Figure 1.

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 the 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 are the:

- Satellite Page
- Map Page
- Navigation Page
- Trip Computer Page
- Main Menu Page



Satellite Page    Map Page    Navigation Page    Trip Computer    Main Menu  
Figure 2.

- The **zoom-in button** only works on the “Map” page. Pressing this button will enable you to zoom to a larger map scale for more detail.
- The **zoom-out button** only works on the “Map” page. This button will enable you to zoom out and view a larger area (at less detail).
- The **find button**: allows you to locate or “goto” a predefined waypoint
- 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).



Figure 3.

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.

The applications (functionalities) associated with these different pages are summarized in the next section.

## Getting Started: Using Your GPS Receiver

Your GPS receiver has many capabilities and functionalities. This section of the handbook will help you to get started using your GPS receiver and to introduce you to some of the major GPS capabilities that can directly

support your natural resource educational programs and application 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 pressing and holding the power button. You should then press the Page button until the “Satellite” page appears (Figure 4).

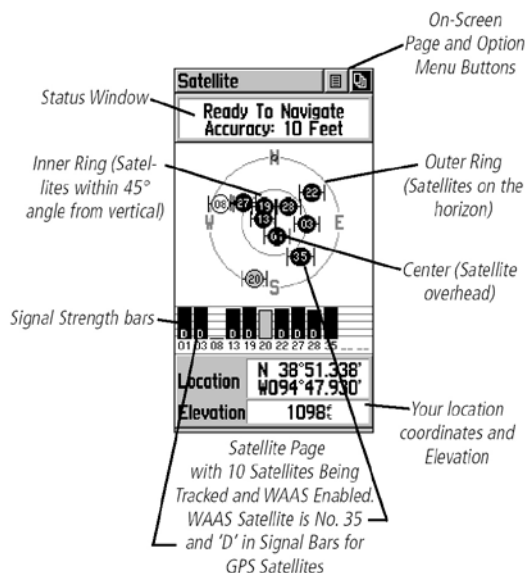


Figure 4.

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 cannot be used until it reads: *Ready to Navigate*.

Once the GPS receiver is ready to navigate, a location coordinates 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 natural resource management application needs. The GPS receiver can be used, for example, to:

- identify and “mark” points 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 receiver. 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 a similar software program) or to a handheld PDA.

### 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 record a waypoint (e.g., a location in a field experiencing drainage problem).
3. Press down and hold the click-stick until the “Waypoint” page appears (see Figure 5).
4. This GPS receiver automatically assigns three-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 scroll down and highlight the waypoint name field (in Figure 5, the name field is 001). Select the name field by pushing down on the click-stick.
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). Click on <OK> when you are finished.

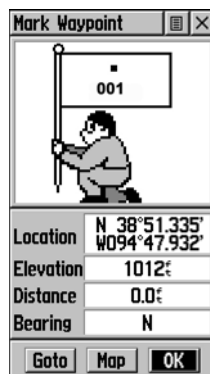


Figure 5.

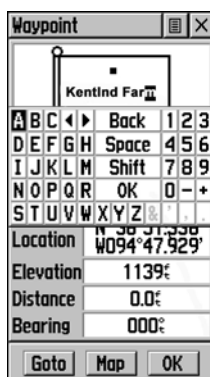


Figure 6.

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 click <OK> to save the waypoint.

## Application 2: Finding (Navigating to) a Waypoint

Your GPS receiver 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 (bottom left hand button).
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 by name).
4. Select the “GoTo” option to create a direct line of travel to the waypoint.

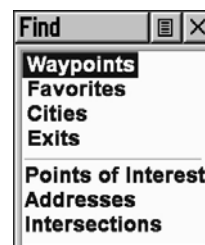


Figure 7.

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 0.72 miles from the waypoint. At your current speed, you will reach the waypoint in approximately 30 minutes (Figure 8).

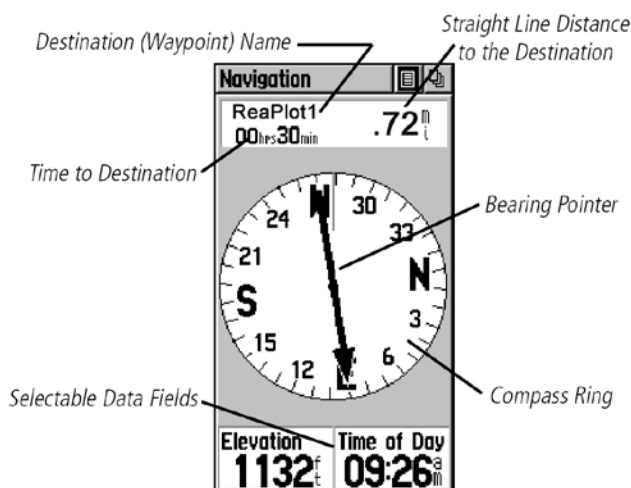


Figure 8.



## 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. This person may have used a different GPS receiver (or even model) and may therefore provide you with coordinate information. (Or, you may have obtained coordinate information off of a Geographic Information System [GIS], an online mapping application such as GoogleEarth, or a hard copy map).

Obviously, your GPS receiver cannot 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 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 and select 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).

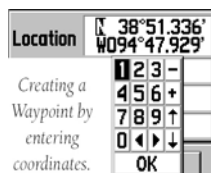


Figure 9.

*Important Tip: In the United States, the first (latitudinal) coordinate will always have an “N” 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 Figure 9). 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.

These procedures could also be used in a geo-caching exercise with a 4-H or scouting group. For more information on geo-caching, refer to: [www.geocaching.com](http://www.geocaching.com) or simply enter “geo-caching” as a keyword in your favorite Internet search engine.

## Application 4: Estimating Area Measurements

Estimating area measurements in a field or forest is a necessary task for many application areas, 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 Method 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 track points are recorded. Otherwise, you will lose accuracy when the receiver occasionally “cuts corners” as you travel the boundary. Use the Page button to go to “Main Menu” > “Tracks” > “Option Menu” button at the top > “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).

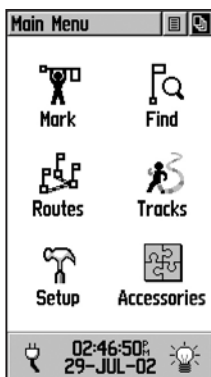


Figure 10.

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.

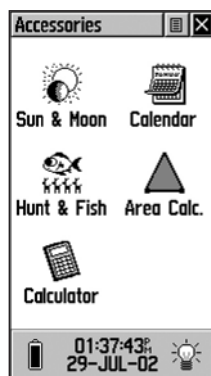


Figure 11.

6. The “Area Calculation” page should open (see 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.

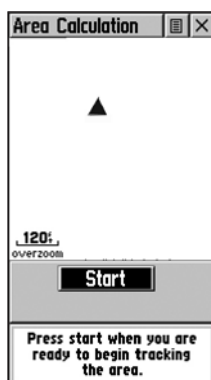


Figure 12.

9. Just 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.

To set up a route for area calculation, first mark and save the key perimeter waypoints that you will need. Go to “Main Menu” > “Routes.” 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 GPS receiver will automatically close the loop for you when calculating route area.

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

The route is automatically assigned a name consisting of the first and last waypoint. You can highlight this name and change it as you wish.

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, but not area. However, the functions associated with the “Trip Computer” page are 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 checking 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. Measurement in feet is not an option). To change the measurement units, navigate to the “Main Menu” page (Figure 15).

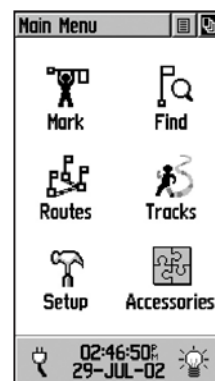


Figure 15.

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

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, you should 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).
- b. On the “Units” page (Figure 17), use the click-stick to scroll down and highlight “Distance/Speed.”

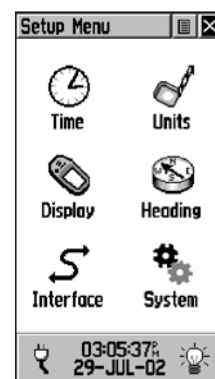


Figure 16.

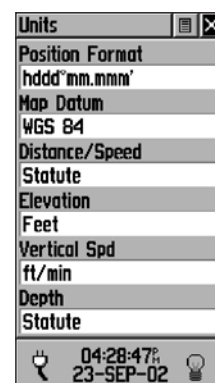


Figure 17.




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.

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. Before you begin, make sure 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> button looks like this: 

- b. Press straight down on the click-stick to open the “Options” page. This will open the “Reset” page. The “Reset” page is illustrated in Figure 19.

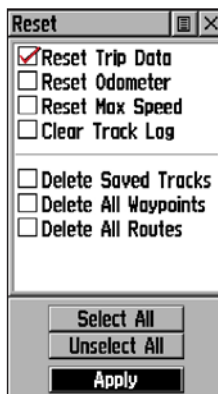


Figure 19.

- 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” 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. Some GPS receivers allow you to obtain (i.e. purchase) digital topographic maps that can be downloaded to GPS unit for reference purposes. However, you need to be aware that not all GPS receivers have this capability. In addition, the topographic maps available for some areas 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 natural resource professionals (1:24,000). Be sure to understand your needs and research available options carefully!

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