# 2004 UPDATING OF THE LIST OF ESTABLISHMENTS GPS USER'S MANUAL

## I. INTRODUCTION

### What is GIS?

GIS (Geographic Information System) is an automated system composed of hardware, software, data and people used to create, store, display and analyze spatial data and related attributes.

Geographic information is made up of two components, location and attribute. Location represents where on the earth the items of interest are located, while the attributes provide information about what is occurring there. Geographic data is made up of three basic elements: points, lines and areas. A point could be a latitude/longitude reading from a GPS (global positioning system) unit, which might represent the center of a village, or a household. Line data could represent road networks, or rivers. Points and lines can also make up areas, polygons. Polygons could be administrative or political units such as regions, or provinces. They could also represent other non-political regions such as health clinic service areas, or places prone to flooding during the rainy season.

All geographic data – whether point, line or polygon – can be geographically located on the earth's surface, or georeferenced. Attribute information such as the number of people in the household, maximum travel speed on a given road surface type, or population in a district can then be linked to geographic locations.

### What is GPS?

GPS (Global Positioning System) is a satellite-based navigation system developed by the United States Department of Defense to provide a consistent and accurate navigation method. While it was designed for military applications, GPS also provides commercial and recreational users with worldwide navigation coverage that is accurate to 15 meters (49 feet).

The development of the GPS started during the arms race between the United States and the Soviet Union. The US wanted a precise way to hit the enemy's missile silos from their submarines. GPS was the solution to their problem as it enabled them to instantaneously determine their position anywhere in the globe, as well as to compute for the missile trajectory.

GPS was initially called NAVSTAR (Navigation Satellite Timing and Ranging) by the military. Its main purpose was to aid in navigation, in troop deployment and in artillery firing. But because of the passing of an executive decree in 1980, GPS technology was made available for civilian use.

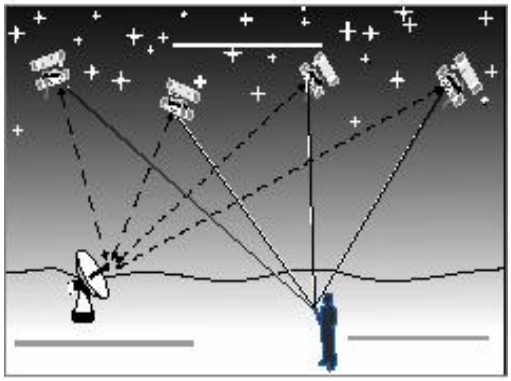
## How does GPS work?

A GPS receiver determines its position using a set of 24 satellites that orbit the earth. Each satellite emits radio signals that contain its position and the current time. The GPS receiver receives these signals and uses them to calculate its position in terms of latitude, longitude, and altitude.

The accuracy of the GPS receiver's calculated position depends on the strength and number of signals that it receives. Its calculated position is most accurate when it is receiving strong signals from many satellites; it is least accurate when it is receiving weak signals from few satellites.

### The 3 Segments of GPS

The GPS is consists of a space segment (the satellites), a control segment (the ground stations), and a user segment (you and your GPS receiver).



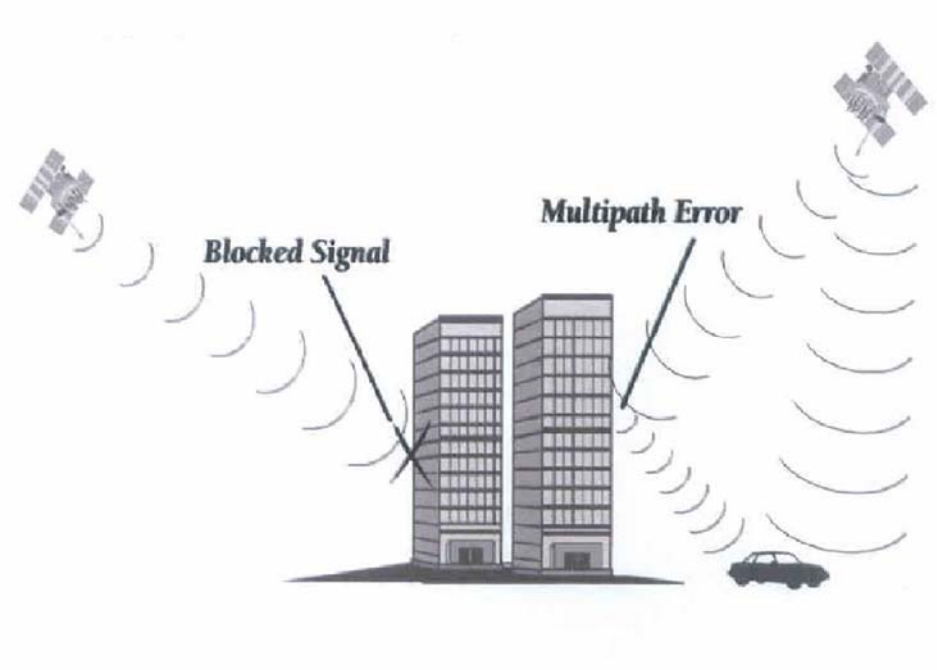
The **space segment**, which consists of at least 24 satellites (21 active plus 3 operating spares) is the heart of the system. The satellites are in what's called a "high orbit" about 12,000 miles above the Earth's surface. Operating at such a high altitude allows the signals to cover greater area. The satellites are arranged in their orbits so a GPS receiver on earth can always receive from at least four of them at any given time.

The **control segment** does what its name implies – it controls the GPS satellites by tracking them and then providing them with corrected orbital and clock (time) information. There are five control stations located around the world – four unmanned monitoring stations and one "master control station". The four unmanned receiving stations constantly receive data from the satellites and then send that information to the master control station. The master control station corrects the satellite data, and together with two other antenna sites, send ("uplinks") the information to the GPS satellites.

The **user segment** simply consists of you and your GPS receiver. As mentioned previously, the user segment consists of boaters, pilots hikers, hunters, the military and anyone else who wants to know where they are, where they have been or where they are going.

**What's the signal?**

GPS satellites transmit two low power radio signals, designated L1 and L2. Civilian GPS uses the L1 frequency of 1575.42 MHz in the UHF band. The signals travel by line of sight, meaning they will pass through clouds, glass and plastic but will not go through most solid objects such as buildings and mountains.




**Sources of GPS signal errors**

Factors that can degrade the GPS signal and thus affect accuracy include the following:

1. **Ionosphere and troposphere delays** - The satellite signal slows as it passes through the atmosphere. The GPS system uses a built-in model that calculates an average amount of delay to partially correct for this type of error.

2. **Signal multipath** - This occurs when the GPS signal is reflected off objects such as tall buildings or large rock surfaces before it reaches the receiver. This increases the travel time of the signal, thereby causing errors.
3. **Receiver clock errors** - A receiver's built-in clock is not as accurate as the atomic clocks onboard the GPS satellites. Therefore, it may have very slight timing errors.

4. **Orbital errors** - Also known as ephemeris errors, these are inaccuracies of the satellite's reported location.

5. **Number of satellites visible** - The more satellites a GPS receiver can "see," the better the accuracy. Buildings, terrain, electronic interference, or sometimes even dense foliage can block signal reception, causing position errors or possibly no position reading at all. GPS units typically will not work indoors, underwater or underground.

6. **Satellite geometry/shading** - This refers to the relative position of the satellites at any given time. Ideal satellite geometry exists when the satellites are located at wide angles relative to each other. Poor geometry results when the satellites are located in a line or in a tight grouping.

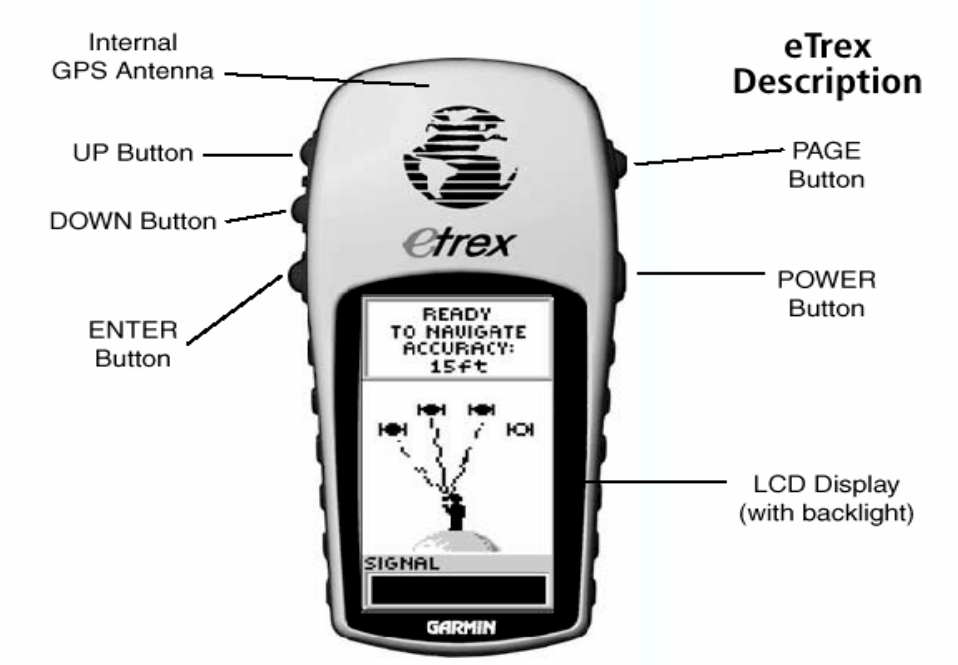
7. **Intentional degradation of the satellite signal** - Selective Availability (SA) is an intentional degradation of the signal once imposed by the U.S. Department of Defense. SA was intended to prevent military adversaries from using the highly accurate GPS signals. The government turned off SA in May 2000, which significantly improved the accuracy of civilian GPS receivers.

### Why is the 2004 Updating of the List of Establishments using GPS?

GPS receivers will be used to record the position (in terms of latitude and longitude) of every establishment in Quezon City. These positions can be used to link data to the information collected during the 2004 ULE enumeration. Positions can also be used to graphically present the findings from the ULE on maps. With this locational information, data can be analyzed as part of a geographic information system (GIS) to gain new perspective in the development of Small and Medium Enterprises.

## II. THE GARMIN ETREX GPS

## A. PARTS




The **UP/DOWN** Buttons:

- Select options on pages and menus
- Adjust display contrast on Satellite Page
- Zoom in and out on Map Page
- Cycle through trip data on Pointer Page

The **ENTER** Button:

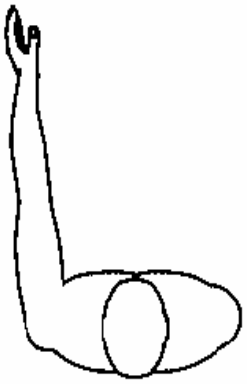
- Confirms data entry or menu selections
- Displays options on main pages
- Pressing and holding the **ENTER** button activates the Mark Waypoint Page


The **PAGE** Button:

- Switches between pages and backs you out of pages. If you start to do something and you don't want to continue, you can stop by pressing the **PAGE** Button.

The **POWER** Button:

- Turns the unit on and off
- Turns the display backlight on and off



*The eTrex is ergonomically designed to be held in the left hand.*


## B. PRECAUTIONS

GPS receivers are made of high quality materials and special handling is required. Each team will be responsible for the GPS receiver that it is issued to use during the survey. When the receiver is not in use, it must be stored in its carrying case. Even when it is not in use, the receiver must be in the possession of a team member and it must be turned off to save battery power. Do not leave it in any place under any circumstances during enumeration.

Do not expose the GPS receiver to high temperatures and do not immerse it in water. The receiver can be used when it is raining, but it must be wiped dry with a clean, soft cloth before it is put back into its carrying case.

## C. BATTERIES

The GPS receiver that you will use operates on 2 AA batteries, which provide up to 12 hours of use. The batteries must be installed before the receiver can be used. During the survey, each team will be given 4 AA batteries. These batteries will be enough to operate the receiver for the duration of the survey.

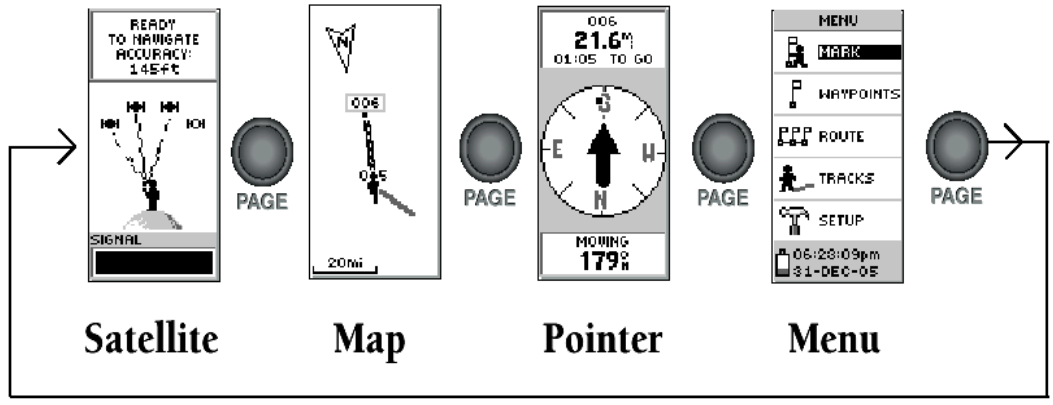
Before installing or changing batteries, make sure that the GPS receiver is turned off. The battery cover is located at the base of the receiver. To install or change batteries

1. Open the battery cover by turning the thumb loop counter-clockwise ¼ of a turn. This action will reveal two battery tubes; one will be marked with a '+' sign and the other will be marked with a '-' sign.
2. Insert two batteries with their '+' ends pointing upwards into the '+' battery tube.
3. Insert two batteries with their '-' ends pointing upwards into the '-' battery tube.
4. Replace the battery cover and close it by turning the thump loop clockwise ¼ of a turn.

The battery charge indicator is located on the receiver's menu page (see section D).

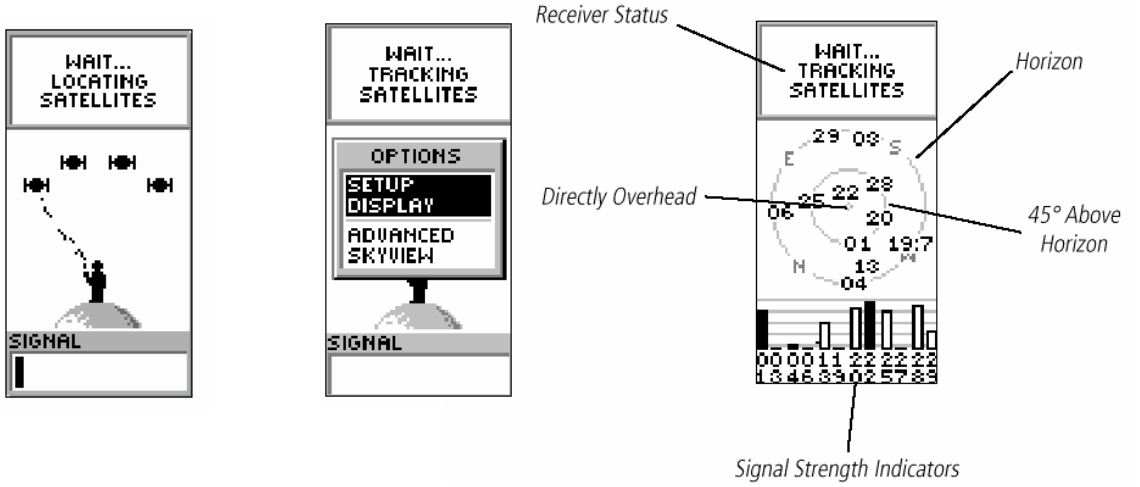
## D. GPS PAGES

The **Garmin eTrex** receiver has four primary pages: the satellite page, the map page, the pointer page, and the menu page.




### The Satellite Page

The Satellite Page shows the eTrex gathering all the necessary satellite information in order to work. There are two display options on the satellite page, Normal Skyview and Advanced Skyview. Normal Skyview shows you (in animation), the satellites, satellite signal strength, and the eTrex's estimated location accuracy.



To activate the Advanced Skyview page, simply press ENTER on the Satellite Page, select 'Advanced Skyview' and pres ENTER again. This page displays the numbered satellites the eTrex is using, their proximity to your current position, and their individual signal strengths. To determine the location of the satellites being used around you, the outer circle of the display represents the horizon and the center represents the sky directly overhead.

The bottom half of the satellite page shows the strength of the signal that the GPS receiver is receiving from each satellite. The satellites are once again represented by their numbers.

### The Map Page

The Map Page show where you are and provides a real picture of where you are going. As you travel and leaves a "tail" (track log). Waypoint names and symbols are also shown on the map.

### The Pointer Page

The Pointer Page helps guide you to a destination. When you're moving with no particular destination in mind, the Pointer Page shows you your moving direction and speed. When you're moving towards a specific destination, the Pointer Page show you the name of the location, the distance and time to go, and displays a direction arrow in the compass ring.

### The Menu Page

The Menu Page gives you access to more advanced features. With the Menu Page you can create and view waypoints, create a route, save and view track logs or access the system setup features.

## E. CHOOSING A LOCATION

The location where a GPS receiver is used affects the accuracy of its calculated position. The GPS receiver must be able to contact as many satellites as possible. The ideal location is a large open area that has a clear view of the sky from horizon to horizon, the more elevated the area, the better.

If no such location exists, try to find an area that has as clear a view of the sky as possible. If there is no area with a clear view of the sky, try to get a reading anyway. If the GPS receiver cannot calculate its position, find the closest area that has a clear view of the sky and try again. Otherwise just plot the location on the GIS map and put "EP" (estimated position) on the remarks column of ULE Form 8.

## F. INITIALIZING THE GPS RECEIVER

The first time a GPS receiver is used in an area, it will take up 5 minutes to gather enough satellite data to calculate its position. This process is known as initialization. After the receiver has been initialized, it can calculate its position much more quickly by using the information gathered during initialization. If the receiver moves more than 500 miles with the power off, it will automatically re-initialize itself.

To initialize a GPS receiver

1. Find an open area that has clear view of the sky.
2. Press the Power button. This action will turn on the GPS receiver and display the welcome screen, the database info screen, and then, after a delay, the satellite page.
3. Hold the GPS receiver away from your body or, if possible, place it on a flat, elevated surface.
4. Wait until the position page is displayed; this should take 2-5 minutes. The GPS receiver is now initialized.
5. Hold down the power button for 3 seconds. This action will turn off the GPS receiver.

## G. USING THE GPS RECEIVER FOR 2004 ULE

The purpose of this activity is not only to have a GIS based list of establishments but also to have an updated GIS map in Quezon City. This can be achieve by getting the coordinates of all prominent landmarks by using a GPS receiver.

The ULE Mapping Group (UMG) will be composed of 15 teams having two members each. One member will record the waypoints in the GPS receiver and the other will transcribe it to the ULE Form 8 and plot the landmark on the GIS barangay map.

Once a week during operation, they will have to bring their GPS receiver to DGSS to download the recorded waypoints and tracks and prepare the forms and materials for their next area of assignment.
Forms and materials to be used during this activity:

1. Copy of ULE Form 1A and updated barangay sketch map from NCR II.
2. GPS receiver, with two pairs of AA alkaline batteries (one pair for backup).
3. Pencil, ballpen and eraser.
4. 2004 ULE GPS Coordinate Listing Form (ULE Form 8).

Preparatory Activity:

1. For Barangays that have been enumerated in NCR II, the ULE Mapping Group must transcribe the BSN and Building Name/Business Address of ULE Form 1A to ULE Form 8. For one building one establishment unit, with no building name, they have to use the Business Name. They will also have to make a photocopy of the updated barangay sketch map. From the sketch map, list down the names of landmarks in the ULE Form 8 and assign the waypoint name as L001, L002, L003 and so on. For road networks, we must be able to plot the shape of all road networks by plotting points on the center of the roads for every intersections and

corners and saving tracks recorded by the GPS receiver. The GPS starts recording the tracks as soon as the GPS gets a location fix (see "To save a tracks on GPS receiver").

2. The UMG will verify if all the BSN listed in ULE Form 1A were reflected in the updated barangay maps or vice versa. If not, he/she will ask the NCR II to verify and make the necessary corrections.

3. By referring to the sketch barangay map. Select at least 3 estimated reference points which can be easily identified in your assigned barangay. These reference points must be accessible and will be use to improve the accuracy of our GIS coordinates and must be transcribe in the first three or four rows of the first page of ULE Form 8. Plot the points in your map and name it R1, R2, R3, etc.

4. The UMG must also indicate in every page of the ULE Form 8 the current page and total number of pages found in the upper corner, and the Barangay Code.

Field Operations Activity

1. Find a suitable area and initialize the GPS receiver for 2 to 5 minutes, until you see the message "READY TO NAVIGATE". The ideal accuracy of the GPS receiver is below 15 meters.

2. Go to the location of each reference points, get the coordinates or waypoint and save it in the GPS (see "To save a waypoint in the GPS receiver"). Rename the waypoint name to R1, R2, and R3 (see "To change the waypoint name").

3. Write the saved coordinates in the ULE Form 8 under the X and Y columns, and accuracy (as much as possible, the accuracy must be below 20 meters).

4. Go to the location of all the establishments and landmarks listed in ULE Form 8 in a clockwise manner. Without turning off the GPS receiver, it only needs about 15 to 45 seconds to stabilize before getting the coordinates of a given location. The ideal location must be in front or adjacent to the building/landmark with a clear view of the sky.

5. Save the coordinates of the establishments and prominent landmarks in the GPS. For establishments, change the default name assigned by the receiver to the 3 digit Building Serial Number. For prominent landmarks, rename the waypoint name to L001, L002, L003 and so on.

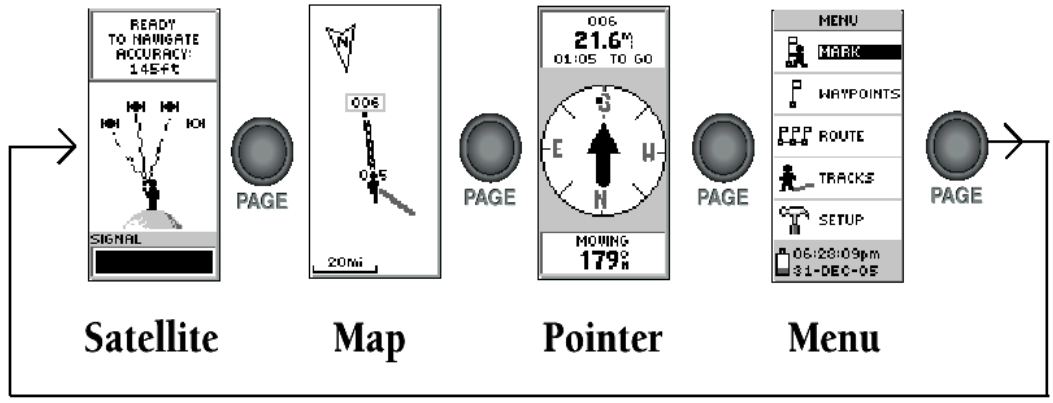
6. In getting the coordinates, ideally you must be in the center of the given location. But most of the time it is not possible because of many reasons like in road networks, there are always vehicles passing through, in tall buildings the GPS signal is always weak, etc. The most practical way is to be in the location where you can get a better signal, get the coordinates, write the necessary details in the GPS form, write in the REMARKS column your approximate distance (in meters) from the said location. Plot the ideal location and put an arrow (→) in the map, starting from the relative position of the given location pointing to your approximate location.

7. We can save the tracks recorded by the GPS to get the shape of curved road networks.

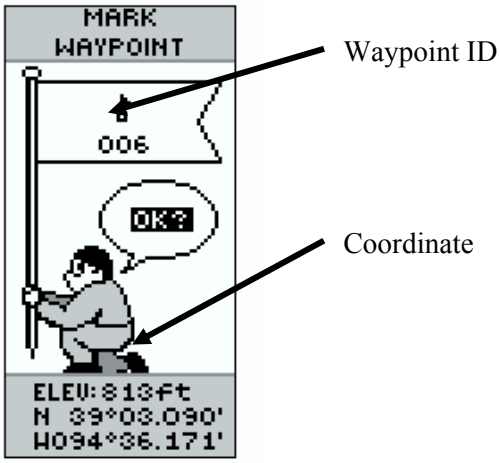
8. Also, get the coordinates of all establishments and prominent landmarks that were not included during the enumeration.

To save a waypoint on the GPS:

1. Find a suitable location for taking a reading.
2. Press the power button. This action will turn on the GPS receiver and display the welcome screen, the country database screen and then, after a short delay, the satellite page.
3. Hold the GPS receiver away from your body or, if possible, place it on a flat, elevated surface.
4. When you see the "READY TO NAVIGATE" message on the Satellite Page, the receiver has found your location and you can mark your position.
5. Press the page button until you reach the Menu Page and select MARK.



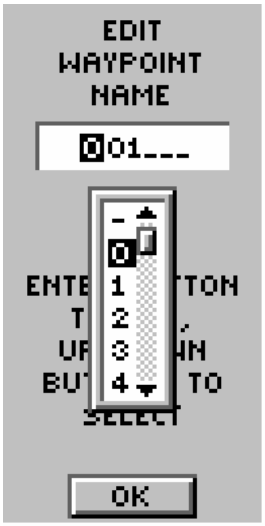

6 Assign the waypoint name in the waypoint ID.




To change the waypoint name

1. On the "MARK WAYPOINT" Page, press the UP or DOWN Button to highlight the Waypoint Name.

2. Press ENTER. The “EDIT WAYPOINT NAME” Page appears.

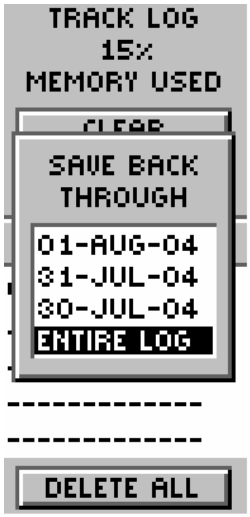



3. Press ENTER. Using the UP or DOWN Button, scroll through the letter selections. Press ENTER to select a letter or number until you complete the EA name.
4. Press the UP or DOWN Button to highlight the OK field and press ENTER. The “MARK WAYPOINT” Page appears.
5. Press the UP or DOWN Button to highlight the OK field and press ENTER. Your location and named waypoint is now marked and stored in memory.

To Save Tracks on GPS Receiver

1. Press the “PAGE” Button and switch to the “MENU” Page. Press the UP or DOWN Button and highlight “TRACKS”. Press ENTER. The “TRACK LOG” Page appears.

2. Press the UP or DOWN Button and highlight “SAVE” and press ENTER. The “SAVE BACK THROUGH” window appears giving you a time frame for saving a track or “ENTIRE LOG”. Press the UP or DOWN Button and select the desired option. Press ENTER. The saved track appears graphically on a sub page. Press UP or DOWN Button and select “OK”. Press ENTER.





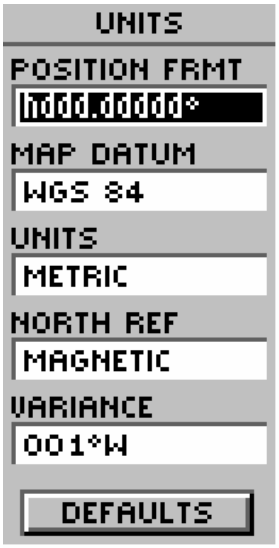
3. The track is now saved and appears in the “SAVED TRACKS” list on the “TRACK LOG” Page.

To check Settings

1. On the “MENU” Page, select the “SETUP” Page.


2. On the “SETUP” Page, select the “TIME” Page and copy the settings below to your eTrex.

3. On the “SET UP” Page, select the “UNITS” Page and copy the settings below to your eTrex.

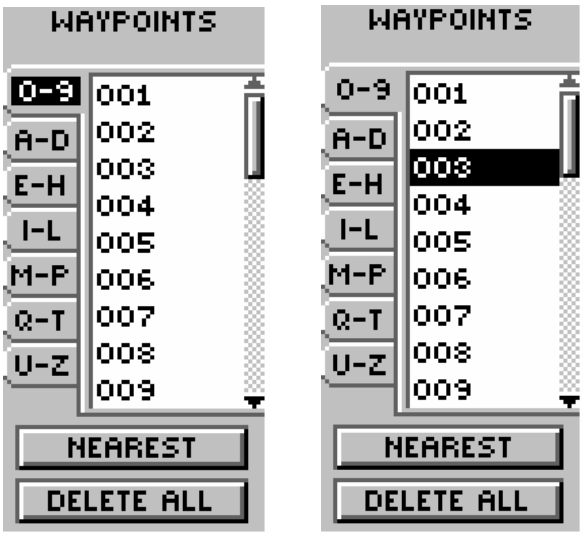



4. On the “SET UP” Page, select the “SYSTEM” Page and copy the settings below to your eTrex.

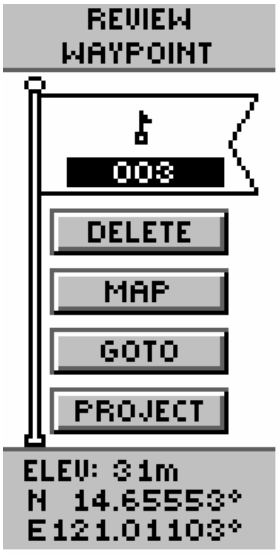
Review Waypoint Page

1. On the “MENU” Page, select the “WAYPOINTS” Page.


2. On the “WAYPOINTS” Page, select to the group of waypoints on the left side menu. All waypoint name starting with numbers will belong to the “0-9” menu and the rest belong to alpha menu (i.e., “A-D”, “E-H”, “I-L”, etc.).



3. From the “WAYPOINTS” Page, select the desired waypoint and the “REVIEW WAYPOINT “ Page will appear. The “REVIEW WAYPOINT” Page allows you to change the waypoint symbol and name (just like on the “MARK WAYPOINT” Page). You can also delete or display a waypoint.



# H. GLOSSARY

## Latitude

A north/south measurement of position perpendicular to the earth's polar axis. Latitude is measured in degrees (0-90), seconds (0-59), and thousands of a second (0-999). Readings for Philippines must be approximately between N 4.574878° (4°34'29.56") and N 20.405247° (20°24'18.89").

## Longitude

An east/west measurement of position in relation to the Prime Meridian, an imaginary circle that passes through the north and south poles. Longitude is measured in degrees (0-180), seconds (0-59), and thousands of a second (0-999). Readings for Philippines must be approximately between E 112.417017° (112°25'1.26") and E 126.5794° (126°34'45.84").

## Position

An exact, unique location based on a geographic coordinate system. A 2 dimensional position is expressed in terms of latitude and longitude. A 3 dimensional position is expressed in terms of latitude, longitude, and altitude.

## Waypoint

A specific location saved in the receiver's memory.

## Landmarks

Natural and man-made features like roads, buildings, rivers, mountains, etc.

## Tracks

Recorded pathways that can be saved in the GPS receiver.