

Guide to Global Position Systems (GPS)

Global positioning systems (GPS) can be split up into two parts and this document is structured to match this:

- Part 1: Setting up and using a GPS receiver
- Part 2: Defining protocols for field use

Setting up and using a GPS receiver

GPS receivers are simple electronic devices and as such the way they are set up will effect what data is collected. Before going into the field all staff must know how to use the GPS receiver, what to check for before collecting data, and simple maintenance of the devices.

Every GPS receiver will be slightly different, so it is not possible to give exact details in this document. The manual that came with the GPS receiver should be used to find the exact methods to carry out the tasks listed below.

Using the GPS receiver for the first time, or in a new country

Almost all GPS receivers have a set of physical buttons on the top and/or the side. These allow the device to be turned on/off and for users to move between the different screens. There is always a simple picture included with the device which shows the functions of these buttons, and the person responsible for maintaining the devices should ensure they are familiar with the functions of the buttons so they can explain them to field workers.

We include images of the Garmin eTrex 20 GPS receiver but these instructions will work similarly for most Garmin GPS receivers.

To start turn the device on, usually done by holding down the power button on the side of the device for 2 – 3 seconds.



GPS receivers work by receiving signals from satellites that orbit the Earth. When you use the receiver for the first time, it has to find the satellites and update all its information on satellite locations. Most GPS receivers call this “Searching the sky”. This process can take up to 30 minutes, during which the GPS should be left somewhere with a clear view of the sky. Once the process is complete the position will be shown on the screen.

This process must be repeated if the receiver is not used for 4 months or if it is moved large distances, i.e. between countries or within very large countries. If you move less than 200km from the previous location then the update will not be required.

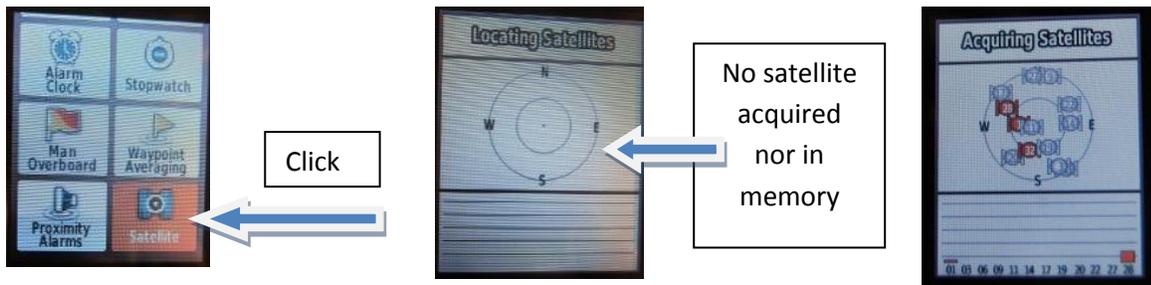


Step 1: Check that your GPS receiver quickly returns your position and does not “search the sky” (or “Acquiring satellites” with the eTrex20 – go to Menu and scroll down and select Satellite to check)

Acquiring satellites

Once the GPS receiver is set up field staff must know how to record waypoint locations and issues that can interfere with getting an accurate location. Accuracy is determined by the number of satellites from which data are collected. The accuracy is normally provided on either the **Satellite page**, or the **Position Page**. As well as the number of satellites in the sky overhead, the accuracy is affected by objects that obscure the sky, specifically buildings. During training this can be shown by walking up to buildings slowly and watching the **Satellites Page**. As you get closer to the building satellites will drop off the list of those available and accuracy will decrease. Field staff should be able to check for the number of satellites being used, and by looking at the features around them work out if they can move slightly to improve the accuracy.

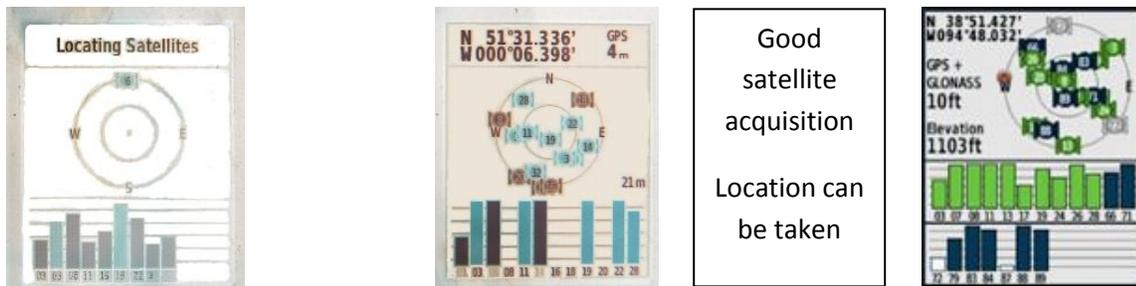
For the eTrex 20: "satellite" is at the bottom right position on the main menu. Use the joystick or the arrows to scroll down.



1 – Select satellite in the menu

2 - First satellites acquisition

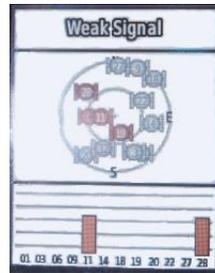
3 - Looking for Satellites



4 - Finishing calculating position

5 - Now it is set

5bis - Other model screen



If there is not enough satellite signals the screen will display “weak signal”. In this case waypoint acquisition is not recommended. Move to a better position (i.e. open sky location, away from tall buildings or tree cover)

The final factor that affects accuracy is how the receiver is held; the human body is a good block and holding your hand over the antennae part of the receiver or holding the receiver at waist height and bending over to look at it will reduce the accuracy. Receivers should be held up at roughly shoulder height to get the best result.

The final stage of collecting the location of a waypoint is allowing the receiver to settle. GPS positions update every second, and it takes a few seconds for them to settle down. There are a defined set of steps that field workers should follow before recording a position. These are:

- Turn receiver on
- Check how many satellites you are detecting and the accuracy
- If accuracy is poor, move to improve accuracy
- Once good accuracy is achieved stay at that location until the position is stable, usually around 10 seconds
- Record position

Step 2: Ensure field staff know procedures for acquiring satellite signal

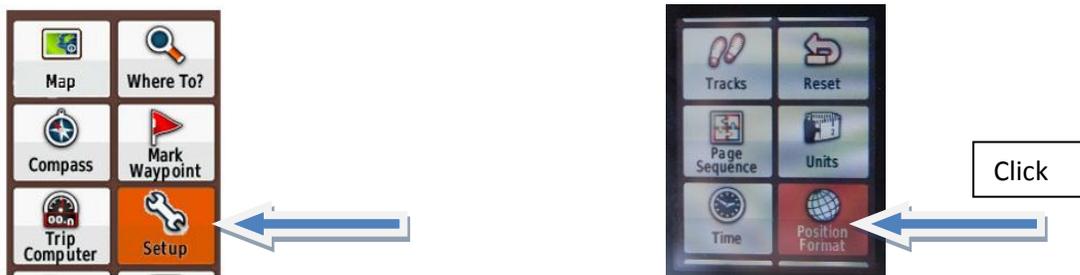
Checking GPS receiver setup

Once the GPS is giving your position, the coordinates and other settings should be checked.

The most important setting is the coordinate system and map datum. In theory it does not matter what you set these to as long as you record them, in practice you can save a huge amount of time by using one of two standards

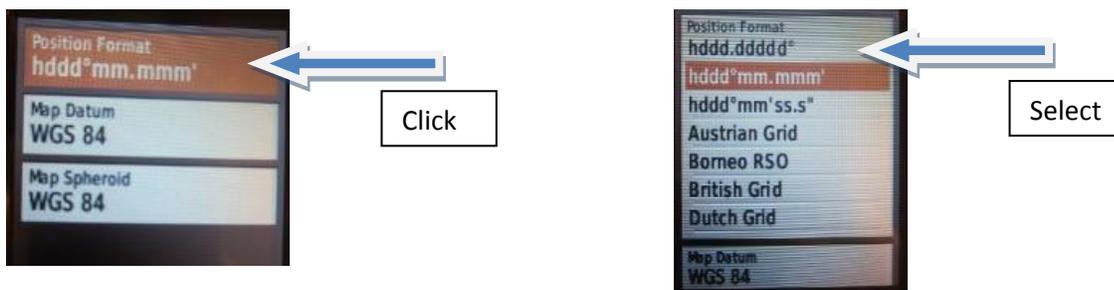
- WGS 1984 – latitude and Longitude (decimal degrees)
- National Grids or Universal Transverse Mercator (UTM)

Both of these are usually set through the **Setup menu** page, in most cases under the **Units** option.



Unless you know you are using a specific National Grid, the default should be to use Latitude and Longitude.

- **Position Format** should be set to **Hddd.dddd°** (decimal Degrees). The eTrex 20 is set by default to **Hddd°mm.mmm'** (Degree decimal Minutes)



- **Map Datum** should be set to **WGS 84**

Step 3: Set the Position Format and Map Datum.

Recording coordinates for waypoints

Waypoint coordinates may be recorded in different ways:

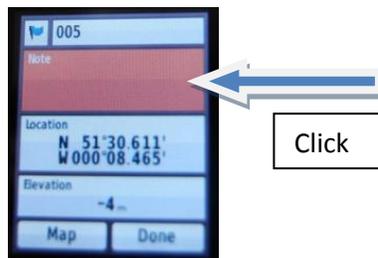
- Write on paper
- Record in the device and download later
- Type into a database
- Enter into a storage device

The simplest is to have two columns on a paper form to enter the coordinates. The X coordinate and Y coordinate can simply be written down into the correct columns. It is important to ensure they are written down in the correctly, and note if the position is N or S (north or south) and E or W (East or West). Having written down the coordinates it should be double checked to reduce errors. This method works best if other information is being collected at the same time, e.g. information about a case or structure.

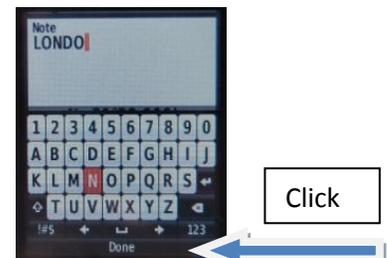
If only the coordinates are being collected then it can be stored in the GPS receiver as a **waypoint**. Most GPS receivers will store up to 250 waypoints at a time. Having got the location the **waypoint** is created or **marked**. This stores the coordinates to be downloaded directly into a computer at a later date. If storing coordinates this way, you still have to keep a written record of what each **waypoint** represents. Care needs to be taken to ensure these **waypoints** are downloaded. Check frequently to avoid the memory filling up.



Select **Mark Waypoint** in **Menu**, to save a location.



Select **Note** to add info such as name, type of location, population etc...



To save click **Done**, and then **Done** on the next screen.

By storing the location as waypoints in the GPS device, Google Earth can map the waypoints directly (in Google Earth select Tools / GPS select Garmin – waypoint and click Import)

The final way which is less common, is when data are being entered directly into a storage device (laptop, data logger or 3G phone). In this case the coordinate is collected as usual and then the X & Y

coordinates typed into the storage device. It may be possible to combine these if the GPS receiver is a component of the data storage device, but this is expensive.

Step 4: Ensure field staff know the procedure for recording waypoints using the two main methods of writing them down or marking waypoints in the GPS receiver.

Maintenance

GPS receivers should be regularly checked and maintained. There are two main parts to this:

- Check batteries. GPS receivers batteries usually only last for between 14 – 16 hours. The simplest way to do this is to turn the receiver on and there is no “Low battery” warning. It is vital that especially when going to remote locations that there are spare batteries.
- Clean up memory. Receivers store information and this can be confusing. GPS receivers should be regularly cleaned up with all waypoints and tracks removed so that all the memory is available.

Step 5: Check batteries and clean up memory on a regular basis

Defining protocols for field use

Part 1 covered using the GPS receivers and before going out into the field, staff should know how to perform steps 1-5. Once they are familiar with using the GPS receivers the field protocols, specific to the projects, can be established and these define how and when GPS should be used in the project. The information that should be defined as part of the field protocols includes:

- Coordinate system and Map Datum
- Acceptable accuracy for waypoints
- Position to stand to find location
- Checking / maintenance routine

Coordinate system and map data

The default coordinate system and map datum should be latitude and longitude, and WGS 84. Only on rare occasions should anything else be used. Where it is, all receivers should be regularly checked and it should be clearly stated in the documentation.

Accuracy

Standard GPS receivers are only guaranteed accurate to 20m however in locations with only 1 storey buildings the accuracy is usually better than 10m. The accuracy required should be defined and waypoints only collected when the accuracy is below that threshold. For village or area centroids than an accuracy of <20m is usually good enough. For houses you would normally want an accuracy of <10m, although in some areas, especially in sparsely populated or forest areas this may be expanded to 20m.

Define the accuracy that is required and make sure the field workers understand that waypoints should be highlighted if the accuracy is not better than that defined in the protocol. It may be that you have to return to the location on another day to get better accuracy.

Location

Where the field worker stands to mark the location affects the accuracy. So a protocol defining the default locations should be tested before starting field work.

- For village centroids or area centroids, somewhere on the main road / path through the village may be a suitable location.
- For a house it may be suitable to stand 1 – 2m in front of the main entrance to the house.

The approximate order of collection of features should also be determined. It is easier to check data later if all data are collected by groups, i.e. village by village, district by district, instead of moving randomly around. If disease case locations are being marked or it is not possible to collect positions systematically then recording village name and district, and including whether the house is part of a compact village or scattered housing, will help to verify its position later.

It is important to test this procedure and for field staff to highlight any issues.

Checking and maintenance

There should be a protocol for verifying the coordinates collected and for maintenance of the GPS receivers.

Coordinates should be checked frequently, ideally at least once a week to look for possible errors. The best way to do this is to look at the data on an electronic map to check they are in the correct place, i.e. all houses within a village are close together and there are no outliers. Google Earth™ can be used for this even if there is no accurate image available. If no mapping is available then simply looking at the coordinates to see that those within the same village look similar and that none are noticeably different. These simple checks will also pick up if the X & Y coordinates are being recorded the wrong way around.

For maintenance the person responsible for checking the batteries and cleaning up the machines should be determined.

By the time the field work starts the field work protocol should be defined and documented, with the field staff trained to ensure they understand each step and why the protocols have been set. Ideally there should be some way to test that protocols are being followed.