

STANDARD OPERATING PROCEDURE (SOP) FOR DIGITIZATION OF FOREST BOUNDARIES FOR WORKING PLANS



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STANDARD OPERATING PROCEDURE (SOP)

The GPS system belongs to the Department of Defense (DOD) and is officially known as the NAVSTAR System (Navigation Satellite Timing and Ranging). Its primary mission is to provide the U.S. Government and the Department of Defense the ability to accurately determine one's position at any point on the earth's surface, at any time of the day or night, and in any weather condition. GPS has a variety of applications on land, sea and air and it allows its users to locate positions anywhere on earth. This device was originally designed to serve military purposes but over the years its application has been expanded to serve various civilian purposes as well.

This Standard Operating Procedure (SOP) has been written specially for the people working in the forestry sector. It will be most beneficial to the users who need to collect data directly from field and store it for future use in GIS environment e.g. digitization of any Reserve Forest boundary with the help of GPS directly on field. This SOP directs the users to operate the GPS in the most easiest and efficient way.

The SOP guides the user about the working of GPS on field in step wise manner and also illustrates the same with the help of diagrams making it more interactive and interesting. Along with the working of GPS it also explains in what environment and settings one should use the GPS before going to field such as what datum to use, weather conditions.

This SOP not only provides information on how to use the GPS on field but also guides the user how to transfer and view the GPS data on any computer system. It also explains ways to save the data from the GPS into the computer systems in different formats which are compatible with the GIS environment thus making the data simpler to work on.

GPS readings might be erroneous at times due to certain conditions. This SOP elaborates the various possible errors that might occur while handling the device at different points. This will help its users to take precautionary steps wherever possible so that the data that is being collected does not generate wrong information.

1. GLOBAL POSITIONING SYSTEM (GPS)

The global positioning system (GPS) is a satellite based navigation system made up of a network of 24 satellites placed into orbits by the US Department of Defense.

GPS is a handheld device used to take information of

- ✓ Latitude
- ✓ Longitude
- ✓ Altitude
- ✓ Velocity

GPS device also helps in locating and navigating to a particular point. The device plays an important role in calculating the area of any patch of land.

2. OVERVIEW OF GPS (GARMIN 72)

The **IN** and **OUT** keys (Fig 1) are used on the map page and the plot page. When pressed, the **IN** keys decreases the map scale or decreases the horizontal plot scale, allowing us to view a smaller area with greater detail. When pressed, the **OUT** key increases the map or horizontal plot scale allowing us to view a larger area with less detail.

The **GOTO/MOB** key (Fig 1) is used to begin or stop navigation to a waypoint. If the **GOTO/MOB** key is pressed and held down, the GPS stores the current location (a man overboard point) and gives you the opportunity to begin immediate navigation to that point.

The **PAGE** key (Fig 1) will cycle you through the five main display pages in sequence.

The **POWER** key (Fig 1) is used to turn the unit on and off. To turn the unit off press the **POWER** key and hold it. The **POWER** key is also used to display the adjustment window for the backlight and contrast. To activate the backlight/contrast adjustment window, press and release the **POWER** key.

The **MENU** key (Fig 1) is used to display page option menus. If pressed twice, the main menu will be displayed.

The **QUIT** key (Fig 1) will cycle you through the five main display pages in reverse sequence. The **QUIT** key will end an operation in progress and display the previous page.

The **ENTER/MARK** key (Fig 1) is used to activate a data field or confirm a selection. If the **ENTER/MARK** key is pressed and held, the GPS 72 will store the current location and display the Mark Waypoint page.

The **ROCKER** key (Fig 1), located in the center of the keypad, is used to control the Up/Down and Left/Right movement of the cursor on the display pages and during data entry.



Fig 1. Interface keys

3. MAIN DISPLAY PAGES

In the GPS device there are five main display pages (Fig. 2). They are the GPS Information Page, Map Page, Pointer Page, Highway Page and the Active Route Page.

For our use, only two Main Display Pages are of importance i.e., **GPS Information Page** and **Pointer Page** that have been described below.

The **GPS Information Page** displays speed, elevation, the estimated accuracy, receiver status, satellite locations, satellite signal strength, the date, time and the GPS receiver's current location.

The **Pointer Page** navigates to an already stored waypoint in the GPS, where straight line cannot be followed and helps the user to reach to the point.

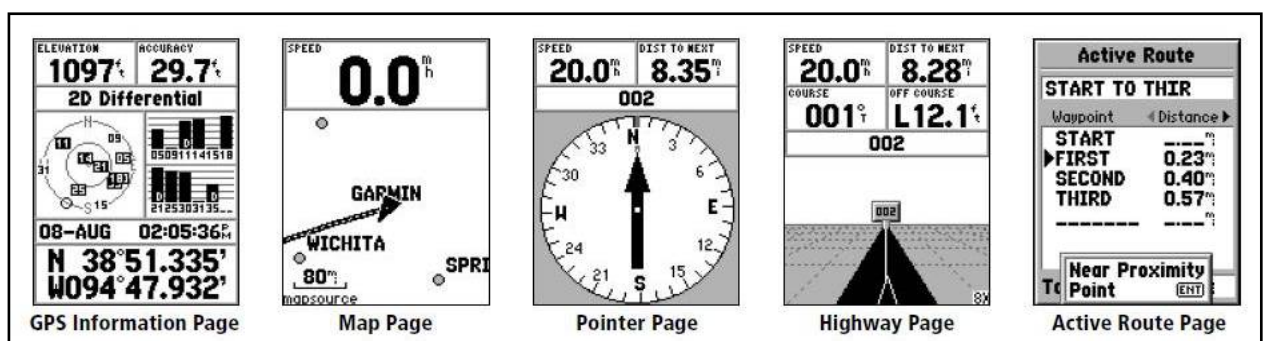


Fig 2. Main Display Pages

4. INITIALIZING THE GPS RECEIVER

- i. When the GPS is used on the field for the first time, the receiver needs to be initialized.
- ii. With fresh batteries installed take the unit outside where it can get a clear 360° view of the sky. Turn it on and hold the unit with the top tilted towards the sky.
- iii. Automatically the GPS captures satellites and it takes not more than five minutes for the unit to become operational. When it is able to navigate it will show 2D GPS Location or 3D GPS Location in the Receiver Status Field.
- iv. The Setup of the GPS Receiver should also be checked before using the device on ground for example
 - Location format-hddd°mm'ss.s" (deg.min.sec)
 - Map Datum- WGS 84
 - North Reference- True
 - WAAS Disabled

5. MAIN MENU PAGE

The Main Menu Page (Fig 3) contains settings and features that are not on the Main Pages. The Main Menu can be accessed from any of the Main Pages by pressing **MENU** twice. To select an item on the Main Menu, place the highlight over the menu item then press **ENTER**.



Fig 3. Main Menu

6. GPS SETTINGS BEFORE GOING TO FIELD

- i. Switch on the GPS by pressing the **POWER** key.
- ii. Press the **MENU** key twice to go to the Main Menu.
- iii. Using the **ROCKER** key highlight the **setup option** and press **ENTER**.
- iv. The Setup Menu- '**General Tab**' (Fig 4) gets highlighted.
- v. Using the **ROCKER** key highlight the '**Location**' tab (Fig 5) of the Setup Menu.
- vi. The given fields in the **Location** tab should be

Location format-hddd°mm'ss.s" (deg.min.sec)

Map Datum- WGS 84

North Reference- True

- vii. If any of these three are not set as given above- Using the **ROCKER** key highlight that field e.g. Location Format and Press **ENTER**. A drop down menu comes for the selected field. Using the **ROCKER** key select the required format from the list and press **ENTER**.
- viii. After setting the three fields correctly, press **PAGE** key twice to go to the GPS Information Page or press **POWER** key to turn the unit off.



Fig 4. Setup menu- General Tab

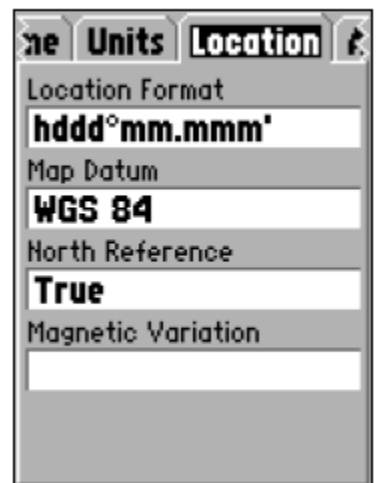


Fig 5. Setup menu- Location Tab

6.1 Clear Track Log

Before starting work on the field one should clear the track log so as to avoid data crowding in GPS.

- i. Press the **MENU** key twice to display the **MAIN MENU**.
- ii. Highlight **TRACKS** then press the **ENTER** key.
- iii. Highlight the **CLEAR** button and then press the **ENTER** key (Fig 6).
- iv. Highlight **YES** and then press the **ENTER** key.
- v. Press the **PAGE** key until the **MAP PAGE** is displayed.



Fig 6. Main menu- Tracks Page

7. WAYPOINTS

Waypoints can be saved in two ways for the required activity as follows:

7.1 Creating a waypoint using the ENTER/MARK Key

Procedure

- i. When at a location switch on the GPS device. It will show you the GPS Information Page.
- ii. Wait till it shows the 3D mode and minimum four satellites and ensure that the **Internal Antenna** is in correct position.
- iii. Also check that the 'Accuracy' is less than 10.
- iv. To record the point press and hold **ENTER** button until the Mark Waypoint Page is displayed (Fig 7).
- v. At this point you can edit the way point name, symbol, elevation and depth with the help of the **ROCKER** and **ENTER** Key.
- vi. To save the waypoint to memory, highlight the 'OK' button with the help of the **ROCKER** Key and press **ENTER**.

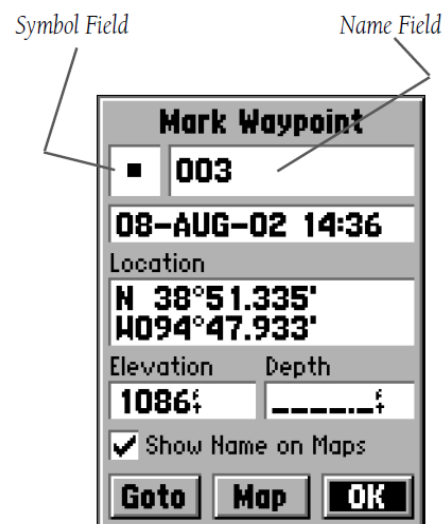


Fig 7. Mark Waypoint Page

7.2 Creating a waypoint manually using existing coordinates

Procedure

- i. Switch on the GPS device. It will show you the GPS Information Page.
- ii. Press and hold **ENTER/MARK** until the Mark Waypoint Page is displayed. The unit will capture its current location.
- iii. Highlight the location using the **ROCKER** Key. Press **ENTER** to accept the change.
- iv. At this point you can edit the waypoint name, symbol, elevation and depth.
- v. To save the waypoint to memory, highlight the 'OK' button and press **ENTER**.

7.3 How to reach the desired location (Waypoint) which is already recorded

Procedure

- i. Press **GOTO** button and select **Waypoints**.
- ii. Then select the desired **Point** to be reached and press **ENTER**.
- iii. Double click **PAGE** button it will open **Pointer** page.
- iv. This page will display distance to destination, speed and the direction of destination.

8. TRACKS

The Tracks Page displays the amount of Track Memory used. It allows the user to 'Save' or 'Clear' the current Track Log and displays a list of any saved Tracks.

8.1 How to save a Track

Procedure

- i. Double click on **MENU** button.
- ii. Select the **Tracks** option and press **ENTER**. This will display the Tracks Page.
- iii. Press **ENTER** and 'Save Back Through' the tracks listed in the drop down menu.
- iv. This will give you different times when the device has been recording tracks.
- v. To save the selected Track, highlight the 'OK' button and press **ENTER** (Fig 9).
- vi. The editing of the Track fields can be done on the track Page only by using the **ROCKER** and **ENTER** Keys.

(Note: To view the track on the GPS device itself, check the 'Show on Map/Highway', Highlight 'Map' button and press **ENTER**).

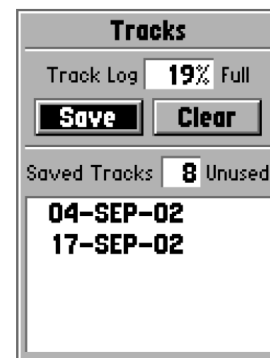


Fig 8. Main Menu-Tracks Page



Fig 9. Track Information Page

9. DELINEATING FOREST BOUNDARY

GPS is the most helpful device for the foresters who want to delineate forest boundaries now and then. GPS readings can help keep a check on encroachments also if the boundary is marked properly at regular intervals. Boundary delineation can be done with the following easy steps:

1. Mark a starting point on the forest boundary and switch on the device at that point.
2. Make sure that the previous track logs have been cleared as explained in section 6.1
3. Now you can delineate forest boundary in two ways:
 - i. **By saving waypoints (Section 7.1) at different locations along the boundary.**
 - Take the first reading at the starting point and then start moving along the boundary at a regular pace.
 - Take readings at equal distance. More readings should be taken on turns.
 - Take the last reading again at the point where you started.
 - ii. **By saving Tracks (Section 8.1).**
 - Forest boundary can also be marked by saving the Track which was recorded while saving the waypoints. You can save the track as explained in Section 8.1.

- Even if you do not save waypoints at different places and keep on moving with the device switched on at a regular pace, the track that you have moved will be recorded in the device and you can later save it as explained in section 8.1.
4. Either select a single track or select ‘Entire Log’ to select all the tracks that were being recorded by the GPS. ‘Entire Log’ is selected to ensure that if the track, that was being automatically recorded, was interrupted at some point due to signal loss or any other reason, is also saved and the entire boundary is delineated.
 5. For marking a boundary the data should be transferred to the Computer and digitized using any GIS software. Transferring and digitization of the data has been dealt with in the next section.

10. TRANSFERRING DATA FROM GPS DEVICE TO COMPUTER

The data recorded in the GPS device, in the form of Waypoints and Tracks, can be transferred to a personal computer for further use in GIS and Remote Sensing softwares as well as to be viewed in Google Earth to check the authenticity of the data. Transferring of data can be done in two ways:

- Using GPS softwares such as Map Source. The data can be transferred with the help of Map source software which comes with Garmin GPS Device.
- Using Google Earth directly.

10.1 Data Transfer Through Map Source

- i. Connect the GPS device to the Personal Computer where the data is to be transferred.
- ii. Switch on the device and click on the ‘Receive from device’ button OR from the Transfer tab click ‘Receive from device’. This opens a dialogue box where the device is shown (Fig 10).
- iii. Place a checkmark in front of the items that you want to transfer.
- iv. Click ‘Receive’ button. Data is sent to the Map Source (Fig 11).



Fig 10. Receive From Device Dialog Box

The data thus received can be saved in two ways:

- For the data to be viewed on Google Earth click on the ‘File’ tab and select ‘Save as’ option. The file is saved in .gdb format.
- For the data to be used in other softwares or spreadsheets click on the ‘File’ tab and select ‘Export’ option. The data can be saved in .txt or .dxf format.

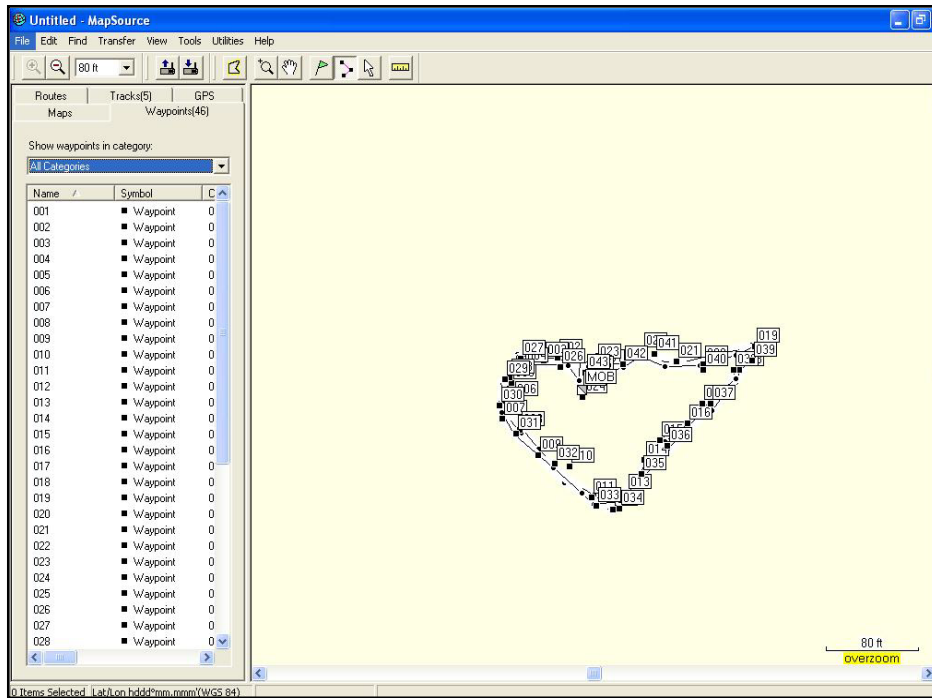


Fig 11. Data Imported from GPS Device as seen on Map Source Viewer

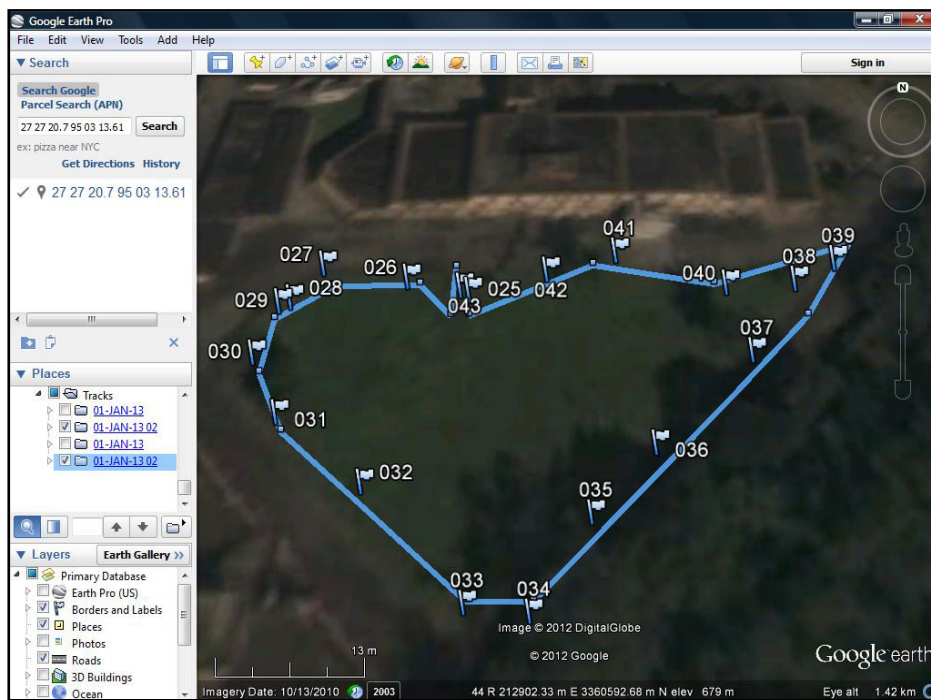


Fig 12. Data Imported from GPS Device as seen on Google Earth

10.2 Data Transfer Through Google Earth

- i. Connect the GPS device to the Personal Computer where the data is to be transferred.
- ii. Open Google Earth, go to 'Tools' tab and select 'GPS'.
- iii. The 'GPS Import' window appears (Fig.13).
- iv. Select both the output options and click 'Import'.
- v. The data gets transferred on the Google Earth itself.
- vi. The data received on Google Earth directly can be saved as kml files only.

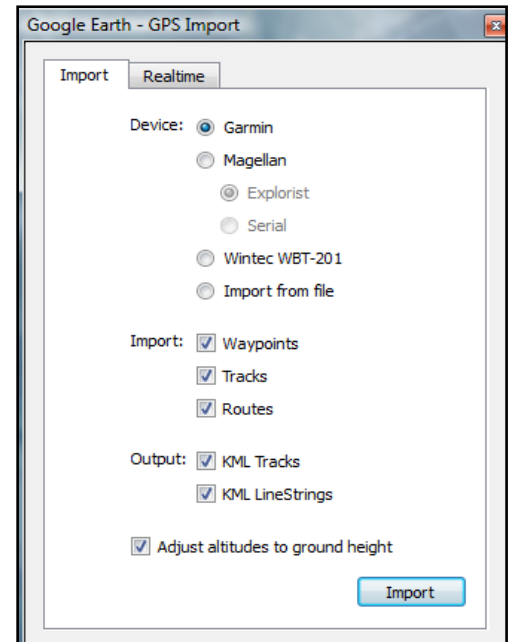


Fig 13. GPS Import dialog box of Google Earth

11. HOW TO GENERATE KML FILES FROM GOOGLE EARTH

- i. To view the data on Google Earth open the software, go to 'File' tab and click 'Open'.
- ii. Select the file type GPS (.gdb) and open the location of the file. The data that was taken from the GPS device is shown on Google Earth (Fig 12).
- iii. From the time slider tab, select the imagery with more clarity.
- iv. Taking the GPS waypoints and tracks as a reference, using the Add Polygon Tab, digitize the required polygon.
- v. The properties of the new created polygon can be edited at this point only. Click 'Ok' and the polygon is saved under the 'Places' in the sidebar.
- vi. Right click on the polygon created in the sidebar and select 'Save Place As', give the file name, for example 'FSI.kml' and click 'Save'.
- vii. These .kml files can be converted to feature class using GIS softwares such as 'ArcMap-10'.

NOTE: Before transferring the points check for the default setup of the software.

PROBABLE SOURCES OF ERROR AND RELEVANT ISSUES REGARDING CAPTURING OF DATA

The process of taking coordinates on field from GPS and transferring it to the computer system involves series of steps and if due care is not taken it may generate erroneous data. Some possible sources of error that can be taken account of and minimized in future are as follows:

- **Default setup of the GPS device:** This can be a source of error in taking the approximate location of a point as the datum taken other than WGS 84 in GPS may lead to coordinates showing considerable shift from the original location when seen on Google Earth.
- **Improper use of GPS device:** This includes mishandling of the lock by user i.e. position of GPS antenna, data taken with less than three satellites etc.
- **Adverse weather conditions:** These conditions also affect data quality because satellite reception is very weak in bad weather.
- **WAAS:** WAAS should be disabled because it leads to the collection of incorrect coordinates, as the GPS location coordinates are received from the control stations rather than satellites.